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Model of Web-Based Learning for Elementary Students using Gamification Technique

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Abstract

This paper evaluates a web-based learning platform for elementary students by applying a usability-driven approach and integrating gamification elements. We utilize structured testing across multiple navigation tasks and user interactions to assess system performance. The results show an overall usability score of 4.3667 on a 1–5 scale, indicating a very good level of user acceptance. All testing categories achieve scores above 4.28, with the highest results observed in Navigation Task 3 (4.44) and Navigation Task 4 (4.41), demonstrating strong user capability in handling both basic and advanced features. We also apply user satisfaction analysis across three key aspects: layout, engagement, and ease of use. The evaluation results indicate that 92.53% of users respond positively to the interface design, 90.80% find the learning content engaging, and 86.30% report the system as easy to use. These findings confirm that the platform successfully delivers an interactive and visually appealing learning experience, although minor improvements are still required in specific features. Furthermore, this paper utilizes gamification components such as points, badges, and leaderboards to enhance user interaction. The findings show that these elements contribute positively to usability without introducing complexity, as reflected by consistently high navigation scores above 4.2. Overall, this study demonstrates that the integration of gamification in a web-based learning system effectively improves user satisfaction and engagement, while maintaining high usability standards, making it suitable for practical educational applications.

Keywords:

Elementary Education, Gamification, Interactivity, Online Learning Platform

1. Introduction

The presence of technology in modern society has fundamentally changed the educational paradigm, starting in a new era of innovative pedagogical approaches. One such paradigm-shifting development is the integration of gamification into learning information systems, a strategy that has received considerable attention in recent years, particularly at the higher education level [1]. Gamification is a trend that encourages users to actively participate in the educational world.

Gamification, defined as the application of game design elements and principles in non-game contexts, has been widely recognized for its ability to enhance student motivation, engagement, and overall learning outcomes [1][2]. Research has consistently demonstrated the benefits of gamification in learning environments that utilize game mechanics such as points, badges, leaderboards, and feedback to create more immersive and enjoyable educational experiences [3][2]. Existing literature from the past to the present [2], [4]–[8] shows that customizing learning systems by implementing gamification elements can yield significant benefits. User personalization has been identified as a critical component in enhancing the effectiveness of gamified learning platforms. By tailoring

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gamification elements to each learner's preferences, demographics, and learning style, educators can foster feelings of autonomy, competence, and connectedness, which are essential for intrinsic motivation and sustained engagement [9]. Therefore, integrating gamification elements into learning systems has the potential to address the pressing issue of declining student motivation and engagement in traditional educational settings.

SDK Sorowajan, as a private elementary school, plays an important role in supporting efforts to improve the quality of basic education, particularly in Yogyakarta. As part of the broader educational ecosystem, the school is committed to nurturing students not only academically but also holistically, emphasizing character formation, critical thinking, and social responsibility. SDK Sorowajan consistently strives to create a learning environment that is inclusive, adaptive, and responsive to the evolving educational landscape, especially in the era of digital transformation.

The school implements the Reflective Pedagogy Paradigm (PPR) as the foundation of its teaching and learning process. Through this approach, students are encouraged to experience, reflect, and take meaningful action based on their learning experiences. Reflection becomes a key element that helps students connect knowledge with real-life contexts, fostering deeper understanding and personal growth. In addition, SDK Sorowajan actively optimizes its resources by collaborating with strategic partners, including higher education institutions and technology developers, to enhance instructional quality and innovation. This collaborative and reflective commitment positions the school as an institution that not only delivers academic excellence but also continuously evolves to meet contemporary educational challenges.

Reflective learning is an approach to learning that emphasizes self-reflection as part of the teaching and learning process. This approach aims to help students understand their learning experiences, evaluate their understanding, and connect theory to practice [10][11]. In accordance with SDK's commitment to providing reflective-based education, by the end of 2024, the research roadmap had been implemented, including conducting user needs studies and training. The study found that the gamification process had a positive impact on students learning motivation [12]. This demonstrates that gamification has a positive impact, even though it has not yet been implemented in an interactive learning information system. The development of an integrated learning information system is considered an effective approach to improving efficiency and usability in managing learning activities. An integrated system allows seamless coordination between users, data, and features such as content management, assessment, and monitoring, thereby reducing manual processes and minimizing errors. Studies showing that web-based information systems can enhance efficiency and streamline academic processes through structured data management and system integration [13]. Similar research on system development using structured approaches such as UML and database integration highlights the ability of such systems to automate workflows and improve overall usability [14]. These findings reinforce that the implementation of an integrated gamification on learning information system not only supports operational efficiency but also provides a more organized and user-friendly learning environment for both students and educators.

Following the positive trends from the 2023 research, the 2025 research will focus on developing a learning system integrated with gamification elements. Learning content focuses on 5th grade elementary school mathematics material. The gamification elements to be implemented are a points system, badges, and a leaderboard. These three elements were created based on the results of a needs survey from the previous research. Prior studies have shown that the points system can effectively track learning progress and motivate students to complete tasks [15][16]. The use of badges has also been proven to

strengthen intrinsic motivation and provide non-financial rewards that acknowledge students achievements [17][18]. Meanwhile, the integration of a leaderboard fosters healthy competition, increases social interaction, and enhances engagement during the learning process [16][19]. The selection of gamification as the main approach in this study is based on its consistent effectiveness in addressing low student motivation and engagement, particularly in digital learning environments. Compared to conventional approaches, gamification provides immediate feedback, clear progress indicators, and interactive experiences that are more suitable for elementary school students. Furthermore, gamification elements are relatively simple to implement within web-based systems while still providing significant pedagogical impact, making it a practical and scalable solution for schools with limited technological resources.

This study offers several novelties compared to previous research. First, it integrates gamification elements into a web-based learning information system specifically designed for elementary school students, whereas most prior studies focus on higher education contexts. Second, the design of gamification elements in this study is based on a prior needs analysis and reflective learning approach (PPR), ensuring alignment with students' characteristics and learning context. Third, this study combines system development with usability evaluation in a real classroom setting, providing empirical evidence of user experience and system effectiveness. Finally, the research contributes to the development of an integrated learning platform that not only enhances engagement through gamification but also supports structured learning management, monitoring, and reflective learning processes.

2. Method

This study aims to produce a web-based learning system that integrates gamification elements aligned with students' reflective needs and learning characteristics. The development process is grounded in the principle that effective educational technology should not only deliver content digitally, but also foster motivation, engagement, and meaningful learning experiences. Therefore, the system is designed by incorporating gamification components such as points, badges, and leaderboards based on previously identified student needs and reflective feedback. These elements are expected to support active participation, encourage continuous improvement, and create a more interactive learning environment, particularly for elementary school students.

2.1 Data Collection

This study collects the required data at the initial stage to support system modeling and design. We gather student information, learning materials, question banks, and answer keys, which serve as the foundation for constructing the system use case diagrams. In addition, this study collects supporting research data to determine appropriate gamification elements for the learning system. We adopt a point system to represent learning progress and motivate students to complete more material, as prior studies show its effectiveness in increasing engagement. We also implement badges as non-financial rewards to encourage rule compliance and provide a sense of achievement, which strengthens intrinsic motivation. Furthermore, we integrate a leaderboard feature to promote healthy competition and increase student participation. This paper obtains that combining points, badges, and leaderboards provides a balanced gamification approach that enhances motivation, engagement, and overall learning experience.

2.2 Data Analysis

This study collects and processes data through a structured analysis and cleansing stage to ensure data quality, consistency, and readiness for system development. We gather and refine datasets to build a reliable database that meets new requirements identified during the initial needs analysis. This step supports the development of baseline data and enables meaningful learning analytics, which can reveal student performance patterns and support data-driven decisions. After preparing the data, we design the application by modeling business processes, creating initial interface concepts, and structuring the database. We focus on building a simple and user-friendly interface suitable for different screen sizes, while also integrating engaging gamification elements for elementary students. We construct the system architecture using a front-end and back-end approach to allow flexible and modular future development. This study then develops the application from design to implementation, including interface refinement, system integration, and deployment for real classroom use by students and teachers. Finally, we conduct implementation and testing by integrating all system components and evaluating performance using usability testing to measure both functionality and user engagement. This paper obtains that a structured pipeline—from data preparation to system evaluation including ensures a reliable, scalable, and user-centered web-based learning system.

2.3 Proposed Method

In this study, we implemented the gamification features within a fully functional working system. It is to ensuring that each component that integrated into the overall learning workflow. The development process followed structured stages, beginning with requirement analysis, system design, implementation, integration of front-end and back-end functionalities, and usability evaluation.
A concise mathematical model for a web-based learning system with gamification can express overall learning performance as a combination of achievement, engagement, and gamification rewards:

$$L_i = \alpha A_i + \beta E_i + \gamma G_i \quad (1)$$

$$G_i = w_p P_i + w_b B_i + w_l R_i \quad (2)$$

where:

- L_i = overall learning performance of student i
- A_i = academic achievement (e.g., quiz/test scores)
- E_i = engagement level (e.g., activity frequency, time spent)
- G_i = gamification score
- P_i = points earned
- B_i = badges obtained
- R_i = leaderboard rank score (normalized)
- α, β, γ = weighting factors for learning components
- w_p, w_b, w_l = weights for gamification elements

The formulation models how gamification elements contribute to overall student learning performance in a web-based system. The proposed gamification model represents student learning performance as a weighted combination of academic achievement, engagement,

and reward-based interaction. This study defines overall performance L_i as a linear function of achievement A_i, engagement E_i, and gamification score G_i, where each component contributes proportionally based on predefined weights $\alpha, \beta,$ and γ. We further model the gamification component G_i as the aggregation of points, badges, and leaderboard ranking, weighted by $w_p, w_b,$ and w_l. This formulation allows the system to quantify how reward mechanisms influence user behavior and motivation. By adjusting the weighting parameters, we can balance cognitive outcomes and motivational factors, enabling the model to reflect both learning progress and user engagement in a measurable and scalable manner.

3. Result and Analysis

The entire interface is presented in Bahasa Indonesia to ensure accessibility and comprehension, considering that the primary users are elementary school students in Indonesia. The use of familiar language aims to reduce cognitive load and help students feel comfortable and confident when interacting with the system. Additionally, the wording is intentionally simple and age-appropriate to match the literacy level of 5th and 6th grade students. By combining an intuitive layout, culturally appropriate language, and user-centered design principles, the landing page plays a crucial role in establishing usability, engagement, and trust from the very beginning of the user experience.

This model constructs the page for students to select and access relevant quizzes, displaying brief instructions, duration, number of questions, and the option to start or preview the quiz. The inclusion of ranking information, especially when integrated with gamification elements, can further motivate students to improve their performance while maintaining a healthy sense of competition. This feature enables educators to identify students who may need additional support or enrichment activities based on their results. By combining quantitative data with an accessible and organized display, Fig. 1 shows personalized evaluation, data-driven decision-making, and continuous improvement in teaching strategies to enhance overall learning outcomes.

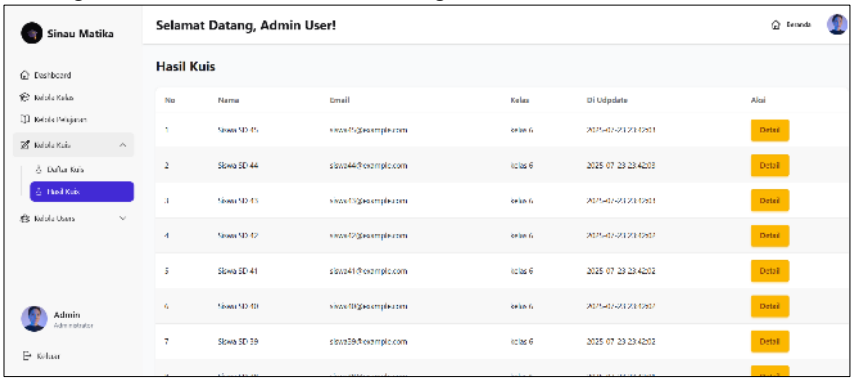

Fig. 1 Quiz Page

In practice, several adjustments were made to the usability questionnaire to ensure that it was appropriate for the respondents, who were 6th-grade elementary school students, whereas the previous study involved 5th-grade students. The language and wording of the questions were simplified to match the cognitive and reading comprehension level of the participants, while still maintaining the validity of the evaluation instrument. The usability test consisted of five categories of questions representing Navigation Task 1, Navigation Task 2, Navigation Task 3, Navigation Task 4, training tasks, and general questions about the website. Each category contained specific

items designed to measure ease of use, clarity of instructions, and overall user satisfaction, as presented in Table 1. In particular, question number 4 was dedicated to evaluating general perceptions of the website, including overall comfort, attractiveness, and enjoyment in using the platform. These adjustments ensured that the usability evaluation remained reliable, age-appropriate, and aligned with the objectives of assessing user experience in the developed learning system.

Table 1 Adapted Usability Questionnaire

No	Questions
1	Is this website easy to use?
2	Do you like the layout?
3	Are the lessons engaging or boring?
4	Would you use this website again?

A summary of the questionnaire results obtained during the usability test for grade 6 students at SDK can be seen in Table 2 below.

Table 2 Summary of Usability Test Results for Grade 6 Students at SDK

Navigation Task 1					
Questions	5	4	3	2	1
Is this website easy to use?	14	10	3	1	1
Do you like the layout?	15	13	0	1	0
Are the lessons engaging or boring?	15	13	0	0	1
Navigation Task 2					
Questions	5	4	3	2	1
Is this website easy to use?	15	9	4	1	0
Do you like the layout?	15	12	2	0	0
Are the lessons engaging or boring?	12	14	1	1	1
Play and Practice Tasks					
Questions	5	4	3	2	1
Is this website easy to use?	11	11	7	0	0
Do you like the layout?	14	13	2	0	0
Are the lessons engaging or boring?	13	13	2	0	1
Navigation Task 3					
Questions	5	4	3	2	1
Is this website easy to use?	13	14	1	0	0
Do you like the layout?	15	12	1	0	0
Are the lessons engaging or boring?	14	11	3	0	0
Navigation Task 4					
Questions	5	4	3	2	1
Is this website easy to use?	13	10	2	0	0
Do you like the layout?	13	8	4	0	0
Are the lessons engaging or boring?	12	10	2	0	0
General Interview					

Questions	5	4	3	2	1
Is this website easy to use?	13	9	3	0	0
Do you like the layout?	13	10	2	0	0
Are the lessons engaging or boring?	11	11	3	0	0

Questions	Yes	No
Would you use this website again?	23	2

The questionnaire results indicate that users respond positively to the learning platform across ease of use, layout, and engagement. Most respondents rate the system highly in Navigation Tasks 1 and 2, with the majority giving scores of 4 and 5 for usability, attractive layout, and engaging learning materials, and only a few low ratings observed. In the Play and Practice Tasks, we observe slightly more variation, where many users still give high scores (4 and 5), but some assign a score of 3, indicating minor difficulties in using certain features. Similar positive trends appear in Navigation Tasks 3 and 4, where high ratings dominate, although responses become more varied in Task 4, especially for layout and engagement. The general interview results further support these findings, showing that most users perceive the platform as easy to use, visually appealing, and engaging, with no negative ratings reported.

Table 3 Mean Test Scale

Testing Categories	Score
Navigation Task 1	4.36
Navigation Task 2	4.32
Play and Practice Task	4.28
Navigation Task 3	4.44
Navigation Task 4	4.41
General Interview	4.39
Average	4.3667

Based on Table 3, the overall average score obtained from the usability testing is 4.3667 on a 1–5 scale, which indicates a very good level of user acceptance and system usability. Each testing category achieved a score above 4.28, demonstrating consistent positive evaluations across all measured aspects. Navigation Task 3 received the highest score (4.44), followed closely by Navigation Task 4 (4.41), suggesting that students were able to navigate advanced features and complete structured tasks with a high level of ease and confidence. The General Interview category also achieved a strong score (4.39), reflecting overall satisfaction, comfort, and positive impressions of the platform. Meanwhile, Navigation Task 1 (4.36) and Navigation Task 2 (4.32) show that basic navigation features were well understood by users. The Play and Practice Task, although slightly lower at 4.28, still falls within the “very good” range, suggesting that interactive and practice-based features function effectively and are positively received by students.

When visualized in graphical form, the distribution of scores clearly clusters within the upper range of the scale, particularly in the “good” to “very good” categories. The dominance of high scores on the left side of the graph (representing favorable evaluations) reinforces the conclusion that the platform successfully meets usability standards. Overall, these results demonstrate that the integration of navigation structure, interactive elements, and gamification features contributes positively to the student learning experience and supports the effectiveness of the developed web-based learning system.

This study obtained evaluation results that indicate a high level of user satisfaction with the learning platform across all assessed aspects. The evaluation results produced that

92.53% of respondents gave positive ratings for the layout, showing that users perceived the interface as attractive and consistent. We also gather that 90.80% of respondents rated the lessons as engaging, which reflects that the learning materials are interactive and not monotonous. For ease of use, the system still achieved a strong positive response of 86.30%, although a small number of users reported difficulties in specific features such as the Play and Practice Tasks sections. These findings demonstrate that usability, visual design, and content engagement are closely interconnected in shaping overall user experience. Fig. 2 depicts average rating for each aspect during the learning process.

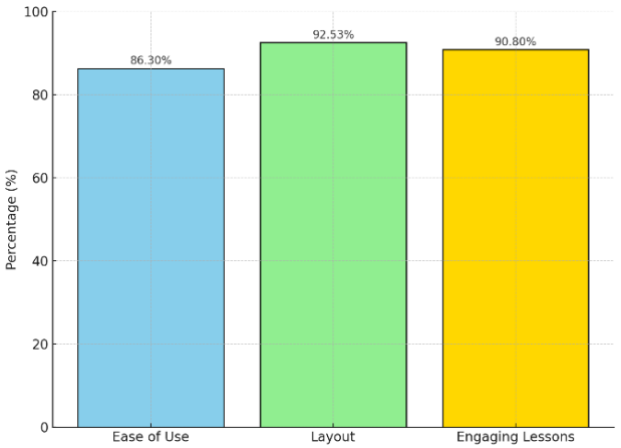

Fig. 2 Average Rating

This study obtained evaluation results that highlight strong user satisfaction across key aspects of the learning platform. The evaluation result produced that 92.53% of respondents rated the layout positively, indicating that users strongly favor the interface design and perceive it as consistent and engaging. We also gather that 90.80% of respondents found the lessons engaging, which confirms that the learning materials are interactive and not monotonous. The ease-of-use aspect achieved a slightly lower positive rating of 86.30%, suggesting that most users can navigate the system effectively, although a small group still experiences difficulties, particularly in the Play and Practice Tasks features. Overall, these findings show that the platform successfully meets user expectations in terms of visual design and learning experience, with minor improvements needed in navigation consistency to further enhance usability.

Furthermore, this study obtained that the integration of gamification elements contributes positively to system usability and student engagement. The evaluation result produced an average usability score of 4.37, indicating that the system is highly acceptable and easy to use. We gather that features such as points, badges, and leader boards do not hinder usability but instead enhance interaction, as reflected by consistently high navigation task scores above 4.2. Compared to earlier studies that focused only on motivation without integrated systems, this study demonstrates improved interaction and user experience through full implementation. The results also suggest that users adapt well to more advanced features, as seen in higher scores for complex navigation tasks. Although this study does not directly measure learning outcomes, the strong usability and engagement indicators provide clear evidence that gamification supports a more effective and satisfying learning process compared to conventional approaches.

4. Conclusion

This paper applies a usability-driven evaluation to assess the effectiveness of the web-based learning platform with gamification features. We utilize structured testing across multiple navigation tasks and user interactions, and we obtain an overall average score of 4.3667 on a 1–5 scale. This result indicates a very good level of user acceptance and system usability. All evaluated categories score above 4.28, which shows consistent positive performance across basic navigation, advanced features, and interactive components. We observe that Navigation Task 3 (4.44) and Navigation Task 4 (4.41) achieve the highest scores, which confirms that users can handle more complex features with confidence. These findings demonstrate that the system design successfully supports both usability and learnability in a practical learning environment.

This study also applies a user-centered evaluation to measure satisfaction in terms of layout, engagement, and ease of use. We obtain that 92.53% of users respond positively to the layout, indicating strong visual appeal and consistency. We also find that 90.80% of users perceive the lessons as engaging, which reflects the effectiveness of interactive and gamified content. The ease-of-use aspect reaches 86.30%, which remains high but reveals minor challenges in specific features such as Play and Practice Tasks. These results show that visual design, interaction quality, and usability are closely connected in shaping user experience. We confirm that the platform meets user expectations while still leaving room for improvement in navigation consistency and feature simplicity.

Furthermore, this paper utilizes gamification elements such as points, badges, and leaderboards to enhance user engagement without compromising usability. We obtain an average usability score of 4.37, which reinforces that the system is easy to use and well accepted by users. We observe that all navigation tasks maintain scores above 4.2, indicating that gamification supports interaction and system learnability. Compared to conventional learning systems, this study demonstrates a more balanced integration between functionality and user experience. Overall, this study confirms that the applied gamification approach effectively enhances both user satisfaction and the quality of the digital learning experience.

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