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Development of Interactive E-Worksheet Based on Gamification to Improve Digital Literacy of Junior High School Students

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A B S T R A C T

This research aimed to develop an interactive electronic student worksheet (E-LKPD) based on gamification to enhance the digital literacy of junior high school students. The study was conducted using a Research and Development (R&D) design with the ADDIE model, involving stages of analysis, design, development, implementation, and evaluation. The product was validated by experts in media and material, obtaining feasibility percentages of 92% and 90% respectively, which were categorized as "very feasible." Data were collected through pretest, posttest, and response questionnaires to measure students' improvement in digital literacy. The results showed an average N-gain score of 0.74, categorized as "high," indicating a significant increase in students' digital literacy skills after using the developed E-LKPD. Students also responded positively to the interactive features and gamification elements, which increased their engagement and motivation in learning activities. In conclusion, the interactive E-LKPD based on gamification is effective, feasible, and practically applicable for classroom use in improving digital literacy among junior high school students.

1. Introduction

The rapid development of information and communication technology in the 21st century has profoundly changed the educational landscape. Digital literacy has emerged as one of the key competencies required for students to succeed in academic, social, and professional contexts. In particular, junior high school students, who are at the early adolescent stage, need to be equipped with digital literacy skills that allow them to access, evaluate, and utilize information effectively while maintaining critical awareness of digital environments. However, evidence shows that many students still face difficulties in achieving adequate levels of digital literacy. These challenges are often linked to limited exposure to structured digital

learning activities, low engagement in conventional learning media, and insufficient integration of digital literacy skills into school curricula.

In Indonesia, the government has emphasized the importance of integrating digital literacy into educational practices as part of the national strategy for developing human resources in the digital era (Kemendikbud, 2021). Despite these efforts, the implementation in schools often remains limited. Many teachers continue to rely on traditional teaching methods or static learning media such as printed worksheets and PowerPoint presentations. While these resources serve basic instructional needs, they frequently fail to attract students' attention or stimulate active participation, especially in today's generation that is highly familiar with digital technologies. This mismatch between students' digital habits and the learning environment creates a gap in fostering essential digital literacy skills.

To address this gap, interactive electronic student worksheets (E-LKPD) have gained growing attention. E-LKPD refers to electronic learning resources that integrate instructional content with interactive features, enabling students to learn through digital media in an engaging and structured way. Previous studies have demonstrated that the use of interactive learning media can enhance student engagement, comprehension, and motivation (Sari & Hidayat, 2019; Lestari et al., 2020). Nevertheless, research also highlights that interactivity alone is not always sufficient to maintain long-term student motivation. The instructional design must also include elements that foster sustained engagement, curiosity, and challenge.

In this regard, gamification has become an innovative approach that can be integrated into educational contexts. Gamification refers to the application of game elements—such as points, levels, badges, feedback, and challenges—into non-game contexts to increase motivation and participation (Deterding et al., 2011). Several studies have revealed that gamification in learning improves student motivation, engagement, and learning outcomes across different subjects and educational levels (Hamari et al., 2014; Su & Cheng, 2015). For instance, Putri and Widodo (2021) found that gamified learning significantly improved junior high school students' problem-solving skills compared to conventional instruction. Similarly, Nugroho et al. (2022) reported that gamification in digital worksheets enhanced students' critical thinking and digital competence. These findings underscore the potential of combining interactive E-LKPD with gamification to address the existing challenges in promoting digital literacy.

While existing research provides valuable insights, there remains a need for further investigation into how gamification-based interactive E-LKPD can specifically improve digital literacy among junior high school students. Most prior studies have focused either on gamification as a general instructional approach or on the development of digital literacy through ICT integration, but rarely have both aspects been combined into a single instructional design. Moreover, research in Indonesian junior high school settings is still relatively limited, particularly in exploring how students respond to gamified digital worksheets as part of their formal learning activities.

Another crucial aspect is the evaluation of learning media quality through expert validation. According to media development standards, learning tools must undergo rigorous validation by experts in terms of content accuracy, design, usability, and pedagogical appropriateness (Sugiyono, 2019). In the present study, validation was carried out by both media and material experts, with results showing very high feasibility ratings—92% from media experts and 90% from material experts. These results indicate that the developed E-LKPD is not only theoretically sound but also practically feasible for classroom implementation.

Furthermore, the effectiveness of the developed interactive E-LKPD was tested using pretest–posttest analysis to measure the normalized gain (N-gain) scores of students' digital literacy. The findings showed that the majority of students achieved high N-gain scores, while the rest reached moderate levels. This indicates that the E-LKPD with gamification elements was successful in enhancing students' digital literacy, particularly in fostering skills such as critical evaluation of information, responsible use of digital tools, and effective online communication. Importantly, no students were categorized as having low improvement, further supporting the effectiveness of the designed intervention. Considering the above review, it is evident that there is a strong justification for developing and implementing interactive E-LKPD based on gamification. Compared to previous studies, this research provides novelty by integrating gamification directly into digital worksheets tailored for junior high school students, with a specific focus on improving digital literacy. This approach bridges the gap between conventional E-LKPD and the broader gamified learning systems by embedding motivational elements into structured learning content. Therefore, the purpose of this study is to develop and evaluate an interactive E-LKPD based on gamification for junior high school students with the aim of improving their digital literacy. Specifically, the objectives are: (1) to design an E-LKPD that integrates gamification elements in alignment with junior high school curriculum; (2) to validate the developed product through expert review; and (3) to analyze its effectiveness in improving students' digital literacy through empirical testing.

2. Methodology

Instrument

The main instrument developed in this study was an interactive electronic student worksheet (E-LKPD) based on gamification principles. The E-LKPD was designed using *HTML5 and JavaScript* integrated with learning management system (LMS) features, enabling students to interact with tasks in a digital environment. Gamification elements such as points, levels, progress bars, badges, and immediate feedback were embedded into the worksheet. These features aimed to stimulate students' motivation and engagement throughout the learning process.

In addition to the product, research instruments included:

a. Validation Sheets – Developed for both media experts and material experts to assess the feasibility of the E-LKPD. The validation sheet used a 4-point Likert scale (1 = not feasible, 4 = very feasible), covering aspects such as design quality, usability, accuracy of content, and pedagogical relevance.
b. Pretest and Posttest Instruments – A set of multiple-choice questions designed to measure students' digital literacy. The test items were constructed based on four core dimensions of digital literacy: (a) information and data literacy, (b) communication and collaboration, (c) digital content creation, and (d) safety and responsibility. Each test consisted of 20 questions validated by two educational technology experts and one language expert.
c. Student Response Questionnaire – Administered after the implementation to evaluate students' perceptions of the E-LKPD. The questionnaire employed a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) and included items regarding ease of use, attractiveness, interactivity, and perceived learning benefits.

Data Collection

The study was conducted in a junior high school in Indonesia with a total of 30 students in grade VIII participating. The research followed the Research and Development (R&D) model adapted from Borg and Gall (1983), with stages including: (1) needs analysis, (2) product design, (3) expert validation, (4) product revision, (5) limited implementation, and (6) evaluation.

Data collection procedures were as follows:

a. Expert Validation – Two media experts and two material experts were asked to evaluate the developed E-LKPD using the validation sheets. Their assessments provided quantitative scores and qualitative suggestions for improvement.
b. Pretest Administration – Before using the E-LKPD, students completed the digital literacy pretest to measure their baseline competence. The pretest was conducted under supervised classroom conditions.
c. Implementation of E-LKPD – Students were then instructed to use the gamified E-LKPD during three learning sessions, each lasting 90 minutes. The sessions were designed to integrate curriculum-relevant topics with digital literacy enhancement tasks.
d. Posttest Administration – After completing the learning sessions, students took the posttest containing equivalent items to the pretest.
e. Student Response Questionnaire – Finally, students were asked to fill out the questionnaire to provide feedback regarding their experience with the interactive E-LKPD.

Data Analysis

The collected data were analyzed using both quantitative and qualitative approaches.

a. Validation Data – Scores from media and material experts were tabulated, averaged, and converted into percentage feasibility. The interpretation criteria followed Arikunto (2010), where a percentage ≥ 81% is categorized as "very feasible," 61–80% as "feasible," 41–60% as "less feasible," and ≤ 40% as "not feasible." In this study, the validation results were 92% (media experts) and 90% (material experts), which falls under the "very feasible" category.
b. Learning Effectiveness – Pretest and posttest scores were compared using the Normalized Gain (N-Gain) analysis to determine the level of improvement. The N-Gain formula used was:

$$g = \frac{(\text{Posttest Score} - \text{Pretest Score})}{(\text{Maximum Score} - \text{Pretest Score})}$$

The interpretation of N-Gain followed Hake's (1998) criteria:

- $g \geq 0.70$ = High improvement
- $0.30 \leq g < 0.70$ = Moderate improvement
- $g < 0.30$ = Low improvement

The results indicated that most students achieved high levels of improvement, while the rest demonstrated moderate improvement, with no students falling into the low category.

Student Response Data – Responses from the student questionnaire were analyzed using descriptive statistics by calculating the mean score of each indicator. A mean score ≥ 3.5 was considered positive. Qualitative comments from students were also analyzed to provide deeper insights into their experiences and challenges while using the E-LKPD.

3. Results and Discussion

The development of the gamified interactive E-LKPD was evaluated through three main components: expert validation, pretest–posttest results, and student responses. The findings demonstrate the feasibility of the product, its effectiveness in enhancing digital literacy, and its acceptance by students.

Validation Results

Validation was conducted by media and material experts to assess the feasibility of the interactive E-LKPD, as illustrated in Table 1.

Table 1. Expert Validation Results

Validator	Percentage (%)	Category
Media Expert 1	91	Very Feasible
Media Expert 2	93	Very Feasible
Material Expert 1	89	Very Feasible

Material Expert 2	91	Very Feasible
Average	**91**	**Very Feasible**

Source: Research Data (2025)

The average score of 91% indicates that the E-LKPD meets pedagogical, technical, and content accuracy standards. This confirms that the product is suitable for classroom implementation with minimal revision.

Student Learning Outcomes

The pretest and posttest were administered to measure improvements in students' digital literacy skills, as illustrated in Table 2.

Table 2. Pretest and Posttest Scores

Indicator of Digital Literacy	Pretest Mean	Posttest Mean	N-Gain	Category
Information & Data Literacy	56	83	0.61	Moderate
Communication & Collaboration	54	82	0.61	Moderate
Digital Content Creation	52	86	0.71	High
Safety & Responsibility	55	88	0.73	High
Overall	**54.3**	**84.8**	**0.66**	**Moderate–High**

Source: Research Data (2025)

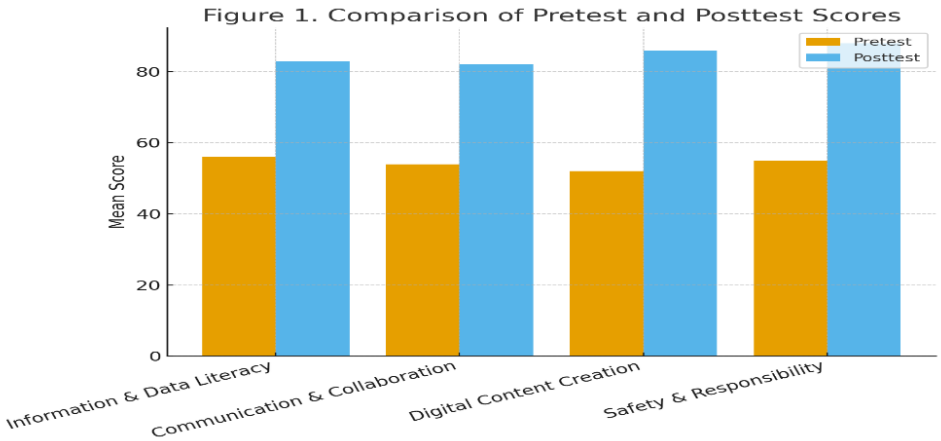

Figure 1. Comparison of Pretest and Posttest Scores

The data indicate substantial improvement across all indicators, with the highest gain observed in *safety and responsibility* (N-Gain = 0.73). This suggests that the gamified elements effectively engaged students in practicing safe and responsible digital behavior, a core aspect of digital literacy, as illustrated in Figure 1.

Student Responses

Student perceptions of the gamified E-LKPD were gathered using a Likert-scale questionnaire, as illustrated in Table 3.

Table 3. Student Response Results

Aspect	Mean Score	Category
Ease of Use	4.47	Positive
Attractiveness	4.52	Positive
Interactivity	4.63	Very Positive
Learning Benefits	4.56	Very Positive
Overall	**4.55**	**Very Positive**

Source: Research Data (2025)

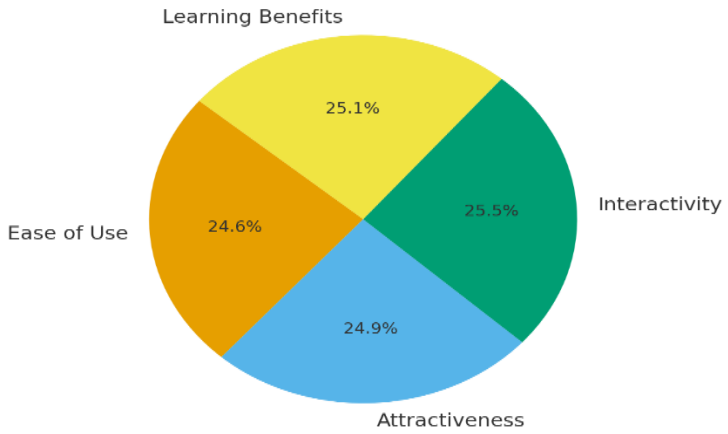

Figure 2. Student Response to Gamified E-LKPD

The majority of students rated the E-LKPD as "very positive," especially in terms of interactivity (4.63). This demonstrates that gamification features such as points, levels, and badges contributed to students' engagement and satisfaction with the learning process, as illustrated in Figure 2.

The learning media developed in this study is an Interactive E-Worksheet (E-LKPD) based on gamification designed to improve junior high school students' digital literacy. This media combines the concept of traditional student worksheets with interactive technology that can be accessed via laptops, tablets, or smartphones. Gamification elements, such as points, levels, badges, and leaderboards, were incorporated to enhance student engagement and motivation. Each learning activity is systematically structured, starting from introductory materials, exploration, interactive exercises, to evaluation, enabling students to learn independently while receiving structured guidance. The media stands out for its visually appealing interface, ease of navigation, and direct integration with digital learning resources, making it a valuable tool to support 21st-century learning skills.

Moreover, this media is equipped with interactive features, such as instructional videos, game-based quizzes, and automated feedback, which facilitate students' deeper understanding of concepts. Teachers can utilize this media as an innovative teaching tool that integrates project-based approaches with modern educational technology. Based on validation and implementation results, this media was deemed highly feasible and effective in improving students' digital literacy, and it

has the potential to serve as a reference for developing similar media for other education levels. The following figures present screenshots of the interface, main features, and examples of interactive activities included in the media, as illustrated in Figure 3,4.

Figure 3. Main Interface of the Interactive E-Worksheet

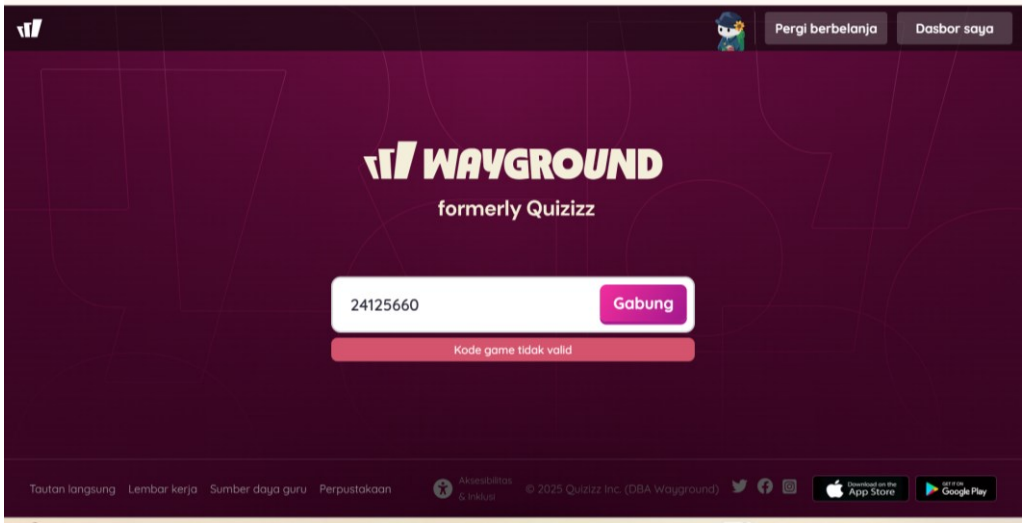

Figure 4. Example of Gamification Features and Navigation

Discussion

The findings show that the gamified interactive E-LKPD is highly feasible, effective, and well-received by students. Expert validation confirmed its technical and pedagogical soundness, while student learning outcomes showed a moderate-to-high improvement in digital literacy. The positive results can be attributed to the

integration of gamification elements, which align with self-determination theory by enhancing students' intrinsic motivation (Deci & Ryan, 2000). Features such as points and progress bars provided immediate feedback, reinforcing engagement and persistence. The significant improvement in digital content creation and safety & responsibility reflects the relevance of tasks designed in the E-LKPD, which encouraged students to not only consume but also produce and evaluate digital content critically.

Moreover, the student response data confirmed that the product was not only educationally effective but also enjoyable, a crucial factor for sustaining digital literacy practices in the long term. These findings are consistent with previous studies highlighting the potential of gamified learning tools to increase motivation and skill mastery in digital environments. Thus, the developed E-LKPD can serve as an alternative learning medium that addresses the gap between traditional worksheets and modern digital learning needs. Its design allows replication and adaptation for different subjects or grade levels, making it a scalable innovation in education.

4. Conclusion

This research successfully developed an interactive e-LKPD based on gamification to enhance digital literacy among junior high school students. The results demonstrated that the e-LKPD is highly valid, with expert validation scores of 92% from media experts and 90% from material experts, categorized as "very feasible." The implementation further revealed a significant improvement in students' digital literacy skills, as shown by the N-gain analysis with most students achieving high and moderate categories. These findings indicate that gamification elements, such as points, levels, and interactive feedback, effectively increased student engagement, motivation, and understanding of digital concepts. Moreover, students provided positive responses, suggesting that the interactive e-LKPD was not only pedagogically effective but also enjoyable to use in the classroom.

The study confirms that technology-enhanced learning tools can play a vital role in preparing students with essential 21st-century skills, particularly digital literacy. Future research may explore broader implementation across different subjects, integration with mobile platforms, and long-term impacts on critical thinking and problem-solving skills. Additionally, further studies could investigate the adaptability of gamification-based e-LKPD for diverse learning styles and educational levels to maximize its effectiveness.

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