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Implementing Interacty-Based Gamification Media to Improve Students' Scientific Literacy in the Context of Local Culture

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Abstrak

The urgency of this research lies in the need for innovative, interactive gamification-based learning media to enhance students' scientific literacy, which remains relatively low, while simultaneously integrating local cultural contexts to support meaningful and relevant 21st-century learning. This study aims to examine the implementation of gamified learning using Interacty integrated with a local cultural context and its effect on students' scientific literacy. This research employed a Classroom Action Research (CAR) design conducted in two cycles, each consisting of planning, implementation, observation, and reflection. The participants were eighth-grade students at a junior high school in Indonesia. Data were collected through scientific literacy tests, observation sheets, and student response questionnaires. Scientific literacy in this study refers to students' ability to identify relevant information, represent problems in structured forms, apply problem-solving strategies, and interpret results within real-life contexts. The learning activities were designed using gamification elements such as interactive challenges and rewards through the Interacty platform, combined with culturally relevant contexts derived from local traditions and daily practices. The results showed a significant improvement in students' scientific literacy, with the average score increasing from 63,5 in the pre-cycle to 74 in Cycle I and 80,3 in Cycle II. Students' learning activities improved from a fair category (2,8) to a good category (3,5). In conclusion, the integration of gamification through Interacty and local cultural context effectively enhances students' scientific literacy by creating a more engaging, meaningful, and contextual learning environment.

Keywords: *Gamification Media, Interacty, Local Culture, Science Literation*

Introduction

The development of students' scientific literacy has become one of the central focuses in 21st-century education. Scientific literacy is no longer limited to the mastery of concepts; rather, it encompasses students' ability to use knowledge to identify problems, interpret information, and make evidence-based decisions in real-life contexts. Within the international framework, scientific literacy is defined as the ability to explain phenomena scientifically, evaluate evidence, and draw conclusions relevant to everyday life (OECD, 2019). Therefore, scientific literacy is considered an essential competence that must be developed through meaningful and contextual learning processes.

However, a critical reflection on classroom practices raises an important question: to what extent have current learning processes truly supported the development of scientific literacy? In many cases, students are able to solve problems procedurally, yet they encounter difficulties when faced with tasks that require contextual understanding and interpretation (Riskawati et al.,

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2025). This condition indicates that learning tends to emphasize lower-order cognitive skills and has not fully facilitated the development of higher-order thinking skills. Empirical findings from recent studies further reinforce this issue. A study reveals that students' scientific literacy is not evenly developed across its components. While the knowledge aspect is categorized as good, the context and competency aspects still require improvement. This suggests that learning practices may place greater emphasis on what students should know rather than how knowledge is applied in real-life situations.

In addition, the lack of connection between learning materials and students' everyday experiences also contributes to the problem. Learning that is abstract and decontextualized tends to make it difficult for students to grasp the meaning of the concepts being studied. This is consistent with findings from, which indicate that non-contextual learning is less effective in developing scientific literacy, particularly in terms of interpretation and problem-solving skills. From a policy perspective, the Merdeka Curriculum has provided a clear direction by emphasizing student-centered, contextual, and competency-based learning (Kemdikbudristek, 2022). Nevertheless, its implementation in classrooms remains challenging. Teachers often encounter difficulties in designing learning activities that simultaneously promote student engagement and the development of literacy skills. This situation highlights the need for instructional approaches that are not only engaging but also capable of creating meaningful learning experiences.

In response to these challenges, it becomes necessary to explore learning approaches that can bridge the gap between curricular expectations and classroom realities (Budianto et al., 2021). Gamification, for instance, has been widely recognized as an approach that can enhance students' motivation and engagement through the integration of game elements (Li et al., 2024; Ruiz et al., 2024). On the other hand, the integration of local cultural contexts into learning has been shown to improve relevance and understanding by connecting academic content with students' lived experiences (Pangga et al., 2023; Mulyani & Julianto, 2022). Therefore, combining these two approaches holds the potential to create learning environments that are more engaging, contextual, and meaningful, thereby supporting the development of students' scientific literacy more effectively.

Interactive digital platforms can significantly improve student academic outcomes when supported by adequate teacher technological proficiency and structured implementation (Rahayu, 2025). Gamification enhances students' motivation and engagement through game elements, but its effectiveness depends on how well it fulfills students' needs for autonomy, relatedness, and especially competence (Ruiz et al., 2024). More recent studies emphasize that gamification supports both intrinsic and extrinsic motivation, which are critical in sustaining students' engagement in learning activities (Coelho et al., 2025; Koivisto & Hamari, 2019). In educational settings, gamification has been shown to promote active learning, increase persistence, and improve problem-solving skills by creating interactive and student-centered learning experiences (Zainuddin et al., 2020). Thus, gamification is not only a motivational tool but also a pedagogical strategy that supports meaningful learning.

In addition, the use of digital interactive media has further strengthened the implementation of gamification in education. One such platform is Interacty, which allows educators to design interactive learning activities such as quizzes, games, and simulations. Interactive platforms like Interacty enable real-time feedback, adaptive challenges, and engaging visual elements that can enhance students' learning experiences. Recent studies highlight that interactive digital media play a crucial role in facilitating student engagement and supporting deeper understanding by

allowing learners to actively participate in the learning process (Zainuddin et al., 2020; Nopitasari et al., 2026). Therefore, integrating gamification with interactive digital platforms provides a more effective approach to creating engaging and meaningful learning environments.

Furthermore, the integration of local cultural context into learning has gained increasing attention as part of culturally responsive pedagogy. Culture-based learning emphasizes the importance of connecting academic content with students' lived experiences, social environments, and cultural values. This approach is grounded in constructivist theory, which posits that knowledge is constructed through interaction with one's environment. Recent studies indicate that incorporating local cultural elements into instruction can enhance students' conceptual understanding, improve engagement, and make learning more relevant (Sumarni et al., 2024; Rahayu et al., 2022). In addition, culturally contextualized learning has been shown to support students in developing meaningful connections between scientific concepts and real-life situations, which is essential for fostering scientific literacy (Armas et al., 2019).

From a broader perspective, both gamification and culture-based learning share a common objective: creating meaningful, engaging, and contextually relevant learning experiences. While gamification focuses on increasing motivation and interaction through game elements, culture-based learning emphasizes relevance and authenticity through real-life contexts. Integrating these two approaches, particularly through digital interactive platforms, offers a promising pathway to enhance students' scientific literacy in a more holistic and meaningful way. Despite the growing body of research on scientific literacy, gamification, and culture-based learning, a closer examination reveals several important gaps. Existing studies have demonstrated that scientific literacy can be improved through contextual and student-centered approaches.

Similarly, gamification has been widely acknowledged for its ability to enhance student engagement and motivation, while culture-based learning has been shown to improve the relevance and meaningfulness of learning experiences. However, these approaches are often examined in isolation. Most studies tend to focus either on gamification as a strategy to increase engagement or on cultural context as a means of contextualizing learning. As a result, there is still limited understanding of how the integration of both approaches can simultaneously support the development of students' scientific literacy, particularly in terms of their ability to identify information, represent problems, apply problem-solving strategies, and interpret results in real-life contexts.

Furthermore, although the use of digital interactive media has increased significantly in recent years, studies that specifically explore the use of platforms such as Interacty in supporting gamified and culturally contextualized learning remain scarce. This indicates a lack of empirical evidence on how digital gamification tools can be effectively integrated with local cultural contexts to enhance scientific literacy in classroom settings. Therefore, this study seeks to address these gaps by investigating the integration of gamification through an interactive digital platform combined with local cultural context to enhance students' scientific literacy. By doing so, this research not only extends previous studies but also provides a more comprehensive and contextually grounded approach to learning.

Previous studies have explored gamification, digital learning platforms, and culturally responsive teaching from different perspectives. For instance, Koivisto & Hamari examined the effectiveness of gamification in increasing student motivation and engagement, showing that game elements can positively influence learning participation (Koivisto & Hamari, 2019). More recent research also highlights that gamified and interactive digital environments can significantly enhance students' engagement and learning outcomes (Zainuddin et al., 2020).

Similarly, Alqahtani investigated the use of digital interactive platforms in education and found that such platforms improve students' learning experiences through active engagement (Alqahtani, 2022).

On the other hand, emphasized the importance of integrating local cultural context in learning to improve students' understanding and relevance of the material (Ramdani & Hapsari, 2022). However, these studies tend to examine these approaches separately. Gamification studies often focus on motivation and engagement without incorporating meaningful cultural contexts, while research on culturally responsive learning rarely integrates interactive digital platforms or gamified elements. As a result, there is still limited research that simultaneously combines gamification, interactive digital media, and local cultural context in a single instructional framework, particularly in the context of improving students' scientific literacy.

Therefore, this study aims to address this gap by implementing gamified learning using Interacty integrated with local cultural context to enhance students' scientific literacy, as well as their participation and engagement in the learning process. The novelty of this research lies in the integration of three key elements: gamification, digital interactive media, and local cultural context. Based on the identified research gap, this study aims to investigate the effectiveness of gamified learning using Interacty integrated with local cultural context in improving students' scientific literacy. Accordingly, the research questions are formulated as follows: (1) How is gamified learning using Interacty integrated with local cultural context implemented in classroom instruction?; and (2) To what extent does the implementation of this approach improve students' scientific literacy across the indicators of identifying scientific information, interpreting and evaluating data, and predicting scientific phenomena?

Method

This study employed a Classroom Action Research (CAR) design aimed at improving students' scientific literacy through iterative learning cycles. The research was conducted in two cycles, each consisting of four stages: planning, acting, observing, and reflecting (Annur, 2015; Sugiyono, 2007). This approach allows for continuous refinement of the instructional process based on the outcomes of each cycle. The study was carried out at UPT SMPN 5 Pinrang involving 30 eighth-grade students with diverse academic abilities. The intervention was integrated into regular classroom instruction using a gamified learning approach combined with local cultural context to enhance the relevance and meaningfulness of learning.

The instructional intervention utilized the Interacty platform, which facilitated gamification elements such as points, levels, challenges, and rewards. Learning materials were contextualized using local cultural elements, enabling students to connect abstract concepts with real-life situations. The research procedure followed the stages of Classroom Action Research. In the planning stage, lesson plans, student worksheets, and scientific literacy instruments were prepared. Gamified learning media were designed using Interacty by integrating scientific literacy tasks with local cultural contexts such as traditions, crafts, and local practices. In the acting stage, the teacher implemented the learning process using the designed media, while students actively participated in interactive quizzes and culturally contextualized challenges. During this process, the teacher acted as a facilitator by providing guidance and feedback.

In the observing stage, the researcher and a collaborator observed students' activities, focusing on participation, collaboration, motivation, and conceptual understanding. Data were collected through scientific literacy tests, observation sheets, and field notes. In the reflecting

stage, the results of each cycle were analyzed to identify strengths and weaknesses, which were then used to improve the implementation in the next cycle. The implementation cycle of this study can be seen in Figure 1.

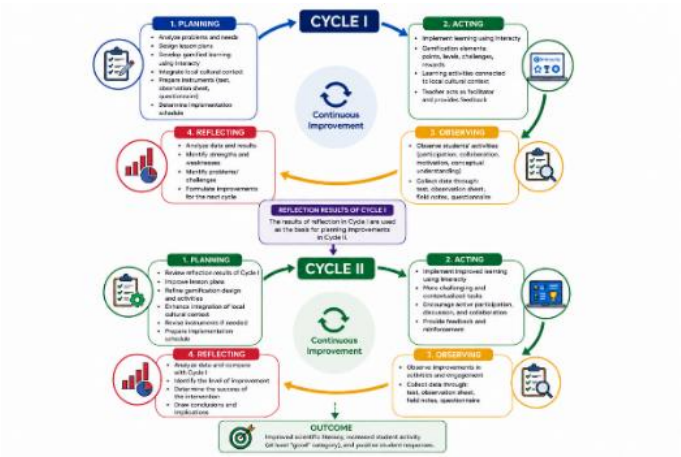

Figure 1. *Classroom Action Research Cycles*

The instruments used in this study included a scientific literacy test, observation sheets, and a student response questionnaire. The scientific literacy test was developed based on PISA indicators, including identifying scientific information, interpreting evidence, and predicting scientific phenomena. The observation sheet assessed students' learning activities, while the questionnaire measured students' responses in terms of media attractiveness, ease of use, engagement, cultural relevance, and perceived learning benefits.

Table 1. *Observation Assessment Aspects*

Observed Aspect	Indicator	Rating Scale (1–4)
Participation	Actively asking and answering questions	1 = never, 4 = always
	Expressing opinions confidently	1–4
Collaboration	Working collaboratively in groups during gamification-based tasks	1–4
	Respecting peers' opinions	1–4
Learning Motivation	Showing enthusiasm in participating in Interacty-based games/quizzes	1–4
	Completing tasks thoroughly	1–4
Conceptual Understanding	Providing simple explanations	1–4
	Relating science problems to local cultural contexts	1–4

To ensure validity, all instruments were evaluated through expert judgment involving two experts in science education. The instruments were revised based on their suggestions and were deemed valid for use. Reliability testing of the questionnaire was conducted using Cronbach's Alpha, which yielded a coefficient of $\alpha > 0.70$, indicating acceptable reliability. In addition, inter-observer agreement was applied during the observation process to maintain scoring consistency. The collected data were analyzed using quantitative and descriptive approaches. The average score of students' scientific literacy was calculated using the following formula (Soesana et al., 2023):

$$\bar{X} = \frac{\sum f\, X_i}{n}$$

To measure the variability of students' scores, the standard deviation was calculated using:

$$S = \sqrt{\frac{n \sum f . {X_i}^2 - (\sum f\, X_i)^2}{n(n-1)}}$$

Observation and questionnaire data were analyzed using a four-point Likert scale and interpreted into qualitative categories as table 2.

Table 2. *Criteria for Data Interpretation*

Scor	Criteria
3,26 – 4,00	Very Good
2,51 – 3,25	Good
1,76 – 2,50	Fair
1,00 – 1,75	Poor

The success indicators of this study were defined as follows: (1) students' scientific literacy scores show improvement across cycles and reach a minimum average score of ≥70; (2) students' learning activities achieve at least the "good" category based on observation results; and (3) students' responses toward the learning process are positive, with questionnaire scores reaching at least the "good" category.

Result

Initial Condition (Pre-Cycle)

Before the implementation of the intervention, a preliminary observation was conducted to identify students' initial level of scientific literacy. The results indicated that students' performance was still below the expected criteria.

Table 3. *Student's Initian Conditioan*

Aspect	Result	Description
Average score	63,5	Below minimum criteria
Mastery percentage	26,7%	Target ≥ 75%
Student activity	Low	Many students were passive
Student response	Passive	Low motivation

These findings indicate that the initial learning process had not yet effectively supported the development of students' scientific literacy.

Cycle I and Cycle II

To examine the improvement of students' scientific literacy, a comparison between Cycle I and Cycle II was conducted based on several indicators, including identifying scientific information, interpreting data, and predicting scientific phenomena. The comparison of students' scientific literacy between Cycle I and Cycle II is presented in Table 4.

Table 4. *Comparison of Scientific Literacy Results*

Indicator	Precycle	Cycle I	Cycle II	Improvement
Identifying scientific information	65,5	78	82	+16,5
Interpreting data and drawing conclusions	61,5	71	80	+18,5
Predicting scientific phenomena	63,5	73	79	+15,5
Average	63,5	74,0	80,3	+16,8

As shown in Table 4, students' scientific literacy improved significantly across all indicators. The average score increased from 74,0 in Cycle I to 80,3 in Cycle II. The improvement was consistent across all aspects, indicating that students developed better abilities not only in identifying information but also in higher-order skills such as interpreting data and predicting scientific phenomena. This suggests that the learning intervention was effective in enhancing students' scientific literacy.

To evaluate students' learning activities, observations were conducted during both cycles, focusing on participation, collaboration, motivation, and conceptual understanding. Students' responses toward the learning process in both cycles are compared in Table 5.

Table 5. *Comparison of Learning Activities Results*

Aspect	Cycle I	Category	Cycle II	Category	Improvement
Participation	2,7	Fair	3,5	Good	+0,8
Collaboration	3,0	Good	3,6	Very Good	+0,6
Learning Motivation	2,8	Fair	3,5	Good	+0,7
Conceptual Understanding	2,6	Fair	3,4	Good	+0,8
Average	2,8	Fair	3,5	Good	+0,7

Based on Table 5, students' learning activities improved significantly from Cycle I to Cycle II. The average score increased from 2,8 (fair category) to 3,5 (good category), indicating a substantial enhancement in overall classroom engagement. The most notable improvements were observed in participation and conceptual understanding, both increasing by 0,8 points. This suggests that students became more actively involved in the learning process and demonstrated a better understanding of the concepts being taught. Meanwhile, learning motivation also showed a considerable increase (+0,7), indicating that the learning approach successfully encouraged students to engage more enthusiastically in classroom activities.

In addition, collaboration improved from 3,0 to 3,6, reaching the "very good" category. This reflects that students were able to work more effectively in groups, particularly during gamification-based activities. Overall, these findings indicate that the implementation of gamified learning using Interacty combined with local cultural context had a positive impact on students' learning activities. The improvement across all aspects suggests that the learning environment became more interactive, engaging, and supportive of students' active participation.

Discussion

The findings of this study provide strong evidence that the integration of gamified learning using Interacty combined with local cultural context can significantly enhance students' scientific literacy, learning engagement, and overall classroom participation. The improvements observed from Cycle I to Cycle II not only reflect the effectiveness of the instructional design but also highlight the importance of iterative refinement in Classroom Action Research. This iterative process allows teachers to continuously adjust instructional strategies based on students' responses, thereby creating a more adaptive and responsive learning environment.

From the perspective of scientific literacy, the results show a consistent and meaningful improvement across all measured indicators, namely identifying scientific information, interpreting and evaluating data, and predicting scientific phenomena. Among these, the most significant increase was observed in students' ability to interpret and evaluate data. This finding is particularly important, as it reflects the development of higher-order thinking skills, which are central to scientific literacy. According to the OECD, scientific literacy involves not only understanding scientific concepts but also the ability to analyze data, evaluate evidence, and apply knowledge in real-life situations (OECD, 2019). Therefore, the improvement observed in this study indicates that the implemented learning approach successfully aligns with international standards of scientific literacy.

More importantly, the improvement across all indicators suggests that the learning intervention did not only support lower-level cognitive skills but also facilitated deeper cognitive processing. Students were encouraged to engage in reasoning, interpretation, and prediction,

which are essential components of scientific inquiry. This indicates that the integration of gamification and contextual learning can serve as an effective means of promoting inquiry-based learning, where students actively construct knowledge through exploration and problem-solving.

The enhancement of higher-order thinking skills can be closely associated with the implementation of gamification. Gamification has been widely recognized as an effective pedagogical strategy that increases student motivation and engagement through the incorporation of game elements into learning environments. Elements such as points, challenges, feedback, and progression systems encourage students to actively participate and persist in completing tasks. This finding is consistent with previous research found that gamification significantly improves user engagement and learning outcomes in educational contexts (Koivisto & Hamari, 2019). Moreover, other researcher emphasized that gamified learning environments promote active learning by encouraging students to interact with content more deeply and meaningfully (Zainuddin et al., 2020).

In addition, gamification also contributes to reducing students' anxiety toward learning complex concepts. By transforming learning activities into game-like experiences, students perceive tasks as challenges rather than obligations, which can lower cognitive barriers and increase willingness to participate. This aspect is particularly relevant in science learning, where abstract concepts often become obstacles for students. In this study, the use of an interactive digital platform further strengthened the impact of gamification. Digital tools such as Interacty enable the integration of multimedia elements, real-time feedback, and interactive challenges, which are essential in creating engaging learning experiences. The role of digital interactive media in education has been increasingly highlighted in recent studies. For instance, recent research indicates that interactive digital platforms significantly enhance student engagement and comprehension by providing dynamic and visually stimulating learning environments. Similarly, studies have shown that digital gamification supports self-paced learning and fosters deeper cognitive processing (Zainuddin et al., 2020).

Furthermore, the immediacy of feedback provided by digital platforms allows students to recognize their mistakes and correct them in real time. This immediate reinforcement is crucial in strengthening learning outcomes, as it supports the process of formative assessment and continuous improvement. As a result, students become more aware of their learning progress and are more motivated to achieve better performance. Another important aspect of this study is the integration of local cultural context into the learning process. The findings show that students not only improved their scientific literacy but also demonstrated higher engagement and better conceptual understanding when learning materials were connected to their cultural background. This supports the principles of culturally responsive pedagogy, which emphasize the importance of aligning instructional content with students' cultural experiences (Pangga et al., 2023).

By incorporating local cultural elements such as traditions, crafts, and daily practices from the Pinrang region, students were able to relate abstract scientific concepts to real-life situations, making learning more meaningful and relevant. This contextualization also plays a role in bridging the gap between formal education and students' everyday experiences. When students recognize that scientific concepts are embedded in their daily lives, their perception of learning shifts from abstract memorization to meaningful understanding. This not only improves comprehension but also fosters a positive attitude toward learning science. From a theoretical perspective, this finding is also supported by constructivist learning theory, particularly the view that knowledge is actively constructed by learners through interaction with their environment.

When students engage with culturally familiar contexts, they are more likely to develop deeper understanding and retain knowledge more effectively.

In addition, contextual learning theory suggests that knowledge becomes more meaningful when it is connected to real-life situations. Recent studies have also shown that integrating cultural context into science learning enhances students' ability to apply knowledge in authentic situations and improves their scientific reasoning skills (Sitio et al., 2025; Sukiastini et al., 2024). In addition to cognitive improvements, this study also highlights significant progress in students' affective and behavioral aspects, particularly in terms of participation, collaboration, and motivation. The observation results indicate that students became more actively involved in the learning process, participated more confidently in discussions, and collaborated more effectively with their peers. This aligns with findings that gamification fosters collaborative learning environments and improves student engagement by promoting interaction and teamwork (Koivisto & Hamari, 2019; Zebua et al., 2024; Mislia et al., 2025).

The improvement in students' motivation is particularly noteworthy. Motivation plays a crucial role in determining students' willingness to engage in learning activities and persist in solving problems. The gamified learning environment created in this study provided immediate feedback, clear goals, and a sense of achievement, all of which are key factors in enhancing intrinsic motivation. This is supported by self-determination theory, which suggests that motivation is enhanced when learners experience autonomy, competence, and relatedness in the learning process. In this context, gamification provides autonomy through self-paced challenges, competence through achievement systems, and relatedness through collaborative activities. Furthermore, students' responses toward the learning process became increasingly positive, as reflected in the questionnaire results. Students perceived the learning activities as more engaging, enjoyable, and relevant to their daily lives. This indicates that the integration of gamification and cultural context not only improves learning outcomes but also creates a positive learning experience. Positive student perception is important because it contributes to sustained engagement and long-term learning success.

The progressive improvement observed between Cycle I and Cycle II also highlights the importance of reflective practice in Classroom Action Research. The challenges identified in Cycle I, such as students' initial difficulties in adapting to the gamified environment and managing time effectively, were addressed through improved instructional strategies in Cycle II. This demonstrates that continuous reflection and adaptation are essential in optimizing the effectiveness of instructional interventions. In addition, the findings of this study provide practical implications for teachers and educators. The integration of gamification and local cultural context can be adopted as an innovative teaching strategy to create a more engaging and meaningful learning environment. Teachers are encouraged to design learning activities that not only utilize technology but also incorporate students' cultural backgrounds to enhance relevance and understanding.

Overall, the findings of this study suggest that the integration of gamification, interactive digital media, and local cultural context provides a comprehensive and effective approach to enhancing scientific literacy. This approach not only improves students' cognitive abilities but also fosters positive attitudes, motivation, and engagement in learning. The results also contribute to the growing body of literature on innovative learning strategies by providing empirical evidence on the effectiveness of combining technological and cultural approaches in education.

Conclusion

The findings of this study indicate that gamification has a positive, although relatively small, effect on students' intrinsic motivation. This result confirms the research objective of examining the effectiveness of gamification in enhancing motivation, as well as addressing the research questions related to its impact on intrinsic motivation and basic psychological needs. Specifically, the study reveals that gamification significantly supports students' sense of autonomy and relatedness, while its effect on perceived competence remains limited. These findings suggest that the integration of game elements can create a more engaging and interactive learning environment, particularly by fostering students' sense of choice and social connection. In terms of implications, this study highlights the importance of designing gamification strategies that go beyond surface-level rewards such as points and badges. Educators are encouraged to develop learning experiences that meaningfully support students' competence, autonomy, and relatedness to achieve more sustainable motivational outcomes. Proper alignment between game elements and instructional goals is therefore essential in maximizing the effectiveness of gamified learning.

However, this study has several limitations. First, the overall effect size of gamification is relatively small, indicating that its effectiveness may depend heavily on implementation quality. Second, most of the analyzed studies relied on self-reported data, which may introduce bias in measuring students' intrinsic motivation. Third, variations in instructional design, duration, and learning contexts across studies may influence the consistency of the findings. Therefore, future research is recommended to explore more robust and long-term implementations of gamification, particularly those that emphasize the development of students' perceived competence. In addition, future studies should incorporate more objective measurement methods, such as behavioral data, to complement self-reported measures. Investigating the role of specific game design elements and their alignment with pedagogical strategies may also provide deeper insights into how gamification can be optimized in educational settings.

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