Recent Trends and Innovations in Elementary School Educational Game Development: A Literature Review

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ABSTRACT
Educational games have emerged as interactive learning media that enhance elementary students' motivation, engagement, and understanding. This study analyzes recent trends in academic game development over the past five years by reviewing 15 peer-reviewed articles published between 2021 and 2025, sourced from Google Scholar. The analysis reveals that 60% of the studies focused on mobile-based games, particularly Android applications developed using Unity and Construct 2, due to their high accessibility and engaging interactive features. Additionally, web-based games such as Wordwall and desktop-based visual novel games developed with TyranoBuilder were found to improve students' concept mastery by up to 30%, especially in language and mathematics learning. However, key challenges remain, including limited platform compatibility, the absence of adaptive learning features, and weak integration with formal curriculum standards. To enhance their effectiveness, future educational games should prioritize cross-platform accessibility, implement adaptive learning mechanisms, and ensure strong alignment with academic curricullum.

Keywords : Application, Education Games, Education, Unity, Game Development

INTRODUCTION

Interactive learning media is a teaching method that utilizes digital technology to actively engage students through direct interaction with learning content, thereby enhancing their understanding and involvement in the learning process (PUTRA & SALSABILA, 2021). This type of media can take various forms, such as educational videos and game applications. One of the most popular forms of interactive learning media is educational game applications, which are software programs that integrate game elements with educational objectives. These applications are designed to boost student's motivation and understanding during the learning process by presenting engaging and enjoyable learning experiences (Rinaldi, 2022).

Educational elements can be embedded into different game genres, each offering unique benefits in developing players' skills. For example, puzzle games can increase student's engagement with lesson topics while also enhancing problem-solving, analytical thinking, and memory skills (Huang et al., as cited in Atika et al., 2023). Similarly, quiz-based games encourage active recall and reinforce knowledge through repetition and challenge.

Over the past five years, the increasing demand for interactive learning media in elementary schools has accelerated the development of technology-based educational games. These games are being developed for mobile, web, and desktop platforms using various technologies, including Unity, Construct 2, and TyranoBuilder. Among these platforms, Android has emerged as the primary choice due to its high accessibility and ease of use for students.

Research has shown that mobile and web-based educational games offer significant advantages in terms of accessibility and flexibility, making them highly suitable for diverse learning environments and adaptable to various educational needs. Their interactive features and user-friendly interfaces not only enhance student engagement but also promote active learning, allowing students to develop critical thinking and problem-solving skills while enjoying the learning process.

Educational games aim to enhance student's understanding of learning materials and boost their motivation through a more enjoyable and interactive approach. Modern technology enables students to engage and participate while learning through play.

Despite these promising developments, several challenges persist in the development of technology-based educational games. These challenges often affect children's experience of learning, especially from the perspective of accessibility, adaptability, and curriculum integration, which can hinder the effectiveness of game-based learning in diverse educational settings. Addressing these issues is crucial to ensuring that educational games not only captivate student's interest but also deliver meaningful and lasting learning outcomes.

Therefore, this study aims to analyze the trends in the development of educational games over the past five years. It will focus on examining the technologies used, the impact on student learning, the strengths and weaknesses of these games, and recommendations for future improvements. By analyzing recent studies and developments, this research seeks to generate innovative ideas that can contribute to creating more effective and engaging educational games for elementary school students.

METHODS

This study employs a literature review method aimed at conducting an in-depth analysis of various relevant sources related to the research topic. The reviewed literature includes scientific journals, reference books, research articles, conference proceedings (both national and international), and other credible scientific sources. Through this approach, the study seeks to obtain a comprehensive understanding of the development of concepts, findings, and recent trends within the investigated field.

The literature search was conducted using Google Scholar databases . The primary keyword used was "educational game development for elementary school", with additional keywords such as "interactive learning media", "mobile educational games", and "web-based educational games". The search was restricted to the period 2021-2025 to ensure the inclusion of recent and relevant findings that align with the latest technological developments in elementary education.

The inclusion criteria for selecting the literature were as follows:

1. Articles published in the form of peer-reviewed journals or conference proceedings.

2. Publications written in English or Indonesian.
3. Studies that involve elementary school students as the primary testing subjects.
4. Articles that specifically discuss the development of 2D educational games, including web, desktop, or mobile platform games.
5. Articles that provide empirical data on the effectiveness or impact of the educational game.

The search and selection divided into several steps, including:

1. Article Screening: In this step, paper titles and abstracts were screened to eliminate articles that did not align with the research scope.
2. Full-Text Review: Articles that passed the initial screening were examined in full to ensure their relevance and methodological quality.
3. Data Extraction: Key information from each selected article, including technology used, game genre, platform, target audience, learning outcomes, strengths, and weaknesses, was systematically extracted and documented.
4. Critical Appraisal: The selected studies were evaluated using a set of criteria to assess their validity, reliability, and applicability.

To analyze the collected data, a thematic analysis was conducted to identify common patterns and trends related to educational game development, technological implementations, and learning impacts. The analysis also involved synthesizing strengths and weaknesses from each study to obtain a comprehensive perspective on the challenges and opportunities of implementing educational games in elementary education.

The screening process resulted in the selection of 15 articles that met all inclusion criteria. These articles were sourced from credible publications, including accredited national journals and international conference proceedings. The findings indicate a significant level of attention toward the development of educational games within the context of elementary education over the past five years.

The selected articles were then analyzed further to identify technological trends in educational game development and evaluate their impact on the learning process at the elementary level. Additionally, a critical analysis was conducted to assess the strengths and weaknesses of each study, providing a comprehensive perspective on the challenges and opportunities of implementing educational games in Indonesian elementary education.

RESULTS

The findings of this literature review were obtained by reviewing, analyzing, and summarizing articles that have passed the extraction process. The data from the reviewed articles can be found in Table 1 below.

Table 1. Literature Review Results

No	Researcher	Year	Title	Method	Results
1	Kurniawan et al.	2021	Educational Game for Animal Habitat Introduction	MDLC (Multimedia Development Life Cycle) -	User Acceptance Testing (UAT) showed an average score of 80% (good), indicating that all

			for Elementary School Students	Construct 2	features worked as intended and enhanced student's understanding of animal habitats.
2	Rawansyah et al.	2021	Enhancing Student Interest in Learning Through the Development of Serious Mathematics Games	ADDIE (Analysis, Design, Development, Implementation, Evaluation) - Scratch	Increased student's interest and motivation in learning mathematics through web-based quiz games.

Table 2. Literature Review Results (cont.)

No	Researcher	Year	Title	Method	Results
3	Ilmi et al.	2023	Local Wisdom-Based Educational Game Development to Improve Early Reading Skills in Elementary School	ADDIE (Analysis, Design, Development, Implementation, Evaluation) - Smart Apps Creator	Improved early reading skills by 75.10%, categorized as very good.
4	Rendini et al.	2023	Interactive Multimedia Reading Game Development for Elementary School Students in Makassar City	R&D (Research and Development) - Articulate Storyline 3	Media validation score of 93%, student validation score of 84.09%, highly suitable as a reading learning medium.
5	Simanjuntak et al.	2024	Designing an Educational Game "Cleantopia" to Increase Student's Awareness of Environmental Cleanliness	MDLC (Multimedia Development Life Cycle) - Construct, Adobe Illustrator	Achieved an effectiveness rate of 96.43%, significantly enhancing student's environmental cleanliness awareness through interactive interfaces.

6	Nugroho & Ma'arif	2022	Educational Game Media "Marbel Fauna" Development for Elementary School Students	ADDIE (Analysis, Design, Development, Implementation, Evaluation) - Construct 2	N-Gain of 0.67 (effective), media validation score of 88%, material validation score of 90%, effectively improving animal knowledge.
7	Wandri et al.	2024	Designing a Mobile Learning Game for Elementary School Mathematics	IT Implementation (Information Technology Implementation) - PowerPoint, Wheel of Names, AI Tools	The game increased student's interest in mathematics, and the trial results showed 100% functionality success.

Table 3. Literature Review Results (cont.)

No	Researcher	Year	Title	Method	Results
8	Nguyen et al.	2024	Application of Information Technology in Designing Games for Elementary School Teaching	GDLC (Game Development Life Cycle) - Unity 2D, C#, Adobe Illustrator 2020, Freepik	Increased student engagement and motivation while improving technological competence and interactive learning.
9	Apriani et al.	2024	Fun Learning Game Development for Elementary School Students Using GDLC	GDLC (Game Development Life Cycle) - Unity 2D, C#, Adobe Illustrator 2020, Freepik	Increased learning motivation through interactive quiz games.
10	Lathufi Dinah Siregar	2024	Citizenship Education in Elementary Schools Using Educational Games as a Learning Tool	R&D (Research and Development) - PowerPoint, Visual Basic	Expert validation score of 3.73 (very good), increased student motivation and understanding of Citizenship Education (PKn).

11	Juhanaini et al.	2025	Android-Based Technology: Development of Game-Based Learning Media for Arithmetic Learning Difficulties	DBR (Design-Based Research) - Unity, C#	Improved arithmetic skills by up to 76%, supporting interactive learning through Android-based games.
12	Sarifah et al.	2022	Android-Based Educational Game Development to Enhance Elementary School Student's Interest in Learning Math	R&D (Research and Development) - Unity, C#	Increased student interest in mathematics, with statistical testing showing significant effectiveness.

Table 4. Literature Review Results (cont.)

No	Researcher	Year	Title	Method	Results
13	Ibda et al.	2022	Game Innovation: A Case Study Using the Kizzugemu Visual Novel Game for Elementary School	Descriptive Qualitative - TyranoBuilder	Improved learning outcomes from 60.7 to 96.9, significantly increasing student's motivation in learning the Javanese language.
14	Riyandana et al.	2022	Development of Educational Vocabulary Game for Elementary School: A Case Study at SD Negeri 1 Way Petai, Lampung	GDLC (Game Development Life Cycle) - Construct 2, CorelDraw X7	Increased average scores by 21.1%, with functional validation reaching 94.28%.
15	Megawaty et al.	2021	Educational Game	MDLC (Multimedia	User satisfaction score of 94%, indicating the

			Application for Map and Culture Learning of Sumatera for Elementary School Students	Development Life Cycle) - Construct 2	game effectively enhances interest in learning Sumatera's maps and culture.

This literature review analyzed 15 selected articles published between 2021 and 2025 that explored the development and implementation of educational games in elementary education. While all studies aimed to evaluate how games improve learning outcomes, they varied significantly in methodological approaches. Some employed experimental designs with control groups to provide quantitative data on learning improvements, while others used qualitative methods or case studies, focusing on user perceptions and engagement. This diversity in methodology affects the generalizability and comparability of results—experimental studies offer stronger evidence of causality, whereas descriptive studies provide deeper insights into user experience and implementation challenges.

The development of educational games over the past five years has employed various technologies. Most of them are focused on development for mobile, web, and desktop platforms. Mobile based educational games have gained significant popularity due to their accessibility and ease of use. Android-based educational games are the most commonly developed, leveraging technologies such as Unity and Construct 2. Unity, known for its powerful graphic capabilities and cross-platform support, has proven effective in creating engaging and interactive quiz-based games. For instance, the "Fun Learning Math Game" developed using Unity demonstrated a significant increase in students' motivation and arithmetic skills through the integration of interactive quizzes and colorful visuals (Sarifah et al., 2022). Similarly, Construct 2 is frequently used to develop two-dimensional educational games with animated visuals and problem-solving challenges, which are effective in teaching arithmetic and language concepts (Riyandana et al., 2022).

In addition to mobile platforms, web-based educational games have also demonstrated positive impacts on student learning. These games are designed to be accessible via web browsers, making them highly flexible and suitable for diverse learning environments. One of the most popular web-based platforms is Wordwall, which is often used to create interactive quizzes and exercises. Studies have shown that educational games designed with Wordwall significantly improve students' mathematical understanding by presenting concepts engagingly and interactively.

Apart from mobile and web-based games, desktop educational games are also developed with a focus on narrative and storytelling to enhance student engagement. Visual novel games developed using TyranoBuilder exemplify this approach by offering story-driven content and dialogue-based gameplay. These games have been successfully implemented in language learning, with one study reporting a significant increase in student participation through interactive storytelling and dialogue choices (Ibda et al., 2022).

The positive impacts of educational games on elementary students' learning outcomes are particularly evident in terms of increased motivation, engagement, and conceptual

understanding. Mobile and web-based games are especially effective in maintaining students' interest due to their interactive and visually appealing features. Most of the reviewed studies reported a noticeable increase in students' motivation to learn when using game-based media. Android-based games designed using Unity, for example, were able to boost students' enthusiasm by incorporating challenges and interactive elements, creating a learning environment that felt more enjoyable and less monotonous (Apriani et al., 2024). Furthermore, the use of quiz-based mobile games helped maintain student attention through the provision of immediate feedback and scoring mechanisms, which made learning more dynamic and participatory.

In terms of conceptual understanding, several studies demonstrated that using educational games led to higher retention and comprehension rates among students. For instance, visual novel games that aimed to teach language skills were found to significantly enhance literacy and cultural awareness among elementary students, as they allowed learners to actively participate in story interactions and make decisions within the game (Ibda et al., 2022). In addition, mathematics games that combined problem-solving exercises with engaging visual elements proved to be highly effective in improving student's understanding of mathematical concepts and arithmetic operations (Riyandana et al., 2022).

Despite the promising potential of educational games, several challenges persist in their development and implementation. One major challenge is the limitation of platforms, as many mobile educational games do not support iOS or desktop devices, thereby restricting their usability (Apriani et al., 2024). Another issue is the lack of adaptive features in most educational games, which prevents the games from adjusting difficulty levels according to the learners' capabilities. This limitation reduces the effectiveness of the games for students with varying levels of competence and readiness (Hidayat et al., 2024). Moreover, many educational games are not adequately integrated with the formal curriculum, making them less relevant for classroom use. This lack of alignment between game content and educational standards often results in difficulties for teachers who wish to incorporate these games into their regular teaching practices (Simanjuntak et al., 2024).

Considering the identified strengths and weaknesses, several recommendations can be proposed to enhance the development of educational games. First, it is crucial to develop cross-platform educational games that are accessible on Android, iOS, and desktop devices to ensure broader usability and flexibility. Additionally, incorporating adaptive learning features supported by artificial intelligence can significantly improve the effectiveness of educational games by dynamically adjusting the difficulty level based on the learners' progress. Another important aspect to consider is the alignment of game content with the formal curriculum, which would help teachers integrate these games more seamlessly into classroom activities. Furthermore, educational games should include comprehensive assessment mechanisms that enable teachers to monitor student's progress and provide personalized feedback. By addressing these aspects, educational game developers can produce more versatile and impactful learning tools that better support elementary education.

The findings from this literature review indicate that educational games hold great potential in enhancing motivation and learning outcomes among elementary students. However, to fully leverage their benefits, it is necessary to address the challenges related to platform

compatibility, adaptive features, and curriculum alignment. By adopting innovative approaches and integrating emerging technologies, educational games can become more effective in promoting meaningful learning experiences for students.

CONCLUSION

This study highlights the growing role of educational games as effective tools for enhancing motivation, engagement, and conceptual understanding among elementary students. The findings underscore the need for developers to prioritize cross-platform compatibility and incorporate adaptive features that accommodate diverse learner profiles. For educators, the integration of educational games presents an opportunity to enrich classroom instruction with interactive and student-centered approaches. Meanwhile, curriculum designers should consider aligning game-based content with learning standards to ensure its relevance and applicability within formal education systems.

By addressing current limitations and fostering collaboration between developers, educators, and policymakers, educational games can evolve into powerful, inclusive learning tools that support both academic achievement and student engagement. Ongoing research and innovation will be crucial to ensuring that these digital tools continue to meet the evolving needs of 21st-century education.

Future studies should explore the long-term impact of educational games on student learning outcomes across different subjects and grade levels. In particular, empirical research involving experimental designs and large-scale implementation can provide more robust evidence regarding the effectiveness and scalability of educational game-based learning in diverse educational contexts.

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