

The Importance of Developing Gamification-Based Interactive Learning Media to Improve Disaster Mitigation and Preparedness Literacy Among Elementary School Students

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Abstract. This study aims to determine the urgency of developing gamification-based interactive learning media for elementary school students in the context of disaster mitigation and preparedness literacy. Elementary school-aged children are in a phase of cognitive and psychomotor development that requires a contextual, participatory, and enjoyable learning approach. However, disaster education in elementary schools still tends to be theoretical, rote, and lacking in practical simulations. To optimize students' understanding and preparedness, a revitalization of the learning approach is needed through the integration of gamification into interactive media. The method used in this study is a systematic literature review. This review begins with the research question: "Why is gamification-based interactive learning media necessary for disaster mitigation literacy in elementary schools?" Articles were searched for via Google Scholar, Scopus, ERIC, Springer, and ScienceDirect using the keywords: gamification, disaster literacy, interactive learning media, disaster mitigation and preparedness, and elementary schools (publication years 2022–2026). Based on the literature review, it was found that disaster mitigation education remains limited to the delivery of cognitive information; gamification has been proven to enhance student motivation, engagement, and memory retention; and interactive media enables safe and repeatable simulations of disaster scenarios. Therefore, theoretically grounded in scientific evidence, gamification-based interactive learning media need to be developed to strengthen disaster mitigation and preparedness literacy, as well as to foster responsive and adaptive habits among elementary school students in disaster-prone areas.

Keywords: gamification; disaster literacy; interactive learning media; disaster mitigation and preparedness; elementary school

INTRODUCTION

Indonesia is one of the countries with the highest levels of vulnerability to natural disasters in the world, ranging from earthquakes, tsunamis, and floods to volcanic eruptions. Children, particularly elementary school students, are a vulnerable group who require an early understanding of disaster mitigation and preparedness (Lestari & Fauzi, 2022). Disaster literacy education at the elementary school level aims not only to provide cognitive knowledge but also to foster responsive behaviors, survival skills, and psychological resilience when facing emergency situations. However, on-the-ground realities indicate that disaster education approaches remain conventional, tend to be overly verbal, and lack safe simulation practices (Prasetyo & Hidayat, 2024). Students mostly memorize terms and procedures without experiencing contextual and participatory learning.

Elementary school-aged children have developmental characteristics that include a love of exploration, play, and social interaction (Darmawan & Pratama, 2023). In this context, gamification (the application of game elements such as points, levels, badges, narratives, and instant feedback in non-game contexts) has been empirically proven to enhance intrinsic motivation, active engagement, and long-term memory retention (Rahmawati & Setiawan, 2022). When combined with interactive learning media, gamification can create an immersive learning environment where students can repeatedly simulate disaster scenarios without physical risk. This aligns with experiential learning theory and social constructivism, where knowledge is constructed through active interaction with the environment and direct feedback (Nugroho & Widodo, 2025).

A prominent issue today is the gap between the urgency of disaster literacy and the availability of learning materials that align with the cognitive and emotional developmental characteristics of elementary school children. Most disaster mitigation materials are still presented in the form of textbooks, static posters, or teacher lectures that do not sufficiently engage students. On the other hand, the development of gamification-based digital media for disaster education still largely focuses on

secondary or higher education levels, making it less adaptable for children aged 6–12 (Martinez et al., 2023). This situation is exacerbated by the lack of integration of local values, regional geographical context, and children’s psychological aspects into the design of existing media (UNDRR & UNESCO, 2023).

Recognizing the benefits of interactive media and the potential of gamification in education, the researchers deemed it necessary to integrate these two elements as a strategic step to address the low levels of disaster mitigation and preparedness literacy among elementary school students (Sari & Anggraini, 2023). This article aims to systematically examine the urgency of developing gamification-based interactive learning media as a tool to strengthen disaster literacy in elementary schools, while also identifying the research gaps that underpin the need for such media development.

METHODS

The method used in this study is a systematic literature review (SLR) that examines a number of scientific journal articles, conference proceedings, and research reports relevant to the topic. The search was conducted through reputable academic databases, namely Google Scholar, Scopus, ERIC, Springer, and ScienceDirect, covering the publication period from 2022 to 2026 to ensure the findings are up-to-date. The keywords used include: gamification, disaster literacy, interactive learning media, disaster mitigation and preparedness, and elementary school (Kurniawan & Susanti, 2024).

The selection process followed the following inclusion criteria: (1) peer-reviewed articles, (2) focusing on elementary education or children aged 6–12 years, (3) discussing the application of gamification or interactive media in the context of disaster education or safety, and (4) available in full text. Exclusion criteria included articles focused on secondary or higher education levels, studies lacking clear methodology, or literature that only addressed technical aspects without pedagogical implications. Data were extracted based on research objectives, methods, key findings, and relevance to disaster literacy in elementary schools. The analysis was conducted thematically to map research trends, identify the strengths and limitations of previous studies, and formulate research gaps that form the basis for the urgency of media development (Wahyuni & Kurniawan, 2025).

RESULTS AND DISCUSSION

Based on the results of the literature review and analysis, the researchers identified three main themes relevant to the urgency of developing gamification-based interactive learning media for disaster literacy in elementary schools.

First, disaster mitigation education in elementary schools remains predominantly cognitive in nature and fails to sufficiently develop practical skills. Most studies indicate that students can list evacuation steps or types of disasters but struggle to apply them spontaneously during emergency simulations (Lestari & Fauzi, 2022). Conventional approaches that rely on lectures and memorization are insufficient for building the procedural memory and automatic responses needed in crisis situations. In fact, disaster literacy is not merely knowledge but a multidimensional competency encompassing risk understanding, survival skills, and psychological preparedness.

Second, gamification has been proven effective in increasing engagement and learning retention among elementary-aged children. Game elements such as adventure narratives, achievement systems (badges/levels), instant feedback, and progressive challenges have been verified to increase intrinsic motivation, reduce learning anxiety, and strengthen emotional connections with the material (Darmawan & Pratama, 2023). In the context of disaster education, gamification allows students to “play” within structured disaster scenarios, enabling them to learn decision-making, teamwork, and stress management in a safe and controlled environment (Rahmawati & Setiawan, 2022).

Third, interactive media serves as a pedagogical bridge between mitigation theory and preparedness practice. Interactive digital platforms (such as 2D/3D simulations, simple augmented reality, or web-based serious games) provide a space for students to explore the consequences of their choices, repeat procedures without risk, and receive adaptive feedback tailored to their level of understanding (Kurniawan & Susanti, 2024). However, research network analysis indicates that most development of interactive disaster media still focuses on technical aspects (graphics, interfaces, system performance) and fails to integrate principles of child-centered instructional design, contextualization of local culture,

and competency-based assessment of disaster literacy (Martinez et al., 2023).

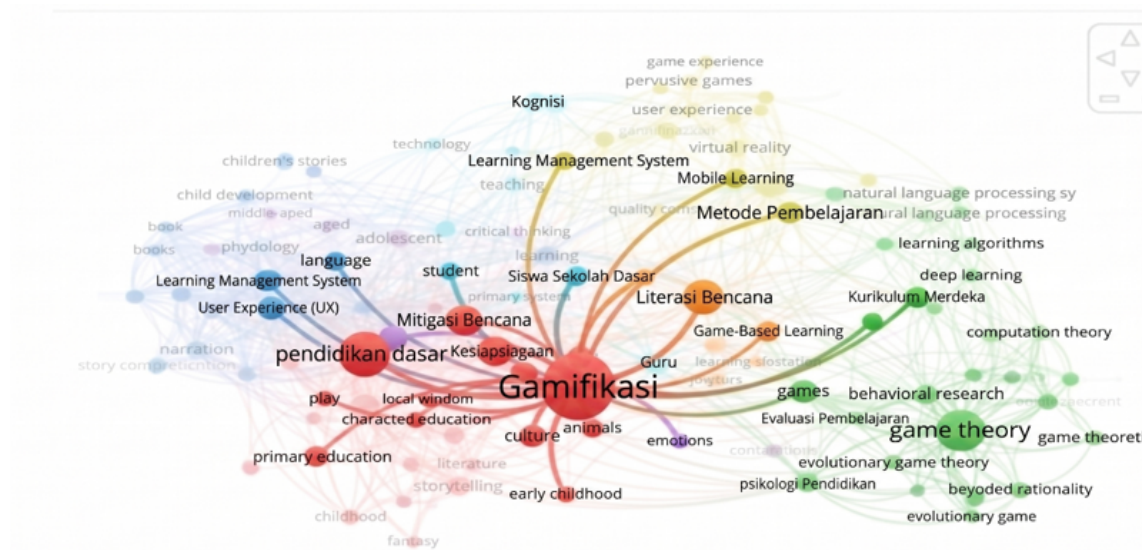


Figure 1. Research network on gamification and disaster literacy in elementary education

The research network map shows that the topics of gamification and disaster literacy have been widely discussed, but the integration of the two in the form of interactive media specifically designed for elementary school students remains limited. On average, studies still apply gamification as a supplement to the material or use simulations that are complex and not tailored to the cognitive capacities of elementary school children (Wahyuni & Kurniawan, 2025). Books or modules on disaster preparedness generally only present evacuation procedures and rules, without providing opportunities for exploration, reflection, or scenario-based decision-making training (Sari & Anggraini, 2023).

Based on this review, the novelty and urgency of this research lie in the need to develop gamification-based interactive learning media that are pedagogically designed specifically for elementary school students, with an emphasis on: (1) simplifying mitigation concepts into age-appropriate narratives and game mechanics, (2) safe, repeated simulations to build procedural memory and psychological readiness, and (3) the integration of local disaster contexts (floods, earthquakes, landslides, etc.) so that disaster literacy is contextual and applicable. Through this approach, teachers can meet the learning needs of children who enjoy exploration while simultaneously instilling the values of preparedness, cooperation, and resilience from an early age (Nugroho & Widodo, 2025). Additionally, gamification-based media can minimize passive learning, maximize active participation, and serve as a supporting tool for the independent curriculum in projects aimed at strengthening the Pancasila student profile under the themes of sustainable living and mutual cooperation (UNDRR & UNESCO, 2023).

CONCLUSION

A gap in the research lies in the predominance of theoretical approaches to disaster mitigation education with minimal practical simulation in elementary schools, while the potential of gamification and interactive media has not yet been pedagogically optimized for disaster literacy at an early age. The urgency of developing gamification-based interactive learning media stems from the need to transform disaster literacy from mere cognitive knowledge into responsive and adaptive practical competencies. The novelty offered is the provision of a media development framework that integrates gamification elements, safe interactive simulations, and the contextualization of local disasters according to the developmental characteristics of elementary school students. The development of this media is expected to serve as a strategic tool for teachers and schools in strengthening disaster preparedness, while simultaneously fostering a resilient, critical, and risk-aware generation from an early age.

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