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Gamified Learning For Preschoolers: Exploring The Benefits And Risks Of Educational Apps In Indonesia

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Abstrak

This study examines the benefits and risks of gamified learning apps for preschool children in Indonesia, where the use of technology among young learners is rapidly increasing. It reviews studies from 2018 to 2025 to show how gamified apps impact cognitive, emotional, social, and behavioral development. Results show that well-designed gamified learning tools increase motivation, problem-solving skills, executive function, and early literacy and numeracy skills. However, concerns persist that some apps are of low quality, encourage excessive screen time, or fail to align with children's developmental needs. Often, there is no parental or teacher guidance. Indonesia also faces limited culturally relevant apps, unequal access to quality digital resources, and low digital literacy among educators. This study calls for gamified learning resources that are developmentally appropriate, grounded in science, and tailored to the local context, with adults providing guidance on their use. It gives recommendations to parents, educators, developers, and policymakers to help safely and effectively integrate gamified learning in early childhood education in Indonesia.

Keywords:
Gamified learning, preschoolers, educational apps, early childhood, Indonesia.

Introduction

Technological advances over the last decade have significantly changed the way children learn, particularly with the increased availability of educational applications on mobile devices, such as smartphones and tablets (Guran et al., 2021). These devices are now easily accessible to even young children, making digital technology an integral part of their learning experience from a preschool age (Stephane et al., 2017). Among these innovations, gamified learning applications have emerged as one of the most popular and widely discussed. This approach incorporates game elements, such as levels, points, badges, rewards, and interactive challenges, into educational content to enhance preschoolers' engagement, motivation, and learning outcomes.

Well-designed gamified educational applications can support active, meaningful, and socially interactive learning experiences, while remaining aligned with children's developmental needs and curriculum goals (Panesi & Ferlino, 2019). Touchscreen interfaces, for example, are particularly appealing to preschoolers because they allow them to interact intuitively with digital objects and receive instant feedback. This combination of features

makes game-based learning particularly well-suited to the context of early childhood education, which emphasizes exploration, play, and social interaction.

However, the popularity of gamified apps does not always correlate with their quality. Concerns have been raised because many commercially available educational apps are not designed based on child development principles or strong pedagogical research. Research indicates that only a small fraction of these apps are genuinely educational and involve early childhood education experts in their development, whereas the majority do not undergo adequate validity testing (Meyer et al., 2021). This challenge becomes even more relevant when considered in relation to the developmental characteristics of children aged 3 to 6 years. At this stage, children have limited reading abilities, short attention spans, and a high need for guidance from adults. These conditions require developers to apply child-centered design principles. Without alignment with these developmental characteristics, the effectiveness of game-based learning applications can be reduced (Guran & Cojocar, 2021).

In Indonesia, the use of mobile devices has increased rapidly, especially since the COVID-19 pandemic, exposing children to various forms of digital learning. Although this development offers great opportunities for early childhood education, various challenges remain, including low application quality, unequal access, lack of cultural appropriateness, and varying levels of digital literacy. Furthermore, research specifically examining the use of gamified learning applications for preschool children in Indonesia is still limited. Given these gaps, this study aims to systematically review the existing literature to evaluate the benefits and risks of game-based learning applications for preschool children, while identifying the challenges and opportunities for their implementation in the Indonesian context.

Literature Review

Benefits of Educational Apps for Preschoolers

Educational applications can provide significant benefits for preschool children's learning and development when designed and used appropriately. Meta-analytic findings indicate that rigorous experimental studies consistently produce positive effects, with a weighted average effect size of +0.31 standard deviations on overall academic achievement, encompassing areas such as mathematics and literacy (Kim et al., 2021). Interestingly, these benefits tend to be stronger in preschoolers than in K–3 students, suggesting that the early years are a highly responsive phase to app-based interventions.

In mathematics, the benefits of educational apps have been demonstrated through various studies. Experimental studies with control groups show that using apps at home can significantly improve math performance compared to traditional classroom practices and non-educational apps (Vaiopoulou et al., 2021). A large-scale randomized controlled trial in the UK involving 389 children aged 4–5 also found significant improvements not only in basic math learning but also in higher-order reasoning and problem-solving skills (Mera et al., 2022). Beyond mathematics, the benefits of educational apps are also evident in various other aspects of development. Several studies have shown improvements in literacy, science, problem-solving, and children's self-confidence (Griffith et al., 2018). Interactive applications, in particular, have a significant impact on language development, with 20% increases in vocabulary, 15% in expressive language, and 10% in receptive language, which are higher results than those achieved with passive educational content (Mahesh et al., 2024).

Gamification features, such as levels, points, rewards, challenges, and immediate feedback, help maintain children's focus, increase motivation, and encourage the repeated practice of basic skills. These elements have been shown to increase children's engagement, cooperation, and enthusiasm in learning (Xezonaki, 2022). Educational apps also show benefits in executive function and behavior. Studies show that playing educational apps can improve

working memory and self-control scores compared to watching cartoons (Fitzpatrick et al., 2023). Another pilot study found that using apps in conjunction with analog materials can improve various components of executive function and reduce ADHD symptoms, particularly in at-risk children (Panesi et al., 2023).

Social benefits are also important. Parents can generally distinguish between the use of devices for learning and entertainment, and they support the use of apps as a medium for educational intervention. Trials show that children are highly engaged when using educational apps, often remain physically active, and app use tends to replace other screen time rather than increase total screen exposure (McCloskey et al., 2018). When used in an interactive environment, educational applications can overcome the boredom associated with conventional learning and enable children to learn while playing, imagining, and interacting with real-life scenarios (Vaiopoulou et al., 2021). When well-designed, educational apps can also encourage creativity, such as drawing, making music, photography, and video creation, and support school readiness and long-term executive function development (Cerniglia et al., 2020). Intuitive tactile interfaces and problem-solving activities also help shape children's learning strategies. Interestingly, many apps can be used independently by children while still encouraging a high level of social interaction (Lorusso et al., 2018).

Risks and Challenges of Educational Apps

Despite their great potential, educational apps also present several risks and challenges that can limit their effectiveness or even harm children's development. A major challenge is the lack of regulation and quality control in the app market, which allows developers to market apps as “educational” without meeting important pedagogical standards (Taylor et al., 2022). Many apps in the education category lack scientific evidence and primarily emphasize the memorization of basic academic skills, often without input from early childhood education experts (Vaiopoulou et al., 2022). Quality assessments of apps reveal that even the most popular educational apps often fall short in terms of quality. The average score is only 9 out of 20 on the educational potential indicator, and both high- and low-quality apps show inadequate use of language (Taylor et al., 2022).

The next risk is related to screen time. Large-scale studies show that excessive screen exposure can negatively impact children's language development, communication skills, emotional health, and social outcomes (Kim et al., 2021). Long screen time is also associated with behavioral problems and learning difficulties (Niklas et al., 2024). The WHO now recommends that children aged 3–4 years spend no more than one hour per day on passive screen time and that educational apps be used in conjunction with adults to facilitate quality language interaction (Kim et al., 2021).

Additionally, many applications are not designed to support face-to-face interaction, which can hinder the development of empathy and self-regulation skills due to their individualized use (Cerniglia et al., 2020). Other risks include potential device addiction, social isolation, and decreased motivation in basic school skills such as writing (Mera et al., 2022). If applications are not appropriate for a child's developmental stage, their use can even hinder creativity (Vaiopoulou et al., 2022).

Teachers also face their own challenges. They must choose applications wisely, ensure age appropriateness, and be aware of health risks and the negative effects of excessive device use (Zhang, 2024).

In low- and middle-income countries, the challenges become even more complex due to limited access to quality educational applications. Of the 36 applications reviewed in one systematic study, only three originated from these countries, indicating a lack of locally relevant educational resources (Chowsomchat et al., 2023). Cost barriers, lack of local content, and minimal awareness of quality applications further exacerbate this gap.

Finally, both parents and educators report a need for clearer guidelines on technology use. Parents require guidance on the use of touchscreen devices at home, while educators often feel uncertain when attempting to integrate technology into the learning of very young children (Taylor et al., 2022). This uncertainty increases the risk of inappropriate implementation, even when quality applications are available.

Methodology

Research Design

This study employs a descriptive analytic research design to systematically explore the benefits and risks of gamified learning applications for preschoolers in Indonesia. The design facilitates a comprehensive understanding of the cognitive, emotional, and behavioral impacts of these educational tools, while also identifying potential risks and gaps in the existing literature. The study focused on peer-reviewed journal articles, conference proceedings, and relevant academic publications published between 2018 and 2025.

Data Collection Methods

Data were collected through a systematic literature review. The search conducted in academic databases such as Google Scholar, JSTOR, and Scopus, using specific keywords such as "gamified learning," "educational apps," "preschoolers," and "Indonesia." The inclusion criteria focused on studies that specifically address the use of gamified learning applications among preschool children. In contrast, exclusion criteria eliminated studies outside the specified timeframe or those not directly related to the Indonesian context. To ensure a comprehensive review, the search also incorporated grey literature, including reports from educational organizations and government publications, to capture a broader perspective on the topic. A data extraction form was utilized to systematically collect relevant information from each source, including study objectives, methods, findings, and identified risks or benefits.

Analysis Approach

The analysis involved thematic synthesis, where data were categorized into themes corresponding to the research objectives. Thematic coding was applied to identify and analyze patterns related to cognitive, emotional, and behavioral benefits, as well as potential risks associated with the use of gamified learning applications. The findings were presented in a narrative format, supplemented by tables and figures to illustrate key themes and trends. Additionally, a critical appraisal of the literature was conducted to evaluate the methodological rigor of the included studies. This involved assessing the quality of the studies based on established criteria, such as sample size, research design, and relevance to the Indonesian context.

Validity Considerations

Several strategies were employed to enhance the validity of the findings. First, a comprehensive and systematic approach to literature search minimized selection bias. Second, triangulation was employed by integrating findings from diverse sources, including both qualitative and quantitative studies, to provide a well-rounded perspective on the benefits and risks of gamified learning applications. Lastly, peer debriefing was conducted, where findings were discussed with experts in the field to ensure the robustness of the interpretations and conclusions drawn from the data.

Result

Indonesian Context and Implementation

Indonesia presents a complex landscape for educational app implementation, characterized by widespread device adoption but significant barriers to accessing quality educational content. The country demonstrates exceptionally high smartphone penetration, with 338.2 million smartphone users recorded in January 2020 among a population of 272.1 million citizens, indicating that many people owned multiple devices (Parkash, 2022). During the COVID-19 pandemic, smartphone usage among young children increased dramatically, with 29% of children aged 0-6 years using smartphones, including 25.9% of toddlers aged 1-4 years and 47.7% of preschool students aged 5-6 years (Parkash, 2022). Despite this high device penetration, Indonesia faces significant challenges in accessing quality educational applications. Research indicates a stark deficiency in effective educational resources in low- and middle-income countries like Indonesia, with only 3 out of 36 reviewed educational apps originating from such countries. This lack of access stems from cost barriers, limited localized content, and a lack of awareness about quality apps among caregivers and educators (Chowsomchat et al., 2023). However, emerging research from Indonesia shows promising outcomes when educational apps are properly implemented.

A qualitative study with 10 parents found that the majority showed agreement on how digital games improved their children's thinking, learning, and social skills, including problem-solving and emotional intelligence, with YouTube platforms also showing positive learning outcomes (Parkash, 2022). Indonesian kindergartens have begun using character-building applications from the Play Store to ensure parents, teachers, and children stay updated with educational activities, with social media integration promoting interaction between teachers and parents (Ali et al., 2020). The COVID-19 pandemic accelerated digital learning adoption in Indonesian preschool education, expanding beyond traditional methods to include online programs that effectively support parents in integrating education at home while contributing to children's intellectual, social, and religious development (Nurhayati et al., 2024). Specific applications like Duolingo have shown positive results for English vocabulary learning among Indonesian early childhood learners. However, research emphasizes that such apps should not be the sole learning source and must be integrated into structured, teacher-directed approaches (Warmansyah et al., 2024). Indonesian educators and developers are increasingly creating localized educational applications to address specific learning needs. Research shows that 85% of children prefer playing with smartphones over reading educational books, driving the development of applications that integrate interactive elements, games, and animations with traditional educational content (Dimas et al., 2024). Educational games are being developed specifically for Indonesian language learning and cultural education, with researchers noting that educational games offer significant advantages over conventional methods through visualization of real problems and active learning engagement (Safitri et al., 2024). The Indonesian context also includes efforts to evaluate and improve app design for local preschoolers. Researchers have used frameworks like Goal-Question Metric (GQM) to investigate interaction design patterns in Indonesian drawing applications for preschool children aged 4-6 years, recognizing that not all drawing games easily fulfill Indonesia's specific preschool drawing competencies (Kusumo et al., 2017).

Discussion

Design Considerations and Quality Factors

The design of educational apps for preschoolers must carefully balance educational effectiveness with developmental appropriateness, accounting for the unique limitations of children aged 3-6 years. These limitations include inability to read or write, inability to focus for long periods, need for rewards when accomplishing tasks, and extremely limited interaction capabilities (Guran et al., 2021).

According to Laranjeiro (2021), successful app design requires consideration of three key components that influence learning: the child (to whom it is addressed), the adult (who guides learning), and the technology itself. Educational apps can be classified into three progressive levels of cognitive engagement. Instructional apps are based on exercise-reward systems aimed at acquiring specific content and skills. Manipulable apps manage ideas and content, allowing multiple responses to variables, and constructive apps feature open structures that enable learners to create or communicate by building learning objects from available components. Research shows there is growth in learner involvement and motivation from instructional to constructive apps, suggesting that higher-level app designs promote greater educational benefits. In terms of interface design, pedagogical applications for preschoolers must use graphics and actions that provide context, employ simple and clear instructions based on images, and feature intuitive interfaces with interactivity for independent use while maintaining a challenging approach with multiple opportunities for success to sustain interest. Gamification provides a fun and interactive learning experience, allowing children to feel in control of their learning process through self-selecting learning menus, which increases motivation and engagement (Fitriah et al., 2023).

However, significant quality issues persist across the app marketplace. Even apps rated highly by evaluation websites scored on average just 9 out of 20 for indicators of educational potential, with both high and low-scoring apps showing poor language quality as determined by psycholinguistic analyses (Taylor et al., 2022). Most apps found under the "educational" category in app stores have no evidence of efficacy, instead primarily targeting rote academic skills with little or no input from developmental specialists or educators (Vaiopoulou et al., 2022). Furthermore, the appropriateness of developmental aspects in software design significantly impacts children's education, as developmentally inappropriate software can negatively affect children's creative skills (Vaiopoulou et al., 2022). Appropriate apps should include prosocial content, non-violent stories and characters, promote diversity in terms of gender and culture, and have low levels of advertising, with content designed to enhance rather than hinder executive function development (Papadakis, 2021).

Adult guidance remains crucial for effective implementation. Adults have a mediating role, whether they are parents or educators, planning and guiding activities with technology, preparing questions, encouraging interaction and experimentation, monitoring screen time, and providing support while promoting gradual autonomy (Laranjeiro, 2021). However, research shows that both parents and educators express the need for further guidance on appropriate technology use, with educators reporting a lack of confidence when integrating touchscreen technology with very young children (Taylor et al., 2022).

Current research reveals that mobile applications can support only a limited portion of preschool curriculum objectives, with one study finding that mobile applications could support just 28 out of 63 total curriculum objectives, with the highest support in cognitive development domains, while remaining insufficient for other developmental areas (Ozlevent et al., 2023). This highlights the importance of selecting appropriate educational media and content tailored to developmental needs, with technology-enhanced learning tools requiring careful adaptation to learner requirements (Fitriah et al., 2023).

Teachers must make thoughtful use of technology and select age-appropriate games and educational tools to meet children's developmental needs while remaining alert to potential risks such as negative health impacts from over-reliance on devices and prolonged screen use (Zhang, 2024). Ongoing teacher training and development of innovative educational applications are essential to maximize technology benefits while protecting children's physical and mental health, with appropriate assessment, feedback, and data-driven personalized instruction ensuring effective integration in preschool education (Zhang, 2024).

Conclusion

This study aims to provide a comprehensive understanding of the benefits and risks associated with the use of gamified learning applications for preschool-aged children in Indonesia. Through a systematic literature review, the research synthesizes current evidence on how these applications influence cognitive, emotional, and behavioral development among young learners. The descriptive-analytic design employed in this study allows for an in-depth thematic synthesis of relevant findings from peer-reviewed publications and grey literature published between 2018 and 2025. By applying strict inclusion and exclusion criteria, triangulating data sources, and conducting critical appraisals of each study, the research ensures a high level of validity and academic rigor. Findings from this review are expected to contribute valuable insights for educators, parents, and policymakers regarding the effective and safe use of gamified educational tools in early childhood settings. Furthermore, this study identifies significant gaps in the current literature and highlights the need for future empirical research that considers the Indonesian socio-cultural and technological context. Ultimately, this research underscores the importance of designing and implementing gamified learning applications that are developmentally appropriate, culturally relevant, and supported by evidence-based practices to enhance early childhood education in Indonesia.

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