



Navigating Challenges and Unlocking Opportunities in Early Childhood Educational Games: A Critical Review

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ABSTRACT:

This paper presents a critical review of recent literature on educational games for early childhood, highlighting not only the key benefits but also the unresolved challenges and emerging opportunities. Unlike previous reviews, this study integrates bibliometric analysis with thematic synthesis to uncover underexplored gaps, such as the limited alignment of game design with child developmental stages, insufficient teacher readiness, and the lack of cross-disciplinary collaboration. The findings emphasize that while technological innovations and interactive designs hold promise for enhancing motivation and learning outcomes, their impact depends heavily on contextual adaptation and pedagogical integration. This review offers unique insights by mapping research trends from 2019 to 2024, identifying overlooked areas, and proposing strategic directions for future work. The implications extend to educators seeking effective classroom integration, researchers aiming to bridge theoretical and practical gaps, and game developers designing inclusive, developmentally appropriate tools. Ultimately, this study contributes a forward-looking perspective on how educational games can be leveraged to create more interactive, equitable, and impactful early learning experiences.

Artikel History

Submission : December 08, 2024

Received : April 16, 2025

Accepted : April 30, 2025

Keywords:

Critical review, Educational games, Bibliometric analysis, Early childhood

Doi:

<https://doi.org/10.21009/jpud.v19i2.46605>

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1. Introduction

Early childhood education represents a critical stage in human development, where children experience rapid growth in cognitive, social, emotional, and physical domains (Rahmawati, 2015). During this period, play is recognized as a natural and effective medium for learning, making educational games an increasingly popular tool in pre-school and kindergarten settings (Marisca & Dharmayana, 2019). Previous studies have shown that educational games can improve literacy, numeracy, problem-solving, and social skills, while also increasing engagement and motivation in learning. Educational games can be played individually or in groups, and can be used in various settings, such as classrooms, homes, and child care centers (Saputra, 2019; Astini et al., 2019)

Based on 'Constitutional Law Number 20 of 2003, it can be seen that education; early childhood as education for pre-school children, coaching through educational encouragement to stimulate children's skills, and coordinating children's physical and spiritual development and growth. Early childhood has an age range from birth to 6 years of age, which is done through providing educational stimulation to help physical and spiritual growth and development so that children are ready to enter further education (Rahmawati, 2022).

Research on educational games for PAUD has developed rapidly in recent years. This research shows the many benefits of educational games for young children, including: a) Improve cognitive skills, b) Improve social and emotional skills, c) Increase learning motivation, d) Increase engagement (hatta, 2021).

Despite these promising outcomes, the integration of educational games into early childhood education faces several challenges. Research highlights issues such as limited technological infrastructure, inadequate game design that does not fully align with developmental needs, and insufficient teacher preparedness to effectively utilize game-based learning (Wulandari et al., 2023; HK et al., 2023). Moreover, there is still a lack of comprehensive reviews that synthesize recent findings, particularly in terms of how educational games can be systematically designed and implemented to address these challenges.

This paper addresses these gaps by providing a critical review of recent studies published between 2019 and 2024, supported by bibliometric analysis. Specifically, the review seeks to: (1) identify the benefits and challenges of educational games in early childhood education, (2) analyze trends and research gaps in the existing literature, and (3) propose future directions for researchers, educators, and game developers. By clarifying the current state of research and offering insights into unresolved issues, this study aims to contribute to the development of more effective, inclusive, and pedagogically sound educational games for early childhood learning.

Understanding child development theories is essential for analyzing the role of educational games in early learning. Piaget's theory of cognitive development emphasizes that play supports children's symbolic thinking, problem-solving, and logical reasoning across developmental stages. This framework helps evaluate whether educational games align with children's cognitive readiness at different ages. Meanwhile, Vygotsky's concept of the Zone of Proximal Development (ZPD) highlights the importance of scaffolding and collaborative play, suggesting that well-designed educational games can facilitate peer interaction and adult guidance to extend children's learning potential.

Other classical theories also offer valuable perspectives on the educational role of play. Froebel's idea of "gifts and occupations" underscores the value of structured play materials in developing basic concepts such as shape, color, and size—principles that can inform the design of both digital and physical educational games. Sutton-Smith's theory of play highlights its cultural and developmental significance, reinforcing the idea that games should not merely entertain but also promote holistic development. Likewise, Huizinga's view of play as the foundation of culture implies that educational games can help shape values, creativity, and social norms during early childhood. By integrating these theoretical perspectives, educational games can be positioned within a broader developmental and cultural context, providing criteria for evaluating whether current games genuinely support children's cognitive, socio-emotional, and cultural growth.

In terms of types of educational games, effective design for early childhood must consider developmental appropriateness and pedagogical intent. At the preschool stage (ages 3–6), play is central to learning, and various forms of play can be transformed into game-based learning experiences. Pretend play supports imagination, symbolic thinking, and understanding of social roles. Educational games incorporating storytelling or role-playing elements can foster language and socio-emotional development, provided they align with children's developmental and cultural contexts.

Constructive play encourages children to build and create, stimulating creativity, fine motor coordination, and problem-solving abilities. Construction-based games, whether digital or physical (such as block-building or puzzle assembly), can translate these skills into interactive learning experiences but should avoid complex mechanics beyond children's cognitive capacity. Physical and motor play emphasizes movement's importance for health and coordination. Motion-based educational games, including those using simple sensors or interactive media, can integrate physical activity with learning content, though accessibility and technological constraints remain challenges.

Socio-dramatic play allows children to practice collaboration, empathy, and communication. Multiplayer or group-based educational games can extend these benefits by promoting teamwork, though teacher facilitation is necessary to ensure balanced participation. Exploratory play reflects children's curiosity and desire to investigate their surroundings. Open-ended educational games can nurture inquiry and discovery as long as they include clear learning scaffolds to prevent cognitive overload.

Lastly, music and movement play enhances rhythm, coordination, and self-expression. Games incorporating songs, music, and simple dance activities can strengthen both cognitive and emotional engagement, especially when linked to early literacy or numeracy concepts. By connecting these types of play with game design, this review emphasizes that effective educational games should not only entertain but also systematically support developmental milestones. The challenge lies in ensuring that both digital and analog formats preserve the essence of play while achieving measurable and pedagogically meaningful learning outcomes.

2. Method

Bibliometric analysis research using vosviewer consists of eight stages, namely defining re-search questions, identifying literature sources, utilising applications such as Publish or Perish for data retrieval, collecting data, importing and cleaning data, text processing, literature analysis, data visualisation, and interpretation of results (S. Kaymak et al., 2021)..To enhance clarity, the methodology is described as follows:

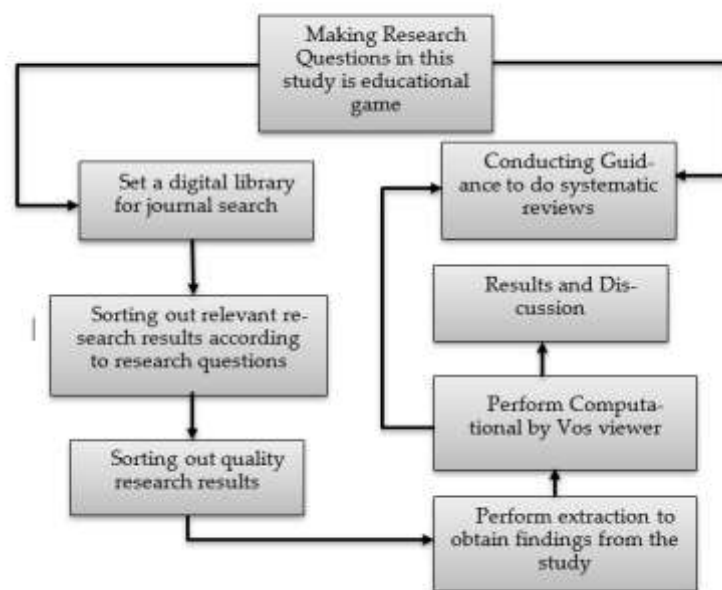


Figure 1 Stages of bibliometric analysis

3. Result

Furthermore, a citation analysis was carried out which showed that the number of citations per year from 2019 to 2024 was 3.460 with an average citation of 692.00 per year. The H-Index for all papers related to this theme was found to be 31, while the g-index was 43.

Table 1 Publications on learning media with the highest number of citations

No	Cites/Year	Author	Title	Years	Source
1	57	D Suryana	Educational games with numbers to stimulate the symbolic thinking abilities of young children	2022	Journal of Early Childhood Education
2	31	U Hasanah	Use of Educational Game Tools (Ape) in Kindergartens throughout Metro City	2019	Journal of Children's Education

No	Cites/ Year	Author	Title	Years	Source
3	21	NC Lestari, Y Hidayah, F Zannah	Application of educational game learning methods to science learning outcomes at SDN Sungai Miai 7 Banjarmasin	2023	Journal on Education
4	21	A Uliyah, Z Isnawati	Educational game methods in Arabic language learning	2019	Journal obsesi
5	20	A Saputra	Educational games for early childhood	2019	Journal.uin- alauddin.ac.id
6	16	PA Indrawan, BM Mando, S Suriata	The Effect of Educational Games on Kindergarten Students' Social Interaction	2024	Journal of Guidance and Counseling Studies
7	15	R Setyaningsih	The Role of Educational Games in Developing English Speaking Skills in Early Childhood	2023	Journal of Early Childhood Education
8	14	RK Sari, M Mudjiran, Y Fitria, I Irsyad	Increasing student motivation and learning outcomes in thematic learning assisted by educational games in elementary schools	2021	Jurnal Basicedu
9	13	M Haryani, Z Qalbi	PAUD teachers' understanding of educational game tools (APE) at Pertiwi 1 Kindergarten, Bengkulu City	2021	educhild.ejournal .unri.ac.id
10	12	NPJD Wulan, IIW Suwatra	Development of educational game media for crossword puzzles oriented towards character education in social science subjects	2019	ejournal.undiksh a

Table 1 above displays a summary of ten recent studies on educational games for early childhood. These studies come from various early childhood education journals in Indonesia, published between 2019 and 2024. Based on this table, it can be seen that there is high interest in the use of educational games in early childhood education. The researchers come from various universities in Indonesia and focus on various aspects of early childhood learning.

Several studies focus on the impact of educational games on certain cognitive skills, such as numeracy (Suryana, 2022) and science (Lestari et al., 2023). Other research examines the influence of educational games on the development of language skills, such as English (Setyaningsih, 2023) and Arabic (Uliyah & Isnawati, 2019). In addition, several studies have also investigated the effectiveness of educational games in increasing learning motivation (Sari et al., 2021) and social interaction (In-drawan et al., 2024) in early childhood. There is also research that discusses teachers' understanding of educational game tools (Haryani & Qalbi, 2021) and the development of educational game media for character building (Wulan & Suwatra, 2019).

Table 2 Publications on game education with the highest number of citations

No	Rank	Author	Title	Years	Source
1	250	BN Astini, IRI Nurhasanah, IN Suarta	Identify the use of educational game tools (APE) in developing children's fine motor skills	2019	Journal of Chemical Information and Modeling
2	210	A Uliyah, Z Isnawati	Educational Game Methods in Learning Arabic	2019	Journal of Islamic Education
3	200	M Wigati, NA Wiyani	Teacher Creativity in Making Educational Game Tools from Used Items	2020	Journal of Early Childhood Education

No	Rank	Author	Title	Years	Source
4	198	JR Widayati, R Safrina, Y Supriyati	Analysis of the development of early childhood scientific literacy through educational games	2020	Journal obsesi
5	170	R Mawaddah, A Wathon	Development of educational game tools based on student talent levels	2020	Journal of Childhood Education

From several interesting trends in the use of educational games for early childhood in Indonesia. These studies provide an initial overview of the development of the use of educational games in the realm of early childhood education in Indonesia. Further research is needed to examine the effectiveness and challenges in implementing educational games, as well as developing best practices for their use in classrooms.

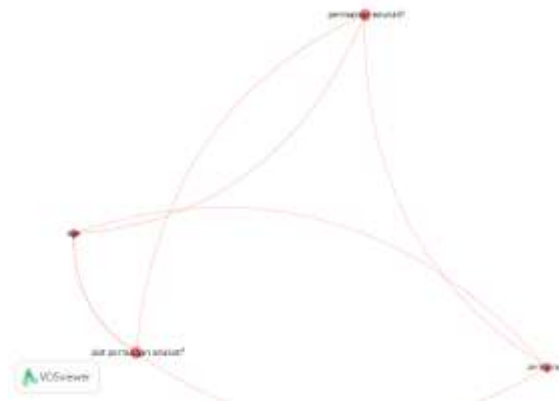


Figure 2. Relationship Between Title And Abstract

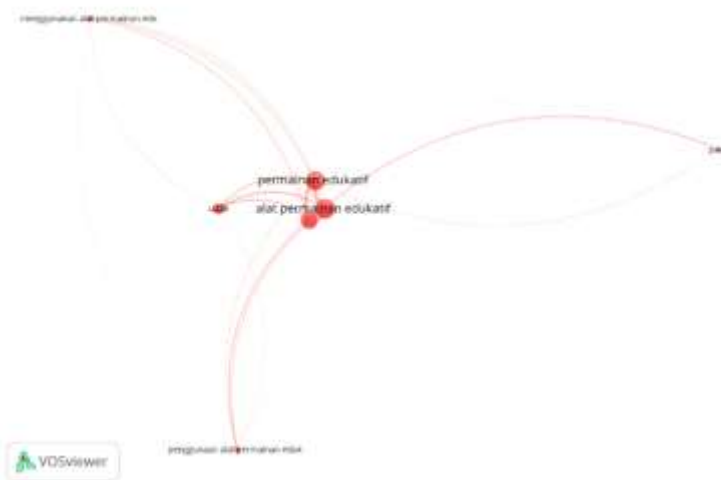


Figure 3. Relationship Between Title

4. Discussion

From the analysis, it can be seen that articles about game education receive an average of 3,460 citations per year, with an average of 31 citations per article. These findings are important because they reflect the scientific impact and recognition of this field of research. The results of this research underline the importance of bibliometric analysis

and data mapping using Vos Viewer in gaining a deeper understanding of developments, trends and important aspects of research in this field. Through this method of analysis, we gain insight into how this academic field has developed over time, and citation density indicates the influence and relevance of the topic.

Bibliometric analysis shows an increase in publications on educational games for early childhood since 2019, with peak growth expected in 2024. This trend aligns with UNESCO's (2021) global report, which emphasizes the importance of digital literacy from an early age. However, the increase in quantity is not always accompanied by a rise in research quality. Most articles are still small-scale exploratory studies, similar to the findings of Wang & Tahir (2020), who showed a predominance of case study-based research rather than longitudinal experiments. This indicates the need for a shift towards more methodologically robust research to test long-term effectiveness.

There are three major patterns that underlie the research that has been conducted, namely related to 1). Increasing knowledge and attitudes, including motivation, engagement, and literacy skills; 2). Game design and technology implementation, namely related to serious games, gamification, mobile apps, and web-based games; and 3). Integration in the context of formal education, namely teacher role and curriculum integration. While this theme is consistent with previous studies (Hirsh-Pasek et al., 2015; Hamari et al., 2016), the results of this review highlight a gap: the limited research linking child development theory to game mechanism design. For example, few publications integrate Piaget's or Vygotsky's theories into game feature design. Thus, there is an opportunity for interdisciplinary research that combines developmental psychology with game technology.

The advantage of using learning media that is interesting, relevant and in accordance with curriculum guidelines is one of the positive aspects of the learning process in the classroom. Of the many advantages, educational games can make learning interesting, motivating and fun (Basuki & Hidayati, 2019), making students more enthusiastic and creating a sense of confidence to participate in learning activities from start to finish. Apart from that, the processed articles offer many other benefits.

The network map shows that research remains fragmented, with publications from developed countries (the US, Europe, and China) dominating. Publications from Southeast Asia, including Indonesia, are relatively few despite the high practical interest in the field. This difference in geographic distribution indicates significant potential for local, contextual research, given that cultural factors play a significant role in the effectiveness of educational games (Marsh, 2019). Practical implications include game developers in developing countries adapting content to suit children's cultural contexts. Critically, although numerous studies show that educational games increase learning motivation, most measure short-term outcomes (e.g., increased literacy scores after a short session). Few long-term studies assess the impact on social-emotional development or critical thinking skills. This aligns with Plass et al.'s (2015) warning that game-based learning often overstates its benefits without longitudinal evidence.

However, another thing that must be considered in building educational games is the challenges in its implementation, and we all know that there are many problems faced in the world of education, especially educational games that are created. Not all learning games are appropriate to student development, resulting in gaps in learning. Not to mention that there are still very few teachers who have received training to build effective educational games, so this becomes an obstacle in implementing the game itself. Paying attention to the challenges that have been mentioned is the first step in developing effective and inclusive solutions in the implementation of quality educational games. With a holistic approach, solutions can be sought that suit each educational context and needs. For researchers, large-scale trials across cultural contexts are needed. Meanwhile, for developers, this research emphasizes the importance of creating games that are inclusive, developmentally appropriate, and not solely entertainment-oriented.

5. Conclusion

Bibliometric analysis was carried out on research related to learning games, utilizing data visualization using Vosviewer. A total of 1000 highly relevant articles were obtained from the search results. This research aims to identify various research trends related to predetermined keywords and analyze them from various points of view. Of the total number of articles identified from 2019 to 2024, it was found that articles related to learning games received 3,460 citations per year, with an average of 31 citations per article. Through an analysis of 1000 publications, the results show that bibliometric analysis and data mapping using vosviewer allows a deeper understanding of developments, trends and important aspects of research in this field. By using bibliometric analysis and applying

a VosViewer approach, this research contributes to the understanding of learning games, while providing an overview of research trends.

This review highlights the rapid development and increasing importance of educational games in early childhood education. The findings reveal not only the benefits of educational games—such as fostering cognitive, social-emotional, and motivational skills—but also the challenges that hinder their optimal implementation, including technological limitations, weak game design, and the lack of integration with curricula. Bibliometric analysis further indicates a significant rise in research interest from 2019–2024, with diverse focuses ranging from literacy and numeracy to STEM and socio-emotional development. Beyond summarizing current trends, this paper emphasizes the need for longitudinal studies, culturally contextualized designs, and multidisciplinary collaboration in future research. The broader impact of this review lies in showing how educational games can evolve from supplementary tools into integral components of early childhood learning ecosystems.

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