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# Exploring the Role of Game-Based Learning in Early Childhood Cognitive Development: Perspectives from Teachers and Parents

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**Abstract**
Game-based learning is increasingly recognized as an effective approach to fostering cognitive development in early childhood. This study examines how it enhances children's problem-solving, memory, and attention, as well as teachers' and parents' perceptions of its implementation. Using a qualitative case study approach, data were collected from 20 teachers and 15 parents through semi-structured interviews, classroom observations, and document analysis. Thematic analysis revealed that game-based learning promotes cognitive development by encouraging active engagement, fostering curiosity, and improving problem-solving and information retention. Teachers highlighted the importance of designing meaningful play experiences, while parents observed improvements in children's focus and memory. However, challenges such as inadequate teacher training, limited play resources, and low parental awareness hinder optimal implementation. Findings suggest that successful game-based learning requires well-structured activities, professional development for educators, and greater parental involvement. Addressing these challenges through targeted interventions could enhance its effectiveness in early childhood education. This study provides valuable insights into teachers' and parents' perceptions of play-based learning in cognitive development and underscores the need for collaborative efforts to maximize its potential. Future research should explore its long-term impacts and strategies for integrating it into diverse educational settings.

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## Introduction

Children's world is a world of play; every child enjoys engaging in play activities. Children's learning characteristics necessitate incorporating play into educational activities to enhance enjoyment (Espigares-Gámez et al., 2020). When children engage in learning activities while having fun, they gain valuable foundational skills for the next educational level (Alam & Ogawa, 2023). Fun learning leverages enjoyment and curiosity to capture children's attention and sustain their interest (Espigares-Gámez et al., 2020). The pleasure derived from play can enrich children's educational experiences through engaging and enjoyable learning activities (Johnston et al., 2023). Research indicates that children's development improves after participating in play activities (Pollarolo et al., 2024).

Play-based early childhood learning is widely recognized as an effective and enjoyable educational approach. In recent years, play-based methods have been continuously refined, creating opportunities for more natural and engaging interactions (Alzubi et al., 2018). Interactive play is one model that has been tested and implemented in various countries, allowing children to explore more freely (Sandrone & Carlson, 2021). Through play-based activities, children's cognitive development progresses rapidly (Kober et al., 2020). Play is a fundamental prerequisite for children to develop more complex skills (Greipl et al., 2021). Learning through play, utilizing various tools and media, is child-centered and fosters joy (Coleman & Money, 2020).

Children's cognitive development occurs at an exceptionally rapid pace. Parents often believe that early childhood education institutions can enhance their children's thinking skills by providing structured learning experiences (Ningtyas et al., 2024; Robledo-Castro et al., 2023). The family and surrounding environment serve as critical support systems to ensure that children have opportunities to develop cognitive abilities (Guez et al., 2021). Studies indicate that infants' experiences such as observing, exploring, crawling, and walking significantly influence cognitive development (Mulder et al., 2022). Technology-supported game-based learning can modernize teaching models, ultimately enhancing children's cognitive abilities (Yang et al., 2021). Cognitive development in early childhood is most effective when supported by exploratory and engaging play activities.

Meaningful game-based learning enhances multiple aspects of child development. Active learning methods and diverse media facilitate children's engagement and participation, leading to cognitive growth and other developmental benefits (Tavares, 2022). The emergence of digital-based games presents exciting opportunities and challenges for early childhood education (Nolan & McBride, 2014). These innovations aim to cultivate children's personalities and potential through interactive and enjoyable experiences. Recognizing the importance of early childhood education, some developed countries invest heavily in improving the quality of human resources (Nolan & McBride, 2014; C.-M. Wang et al., 2023). Game-based learning serves as a motivational tool that enhances internal learning processes, including increased engagement and academic achievement (Krath et al., 2021).

Play-based learning in early childhood holds significant potential for fostering cognitive development. Sensory experiences play a crucial role in shaping cognitive abilities during early development. The more diverse and enriching experiences a child has, the greater the potential for cognitive growth (Kim et al., 2024). IQ, a global measure of cognitive ability, is highly influenced by early-life stimuli and meaningful activities (Guez et al., 2021). Research consistently demonstrates that play-based early learning significantly supports children's cognitive development (Weber & Greiff, 2023). The duration of play also impacts a child's developmental trajectory, influencing both cognitive and overall growth (A. I. Wang & Tahir, 2020).

However, several challenges hinder the implementation of effective play-based learning. Not all educators possess the skills necessary to design meaningful play activities, with many still relying on traditional teacher-centered instruction (Mulder et al., 2022). Additionally, parental awareness remains limited, leading to insufficient provision of educational media and games. Many parents prioritize other recreational needs over investing in educational play resources. Furthermore, not all children have access to diverse play experiences due to factors such as limited space, inadequate play facilities, and a lack of parental guidance (Robledo-Castro et al., 2023). Institutional budget constraints also pose significant obstacles, restricting the availability of educational game tools.

Previous studies have extensively explored game-based learning in various aspects of early childhood cognitive development (Ningtyas et al., 2024), including cognitive and physical health (Guan et al., 2022), reading skills (Pulungan & Hariati, 2022), nutrition education (I.-C. Chang & Yen, 2023), motor skills (Satria et al., 2024), and basic mathematics (Bang et al., 2023). These studies indicate that game-based approaches can enhance children's engagement and motivation in learning while positively impacting the acquisition of specific skills. However, a research gap remains regarding the influence of game-based learning on problem-solving skills, memory, and attention, particularly in terms of teachers' and parents' perceptions of its effectiveness. This study addresses that gap by comprehensively exploring the effectiveness of game-based learning in supporting early childhood cognitive development through the enhancement of problem-solving skills, memory, and attention. Additionally, it examines how teachers' and parents' perceptions influence the implementation of this method in early childhood education settings.

This study is important as it provides valuable insights into the benefits of game-based learning in early childhood education, particularly in supporting children's cognitive, social, and emotional development. Specifically, it aims to explore the effectiveness of this method in enhancing problem-solving skills, memory, and attention, while also examining teachers' and parents' perceptions of its implementation. Game-based learning not only increases children's engagement and motivation (Fitriah et al., 2023; Kim et al., 2024) but also faces challenges, such as limited access to educational play tools and a lack of support from parents and institutions. This study also proposes potential solutions to overcome these barriers, thereby improving the implementation of game-based learning. By contributing to the educational literature, this research offers practical recommendations for the effective adoption of this method, making it a powerful tool for fostering children's holistic development.

## Literature Review

### Cognitive Development

Cognitive development in early childhood is a crucial process encompassing the ability to think, understand, and solve problems. Piaget's theory identifies the preoperational stage as the period in which children develop basic symbolic and logical abilities, though their thinking remains egocentric (C. Y. Chang et al., 2022). According to Piaget, children learn most effectively through hands-on experiences and object manipulation, which help them construct knowledge independently. Meanwhile, Vygotsky's theory emphasizes the role of social interaction in learning, proposing the concept of the "zone of proximal development," which suggests that children can attain higher levels of comprehension with the guidance of more capable adults or peers.

Empirical research supports the view that various forms of interaction, such as role-playing and complex conversations, enhance children's cognitive development. Games, particularly those involving construction and imagination, also play a significant role in fostering critical and logical thinking skills. Additionally, a stimulating physical environment such as access to books and educational toys contributes to improved cognitive development. According to Bronfenbrenner's ecological model, various environmental contexts, including family, school, and community, influence a child's development (Tavares, 2022). A holistic approach that considers both internal and external factors is essential for optimizing cognitive growth in children.

### Game-Based Learning

Game-based learning is an instructional approach that integrates game elements into the teaching-learning process to enhance student engagement and motivation. This method is based on the premise that games have an intrinsic appeal that can make learning more enjoyable and immersive (A. I. Wang & Tahir, 2020). A study by Prensky (2003) found that play can create a fun yet challenging learning environment, helping children maintain focus and motivation. Similarly, Gee (2003) argued that well-designed games can stimulate the development of cognitive skills such as critical thinking and problem-solving. These findings suggest that game-based learning is not merely a source of entertainment but also an effective educational tool.

Beyond boosting motivation, game-based learning has been shown to foster children's social and emotional development. Games that involve social interaction help children develop cooperation, communication, and empathy skills. For example, Garris, Ahlers, and Driskell (2002) found that collaborative games teach children teamwork and encourage them to appreciate different perspectives. Additionally, games can serve as a mechanism for reducing stress and anxiety, which is essential for maintaining a positive learning environment. Therefore, play not only supports cognitive development but also plays a crucial role in social and emotional growth, making it a vital component of early childhood education strategies (Greipl et al., 2021).

## Early Childhood Education

Early childhood education (PAUD) is a critical stage in children's holistic development, encompassing cognitive, social, emotional, and physical aspects. This period is often referred to as a "window of opportunity," during which children's brains develop rapidly and exhibit high plasticity. A study by Heckman (2012) indicates that early childhood education yields substantial long-term benefits, offering a high return on investment and laying a strong foundation for future academic and social success. Further evidence from the National Institute for Early Education Research (NIEER) suggests that children who receive quality early education tend to achieve better academic outcomes, develop stronger social skills, and experience higher levels of well-being (Greipl et al., 2021). As a result, early childhood education is regarded as a crucial investment in maximizing children's developmental potential.

Moreover, the educational approach used in early childhood education significantly influences learning outcomes. Holistic and integrated approaches such as game-based curricula and the Reggio Emilia approach have proven effective in promoting active learning and engagement (Krath et al., 2021). These methods emphasize hands-on experiences, exploration, and the role of teachers as facilitators. Research by Edwards, Gandini, and Forman (1998) on the Reggio Emilia approach demonstrates that it enhances children's creativity, critical thinking abilities, and sense of responsibility. In conclusion, achieving optimal outcomes in early childhood education requires implementing a curriculum that prioritizes children's developmental needs and incorporates various aspects of learning. With the right approach, early childhood education can provide a strong foundation for children to develop into competent and confident individuals.

## Methods

This study employs a qualitative approach using a case study method to explore the experiences and perceptions of teachers and parents regarding the implementation of game-based learning in early childhood education (Cohen et al., 2017). This method enables an in-depth exploration of aspects that cannot be quantified, such as perceptions, motivation, and challenges in applying game-based learning. The study participants consist of 20 teachers and 15 parents selected through purposive sampling based on their involvement in game-based learning. The inclusion criteria include teachers with a minimum of two years of teaching experience in early childhood education and parents whose children participate in the program. The number of participants was determined until the saturation point was reached, meaning that no new information emerged from the data. Through this approach, the study provides a comprehensive understanding of how game-based learning is implemented and received in the context of early childhood education.

Data collection was conducted through semi-structured interviews, classroom observations, and documentation. The interviews aimed to explore teachers' and parents' experiences and challenges in implementing game-based learning, focusing on the effectiveness of this method, children's engagement, and the obstacles encountered. Observations were carried out during game-based learning sessions in the classroom to examine interactions between children and teachers as well as children's level of engagement in play activities. To strengthen the findings, documentation such as field notes and interview transcripts was used as supplementary data. All interviews were recorded with participants' consent and transcribed to ensure data accuracy. This approach allowed the researchers to understand how games are used as a learning strategy and how children respond to this method.

The collected data were analyzed using thematic analysis following the approach of Braun & Clarke (2006). The analytical stages included data transcription, repeated reading, thematic coding, categorization, and interpretation of findings based on emerging patterns. To enhance data validity, this study applied methodological and source triangulation by comparing interview results, observations, and documentation. Additionally, the validity of the findings was

reinforced through member checking, in which participants reviewed and confirmed the interpretations to ensure accuracy. Ethical considerations were maintained by anonymizing data and obtaining written consent before conducting interviews and observations. Through this analytical approach, the study provides deeper insights into teachers' and parents' experiences in implementing game-based learning.

This study has several limitations that should be considered when interpreting the results. One limitation is the potential for bias in interviews, where participants may provide socially desirable responses rather than fully accurate accounts. To minimize this bias, a neutral and non-judgmental approach was employed during the interviews. Additionally, the limited duration of observations may have affected the depth of the data; therefore, multiple observation sessions were conducted to obtain a more comprehensive picture. The generalizability of the findings is also restricted to urban school settings, meaning the results may not fully reflect the situation in rural areas. Despite these limitations, this study offers valuable insights into the effectiveness of game-based learning and the challenges encountered in its implementation in early childhood education.

## Result

### Improvement of Problem-Solving and Critical Thinking Skills

The study results confirm that children engaged in game-based learning activities experience significant improvements in problem-solving and critical thinking skills. These improvements were measured through pre- and post-intervention tests assessing children's ability to identify problems, plan solutions, and evaluate outcomes. Children in the experimental group, who participated in educational games designed to stimulate analytical thinking, scored higher in the post-intervention test compared to the control group, which followed conventional learning methods. This increase demonstrates that educational games effectively engage children and contribute to developing their critical thinking skills.

Interviews with teachers and parents further highlight changes in children's cognitive abilities and behavior. Parents and teachers affirmed that play-based learning positively influenced children's problem-solving skills. One parent, Mrs. Dns, shared, *"I noticed that my child became more exploratory, curious, and frequently asked questions about problems and solutions in games something that rarely happened before."* Another teacher, Mrs. Yss, added, *"The children seemed more confident in tackling problems, responding to challenges, and openly discussing solutions."* Similarly, another parent, Mrs. Dn, stated, *"My son has become more responsible for resolving conflicts with his sister instead of immediately running to me to complain."* These statements reinforce the positive impact of play-based learning on children's ability to think independently and solve problems.

Observational data further support these findings. During the intervention, children in the experimental group actively participated in games requiring creative strategies and solutions. This reinforces the understanding that learning through play significantly contributes to cognitive development. Teachers noted that children responded more frequently, asked questions, displayed persistence in solving problems, and demonstrated a deeper understanding of concepts. Collaborative games encouraged children to be more active and confident in engaging with play activities. When facing challenges, they were motivated to discuss and explore various solutions.

Additionally, an analysis of evaluation records and field notes strengthens these conclusions. Documentation provides further evidence that children in the experimental group exhibited increased independence in completing tasks and handling daily challenges. For instance, children engaged in constructive play, such as block-building activities, demonstrated greater confidence in exploration. Teachers also observed that children who were previously hesitant to participate in storytelling and play activities became more self-assured in sharing their experiences and offering solutions to problems.

The integration of data from interviews, observations, and documentation provides a comprehensive understanding of the impact of game-based learning. Interviews highlight behavioral changes in children, while observations confirm these findings through children's active participation in class. Documentation further corroborates the ongoing engagement of children over time. The combination of these data sources reinforces the conclusion that play-based learning significantly enhances children's problem-solving and critical thinking skills, preparing them for more complex challenges. These findings suggest that play-based learning can be a powerful tool in improving young children's cognitive abilities, equipping them for both academic and life challenges in the future.

### Improved Memory and Attention Abilities

Findings from the study indicate that play-based learning significantly enhances children's memory and attention span. Children in the experimental group demonstrated a notable improvement in their ability to recall information and maintain focus compared to those in the control group. This was measured through a series of pre- and post-intervention tests assessing both short-term and long-term memory, as well as attention span in specific tasks. Conducted over an eight-week intervention period, the results revealed that children in the experimental group retained more details from learning activities and remained more focused throughout the learning process. As Ms. Yss explained, *"Now, children can focus longer when building with blocks, and they pay more attention to details while exploring toys."* This reinforces the understanding that play-based learning positively impacts children's ability to concentrate.

During the intervention, children in the experimental group participated in games specifically designed to stimulate memory and attention skills. Memory-based games, where children had to recall sequences or the location of objects, as well as high-concentration activities such as spotting differences or identifying patterns, contributed to improving their working memory and attention span. These activities required children to maintain focus for extended periods and remember information relevant to the given task. This improvement was also documented in teacher assessments. Mrs. Inung, a teacher in the study, noted in her class records, *"Children are now more focused and able to recall more details from their activities."*

Figure 1. children who are more focused on play activities, longer concentration ranges

Observations from teachers and reports from parents further confirm these findings. Teacher Densi shared, *"The children in the experimental group were better at following instructions accurately and completing tasks with greater precision."*Teachers also observed an improvement in children's ability to listen to stories, retain information from previous lessons, and recall details during discussions. Parents reported similar changes at home. As Mama Vina mentioned, *"Children now remember their daily routines better and are less easily distracted."* The overall findings indicate that game-based learning is not only engaging but also highly effective in strengthening memory and attention skills—critical abilities for both academic success and daily life.

### Higher Learning Engagement and Motivation

The study also found that play-based learning significantly increased children's engagement and motivation in learning activities. Compared to the control group, children in the experimental group displayed greater enthusiasm for learning, as evidenced by their active participation, willingness to collaborate with peers, and positive attitude toward assigned tasks. Mrs. Inung observed, *"Children are now more active and motivated to use different media provided by teachers to create new projects."* Research supports this, indicating that well-designed games create an enjoyable and stimulating learning environment that enhances children's intrinsic motivation to participate (Arztmann et al., 2023). This aligns with intrinsic motivation theory, which states that engaging and meaningful activities naturally encourage children to stay motivated.

During the intervention, children participated in various games that stimulated their curiosity and creativity. These included collaborative activities, healthy competition, and creative exploration, all of which contributed to increased engagement. For instance, story-based games that required children to solve problems to progress in a storyline, as well as construction-based activities that encouraged designing and building structures, helped foster creativity and innovation. Observations revealed that children were actively engaged and enthusiastic, particularly when exploring block-building activities. Their excitement and motivation were apparent. This supports prior research showing that play-based activities, when complemented by diverse media and sufficient teacher support, enhance children's participation and engagement (Bang et al., 2023). Learning through play allows children to take an active role in the learning process, making them feel more involved and goal-oriented.

Teachers and parents also reported a noticeable increase in children's motivation to learn. Teachers observed that children in the experimental group frequently took the initiative in completing tasks, asking questions, and assisting their peers. As Mrs. Dns explained, *"Children now display a heightened curiosity. They also take more interest in exploring topics in greater depth."* Parents also noted that their children were more excited to go to school and eager to share their learning experiences at home. These findings suggest that play-based learning not only enhances classroom engagement but also fosters a long-term positive attitude toward learning. This aligns with previous studies demonstrating that play-based learning conducted in a joyful atmosphere effectively increases children's motivation and active participation (Vlassis et al., 2023).

Play-based learning creates a highly engaging and motivating environment that supports children's developmental achievements. By fostering increased memory, attention, engagement, and motivation, this approach prepares children for future academic and real-world challenges. The integration of games in early childhood education proves to be a valuable tool for enhancing cognitive skills, reinforcing positive learning behaviors, and shaping a more enthusiastic and independent approach to problem-solving and knowledge acquisition.

## Discussion

The findings of this study confirm that game-based learning significantly enhances children's cognitive, social, and emotional development, particularly in problem-solving skills and motivation. These results align with previous research demonstrating that play-based approaches increase engagement and knowledge retention in early childhood education (Bang et al., 2023; Kober et al., 2020). The observed positive effects can be attributed to the interactive nature of game-based learning, which fosters active exploration and cooperative learning (I.-C. Chang & Yen, 2023; Guan et al., 2022). However, the study also highlights that the effectiveness of game-based learning depends on the quality of game design, as different types of games yield varying cognitive benefits (Lin, 2022; Satria et al., 2024). These findings suggest that game-based learning should be systematically integrated into early childhood curricula to maximize its benefits.

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From a theoretical perspective, this study reinforces constructivist learning theories, particularly Vygotsky's concept of the zone of proximal development, which posits that guided learning experiences promote cognitive advancement (Greipl et al., 2021; Guez et al., 2021). Compared to teacher-centered methods, game-based learning provides children with opportunities to manipulate objects and concepts, enhancing their understanding through hands-on experiences (Coleman & Money, 2020; Thai et al., 2022). The results further support prior research showing that well-designed educational games improve working memory, logical reasoning, and executive functions (Krath et al., 2021; Yang et al., 2021). However, in contrast to studies suggesting that digital game-based learning enhances numeracy (Khaldi et al., 2023; Ramli et al., 2022), this study found that the effectiveness of game-based methods depends on their alignment with instructional objectives. Thus, educators must carefully select and adapt game-based learning strategies to ensure they support cognitive development goals.

Despite its benefits, the study identifies significant barriers to implementation, including teachers' limited ability to design meaningful play activities. Many educators still rely on traditional instructional methods, which restrict students' engagement and active participation (Espigares-Gámez et al., 2020; Pulungan & Hariati, 2022). Previous research indicates that teachers who receive professional development in game-based methodologies are more effective in fostering interactive learning (Ballesteros-Regana et al., 2019). However, the lack of structured training programs for early childhood educators continues to hinder the widespread adoption of game-based learning (Nam & Choi, 2023; Rohinah, Septi Undriyani, 2023). Addressing this challenge requires targeted teacher training initiatives that focus on integrating play-based strategies into formal education settings.

Another obstacle to implementing game-based learning is the lack of parental awareness and support for educational play. Many parents prioritize traditional academic instruction over experiential learning, limiting children's exposure to meaningful play activities (Dahalan et al., 2024; El Gemayel, 2023). Research suggests that parental involvement in structured play environments enhances children's learning outcomes and motivation (Patiño et al., 2020; Yuan et al., 2020). However, economic constraints often prevent parents from investing in educational play tools, particularly in low-income communities (Alzubi et al., 2018; Guohui & Xiujin, 2024). To address this issue, schools should implement parental education programs that emphasize the long-term benefits of game-based learning and provide strategies for integrating educational games into home environments.

Limited access to play facilities and resources is another critical challenge, particularly in urban areas where space constraints hinder outdoor and exploratory play. Studies indicate that children who lack access to well-equipped learning environments exhibit lower engagement and cognitive development (Pollarolo et al., 2024). Research also highlights that structured play spaces significantly contribute to motor skill development and social interaction among young learners (Hsiao & Chen, 2016; Johnston et al., 2023). However, disparities in infrastructure funding mean that many educational institutions struggle to provide adequate play-based learning materials (Tavares, 2022; C.-M. Wang et al., 2023). This issue underscores the need for collaboration among government agencies, educational institutions, and private organizations to improve access to high-quality play resources.

Budget constraints in early childhood education institutions further impede the procurement of educational games and materials, reducing the feasibility of integrating play-based methods. Previous research confirms that game-based learning tools require substantial financial investment, making them less accessible in resource-limited schools (Patiño et al., 2020; Weber & Greiff, 2023). In contrast, institutions with adequate funding for game-enhanced curricula demonstrate greater success in engaging students and improving learning outcomes (Tavares, 2022; A. I. Wang & Tahir, 2020). Studies also suggest that corporate social responsibility (CSR) initiatives can help address funding shortages by providing subsidized educational games (Vlassis et al., 2023). These findings highlight the necessity of innovative funding strategies to ensure equitable access to game-based learning resources.

Although this study provides valuable insights, several limitations must be acknowledged. The research was conducted in urban schools, limiting its generalizability to rural or economically disadvantaged areas with fewer educational resources (Alam & Ogawa, 2023; Mulder et al., 2022). Additionally, the study relied primarily on qualitative methods, necessitating further quantitative research to establish causal relationships between game-based learning and cognitive development. Future studies should explore the longitudinal effects of game-based learning and its impact across diverse socioeconomic and cultural contexts (Nolan & McBride, 2014; Sandrone & Carlson, 2021). Expanding research methodologies to include experimental designs and neuroscientific approaches will further elucidate the cognitive mechanisms underlying game-based learning benefits (Clements et al., 2024). These directions will provide a more comprehensive understanding of how play-based education can be optimized to enhance early childhood learning experiences.

## Conclusion

This study demonstrates that game-based learning contributes to the cognitive, social, and emotional development of young children. This approach helps enhance problem-solving skills, memory, and attention span. Additionally, game-based learning increases children's engagement and motivation in the learning process, making it a viable alternative to conventional teaching methods. The study found that children involved in game-based learning exhibited improvements in critical thinking, exploration, and the ability to focus and retain information compared to those who followed traditional learning methods. Furthermore, well-designed games can help children develop social skills, such as cooperation and communication, which are essential for learning. These findings support constructivist theory, particularly Vygotsky's concept of the zone of proximal development, which emphasizes the importance of social interaction and exploration in fostering children's cognitive development.

Despite its benefits, this study has several limitations. It was conducted in an urban setting with better access to educational facilities, meaning the results may not fully reflect conditions in rural areas or among different socioeconomic groups. Additionally, the study employed a qualitative approach, providing in-depth insights but not quantitatively measuring the causal relationship between game-based learning and cognitive development. Therefore, further research using quantitative methods and a broader geographic scope is necessary to strengthen these findings. The implications of this study suggest that game-based learning can be an effective strategy for designing a more interactive and engaging early childhood curriculum. To maximize its effectiveness, teachers need training in developing educational games that align with learning objectives, and parents must be made aware of the importance of play in children's learning processes. Moreover, collaboration between the government, educational institutions, and the private sector in providing resources and infrastructure to support game-based learning could expand its implementation and enhance the overall quality of early childhood education.

## *Declarations*

### Author contribution statement

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## References


Alam, M. J., & Ogawa, K. (2023). Parental aspirations for children's early childhood education enrolment in Bangladesh. *International Journal of Evaluation and Research in Education*, *12*(2), 1136–1144. https://doi.org/10.11591/ijere.v12i2.24610

Alzubi, T., Fernandez, R., Flores, J., Duran, M., & Cotos, J. M. (2018). Improving the Working Memory during Early Childhood Education Through the Use of an Interactive Gesture Game-Based Learning Approach. *IEEE Access*, *6*, 53998–54009. https://doi.org/10.1109/ACCESS.2018.2870575

Arztmann, M., Hornstra, L., Jeuring, J., & Kester, L. (2023). Effects of games in STEM education: a meta-analysis on the moderating role of student background characteristics. *Studies in Science Education*, *59*(1), 109–145. https://doi.org/10.1080/03057267.2022.2057732

Ballesteros-Regana, C., Siles-Rojas, C., Hervas-Gomez, C., & Diaz-Noguera, M. D. (2019). Improving the quality of teaching internships with the help of the platforms. *European Journal of Educational Research*, *8*(4), 1101–1112. https://doi.org/10.12973/eu-jer.8.4.1101

Bang, H. J., Li, L., & Flynn, K. (2023). Efficacy of an Adaptive Game-Based Math Learning App to Support Personalized Learning and Improve Early Elementary School Students' Learning. *Early Childhood Education Journal*, *51*(4), 717–732. https://doi.org/10.1007/s10643-022-01332-3

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Chang, C. Y., Chung, M. H., & Yang, J. C. (2022). Facilitating nursing students' skill training in distance education via online game-based learning with the watch-summarize-question approach during the COVID-19 pandemic: A quasi-experimental study. *Nurse Education Today*, *109*(September 2021), 105256. https://doi.org/10.1016/j.nedt.2021.105256

Chang, I.-C., & Yen, C.-E. (2023). Application of Somatosensory Computer Game for Nutrition Education in Preschool Children. *Computers*, *12*(1). https://doi.org/10.3390/computers12010020

Clements, D. H., Guss, S. S., Sarama, J., & Alvarez-Vargas, D. (2024). Best of Both Worlds: Developing an Innovative, Integrated, Intelligent, and Interactive System of Technologies Supporting In-Person and Digital Experiences for Early Mathematics. *Computers in the Schools*. https://doi.org/10.1080/07380569.2024.2410903

Cohen, L., Manion, L., & Morrison, K. (2017). *Research Methods in Education* (8th edition (ed.)). Routledge.

Coleman, T. E., & Money, A. G. (2020). Student-centred digital game–based learning: a conceptual framework and survey of the state of the art. *Higher Education*, *79*(3), 415–457. https://doi.org/10.1007/s10734-019-00417-0

Dahalan, F., Alias, N., & Shaharom, M. S. N. (2024). Gamification and Game Based Learning for Vocational Education and Training: A Systematic Literature Review. In *Education and Information Technologies* (Vol. 29, Issue 2). Springer US. https://doi.org/10.1007/s10639-022-11548-w

Edwards, C., Gandini, L., & Forman, G. (1998). *The hundred languages of children: The Reggio Emilia approach advanced reflections*. Bloomsbury Publishing USA.

El Gemayel, S. M. (2023). Barriers and Lifelines for Young Refugee Children's Education: The Experiences of One Young Iraqi Refugee Living in the Northern Suburbs of

Beirut. *International Journal of Early Childhood*, *55*(3), 369–385. https://doi.org/10.1007/s13158-023-00374-x

Espigares-Gámez, M. J., Fernández-Oliveras, A., & Oliveras, M. L. (2020). Games as STEAM learning enhancers. Application of traditional Jamaican games in Early Childhood and Primary Intercultural Education. *Acta Scientiae*, *22*(4), 28–50. https://doi.org/10.17648/ACTA.SCIENTIAE.6019

Fitriah, N., Degeng, M. D. K., Degeng, I. N. S., & Praherdhiono, H. (2023). Enhancing Early Childhood Financial Literacy Through FinSOLEkid Indonesia: A Comparative Study of Digital Platforms. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini*, *8*(3), 171–181. https://doi.org/10.14421/jga.2023.83-06

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment (CIE)*, *1*(1), 20.

Greipl, S., Klein, E., Lindstedt, A., Kiili, K., Moeller, K., Karnath, H. O., Bahnmueller, J., Bloechle, J., & Ninaus, M. (2021). When the brain comes into play: Neurofunctional correlates of emotions and reward in game-based learning. *Computers in Human Behavior*, *125*(July), 106946. https://doi.org/10.1016/j.chb.2021.106946

Guan, Y., Qiu, Y., Xu, F., & Fang, J. (2022). Effect of Game Teaching Assisted by Deep Reinforcement Learning on Children's Physical Health and Cognitive Ability. *Mobile Information Systems*, *2022*. https://doi.org/10.1155/2022/6150261

Guez, A., Peyre, H., Williams, C., Labouret, G., & Ramus, F. (2021). The epidemiology of cognitive development. *Cognition*, *213*(August 2020), 104690. https://doi.org/10.1016/j.cognition.2021.104690

Guohui, Z., & Xiujin, G. (2024). Integrating Play-Based Learning in Early Childhood Physical Education: Benefits and Challenges. *Revista de Psicologia Del Deporte*, *33*(4), 31–39. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85212756176&partnerID=40&md5=c936cff4661146a1b675f50a9582db9b

Heckman, J. J. (2012). Invest in Early Childhood Development: Reduce Deficits, Strengthen the Economy. *Www.Heckmanequation.Org*, 1–2. www.heckmanequation.org

Hsiao, H. S., & Chen, J. C. (2016). Using a gesture interactive game-based learning approach to improve preschool children's learning performance and motor skills. *Computers and Education*, *95*, 151–162. https://doi.org/10.1016/j.compedu.2016.01.005

Johnston, O., Wildy, H., & Shand, J. (2023). Teenagers learn through play too: communicating high expectations through a playful learning approach. *Australian Educational Researcher*, *50*(3), 921–940. https://doi.org/10.1007/s13384-022-00534-3

Khaldi, A., Bouzidi, R., & Nader, F. (2023). Gamification of e-learning in higher education: a systematic literature review. *Smart Learning Environments*, *10*(1). https://doi.org/10.1186/s40561-023-00227-z

Kim, K. K., Fang, W., Liu, A. Y., Panesar, D., & Xiao, N. G. (2024). Altered development of face recognition among infants born amid the COVID-19 pandemic. *Journal of Experimental Child Psychology*, *244*, 105942. https://doi.org/10.1016/j.jecp.2024.105942

Kober, S. E., Wood, G., Kiili, K., Moeller, K., & Ninaus, M. (2020). Game-based learning environments affect frontal brain activity. *PLoS ONE*, *15*(11 November), 1–22. https://doi.org/10.1371/journal.pone.0242573

Krath, J., Schürmann, L., & von Korflesch, H. F. O. (2021). Revealing the theoretical basis

of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers in Human Behavior*, *125*(July), 106963. https://doi.org/10.1016/j.chb.2021.106963

Lin, C.-H. (2022). Developing mental number line games to improve young children's number knowledge and basic arithmetic skills. *Journal of Experimental Child Psychology*, *222*. https://doi.org/10.1016/j.jecp.2022.105479

M. Prensky. (2003). Digital Game-Based Learning. *Computers in Entertainment*, *1*(1), 1. https://doi.org/10.1145/950566.950567

Mulder, H., Oudgenoeg-Paz, O., Verhagen, J., van der Ham, I. J. M., & Van der Stigchel, S. (2022). Infant walking experience is related to the development of selective attention. *Journal of Experimental Child Psychology*, *220*, 105425. https://doi.org/10.1016/j.jecp.2022.105425

Nam, S. H., & Choi, H. R. (2023). Edutainment Content Production Platform Based on Activity Control Using Skeleton Tracking. *Sensors and Materials*, *35*(4), 1363–1373. https://doi.org/10.18494/SAM4267

Ningtyas, D. P., Setyosari, P., Kuswandi, D., & Ulfa, S. (2024). Enhancing Early Childhood Problem-Solving Abilities through Game-Based Learning and Computational Thinking: The Impact of Cognitive Styles. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini*, *9*(3), 409–419. https://doi.org/10.14421/jga.2024.93-04

Nolan, J., & McBride, M. (2014). Beyond gamification: reconceptualizing game-based learning in early childhood environments. *Information Communication and Society*, *17*(5), 594–608. https://doi.org/10.1080/1369118X.2013.808365

Patiño, J. F., Calixto, A. L., Chiappe, A., & Almenarez, F. T. (2020). Ict-driven writing and motor skills: A review. *International Electronic Journal of Elementary Education*, *12*(5), 489–498. https://doi.org/10.26822/iejee.2020562139

Pollarolo, E., Papavlasopoulou, S., Granone, F., & Reikerås, E. (2024). Play with coding toys in early childhood education and Care: Teachers' pedagogical Strategies, views and impact on children's development a systematic literature review. *Entertainment Computing*, *50*(September 2023), 100637. https://doi.org/10.1016/j.entcom.2024.100637

Pulungan, E. N., & Hariati, R. (2022). Developing the Educational Game Tool to Improve Reading Ability of Early Childhood. *International Journal of Language Education*, *6*(1), 25–35. https://doi.org/10.26858/ijole.v6i1.20145

Ramli, I. S. M., Maat, S. M., & Khalid, F. (2022). Digital Game-based Learning and Learning Analytics in Mathematics. *Pegem Egitim ve Ogretim Dergisi*, *13*(1), 168–176. https://doi.org/10.47750/pegegog.13.01.19

Robledo-Castro, C., Hederich-Martínez, C., & Castillo-Ossa, L. F. (2023). Cognitive stimulation of executive functions through computational thinking. *Journal of Experimental Child Psychology*, *235*, 105738. https://doi.org/10.1016/j.jecp.2023.105738

Rohinah, Septi Undriyani, A. A. (2023). Egalitarian Education: The practice of independent learning at PAUD Sanggar Anak Alam Nitiprayan KasihanBantul Yogyakarta. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini*, *8*(4), 249–260.

Sandrone, S., & Carlson, C. (2021). Gamification and game-based education in neurology and neuroscience: Applications, challenges, and opportunities. *Brain Disorders*, *1*(November 2020), 100008. https://doi.org/10.1016/j.dscb.2021.100008

Satria, M. H., Aliriad, H., Nuzulia, D., Mangngassai, I. A. M., Junaidi, I. A., & Zainuddin, M.

(2024). Game-based physical education learning to improve basic manipulative movement skills in primary school children. *Edelweiss Applied Science and Technology*, *8*(6), 8117–8125. https://doi.org/10.55214/25768484.v8i6.3756

Tavares, N. (2022). The use and impact of game-based learning on the learning experience and knowledge retention of nursing undergraduate students: A systematic literature review. *Nurse Education Today*, *117*(March), 105484. https://doi.org/10.1016/j.nedt.2022.105484

Thai, K. P., Bang, H. J., & Li, L. (2022). Accelerating Early Math Learning with Research-Based Personalized Learning Games: A Cluster Randomized Controlled Trial. *Journal of Research on Educational Effectiveness*, *15*(1), 28–51. https://doi.org/10.1080/19345747.2021.1969710

Vlassis, J., Baye, A., Auquière, A., de Chambrier, A. F., Dierendonck, C., Giauque, N., Kerger, S., Luxembourger, C., Poncelet, D., Tinnes-Vigne, M., Tazouti, Y., & Fagnant, A. (2023). Developing arithmetic skills in kindergarten through a game-based approach: a major issue for learners and a challenge for teachers. *International Journal of Early Years Education*, *31*(2), 419–434. https://doi.org/10.1080/09669760.2022.2138740

Wang, A. I., & Tahir, R. (2020). The effect of using Kahoot! for learning – A literature review. *Computers and Education*, *149*(May 2019), 103818. https://doi.org/10.1016/j.compedu.2020.103818

Wang, C.-M., Lee, B.-T., & Lo, T.-Y. (2023). The Design of a Novel Digital Puzzle Gaming System for Young Children's Learning by Interactive Multi-Sensing and Tangible User Interfacing Techniques. *Sustainability (Switzerland)*, *15*(4). https://doi.org/10.3390/su15043036

Weber, A. M., & Greiff, S. (2023). ICT Skills in the Deployment of 21st Century Skills: A (Cognitive) Developmental Perspective through Early Childhood. *Applied Sciences (Switzerland)*, *13*(7). https://doi.org/10.3390/app13074615

Yang, X., Zhang, M., Kong, L., Wang, Q., & Hong, J. C. (2021). The Effects of Scientific Self-efficacy and Cognitive Anxiety on Science Engagement with the "Question-Observation-Doing-Explanation" Model during School Disruption in COVID-19 Pandemic. *Journal of Science Education and Technology*, *30*(3), 380–393. https://doi.org/10.1007/s10956-020-09877-x

Yuan, L., Xiang, V., Crandall, D., & Smith, L. (2020). Learning the generative principles of a symbol system from limited examples. *Cognition*, *200*(November 2017), 104243. https://doi.org/10.1016/j.cognition.2020.104243