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GAME INNOVATION IN THE DIGITAL AGE IN THE DEVELOPMENT OF EARLY CHILDHOOD

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ABSTRACT
Digital game innovation now plays a central role in supporting early childhood development in the technological era. This study aims to examine the effect of learning-based digital games on children's cognitive, social, and emotional development, with a focus on literacy and numeracy skills. This study uses a qualitative approach through a case study method at TK Plus Assalam Sidoarjo, involving participatory observation, in-depth interviews, and documentation. The educational application "*Mari Belajar Huruf*" (Let's Learn Letters) is used as an interactive learning medium to introduce letters to students. The research shows that digital games improve children's ability to recognize letters, social interaction, and active participation. Games create a fun learning experience, increase motivation, critical thinking, and collaborative skills. The involvement of parents and teachers prevents technology addiction. Digital game-based learning strategies with the right pedagogical approach are effective in optimizing early childhood development, providing important recommendations for educators and policymakers for healthy integration into the curriculum.

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INTRODUCTION
Game innovation in the digital age has become an important phenomenon in early childhood education, where the use of game-based digital media serves not only as a means of entertainment, but also as an effective learning medium to improve various aspects of child development, including cognitive, social, and emotional development (Rahman et al., 2024). The importance of this innovation lies in its ability to increase children's motivation and engagement in the learning process, as well as supporting the development of 21st-century skills such as critical thinking, problem solving, and collaborative learning (Alotaibi, 2024). Several studies have shown the effectiveness of digital games in improving literacy and numeracy

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skills in early childhood, with the effectiveness of games in improving literacy skills reaching 77% and also being effective in stimulating children's engagement in numeracy learning (Syarfina et al., 2023). Experts state that digital games can provide a fun and effective learning experience, as well as improve children's motor, cognitive, and social skills (Cavedini et al., 2020). However, the role of parents and teachers remains important in supervising the use of technology so that it does not cause dependence (Nurteti, Lilis, Mansyur Srisudarso, Annisa Wahyuni, Mariatul Kamila Ramadhan, 2024).

Game-based learning has become an increasingly popular method in education, especially with the support of digital technology. This method not only increases student motivation but also enriches their learning experience. Studies show that GBL can significantly increase student motivation and participation, making the learning experience more interesting and challenging (Setiawati et al., 2024). In addition, GBL can also increase student motivation and learning behavior, as well as assist in the development of important soft skills (Medina-Merodio et al., 2024). GBL plays an important role in the development of computational thinking (CT) skills, where meta-analyses show that GBL has a significant positive effect on students' CT, with different types of games such as role- playing and puzzles having different impacts (Jingsi et al., 2023). Furthermore, GBL can improve students' understanding of programming concepts and problem-solving strategies.

In comparison to traditional teaching methods, GBL shows comparable results in terms of knowledge acquisition, but excels in increasing student motivation. Students who learn through educational video games created by teachers feel more motivated and enjoy the learning experience more than traditional methods (López-Fernández et al., 2021). However, despite the many benefits of GBL, there are challenges in its design and development, particularly in addressing health issues and technological constraints. Further research is needed to understand how different game dynamics, such as collaborative or competitive, affect student learning (Hussein et al., 2021). In addition, there is a need to further explore the use of analog games in the development of critical thinking skills.

This study aims to explore the phenomenon of digital game innovation in early childhood education with the goal of examining how digital-based games can support children's cognitive, social, and emotional development. More specifically, this study aims to explore the influence of digital games on improving literacy and numeracy skills in early childhood. Furthermore, this study also identifies the impact of learning-based games in developing children's critical thinking skills, creativity, and social competence. More specifically, this study was conducted to provide recommendations regarding the management of technology use, highlighting the importance of parental and teacher supervision to avoid negative impacts on health and dependence on digital devices (Nurteti et al., 2024).

In-depth research will explore whether digital games designed specifically for early childhood can have a positive impact on children's cognitive, social, and emotional development. The use of digital games based on learning (DGBL) will improve children's literacy, numeracy, creativity, and critical thinking skills. On the other hand, this study also examines whether the involvement of parents and teachers in supervising the use of digital games can mitigate potential negative impacts, such as dependence on technology, and ensure the use of technology that supports children's positive development.

METHOD

This study was conducted at TK Plus Assalam Sidoarjo, which has 112 students and 12 educators. This location was chosen based on the integration of technology in the learning process through an educational game application called "*Mari Belajar Huruf*" (Let's Learn Letters). The main focus of this study was to explore how digital game innovations in the technological era affect early childhood development, particularly in terms of letter recognition skills and other developmental aspects (social-emotional, physical-motor, cognitive, and artistic). The unit of analysis referred to is the students of TK Plus Assalam who are directly involved in learning using computer media. The type of research used is qualitative research with a case study approach (Sitorus, 2021; Sugiyono, 2010). The data used in this study is primary data, obtained directly from observations, interviews, and documentation of activities carried out at TK Plus Assalam Sidoarjo. This study aims to understand the phenomenon that occurs in the context of using computer media as a learning tool, particularly in introducing letters to early childhood.

The selection of informants in this study was conducted using purposive sampling techniques with predetermined criteria. For interviews, one school principal was selected as a key informant who understood the policy on the use of technology in schools, two teachers who had at least one year of experience using the "*Mari Belajar Huruf*" application in

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learning and represented different classes, and one parent who actively accompanied learning at home. For observation, five students were selected who met the following criteria: aged 4-6 years, actively using the learning application for at least two months, and demonstrating varying abilities in recognizing letters (two students with high abilities, two students with moderate abilities, and one student with low abilities). The selection of informants considered representativeness and the ability to provide relevant information in accordance with the research focus on the influence of digital games on early childhood development.

In collecting data, this study used several techniques (Sugiyono, 2010), namely: First, participatory observation, in which the researcher was involved in the learning process using the "*Mari Belajar Huruf*" application and observed the interaction between students and computer media. Second, in-depth interviews were conducted with teachers and several students to gain a deeper perspective on their experiences in using digital games for learning. Third, documentation in the form of photographs and field notes taken during the learning process to support the data obtained from observation and interviews. The data collected through observation, interviews, and documentation will be analyzed using qualitative descriptive analysis techniques (Sugiyono, 2019). This analysis aims to describe in detail how the use of computer media and educational game applications affects early childhood development. The analysis process was carried out by identifying the main themes that emerged from the data and relating them to theories of child development and digital education. Coding techniques were also used to categorize relevant information and find patterns that emerged related to child development.

Table 1. Data Collection and Sources

No.	Type of Data	Data Collection Technique	Data Source
1	Obsevational Data	Participatory observation in learning	Students and Teachers
2	Qualitative Data	In-depth interviews	Headmaster, teachers, Students and Parents
3	Documentation Data	Photo documentation and field notes	Direct observation

Source: Researcher's Processed Data (2026)

RESULT AND DISCUSSION

Result

The Use of Computers and the 'Let's Learn Letters' Application in Letter Learning

This study observed the use of the digital game application "Let's Learn Letters" at TK Plus Assalam Sidoarjo as a tool to introduce letters to early childhood. During the observation process, the researcher saw that most children showed high enthusiasm when using this application, which was combined with demonstration-based and play-based learning methods. The use of this application provided a fun learning experience for the children, which was reflected in their more active behavior during the learning sessions. A teacher at TK Plus Assalam shared her experience,

> "Children are more focused and enjoy learning with this app. Previously, they often felt bored when learning letters traditionally, but now they are more enthusiastic and quicker to recognize letters and learn how to type."

The results of observations and interviews show that students have improved in recognizing letters more quickly than before using the application. This shows that game-based learning can stimulate children's interest in learning.

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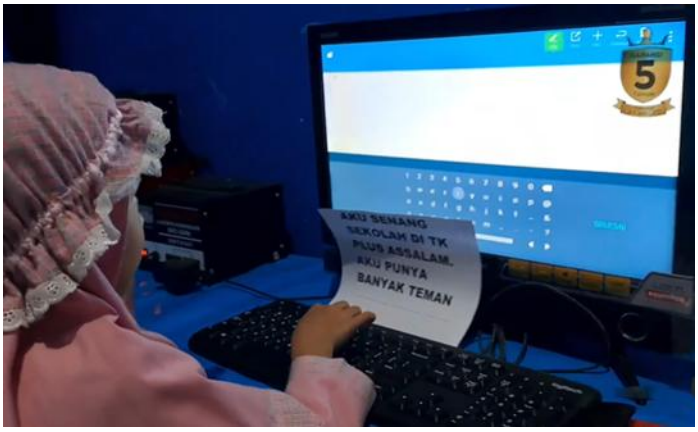

Figure 1. Students Learning Letters and Typing Using Computers
Source: Researcher's Documentation (2026).

From the observations and interviews, several important aspects found in this study include learning motivation, social engagement, and improved cognitive skills. Children's learning motivation increased with the game features in the application that provided challenges and immediate feedback. Social engagement also increased, especially when children worked together in small groups to complete the game. This played an important role in the development of their social skills. From a cognitive perspective, this application not only helps children recognize letters, but also stimulates critical thinking and problem-solving skills through the challenges presented in the games. Researchers also noted that the interactive aspects of the application greatly support learning. For example, the principal of TK Plus Assalam emphasized,

> "The interactive features in this app provide children with the opportunity to learn while playing, making it easier for them to remember and understand the material being taught."



Figure 2. Teacher and Student Interaction in Computer Learning
Source: Researcher's Documentation (2026).

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These facts were found in the context of learning at TK Plus Assalam, which has integrated technology into their educational process. The "Let's Learn Letters" application is used as part of learning activities that take place in classrooms designed to provide a fun and interactive learning experience. During the observation, the teaching and learning process carried out in this environment showed that the use of digital games greatly supported the interaction between students and learning materials. In addition, the success of this learning was also influenced by the active involvement of teachers who not only guided but also motivated children to become more involved in the learning process.

The Impact of Digital Learning on Children's Social-Emotional Development

Further findings reveal that digital learning applications not only have a positive impact on cognitive aspects but also on children's social-emotional development. Children who were initially more reserved and did not interact much with their classmates began to showed significant changes in their social skills after using this app. During play sessions, children were given the opportunity to work together to complete challenges in the game, which encouraged them to interact and share experiences with their classmates. Another teacher explained,

> "Children who were previously less active in interacting with their peers are now more open and enthusiastic about working in groups. They share tips and support each other when facing challenges in the game."

Interviews with parents also showed that children became more confident and more adaptable with their friends after engaging in this game-based learning.

The main factor linking game-based learning and social-emotional development is interactivity. The use of applications that involve challenges in the form of games with reward elements, such as points and levels achieved, encourages children to participate more actively and collaborate with their friends. This aspect not only strengthens their cognitive skills but also their social skills. The principal added,

> "We have noticed that children have become more confident and more open to interacting with their friends after they started getting used to using this app."

This interaction also increases children's metacognitive awareness, where they begin to think more critically about what they are learning and how they approach it in the game. The relationship between digital applications and improved social skills is very clear, as these applications not only provide entertainment, but also challenges that require social collaboration. The relationship between digital game elements and social-emotional development applies in the structured and controlled learning context at TK Plus Assalam. This learning process, based on interactivity and collaboration, takes place under the close supervision of teachers who constantly provide feedback and guidance. Teachers play an important role in directing students to focus not only on individual achievement, but also on the social skills necessary for collaborating with friends. The increase in social engagement seen among children is also the result of a learning environment that supports and encourages positive interactions between students.

This study also revealed that although the use of technology provides many benefits in teaching, supervision by parents and teachers remains very important. These findings emerged through interviews with parents who revealed that they set time limits on the use of digital devices at home. One of the sources, a parent of one of the students, stated,

> "I always supervise my child while they are using this app and limit their usage time. I also make sure they don't spend too much time in front of the screen."

This is in line with the opinion of the second teacher interviewee, who said that although technology provides great benefits, uncontrolled use can lead to dependence on digital devices, which can potentially have a negative impact on children's health and development. The first teacher interviewee added,

> "We always remind the children not to use the app for too long and to always balance digital activities with physical and social activities."

Strategies for Managing Technology Use in Children's Learning

Based on these findings, strategies that can be implemented include managing technology usage time and active supervision by parents and teachers. Controlled and planned use of digital games can provide maximum benefits for children's

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development, but only if proper supervision is carried out. Teachers and parents need to work together to ensure that children do not just spend time in front of screens, but also develop social, emotional, and physical skills through other activities outside of technology.

The greatest opportunity seen in the use of digital games is the creation of fun and engaging learning experiences that can increase children's motivation to learn. This strategy opens the door to the development of 21st-century skills, such as critical thinking, creativity, and collaboration. More importantly, with proper supervision, digital games can help accelerate children's literacy and numeracy development. The involvement of parents and teachers in managing time and technology use creates opportunities to support children's positive development, both at home and at school.

Table 2: Results of Social Engagement Observations

No	Student	Social Engagement Before Application Use	Social Engagement After Application Use
1	Student 1	Tends to be reserved	Begins to interact with friends more often
2	Student 2	Often plays alone	More active in play groups
3	Student 3	Does not interact much with friends	Begins to share tips in games
4	Student 4	Tends to be quiet	Inviting friends to play together
5	Student 5	Less open with friends	Becoming more social after playing together

Source: Researcher's Processed Data (2026)

Discussion

Research shows that after using the digital game application "Let's Learn Letters," children at TK Plus Assalam experienced a significant increase in literacy skills, where students could recognize letters faster than before using the application. This game-based learning application is effective in improving students' understanding of learning materials, especially in terms of letter recognition. This proves the first hypothesis of the study that digital game-based learning (DGBL) innovations can have a positive impact on children's cognitive skills, such as the ability to recognize letters and basic literacy. By increasing children's engagement through interactive elements and rewards in games, this application overcomes the obstacles in traditional learning that are often boring for children. Fun and engaging learning, as found in this study, allows children to learn with more enthusiasm, which is in line with previous research showing that digital games can stimulate high engagement in early childhood learning (Rahman et al., 2024). Therefore, this application provides great opportunities to be more widely integrated into early childhood education to effectively improve children's literacy.

Digital game innovations can improve early childhood literacy skills. Based on the findings, this hypothesis has been proven valid. The use of the "Let's Learn Letters" application in learning not only encourages children to be more interested in learning but also improves their learning outcomes in letter recognition. This fact shows that game-based learning can be a very effective tool for improving children's literacy skills. The use of technology in the classroom provides opportunities for children to learn more interactively and reduces the boredom that usually occurs in conventional learning methods. Thus, it can be concluded that digital game-based applications, with their fun and entertaining features, have great potential to be further implemented in early childhood education curricula, particularly in improving basic skills such as literacy and numeracy.

Research also reveals that the use of digital applications not only impacts children's cognitive skills but also their social skills. Children who were previously introverted began to show significant improvements in social engagement after using these applications. The use of technology in learning not only supports children's cognitive development but also has a positive impact on their social- emotional aspects. Learning based on interaction and collaboration in digital games leads to an increase in children's social skills, which are important for their development in interacting with their peers.

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This increase in social engagement is important because social skills at an early age can influence a child's ability to cooperate, communicate, and resolve conflicts in the future. Positive social interactions that occur when children work together in groups to complete challenges in games prove that technology, when used correctly, can improve social relationships between students (Wang et al., 2023). Therefore, these findings support the importance of incorporating collaborative elements into the design of game-based educational applications to support children's social development.
Learning-based digital games can improve children's social and emotional skills. The findings support this hypothesis, as increased social engagement among children involved in game-based learning shows that these applications can stimulate more active and healthy social interactions. Game- based learning provides space for children to collaborate, share information, and help their friends complete tasks, all of which contribute to the development of their social skills. This shows that the use of technology in education not only affects cognitive abilities but can also support children's emotional and social development.

Research findings show that although there are many benefits to using digital games in learning, supervision by parents and teachers remains an important factor. Uncontrolled use of digital devices can have negative effects, such as dependence on technology. So, what? This means that even though technology can offer many benefits in education, it is important to always maintain balance in its use. Good supervision from parents and teachers not only ensures that children use technology reasonably, but also helps them avoid potential negative impacts such as addiction and health problems due to prolonged use of digital devices. With strict supervision, the benefits of using technology in learning can be maximized, while the negative impacts can be minimized. Therefore, strategies that involve the involvement of parents and teachers in regulating the time and manner of using digital devices are very important to support the positive development of children.
This study states that the involvement of parents and teachers in supervising technology use can mitigate negative impacts, such as dependence on devices. The facts found in this study reinforce this hypothesis. The findings show that with proper supervision, the use of digital-based game applications can provide great benefits for children's development, both cognitively and socially, without causing negative impacts. Therefore, the involvement of parents and teachers in regulating the use of technology is key to ensuring that children can utilize technology in a healthy and productive manner.

CONCLUSION

The most important result of this study is a deeper understanding of the positive impact of learning-based digital games (DGBL) on early childhood development, particularly in terms of literacy, numeracy, and social and emotional skills. This study shows that well-designed digital games, such as the "Let's Learn Letters" application, can increase children's engagement in learning, encourage them to be more active and quicker in recognizing letters, and improve their social skills. Without this study, it would not have been clear how interactivity in digital games can strengthen children's learning experiences and help their development in various aspects.

The theories and concepts used in this study, including game-based learning (GBL) and theories of children's cognitive and social-emotional development integrated with game-based learning, proved effective in addressing the issues raised. Using a qualitative approach and case study methods, this study successfully explored how digital games can improve children's cognitive, social, and emotional skills. The participatory observation, in-depth interviews, and documentation methods used to collect data have provided comprehensive insights into the influence of digital games on early childhood, which may not have been fully understood before.

One of the limitations of this study is the small sample size, which only involved one school, namely TK Plus Assalam Sidoarjo, so the findings may not be fully generalizable to a wider population. In addition, although this study identified positive impacts, it did not explore in depth the long-term effects of digital games on child development, especially in the context of children's ability to distinguish between fantasy and reality. For further research, it is recommended to expand the research sample to various early childhood education institutions and conduct longitudinal studies to further understand the long-term effects of technology use in children's learning. Further research could also explore the role of parents and teachers in ensuring a balance in technology use, to prevent dependence that could affect children's social development and health.

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