https://nawalaeducation.com/index.php/JOG/index
Volume 1 Number 3, November 2024
e-ISSN :3047-6259
DOI : https://doi.org/10.62872/yskex167

Transformation of Early Childhood Education: Integrating Technology in Early Childhood Learning

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ARTICLE INFO

Accepted :October 20, 2024
Revised : October 01, 2024
Approved :November 19, 2024
Published :November 27, 2024

Keywords:
Technology, Early Childhood Education, Learning, Transformation.

ABSTRACT

This study aims to identify, analyze, and summarize the findings of various previous studies on the use of technology in early childhood education (ECE) through the Systematic Literature Review (SLR) method. This method was chosen because it provides a comprehensive understanding by reviewing various relevant articles, journals, and research reports. The SLR process begins with the identification of inclusion and exclusion criteria, which are used to select the studies analyzed. Data were collected from various sources such as academic journals, conference articles, and research reports in the last five years. The main focus of this study is to evaluate the effectiveness of technology in supporting early childhood learning, as well as the challenges and opportunities faced by educators in integrating technology into the ECE curriculum. The results of the study indicate that technology has great potential to transform ECE education, increasing children's engagement, creativity, and learning abilities. However, the success of technology integration is highly dependent on the readiness of educators to utilize technology effectively and adequate access to technological devices. Therefore, educator training and the provision of appropriate infrastructure are essential to maximize the benefits of technology. Further research is needed to explore the best strategies for integrating technology into the ECE curriculum and to identify policies that can support the widespread implementation of technology in the ECE sector.

INTRODUCTION

Early childhood education (PAUD) plays a very important role in building children's character and cognitive abilities. At an early age, children are in a very rapid development phase, both physically, emotionally, socially, and intellectually. Therefore, the learning process at this age must be designed in such a way as to stimulate children's interest in learning and support their holistic development. An interesting and relevant

approach is essential in PAUD learning (Nofianti, R. 2021). Children tend to be more interested and motivated to learn when learning materials are presented in a fun way and according to their interests and needs. For example, the use of educational games, stories, songs, and other creative activities can help children learn in a more fun and meaningful way. In addition, learning that is relevant to children's daily lives is also very important. When children can see the connection between what they learn in class and the real experiences and situations they face every day, they will be more motivated to learn. For example, teaching basic mathematical concepts through everyday activities such as shopping or cooking can help children understand and apply their knowledge better (Kamila, I., & Wathon, A. 2021).

Overall, engaging and relevant early childhood education can help children develop good character, social skills, and strong cognitive abilities, which will be a solid foundation for their future development (Annas, et al. 2024). In the digital era like today, technology is present as a tool that has great potential to support more interesting, interactive, and innovative learning. The use of technology in early childhood education (PAUD) can provide various significant benefits. For example, educational applications and interactive games can help children learn in a fun and interesting way. These applications are often designed with features that can stimulate children's interest in learning, such as animation, sound, and challenges that are appropriate to their level of development. In addition, technology also allows access to a wider range of learning resources. Children can explore various topics and learning materials through educational videos, e-books, and other online resources. This not only enriches their learning experience but also helps them develop digital literacy skills that are important in this modern era (Pratiwi, L. 2021).

Technology can also support more personalized and adaptive learning. By using intelligent software, teachers can monitor each child's learning progress and adjust learning materials according to their individual needs and abilities. This allows for a more personalized approach to education, where each child can learn at the pace and in the way that best suits them (Depita, T. 2024). However, it is important to remember that the use of technology in early childhood education must be done wisely and in a balanced way. Too much screen exposure can have a negative impact on a child's physical and social development. Therefore, technology should be used as a supporting tool that complements traditional learning methods, not replaces them. Overall, technology has great potential to support more engaging, interactive, and innovative learning in early childhood education (Pebriani, M., & Darmiyanti, A. 2024). With the right approach, technology can help children develop cognitive, social, and emotional skills that are important for their future. However, the application of technology in PAUD is not only limited to providing hardware and software, but also requires changes in the mindset, teaching methodology, and skills of teachers. The use of technology in PAUD can include a variety of tools, from learning applications, educational games, to digital platforms that enable interaction between teachers and students.(Hapudin, HMS 2021).

On the other hand, the transformation of early childhood education through technology integration also poses its own challenges. One of them is the readiness of educators to utilize technology effectively and efficiently. Educators' knowledge and skills regarding the use of digital tools and educational technology must be updated along with the development of the technology itself. In addition, access to adequate technological devices is also a determining factor in the success of technology integration in early childhood education. In some areas, especially those with limited resources, the

implementation of technology in learning may experience obstacles, both in terms of infrastructure and teacher training (Wang, 2023).

Various previous studies have shown that the use of technology in PAUD can increase children's interest and motivation to learn. Technology used in the context of early childhood education is not only entertaining, but can also provide a deep and meaningful learning experience. Digital-based learning opens up new opportunities to improve educational accessibility, student engagement, and diversify learning methods. By using digital media, students can more easily access relevant information and learning materials, thereby increasing their interest and motivation to learn.(Lutfi, L. 2023).

For example, game-based learning applications can help children understand basic concepts of mathematics, reading, and writing in a fun way. Technology also allows teachers to provide learning materials that are tailored to the abilities of each child, considering that each child has a different learning speed. Although the potential of technology in early childhood education is enormous, the challenges in its implementation cannot be ignored (Ismawati, D., & Puspita, Y. 2024). One of the major challenges faced is the lack of training for educators to use technology effectively. Many educators in PAUD are not yet familiar with technological devices, so they find it difficult to integrate technology into their learning activities. In addition, there is also concern that excessive use of technology can have a negative impact on children's social and emotional development, because children tend to spend more time in front of the screen than interacting directly with peers and teachers (Fadhilah, R. 2024).

As technology advances, there are various devices and applications that are specifically designed to support early childhood learning. These applications are designed to develop various skills, such as fine motor skills, language skills, and children's cognitive skills. One example that is widely used is an application that teaches children about letters and numbers through interactive and fun games. By using this technology, children can learn in a more interesting way without feeling burdened by the monotonous learning process (Ovita, E. 2023).However, it is important to remember that the use of technology in early childhood education must be done wisely and in balance. Too much screen exposure can have a negative impact on children's physical and social development. Therefore, technology should be used as a supporting tool that complements traditional learning methods, not replaces them. Overall, technology has great potential to support more engaging, interactive, and innovative learning in early childhood education. With the right approach, technology can help children develop cognitive, social, and emotional skills that are important for their future (Yulianah, Y., & Rozi, MM 2023).

In addition to applications, hardware such as tablets and computers also provide great opportunities to improve the quality of education in PAUD. By using these devices, teachers can utilize various digital resources, such as educational videos, interactive learning materials, and exercises that can be accessed by children. This not only makes learning more interesting, but also broadens children's insights into the outside world that they may have difficulty accessing in their surroundings. In addition, technology also provides ease in accessing various information that can be used to develop PAUD curricula. (Bintang, et al. 2024). Along with the many studies that discuss the use of technology in education, it is important to understand how technology can be applied in the PAUD context effectively. This study aims to provide a clearer picture of the transformation of PAUD education through technology integration, as well as to identify the benefits and challenges that may arise in its implementation. By understanding how

technology can be utilized in early childhood education, we can ensure that technology is used to support children's development, not hinder it.

METHODOLOGY

This study uses the Systematic Literature Review (SLR) method to identify, analyze, and summarize findings from various previous studies on the use of technology in early childhood education (PAUD) (Melati, et al. 2024). The SLR method was chosen because it allows for a comprehensive understanding of the topic by examining various relevant articles, journals, and research reports. The SLR process begins with the identification of inclusion and exclusion criteria, which are then used to select studies to be analyzed. In this study, data were collected from various sources including academic journals, conference articles, and research reports published in the last five years. The main focus of the analysis is to evaluate the effectiveness of technology in supporting early childhood learning, as well as the challenges and opportunities faced by educators in integrating technology into the PAUD curriculum. After data collection, the next stage is the synthesis of the findings, which are then interpreted to draw relevant conclusions.

The analysis process in this SLR is carried out systematically using software tools to organize data and map the main findings from various studies. The results of this study are expected to provide deeper insights into how technology can be applied in early childhood education, as well as provide practical recommendations for educators and policy makers to optimize the use of technology in the context of PAUD.

RESULTS AND DISCUSSION

Increased Interest and Motivation for Learning

The use of technology in early childhood learning has been shown to increase children's interest and motivation to learn. Educational applications and interactive games make learning more interesting and fun for children. Educational applications are designed to teach children various skills and concepts in a fun and interactive way. For example, applications that teach letters, numbers, colors, and shapes use interesting animations, sounds, and games (Juannita, E., & Mahyuddin, N. 2022). Children can learn while playing, which makes the learning process more fun and less boring. Interactive games allow children to actively participate in the learning process. For example, games that involve solving puzzles, memory, and logic can help children develop critical and analytical thinking skills. These games are also often designed with gradually increasing levels of difficulty, so that children can continue to challenge themselves and develop their skills (Muniroh, L., & Wathon, A. 2019).

Technology makes learning more interesting and relevant for children. When children feel interested and engaged in the learning process, they tend to be more motivated to learn. Educational apps and interactive games provide fun and meaningful learning experiences, which can increase children's interest and motivation to learn. Technology also allows children to access a wider range of learning resources. For example, educational videos, e-books, and other online resources can enrich children's learning experiences and help them develop digital literacy skills that are important in this modern era (Ayun, Q., & Wathon, A. 2021).

Overall, the use of technology in early childhood learning has many significant benefits. With the right approach, technology can help children develop cognitive, social, and emotional skills that are essential for their future. The results of the study show that the integration of technology in early childhood education has a significant

impact on children's cognitive and social development. Various technology-based learning applications can improve children's ability to recognize letters, numbers, and other basic concepts. Technology also provides opportunities for children to learn independently and exploratively, which supports the development of critical and creative thinking skills. The use of technology in PAUD provides a more interactive and enjoyable experience, which in turn increases children's learning motivation (Setiadi, et al. 2024).

Cognitive Skills Development

Technology helps in the development of children's cognitive skills, such as critical thinking, problem solving, and logic. Apps specifically designed for young children can help them develop these skills through fun and challenging activities. Educational apps are often designed to encourage children to think critically (Mumtaziah, HQ, & Majid, NWA 2023). For example, games that involve puzzles or logic challenges require children to analyze situations, consider various possibilities, and make informed decisions. These activities help children develop their critical thinking skills in a fun way. Many educational apps are designed to help children develop problem-solving skills. For example, games that involve certain scenarios where children must find solutions to given problems. These activities teach children to think creatively and logically in finding solutions, as well as developing their problem-solving skills. Apps that focus on developing logic skills often include games that involve grouping objects, counting, or sequencing (Rahayu, E. 2023). For example, games that ask children to group objects by color or shape, or to order numbers from smallest to largest. These activities help children develop their logic skills in a fun and challenging way. By using these applications, children can learn and develop their cognitive skills through fun and interactive activities. Technology not only makes learning more interesting but also helps children develop various skills that are important for their development. However, it is important to remember that the use of technology must be balanced with physical activity and social interaction to ensure holistic development for children (Rahmawanti, A. 2023).

However, while technology can provide significant benefits in early childhood education, the main challenge faced is the gap in access and digital skills among educators. Many educators are not yet skilled in using technology in the learning process, thus limiting the potential of technology in improving the quality of early childhood education. Therefore, ongoing training for early childhood teachers is essential to ensure that they have the skills needed to use technology effectively.

In addition, this study also found that although technology can enrich the learning experience, unwise use of technology can cause children to spend too much time in front of the screen, which can have a negative impact on their social and emotional development. Therefore, it is important to maintain a balance between the use of technology and direct social interaction between children and educators (Sari, F., & Riansi, ES 2024)

Fine Motor Skills

Using apps that involve activities such as drawing, coloring, and games that require hand-eye coordination helps children develop their fine motor skills. Fine motor skills are the ability to control the movement of small muscles, especially in the hands and fingers, which are important for tasks such as writing, buttoning clothes, and using cutlery (Wulansari, M., & Wathon, A. 2020). Apps that teach children to draw and color often involve activities that require hand-eye coordination. For example, children may be

asked to trace lines or fill in a picture with a specific color. These activities help children develop better control over their hand and finger movements, as well as improve hand-eye coordination (Falera, A. 2024). Many educational apps are designed to engage children in games that require hand-eye coordination. For example, games that ask children to catch moving objects on the screen or put together puzzle pieces. These activities help children develop their fine motor skills in a fun and challenging way. Good fine motor skills are essential for a variety of everyday activities. Children who have good fine motor skills will find it easier to learn to write, draw, and do other tasks that require precision and coordination. In addition, fine motor skills are also important for children's cognitive and social development, as they help them become more independent and confident in doing various activities. By using these applications, children can learn and develop their fine motor skills through fun and interactive activities. Technology not only makes learning more interesting, but also helps children develop various skills that are important for their development. However, it is important to remember that the use of technology must be balanced with physical activity and social interaction to ensure holistic development for children (Sudarso, 2024).

Language Ability

Apps that focus on developing language skills help children increase their vocabulary, understand sentence structure, and improve their speaking and listening skills. These apps are often designed with a variety of word games, interactive stories, and pronunciation exercises that introduce children to new words (Suraya, S., & Siagian, FM 2024). For example, an app may have a feature where children must match a picture to the correct word or fill in the missing word in a sentence. These activities help children expand their vocabulary in a fun and interactive way. Educational apps also help children understand sentence structure by providing exercises that involve putting words together to form correct sentences. For example, children may be asked to put jumbled words together to form meaningful sentences or complete sentences with the correct word. These activities help children understand how words work together to form correct and meaningful sentences. Many apps provide a feature to record and play back the child's voice, so that they can hear and improve their own pronunciation. In addition, these apps often include interactive stories and dialogues that encourage children to speak and listen carefully. For example, an app may have a character that speaks and asks children to respond or follow instructions. These activities help children develop their speaking and listening skills in a fun and interactive way. By using these apps, children can learn and develop their language skills through fun and interactive activities. Technology not only makes learning more interesting, but it also helps children develop various skills that are important for their development. However, it is important to remember that the use of technology must be balanced with physical activity and social interaction to ensure holistic development for children (Rubminto, AB 2024).

Educator Readiness

One of the main challenges in integrating technology into early childhood education is the readiness of educators. Teachers need to have adequate knowledge and skills to utilize technology effectively and efficiently. Ongoing training and professional development are essential to ensure that educators can utilize technology in the most effective way. Teachers must be ready to adopt technology in the learning process. This means that they must understand how technology devices and applications work, and how

to integrate them into their curriculum and teaching methods. Without adequate knowledge and skills, teachers may find it difficult to utilize technology effectively (Dini, JPAU 2022). Ongoing training and professional development are essential to ensure that teachers are always up-to-date with the latest technological developments. This training can cover a variety of aspects, from the use of hardware and software, to effective teaching strategies using technology. With the right training, teachers can feel more confident and competent in using technology to support learning. To utilize technology effectively and efficiently, teachers need to understand how technology can be used to achieve learning goals. This includes selecting applications and devices that are appropriate to students' needs, as well as designing learning activities that utilize technology in the most effective way. Teachers also need to manage time and resources well, so that technology can be used as a tool that supports, rather than interferes with, the learning process. Overall, educator readiness is a key factor in the success of technology integration in early childhood education. With adequate knowledge and skills, as well as ongoing training and professional development, teachers can use technology in the most effective way to support children's learning and development.

Access to Technology Devices

Access to adequate technological devices is also a determining factor in the success of technology integration in early childhood education. In some areas, especially those with limited resources, the implementation of technology in learning may experience obstacles, both in terms of infrastructure and teacher training. Adequate infrastructure is essential to support the use of technology in education. This includes the availability of hardware such as computers, tablets, and a stable internet connection. In areas with limited resources, it is often difficult to provide adequate technological devices. These limitations can hinder the ability of teachers and students to use technology effectively in the learning process (Pasaribu, RF, & Salmiah, AI 2024). In addition to infrastructure, teacher training is also an important factor in the success of technology integration. Teachers need to have adequate knowledge and skills to use technology in learning. In areas with limited resources, teacher training may not always be available or affordable. Without adequate training, teachers may find it difficult to use technology in an effective and efficient manner. The digital divide between areas with good access to technology and areas with limited resources can exacerbate inequality in education. Children in less developed areas may not benefit equally from technology in their learning compared to children in more developed areas. Therefore, it is important to address this gap by providing more equitable access to technology tools and teacher training. Overall, access to adequate technology tools and ongoing teacher training are key factors in the successful integration of technology in ECE education. By addressing these barriers, we can ensure that all children have an equal opportunity to benefit from technology in their learning (Wahyuni, 2024).

Wise Use of Technology

It is important to remember that the use of technology in early childhood education must be done wisely and in balance. Too much screen exposure can have a negative impact on a child's physical and social development. Therefore, technology should be used as a supporting tool that complements traditional learning methods, not replaces them. The use of technology must be regulated in such a way that it does not interfere with children's physical activities and social interactions. Children need time to play

outside, interact with peers, and do physical activities that are important for their development. Too much time in front of the screen can reduce children's opportunities to engage in these activities. Too much screen exposure can have a negative impact on a child's physical and social development (Sembiring, 2024). For example, children who spend too much time in front of the screen may experience health problems such as impaired vision, obesity, and sleep disorders. In addition, lack of social interaction can affect the development of children's social and emotional skills. Technology should be used as a supporting tool that complements traditional learning methods, not replaces them. For example, technology can be used to enrich a child's learning experience by providing additional learning resources, such as educational videos and interactive applications. However, traditional learning methods such as reading books, role-playing, and physical activity are still important and should remain part of a child's learning routine. With a wise and balanced approach, technology can provide great benefits in early childhood education without sacrificing other important aspects of child development. It is important for parents and educators to manage the time spent using technology and ensure that children continue to receive a holistic and balanced learning experience (Miyazaki, 2024).

Other research findings show that the use of technology in PAUD can also increase parental involvement in children's education. Digital applications and platforms designed for PAUD often include features that allow parents to monitor their children's learning progress in real time, which encourages their participation in the educational process. This shows that technology is not only beneficial for children and teachers, but can also strengthen the relationship between schools and families. In this context, PAUD curricula must be designed with consideration for the wise use of technology and in accordance with the child's developmental stage. Technology should be used as a tool, not as a substitute for direct interaction between teachers and children. A balanced approach will ensure that technology can provide maximum benefits in supporting the teaching and learning process.

CONCLUSION

Based on the results of this study, it can be concluded that technology has great potential to transform early childhood education by increasing children's engagement, creativity, and learning abilities. However, the success of technology integration in PAUD is highly dependent on the readiness of educators to utilize technology effectively and on adequate access to technological devices. Therefore, educator training and the provision of appropriate infrastructure are essential to maximize the benefits of technology in early childhood education. Moving forward, further research is needed to explore more deeply the best strategies for integrating technology into the PAUD curriculum, as well as to identify policies that can support the widespread implementation of technology in the early childhood education sector.

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