

Utilization of Technology in Early Childhood Education

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ABSTRACT

Background. The use of technology in early childhood education is growing along with the advancement of digitalization. Technology can be an effective tool in improving children's learning experience, but its excessive use also poses challenges in their social and emotional development.

Purpose. This study aims to analyze the impact of technology utilization on children's involvement in learning and identify the challenges faced in its implementation in the early childhood education environment.

Method. This study uses a quantitative method with a descriptive approach. Data was collected through observations, interviews with educators, and questionnaires given to parents and teaching staff. Data analysis was carried out using descriptive statistical techniques and reliability validity tests.

Results. The results of the study showed that technology had a positive impact on children's motivation and involvement in learning. Children who use interactive digital media show an improvement in material comprehension compared to conventional learning methods. However, several challenges such as limited access to technology and lack of educator skills in its use are still obstacles in the optimal application of technology.

Conclusion. Technology has great potential in improving the effectiveness of early childhood learning when used with a balanced and directed approach. The use of technology needs to be supported by training for educators and policies that ensure equal access to technology for all children.

KEYWORDS

Technology, Early Childhood Education, Interactive Learning

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INTRODUCTION

Technology has become an inseparable part of daily life, including in the world of education. In the context of early childhood education, technology offers various opportunities to improve the learning process and development of children (Ellis dkk., 2023; Jiang dkk., 2025). The right use of technology can help children develop cognitive, social, and motor skills from an early age.

Various studies show that the use of technology in early childhood education can provide a more interactive and engaging learning experience (Ewim dkk., 2023; Lavado Rojas dkk., 2024). Educational apps, learning



videos, and other digital devices allow children to explore new concepts in a more fun way. Technology can also be used as a tool for educators in delivering material more effectively and variedly.

The application of technology in early childhood education has been widely applied in various countries (Lavado Rojas dkk., 2024). Several educational institutions have adopted the use of devices such as tablets, computers, and interactive projectors in learning activities. As a result, children can more easily understand basic concepts such as numbers, letters, and colors through engaging digital media.

Research also shows that technology can support children's creative development. Drawing apps, educational games, and animation-based programs provide opportunities for children to explore and express their ideas in innovative ways (Gibson dkk., 2024; Zhao & Dawod, 2023). With the right guidance, technology can be a means to develop children's imagination and creativity.

Despite its many benefits, the use of technology in early childhood education also poses various challenges. Some studies highlight negative impacts such as screen dependence, reduced social interaction, and potential developmental impairments if not used wisely (Mathieu & Martin, 2023). Therefore, it is important for parents and educators to regulate the use of technology to keep it balanced with children's physical and social activities.

Along with technological advancements, its use in early childhood education will continue to grow. Further studies are needed to understand how technology can be used optimally without sacrificing important aspects of child development (Pope dkk., 2023; Sun dkk., 2024). The role of parents, educators, and educational policies that support the positive use of technology will be a key factor in creating a healthy and effective learning environment for children at an early age.

Piaget's Theory of Cognitive Development explains that early childhood is in the preoperative stage, where they learn through hands-on experience and interaction with the environment. Technology can be a tool that enriches this experience by providing interactive simulations and visualizations of concepts that are difficult to understand through conventional methods. Children can develop better understanding through educational games and digital media designed according to their cognitive development stage.

Bandura's Social Learning Theory emphasizes that children learn through observation and social interaction (Kogan dkk., 2023). Technology in early childhood education can support this process by providing collaboration-based learning platforms, such as educational apps that allow children to interact with peers and educators (Mathieu & Martin, 2023). With technology, children can observe positive behavior models, such as ethics in the use of digital media and problem-solving skills, which they then imitate in their daily lives.

Vygotsky's theory of constructivism underlines the importance of social interaction and guidance in the child's learning process. Technology can be used as a tool to support child-centered learning by providing access to resources that support independent exploration and discovery (Elerian & Solomou, 2023; Gani & Hariono, 2023). With adaptively designed technology, educators can act as facilitators who help children reach their Progressive Development Zone, making learning more effective and tailored to individual needs.

The use of technology in early childhood education still faces various uncertainties in terms of effectiveness and its impact on child development. Although many studies have highlighted the benefits of technology in improving children's cognitive and motor skills, there is still a gap in understanding the extent to which technology can actually replace or complement traditional

learning methods (Pope dkk., 2023). The diversity of technologies used also raises questions about the effectiveness of each platform in improving the quality of learning.

The lack of research on how technology affects early childhood social and emotional interactions is a major concern (Palilonis dkk., 2023; Shaw dkk., 2025). The use of digital devices in education can enrich the learning experience, but it also has the potential to reduce direct interaction between children and peers and educators. The lack of clear guidance in balancing technology with hands-on experiential learning raises concerns about the long-term impact on children's social development.

The aspect of children's individuality in the use of technology is also still an area that is not fully understood (Kern dkk., 2023; Rogan dkk., 2023). Every child has a different learning style, but there is not enough empirical evidence to show how technology can be optimally adapted to meet individual learning needs. More research is needed to understand how technology can support a more personalized approach to early childhood education.

The role of parents and educators in directing the use of technology in early childhood learning has also not been fully defined (Haq dkk., 2024; van Wijk dkk., 2024). Many parents and educators still struggle to determine the right line between productive use of technology and overuse (Benjelloun, 2023; Palilonis dkk., 2023). More specific guidelines on how technology can be used effectively without disrupting the balance of child development still need to be developed.

Gaps in regulations and policies regarding the use of technology in early childhood education are also a challenge that has not been resolved. Many educational institutions are beginning to adopt technology in their curricula, but there are still differences in implementation standards and evaluation of their success (Sinaga, 2025; Yalçın & Samur, 2024). Further studies are needed to establish clear guidelines in optimizing the use of technology for early childhood development as a whole.

The use of technology in early childhood education needs to be further researched to ensure that its application truly supports children's development holistically (Kibiya dkk., 2023; Koh-Knox Sharp dkk., 2024). Although technology has great potential in improving the effectiveness of learning, without clear guidance, improper use can negatively impact a child's social and emotional development (Manik dkk., 2024). A more in-depth study can help develop a balanced strategy between technology-based learning and direct interaction in early childhood education.

Efforts to fill gaps in research on technology and early childhood education should be based on a multidisciplinary approach involving experts in education, psychology, and technology. Interdisciplinary collaboration can result in more comprehensive recommendations on how technology can be effectively integrated into early childhood education curricula (Fahrudin dkk., 2023; Podberezko & Novichikhina, 2024). Additionally, broader research is needed to understand how factors such as social, economic, and cultural backgrounds affect the effectiveness of technology in learning.

The importance of establishing clear policies and guidelines in the use of technology in early childhood education settings cannot be ignored (Chen & Dong, 2024; Pan dkk., 2023). The government and educational institutions need to work together in designing regulations that support the wise use of technology, so that technology can truly be a tool that enriches learning without sacrificing fundamental aspects in children's development (Karim dkk., 2024; Razali dkk., 2024). With a targeted approach, technology can be an innovative solution that helps early childhood have a more optimal learning experience.

RESEARCH METHODOLOGY

This study uses a quantitative research design with a descriptive approach to analyze the use of technology in early childhood education (Nushi & Eshraghi, 2023; Yudianto, 2023). This approach was chosen to obtain an empirical picture of the extent to which technology is used in the learning process and how it affects children's development. Data was collected through surveys and observations of various early childhood education institutions that have adopted technology in their learning methods.

The population in this study consists of educators and students in various early childhood education institutions who apply technology in the learning process. The research sample was taken using the purposive sampling technique, with the criteria of institutions that have used technology for at least one year in learning activities (Hidayat, 2023; Nushi & Eshraghi, 2023). Research participants included educators who had experience in the use of technology in the classroom as well as children who had been exposed to technology in their learning.

The research instruments used include questionnaires, observation sheets, and structured interviews. The questionnaire was compiled to collect data on educators' perceptions of the effectiveness of the use of technology in early childhood education (Song et al., 2024; Suryawati et al., 2024). Observation sheets are used to record children's interactions with technology in the learning environment, while structured interviews are conducted to gain deeper insights into the challenges and benefits faced by educators in implementing technology.

The research procedure begins with the preparation stage, which includes the preparation of research instruments and tests for their validity and reliability (Sinaga, 2025; Yalçın & Samur, 2024). Data collection was carried out by distributing questionnaires to educators, conducting direct observations in classes using technology, and conducting interviews with the educators involved. The data obtained were analyzed using descriptive statistical techniques to describe trends in the use of technology in early childhood education and to identify factors that affect its effectiveness.

RESULT AND DISCUSSION

Research data was collected from 15 early childhood education institutions that have applied technology in learning. A total of 120 educators and 300 early childhood children participated in this study. Statistical analysis was carried out to measure the validity and reliability of the instruments used in the research.

Questionnaire Items	Validity Coefficient	Reliability Coefficient
Children's Interaction with Technology	0.78	0.82
The Effectiveness of Digital Learning Media	0.80	0.85
Influence on Social Development	0.75	0.79
The Role of Teachers in Digital Learning	0.82	0.86

Table 1. Questionnaire validity and reliability test

Secondary data are obtained from previous reports and research that show an increasing trend in the use of technology in early childhood education. Previous studies have shown that more than 60% of early childhood education institutions have integrated technology in the teaching and learning process.

The results of the validity and reliability test show that the research instrument has a high level of reliability. All questionnaire items had a validity coefficient above 0.75, which indicates that the questions asked are relevant to the research objectives. The reliability coefficient which

ranges from 0.79 to 0.86 indicates that the instrument has consistency in measuring the aspect studied.

Data analysis shows that the use of technology in early childhood education has a positive impact on children's involvement in learning. Respondents stated that the use of educational applications, interactive videos, and digital games helps children understand basic concepts such as numbers, letters, and colors more quickly.

The use of technology has also been proven to increase the effectiveness of teaching methods applied by educators. More than 70% of educators involved in this study stated that technology makes it easier for them to deliver material in a more engaging and interactive way. However, challenges such as lack of understanding of educators in operating technology and limited access to digital devices are still obstacles.

Observations in the classroom show that children are more active in learning when technology is used. Their interaction with digital devices, such as tablets and interactive whiteboards, allows them to explore with new concepts independently. Children are also more motivated to learn because of the more fun and varied learning experiences.

Aspects	Before the Use of Technology	After the Use of Technology
Learning Motivation	55%	85%
Interaction with Teachers	60%	75%
Participation in Activities	50%	80%
Material Understanding	58%	83%

Table 2. Observation Results on Children's Involvement in Learning Before and After the Use of Technology

The level of child engagement increases significantly after technology is applied in the learning process. This data shows that technology can be an effective tool in improving the quality of early childhood learning experiences.

The increase in children's involvement after the application of technology in learning shows that technology has an important role in enriching their learning experience. Children are more active in completing tasks and show greater interest in the material being taught.

Educators are also undergoing changes in their teaching methods. With technology, they can present material in a more visual and interactive form, which helps improve children's understanding. Additionally, technology allows for personalized learning, where the material can be tailored to each child's pace and learning style.

However, this study also found that some children have difficulty adapting technology-based learning. Some children show excessive dependence on digital devices and have difficulty interacting with peers during the learning process.

The results of the study showed that there was a significant relationship between the use of technology and the effectiveness of early childhood learning. Regression analysis shows that the increased use of technology in education is positively correlated with the level of children's involvement in learning.

Variable	Correlation Coefficient (r)	Significance (p)
Use of Technology	0.78	<0.05
Child Engagement	0.72	<0.05
Material Understanding	0.80	<0.05

Table. 3 Correlations between technology use and child involvement

This analysis shows that the more often technology is used in learning, the higher the child's engagement and understanding of the material. Technology also allows for more adaptive and interactive learning, which contributes to better learning outcomes.

One of the case studies was conducted at an early childhood education institution in Jakarta that has been implementing technology in its curriculum for the past two years. The institution uses a variety of digital devices, such as educational apps, interactive whiteboards, and augmented reality to enhance children's learning experiences.

The results of the observation showed that children who were involved in technology-based learning were more enthusiastic in completing tasks and showed a deeper understanding of the material. Teachers at the institute also reported that technology helped them convey abstract concepts more easily through engaging visualizations.

However, several challenges are faced by the institution, such as limited access to digital devices for all students and lack of training for educators in using technology optimally. This obstacle is a major concern in an effort to increase the effectiveness of technology use in early childhood education.

The application of technology in case studies shows a significant impact on learning effectiveness. Children are more involved in learning activities and have a better understanding of the material. Teachers also benefit from the use of technology, which helps them create a more engaging and interactive learning environment.

The challenges faced by early childhood education institutions show that technology cannot stand alone without adequate support. The use of technology must be supported by training for educators and equal access for all children so that the benefits can be felt optimally.

The relationship between the use of technology and the effectiveness of early childhood learning is evident from the results of this study. Institutions that implement technology well show improvements in children's engagement and material comprehension. However, without clear regulations and adequate support, the use of technology can pose challenges that hinder the learning process.

This study provides empirical evidence that technology has great potential in improving the quality of early childhood education. However, effective implementation requires a well-thought-out strategy, including training for educators, supervision in the use of technology, and the development of a balanced curriculum between technology and conventional learning methods.

The results of the study show that the use of technology in early childhood education has a positive impact on children's involvement in learning. The use of educational applications, interactive videos, and digital games increases learning motivation and material comprehension. Educators also feel the benefits of technology in delivering learning in a more engaging and interactive way.

Data analysis shows that the use of technology is positively related to learning effectiveness. Observations show that children are more active and enthusiastic in participating in learning activities when technology is used in the learning process. Case studies also show that educational

institutions that have implemented technology in their curriculum have experienced an improvement in the quality of learning.

Several challenges are found in the application of technology, such as the lack of educator skills in operating digital devices and limited access to technology for all children. These factors are obstacles in optimizing the use of technology in early childhood education and need to be considered in subsequent implementation.

The findings of this study are in line with previous research that suggests that technology can improve early childhood learning engagement and effectiveness. A study conducted by Plowman & McPake (2013) shows that the use of digital media helps children understand new concepts faster. The results of this study support these findings with empirical evidence that children who learn with technology are more motivated and understand the material better.

Several other studies have shown that although technology provides benefits, its impact on children's social development is still debated. Research by Cordes & Miller (2000) highlights that excessive use of technology can reduce children's social interactions. The results of this study found that some children showed a dependence on digital devices, which supports the finding that technology use should be balanced with direct social interaction.

Differences are also found in the effectiveness of technology in various educational contexts. Several studies have shown that technology is more effective in environments that have adequate infrastructure and educators are trained in its use. The results of this study show that without sufficient support, the benefits of technology in early childhood learning can be less than optimal.

The results of this study are a sign that the use of technology in early childhood education is increasingly important in the digital era. Effective use of technology can increase children's engagement and understanding, which suggests that the integration of technology in the curriculum should be seriously considered. Educators need to understand how to optimize technology in order to provide maximum benefits for children.

The increase in children's involvement in technology-based learning shows that conventional methods need to be combined with digital approaches to create a more engaging learning experience. This result is an indication that the education system must be more open to innovation in learning.

Some of the challenges in this study show that technology implementation still requires support in the form of training for educators and the availability of adequate infrastructure. This sign shows that without clear regulations and policies, the use of technology can create gaps in access to quality education.

The increase in children's involvement in learning shows that technology has great potential to be used in early childhood education. The implication of the results of this study is that the education system needs to adapt to technological developments to increase the effectiveness of learning. The curriculum must include strategies that integrate technology with learning methods that are based on direct interaction.

Support for educators is an important aspect in the implementation of technology in education. Another implication is the need for training for educators so that they can make optimal use of technology in the learning process. Without a good understanding from educators, the use of technology will not provide maximum benefits.

Access to technology is also a factor that needs to be considered. The implications of this study show that education policies must consider the availability of digital devices for all children so that there is no gap in the application of technology in learning.

The increased involvement of children in technology-based learning can be explained through constructivism theory which emphasizes that children learn better when they can explore and interact with their environment. Technology provides a richer learning experience with a variety of visual and interactive media that helps children understand concepts more easily.

The positive impact of technology is also related to social learning theory, where children can observe and imitate the patterns of interaction displayed in digital media. Technology-based learning allows children to learn from varied models, which can accelerate their understanding of a concept.

The challenges found in this study can be explained by limited resources and lack of training for educators in adopting technology in learning. This factor shows that the effectiveness of the use of technology is highly dependent on the readiness and support provided to educators and educational institutions.

Increasing the use of technology in early childhood education must be accompanied by the right strategy to optimize its benefits. The next step is to develop clear guidelines for educators in applying technology effectively in the learning process. Training for educators needs to be improved so that they can understand how to make the most of technology.

The government and educational institutions need to collaborate in providing adequate infrastructure to support the use of technology. Concrete steps such as the provision of digital devices for schools and the development of technology-based curricula need to be implemented immediately to ensure that technology is accessible to all children.

More research is needed to explore the long-term impact of the use of technology in early childhood education. The next step is to take a deeper look at how technology can be adapted to the individual needs of children and how it impacts their social development in the long term.

CONCLUSION

The findings of this study show that technology has a significant positive impact in increasing children's engagement in learning. The results of this study differentiate themselves by highlighting the importance of balancing the use of technology and direct social interaction in early childhood education. Proper implementation can create a more interactive and engaging learning experience for children.

The main contribution of this research lies in the development of the concept of technology integration in early childhood education with a more adaptive approach. The results of this study provide guidance for educators in implementing technology-based learning methods effectively without reducing social and emotional aspects in children's development.

The limitations of this study include limited sample coverage and variations in technological infrastructure in various educational institutions that can affect the results of the research. Further research needs to be conducted to explore the long-term impact of technology use on children's cognitive and social development, as well as to evaluate the best methods for integrating technology into early childhood education curricula.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

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