



## The Role of Artificial Intelligence (AI) in Improving the Quality of Education in Early Childhood Education Programs

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DOI: <https://doi.org/10.61987/ijpp.v1i1.666>

### Abstract:

The purpose of this study is to examine the role of artificial intelligence (AI) in improving the quality of early childhood education (PAUD). This study reviews relevant journals, books, and other academic sources using a qualitative approach to literature research. The findings indicate that AI can significantly enhance the quality of PAUD by facilitating access to educational content and providing personalized learning experiences. AI technologies, such as visual mentors, voice assistants, intelligent content, and personalized learning platforms, support early childhood development and can adapt to children's individual needs. AI applications like ChatGPT, Kahoot, and Animaker also contribute to interactive and adaptive learning environments, making learning more engaging and efficient. By utilizing AI, PAUD can offer more compelling content delivery, improve the stimulation of child development, and introduce children to digital tools in an age-appropriate way. This allows for a more meaningful learning experience that fosters early digital literacy and supports adaptive learning processes.

### Article History

*Received: 08 January 2025*

*Revised: 14 February 2025*

*Accepted: 21 March 2025*

### Keywords

Management, Public, Trust, Artificial Intelligence, Quality of Education

## INTRODUCTION

Early childhood Education (PAUD), according to Permendikbud number 37 of 2014, explains that early childhood education is education given to children aged 0-6 years to stimulate and maximize aspects of their development. Early childhood development includes six aspects, namely the development of religious and moral values, cognitive, language, physical motor, social-emotional, and art (Hunkenschroer & Luetge, 2022). According to Froebel, the founder of kindergarten, early childhood education involves playing while learning. According to Froebel, children are likened to flowers that are and will grow, so they must be filled with good and correct education so that their development also develops well (Nurdaningsih et al., 2023).

The learning process plays a very important role in improving the quality of education, so educators need to provide learning that can benefit students. Usefulness and meaningful learning can be built by creating a pleasant learning atmosphere and stimulating early childhood from various aspects to help children explore their potential optimally. Cascella et al. (2024) say that one learning process that can support early childhood development is utilizing sophisticated technology. In the digital era like today, technology is developing rapidly and can be accessed by anyone, including early childhood. Hobeika et al. (2024) also say that utilizing technology in education can

provide children with broader knowledge and learning experiences. In addition, with the existence of technology, learning for PAUD is increasingly easy to access, making it easier for children to obtain the information they want to find without geographical limitations. However, educators must continue to supervise its use. The use of technology in this modern era allows learning to be more interesting and more interactive in accessing various media such as images, videos, and simulations (Putri et al., 2023). So that children will find it easier to understand abstract concepts that were previously difficult to understand.

One of the technological developments that attracts attention is artificial intelligence. Artificial intelligence includes the development of machines with a certain level of intelligence and functions similar to humans, including perception, knowledge, assessment, and environmental adaptation. Artificial intelligence (AI) can be the basis or foundation for providing applications that can be used as learning media and can be utilized by educators and students to facilitate the teaching and learning process (Campbell & Cox, 2024). The use of artificial intelligence is expected to be able to improve the quality of education through various updates to the design of learning activities and innovations in education with technological developments that must be adjusted.

By utilizing technology, children need to develop digital skills from an early age so that they are prepared to face an increasingly modern life (Hofeditz et al., 2022). Children can gain a better understanding of software, applications, and digital tools that are currently widely used by humans in various fields. Artificial intelligence allows the provision of educational content that can be tailored specifically for early childhood. Improving the quality of education can be done through approaches such as the use of artificial intelligence (Yu et al., 2022). In this context, this study aims to introduce and provide insight and explore the role of artificial intelligence (AI) in improving the quality of early childhood education (PAUD). Understanding the importance of using this artificial intelligence technology can create learning according to the needs and interests of each child because every early childhood child must have different learning needs. Hence, the quality of education in PAUD also increases.

This research explores the role of artificial intelligence (AI) in improving the quality of early childhood education (PAUD). With the rapid development of technology, the application of AI in learning can create more interactive, adaptive methods that suit each child's needs. AI allows the personalization of teaching materials, provides a more enjoyable learning experience, and helps children understand abstract concepts more easily through visual media and simulations. Apart from that, the integration of AI in PAUD can optimize the role of educators in providing more effective stimulation for children's cognitive, social-emotional, and motor development. Therefore, using AI in PAUD education is a strategic step to improve the overall quality of learning.

This study provides an original contribution by offering a comprehensive analysis of how AI-driven educational strategies can be specifically tailored to meet the developmental needs of early childhood education (PAUD). Unlike previous studies that have broadly examined AI applications in education, this research focuses on the unique cognitive, socio-emotional, and motoric aspects of PAUD learners. The novelty of this study lies in its exploration of AI's role in personalized learning adaptation, where AI-based systems can dynamically adjust teaching materials and methods according to each child's learning style and progress. Moreover, this study introduces a framework for AI-enhanced interactive learning, which integrates AI-powered visual simulations, speech

recognition, and adaptive storytelling to facilitate engagement and understanding in early childhood learning. The findings of this research contribute to the academic discourse by emphasizing the ethical considerations and challenges of AI implementation in PAUD, ensuring that AI not only enhances learning outcomes but also supports child-friendly and developmentally appropriate pedagogy. Through this approach, the study extends existing knowledge of AI in education by demonstrating its transformative potential in the foundational stages of human learning.

## RESEARCH METHOD

This research uses a qualitative approach with a case study method to explore the application of artificial intelligence (AI) in education and library systems. The case study method was chosen because it provides an in-depth understanding of phenomena that occur in authentic contexts. Case study research allows researchers to observe and analyze interactions, dynamics, and factors that influence the application of technology in specific organizations or institutions, thereby producing more concrete and applicable insights. (Soesana et al., 2023).

According to Fadli (2021), a case study is a research method used to study one or more cases in a real-life context to understand the complexity, processes, and reasons behind the phenomena that occur. In this research, case studies were carried out by selecting several institutions that have implemented AI technology in their operations, both in the education and library sectors. The data collection process was carried out through several stages, namely direct observation of the institution's operational activities, in-depth interviews with various stakeholders (such as library managers, lecturers, and AI experts), as well as document analysis, which included implementation reports and evaluation results of AI implementation.

The advantage of the case study method lies in its ability to explore the social, cultural, and organizational context that influences the application of technology. Researchers collect data based on existing theoretical information and obtain relevant primary data from sources directly involved in the application of AI in the field. Through this approach, researchers can better understand technology's challenges, successes, and impact on institutional operations. Data obtained through interviews and observations will be analyzed using a thematic approach, which allows for identifying main patterns or themes that emerge from the application of AI. It is hoped that the findings from this research can make a significant contribution to the development of theory and practice in the field of information technology, especially in terms of the application of AI in the education and library sectors.

Using the case study method, this research focuses on the technical aspects of implementing AI and the social and cultural impacts (Haryono, 2023). The results of this research will provide deeper insight into how AI can be utilized effectively to improve the efficiency and accessibility of services in the education and library sectors and provide practical recommendations for other institutions interested in implementing similar technology.

## RESULT AND DISCUSSION

According to Biechler and Snowman, Early childhood is those aged between 3-6 years. They usually follow early childhood education programs that include child care, namely in the age range of 3 months-5 years, playgroups for 3 years old, while at the age

of 4-6 years, they have followed the kindergarten program. Early childhood education aims to optimize the potential in children's developmental aspects, including the development of religious and moral values, cognitive, language, social-emotional, physical motor, and art. Early Childhood Education (PAUD) is a significant investment for families and the nation. Children are a gift from God Almighty that must be protected because they are the next generation of the family and nation. If children grow and develop well, be it in the fields of education, society, or within the family itself, then the parents will also feel happy. Likewise, with this nation, this nation needs human resources that grow with good character so that they can live prosperously and peacefully. With the existence of PAUD, it is hoped that it will be able to help develop the potential of early childhood.

## Result

Children are seen as individuals who are new to the world. They learn to understand the world and its contents through the guidance of those around them. Early childhood is the right time (golden age) to instill nationalism, religion, ethics, morals, and social values that are useful for the child's future life. Thus, an educator must understand their students' unique or individual needs. PAUD is directed to facilitate each child's development in the right environment and learning guidance. By using various media, methods, and things that can help children in the education process by developing science and technology that increasingly encourages innovation in the learning process. Below is an explanation of the findings in question.

### Early Childhood Education Programs

Artificial intelligence (AI) is also called intelligence. According to the father of artificial intelligence, John McCarthy, artificial AI is a device used to understand and model the human thought process and design machines by imitating human behavior. According to the Britannica Encyclopedia, AI is the ability of a computer (digital) or robot that is controlled to be able to perform tasks related to intelligence. The Encyclopedia of Life provides an overview that AI is an area of study that is programmed in computers. So, AI can be interpreted as programming between the work of programs, software, and hardware that are designed to be able to imitate intelligence like humans.

Mr. John, an AI Technology Expert, responded, "AI is a technology designed to imitate how humans think. According to John McCarthy, AI is used to understand and model human thought processes and create machines that can imitate human behavior. AI works by combining software, programs, and hardware to achieve these functions". Sarah, one of the students, also stated, "Strong AI, or Artificial General Intelligence (AGI), is designed to think and act like humans, has consciousness, and can solve various complex problems. However, until now, AGI is still in the research stage and has not been realized in the real world. There is even a concept of super AI or Artificial Super Intelligence (ASI), which is said to be able to surpass human intelligence, but this is still just a theory."

From the interview above, we can conclude that artificial intelligence is designed to transform like humans who can think. AI can learn, provide responses or responses (reasoning) and provide self-correction. However, not only focusing on these three abilities, AI can adapt like humans. Weak AI, also called narrow AI or artificial narrow intelligence (ANI), is trained AI that focuses on performing specific tasks. This type of AI

is often found in everyday life and plays a role as a supporter of applications such as Apple Siri, Amazon Alexa, IBM Watson, and Autonomous Vehicles.

Strong AI is also called artificial general intelligence (AGI) and artificial superintelligence (ASI). Its working process resembles human intelligence; it is self-aware and can solve problems, learn, and plan. ASI, also known as superintelligence, is designed to exceed human intelligence. It has not yet existed in the real world but is already in the theoretical stage.

### Application of AI in Education

Artificial intelligence can provide feedback on the learning process and practice questions worked on by students, such as providing recommendations for material that needs to be studied again. One type of AI, namely Blackboard, is widely used in universities in Europe and America. Blackboard allows questions and assignments to be submitted for the assessment process, either in the form of quizzes or tests. In addition, this type of AI can explain students' weaknesses and misunderstandings during the learning process. Voice assistants are also called voice assistants that can be used in various fields, especially education. Voice assistants can contribute to finding learning materials such as reference questions, articles, and even books just by mentioning keywords.

By using this intelligent content, both educators and students can more easily find learning materials and digital books that have been programmed virtually. AI can also provide relevant book recommendations according to the book being searched for. This AI is almost the same as a voice assistant, relying on voice to perform its functions. The use of this translator is to be able to present a foreign language in the language we want. So that users of this AI only listen to the explanation without having to read it first. So, with the help of this AI, you can easily and quickly understand journals, articles, books, or other forms of notes that use foreign languages more easily.

**Table 1. Application of AI in education**

No	Name	Position	Argument
1	Dr. Andi Saputra	Educational Technology Lecturer	AI, like Blackboard, helps provide automatic feedback to students, speeds up the evaluation process, and helps lecturers analyze student understanding.
2	Prof. Lina Wijaya	Professor of AI & Education	AI systems in education are very beneficial, especially in providing personalized study materials and helping students understand their mistakes through automatic analysis.
3	Dr. Budi Santoso	AI Researchers in Education	Voice assistants help students quickly find academic references, especially in keyword-based searches for articles, journals, and books.
4	Dr. Siti Rahma	Lecturer in Linguistics	AI translators enable students to access more resources in foreign languages more efficiently, thereby increasing accessibility to global academic resources.
5	Prof. Rudi Hartono	EdTech Expert	AI in learning has changed how students access and understand material, providing appropriate book recommendations and assisting in understanding context through voice technology.

Table 1 shows us that global courses benefit from the ability to search for and follow online courses worldwide. The course platform can recommend interests

according to the keywords entered. Various free courses are offered with engaging, interactive, and structured content.

Assessment can now be done quickly through sophisticated AI. This feature can help educators or tutors prepare quizzes or tests easily and practically. Teachers only need to choose the type of subject, school level, number of questions, level of difficulty, and various other options. Quizzes and exercises can be shared directly online. This AI technology allows students to get services like a personal assistant. AI will collect information and data from learning activities that have been carried out by users and then provide alternatives or learning solutions that suit the user's needs. AI will inform users of their study schedules, provide content recommendations, and various other important functions. AI will learn to optimize the user's learning methods so that the learning process can be better and more effective.

Utilizing AI Animarker can be a valuable tool in early childhood learning. This online platform allows educators to create animated videos easily without special skills. Wordwall is a game application that can be used as a learning medium, learning resource, or online-based assessment tool that is certainly interesting for students. This application has many templates that can be developed in the form of games. However, the application of wordwall is still rarely used in institutions, especially at the PAUD level, because it has not been socialized and applied by educators. By using the wordwall educational game, students' interest in learning can increase.

## The Role of Artificial Intelligence in Education

In improving the quality of education, artificial intelligence has a very significant role in the learning process. Assisting with basic activities such as automated assessment processes by using AI, assessments do not have to be done in the classroom. This means that the time used is more efficient because educators will be more focused on interacting with students, preparing learning, and working on other professional development. Starting from early childhood education (PAUD) to higher education, the impact of using AI provides opportunities to implement more excellent individual learning. Starting with adaptive learning programs, educational games, and other software. AI will help provide understanding according to students' learning needs. Providing opportunities to master specific learning topics and repeat learning that has not been mastered by students

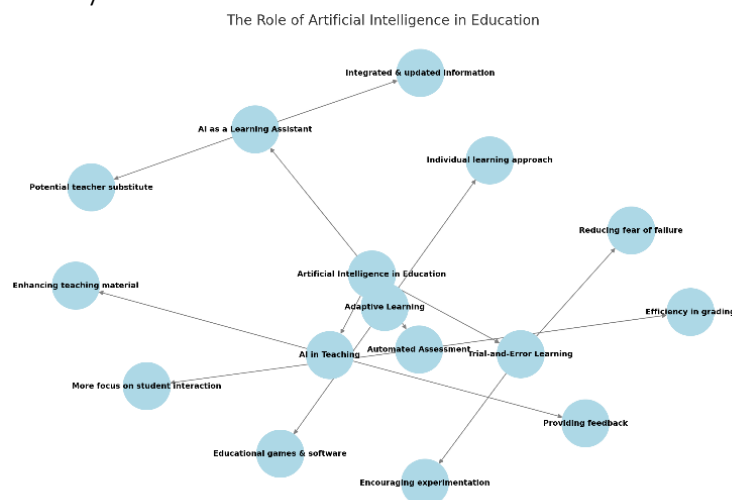


Figure 1. The role of artificial intelligence in education

From Figure 1 above, we can conclude that the role of artificial intelligence can now help students understand learning materials online with a high level of creativity. AI can provide feedback to educators and learners on the overall success of the course. In addition, AI can provide support in improving teaching that may be difficult with the learning material to be delivered. AI is an artificial intelligence that plays a significant role in creating interactions with information in personal and professional life. Educators and participants can quickly get more integrated and updated information according to their current and future needs.

### **Benefits of Implementing AI in Early Childhood Education**

AI will undoubtedly positively impact the development of the teaching and learning process in PAUD. By providing content and learning materials according to each child's needs, the quality of learning will be increasingly improved and meaningful. The application and use of AI can help the learning process of children's education. Early age (PAUD) in knowing, using, and developing children's knowledge related to digital. Use AI can create and provide an inclusive approach to the early childhood learning process.

Mr. Arif, an Early Childhood Education Expert, said, "AI has a huge positive impact in supporting the teaching and learning process in PAUD. With AI, learning can be tailored to each child's needs, making it more meaningful and effective. AI also allows children to recognize and use digital technology from an early age, which will help them face the digital era more confidently". Mrs. Rina, an experienced PAUD teacher, added, "AI allows learning to be more interactive and responsive to children's development. With technology such as augmented reality (AR) and virtual reality (VR), children can learn new concepts more interestingly and with fun. This improves their understanding of the material and helps develop their social-emotional and motor aspects through more active interactions with friends and a more dynamic learning environment."

From the interview results above, it can be seen that AI has great potential to improve the effectiveness of learning in PAUD by creating a learning environment that is more responsive to each child's individual needs. With the help of AI, learning can be personalized according to a child's developmental level and learning style, allowing them to gain a deeper understanding. Apart from that, AI can also be used to develop more innovative learning methods, such as augmented reality (AR) and virtual reality (VR) technology, to introduce new concepts more interestingly and interactively. Thus, the application of AI in early childhood education improves the quality of learning and provides a more enjoyable learning experience, supports children's cognitive, social-emotional, and motor development, and helps them face the digital era from an early age.

### **Discussion**

The field of artificial intelligence seeks to understand the intelligence that exists in humans, which is then applied in the form of automation of intelligent behavior through computer media (Artyukhov et al., 2024; Balakrishnan et al., 2022; Bukar et al., 2024) However, artificial intelligence seeks to build the existence of intelligence that is by human understanding. In artificial intelligence, computers can receive human input or commands by using their knowledge through simulation of the human reasoning process to solve problems. Although not fully gaining knowledge and experience and being able

to research like humans, computers can gain knowledge according to their needs through efforts given by human experts (Alali & Al-Barakat, 2024).

ChatGPT stands for Chat Generative Pre-Trained Transformer, which is part of artificial intelligence that aims to produce high-quality text in human language (Munawwaroh, 2024). One of the main features of chatGPT is its ability to interact through a conversational model. By receiving input in the form of questions, statements, or instructions, this model can produce appropriate responses based on its knowledge of the language (Abdullah & Java, 2024; Hidayah et al., 2024; D. F. Putri, 2024). The use of chatGPT is a learning tool that allows automatic responses and feedback to students' answers that can make it easier for them to understand the material presented by students.

Leonardo AI is a tool that combines artificial intelligence with art. By using Leonardo, educators, especially in PAUD, can easily create high-quality images so that they can increase creativity, especially in drawing activities (Heru & Bali, 2024). AI technology is software to create graphic designs such as posters, banners, infographics, presentations, and so on. By using Canva, it can make it easier for users to create attractive and professional designs. Early childhood learning can be found through TikTok. TikTok provides short videos that can support the learning process in PAUD (Faisal et al., 2024). Kahoot is a game-based learning platform that can be used to create quizzes, discussions, and surveys interactively. Kahoot is designed to create an interactive and fun learning atmosphere during the learning process.

In an educational process, the role of a teacher will never be separated. However, with the presence of new technology, it is possible to take over the work of a teacher, one of which is filling in assessments that are carried out automatically, helping students improve their learning, and even becoming a substitute for a tutor in the real world (Rico-Bautista et al., 2021). AI also functions as a place for students to ask questions and seek information that has the potential to replace the potential of a teacher in delivering learning materials (Zubaidi, 2024). In many cases, AI will change the role of the teacher to a facilitator. Making trial-and-error learning less scary in learning, trial, and error are important parts that must occur (Herlina, 2024). However, students who experience errors will experience a lower interest in learning. Artificial intelligence can allow students to experiment with free learning from the assessment process (Santosa et al., 2023).

Increase interest in learning and motivation and create a more interactive atmosphere in the learning process (Guo & Lee, 2023). It can help develop aspects of a child's development, for example, fine motor skills, namely when a child moves his finger to touch the screen, and cognitive, when a child begins to use his thinking process to find ideas or concepts when learning using one of the AI applications, social-emotional, namely in addition to learning being packaged in a fun way, children can collaborate and interact socially with their friends (Synekop et al., 2024)—providing more adaptive and enjoyable learning facilities for children aged in PAUD. Make it easier for children at an early age to learn and understand the material presented by educators (Xia, 2021).

## CONCLUSION

Early childhood education aims to develop the developmental aspects of children. With the sophistication of technology, it can facilitate access to information in life, especially in the field of education at the PAUD level. The technology that is widely used today is artificial intelligence. Artificial intelligence is a device designed with a design that

can be transformed like humans, namely having the ability to learn and provide feedback and corrections. Some applications of AI in education are visual mentors, voice assistants, intelligent content, presentation translators, global courses, automatic assessments, personalized learning, chatGPT, Leonardo, Kahoot, TikTok, Animaker, and educational word wall games. Artificial intelligence can improve the quality of learning in PAUD because the content presentation is adjusted to the individual needs of early childhood. It can help stimulate aspects of child development in PAUD. Artificial intelligence can also provide meaningful and more efficient learning experiences, provide early knowledge related to digital use for children, and make the learning process more interactive and adaptive.

## ACKNOWLEDGMENT

We want to extend our heartfelt thanks to Universitas Annuqoyah Madura for their continuous support and the resources provided during this research. Their commitment to promoting academic excellence has been essential in completing this study.

## DISCLOSURE STATEMENT

The authors declare no potential conflicts of interest concerning this article's research, authorship, or publication.

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