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Artificial Intelligence-Assisted Early Childhood Development: Effectiveness, Challenges, and Ethical Issues

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Abstract

This article examines the impact of AI-supported early childhood development interventions on children's cognitive, social, and emotional development, while also addressing the ethical considerations associated with these interventions. The review indicates that AI-based tools facilitate children's capacity for problem-solving, critical thinking, and emotional intelligence development by offering tailored learning experiences. In particular, intelligent toys such as Maya and educational apps like Duolingo have been shown to enhance children's cognitive abilities, while robots like Blue Bot have been demonstrated to facilitate the development of social skills. Nevertheless, the ethical implications of AI usage are also significant. The societal impact of these interventions is also contingent upon considerations of privacy and security of children's personal data, as well as the potential for inequality in access to technologies. Additionally, there are potential disadvantages, including the possibility of digital addiction and a lack of human interaction. It would be beneficial for future studies to investigate the long-term efficacy of AI-based interventions and to establish ethical standards for their use. The results of these studies will provide guidance on how technologies can be utilized in a manner that is beneficial to children's development.

Keywords: Artifical intelligence, Early childhood, Childhood development.

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Introduction

In recent years, artificial intelligence (AI) technologies have begun to assume a significant role in the realms of education and child development, as they have in numerous other domains. The early childhood period represents a critical stage during which the foundations of individuals' cognitive, emotional, and social development are established (Yi et al., 2024). The use of AI-supported interventions is becoming increasingly prevalent in efforts to enhance and facilitate these developmental processes (Vollmer et al., 2018). The integration of such technologies into children's learning processes presents a multitude of potential advantages, including the provision of individualized educational materials and the creation of interactive learning environments (Barua et al., 2022).

Nevertheless, it is crucial to investigate the impact of AI-facilitated early childhood development initiatives and the ethical implications associated with these interventions. The impact of these technologies on children's cognitive, emotional, and social developmental processes remains an understudied area, despite the existence of conflicting opinions in the literature (Su & Yang, 2024). Furthermore, the utilisation of AI technologies in the field of education and developmental interventions gives rise to a number of ethical concerns. The safe and effective use of these interventions is called into question by a number of critical factors, including the protection of children's data privacy, the risk of digital addiction, the potential for psychological manipulation, and the issue of parental consent (Yi et al., 2024).

The objective of this study is to examine the impact of AI-supported early childhood development interventions on children's cognitive, social, and emotional development. Furthermore, it seeks to provide novel insights, both theoretical and practical, by confronting the ethical challenges that emerge alongside the utilisation of these technologies. By examining the extant literature on the effects of AI on child development, the study aims to address existing gaps in this field and develop recommendations for the safe use of these technologies.

The article is comprised of four principal sections. The initial section will examine the role and applications of AI technologies in the context of early childhood development. The second section will examine the cognitive, social, and emotional effects of AI on child development. In the third section, the ethical issues that have been raised by AI-supported interventions will be examined. Finally, the findings of the study and suggestions for future research will be presented.

The Role and Uses of AI Technologies in Early Childhood Development

Artificial intelligence (AI) technologies are playing an increasingly significant role in early childhood education and development processes. Recent studies indicate that AI applications have the potential to facilitate the development of cognitive, linguistic, motor, and social skills (Berson et al., 2022; Su & Yang, 2022). Artificial intelligence has the potential to enhance the efficacy of educational processes, particularly through the provision of personalized experiences tailored to children's learning speed, interests, and developmental stages (Castro et al., 2024).

The use of AI-based applications has the potential to accelerate children's language development by providing adaptive learning materials tailored to their needs during the early childhood years. By providing personalized experiences that can be tailored to children's individual learning needs, these technologies facilitate the strengthening of children's vocabulary, grammar understanding, and communication skills (Su & Yang, 2022). To illustrate, speech recognition and language processing systems provide interactive tools that can facilitate an expansion of children's vocabulary (Su & Yang, 2023). Such AI systems facilitate children's acquisition of accurate pronunciation and usage of words, while simultaneously streamlining the process of monitoring developmental progress.

By addressing children's disparate learning styles, AI systems can be beneficial for both children who are developmentally typical and those with special needs. In particular, AI-based games and interactive platforms are among the most effective tools currently available for language learning. Children have the opportunity to learn at their own pace through these platforms (Rane et al., 2023). Moreover, such technologies offer a significant advantage in personalizing the learning process for children with different language abilities. These personalized approaches contribute to providing equal opportunities in education, especially for children from low-income families (Hongli & Leong, 2024).

Additionally, AI plays a significant part in the advancement of social abilities. The use of AI-enabled interactive robots and digital games has been demonstrated to enhance children's empathy, cooperation, and communication skills. Research indicates that children can enhance their social skills and augment their emotional intelligence by interacting with AI-based robots (Sethi & Jain, 2024). However, it is essential to adopt a balanced approach to the utilisation of AI, as excessive digital interactions and the replacement of face-to-face interactions may have adverse developmental consequences. Furthermore, the utilisation of AI tools can facilitate the advancement of critical thinking, creativity, and problem-solving abilities, which are indispensable for success in the twenty-first century (Su & Yang, 2023).

The analysis of children's emotional states and performance data enables the dynamic adjustment of instructional content, pace, and interventions by AI platforms. For instance, targeted feedback and resources can be furnished to students experiencing difficulties with emotional regulation. Artificial intelligence-based emotion analysis tools and emotional information processing systems can provide real-time feedback on children's emotional states (D'Mello & Graesser, 2012). Furthermore, the incorporation of gamification techniques and interactive simulations facilitates the development of empathy and social interaction skills in students (Deterding et al., 2011; Gonzalez-Brenes et al., 2016). Artificial intelligence can facilitate the creation of engaging and immersive learning experiences through the personalization of game mechanics. Artificial intelligence-powered chatbots and virtual assistants have the potential to provide personalized emotional support and guidance to children, which could foster self-awareness and well-being (Laranjo et al., 2018; Lucas et al., 2014).

The role of AI technologies in facilitating early diagnosis and intervention represents a significant avenue of investigation. Artificial intelligence-based monitoring systems can facilitate more precise tracking of children's motor skills, social interactions, and language development. In this regard, AI-based methodologies facilitate more judicious decision-making based on the behavioral and medical characteristics of individuals, while simultaneously enhancing the precision and expediency of diagnosis. Such technologies may prove useful for the early detection of developmental disorders, including autism spectrum disorder. The utilization of AI in early intervention systems has been demonstrated to facilitate the identification of developmental delays in children at an earlier stage (Joudar et al., 2023).

Additionally, AI-based robots are utilized in the field of early childhood education as educational tools. To illustrate, in domains such as language instruction and mathematical reasoning, robots can facilitate individualized instruction for children. Furthermore, AI robots facilitate personalized learning processes and provide educational guidance during the teaching process. Some studies have demonstrated that such robots enhance children's educational outcomes (Alabdulkareem et al., 2022). However, it is important to note that excessive reliance on robots may impede children's social development and supplant traditional learning approaches. In order for AI systems to be effective, it is essential to adopt a balanced approach

that optimizes the educational potential of technology while also facilitating social interactions among children.

The Impact of Artificial Intelligence on Child Development

The use of artificial intelligence (AI) in early childhood education is becoming increasingly prevalent, and it is becoming evident that this technology affects children's cognitive, social, and emotional development processes. While AI-based applications offer opportunities in many areas, from children's education to social interactions, the effects of this technology on early childhood development are a topic of considerable academic study. In addition to the potential benefits of AI, there are also concerns regarding its impact on children's developmental requirements.

Cognitive Effects

Artificial intelligence is becoming an increasingly influential tool in the shaping of children's cognitive development. In particular, AI-based educational tools that are capable of personalizing children's learning processes are conducive to their cognitive development by adapting to the individual pace and learning style of each child. As posited by Luckin and Holmes (2016), AI-based adaptive learning systems optimize learning processes by discerning children's strengths and weaknesses and presenting content in a manner that aligns with their individual needs. Such systems enhance children's learning experiences and facilitate more efficacious educational outcomes. Nevertheless, the deployment of AI as a pervasive and unidirectional conduit of information may impede children's capacity for critical thinking. Resnick (2018) cautioned that AI has the potential to impede the development of creative thinking and problem-solving abilities. Such an approach may result in children being directed solely to search for the correct response, thereby limiting their cognitive flexibility and divergent thinking. The influence of AI on cognitive development is not confined to the domain of learning processes. Furthermore, it presents a multitude of avenues for fostering children's cognitive flexibility and problem-solving abilities. Additionally, AI-based applications have been demonstrated to enhance children's abilities in analytical thinking and logic development (Mayer-Schönberger & Cukier, 2013). However, there is a possibility that such practices may shape children's learning processes too much, preventing them from thinking more deeply and critically.

Social Impacts

AI also has a significant impact on children's social development. In particular, social robots and interactive digital tools help children develop their social skills. Social robots are used as an effective educational tool for children on the autism spectrum. Scassellati et al. (2012) emphasized that social robots support the development of social skills by enabling children to recognize facial expressions and emotional cues. Such robots are designed to teach children empathy, cooperation and emotional intelligence skills. However, the overuse of AI can cause children to experience difficulties in face-to-face social interactions with people. This leads to digital tools replacing human relationships and can hinder the development of children's natural social skills. Turkle (2015) pointed out that the substitution of digital interactions for human interactions can lead to the weakening of children's social skills. The constant use of AI-based tools may cause children's empathy, emotion recognition and conflict resolution skills to underdevelop.

Emotional Impacts

Artificial intelligence (AI) has a dual impact on children's emotional development. On the one hand, AI-based applications have the potential to facilitate children's emotional regulation and stress coping skills. In particular, mindfulness practices have been demonstrated to enhance children's emotional awareness and fortify their emotional regulation abilities (Bakır, 2021). Such practices have been demonstrated to have a beneficial impact on children's emotional well-being, assisting them in effectively coping with stressful circumstances. Nevertheless, the pervasive perception of AI as a panacea may inadvertently impede children's capacity to cultivate emotional resilience. Greenfield (2014) highlights the potential risks associated with excessive reliance on AI, suggesting that it may lead to a decline in children's emotional regulation and self-control abilities. The tendency of children to turn to digital tools for every problem may have a detrimental impact on their emotional intelligence and problem-solving abilities. Furthermore, the capacity of AI to comprehend and respond to children's emotional states, and to establish emotional connections, is a subject of ongoing discussion. While AI-based tools can facilitate children's development of emotional empathy, the replacement of these technologies with human interactions may impede children's capacity to comprehend emotions in a nuanced manner. In instances where AI provides only superficial and mechanical interactions, children may be unable to grasp the nuances of genuine human connections and emotional responses.

Ethical Issues Raised by AI-Assisted Interventions

The early childhood period is of particular significance in regard to the shaping of an individual's cognitive, emotional, and social development, as well as the formation of lifelong behavioral patterns. Artificial intelligence (AI) has the potential to facilitate early diagnosis, individualized learning, social-emotional development, and behavioral assessment processes during this period. Nevertheless, the deployment of such technologies necessitates an ethical evaluation, particularly in light of the potential implications for human well-being. The incorporation of AI into early childhood education gives rise to a number of ethical concerns that could have implications for the child's future.

Artificial intelligence (AI) applications in early childhood education gather substantial volumes of sensitive data. The data may encompass a multitude of subjects, including a child's cognitive development, emotional responses, social interactions, and learning processes. In particular, long-term data retention policies may pose significant risks to children's right of access to this data in later years. Such risks may include identity theft and invasion of privacy (Livingstone & Third, 2017). The issue of children's inability to provide their own consent to data processing, even when parental consent is obtained, represents a significant ethical challenge. While regulations such as the European Union's General Data Protection Regulation (GDPR) offer protections for children's data, the extent to which these legal frameworks are effective in practice remains a topic of debate (ICO, 2021). In light of these considerations, it is of paramount importance to develop robust encryption techniques and ethical oversight mechanisms to guarantee the security of data.

The development of biases in AI systems may be contingent upon the content of the data sets utilized to assess children's developmental processes. The decision-making processes of these systems may be influenced by socioeconomic differences, language barriers, and cultural contexts (Noble, 2018). For example, an AI application designed to assess language development may produce inaccurate assessments of children with different mother tongues,

which could have the unintended consequence of undermining equality of opportunity in education. Research indicates that children residing in low-income areas are at an elevated risk of being misassessed by AI systems, which frequently rely on constrained resources (Eubanks, 2018). Such biases have the potential to negatively impact children's educational and social development through early misdiagnosis.

The deployment of AI systems in early childhood interventions gives rise to the question of who bears responsibility for the harms that result from misdiagnosis or misdirection. In the event of an erroneous diagnosis by an AI application, it is unclear whether responsibility for this error lies with the developer, the user, or the organization managing the system (Floridi & Cowls, 2019). It is imperative that accountability mechanisms be made more explicit, particularly in light of the long-lasting consequences of erroneous interventions at an early age, which can persist throughout the child's lifespan.

The period of early childhood is a crucial time for the formation of social bonds and the development of emotional resilience. The potential for AI-supported systems to discourage one-to-one human interaction raises concerns about the pedagogical and psychological effects of these technologies (Turkle, 2015). In particular, during this period when empathy and emotional support are of paramount importance, the restricted emotional capacity of AI may result in disturbances in children's social development.

The capacity of AI to make decisions in ethically complex situations by considering contextual factors is limited. The specific needs of individual children and the nuances of family dynamics may not be fully addressed by generalized algorithms (Borenstein & Howard, 2021). To illustrate, a system that is lacking in sensitivity to the specific needs of a child with a traumatic background may result in inappropriate interventions and impaired child well-being.

The utilization of AI in early childhood can have social, emotional, and cognitive ramifications that may persist into adulthood. For instance, it has been proposed that children who are consistently engaged in AI-facilitated learning may be unable to cultivate social competencies through human interaction (Zuboff, 2019).

The advent of AI-supported interventions for early childhood presents a host of ethical considerations. It is therefore imperative to establish ethical frameworks that prioritize children's rights, privacy, and developmental needs during the use of these technologies. It is imperative that parents, educators, psychologists, and AI developers collaborate in order to address these issues.

Method

This study aims to examine the effects of artificial intelligence (AI)-supported early childhood development interventions on children's cognitive, social and emotional development and to address the ethical implications of these interventions. In the study, narrative synthesis method was used to evaluate the various effects of AI-supported interventions from a holistic perspective, and SWOT analysis was applied to identify the strengths, weaknesses, opportunities and threats of each type of intervention (Popay et al., 2006; Raines, 2006).

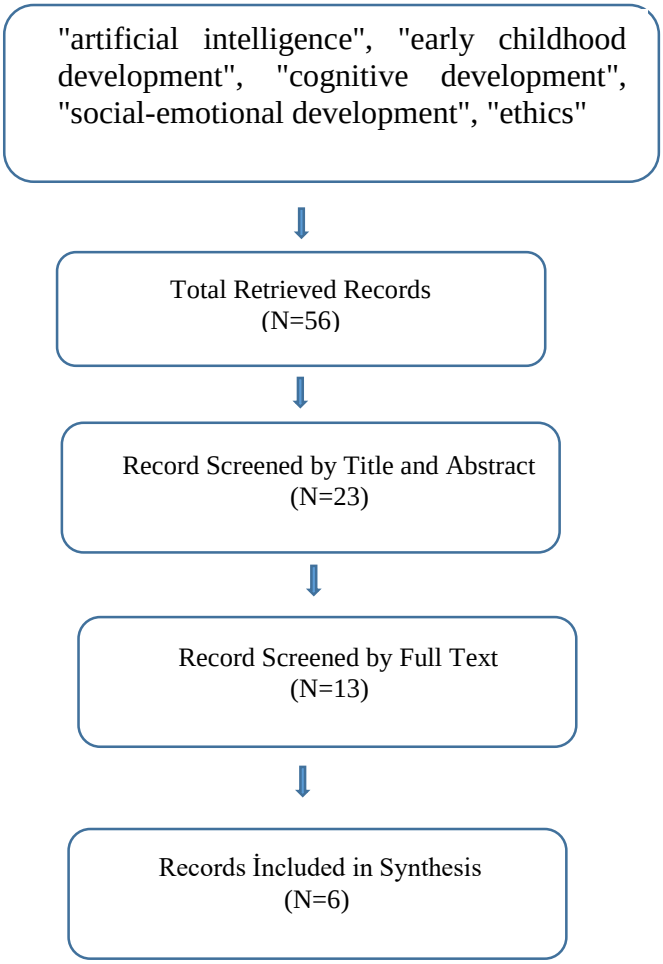
Research Design

Using a narrative synthesis approach, this study systematically combines the findings from different literature studies to form a meaningful whole. In the literature review, we particularly

focused on studies that addressed the effects of AI in early childhood. Such studies provide both qualitative and quantitative data on children's cognitive, social and emotional development and examine the contribution of AI technologies to these developmental processes (Tapalova & Zhiyenbayeva, 2022; Akdeniz & Özdinç, 2021).

Literature review

The main data for the study were obtained through a comprehensive review of the existing literature on AI-based early childhood development interventions. The literature review was limited to qualitative and quantitative studies published within the last five years. The review focused specifically on studies of children's cognitive, social and emotional development. Care was taken to ensure that the research group included children in early childhood. In addition, the literature on parent-child relationships, family dynamics and ethical dimensions of AI technologies was also assessed and the social and ethical dimensions of these interventions were discussed in depth (Shonkoff & Phillips, 2000; Lindgren, 2012). The literature review was conducted using academic databases (PubMed, PsycINFO, Google Scholar, etc.). The key words were "artificial intelligence", "early childhood development", "cognitive development", "social-emotional development", "ethics".



Details of the 6 studies obtained are given in the table below.

Author, Year	Name of the Research	Study Design and Sample	AI Intervention Type
Villegas-Ch . , W. , Jaramillo-Alcázar , A., &	Assistance system for the Teaching of natural numbers to preschool children with the artificial	The study group consisted of 12 children aged 3 to 4 years in an educational institution in Ecuador . A control and an	The goal was to create an AI-powered recognition system that enables preschool children in an early childhood education

Mera- Navarrete , A. (2022).	use intelligence algorithms . *Future Internet* , *14* (9), 266.	experimental group were created, and AI-supported instruction was applied to one group and traditional instruction was applied to the other.	center to recognize numbers from 0 to 9.
Samara , V ., & Kotsis , K. T. (2024).	Use of the artificial intelligence in teaching the concept of magnetism in preschool education . *Journal of Digital Educational Technology* , *4* (2), ep2419.	It presents the design, implementation and results of a teaching intervention in a Greek kindergarten, highlighting the significant positive impact of artificial intelligence (AI) tools on children's learning of the concept of Magnetism.	The teaching intervention was implemented as an extension of a specific thematic unit previously covered in kindergarten using STEM tools and new technologies. A total of 3 activities including artificial intelligence applications were implemented for a total of 8 lesson hours.
Water, J. , Yang , W., Yim , IHY, Li , H., & Hu, X. (2024).	Early artificial intelligence education : Effects of cooperative Play and direct instruction on kindergarteners ' computational thinking , sequencing , self-regulation and theory of mind skills . *Journal of Computer Assisted Learning* , 40(6), 2917-2925.	An experimental study was conducted with 90 kindergarten students (ages 5-6) using direct instruction, cooperative play, or a control group.	Artificial intelligence robots have been used, including UBTECH robots, which are compact artificial intelligence robots designed specifically for young children, and artificial intelligence dogs.
Kewalramani , S. , Kidman , G., & Palaiologou , I. (2021).	Using artificial intelligence (AI) - interfaced robotic toys in early childhood settings : A case for children's inquiry literature . *European Early Childhood Education Research Journal* , *29* (5), 652-668.	Design-Based Research (DBR) approach was implemented in two kindergarten classes (children aged 4-5) and different AI-interfaced robots functioning in different styles (concrete and hybrid) were introduced to observe children's investigation processes.	Cosmo , BlueBot , Coji by Wowee , Qobo the snail , Vernie – LegoBoost Bot
Yang , W ., Hu, X., Yeter, IH, Su, J., Yang , Y., & Lee, J. C. K. (2024).	Artificial intelligence education for young children : A case study of technology-enhanced embodied learning *Journal of Computer Assisted Learning* , *40* (2), 465-477.	A case study research methodology was used to describe and understand the complexity of change processes created by integrating an embodied artificial intelligence curriculum called "AI4Kids" in a specially selected kindergarten (ages 5-6) in Hong Kong .	AI4Kids
Samuelsson , R. (2023).	A shape of play to come : Exploring children's Play and imaginary with robots and AI. *Computers and Education : Artificial Intelligence* , *5* , 100173.	The study was implemented with a mixed methods design in two groups of preschool children aged 1-2 and 3-5.	A programmable floor robot called Blue-Bot

Data Analysis

Data from the study were analyzed using the narrative synthesis method. In this analysis, the effects of AI-based early childhood development interventions on cognitive, social, and emotional development, effects on parent-child relationships, and ethical concerns were evaluated as a whole (Popay et al., 2006). These data were categorized by intervention type and area of impact, and the strengths, weaknesses, opportunities, and threats of each intervention type were identified. In addition, a strategic assessment of each type of AI-supported intervention was conducted using the SWOT analysis method. SWOT analysis aims to provide information to support the effective use of intervention types by systematically identifying the strengths, weaknesses, opportunities, and threats that each intervention type may face (Cherney & Wagner, 2020).

Ethical concerns

While the research examined the impact of AI technologies on early childhood development, it also addressed ethical concerns related to the use of these technologies. In addition to the effects of AI-assisted interventions on children's cognitive and emotional development, important issues such as the collection of children's personal data, privacy rights, safety, and ethical responsibilities were discussed (Gunkel, 2018; Bryson, 2020). In this context, within the framework of ethical principles in research, child protection, data security, and potential risks of AI technologies on children's health were carefully evaluated.

Effectiveness And Ethical Implications Of AI-Based Interventions In Early Childhood Development

Artificial intelligence (AI) technologies represent an important milestone in education. They enhance the learning experience and improve academic performance of individuals of different ages, academic levels, and socioeconomic backgrounds (Tapalova & Zhiyenbayeva, 2022). AI makes learning processes more dynamic by providing solutions tailored to the needs of each individual, giving the opportunity to choose the most effective teaching methods, taking into account strengths and weaknesses. This process particularly contributes to the development of children's social and emotional learning skills.

Impact on cognitive development

Many studies show that AI-based tools have a positive impact on children's cognitive development. For example, Tapalova & Zhiyenbayeva (2022) found that applications such as Altitude Learning, Gradescope, KnewtonAlta, Knowji, and Duolingo increase students' engagement in learning and tailor educational content to individual needs. Such tools stimulate children's mental activity, speed up the teaching process, and enable students to learn more deeply. AI applications also support collaborative learning in education, increasing interaction between students and personalizing educational materials.

Maya, a smart toy developed by Akdeniz and Özdinç (2021), is an AI tool that aims to support the cognitive development of preschool children. This robot allows children to learn at their own pace and provides teaching methods that are appropriate for each individual. Similarly, Villegas-Ch et al. (2022) showed that systems supported by AI algorithms increase preschool children's interest in learning about numbers and thus develop their creativity. In addition, such tools improve children's problem-solving and critical thinking skills. Another important study showing that AI has a profound impact on cognitive development is by Su et al. (2024), who show that AI-powered robots improve children's computational thinking and sequencing skills.

Impact on Social and Emotional Development

AI-enabled tools also offer important opportunities to develop children's social skills and emotional intelligence. Studies such as Samuelsson (2023) and Kewalramani et al. (2021) have shown that AI-enabled robots enhance children's social skills such as collaboration and empathy. For example, robots such as Blue Bot encourage children's creative play skills while also supporting group work and collaborative learning. These robots help children develop social skills such as emotional intelligence and empathy. Moreover, it has been observed that AI applications increase children's social interactions and teach them skills such as sharing emotions and group work (Yang et al., 2023).
Another study by Su et al. (2024) found that AI-supported robots developed computational thinking, sequencing, and ToM skills in children. These findings suggest that the use of technological tools at an early age has a significant impact on children's emotional and social development. There is a growing body of literature suggesting that AI-enabled tools enable children to grow up to be more empathetic and cooperative individuals.

Technology and AI Literacy

Introducing AI technologies at an early age lays an important foundation for children to use these technologies more effectively in the future. A study by Yang et al. (2023) found that AI literacy enables children to be more efficient in their future education. In addition to cognitive development, this contributes to children's readiness for the digital world. Introducing AI technologies at an early age accelerates children's adaptation to these technologies and raises them as digitally literate individuals.

Ethical concerns and risks

While AI-based interventions have the potential to transform children's education, there are important ethical concerns associated with the use of these technologies. Issues such as child privacy, data security, and equitable access constitute the ethical dimensions of AI applications. The literature emphasizes that necessary ethical standards should be established for the safe implementation of technologies (Yang et al., 2023). In particular, the protection of children's personal data is crucial for the safe use of these technologies. In addition, equal access to AI-enabled tools should ensure that all children benefit equally from these opportunities.

SWOT Analysis

AI-based early childhood development interventions offer potential benefits, but also some challenges and threats. This analysis systematically addresses the strengths, weaknesses, opportunities, and threats of each AI intervention.

1. Strengths: The strengths of AI-based early childhood development interventions relate to their effectiveness in improving children's cognitive skills. Specifically, AI can provide content and activities that match children's learning pace, offering personalized learning processes. This personalization plays an important role in improving cognitive skills (Woolf, 2010). In addition, AI tools support children's problem solving, reasoning, and language development (Su & Zhong, 2022). AI-based interventions are an effective tool for accelerating teaching processes and stimulating mental activities (Tapalova & Zhiyenbayeva, 2022). Children have the opportunity to learn more deeply with AI content tailored to their personal needs.

2. Weaknesses: Weaknesses of AI interventions are their limited impact on children's social and emotional development. Issues such as lack of human interaction, failure to establish emotional bonds, and poor development of social skills are challenges that AI tools face (Patil & Singh, 2023). For example, in early childhood, social skills are developed through interaction with children's peers, and AI applications may not be able to provide this interaction sufficiently. In addition, there may be limited effects on the development of emotional intelligence and social skills such as empathy.

3. Opportunities: AI-enabled tools can provide equal opportunities in education, especially in developing regions. Where access to educational resources is limited, AI-based applications can provide quality education to children and reach a wider audience (Rahayu, 2023). In addition, AI technologies can provide interventions that are more tailored to the individual needs of each child through personalized learning in education, which can make learning processes more effective. These capabilities can be an important tool for achieving equity in education. The effective use of AI enables children to acquire greater digital literacy and makes their future education more efficient (Yang et al., 2023).

4. Threats: One of the greatest threats associated with AI-enabled interventions relates to data security and privacy. Children's personal information can be collected and misused through such applications. The risk of technological addiction can lead to over-exposure of children to digital environments, which can have negative consequences such as social isolation and attention disorders (Wang et al., 2024). There are also uncertainties about the ethical use of AI tools. Ethical issues such as how to monitor children in the digital environment and how to use the collected data are important. Establishing ethical standards is critical for the safe and responsible use of these tools.

Ethical Assessment

Several ethical concerns arise in the use of AI-based interventions for early childhood development. These concerns include elements that may affect children's privacy, data security, and social interactions.

Privacy and Data Security

AI applications have the potential to collect children's personal information. This raises important ethical questions about data security and privacy. Risks such as misuse, unauthorized access or misappropriation of data can threaten children's privacy. In this context, it should be ensured that AI systems store data securely and use it only as authorized (Wang et al., 2024; Patil & Singh, 2023).

Inequality of access

The use of AI technologies in education has the potential to create significant inequality for low-income families. In such families, children may have limited access to such tools, leading to inequality of opportunity in education. If only a certain segment of the population benefits from the opportunities offered by AI, it can further deepen inequality in education (Rahayu, 2023; Woolf, 2010). This situation calls for the development of egalitarian educational practices.

Lack of human interaction

AI tools can limit children's social interactions. Human interaction is a critical factor in children's emotional and social development. As the role of AI in education increases, there is a risk that children will be deprived of real human interactions that can develop their social skills. The inability of AI to adequately support such social interactions may lead to weaknesses in children's social skills such as empathy, emotion management, and cooperation (Patil & Singh, 2023; Su & Zhong, 2022).

Conclusion and Recommendations

The effects of artificial intelligence on child development are shaped by both potential benefits and potential risks. While AI has the capacity to support children's cognitive, social and emotional development, it can negatively impact these developmental processes if not used carefully and ethically. While the role of AI in critical areas such as the development of cognitive skills, social interactions and emotional regulation is becoming increasingly important, at the same time the importance of children's natural developmental processes and human relationships should not be ignored. Educators, parents and policy makers should integrate technology in ways that are appropriate to children's needs, taking into account the effects of AI on these processes.

AI-supported early childhood development interventions contribute significantly to children's cognitive, social and emotional development, and the use of technology at an early age enables children to acquire stronger digital literacy in the future. However, it is important to develop strategies for the ethical use of these technologies and to ensure children's privacy and data security. In the future, as AI-enabled tools become more widespread, more work needs to be done on ethical standards for their safer, accessible and effective use.

Prevention Strategies for Ethical Issues

A number of strategies can be implemented to circumvent the ethical issues associated with AI-supported interventions. First and foremost, it is of paramount importance to develop robust data protection protocols to ensure the security of children's personal data. The protection of children's privacy can be ensured by ensuring that AI applications only work with authorized data and that data is collected transparently (Wang et al., 2024). Furthermore, in order to guarantee equality of opportunity in education, initiatives that will facilitate low-income families' access to these technologies should be implemented. To enhance the accessibility of AI, it is essential to reinforce digital infrastructures in collaboration with governmental and private sector entities (Rahayu, 2023). Ultimately, for AI tools to facilitate social and emotional growth, these technologies must be designed to foster social interaction.

Suggestions for Future Research

Future research should examine the effects of AI on early childhood development in more depth. In particular, the long-term effects of AI-supported tools on children's social skills and emotional intelligence should be explored. Furthermore, the effects of these tools on family dynamics and parent-child relationships should be examined in more detail. Finally, further studies on the role and potential risks of AI in education in the light of ethical issues will ensure that future applications are safer and more effective.

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