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Artificial Intelligence and Early Childhood Development (ages 0-5): Exploring Benefits, Risks and Ethical Consequences

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Abstract

It is increasingly evident that Artificial intelligence (AI) has permeated contemporary society and fundamentally transformed human activities globally. In spite of evidence on the rapid benefits of AI in different sectors in society like health, industry, education and so on, there is still limited research on the impact of AI on early childhood development (ages 0-5). Early childhood is often a critical period when it comes to the cognitive, emotional and behavioral growth of an individual. Therefore, understanding how AI-integrated environments reshape these formative years is essential. The paper utilizes a narrative review of journal articles, relevant academic literature, policy briefs, books and internet sources. Findings indicate that while artificial intelligence offers many benefits for children at their early development such as personalized adaptive learning, interactive play, enhanced creativity, early detection and special education, problem solving and acquisition of social skills, it also poses significant risks. However, over-dependence on AI may hinder natural social interactions, and unrestricted use of certain AI tools can expose children to digital safety threats. This paper concludes by recommending a balanced approach that integrates technology use with conventional learning. It further emphasises the vital role of parental and educator guidance on the use of AI technologies by children as one of the important ways to mitigate the negative impacts of AI on the developing child, which extends to the family and society.

Keywords: Early childhood development, Artificial intelligence, AI ethics, Social development, AI technologies

Introduction

Artificial Intelligence (AI) is an umbrella term that encompasses a wide range of computational approaches designed to imitate aspects of human intelligence, which has multiple subfields, including machine learning, natural language processing and computer vision (Thakkar et al, 2024). It is a branch of computer science which focuses on performing human intelligence tasks by way of learning, problem-solving and inferential

decision-making (Yu et al., 2025). In simpler terms, AI makes computers think, learn and perform tasks like humans, such as recognizing patterns, interpreting language, making predictions, or deciding what action to take next. Machines are enabled to learn from experience, adapt to new inputs, and perform tasks that traditionally require human intervention. (Jenni, 2023; Karimov, 2026)

In the present day, children are familiarised with digital technologies before they learn to talk, crawl or walk (Adeyemi, 2025). Currently, traditional media, like television, radio and conventional learning methods, are gradually getting replaced by interactive digital technologies that offer instant access to information, entertainment and learning. Furthermore. new digital applications, platforms, and technologies are emerging at a pace that researchers and technically skilled individuals find it difficult to keep up with (Ali & Alam, 2024), and it is evident that Artificial Intelligence is transforming all societal sectors in quick succession, including early childhood development and care.

Child development is how a child grows and changes over time (Cleveland Clinic, 2025). Early Childhood Development (ECD), according to Nadeau et al. (2016), is an all-inclusive concept that refers to the physical, cognitive, socio-emotional, and linguistic development of young children until the time they move into primary school. UNICEF (2024) also posits that early experiences have profound impacts on children's physical, cognitive, emotional, and social development, which equally extend into adulthood. Early childhood development which ranges from (0-5) years, therefore is a critical stage for brains in developing their lifelong cognitive competencies, such as memory or decision-making, emotional and physical health essential for children to thrive, and for family and society's well-being.

Consequently, young children are progressively exposed to technology in this digital era, which changes the way they learn and interact with their surroundings. AI applications offer a variety of interactive features designed to support learning, from educational games to adaptive learning aids (Muttaquin et al., 2024). In some places in the world, especially in China, young children interact with AI that can be found in their environments in the form of AI-assistive tools such as AI-enabled toys or AI-powered voice assistants (Rui, 2024). This increased exposure to AI has tremendously transformed society. It has the potential to improve children's well-being but also raises some concerns about security, safety, and equity on the use of these AI technologies (UNICEF, 2025; Rui, 2024). However, the use of AI in children's development is gradually replacing the traditional face-to-face, physical nurturing of children, which involves direct interaction, emotional bonding, personal care and cultural transmission of traditional values and norms.

Theoretical Foundation

This study adopts Urie Bronfenbrenner's Ecological Systems Theory (1979). The theorist emphasises that children's development is influenced by multiple levels of their surrounding environments. The first of the five systems which is the

microsystems is all about the child's interactions within the family and educational settings, peers. The second, which is the mesosystem is where children are affected not only by their immediate environments but also with connections between microsystems, that is, how parents and teachers' communication about a child's progress affects the child's development. Third, the exosystem has to do with external factors that indirectly influence child's development such as parental workplace conditions. Fourth, the macrosystem represents the broader cultural context that shapes all other systems, for instance - societal values, beliefs, laws, and socioeconomic values. Finally, the chronosystem which accounts for temporal changes, including life transitions, historical events (pandemics, wars), and societal changes that reshape individual development across the lifespan (Guy-Evans, 2025).

These systems in Bronfenbrenner's theory support early childhood development in various ways in the sense that changes in one level can have a resounding impact on the other levels (Cherry, 2026). AI as well, can play many different roles in early childhood development. Analyzing the relationships between Bronfenbrenner five ecological systems that interacts with children for their development in connection with Artificial intelligence tools, there are varieties of AI tools that children can engage with directly, there are also some technological tools parents and others who interact directly with children can operate, as well as ones for stakeholders like policy makers and government who indirectly interact with children (Yu et al., 2025).

However, for AI to serve children, especially in the formative ages of birth to five years (ages 0-5years) effectively, policy makers must establish comprehensive policies and regulatory frameworks to ensure communities implement these tools safely (UNICEF, 2024). When AI tools used in early childhood development are well guided and supported by educators, families, policy makers, they have the potential to become powerful tools for fostering inclusion, promoting ingenuity, and bringing joy and growth to toddlers' lives. Nevertheless, if the tools are misused, it raises some serious ethical concern for both the current and future generations (Pei, 2025).

Methodology

This paper utilizes a narrative literature review approach. The articles were obtained from electronic repositories including Google Scholar, Web of Science, Research Gate, alongside published reports from Non-Governmental Organizations and other verified online sources. The study prioritized especially articles that emphasized the use of AI and early childhood development including education. However, other literature talking about the benefits of AI and the risks were also included. This paper therefore synthesizes literature, published policy reports and academic papers to evaluate the benefits, risks and the consequential ethical effects of the use of AI during early childhood development (ages 0-5). This paper is organized under the following headings:

1 Innovation of Artificial Intelligence
2 Stages of early childhood development
3 The use and benefits of AI on early childhood development
4 The risks and consequences of the use of AI in the early childhood stage
5 Recommendations and conclusion

Innovation of Artificial Intelligence

The innovation of AI began in the 1950s when Alan Turing proposed a practical test for machine intelligence. This gave way to the invention of Artificial Intelligence in 1956 by John McCarthy during the Dartmouth Summer Research Project on Artificial Intelligence; hence, it became an official academic discipline. The focus was on making machines use language to solve problems (Cordeschi, 2007; Heikh et al., 2023). Since the introduction of AI, its development spans decades, with each phase bringing new approaches, innovations, and challenges. AI seeks to imitate human cognitive functions such as reasoning, learning, and decision-making, empowering machines to solve complex problems (Olabiyi et al., 2025).

The year 2017 was referred to as the year of AI, when Google released the original transformer model, which is now a foundation of deep learning designs (Amatrain, 2023). The recent development of Generative AI, such as ChatGPT, a branch of AI which focuses on creating new content, such as text, images or audio, was another advancement in the field of AI (Oniani et al, 2023). It recently gained popularity due to its complex language models and its ability to facilitate natural language conversations, answer queries as well as assist with various other activities. All these tools have been increasingly used in early childhood development, and they particularly influence how young children grow and learn (Su & Yang, 2023).

Stages of early child development

The early developmental stages of a child are classified into three distinct phases: (1) infancy (from birth to 12 months, (2) toddlerhood (1-3 years) and (3) pre-school age (from 3-5 years) (Cleveland Clinic, 2025). These are the stages this paper adopts. During these stages, children develop their motor skills and master some psychomotor skills, such as using hands and fingers, walking and moving around by children. At these stages, a child's brain also undergoes rapid development and is highly sensitive to environmental stimuli, both positive and negative, making it an essential stage for growth and development (Richter et al., 2019). They also learn language and communication skills to interact with others, while simultaneously building the social-emotional competencies that enable them to express and regulate their feelings and emotions (Cleveland Clinic, 2025). Rapid growth and significant development at an early age, according to Warmansyah et al. (2023), often form the basis for children's abilities in the future.

The cognitive, emotional, and social areas of early child development influence one another in many ways. At the cognitive level, being with other children helps them learn to consider not only their own point of view but also others'. Socially, playing with others allows a child to put into action different skills that stimulate cognitive skills, such as solving problems, imagining games and developing his sense of

humour. However, the more the child develops these skills, the more enriching his contacts with others. Furthermore, emotionally, by being in contact with peers, he develops the management of his emotions (Meriem et al., 2020). For children to achieve their full potential, as they grow up, they need proper care, protection from harm and a sense of security, opportunities for early learning, and responsive caregiving; like talking, singing and playing – with parents and caregivers who love them. This nurturing environment is essential to nourish developing brains and fuel growing bodies, a dynamic that is increasingly mediated by children's interaction with emerging AI technologies (UNICEF, 2017).

Uses and benefits of AI on early childhood development

AI in early childhood development is all about how machine learning and automation can support real intellectual, cognitive and social development in children. In this contemporary digital age, toddlers can navigate Tablet interfaces faster than most adults (Lee, 2025). Therefore, the integration of artificial intelligence into early childhood learning environments and development is not a distant possibility but an urgent reality (UNESCO, 2021). Some AI applications help children to learn and at the same time, support their cognitive and social development in a fun and engaging way. It is now very important that parents, caregivers and teachers choose applications that suit the needs and development of children at their early stage in life (Muttaquin et al., 2025). AI benefits early childhood development in the following ways:

Artificial Intelligence and early childhood learning and cognitive support

The use of Artificial Intelligence technologies in early childhood learning helps to improve teaching, personalize learning, and to enhance classroom effectiveness during the early years. It can also support caregivers (Cheathan et al., 2025). Furthermore, when AI technologies are incorporated into educational platforms, such as play-based learning tools, KIBO Robots, OSMO learning system, StoryBots classroom and others, they help in better cognitive development in children by delivering individualized learning experiences, especially during the early stage. Through interactive exercise like storytelling, vocabulary games, art generation, music composition, and conversation practices, AI can support language acquisition and creativity, thereby helping children build and acquire skills in a playful manner (Lee, 2025; Benebo-Solomon & Ohaka, 2024).

The inclusion of AI in early childhood education proffers series of benefits which can transform learning experiences in young children while developing required skills. In terms of personalized learning, AI-powered platforms assess each child's performance and adjust activities accordingly. This allows children to learn at their own pace, supporting both advanced and struggling learners. The interactive learning experiences, from gamified apps (Duolingo [languages], Kahoot [quizzes], SoloLearn [coding], and Khan Academy [various subjects] to AI-driven storytelling and pronunciation tools, AI makes learning

more engaging and responsive to each child's interests (Yu et al., 2025).

Furthermore, AI enhances accessibility and inclusion when it comes to childhood development. Specialised tools powered by AI ECD technology assist children with special needs or language barriers to participate fully in classroom activities. Childhood AI systems can identify signs of developmental delays or learning disabilities, providing teachers and parents with early alerts and knowledge (Lee, 2025; Benebo-Solomon & Ohaka, 2024). AI-based learning activities often involve problem-solving scenarios and critical thinking exercises. This stimulates critical thinking by presenting the learners with challenges, scenarios, and puzzles that require them to think, analyse, evaluate, and apply their knowledge (Yu et al., 2025).

It allows for a more personalised learning experience and is helpful in special education. The use of AI can also improve skills of creative inquiry, as well as theory of mind skills – the ability to understand that others may have thoughts, beliefs, desires, and intentions that differ from one's own – which is crucial for developing empathy and navigating complex social situations (Cheatham et al., 2025). Concurrently, conversational AI applications foster interaction in children who may struggle in traditional social settings, while optimising teaching quality, parent-child interactions, early childhood assessment, and administrative tasks (Cheatham et al., 2025).

By powering administrative tasks like attendance tracking, documentation, and communication with families, AI grants educators more time to focus on teaching (Lee, 2025). Furthermore, early exposure to AI technologies would familiarize children with emerging technologies. This early exposure would also prepare them for a future where technology will play an increasingly integral role in various aspects of their life and work (Yu et al., 2025). In cognitive support and development, AI technologies can supplement and enhance children's cognitive development by providing tools that support learning and skill acquisition. It enhances learning experiences help children develop crucial skills, such as problem-solving, critical thinking and creativity (Fillipcic, 2024). Consequently, AI-powered mental health applications can provide children with immediate, personalised support by offering coping strategies, mindfulness exercises, and virtual therapeutic sessions, thereby making mental and emotional health care highly accessible (Fillipcic, 2024).

Finally, AI bridges the accessibility gap in education. For instance, AI- powered tools provide invaluable support for children with disabilities. AI programmes like Google's speech-to-text programs, real-time translation, and sensory-friendly educational applications make learning more inclusive. All these advancements enable every child to participate fully, regardless of physical or cognitive challenges (Martin, 2025).

Artificial Intelligence and Social Development of Children in the Early Years

Social development in early childhood is the process by which young children learn and develop the social skills and emotional intelligence necessary to engage in

meaningful interaction and build relationships with others and navigate their environment (Preidyte, 2025). It covers learning how to communicate, cooperate, resolve conflicts, and understand social and cultural norms. Some factors, like family interactions, peer relationships, cultural environment, and most importantly, in this epoch, exposure to artificial intelligence, are known to influence the social development of children (Adeyemi, 2025).

AI significantly impacts children's social trajectories. Social robots and interactive digital tools, for instance help children develop and boost their social skills like communication skills, virtual interactions, emotional regulations, cooperation and building relationship with their peers in a controlled and safe manners (Montessori Academy, 2024; Filipcic, 2024; Sethi & Jain, 2024). These social robots are also effective social development tools for children with special needs (Bakir, 2024). They help them to manage collaborative play, compliment the work in the classroom and provide the opportunity for basic and cognitive learning (Robin, 2018).

Social robots/toys like Gabbo, which incorporates a voice-activated AI Chatbot from Open AI has been designed to encourage pre-school children to talk to it, interact with it and carry out imaginative play with it. The toy has the potential to teach the children language and communication skills (Kleinman & Calder, 2026). Similarly, the social robot Moxie is created as a companion for children. It has friendly eyes, which enable children to better recognise emotions and navigate social situations. It teaches children core life values like kindness, friendship, empathy and respect (Hitti, 2020). Kasper, another specialised social robot, was created to help children with autism spectrum disorder. It serves as an educational or therapeutic tool to facilitate and help develop communication and social interaction skills in children with autism. The robot assumes the role of social mediator and encourages the children to interact with fellow children and adults (Robins et al., 2018).

Artificial Intelligence and Emotional Development of Children on Early Childhood

The emotional impact of AI tools is another important area where these technologies are making a significant difference in early childhood development. AI tools such as robotic toys like Alpha Mini, Coji, Qobo, and LegoBoost are increasingly designed to create positive emotional experiences, nurturing an intimate bond between the child and the technology. These robots involve children in activities that require emotional expression and social collaboration (Kewalramani et al., 2021; Huang et al., 2024). Coji, for instance, uses emoji language, and this not only makes learning fun but also encourages children to articulate their emotions. Qobo and LegoBoost, on the other hand, with their abilities to perform compound sequences like dancing or singing, create opportunities for children to engage in collaborative play, thereby enhancing their socioemotional development in a way that is both engaging and educational (Huang et al., 2024). This is achieved through thoughtful design choices that emphasise politeness, cheerfulness, and friendly

interactions. Children can now learn to feel and show empathy for others (Ali-Ahmad, 2025).

Nevertheless, the future of early childhood development will not be shaped by technology alone, but by meaningful collaboration between educators, researchers, innovators, and families who share the same goal of giving every child the opportunity to thrive (Rajab, 2026).

Risks of Use of AI in Early Childhood Development

Generation of Harmful Information to Children

AI has vast opportunities for humanity, yet its integration into early childhood development is not without risks and ethical dilemmas. Because of the vulnerability of young children (ages 0-5), they demand an exceptionally cautious and responsible approach to the use of technology. AI could help with creativity, education, and social and emotional development in early childhood, but it can confuse young children and generate harmful misinformation and inappropriate content (Chng, 2025). AI algorithms may, for instance, strengthen existing biases when taught on biased data (Lee, 2025; Grundmeier et al., 2026). Since the technologies are created to show information and content one requested and shows interest in, it can be dangerous for children because it can allure them into discriminatory, violent, immoral or dangerous content.

Issues of "Deskilling" and "Never-skilling"

There are major concerns about the use of AI in the early years of children's development. Grundmeier et al. (2026) are deeply worried about the exposure of AI programmes to children in their early childhood without proper guidance from parents and caregivers. Such exposures can lead to issues like "deskilling", which simply means a situation where kids lose the ability to do something they could previously do because of an over-dependence on AI tools. There also came "never skilling," which means that children never learn to do a particular task because they have actually asked AI to do it for them as opposed to using the AI as a tool to help them to learn (Grundmeier et al., 2026). The constant use of AI and relying heavily on AI recommendations and computerised decision-making processes may hinder children's development of critical thinking, problem-solving abilities and independent decision-making skills (Cela et al., 2024).

Digital Divide in using AI tools

The digital divide could be referred to as the gap between those who have access to digital technologies, like the internet and AI, and those who do not have access to such technologies (Bozic, 2023). AI can risk aggravating the existing digital divide, since it can inflate access. The benefits of AI in early childhood development will largely help those with access to reliable internet, suitable devices, and parents or educators equipped to integrate these tools (Dong, 2025). However, families from lower socioeconomic backgrounds may lack the financial resources for AI-powered devices or high-speed internet, creating a new form of educational inequality. Furthermore, educators and parents in underserved communities may not receive adequate training on how to effectively use

AI tools, leading to underutilization or misuse of the technology (Dong, 2025).

Excessive Screen Time

Over-reliance on AI-powered digital tools could lead to excessive screen time, which potentially displaces face-to-face interaction. Excessive use of screens by children (ages 0-5) can be detrimental to their health (Muppala et al., 2023). This has been linked to adverse effects on neurodevelopment and cognitive performance. Prolonged screen exposure may impair attention, regulation, memory consolidation, and fine motor skills (Murillo & Rocca, 2025). Again, AI cannot replicate the nuanced emotional connection, spontaneous responsiveness, and empathetic guidance that a human educator or parent provides. There is a risk that children might interact more with screens than with people, hindering their social development. The long-term effects of extensive AI interaction on young children's developing brains are not yet fully understood, raising concerns about attention spans, creativity, and critical thinking. Therefore, AI must always be viewed as a supplement to human interaction, not a *substitute*. The human element remains the irreplaceable cornerstone of early childhood (Cimino et al., 2024). As a result of this negative effect, the international guidelines from the World Health Organization (WHO) and the American Academy of Pediatrics (AAP) recommend limiting screen time (ST) to a maximum of 1 hour per day for children aged 2 to 5 years (Nuvoli et al, 2025).

Content Quality

When it comes to the quality of AI-generated content designed for children, this can vary extensively. It may cause concerns regarding the suitability, accuracy, and educational and developmental value of the information provided to children. If these AI tools used by children (ages 0-5) are not meticulously selected, carefully curated, or regulated, they can propagate misinformation or content that is not developmentally appropriate for these children (UNICEF, 2024).

Ethical risks

Artificial Intelligence has made some outstanding progress recently by enabling machines to perform complex and difficult tasks and make independent decisions. Nevertheless, the improvement raises some essential ethical questions. One of the greatest problems is whether AI can be programmed to have morals, as moral decision-making is a human trait that involves empathy and the ability to distinguish between right and wrong. Although AI systems can operate from vast amounts of data and mimic human behaviour, they lack the inherent understanding of morality that humans possess (Shin, 2025; Olufemi, 2023). However, in early childhood development, personal data collected and analysed about children (e.g., sensitive information about behaviour and preferences) raises serious ethical questions regarding privacy and data security, particularly when data are collected without parental consent or adequate protections (UNICEF, 2024).

Furthermore, considering the ethical implications of using AI with children

involves questions regarding consent, the appropriate role of AI in childhood development, and the long-term impact of early exposure to AI technologies. Therefore, there is an urgent need for teachers, school administrators, parents, as well as policymakers to establish effective and ethical AI policies designed to ensure that AI systems for early childhood are developed and implemented responsibly (UNICEF, 2024).

Conclusion

This paper bridges gaps in literature by exploring the benefits, risks and ethical implications of the use of AI technological tools on early childhood development (ages 0-5). Other research has not really paid much attention to the use of AI and children (ages 0-5). It was found in the paper that AI has enormous opportunities and benefits for children in their early formative years. The study highlighted some of the benefits of AI on early childhood development, especially for children (ages 0-5). However, its integration into early childhood development is not without risks and ethical impasses. AI in early childhood care can be used directly by children and by individuals who interact directly with children, such as parents, family members and educators. As society continues to harness AI technologies to enhance early childhood development, there is a need to develop corresponding practical frameworks to mitigate the risks of AI on early childhood development and care.

Recommendations

- Supervision of AI tools: AI Chatbot and tools must be used by children under the guidance and supervision of their parents and caregivers to help them navigate the risks and avoid misinformation and inappropriate content.
- There should be a balanced approach that integrates technology use with conventional learning. Since children are becoming immersed in the use of AI, it must be ensured that AI serves as a supplement to, not as a replacement of, play-based learning and in-person education from parents and teachers.
- AI tools should be designed in such a way that they support children from low socio-economic regions. All children should benefit from AI technologies.
- There should be a comprehensive AI training programme for both parents and educators to enable them to understand the use of AI and how to monitor the technologies used by the children.
- Policy makers, institutions and government must enforce strict data privacy standards specifically for early childhood development.
- To mitigate these risks, AI systems must be designed with vigorous ethical guidelines that prioritise inclusivity, transparency, and accountability.
- It is therefore imperative to establish ethical frameworks that prioritise children's rights, privacy, and developmental needs during the use of these technologies. Parents, educators, psychologists, and AI developers must collaborate in order to address these issues.

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