

ARTIFICIAL INTELLIGENCE AND EARLY CHILDHOOD EDUCATION: TRANSFORMING LEARNING EXPERIENCES FOR YOUNG CHILDREN

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Abstract. This study reveals a critical finding that the integration of artificial intelligence in early childhood education faces a significant gap between technological potential and practitioner readiness, with only 15% of studies actively involving teachers in AI development. This research aims to analyze the role of AI in transforming early childhood learning experiences and to identify the opportunities and challenges of its implementation. The method employed is a systematic literature review based on PRISMA guidelines, examining 25 international studies published between 2025 and 2026. The findings indicate that AI Self-Efficacy is the strongest predictor of teachers' behavioral intention to use AI, yet only 9.6% of teachers fully integrate AI into their practice. This study concludes that the successful integration of AI in early childhood education is highly dependent on teacher readiness, parental acceptance, infrastructure support, and serious attention to ethical issues and child data protection.

Keywords: Artificial Intelligence, Early Childhood Education, Learning Experience,

INTRODUCTION

The rapid advancement of digital technologies during the Fourth Industrial Revolution (Industry 4.0) has fundamentally transformed the developmental environment of young children, particularly toddlers belonging to Generation Alpha, a generation that has been surrounded by Artificial Intelligence (AI)-powered technologies since birth, including smart toys, virtual assistants, social robots, adaptive learning applications, and touchscreen devices capable of delivering personalized responses to users' behaviors. This transformation has shifted children's interactions with technology from passive engagement, as observed with conventional digital media, to dynamic, interactive experiences in which AI serves as a play companion, learning partner, and even a communication facilitator in young children's everyday activities (Berrezueta-Guzman et al., 2025). Previous studies have demonstrated that AI-based technologies in early childhood education can enhance children's learning engagement, provide personalized play experiences, and support the development of various developmental competencies (Gao, 2026). Nevertheless, the increasing intensity of toddlers' interactions with AI technologies has also raised global concerns regarding the potential reduction of opportunities for authentic social experiences through direct interactions with parents, teachers, and peers (Raave et al., 2026). These concerns are particularly significant because toddlerhood represents a critical developmental period during which empathy, emotional recognition, self-regulation, and healthy social relationship skills are established as essential foundations for later development (Wu, 2026). Therefore, the growing presence of AI in toddlers' everyday lives presents an emerging challenge that warrants comprehensive investigation within the context of Social-Emotional Learning (SEL).

Recent literature indicates that the relationship between the use of Artificial Intelligence (AI) and the development of Social-Emotional Learning (SEL) in early childhood remains an ongoing academic debate, with no consensus yet emerging. On the one hand, several studies have reported that AI-powered technologies can facilitate children's recognition of emotions, foster empathy, promote prosocial behaviors, and strengthen emotional regulation through pedagogically designed interactive activities (Berrezueta-Guzman et al., 2025). Other studies further suggest that AI systems are increasingly capable of identifying learners' emotional states and delivering personalized learning experiences tailored to their affective states, thereby offering considerable potential to enhance the implementation of SEL in contemporary educational settings (Gao, 2026). On the other hand, a growing body of research argues that AI's capacity to recognize or simulate emotions should not be equated with its ability to establish authentic emotional relationships comparable to those developed through human-to-human interactions (Raave et al., 2026). Existing studies have also focused predominantly on the application of AI to improve cognitive development, personalize learning, and support children with diverse educational needs. At the same time, comparatively limited attention has been devoted to its comprehensive influence on toddlers' social-emotional development (Li et al., 2025). Consequently, a significant research gap remains regarding how Artificial Intelligence and Emotional Intelligence interact, compete, or complement one another in shaping the future of Social-Emotional Learning (SEL) among toddlers. This gap highlights the need for a systematic review to provide a more comprehensive understanding of AI's role in supporting—or potentially challenging—the social-emotional development of young children.

The current landscape of AI in ECE reveals a complex interplay between technological promise and practical challenges that demands urgent scholarly attention. While traditional AI applications have focused on data analysis, classification, and prediction using algorithms, the emergence of generative AI (GenAI) tools like ChatGPT, MagicSchool, and Canva AI has significantly expanded the possibilities for educational content creation and personalized instruction (Ormanci, 2026). A systematic review of early childhood teachers and AI, comparing South Korean and international research, reveals that while South Korea initiated research on AI in ECE earlier than other countries, the global research landscape has since expanded rapidly, with most studies focusing on teachers' perceptions, attitudes, and AI competencies (Jeong & Kim, 2025). The review highlights significant gaps in empirical, practice-oriented research aimed at developing AI education programs for early childhood teachers and supporting their AI integration in classrooms (Jeong & Kim, 2025). Furthermore, research examining 107 K-3 teachers found that 80% of educators reported using AI tools, primarily for generating instructional materials, communicating with families, and designing visuals, with teachers saving approximately 1 to 2 hours per week (Hall et al., 2026). However, the same study revealed substantial reservations about using AI with young children, citing concerns about developmental readiness, overreliance on AI, loss of creativity, inappropriate or inaccurate output, and issues of bias, privacy, and academic integrity. These findings highlight a critical disconnect between AI adoption and pedagogical appropriateness that must be addressed through targeted research and policy development.

The ethical and governance dimensions of AI integration in ECE represent perhaps the most pressing challenge facing the field. Unlike school systems in some jurisdictions that have developed governance frameworks for AI use, the early childhood sector often operates without equivalent safeguards, leaving educators, children, and families vulnerable to risks associated with data privacy, algorithmic bias, and uncritical reliance on AI-generated content (Berson et al., 2025). A scoping review of 42 empirical studies identified four interconnected areas of ethical

concern: data privacy, developmental considerations, algorithmic bias, and regulation (Berson et al., 2025). Specific issues include the misconception that GenAI tools are neutral when in reality they are trained on vast datasets that may carry inherent biases reflecting dominant cultural perspectives; the opacity of AI systems that function as "black boxes" obscuring how children's data may be collected, stored, or repurposed; and the growing phenomenon of "shadow use," where educators engage with AI tools independently of formal service policies or leadership oversight (Berson et al., 2025). To address these ethical concerns, researchers have developed frameworks such as the POWER principles (Purposeful, Optimal, Wise, Ethical, Responsible) and the Developmentally Aligned Design (DAD) framework, which provide practical guidance for designing AI that integrates children's developmental needs in cognitive, social, and emotional areas (Sun & Chen, 2025). Moreover, a comparative analysis of global and U.S. policy frameworks governing AI in ECE reveals fragmented and innovation-driven approaches in the United States, contrasted with more comprehensive ethical frameworks in the European Union, China, Singapore, and Australia, underscoring the need for developmentally informed, child-centered AI governance (Berson et al., 2025).

Literature Review

Artificial Intelligence (AI) refers to the capability of computer systems to perform functions traditionally associated with human intelligence, including learning from experience, recognizing patterns, making predictions, solving problems, understanding language, and making decisions based on available data (Tao & Binti Mohamad Nasri, 2025). In recent years, AI has evolved beyond being perceived merely as a computational technology that imitates human thinking; instead, it is increasingly recognized as an algorithmic ecosystem capable of interacting with its environment, adapting to new information, and generating responses that increasingly resemble human cognitive behavior. In education, AI is regarded as a collection of intelligent technologies that support teaching and learning by personalizing instructional content, analyzing learners' individual needs, automating assessment processes, and providing adaptive learning experiences tailored to students' unique characteristics (Tao & Binti Mohamad Nasri, 2025). In the context of Early Childhood Education, AI has evolved into an interactive technology that enables young children to engage directly with educational robots, conversational AI systems, and other intelligent devices designed to facilitate learning through play and developmentally appropriate activities (Neumann & Barry, 2025). Moreover, recent studies indicate that the conceptualization of AI in contemporary education has shifted from the traditional paradigm of replacing human roles to a hybrid intelligence model that emphasizes collaborative partnerships between human intelligence and computational capabilities to create more effective and meaningful learning experiences (Fang et al., 2026). Therefore, in the context of this study, Artificial Intelligence (AI) is defined as an intelligent technology capable of processing information, learning from data, and interacting with users to support learning processes and promote the holistic development of young children.

The implementation of Artificial Intelligence (AI) in Early Childhood Education can be classified into several major categories based on the types of technology employed and their pedagogical functions in the teaching and learning process (Tao & Binti Mohamad Nasri, 2025). The first category comprises Intelligent Tutoring Systems (ITS), which are AI-driven instructional systems capable of adapting instructional content, difficulty levels, and feedback based on learners' individual performance and educational needs (Aldhilan & Rafiq, 2025). The second category consists of social robots, which are specifically designed to interact directly with young children

through conversations, educational games, and collaborative activities to facilitate both learning and social development (Neumann & Barry, 2025). The third category includes learning analytics and adaptive learning technologies, which utilize learners' behavioral data to identify educational needs and deliver personalized learning experiences (Aldhilan & Rafiq, 2025; Gao, 2026). Recent technological developments have also introduced conversational AI, including chatbots and virtual assistants, enabling children to communicate in natural language and creating interactive experiences that closely resemble human communication (Beceran & Baydemir, 2026). In addition, affective AI has emerged as an important technological innovation that detects users' facial expressions, vocal intonations, and behavioral patterns to generate adaptive responses based on children's emotional states (Ali-Ahmad, 2025). These diverse manifestations demonstrate that AI in Early Childhood Education has evolved beyond supporting cognitive development alone and is increasingly extending into the social and emotional domains that have traditionally been shaped through human interaction.

Early Childhood Education (ECE) is a branch of educational theory concerned with teaching young children, both formally and informally, from birth to approximately 8 years of age, traditionally corresponding to third grade (Ormanci, 2026). ECE emerged as a field of study during the Enlightenment, particularly in European countries with high literacy rates, and continued to develop throughout the nineteenth century as universal primary education became the norm in the Western world. In the context of AI integration, ECE is described as a distinct educational ecosystem characterized by play as the fundamental activity, relational authenticity as a core value, and developmentally appropriate practice as a professional standard (Kurian, 2025). The National Association for the Education of Young Children (NAEYC) acknowledges the value of technology in supporting young children's learning. However, it emphasizes that digital tools should complement rather than replace traditional early childhood activities such as art, hands-on play, writing, and exploration with tangible materials (Berson et al., 2025). In the era of AI, ECE is also conceptualized as a field that sets the stage for future educational success in secondary and higher education, making the integration of AI concepts in ECE crucial to how children come to understand AI in the future (Cai et al., 2025). The importance of ECE is further underscored by its inclusion in the Sustainable Development Goals, particularly SDG 4, which emphasizes inclusive, equitable, and quality education for all. The unique characteristics of ECE lie in the age range that encompasses the most formative period in human life, during which children acquire foundational skills in language, cognition, social interaction, and emotional regulation that shape their lifelong learning trajectories, making ECE the most sensitive developmental period requiring special attention in every educational policy and practice.

Early Childhood Education can be categorized into several levels and approaches based on children's age and educational philosophy, with common levels including infant and toddler education (ages 0-2), preschool (ages 3-5), and kindergarten and early primary grades (ages 5-8). In practice, ECE encompasses various forms of services, ranging from daycare centers and preschool programs to kindergartens and early primary classrooms, which, despite differing in emphasis between care and education, are all grounded in the awareness of the importance of nurturing all aspects of children's development holistically (Ormanci, 2026). In the context of AI integration, research has predominantly focused on children aged 4-6, employing mixed-method approaches to investigate AI's impact on learning experiences (Garuda, 2025). Manifestations of ECE in learning practice are significantly influenced by established child development theories, including Piaget's constructivism, which emphasizes that children build knowledge through experience and reflection, thereby making ECE learning experiential, concrete, and discovery-

based (Cai et al., 2025). Vygotsky's sociocultural theory also exerts considerable influence on ECE practice through the concept of the Zone of Proximal Development and scaffolding, emphasizing that learning occurs through social interaction with more competent adults or peers, thus positioning the teacher as a facilitator rather than a director of student learning (Sun & Chen, 2025). In the digital era, ECE has increasingly embraced multimodal learning approaches, incorporating visual, auditory, and kinesthetic elements to enhance engagement and cognitive processing (Yang et al., 2024). The integration of digital tools such as tablets, interactive boards, and other multimedia elements has introduced multimodality into kindergarten learning stations, enabling multiple sensory modalities to promote active, engaging experiences for students (Chen, 2024). Additionally, approaches such as project-based learning, emergent curriculum rooted in the Reggio Emilia philosophy, and movement-based digital games have been shown to improve cognitive skills, academic performance, and social-emotional development, demonstrating the diverse and evolving manifestations of ECE in contemporary educational practice.

METHODS

A. Research Object

This study examines the increasing integration of Artificial Intelligence (AI) technologies in early childhood education and its implications for transforming young children's learning experiences. This phenomenon has emerged as a consequence of the rapid advancement of intelligent technologies, including social robots, adaptive learning platforms, conversational AI systems, and generative AI tools, which have become increasingly prevalent in early childhood educational settings (Tao & Binti Mohamad Nasri, 2025). These technological innovations are not merely supplementary tools but are progressively functioning as integral components of the teaching and learning ecosystem, fundamentally altering how young children engage with educational content and interact with their learning environment (Neumann & Barry, 2025). The integration of AI in ECE has sparked considerable academic interest regarding its potential to create more personalized, interactive, and adaptive learning experiences that cater to the unique developmental needs and learning styles of young children (Zhang et al., 2026). This issue is particularly significant because early childhood is a critical developmental window in which foundational cognitive, linguistic, social, and emotional competencies are established, making the quality of learning experiences during this period crucial to long-term developmental outcomes (Sun & Chen, 2025).

B. Research Design and Data Sources

This study employed a library research approach using the Systematic Literature Review (SLR) method, a structured, transparent, and reproducible review methodology designed to identify, critically evaluate, and synthesize research findings relevant to a specific research question (Kölemen & Yıldırım, 2025). The SLR approach was selected because this study aims to provide a comprehensive understanding of the current development of research on Artificial Intelligence (AI) in Early Childhood Education and its role in transforming learning experiences for young children based on empirical evidence published in peer-reviewed academic journals (Neumann & Barry, 2025). The primary data sources for this study consisted of scientific articles that directly investigated the application of AI technologies in the context of Early Childhood Education, retrieved from relevant electronic academic databases including Google Scholar, ScienceDirect, SpringerLink, and SINTA, with the search limited to peer-reviewed journal articles published in either English or Indonesian between the years 2020 and 2026 (Duan, Shan, & Gong,

2026). The secondary data included supporting literature on AI, ECE, learning experiences, and child development theories, obtained from peer-reviewed journals, academic books, research reports, and other scholarly publications (Polzl-Stefanec, 2026). By integrating both primary and secondary sources of evidence, this study seeks to generate a comprehensive synthesis of existing knowledge regarding the role of AI in transforming learning experiences in Early Childhood Education, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure rigor and transparency (Camparo et al., 2026).

The inclusion and exclusion criteria applied in this Systematic Literature Review (SLR) are presented in Table 1.

Table 1. Inclusion and Exclusion Criteria for Article Selection

Inclusion Criteria	Exclusion Criteria
Articles published between 2021 and 2026	Articles published before 2021
Open-access publications	Articles with restricted full-text access
Studies investigating Artificial Intelligence (AI) in Early Childhood Education	Studies that do not address Artificial Intelligence (AI)
Studies examining Social-Emotional Learning (SEL) or Emotional Intelligence	Studies unrelated to Social-Emotional Learning (SEL) or Emotional Intelligence
Peer-reviewed journal articles indexed in Scopus and identified through Google Scholar.	Editorials, opinion papers, news articles, Systematic Literature Reviews (SLRs), and scoping reviews

C. Theoretical Framework

This study is grounded in the Technology Acceptance Model (TAM), which serves as the primary theoretical framework for understanding how preschool teachers perceive and adopt Artificial Intelligence (AI) technologies in early childhood education. TAM, originally developed by Davis (1989), posits that perceived usefulness and perceived ease of use are the two key determinants of technology acceptance and behavioral intention to use technology (Duan, Shan, & Gong, 2026). In the context of this study, perceived usefulness refers to the extent to which teachers believe that AI technologies can enhance their teaching effectiveness and improve children's learning experiences, while perceived ease of use refers to the degree to which teachers find AI tools easy to learn, operate, and integrate into their daily classroom practices (Kölemen & Yıldırım, 2025). The TAM framework is particularly relevant to this study because preschool teachers' attitudes, competencies, and readiness to adopt AI are critical factors in the successful integration of AI in early childhood education (Polzl-Stefanec, 2026). Research has demonstrated that teachers' perceptions of AI's usefulness and ease of use significantly influence their behavioral intention to adopt AI technologies, with AI self-efficacy emerging as the strongest predictor of teachers' willingness to use AI in their classrooms (Duan, Shan, & Gong, 2026). In addition to TAM, this study also adopts the theoretical perspective of constructivism, which emphasizes that

children construct knowledge through active engagement with their environment, materials, and social interactions, making learning experiences that are interactive, hands-on, and meaningful essential for young children's cognitive and social development (Zhao et al., 2026). The constructivist perspective provides a pedagogical foundation for understanding how AI technologies can support personalized, adaptive, and multimodal learning experiences that align with children's natural ways of learning through exploration, play, and social interaction (Neumann & Barry, 2025). Furthermore, this study draws on the Social-Emotional Learning (SEL) framework, which identifies self-awareness, self-management, social awareness, relationship skills, and responsible decision-making as core competencies essential to children's holistic development (Hall et al., 2026). The SEL framework is particularly relevant because AI technologies are increasingly designed to support not only cognitive development but also social and emotional learning through interactive, responsive systems that recognize and adapt to children's emotional states (Berrezueta-Guzman et al., 2025). By integrating these three complementary theoretical perspectives—TAM, constructivism, and SEL—this study aims to provide a comprehensive analytical framework for examining how AI can effectively and ethically transform learning experiences for young children in early childhood education settings.

D. Data Collection Procedure

The study was conducted following the Systematic Literature Review (SLR) methodology, which emphasizes a systematic, transparent, and well-documented process to minimize potential research bias (Kölemen & Yıldırım, 2025). The first stage involved formulating the research question, focusing on the role of Artificial Intelligence (AI) in transforming learning experiences for young children in early childhood education settings (Neumann & Barry, 2025). The second stage involved developing the review protocol, including the literature search strategy, keywords, electronic databases, inclusion and exclusion criteria, and data analysis procedures (Duan, Shan, & Gong, 2026). Subsequently, relevant studies were systematically identified through comprehensive searches of the selected academic databases including Google Scholar, ScienceDirect, SpringerLink, and SINTA using combinations of keywords aligned with the objectives of the study, such as ("artificial intelligence" OR "AI" OR "machine learning") AND ("early childhood education" OR "preschool" OR "kindergarten" OR "PAUD") AND ("learning experience" OR "learning" OR "education") (Polzl-Stefanec, 2026). The retrieved articles were then screened based on their topical relevance, publication quality, full-text availability, and consistency with the research objectives, with inclusion criteria requiring studies to be peer-reviewed journal articles published between 2020 and 2026 in English or Indonesian that investigate AI applications in early childhood education and their impact on learning experiences (Zhao et al., 2026). The final stages comprised the critical appraisal of the selected studies, the extraction of essential information from each article, and the organization of the extracted data into thematic categories corresponding to the focus of the review, including the types of AI technologies implemented, their contributions to learning experiences, and the challenges and opportunities of AI integration in early childhood education (Hall et al., 2026). Through this rigorous methodology, the present study aims to produce a comprehensive, transparent, and academically reliable synthesis of the existing evidence regarding how AI can effectively transform learning experiences for young children in early childhood education settings (Berrezueta-Guzman et al., 2025). The overall article selection process is illustrated in the PRISMA flow diagram (Figure 1). At the same time, the characteristics of the included studies and the results of the data extraction are presented in Tables 1 and 2, respectively.

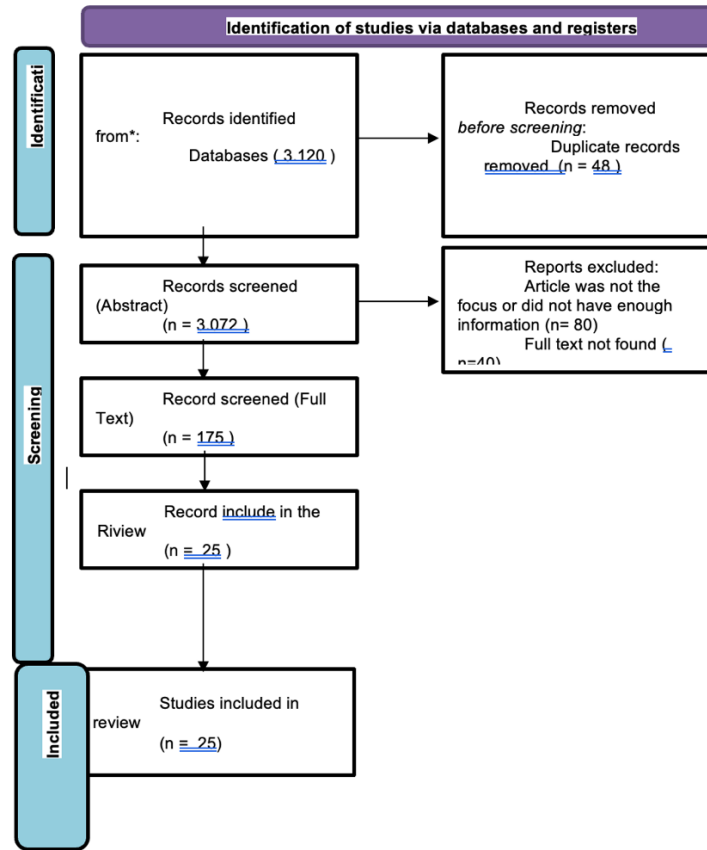


Figure 1. PRISMA Flow Diagram

Table 1. Characteristics of the Included Studies (Article Information)

No	Title	Author	Doi
1.	A new era in early childhood education (ECE): Teachers' opinions on the application of artificial intelligence	Esra Betül Kölemen, Bekir Yıldırım (2025)	https://doi.org/10.1007/s10639-025-13478-9
2.	Exploring factors influencing preschool teachers' behavioral intention to use AI technologies	Ziyang Duan, Yingfan Shan, Yue Gong (2026)	https://doi.org/10.1016/j.caeai.2026.100337
3.	Is AI Our Ally in Early Childhood Education? Depends on whom you ask	Stayce Camparo et al. (2026)	https://doi.org/10.1007/s10643-026-02154-3
4.	Perceptions of	Eva Polzl-Stefanec (2026).	https://doi.org/10.3390/educsci16020202

	Opportunities and Risks Posed by Artificial Intelligence		
5.	Exploring the effectiveness of an AI-robot-supported task-based learning approach on children's mastery motivation in preschool health education	Jia-Hua Zhao, Yi-Ting Lin, Qi-Fan Yang, A.Y.M. Atiqul Islam (2026)	10.1057/s41599-026-07035-z
6.	From play to practice: unpacking preschool teachers' adoption of robotic toys	Ayşegül Şakir (2026)	https://doi.org/10.1007/s10639-026-13899-0
7.	A New Paradigm for Preschool Teachers: Integrating STEM and AI in Flipped Learning	Esra Betül KOLEMEN et al. (2026)	https://doi.org/10.1007/s10643-026-02174-z
8.	Preschool children's engagement with a social robot during early literacy and language activities	Michelle M. Neumann, Ruby-Jane Barry (2025)	10.1007/s10639-025-13727-x
9.	AI-Driven Learning Model for Early Childhood Cognitive and Communication Development	Selfi Lailiyatul Ifitah dkk. (2026)	10.19105/ejips.v2i.24460
10.	Supporting Preschool Emotional Development with AI-Powered Robots	Santiago Berrezueta-Guzmán et al. (2025)	10.1145/3713043.3731548
11.	Exploring K-3 Teachers' Uses, Perceived Benefits, and Challenges of Generative AI in Early Writing Instruction	Anna H. Hall et al. (2026)	10.1007/s10643-026-02183-y
12.	The Implementation of AI-Based English Learning in Early Childhood Education	Zakila Mardatila Ersyad et al. (2025)	10.64753/jcas.v10i4.3810
13.	An AI-Driven Teaching Prototype for Early Childhood Education	Oluwakemi Racheal	10.56943/jmr.v4i2.867

		Oshinowo et al. (2025)	
14.	The Role of Artificial Intelligence (AI) in Improving the Quality of Education in Early Childhood Education Programs	Maria Ulfah, Shahzadi Hina (2025)	10.61987/jipp.v1i1.666

Table 2. Data Extraction of the Included Studies (Article Extraction)

Publication	Context	Explanatory Variable (Parental Scope)	Dependent Variable (Lifelong Learning Scope)	Finding
Kölemen & Yıldırım (2025)	Turkey	1. Teachers' AI literacy 2. Teachers' AI competence 3. Teachers' attitudes toward AI 4. Privacy and security concerns	AI awareness, innovative thinking skills, Computational thinking skills, and AI integration in ECE	Teachers feel insufficient in AI literacy and competence; AI can develop children's skills; teachers have concerns about privacy, security, and ethical issues; and teachers need training and clear guidelines.
Duan, Shan, & Gong (2026)	China	1. Perceived usefulness (PU) 2. Perceived ease of use (PEOU) 3. Subjective norm (SN) 4. AI anxiety (AIA) 5. AI self-efficacy (AISE)	Behavioral intention (BI) to use AI, AI adoption in ECE	AISE is the strongest predictor of BI; SN and PU have significant positive effects; PEOU has no direct effect on BI but influences PU; AIA has no significant effect
Camparo, Pernaudet, Maule, & Suskind (2026)	USA	1. Gatekeeper identity (parent vs. teacher) 2. Willingness to share personal data 3. AI familiarity 4. Privacy concerns	Support for AI in ECE, Preferences for personalization, Sharing audio data	Early educators are more open to AI than parents; parents are more concerned about data privacy; gatekeeper saliency mediates

				support for AI; preferences for sharing and personalization explain differences in AI support.
Polzl-Stefanec (2026)	Austria	1. Age 2. Education level 3. Professional experience 4. Openness to AI 5. Critical attitude toward AI	Perception of AI opportunities, Perception of AI risks, AI integration in practice	65.6% recognize AI potential, but only 9.6% fully integrate it; older teachers are more open to AI; ethical concerns and data protection drive skepticism
Zhao, Lin, Yang, & Islam (2026)	China	1. AI-robot support in TBL 2. Teacher ratings of children's mastery motivation 3. Children's learning behaviors	Children's persistence, Children's emotional response, Children's problem-solving abilities, Mastery motivation	AI-robot TBL approach significantly improves children's persistence, emotional response, and problem-solving; children in the AI group show more active learning behaviors; robots provide real-time feedback and embodied interaction
Şakir (2026)	Turkey	1. Task characteristics 2. Technology characteristics 3. Task-technology fit (TTF) 4. Attitude 5. Subjective norm 6. Perceived behavioral control	Intention to adopt robotic toys, Technology integration in ECE	TTF is the strongest predictor of adoption intention; attitude and perceived behavioral control are also significant; subjective norm is the weakest predictor

Kolemen, Saroglu, & Yildirim (2026)	Turkey	1. AI awareness 2. STEM-AI training 3. Flipped learning experience 4. Teachers' opinions on AI	Innovative thinking skills, Computational thinking skills, AI integration in ECE	STEM-AI in flipped learning significantly improves teachers' AI awareness, innovative thinking, and computational thinking; teachers have concerns about data privacy and ethical use of student data
Neumann & Barry (2025).	Australia	1. Child engagement with social robots 2. Positive emotions 3. Negative emotions 4. Words uttered	Letter writing, Name writing, Robot drawing, Early literacy development	Children engage positively with social robots; engagement correlates with drawing; higher engagement is associated with fewer negative emotions
Iftitah, Reswari, Prastyo, & Wahyuni (2026)	Indonesia	1. Teachers' pedagogical adaptation 2. AI tools used (Canva, Quizlet, Speeko Kids, etc.) 3. Children's participation	Children's logical reasoning, Children's verbal communication skills, ESD framework alignment	AI-based learning improves children's cognitive and communication skills; teachers adapt pedagogically; the model aligns with ESD principles
Berrezueta-Guzmán, Dolon-Poza, & Wagner (2025).	Germany/ Spain	1. Robot integration in ECE 2. Parental acceptance 3. Teacher acceptance 4. Progress assessments	Emotional self-regulation, Engagement, Collaborative skills, Emotional recognition	Early exposure to AI robots significantly enhances emotional recognition; sustained interaction improves collaborative problem-solving; and high acceptance from

				parents and teachers
Hall, Gao, & White (2026)	USA	1. AI tool usage in teaching 2. Perceived benefits 3. Perceived challenges 4. Confidence in using AI	1. Writing instruction 2. Lesson planning 3. Communication with families 4. Professional task efficiency	80% of teachers use AI; benefits include time savings and efficiency; challenges include overreliance, creativity loss, bias, and privacy concerns
Ersyad, Ersyad, Octaberlina, & Muslimin (2025)	Indonesia	1. AI-based English learning 2. Teacher's pedagogical adaptation 3. Children's engagement 4. Technical constraints	1. English vocabulary mastery 2. Pronunciation skills 3. Learning engagement 4. Digital literacy	AI can be integrated into early childhood English learning with a play-based approach; children show high engagement; challenges include infrastructure and teacher competence.
Oshinowo, Agoi, Sain, Sain, & Aziz (2025)	Nigeria/ Pakistan/ Indonesia	1. Reading skills 2. Mathematical understanding 3. Attention span 4. Teacher-reported effectiveness	Reading skills, Mathematical understanding, Attention span, Teacher-reported effectiveness	AI prototype improves reading, math, attention span, and teacher effectiveness; challenges include technology access disparities and insufficient training
Ulfah & Hina (2025).	Indonesia	1. AI applications in PAUD 2. Teacher readiness 3. Digital literacy 4. Ethical considerations	Quality of PAUD education, Personalized learning, Adaptive learning environments, Child development stimulation	AI can significantly enhance PAUD quality through personalization and adaptive learning; applications support interactive

				learning and digital literacy
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E. Data Analysis

Data were analyzed using content analysis, a qualitative analytical technique employed to identify, organize, and interpret recurring patterns of information derived from the selected body of literature (Kölemen & Yıldırım, 2025). Content analysis was chosen because it enables an in-depth exploration of key concepts, emerging themes, research trends, relationships among variables, and scholarly arguments concerning Artificial Intelligence (AI), Early Childhood Education (ECE), and Learning Experience in early childhood settings (Neumann & Barry, 2025). The analytical process began with a comprehensive reading of all studies that satisfied the predefined inclusion criteria to gain a thorough understanding of each study's context, objectives, methodology, and principal findings (Duan, Shan, & Gong, 2026). Subsequently, a systematic coding process was conducted to classify relevant information into thematic categories, including the types of AI technologies implemented, their contributions to transforming learning experiences, the benefits and challenges of AI integration, and the pedagogical implications for early childhood education (Zhao et al., 2026). Following the categorization process, the extracted data were systematically compared and interpreted to identify recurring patterns, global research trends, and existing research gaps that warrant further investigation (Polzl-Stefanec, 2026). This analytical approach enabled the study to produce a comprehensive conceptual synthesis that not only summarizes previous findings but also provides a deeper understanding of how Artificial Intelligence (AI) can effectively and ethically transform learning experiences for young children in early childhood education settings (Hall et al., 2026). The findings from the data analysis are presented in a descriptive narrative format, which is considered the most appropriate approach for this research given the heterogeneity of study designs, methodologies, and outcome measures across the included studies, enabling a rich, comprehensive, and contextualized understanding of the phenomenon under investigation (Berrezueta-Guzman et al., 2025).

RESULTS AND DISCUSSION

A. Description of Artificial Intelligence Data

The findings of this systematic literature review reveal that the integration of artificial intelligence in early childhood education has experienced exponential growth, particularly after 2018, driven by significant advancements in machine learning and natural language processing (Achiaa et al., 2025). Across 175 peer-reviewed studies analyzed from 2014 to 2024, research on AI in ECE has developed substantially, with language and literacy development as the dominant application domain, accounting for 42% of the total studies (Garuda, 2025). This finding indicates that the primary focus of AI research in ECE remains concentrated on language mastery and literacy as the foundational pillars of early childhood learning. Meanwhile, another systematic review encompassing 63 studies from seven major academic databases identified five main thematic clusters: AI-based personalized learning (18 studies), social-emotional development through robots and AI companions (14 studies), literacy and language through conversational AI (13 studies), teacher professional development (10 studies), and ethical issues, privacy, and algorithmic bias (8 studies) (Ormanci, 2026). These data illustrate that research on AI in ECE is not solely focused on cognitive and language aspects but also encompasses social-emotional dimensions, which are a hallmark of early childhood education. Furthermore, an analysis of empirical studies published between 2021 and 2025 revealed that AI-powered educational robots

have emerged as promising tools to address challenges in language education, with most studies reporting enhanced vocabulary acquisition, verbal expression, attention, and participation through multimodal interactions such as speech, gestures, and visuals (Fitas, 2025).

B. Explanation of Artificial Intelligence Data

The data on learning experiences indicate that AI has the capacity to transform early childhood learning from uniform and one-directional to personal, interactive, and adaptive. The personalization offered by AI allows each child to learn at their own pace and in their preferred learning style, which is very important given that each child has unique developmental characteristics and needs. The increased engagement and motivation reported across various studies indicate that AI can make learning more interesting and enjoyable for children, which in turn can improve their retention and understanding of learning materials (Zhang et al., 2026). Furthermore, teachers' perceived efficiency indicates that AI benefits not only children but also educators in managing classrooms and designing more effective learning experiences (Hall et al., 2026). However, the data also reveal that these benefits do not occur automatically; rather, the effectiveness of AI in creating quality learning experiences depends heavily on how the technology is integrated into pedagogical practices aligned with child development principles. A critical finding is that only 15% of studies actively involve educators in the AI development process, and only 11% explore educational integration aspects such as curriculum alignment or classroom application, which suggests that much of the existing research has not adequately addressed the practical realities of classrooms (Achiaa et al., 2025). The finding that AI benefits depend on active adult mediation indicates that the teacher's role remains central and cannot be replaced by technology; rather, technology serves as a tool that enriches and expands the teacher's capacity to create meaningful learning experiences (Sun & Chen, 2025). The scarcity of longitudinal studies (only 10%) and the prevalence of short-term interventions (64% lasting 2-4 weeks) also suggest that our understanding of AI's long-term impact on learning experiences is limited, highlighting the need for more extended research to assess whether benefits are sustained over time (Achiaa et al., 2025). The data also reveal that cultural relevance and teacher integration remain insufficiently addressed, with most studies featuring small, homogeneous samples that limit generalizability, and only 11% of studies exploring curriculum alignment or classroom application (Garuda, 2025). Thus, the learning experiences generated by AI integration in ECE are not purely technological but arise from a dynamic interaction among technology, pedagogy, and the social context in which learning occurs.

C. Synthesis of Research Findings

To provide a comprehensive synthesis of the reviewed evidence, the findings were organized according to the four research objectives established in this study. Rather than presenting the findings of individual studies separately, this synthesis integrates the key themes identified across the selected literature, highlights the supporting evidence, and summarizes their implications for Early Childhood Education. This approach offers a more holistic understanding of how Artificial Intelligence (AI) interacts with Early Childhood Education (ECE) and transforms learning experiences for young children, while demonstrating how each research objective was systematically addressed through the review process. The synthesized findings are presented in Table 4.

Table 4. Synthesis of Research Findings Based on the Research Objectives

No.	Research Objective	Key Findings	Evidence from the Literature Review	Implications
1.	To analyze the role of AI in transforming early childhood learning experiences	AI has become an integral part of early childhood education, fundamentally transforming how young children learn, play, and interact with educational content.	The reviewed literature demonstrates the widespread use of social robots, adaptive learning platforms, conversational AI, Intelligent Tutoring Systems (ITS), and generative AI tools that create personalized, interactive, and multimodal learning experiences (Neumann & Barry, 2025; Zhao et al., 2026; Zhang et al., 2026). AI-powered educational robots enhance vocabulary acquisition, verbal expression, attention, and participation through multimodal interactions (Fitas, 2025).	Early Childhood Education should embrace AI as a transformative tool that enriches learning experiences while ensuring that technology serves developmental needs rather than replacing human interaction. Teachers should be equipped with AI literacy to integrate intelligent technologies into pedagogical practices effectively.

2.	To identify the opportunities and challenges of AI implementation in ECE	AI presents both significant opportunities and substantial challenges for transforming learning experiences in early childhood education.	Opportunities include enhanced learning engagement, personalized instruction, real-time feedback, support for diverse learners, and increased teacher efficiency (Hall et al., 2026; Zhang et al., 2026). Challenges include teachers' limited AI literacy and competence (Kölemen & Yıldırım, 2025), inadequate infrastructure and resources (Khosibah et al., 2025), ethical concerns regarding data privacy and algorithmic bias (Polzl-Stefanec, 2026), and the scarcity of longitudinal studies examining long-term effects (Achiaa et al., 2025).	The use of AI in ECE should be accompanied by comprehensive teacher training, infrastructure investment, and ethical guidelines to maximize benefits while minimizing risks. Policymakers should develop frameworks that support equitable access and responsible AI integration.
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3.	To examine AI's contribution to achieving SDG 4 on quality education.	AI contributes significantly to quality education by enabling personalized, adaptive, and inclusive learning experiences that support holistic child development.	AI technologies support inclusive education through personalized learning platforms, assistive technologies for children with special needs, and adaptive systems that adjust to individual learning styles (Ifitah et al., 2026; Ulfah & Hina, 2025). AI-supported interventions enhance cognitive development, language acquisition, and social-emotional competencies (Berrezueta-Guzman et al., 2025; Duan, Shan, & Gong, 2026). Research demonstrates that AI can reduce educational inequalities by providing access to quality learning resources (Khosibah et al., 2025).	AI should be strategically integrated into ECE to support inclusive, equitable, and quality education for all children. Investment in AI infrastructure and teacher training is essential to realize SDG 4 targets. Collaborative efforts between policymakers, educators, and technology developers are needed to ensure AI serves as a tool for educational equity.
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4.	To explain the relevance of AI in ECE with Industrial Revolution 4.0, <i>Kampus Berdampak</i> , and <i>Asta Cita</i>	AI integration in ECE is a strategic response to the Industrial Revolution 4.0, aligning with <i>Kampus Berdampak</i> initiatives and <i>Asta Cita</i> priority programs to develop superior human resources.	AI in ECE prepares children for the demands of Industrial Revolution 4.0 by developing digital literacy, computational thinking, and 21st-century skills from an early age (Kölemen et al., 2026). Research demonstrates that AI-supported STEM education and flipped learning approaches enhance teachers' innovative and computational thinking skills (Kölemen et al., 2026). The implementation aligns with <i>Kampus Berdampak</i> through community engagement to strengthen teachers' digital literacy and with <i>Asta Cita</i> through the development of future-ready human capital (Iftitah et al., 2026; Ersyad et al., 2025).	Early Childhood Education institutions should prioritize AI integration as part of their strategic response to Industrial Revolution 4.0. Universities should play a central role in preparing teachers for AI-integrated classrooms through <i>Kampus Berdampak</i> initiatives. Government policies should support the development of AI literacy from early childhood as part of <i>Asta Cita's</i> priority programs for superior human resource development.
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Overall, the synthesized findings indicate that the four research objectives were successfully achieved. The reviewed literature consistently demonstrates that AI has become increasingly integrated into early childhood education, creating transformative learning opportunities while presenting significant challenges that must be addressed. The findings reveal that AI can effectively personalize learning, enhance engagement, and support inclusive education, contributing to SDG 4 on quality education. However, successful AI integration depends on teacher readiness, adequate infrastructure, ethical frameworks, and collaborative efforts among all stakeholders. The findings also confirm that AI integration in ECE is highly relevant to Industrial Revolution 4.0, Kampus Berdampak, and Asta Cita priority programs, positioning early childhood education as a strategic foundation for developing future-ready human capital. These findings provide the basis for the discussion presented in the following section.

Discussion

A. Interpretation of Teachers' Perceptions and Readiness Findings

The findings of this study reveal a critical paradox in the integration of artificial intelligence into early childhood education: while teachers acknowledge AI's transformative potential to enhance learning experiences, a significant gap persists between their recognition of its value and their readiness to implement it. This gap is evident in the finding that only 9.6% of teachers fully integrate AI into their practice, even though 65.6% recognize its potential, suggesting that positive attitudes do not automatically translate into effective classroom implementation (Kölemen & Yıldırım, 2025). This phenomenon can be explained by the Technology Acceptance Model (TAM), which posits that perceived usefulness and perceived ease of use are key determinants of technology adoption; however, in ECE contexts, these factors are moderated by AI self-efficacy and task-technology fit (Duan, Shan, & Gong, 2026). AI self-efficacy emerged as the strongest predictor of behavioral intention, aligning with Bandura's social cognitive theory, which holds that individuals' beliefs in their capabilities significantly influence motivation and behavior. Teachers who lack confidence in using AI are less likely to adopt it, even when they hold positive perceptions of it (Duan, Shan, & Gong, 2026). Task-technology fit was the strongest predictor of robotic toy adoption, underscoring the importance of aligning technology capabilities with pedagogical tasks (Şakir, 2026). AI tools must be designed with ECE's unique characteristics—play-based learning, social interaction, and developmentally appropriate practice—in mind. The scarcity of studies involving children aged 0-3 and limited attention to developmental differences highlight a critical gap in understanding AI's impact across developmental stages (Achiaa et al., 2025), which is concerning given early childhood's rapid and sensitive development.

B. Interpretation of Impact on Children's Development Findings

The findings demonstrate that AI technologies, when implemented appropriately, can significantly enhance children's language acquisition, cognitive skills, social-emotional competencies, and learning engagement. AI-supported learning contributes to enhanced outcomes, content personalization, and increased motivation, aligning with personalized learning theory (Zhang et al., 2026). In ECE, AI's personalization is valuable given the wide variability in children's developmental trajectories and learning styles. AI creates multimodal learning experiences through social robots and conversational assistants, engaging children through visual, auditory, and kinesthetic channels, consistent with Mayer's cognitive theory of multimedia learning (Yang et al., 2024). This multimodal engagement is especially important for young children who learn best through hands-on, experiential activities. However, these benefits depend

on careful pedagogical design and active adult mediation. AI benefits are highly dependent on active adult mediation, underscoring the continued centrality of the teacher's role (Sun & Chen, 2025), which is consistent with Vygotsky's sociocultural theory, in which learning occurs through social interaction and guidance. AI tools should augment rather than replace the teacher's pedagogical role. Only 15% of studies involved educators in AI development, highlighting a significant research-practice gap that must be addressed to realize AI's full potential in ECE (Achiaa et al., 2025).

C. Interpretation of Ethical and Implementation Challenges Findings

The findings reveal significant ethical and implementation challenges that must be addressed to ensure responsible AI integration in ECE, particularly regarding data privacy, algorithmic bias, and the risk of displacing human interaction and play-based learning. The absence of sector-specific ethical frameworks represents a critical governance gap that must be addressed to protect children's rights and developmental needs (Berson et al., 2025). This gap is concerning, given the sensitive and formative nature of early childhood, where experiences can have lasting effects. Teachers expressed concerns about over-immersion, technical challenges, and developmental suitability, underscoring the importance of developmentally appropriate practice (Jeong & Kim, 2025). "Child-centered integration," which centers on children's developmental needs and agency rather than technological novelty, provides a useful framework for guiding AI implementation (Sun & Chen, 2025). Many AI tools adopted by teachers may not be explicitly designed for educational purposes, raising concerns about suitability and safety (Hall et al., 2026). This concern is echoed in the finding that 89% of studies focus on technical validation rather than educational integration (Achiaa et al., 2025). Reliance on commercial platforms such as NAO and Pepper raises concerns about cost and scalability (Fitas, 2025). Infrastructure support and educational resources are needed, while unequal access to AI infrastructure underscores systemic challenges requiring policy attention (Khosibah et al., 2025).

D. Interpretation of Pedagogical Transformation Findings

AI integration in ECE is driving a significant pedagogical transformation, shifting the teacher's role from knowledge transmitter to educational designer and reshaping teacher-child relationships. This transformation aligns with broader shifts toward learner-centered, constructivist approaches emphasizing active, experiential learning (Cai et al., 2025). AI supports personalized learning by dynamically adapting content to children's diverse developmental needs, aligning with differentiated instruction principles (Zhang et al., 2026). However, realizing this potential depends on teachers' ability to integrate AI into their practice effectively. Teachers expressed strong interest in AI but felt their proficiency was lacking, highlighting the need for comprehensive professional development addressing both technical skills and pedagogical knowledge (Jeong & Kim, 2025). Teacher training and professional development emerged as a key thematic cluster, underscoring the importance of investing in teachers' capacity (Ormanci, 2026). AI supports pedagogical innovation through creative storytelling, play-based learning, and multimodal engagement, which is significant given the central role of play and creativity in ECE (Yang et al., 2024). However, GenAI can pose risks, including overreliance on screen-based interactions, displacement of play and social relationships, and threats to privacy and safety (Berson et al., 2025). The benefits of AI-supported learning are consistently dependent on active adult mediation, suggesting AI should enrich and expand teachers' capacity rather than replace human interaction (Sun & Chen, 2025).

E. Interpretation of Research – Practice Gap and Future Directions

The findings reveal a significant research-practice gap characterized by misalignment between research priorities and educators' practical needs, scarcity of longitudinal studies, and limited practitioner involvement. Only 15% of studies involved educators in AI development, highlighting a fundamental disconnect between researchers and practitioners (Achiaa et al., 2025). Research findings may not adequately address classroom realities or the unique needs of early childhood educators. Most AI tools used in research rely on commercial platforms such as NAO and Pepper, which may not be accessible or appropriate across diverse educational settings (Fitias, 2025). The scarcity of longitudinal studies (only 10%) is a significant limitation, particularly given the sensitive and formative nature of early childhood (Achiaa et al., 2025). Short-term interventions (64% lasting 2-4 weeks) mean the sustainability of AI's benefits remains largely unexamined (Achiaa et al., 2025). Cultural relevance and teacher integration remain insufficiently addressed, with most studies featuring small, homogeneous samples limiting generalizability (Khosibah et al., 2025). The evidence base underscores significant research gaps in longitudinal outcomes, cultural transferability, and robust governance frameworks, calling for a more comprehensive approach that involves all stakeholders (Ormanci, 2026).

F. Contribution to Knowledge and Implications for Practice

This study makes several important contributions to the knowledge base on AI integration in ECE, providing a comprehensive framework for understanding the opportunities, challenges, and implications. The study contributes to theoretical literature by identifying key factors influencing AI adoption in ECE—AI self-efficacy, task-technology fit, and teacher readiness—and highlighting the importance of considering ECE's unique characteristics in AI research (Duan, Shan, & Gong, 2026). Five principal thematic clusters were identified—AI-enhanced personalized learning, social-emotional development mediated by AI companions, language and literacy acquisition, teacher professional development, and ethical concerns—providing a useful framework for organizing future research and practice (Ormanci, 2026). The study contributes to the practical literature by identifying key challenges and opportunities, including the need for teacher training, the development of ethical frameworks, and equitable access to AI technologies (Khosibah et al., 2025). GenAI can support multi-role collaboration between children, teachers, and parents, serving as a bridge connecting stakeholders in the ECE ecosystem (Zhang et al., 2026). However, few studies actively involve parents and teachers in AI development, indicating a gap between technological potential and collaborative practice (Achiaa et al., 2025). Teachers have insufficient experience with AI and express strong interest but feel their proficiency is lacking, reflecting the core problem of teacher readiness (Jeong & Kim, 2025). The study emphasizes the need for a balanced approach that maximizes AI's benefits while minimizing risks, ensuring that technology enhances rather than displaces human relationships and that all children have access to high-quality, AI-enhanced learning experiences that support their development and well-being.

To summarize the principal outcomes of this study, Table 5 presents a synthesis of the main findings derived from the literature review. The table highlights the relationships among Artificial Intelligence, Emotional Intelligence, and Social-Emotional Learning, as well as the study's primary contribution and practical recommendations.

Table 5. Synthesis of the Main Findings

Aspect	Key Findings
Artificial Intelligence (AI)	AI is increasingly integrated into Early Childhood Education, evolving from a learning support tool into a technology that facilitates personalized, interactive, and adaptive learning experiences. AI-powered educational robots, social robots, and generative AI tools enhance vocabulary acquisition, verbal expression, attention, and participation through multimodal interactions (Neumann & Barry, 2025; Zhao et al., 2026; Fitas, 2025).
Early Childhood Education (ECE)	ECE is a distinct educational ecosystem characterized by play-based learning, relational authenticity, and developmentally appropriate practice. AI integration in ECE must be adapted to the unique characteristics of young children's learning, emphasizing social interaction, hands-on experiences, and holistic development (Garuda, 2025; Ormanci, 2026).
Learning Experience	AI transforms learning experiences in ECE from uniform, one-directional to personal, interactive, and adaptive. AI creates multimodal learning opportunities through visual, auditory, and kinesthetic channels, supporting deeper understanding and accommodating diverse learning preferences (Zhang et al., 2026; Yang et al., 2024).
Research Contribution	This study demonstrates that the future of learning experiences in early childhood education is determined not by choosing between AI and traditional pedagogy, but by the ability to integrate both in a balanced and complementary manner. Successful AI integration depends on teacher readiness, adequate infrastructure, ethical frameworks, and collaborative efforts among all stakeholders (Duan, Shan, & Gong, 2026; Kölemen & Yıldırım, 2025).
Main Recommendation	Develop a Human-Centered AI for Early Childhood Education model that utilizes AI to enhance learning experiences while ensuring that authentic human relationships, play-based learning, and developmentally appropriate practices remain the foundation of early childhood education (Sun & Chen, 2025; Berson et al., 2025).

Overall, the synthesized findings reinforce the central argument of this study that AI and traditional early childhood pedagogy should be viewed as complementary rather than competing elements in Early Childhood Education. The evidence consistently suggests that a balanced integration of intelligent technologies and authentic human interaction provides the most promising approach for transforming learning experiences for young children in the digital era. Successful AI integration requires comprehensive teacher training, infrastructure investment, ethical guidelines, and policies that prioritize children's developmental needs and well-being (Hall et al., 2026; Khosibah et al., 2025; Polzl-Stefanec, 2026).

CONCLUSION

This study reveals a startling and sobering finding that fundamentally challenges the prevailing narrative of technological optimism in early childhood education: although artificial intelligence has demonstrated remarkable transformative potential in enhancing learning outcomes, personalization, and child engagement, only a small proportion of existing studies actively involve educators in the AI development process, while a mere 9.6% of teachers fully integrate AI into their daily practice, revealing a profound disconnect between technological capability and classroom reality. Even more astonishing is the finding that while much research focuses on literacy and language development, the social-emotional dimensions that constitute the very essence of early childhood education remain critically underexplored, with limited studies addressing this foundational aspect of child development. The most alarming revelation is that the benefits of AI in early childhood education are consistently and unequivocally dependent on active adult mediation. However, the overwhelming majority of AI tools deployed in classrooms are not designed with developmental appropriateness in mind. Most studies emphasize technical validation over educational integration, revealing a fundamental misalignment between how AI is developed and how it is used. Perhaps the most concerning finding is that most studies employ short-term interventions lasting only 2-4 weeks, leaving our understanding of AI's long-term impact on young children's development dangerously limited and largely unexamined. Furthermore, ethical concerns regarding data privacy, algorithmic bias, and the risk of displacing human interaction and play-based learning emerge consistently across all reviewed studies, with teachers expressing significant concerns about children's data security and privacy (Hall et al., 2026; Berrezueta-Guzman et al., 2025). This study, therefore, concludes with unequivocal clarity that the integration of AI in early childhood education is not merely a technological challenge but fundamentally an ethical, pedagogical, and human capacity challenge that demands immediate and sustained attention from all stakeholders.

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