Artificial Intelligence in Early Childhood Education: Effects and Interactions' Importance: A Conceptual Model

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Abstract

The issue of Artificial Intelligence is gaining popularity in the field of education. While AI increasingly impacts all aspects of our lives, its effects on early childhood development remain largely underexplored. Early childhood being a critical period in terms of cognitive, emotional and behavioral development, it is crucial to have a better understanding of the risks and opportunities created by young children's exposure to AI and how the introduction of AI in their environment is reshaping development in the early years. Based on conducting an integrative literature review, this study proposes a model focusing on the incorporation of Artificial Intelligence into early childhood education and its notable effects on students' enjoyment, creativity, and "soft skills" development. Discussion, hypotheses development and suggesting further areas of research are discussed.

Key words: Artificial Intelligence (AI), Early Childhood Education (ECE), Soft Skills, Fun and Creativity, effects and interactions, Conceptual model.

1. Introduction

In 1956, John McCarthy defined AI as "the science and engineering of creating intelligent machines" (McCarthy,2007; Su et al., 2023). Using techniques like machine learning, neural networks, and natural language processing, AI research aims to build intelligent machines that are capable of a wide range of tasks. Science, psychology, public policy, and health are just a few of the fields that AI is transforming (Xu et al., 2021). AI has several applications in education, such as automating tests, forecasting student performance and learning status, and suggesting educational materials (Yahya & Mohamed, 2024).

Kewalramani et al. (2021) examine the use of interactive AI in robotic toys in early childhood (EC) settings to enhance children's inquiry literacy. There is a lot of interest in the role of AI in education because of the potential for incorporating technology into children's play and education (Göçen & Aydemir, 2020). Teachers actively used AI robotic toys to keep students aged 4 to 5 engaged in play (Xieling Chen et al.,2020). With interactive tools and personalized learning platforms, AI technology can assist young students in developing critical "soft skills" like communication and cooperation. With the help of these technologies, education can be tailored to

each student's needs, increasing confidence and self-worth. They also make problem-solving easier by offering research opportunities. Additionally, AI fosters children's creativity by providing them with fresh and imaginative means of self-expression.

The information obtained from observational studies, instructor interviews, and student artifact analysis showed how creatively the kids collaborated with their peers. Playing with the AI robot helped kids develop their inquiry literacy in the areas of creativity, cooperation, and emotion (Kewalramani et al., 2021). In the field of education, AI is a topic that is gaining popularity. Very little research has been done on AI in ECE; most of the research has focused on primary, secondary, and university education (Su & Yang, 2022; Yahya & Mohamed, 2024). All students, including children, should read AI literature to adequately prepare them for the challenges of the future, claim Ng et al., 2023; Su et al., 2023, they suggested that teachers instruct kids on the ethical quandaries posed by AI, the advantages and disadvantages of internet-of-things applications, and how computers learn from data. Accordingly, the primary goal of this study is to create a conceptual framework for comprehending AI's role in ECE.

This study investigates how AI is revolutionizing education through gamified learning environments, interactive software, and innovative tools that pique students' interest and encourage creativity. It also draws attention to the difficulties and moral conundrums associated with AI integration. Also, this study highlights how crucial it is to use AI responsibly and collaboratively in order to promote kids' overall development. The significance of AI in ECE, the moral dilemmas it presents, and how it can help children develop their creativity and soft skills were all covered by creating a conceptual model based on the finished literature study By creating a conceptual framework based on the completed literature research, this study will assist us in addressing the following questions: What are the potential benefits of artificial intelligence for children receiving ECE? , understanding the

significance of AI in ECE, the ethical quandaries surrounding its use in ECE, and how it might foster children's creativity and soft skills.

2. Theoretical Framework:
2.1. Artificial intelligence:

AI In 1955, John McCarthy coined the term AI to refer to a computer that could perform a range of cognitive functions that are normally performed by humans, such as speaking, thinking, learning, and problem-solving (Nilsson, 1998). According to Russell and Norvig (2010), artificial intelligence has been used to simulate complex cognitive processes like sensing, learning, and prediction. According to Berendt et al. (2020), AI is the ability of a digital computer or computer-controlled robot to perform tasks that are typically performed by intelligent people.

A vast array of technologies and algorithms are included in the broad definition of AI (Baker and Smith, 2019; Jantakun et al., 2021). It is the study of problem-solving with modern technology, including neural networks and machine learning (Wang, 2019; Yang, 2022). According to Kaplan and Haenlein (2019), Zhang and Aslan (2021), and others, the amount of literature on AI has increased due to the advancements in research in various fields. These days, artificial intelligence is used in a wide range of fields, such as computer programs, robotics, natural language processing, embedded control systems in machinery, and speech and vision-based identification (Jantakun et al., 2021).

Using technologies for visual and auditory monitoring, some robots can communicate with humans (Li et al., 2020; Zhu, 2020). Because AI can communicate with people and improve their performance, it is quickly emerging as the next big thing in technology (Zhai et al., 2021). According to Zheng et al. (2021), AI is a major element of the fourth industrial revolution and has the potential to ignite a fourth revolution in education. AI and big data are working together to develop inclusive, personalized, flexible, and interesting learning opportunities (Berendt et al., 2020).

AI systems that are efficient, autonomous, and adaptive are now widely used in a variety of

academic fields thanks to developments in computer science and computational technology. Applying AI to support changes to educational systems is the main goal of this field (Holmes et al., 2023; Hwang and Tu, 2021; Xu and Ouyang, 2022). Because AI has the potential to greatly enhance education by personalizing learning experiences, researchers and educators are interested in its application in the classroom. Teaching, learning, and testing are made easier by AI (Su and Yang, 2022).

2.2. Early Childhood Education with Artificial Intelligence:

Because of AI, children in future generations will engage with technology in very different ways than those in previous generations. AI is changing how we work, play, and live our daily lives (Ali et al., 2019). AI tools are increasingly being used in ECE to enhance young children's learning and development (Su and Yang, 2022). Most studies showed how AI has significantly enhanced kids' comprehension of computer science, robotics, AI, machine learning, and related subjects. Furthermore, according to Su and Yang (2022), it has enhanced children's reading, creative, emotional-regulation, cooperative learning, and computational thinking skills. AI tools are increasingly being used in ECE to enhance the learning and development of young children (Lin et al., 2020; Su and Yang, 2022; Vartiainen et al., 2020). For instance, two recent studies (Lin et al., 2020; Su and Yang, 2022; Vartiainen et al., 2020) looked at teaching machine learning to children using AI robots.

Numerous earlier studies have looked at the most effective methods for teaching college students AI concepts and proficiency (Torrey, 2012). The use of AI in early childhood (ages 3 to 8) has not received much attention in the literature (Su and Yang, 2022). However, children's lives are becoming more and more dominated by AI devices, such as voice assistants, networked smart toys, and domestic robots (Williams et al., 2019). AI improves system development and performance (Su et al., 2023). AIECE looks at creation, perception, learning, actions, senses, and sense-making processes in addition to computational thinking.

Williams et al. (2019) claim that because younger children learn best through active and intellectual engagement, they gain the most from hands-on learning methods. Su and Zhong (2022) suggest that children as young as three years old may be able to start receiving basic instruction about AI. In order to give children AI literacy, (Kim et al., 2021) looked at curriculum development for ECE from three perspectives: help kids identify AI technologies in their everyday lives, teach them programming so they can use the technology in real-world situations, and raise awareness of any potential ethical issues with using AI technologies.

As a result, they listed knowledge, skill, and attitude regarding AI as the three prerequisites for becoming literate in the field (Su and Zhong, 2022). The goal of AI Knowledge is to assist students in comprehending the foundations of AI (Kim et al., 2021). These five clusters— "definitions and types of AI," "reasoning," "problem-solving and search," "applications," and "data"—make up the AI Knowledge competency.

According to their programming, the AI Knowledge initiative aims to help students understand the fundamentals of artificial intelligence (Kim et al., 2021). "Definitions and types of AI," "reasoning," "problem-solving and search," "applications," and "data and machine learning" are the five components that comprise the AI Knowledge competency (Su and Zhong, 2022). "AI-savvy" students can use their programming knowledge to think computationally. "Using AI tools" and "computational thinking and programming" are the two requirements for AI capabilities (Yahya & Mohamed, 2024; Kim et al., 2021).

Pupils who are competent in attitude toward AI are more likely to come up with ideas about AI in general. "Collaborate with AI" and "social impact" are two components of the AI mindset, according to Kim et al. (2021). Students' ability to think critically about the use of AI and their

understanding of both the benefits and drawbacks of AI for society are assessed by the AI mindset competency (Su and Zhong, 2022).

While AI fosters creativity, it also has an impact on children's rights to privacy, safety, and security. This is especially concerning because children often lack the resources to express their opinions and are not fully aware of the implications of AI technology. Recent advancements in tools and methodologies have made AI more accessible to younger students.

3.Literature Review:
3.1. Soft Skills and AI:

The development of personalized, interactive learning experiences that can adapt to the requirements and interests of young students is made possible by AI. The primary and direct elements of skills preparation are fostering a culture of literacy and continuous learning, enhancing personal competencies, and cultivating a positive behavioral attitude.

Software treatments have aimed to improve social interaction, language, and affective skills (Deng et al., 2013). The same is stated by (Massaro and Bosseler, 2006; Rahman et al., 2011). Leading young brains through interactive, adaptive AI-based learning requires "soft skills" like creativity, teamwork, and communication. Additionally, the creation of AI-enhanced learning environments depends more on emotional intelligence. The core ideas of the concept are that individuals possess innate skills that can be significantly enhanced.

These abilities can be separated into two categories: interpersonal skills, which include relationship-building and group projects, and self-related skills, which include emotional control, openness to advice, time management, and keeping an optimistic outlook. It is believed that hard and soft skills complement one another well. According to LaFrance (2016), better performance results from cultivating and refining one's interpersonal and personal habits.

This encompasses traits like self-assurance, flexibility, integrity, and moral rectitude. The term

"soft skills" refers to abilities and life lessons that benefit people, communities, groups, and spirituality. These traits, which are supported by emotional intelligence, communication, language skills, values, teamwork, ethics, and spirituality, help one become recognized in the community. The soft talents dictate how the hard skills are applied.

Because they affect how one applies their scientific knowledge and skills, mastery of these fields is crucial. The capacity to establish connections with both oneself and other people is one of the soft skills, according to Yahya &Mohammed (2024), Values, behavior, routines, motivation, character, and attitude are some of these skills. An individual's thought, expression, and behavior patterns have an impact on these traits.

In a nutshell, "soft skills" are the inherent aptitudes that each person possesses, are essential, and are always in demand as additions to hard skills. Hard and soft skills are perfectly balanced when they follow the same trajectory and run parallel to one another. As can be observed, there is growing interest in combining human and AI methods to enhance learning (Baker, 2016; Baker & Smith,2019).

Zheng et al. (2020) looked into the educational advantages of an adaptive learning platform driven by artificial intelligence. Their results showed how successful it is to adapt language instruction to each student's particular needs. The study highlighted the importance of tailored assessments and feedback in enhancing students' involvement and development.

They looked at how AI-powered chatbots affect language acquisition, emphasizing how they can offer interactive, real-time language practice. Students reported feeling more motivated and involved as a result of these chatbots' ability to have natural language conversations and provide tailored feedback. These results demonstrate the potential pedagogical benefits of AI technologies by promoting student autonomy and enabling customized learning. Children can learn the social and cognitive skills necessary for clear

communication, problem-solving, and critical thinking as AI develops into a valuable teaching tool. People who receive ECE that integrates AI and soft skills grow up to be resilient, self-assured, and well-rounded people who can successfully negotiate the challenges of a rapidly evolving digital world. It also prepares children for a world that has advanced technologically.

AI-powered smart learning systems enable students to receive personalized educational content according to their preferred learning styles and areas of interest. Although AI can provide fascinating insights and adaptable learning opportunities, soft skill development is just as important. A broad range of interpersonal and cognitive abilities, including communication, creativity, teamwork, emotional intelligence, and critical thinking, are included in soft talents. These abilities serve as the cornerstone of an all-encompassing education that prepares kids for success both inside and outside of the classroom.

3.2. Fun/creativity and AI:

The studies reviewed at employed a variety of innovative theories. To foster critical thinking, creativity, and problem-solving abilities, educational strategies are recommended to integrate AI and computational thinking (Alam, 2022; Bocconi et al., 2022). Technology should make it easier for teachers and students to collaborate and enjoy trying out new teaching and learning strategies (Braun et al., 2020) . Furthermore, educational institutions must offer a quality education in a world where technology is developing quickly and employment markets are dynamic and complex.

Mednick, S., 1962. The associative basis of the creative process. Psychological review 69, 220.

Vitrano et al. (2021) stated that highly creative people can create more word associations in response to a stimulus than less creative people, according to the creativity theory (Mednick, 1962) . Prior research on marketing creativity has used this approach in studies on advertising (Smith and Yang, 2004) and product innovation management (Im et al., 2013). According to Peters and Reveley

(2015), the growth of a supra-individual collective intelligence is the source of creativity.

Chang et al. (2010) claim that the concept of "collective intelligence" was interpreted culturally. A team's combined efforts are more likely to produce innovative results than an individual's, claims Sawyer (2011). According to Amabile's (1983) "interactionist" interpretation of the componential theory of creativity, an individual's social environment and personal characteristics influence their creativity.

Amabile (1983) asserts that creativity is a process that includes both gradual creations and important advances in the arts and technology. Applying generative theory (Epstein, 1991) has been proposed as a way to challenge accepted behavioral and cognitive norms, foster creativity, and improve personal understanding.

The digital revolution has brought about a significant transformation in our surroundings. It has been noted that since these skills are necessary for the growth of creativity, children should be encouraged to develop their critical thinking, problem-solving, communication, and teamwork abilities. In practical terms, the future will demand the ability to solve problems, work with others, and communicate effectively. The use of advanced technological tools is essential for the development of 21st-century skills, claim Ferrari et al. (2012).

This makes more sense when viewed through the lens of the education-related Activity Theory (Batiibwe, 2019; Zhang et al., 2022), where new technologies serve as a mediator between the players and the advancement of knowledge. Creativity has a big impact on computer science because it can improve performance and information intake, inspire students, and pique their interest in the subject. Additionally, data indicates that not much research has used AI as a tool to help kids develop their creativity and problem-solving skills (Salisu et al., 2022). This mostly relies on how well educators find resources and utilize these technological tools.

3. Conceptual Model Development:

In ECE, AI offers a special chance to support young students' soft skill development. Although

artificial intelligence is frequently associated with technology, there is growing recognition that AI can enhance children's critical thinking, communication, teamwork, and adaptability skills. AI has the potential to improve creativity, fortify social bonds, and hone problem-solving skills through interactive platforms and personalized learning experiences. AI has the potential to support the development of a variety of soft skills and accommodate different learning styles by utilizing tailored strategies and adaptable algorithms.

AI presents a fascinating chance to increase the creativity and enjoyment of ECE among young students. AI-powered tools and platforms enable children to participate in imaginative and captivating activities. This might spark their interest and inspire imaginative play. These websites provide personalized learning experiences that encourage enjoyment and play in academic endeavors. AI has the potential to add entertainment value to educational activities.

AI has the potential to drastically alter how young children learn in ECE. Thanks to platforms and technology powered by artificial intelligence, a greater variety of students can now access personalized learning that considers their unique preferences, learning preferences, and areas of strength and weakness. These interactive and adaptable technologies provide more efficient and captivating educational opportunities. The following hypotheses were proposed in light of the discussion above:

Hypothesis One (H1): The use of AI in ECE is positively impacted by soft skills.

Hypothesis Two (H2): AI increases children's creativity and happiness (fun).

Hypothesis Three (H3): Creativity and enjoyment can improve learning in ECE.

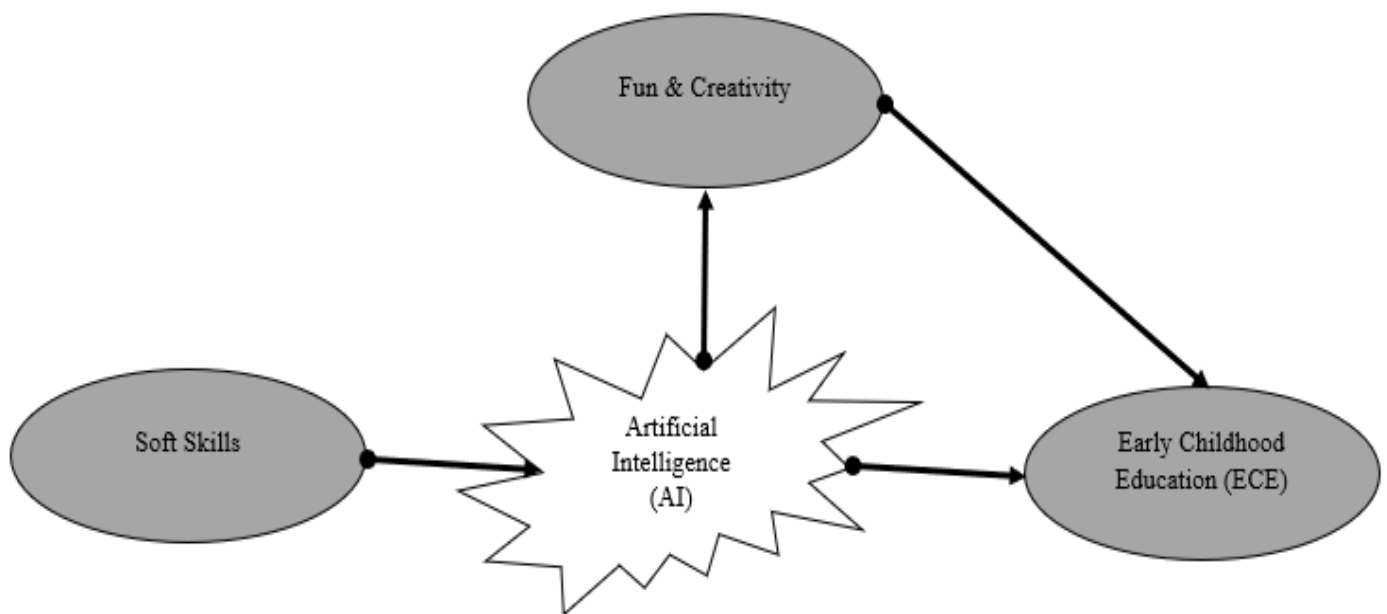*Hypothesis Four (H4): The implementation of AI in ECE is advantageous.*

Figure 1: AI – based Model to ECE

AI has the potential to improve children's inquiry literacy in ECE. Regulations must be put in place and the ethical implications of AI must be considered in order to ensure that it is used responsibly and ethically. But it takes careful preparation, continuous assessment, and a suitable approach that balances technological innovation with children's overall development. AI holds enormous promise for improving the development of soft skills and better equipping young people to face the challenges of a world that is changing quickly. AI has the potential to foster children's

creativity by providing them with resources related to design, music, and art. This allows kids to freely express themselves and experiment with different concepts in a supportive and safe learning environment. Because AI fosters a lifelong love of learning, it significantly improves ECE. It enhances the educational process as well. But educators still have a vital role to play in guiding and refining AI-enabled learning activities, helping students develop as social workers, providing emotional support, and teaching values that go beyond technology.

4. Conclusion, Implications, and Future Work Considerations:

Because AI enhances many facets of learning, it has the potential to revolutionize ECE. AI has the potential to automate assessments, suggest learning materials, and forecast students' performance and learning status (Crescenzi-Lanna, 2023; Mousavinasab et al., 2021; Su et al., 2023, 2022; Zawacki-Richter et al., 2019; Zheng et al., 2021).

Through specialized methods, the AI can support the development of critical thinking, communication, teamwork, and other crucial soft skills. Customized education helps children develop the specific skills they need to successfully navigate a complex world. AI incorporated into educational systems can also help younger students succeed by fostering an imaginative and stimulating environment that appeals to their younger senses.

AI-powered resources like interactive games, creative apps, and adaptive tutoring systems encourage kids to try new things, use their imaginations, and express themselves freely. Students enjoy learning more thanks to this creative combination of technology and education, which also gives them the abilities and perspective they need to succeed in the future. Teachers must receive training on ethical concerns and the use of AI in the classroom if they are to adopt a well-rounded strategy that prioritizes holistic development and makes the most of AI's potential in ECE. AI can offer personalized and engaging learning experiences, but it cannot take the place of

educators in fostering moral values, encouraging social and emotional development, and imparting essential life skills. Teachers are able to identify the individual needs of each student and provide them with tailored instruction.

Therefore, the researcher recommends the following: carrying out quantitative research that considers the part teachers play in this process; conducting an empirical study to test the proposed model represents a promising research avenue within the context of ECE settings. All things considered, additional study on the integration of AI technology in ECE contexts has to be done. AI educational robots are one of these technologies that may combine various fields of study and several technologies at once to significantly improve children's educational experiences in our quickly evolving digital society.

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