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Artificial Intelligence (AI) Use in Preschool: A PRISMA-Based Systematic Review*

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ABSTRACT

Although the idea of a machine being able to think dates to ancient times, it is possible to say that AI gained momentum in the modern sense in the 20th century. The technological age that we live in, which paves the way for the use of AI in many different areas such as education, health, and service sectors, reveals that having a deep understanding of the basic knowledge and concepts of AI is inevitably important and necessary. This systematic review explores the integration of Artificial Intelligence (AI) in preschool education using the PRISMA framework. The study synthesizes findings from reviewed studies, identifying AI's role in preschool, why and how it is used and what are the perceptions/perspectives on the use of AI. Within the scope of the current research problems, seven different databases, namely ERIC, Scopus, WoS (Web of Science), EBSCO, Google Scholar, Proquest Dissertations & Theses, and YÖK Thesis Center, were used to identify relevant studies. According to the findings, AI enhances educational outcomes, challenges such as ethical concerns, teacher preparedness, and infrastructure limitations persist. Teachers and parents exhibit both enthusiasm and apprehension, highlighting the need for professional development and responsible AI implementation. The findings emphasize the potential of AI in preschool education while underscoring the necessity for ethical, pedagogically sound approaches to ensure meaningful learning experiences. In addition, the findings show that the use of AI and AI technologies in the pre-school period is still in the development stage and that detailed information about the use of AI in pre-school is needed.

Keywords: Artificial intelligence (AI), early childhood technology integration, preschool education, PRISMA-based systematic review, teachers' perspectives, parents' perceptions

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1. INTRODUCTION

1.1. History of Artificial Intelligence (AI)

The idea of "artificial intelligence" (AI) dates back thousands of years, to the years when ancient philosophers were addressing the questions of life and death. In ancient times, inventors designed mechanical devices called "automata" that acted independently of human intervention. The word "automata" comes from ancient Greek and means "to act by one's own will" (Andrews, 2023). Examples of the oldest automata in history include Archytas' Dove (dating back to 400 BC), Leonardo da Vinci's Knight (1945), French inventor Jacques de Vaucanson's Digesting Duck (1730) and Al-Jazari's Floating Orchestra (as cited in Andrews, 2023). Al-Jazari's (1206) book titled "Kitab-ül Hiyel" (Translated as Book of Machines) includes information about the robots and machines he designed. Al-Jazari, who especially draws attention with his innovative studies on robots and mechanical automation, is considered a pioneer of robotics and cybernetics (as cited in Çırak and Yörük, 2015).

Although the idea of a machine being able to think dates to ancient times, it is possible to say that AI gained momentum in the modern sense in the 20th century. The conceptual foundations of AI, which has been in existence since the mid-20th century, are based on the work of computer scientists and mathematicians. Who first used AI and how it was defined has been a subject of much research. According to Nilsson (1998), the term AI was first used by John McCarthy in 1955. John McCarthy defined AI as a computer that can perform various cognitive tasks typically performed by humans, such as speaking, thinking, learning, and problem solving. According to Augusto (2021), the term "artificial intelligence" first emerged at the Dartmouth Conference (1956), and AI was accepted as a separate academic field of study. Harnad (2008), on the other hand, states that the first person to lay the foundations of AI and use it was Alan Turing. It is said that Alan Turing, as one of the prominent

* Since the study did not involve human practices, there was no need to obtain an ethics committee approval.

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researchers in this field, laid the foundations of modern AI with his article titled “Computing Machinery and Intelligence” in 1950. In this article, Turing took the first crucial step in this field by proposing the Turing Test to measure machine intelligence (Turing, 1950; Cited in Harnad, 2008). The study titled “Can a Machine Think and How Can It Think?” written by mathematician Professor Cahit Arf, who was one of the first to use it in Turkey, supports Alan Turing’s concept of machine intelligence and contributed to the concept of machine learning (Arf, 1959). However, AI experienced periods of stagnation, especially due to overly optimistic initial expectations and the cutting of research funds, as in the “AI winter” periods of the 1970s and 1980s. The term “AI Winter” first emerged as a public discussion topic at the annual meeting of the American Association of Artificial Intelligence (AAAI) in 1984 (Floridi, 2020).

The field of AI gained momentum again in the 1990s and 2000s with the resurgence of machine learning, particularly with the development of neural networks and other complex algorithms (Gugerty, 2006). The increase in computational power and access to large data sets has allowed AI to reach new heights in activities such as identifying natural language elements and seeing through computers. Today, deep learning techniques of AI, which are a powerful driving force in various fields such as health care and finance, are at the forefront of recent developments (Gugerty, 2006).

1.2. Definition of AI

When the relevant literature on the concept of AI is examined, it is striking that many different definitions have been made for this concept. For example, AI, defined by Russell and Norvig (2010) as a “tool’’ used to imitate complex cognitive functions such as perception, learning and prediction, was defined by Berendt et al. (2020) as the capacity of a digital computer or a computer-controlled robot to perform tasks often associated with intelligent individuals. According to Yang’s (2022) definition, AI is the study of using contemporary technology to solve problems. Mijwel (2015) defines AI as the general name of the technology aimed at developing machines that are created entirely by artificial means and can exhibit human-like behaviors and movements without the use of any living organism. Ertel (2018) defines AI as the field of study that aims to enable computers to perform tasks that are currently in the domain of humans. The common point of these definitions is that AI is the behavior of giving machines thinking and human-like behaviors.

1.3. The Use of AI in Education

The technological age we are in, which paves the way for the use of AI in many different areas such as education, health, and the service sector, reveals that having a deep understanding of the basic knowledge and concepts of AI is inevitably important and necessary. It is noteworthy that the subject of AI has been frequently addressed and explained in educational research, especially in the last quarter.

When we look at the historical development of AI in education, it is seen that AI techniques were first integrated into educational tools and used. In the 1960s, researchers began experimenting with computer-assisted learning with the assumption that AI could improve educational experiences. Important projects such as MIT’s Project MAC aimed to apply AI to the field of education by investigating the potential of computers to assist in learning processes (as cited in Guan et al., 2020). In 1970, Kenneth Carbonell developed a pioneering AI-based teaching system called SCHOLAR to identify natural language elements and help students learn through interactive conversation. This system was one of the first applications of AI to facilitate customized learning experiences, paving the way for future educational technology breakthroughs (as cited in Guan et al., 2020).

During the 1980s and 1990s, the use of AI in education increased significantly, resulting in the development of Intelligent Tutoring Systems (ITS). These systems aimed to provide individualized education by adapting to the unique needs of each student and providing personalized feedback. The development of ITS systems such as CARL and Elliot demonstrated the ability of AI to improve educational outcomes (Wenger, 2014). By the 2000s, AI technologies integrated into digital educational tools and online learning platforms provided the opportunity to provide personalized learning paths and more efficient teaching techniques. Today, AI continues to shape education by facilitating personalized learning and helping teachers improve their teaching methods (Rane, 2023).

1.4. The Use of AI in Preschool Education

The use of AI in preschool education dates to the late 20th century. During this period, there was a great increase in interest in educational technologies. The field of AI in education began to grow in the 1970s and 1980s, but preschool education remained outside the focus area at that time. With the development of technology, researchers began to examine how AI could be used to support young children's learning. One of the first notable AI-based educational tools developed for preschool education was the intelligent tutoring systems (ITS), which emerged in the 1980s. An intelligent tutoring system (ITS) is a computer system that mimics teachers and aims to provide immediate and personalized instruction or feedback to children, usually without the assistance of a teacher (Arnau-González et al., 2023). First created for older students, these systems have shown that adaptive learning strategies that can adapt to different learning speeds and styles are possible (McCalla, 2023). In the late 1990s and early 2000s, AI programs created specifically for preschool education began to gain popularity. AI-powered systems began to use techniques such as natural language processing, speech recognition, and interactive features to interact

with young children in a more personalized and supportive way. AI systems were created that allowed teachers to learn about children's cognitive development, track children's individual learning in real time, and make recommendations for teachers for individualized educational strategies (Traxler & Kukulska-Hulme, 2007). These tools aimed to allow teachers to spend more quality time with students. Zoombinis was one of the first programs to combine learning with game-based methods and was developed to help preschoolers develop skills such as logical thinking and problem solving through interactive play (Resnick, 1997). These advances laid the foundation for modern AI use for preschool education applications and platforms in creating more engaging and personalized learning experiences for young children. With the development of AI technologies, the number of applications that provide customized and dynamic teaching experiences in preschool education has increased. In the 2000s, AI technology began to be more integrated into preschool education environments, strengthening the role of teachers by providing them with tools to improve teaching strategies and meet different learner needs (Fitria, 2021).

AI-supported technologies, such as speech recognition and identifying natural language elements, have been used to assess children's language development and provide teachers with feedback on areas where children may need more help (Fitria, 2021). Speech recognition software can help children learn correct pronunciations and support the language learning process by understanding what children say and providing feedback.

It is emphasized that AI-based systems can dynamically present content according to children's developmental needs, which can create personalized learning experiences (Zawacki-Richter et al., 2019). In addition, AI can help teachers use their time more efficiently and provide personalized suggestions to support their professional development. AI can facilitate processes such as teachers following children's development, organizing activities, and analyzing data in the classroom.

It is noteworthy that there are different views on the use of AI in the preschool period. Studies show that preschool teachers are both excited about the use of AI in the preschool period and cautious about artificial intelligence (Lim, 2024; Traxler & Kukulska-Hulme, 2007). Many teachers believe that AI improves individualized learning by adapting to each child's learning pace and providing rapid feedback (Lee et al., 2024; Lim, 2024; Yang, 2024). These advantages are especially important in preschool, a period when personalized instruction is critical for development (Traxler & Kukulska-Hulme, 2007). Teachers' emphasis on AI technologies that assess children's developmental progress allows them to change their teaching strategies more efficiently. On the other hand, some educators express concerns about excessive dependence on technology and worry that AI may negatively affect social interaction, and they think that AI-based applications that are pedagogically inadequate and that are used without considering the needs and developmental characteristics of the child may weaken children's social and emotional development (Pellegrini and Smith, 1998; Radesky et al., 2015; Turkle, 2011). Berson et al. (2025) state that the rapid integration of artificial intelligence (AI) into early childhood education (ECE) presents transformative possibilities but raises urgent ethical challenges that demand immediate attention. AI systems collect a wide range of data, including children's behavior, learning preferences, and emotional responses. Failure to store this data securely poses risks such as unauthorized access, misuse, and data leakage (Berson et al., 2025). These contradictory views in the literature show that the use of AI and AI technologies in the preschool period is still in the developmental stage and that detailed information is needed about the use of AI in preschool. It is also noteworthy that the use of artificial intelligence in preschool education is relatively new compared to its use in other educational levels. Although AI has the potential to support children's early development, assist teachers, and personalize learning processes, there are several difficulties and obstacles such as lack of infrastructure (Sheng, 2022), lack of teacher competence (Zawacki-Richter et al., 2019), and pedagogical suitability that prevent these technologies from becoming widespread and being implemented effectively in preschool education. Furthermore, our level of knowledge about the advantages and disadvantages of using artificial intelligence-based applications and systems in the preschool period is still in the development stage. To overcome these obstacles and difficulties, it is very important for teachers to gain knowledge and skills on how to use AI technologies in education. Increasing teachers' digital literacy will make teachers more prepared on how to implement these technologies in the classroom. Based on the idea that there is a need for deeper knowledge and understanding on the use of AI in the preschool period, this study aims to examine the perspectives on AI in preschool education and to make a systematic compilation on how and in what way AI is handled. It is thought that this study will support experts and teachers working in the field on the use of AI technologies. In line with this idea, the research questions determined are as follows:

1. Why is AI used in preschool education?
2. How is AI used in preschool education?
3. What are the perceptions/perspectives on the use of AI in the preschool period?

2. METHODOLOGY

This study, which uses the systematic review method, aims to provide a comprehensive and general view of the use of AI in the preschool period. It is possible to define systematic review as a method of finding, evaluating and synthesizing evidence. Systematic reviews are a way of synthesizing scientific evidence to answer a specific research question in a transparent and reproducible way, while trying to include all published evidence on the subject and evaluate the quality of this evidence (Lamé, 2019). According to Archie Cochrane (1972), who is considered the first researcher to use systematic review, a systematic review attempts to identify, evaluate and synthesize all empirical evidence that meets predetermined eligibility criteria to answer a specific research question. Cochrane, who is known for systematic reviews and literature reviews that

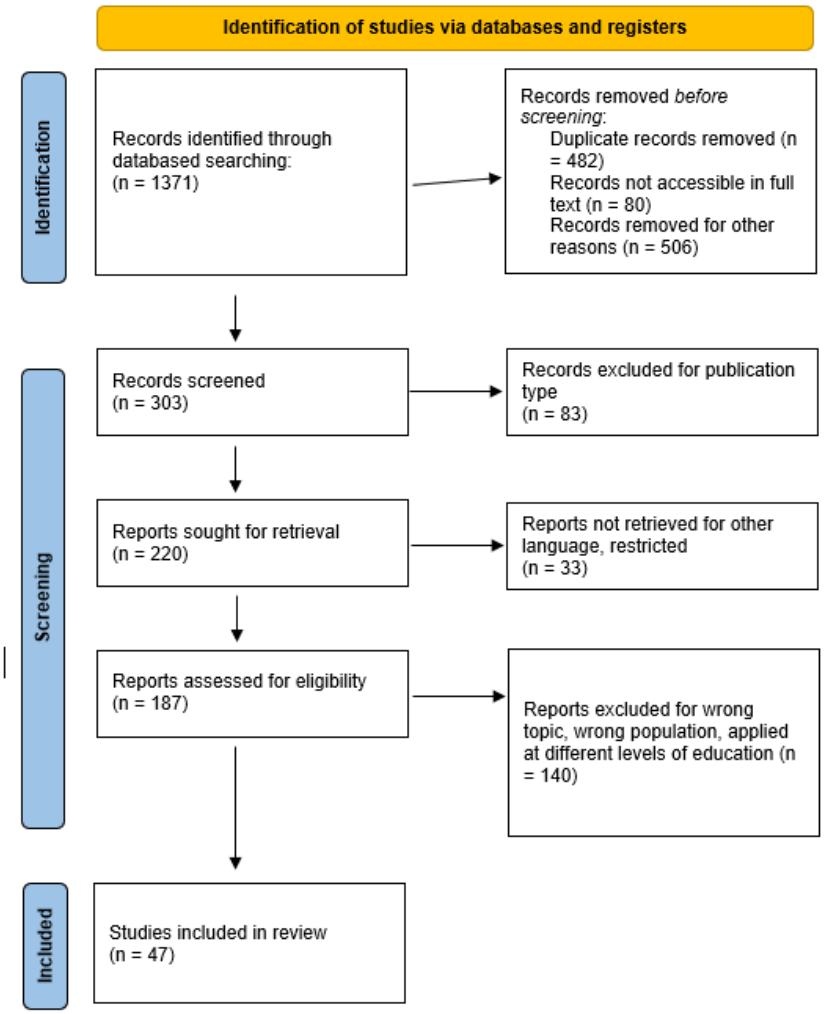
evaluate the effectiveness of treatment methods, especially in the field of health, developed systematic review methods used in health research in the 1970s and aimed to increase the reliability of clinical research. One of Cochrane's most important contributions to the field is that it paved the way for the establishment of the Cochrane Collaboration in 1993 (Cochrane Collaboration, 2024). According to Higgins and Green (2008), a systematic review is a method of bringing together evidence related to a specific research question with predetermined eligibility criteria from studies. Nunn and Chang (2020) describe it as a type of evidence synthesis that formulates research questions that are broad or narrow in scope and identifies and synthesizes data directly related to the systematic review question.

Researchers conducting systematic reviews use open, systematic methods that aim to minimize bias to produce more reliable findings to enable decision-making (Cochrane Collaboration, 2024). In a systematic review, studies that are relevant to the research question and eligibility criteria are systematically identified and critically evaluated (Moher et al., 2010). After the selection of standardized studies, all relevant data are extracted and summarized, and for data synthesis, the results are expressed either in a quantitative way (meta-analysis) or through a narrative synthesis (Moher et al., 2010).

In this study, which aims to create a broad perspective on the use of AI in the preschool period, the ''Preferred Reporting Items for Systematic Reviews and Meta-Analyses'' (PRISMA) system was used. PRISMA is a reporting guideline designed to address the problem of poor reporting of systematic reviews (Moher et al., 2010). It is a minimum set of evidence-based items for reporting in systematic reviews and meta-analyses (Page et al., 2021).

2.1. Research Strategy and Data Collection Process

Within the scope of the current research problems, seven different databases named ERIC, Scopus, WoS (Web of Science), EBSCO, Google Scholar, ProQuest Dissertations & Theses and YÖK Thesis Center (Council of Higher Education Thesis Center) were used to identify relevant studies. For the process of identifying relevant studies to be appropriate and functional, searches were conducted in the databases on November 25th, 2024, using keywords determined in the context of the researched topic. The keyword string used in the databases in English is “kindergarten” OR “preschool” OR “pre-kindergarten” OR “pre-k” OR “early childhood” OR “pre-school” AND “artificial intelligence” and in Turkish “anaokulu’’ OR “okul öncesi’’ OR “anasınıfı’’ OR “erken çocukluk’’ AND “yapay zekâ’’. The relevant keywords were brought together in a way compatible with the search codes and symbols specific to the databases and the search was conducted. Below is the table regarding the selection process of the selected studies (PRISMA, 2020).



Note: Records identified through databased searching (ERIC= 1019, Scopus= 59, EBSCO= 43, Google Scholar= 174, Google Scholar TR= 1, ProQuest=12, YÖK Tez=1)

Figure 1. PRISMA flow chart in the process of selecting studies

According to Figure1, when examining studies on the use of AI in the preschool period, the titles, keywords, and abstracts of the studies were primarily considered, resulting in 1371 studies. After removing 482 duplicate studies, the remaining 889 studies were determined. Of these 889 studies, 83 were excluded because they were in a different publication type (proceedings and book chapters), 80 could not be fully accessed, and 506 were not between 2019-2024.

2.2. Exclusion and Inclusion Criteria

After the calculations, the remaining 220 studies were then subjected to a systematic selection process for inclusion based on the following criteria:

- Studies using AI in the preschool period
- Studies conducted with preschool children, their parents, and preschool teachers
- Articles and theses written in English and Turkish
- Dissertations and theses with full access

Within the framework of the specified inclusion criteria, the remaining 220 studies were analyzed, 173 of which were excluded because they did not meet the specified inclusion criteria. The remaining 47 studies were selected for systematic review because they met all the specified inclusion criteria. One of the selected articles was Yang's ''Research on intelligent teaching curriculum of preschool education majors in universities based on artificial intelligence technology support'' study (2024).

2.3. Analysis Process

In the analysis process of the relevant study, descriptive analyses of the identified studies were first conducted. Figure 2 shows the descriptive analyses of the reviewed studies according to their research designs:

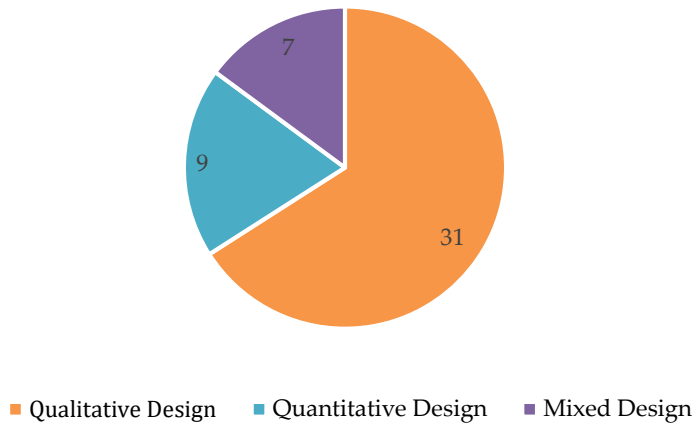


Figure 2. Distribution of Examined Studies According to Research Designs

Based on Figure 2, the 47 studies examined were grouped based on their research designs. As a result of the grouping, it was seen that 31 studies (66%) were conducted using qualitative designs, 9 studies (19%) were conducted using quantitative designs, and 7 studies (15%) were conducted using mixed designs.

Table 1.
Distribution of Studies According to Target Groups

Target Groups	**Numbers of Studies**
Preschool and Primary School Children	14
Preschool Children	18
Preschool Teachers	4
Preschool and Primary School Teachers	2
Preschool Special Education Teachers	1
Preschool Teacher Candidates	2
Parents	1
Parents, Children and Teachers	1
Parents, Children and Speech Therapists	1
Teachers and Students at Different Levels of Education	1
Teacher Candidates from Different Branches	1
Preschool Children and Special Education Specialists	1

After reviewing Table1. and when the 47 studies examined were evaluated according to their target groups, 14 studies (%30) were conducted with Preschool and Primary School Children, 18 studies (%39) were conducted with Preschool Teachers, 4 studies (%9) were conducted with Preschool and Primary School Teachers, 2 studies (%4) were conducted with Preschool Teacher Candidates, 2 studies (%4) were conducted with Preschool Special Education Teachers, 1 study (%2) was conducted with Parents, Children and Teachers, 1 study (%2) was conducted with Parents, Children and Speech Therapists, 1 study (%2) was conducted with Teachers and Students at Different Levels of Education, 1 study (%2) was conducted with Teacher Candidates from Different Branches, 1 study (%2) was conducted with Parents, 1 study (%2) was conducted with Preschool Children and Special Education Specialists. It is seen that most of the studies on the use of AI in the preschool period were conducted with preschool children. Then, content analysis was conducted using the coding framework in line with the determined research problems. Both researchers independently conducted content analysis in line with the coding framework and then compared the analysis findings they obtained with each other. The comparison process continued until the researchers reached a consensus on the themes and coding they created. The results obtained within the scope of the research questions are given below.

3. FINDINGS

3.1. Research Question 1: Why is AI used in preschool education?

The first research question, which is about why AI is used in the preschool period, was addressed in line with the 11 purposes determined according to the common frameworks of the 47 studies.

Table 2.
Numbers of Studies Determined in Line with the Purposes

Purposes	Numbers of Studies
(I.) Aims to inform children about AI	1
(II.) Aimed to include AI in children's education with different sub-purposes	9
(III.) Used AI to support children's development and skill acquisition	13
(IV.) Aimed at exploring parents' perspectives on AI	2
(V.) Aimed at exploring teachers' or prospective teachers' perspectives on AI	4
(VI.) Aimed to support the professional development of preschool teachers	5
(VII.) Were written to discuss the opportunities and challenges of AI	4
(VIII.) Was written to discuss the ethical problems of AI	1
(IX.) Were written with the aim of supporting, developing, and improving school curricula with AI	6
(X.) Was conducted to see how AI would be used in the evaluation process	1
(XI.) Was conducted to determine how AI and big data would be used in preschool education	1

It is noteworthy that these 11 purposes also have various sub-purposes. As a result of the review of Table 2., 1 study *(I.) aims to inform children about AI* (Su and Yang, 2024a); It was observed that 9 studies *(II.) aimed to include AI in children's education with different sub-purposes* (Crescenzi-Lanna, 2023; Edwards, 2024; Eı Helow and Salem, 2022; Fikri and Rhalma, 2024; Lee et al., 2024; Li, 2022; Yang 2024; Yi et al., 2024; Su and Yang, 2022). When the sub-goals of incorporating AI into children's education are examined, it has been seen that they are listed as using AI tools that will support children's education within the scope of AI transformation (Fikri and Rhalma, 2024; Lee et al., 2024; Yang, 2024; Yi et al., 2024), providing perspective on the use of AI in education (Crescenzi-Lanna, 2023; Edwards, 2024), introducing the concepts of smart learning and smart classroom (Li, 2022), addressing the current literature on AI (Su and Yang, 2022), and using AI effectively to meet special learning needs (Eı Helow and Salem, 2022).

It was determined that 13 studies *(III.) used AI to support children's development and skill acquisition* (Ahmed, 2020; Akdeniz, 2019; Akdeniz and Özdinç, 2021; Bayoumi, 2024; Kewalramani et al., 2021; Kucirkova and Mackey, 2020; Ongoro and Fanjiang, 2023; Sit et al., 2024; Su, 2024; Su and Yang, 2024b; Villegas-Ch et al., 2022; Utepbayeva et al., 2024; Yılmaz et al., 2022). For example, in the studies of Ongoro and Fanjiang (2023) and Yılmaz et al. (2022), AI was used to support children's English language learning skills. In the studies of Kucirkova and Mackey (2020), Su (2024), Su and Yang (2024b), Su et al. (2023) and Kewalramani et al. (2021), it was observed that the aim was to support digital literacy skills in preschool children. In addition, it was determined that AI was used in preschool education to develop children's positive thinking skills (Bayoumi 2024), to support concept learning and development in children (Akdeniz, 2019; Akdeniz and Özdinç, 2021; Sit et al., 2024; Villegas-Ch et al., 2022) and to ensure that preschool children with special needs develop skills (Ahmed, 2020; Utepbayeva et al., 2024). It is also noteworthy that there are studies conducted to obtain opinions from different target audiences regarding the use of AI in the preschool period. As a result of the reviews; *(IV.) Two studies aimed at exploring parents' perspectives on AI* (Köken and Dagal, 2024; Otermans et al., 2024); *(V.) Four studies aimed at exploring teachers' or prospective teachers' perspectives on AI* (Arnone et al., 2023; Küçükkara et al., 2024; Köken and Dagal, 2024; Lim, 2024; Mohammed, 2023) were found. Köken and Dagal's (2024) study was written in both categories because it included both teachers' and parents' views on the use of AI in preschool education. The findings of the relevant studies showed that both teachers' and parents' knowledge about AI was incomplete, and this lack of knowledge could cause teachers to think that AI could be dangerous and harmful to children. In addition, teachers and parents thought that AI could make positive contributions to children's development and education. It was observed that all 5 studies examined (Ali, 2024; Alghamdi et al., 2023; Elmorsy et al., 2024; Kazanidis and Pellas, 2024; Oh-Young and Karlin, 2024) *(VI.) aimed to support the professional development of preschool teachers*. For example, Elmorsy et al.'s (2024) study showed that the use of Chat GPT contributed to significant improvements in teachers' abilities in areas such as planning the creative writing process, producing written content, editing and revising tasks. In their study, Oh-Young and Karlin (2024) emphasized the role of AI in supporting teachers' pedagogical competencies and showed that teachers can increase the quality of educational processes by creating activities for children's interests through AI. As a result of the reviews, it was seen that 4 studies (Alakabawy, 2024; Su et al., 2023; Samawi and Al-Assaf, 2023; Cheng, 2024) *(VII.) were written to discuss the opportunities and challenges of AI*. For example, Alakabawy (2024) emphasized that AI has immense potential to advance education, while Su et al. (2023) mentioned the positive effects of AI in curriculum development and preparing a qualified teaching plan. It was stated that 1 study (Kurian, 2023) *(VIII.) was written to discuss the ethical problems of AI*. Kurian (2023) emphasized the ethical necessity of protecting children from the negative effects of AI and developing child-centered design in his study. This was the only study related with ethics in this systematic review. It was observed that 6 studies (Fatmawati, 2024; Katsouda, 2024; Samara and Kotsis, 2024; Su and Zhong, 2022; Zhang, 2023; Zhao et al., 2024) *(IX.) were written with the aim of supporting, developing, and improving school curricula with AI*. For example, Fatmawati (2024) emphasized that AI technologies can improve early childhood education, the importance of exploring teacher training strategies to expand the scope of AI in education and ensure the effective implementation of AI technologies and mentioned the benefits of laying the foundations of an AI-based education curriculum. Katsouda (2024) presented a set of educational scenarios in which the curriculum and AI were integrated to provide knowledge and a positive perspective on AI. In the preparation process of this educational scenario, support was received from many AI-based tools (ChatGPT, Lumen5, Suno, Leonardo.Ai, DALL-E and ElevenLabs). It was seen that 1 study (Derinoğlu and Laçinbay, 2024) *(X.) was conducted to see*

how AI would be used in the evaluation process, and 1 study *(XI.) was conducted to determine how AI and big data would be used in preschool education*.

3.2. Research Question 2: How is AI used in preschool education?

The second research question, which is about how AI is used in preschool education, was addressed in line with the 47 studies determined. These studies were examined under 6 categories according to the AI source used: (1) AI Tools and Robots, (2) AI-Supported Texts and Books, (3) AI Sources Not Specified, (4) AI-Supported Programs/Curriculum, (5) AI-Supported Educational Toys and (6) AI Assessment Techniques.

Table 3.
Distribution of Studies According to AI Sources

AI Resources	Numbers of Studies
(1) AI Tools and Robots	13
(2) AI-Supported Texts and Books	1
(3) AI Source Not Specified	17
(4) AI-supported programs/curricula	10
(5) AI-Supported Educational Toys	4
(6) AI Evaluation Techniques	2

The aim here is to emphasize the AI sources that were concretely used in the 47 studies identified. It was seen in the Table 3. that 13 studies included *(1) AI Tools and Robots* as AI sources. 6 studies (Arnone et al., 2023; Edwards, 2024; Elmorsy et al., 2024; Katsouda, 2024; Oh-Young and Karlin, 2024; Samara and Kotsis, 2024) were encountered in which Chat GPT was used as an AI Tool and in these studies; It has been seen that it has been used to support the professional development of preschool teachers (Arnone et al., 2023; Elmorsy et al., 2024; Oh-Young and Karlin, 2024), to improve the quality of education provided to preschool children (Katsouda, 2024; Samara and Kotsis, 2024) and to show how to use Chat GPT effectively in the preschool period (Edwards, 2024). Related studies have shown that Chat GPT supports teachers in preparing activity plans, developing free writing skills, and designing educational materials. In 5 studies, it was seen that conversation-based AI applications (Kurian, 2023; Otermans et al., 2024) and AI-based video creation and development tools (Fatmawati, 2024; Kazanidis and Pellas, 2024; Li, 2022) were used as AI tools. Two studies (Lee et al., 2024; Yi et al., 2024) were found in which AI robots were used in the preschool period. While the study by Lee et al. (2024) provides sample applications for the use of humanoid robots in diverse types of activities, the bibliometric study by Yi et al. (2024) provides information on different AI robots that can be used in the education of children.

As a result of the reviews, 1 study (Kucirkova and Mackey, 2020) was found that can be evaluated in the category of *(2) AI-Supported Texts and Books*. Kucirkova and Mackey (2020) used AI-supported books and texts to evaluate the potential impact of AI on children's developing self-perception. The results of the study showed that AI-supported books and texts can be effective in developing children's sense of identity. *(3)* In 17 studies in the category of *AI Source Not Specified* (Alakabawy, 2024; Alghamdi et al., 2023; Cheng, 2024; Crescenzi-Lanna, 2023; Fikri and Rhalma, 2024; Köken and Dagal, 2024; Küçükkara et al., 2024; ; Li and Chan, 2024; Lim, 2024; Mohammed, 2023; Samawi and Al-Assaf, 2023; Sit et al., 2024; Su, 2024; Su and Yang; 2022; Su and Yang, 2024a; Su et al., 2023; Zhao et al., 2024), it was determined that the concept of AI was addressed in different ways in the preschool period, but no AI source was included. As a result of the review, it was seen that 10 studies (Ahmed, 2020; Bayoumi, 2024; Eı Helow and Salem, 2022; Ongoro and Fanjiang, 2023; Su and Yang, 2024b; Su and Zhong, 2022; Utepbayeva et al., 2024; Villegas-Ch et al., 2022; Yang, 2024; Zhang, 2023) included *(4) AI-supported programs/curricula in order to improve the quality of education*. While Ongoro and Fanjiang used Digital Game-Based Technology for English Language Learning to support preschool children's foreign language learning in their study in 2023, Yang (2024) used the PopBots program that he developed to assist children in their education. Studies were found that emphasized that preschool education should be reorganized and developed according to the requirements of the age. For example, Su and Zhong (2022) and Eı Helow and Salem (2022) proposed a program that includes machine learning, coding training, and AI-based applications to address deficiencies in the AI curriculum in early childhood education. Zhang, in his study conducted in 2023, included the Smart AI-Supported Dance Teaching Program (AI Dance Teaching Platform), which will enable preschool teacher training programs in higher education institutions to be reshaped according to the age. There are also studies showing that AI-supported education programs can be used in the education of children with special needs. Ahmed (2020) mentioned a curriculum designed for the education of children with learning disabilities, which includes AI-supported applications. Utepbayeva et al. (2024) used an intervention program prepared with AI-supported applications (Fluency SIS, Articulation Station Pro, and Apraxia Farm) for young children with speech disorders. In the study by Su and Yang (2024b), an emphasis was placed on the AI Literacy Program that will support children's AI literacy and creativity. In the study conducted by Bayoumi (2024), a program based on AI applications (LearningApps) was developed to support children's positive thinking skills, while in the study conducted by Villegas-Ch et al. (2022), a game simulation called the AI-Based Image Recognition System was designed to support children's concept learning. In the 4 studies examined, it was observed that *(5) AI-Supported Educational Toys* were used as AI sources. It was observed that AI-supported educational toys were used to develop children's research literacy (Kewalramani et al., 2021), to support concept learning processes (Akdeniz, 2019; Akdeniz and Özdinç, 2021), and to improve word learning and recall skills in the English learning process (Yılmaz et al., 2022).

2 studies (Ali, 2024; Derinoğlu and Laçinbay, 2024) were found in the category of *(6) AI Evaluation Techniques*. These 2 studies used AI-supported evaluation techniques as AI sources. In his study, Ali (2024) aimed to evaluate and improve the professional performance of preschool teachers by using three AI techniques, namely NB, SVM and DNN. In the study conducted by Derinoğlu and Laçinbay (2024), AI-based techniques were used in the evaluation of preschool children's drawings.

3.3. Research Question 3: What are the perceptions/perspectives on the use of AI in preschool education?

The third research question, which is about the perceptions/perspectives on the use of AI in preschool education in the preschool period, was addressed in line with the results and recommendations of the 47 studies.

When the results of the 47 studies were examined within the framework of the perspectives they presented; it was seen that preschool teachers were not sure how to teach AI and did not have confidence in providing AI training (Su and Yang; 2024a). Early Childhood Educator candidates accept the importance of AI for their future careers and express their satisfaction with using AI-based software (Kazanidis and Pellas, 2024). In addition, preschool teachers stated that their professional development and competence improved significantly when they included AI in their education plans (Oh-Young and Karlin, 2024). In the study conducted by Lim (2024), it was observed that although teachers see AI as a difficult concept to learn, they have a positive view on learning and using AI for educational purposes. Teachers stated that AI tools and AI-supported platforms are effective in teaching children the concepts of AI and machine learning. It has been observed that the use of AI in early childhood education can significantly improve the teaching and learning process (Su and Yang, 2022). Küçükkara et al. (2024) reveal that although teachers are interested in AI, they are concerned about AI because they do not have sufficient knowledge and awareness in this area. In the study conducted by Köken and Dagal (2024), it was concluded that although teachers define AI based on the correct scientific basis, they do not have sufficient knowledge about AI, they do not use AI in educational environments to increase children's productivity, and they are anxious about the use of AI. The reasons for teachers' negative attitudes towards AI include the potential for misuse of AI, lack of knowledge about AI, and reliability concerns; The reasons for their positive attitudes towards AI include saving time, enabling personal development, and preparing individualized education plans.

There are also study findings that reveal parents' perspectives on AI. Köken and Dagal (2024) revealed that AI is not defined correctly and that there is a lack of knowledge about AI, based on the answers given by mothers and children to questions about AI; mothers are concerned that AI may be harmful to their children, while children see AI as a living being they can talk to. In the study by Otermans et al. (2024), parents state that they will allow their children to use AI tools safely and think that AI-based education applications will enable children to learn faster when integrated into the education system. In addition, although they think that AI will have a positive impact on children's education for the future, it has also been observed that parents are concerned about the unknown aspects of AI.

In the process of evaluating the perceptions/perspectives on the use of AI in preschool education, the recommendations of the 47 studies reviewed were also examined. In several of the relevant studies (Ahmed, 2020; Fatmawati, 2024; Köken and Dagal, 2024; Küçükkara et al., 2024; Li and Chen, 2024; Lim, 2024; Mohammed, 2023; Sit et al., 2024; Zhong, 2023), it was suggested that teachers should be trained on AI, and their professional development should be supported through AI. Kurian (2023) suggested that children's well-being and safety should be taken into consideration in the process of incorporating AI into preschool education; Otermans et al. (2024) and Samawati and Al-Assaf (2023) suggested that parents should be informed about AI and take a role in the teaching process of AI. In addition, there are also studies suggesting the use of AI applications and robots to improve the quality of the teaching process in preschool education (Alakabawy, 2024; Arnone et al., 2023; Katsouda, 2024; Kewalramani et al., 2021; Li et al., 2024; Su and Yang, 2022; Su and Zhong, 2022; Yang, 2024).

4. RESULTS, DISCUSSION AND RECOMMENDATIONS

4.1. Results and Discussion

When the results obtained within the scope of the first research question are examined, it is seen that AI is used for many different purposes in the preschool period, from supporting children's skill acquisition and development to increasing teacher competence. The examined studies reveal that AI can play an active role in increasing the quality of preschool education and can provide knowledge and awareness about AI. However, there are study findings that draw attention to the fact that sufficient equipment and information on the use of AI in preschool education has not yet been obtained, and as a result, there are doubts and concerns about AI (Köken and Dagal, 2024; Küçükkara et al., 2024; Su and Yang; 2024a). The fact that the use of AI in preschool education is relatively new and open to development compared to other levels of education may be the reason for this lack of information. To support the effective use of AI, it can be said that it would be beneficial to inform individuals and groups who are stakeholders of preschool education about AI and to present sample applications for the efficient use of AI in preschool. With the correct definition of AI and its use in accordance with its purpose, children's learning status and performance can be predicted and learning resources suitable for their needs can be provided, and teachers can be supported to improve themselves by supporting their pedagogical competence. It is seen that the most used AI tool in supporting teachers' professional competence is Chat GPT. The fact that Chat GPT is one of the first AI tools released to the

market, its easy accessibility and ease of use with a simple interface may be the reason why it is preferred more than other AI resources.

The findings obtained within the scope of the second research question reveal that different AI sources are used to integrate AI with preschool education. It is seen that in a total of 17 studies, the concept of AI in the preschool period is addressed in different contexts, but no AI source is included. The reason for this may be that the relevant studies are presented in a qualitative research design, aiming to provide information and develop perspectives on the use of AI in preschool education. By using different qualitative research methods (phenomenology, case study, systematic review, scope review, literature review), it is aimed to reveal the status of AI in preschool education and the perspective towards AI. In 13 studies that included AI tools and robots as AI sources, the most used AI tool was again Chat GPT (Arnone et al., 2023; Edwards, 2024; Elmorsy et al., 2024; Katsouda, 2024; Oh-Young and Karlin, 2024; Samara and Kotsis, 2024). It can be said that Chat GPT can be used as an effective factor in increasing the professional competence of the teacher, planning in-class activities, and effectively managing the learning process. There is only 1 study in which AI-supported texts and books were used as AI sources. The reason for this may be that researchers do not have sufficient knowledge in creating AI-supported written sources. The fact that experts in preparing quality children's books come together with experts in AI tools and conduct interdisciplinary studies may increase the number of studies that examine AI-supported texts and books. In addition, there are studies showing that integrating educational curricula with AI to adapt the preschool education curriculum to the needs of the age yields positive results (Eı Helow and Salem, 2022; Ongoro and Fanjiang, 2023; Su and Zhong, 2022; Yang, 2024; Zhang, 2023). However, to see the effectiveness of these AI-based educational curricula, it is thought that it is important to conduct long-term studies and multi-faceted process evaluations. The fact that there are few or no different studies evaluating the effectiveness and generalizability of AI resources used in preschool education in relevant studies reveals the necessity of studies to be conducted on this subject.

When the results obtained within the scope of the third research question are examined, it is seen that the perspectives on the use of AI in preschool education vary. Both teachers and parents see AI as important and state that the use of AI will benefit children's development. However, despite their positive perspectives towards AI, adults stated that they are anxious and afraid because of not having sufficient knowledge about AI. The fact that AI-based studies and applications are not presented in accordance with the nature and functioning of AI may be one of the reasons for the lack of knowledge in the relevant field. In addition, the insufficient number of AI-based educational applications and research may be another reason for this lack of information.

In general, this systematic review study, unlike previous studies, examines the use of AI in preschool education in a multifaceted manner and presents the results of the studies systematically. First, the study mentions why AI is used in preschool education. Second, how AI is used in preschool education and third, what the perceptions/perspectives are on the use of AI in the preschool period. All these results reveal the originality of the study.

4.2. Recommendations

When studies on the use of AI in preschool education are examined, it is seen that studies are being conducted to support children's development, skill acquisition, and to increase teachers' competence. However, it is noteworthy that measures to ensure children's well-being and safety are not sufficiently included in the relevant studies. Only one study was found discussing the ethical aspects of AI. Considering the age range of preschool children, it is thought that direct exposure of these children to AI will bring about some negative consequences such as a decrease in social communication and physical activity, technology addiction, privacy, and security problems. There is a need for ethically sound applications that will not have a negative impact on the development and safety of young children. Therefore, to address the ethical issues that AI poses in education, it would be beneficial to develop policies that cover all stakeholders of preschool education and to put into effect regulations that prioritize ethical elements in the use of AI. Ethical problems that may be encountered with the use of artificial intelligence in education should be discussed from a multifaceted perspective.

Teachers and parents state that AI can have a supportive effect on children's education and development. However, the lack of knowledge about AI causes anxiety and fear towards AI. For this reason, it would be beneficial for relevant experts and policy makers to shed light on the unknown aspects of AI, to inform families and teachers about AI, to provide training, organize seminars, and implement family education practices.

To support children's education, it is important to inform adults about how and when to use AI-based applications. For this reason, it would be appropriate to provide comprehensive family training for families and AI-based in-service training for teachers on AI tools and applications that can be used in preschool education.

To adapt to the developing technology age and to facilitate the acquisition of the necessary digital skills, it is recommended to support the digital literacy skills of both adults and children by developing AI applications suitable for the preschool education level.

It's important to consider the economic and social dimensions of AI. AI-based educational tools can put financial strain on families and children who are socioeconomically disadvantaged.

Research and Publication Ethics Statement

This study was prepared based on scientific publication ethics and research principles.

Contribution Rates of Authors to the Article

This study is a study by 2 authors. The contribution of both authors is equal (First author = 50%, second author = 50%).

Statement of Interest

There is no conflict of interest between the authors of this study.

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