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Analysis of Studies Based on Türkiye Examining the Relationship between Artificial Intelligence and Education: A Meta Synthesis Study

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Abstract

Artificial intelligence is defined as man-made systems that mimic the thinking, perceiving and learning abilities of the human brain.This paper aims to synthesize the existing literature on AI applications in the field of education within a specific time frame and to develop a holistic perspective. In the paper, 20 studies written in the last five years on AI and education were examined using the metasynthesis method. The research question was defined as: "What trends exist in academic research on AI and education conducted in Turkey over the past five years?" The data source for the research was determined using the criterion sampling method. In line with this goal, a detailed search was conducted in databases such as Google Scholar, Academia, TÜBİTAK ULAKBİM, and Dergipark using the keyword "artificial intelligence and education." The analyses revealed that while AI's contribution to the field of education is emphasized, there are also concerns on the subject. AI's benefits, particularly in providing personalized learning experiences, saving time, and enhancing student performance, were highlighted, but issues such as data privacy and ethical principles in AI use raised concerns. Additionally, the need for education and development for AI users was identified.

Keywords: Artificial intelligence, education, educational technologies, meta synthesis, technology

Yapay Zekâ ve Eğitim İlişkisini İnceleyen Türkiye Adresli Çalışmaların Analizi: Bir Meta Sentez Çalışması

Öz

Yapay zekâ; insan beyninin düşünme, algılama ve öğrenme becerilerini taklit eden insan ürünü sistemler olarak tanımlanmaktadır. Teknoloji alanında yaşanan değişimle birlikte yapay zekanın kullanım alanı da artmıştır. Yapay zekanın eğitim alanında popülerleşmesi bu konuda yapılan araştırmaları arttırmıştır. Bu makalede yapay zekanın eğitim alanıdaki uygulamalarına ilişkin belirli yıllar aralığındaki mevcut literatürün sentezlenmesi ve bütüncül bir bakış açısının geliştirilmesi amaçlanmaktadır. Makalede son beş yılda yapay zekâ ve eğitim konusunda yazılmış 20 çalışma meta-sentez yöntemiyle incelenmiştir. Araştırmanın problem cümlesi ‘‘Türkiye’de son beş yılda yapay zekâ ve eğitim konusunu ele alan akademik araştırmalarda nasıl bir eğilim vardır?’’ olarak belirlenmiştir. Araştırmanın veri kaynağı, ölçüt örnekleme yöntemi kullanılarak belirlenmiştir. Bu amaç doğrultusunda “yapay zekâ ve eğitim” anahtar kelimesi ile Google Akademik, Academia, TÜBİTAK ULAKBİM, Dergipark, veri tabanlarında detaylı bir tarama gerçekleştirilmiştir. Yapılan analizler sonucunda, çalışmada yapay zekanın eğitim alanına olan katkısı vurgulanmış fakat bu konuda bazı endişelerin de var olduğu tespit edimiştir. Yapay zekanın; kişiselleştirilmiş öğrenme deneyimi, zaman tasarrufu, öğrenci performansını arttırma konularında katkıları vurgulanırken veri gizliliğinin sağlanamaması ve yapay zekâ kullanımında etik ilkelere dikkat edilememesi gibi konularda ise endişelerin olduğu sonucuna ulaşılmıştır. Ayrıca yapay zekâ kullanıcılarına yönelik eğitim ve gelişim ihtiyaçlarının olduğu tespit edilmiştir.

Anahtar Kelimeler: Eğitim, eğitim teknolojileri, meta-sentez, yapay zekâ, teknoloji.

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1. Introduction

Artificial intelligence (AI) is defined as human-made systems that mimic the thinking and learning skills of the human brain and can improve themselves by using the information they collect (Çelebi & İnal, 2019; Obschonka & Audretsch, 2020). Thanks to these capabilities, artificial intelligence learns to solve increasingly complex computational tasks and has the potential to profoundly affect the future development of humanity with its unprecedented performance characteristics. Artificial intelligence is effective in many fields such as industry, agriculture, health, entertainment, finance, engineering, communication, psychology and education (Wang, Rau, & Yuan, 2023). Artificial intelligence has recently shown a rapid development in these areas. These rapid advances in artificial intelligence technologies have led to major changes in the field of education (Lee and Kim, 2019). This technology plays a critical role in reshaping teaching methods, assessment processes and student support services in education. The integration of such technologies into educational environments differentiates the educational processes of both teachers and students (Thompson, 2022).

The applications of artificial intelligence in the field of education offer some opportunities such as the use of automated assessment systems, the creation of personalized learning platforms, the provision of flexible and engaging learning opportunities, and the opportunity to respond not only to the material learned, but also to students' emotions (Luckin, Holmes, Griffiths, & Forcier, 2016; Evans, 2023). At the same time, AI technologies are used in many areas such as monitoring student performance more effectively, providing materials suitable for individual learning characteristics, and organizing course content according to individual learning speed (Wilson, 2024). In particular, AI-supported learning tools offer students a personalized educational experience and can respond more effectively to their individual learning needs (Martinez, 2021).

The impact of artificial intelligence in education is not limited to classroom applications. Artificial intelligence has also led to significant changes in education management systems. The use of artificial intelligence in management processes makes data analysis more effective in schools and universities (Willis, 2023). In addition, AI-based analyses provide significant convenience to its users in predicting student success and providing support services to students. In addition, although it is thought that artificial intelligence applications will replace some professions, in fact, this technology facilitates and improves many jobs and helps to overcome difficult tasks (Bader & Kaiser, 2019).

In recent years, as in many other fields, studies on the use of artificial intelligence in education have gained momentum (Taşçı & Çelebi, 2020). Various studies have been conducted on the use and development of artificial intelligence in education, the contributions of AI to education, potential threats, future scenarios, and the roles of AI in learning processes (Popenici & Kerr, 2017; Taşçı & Çelebi, 2020). The increase in research conducted in the field of AI and education has enriched the knowledge base in this area (Garcia & Jones, 2021). It is understood from the studies that while there are countless benefits to using AI in education, there are also challenges that need to be addressed. These challenges include technical, ethical, and accessibility issues that must be carefully managed to enhance the quality of AI's contributions to education (Alkan, 2024). Therefore, studies in the field of AI and education should be thoroughly analyzed, and new research should be conducted to shape the future of this field. By doing so, educational institutions can adopt AI technologies,

improve educational processes within the framework of ethical rules, and introduce various innovations in education. In this context, there is a need for meta-synthesis studies that bring together and comprehensively analyze the findings of studies on AI in education. This article aims to present a meta-synthesis of studies conducted in the field of AI and education over the past five years. For this purpose, the existing literature on the applications of artificial intelligence in the field of education has been synthesized to develop a holistic perspective and to provide a viewpoint for researchers interested in this area. The article includes recommendations for future research in the field of artificial intelligence and education. In this context, the findings obtained using various research methods and analysis techniques in the article will help to understand the role of artificial intelligence in education and guide future studies in this field.

2. Literature

There are various definitions of artificial intelligence in the literature. Understanding AI is crucial for recognizing and interpreting the social, personal, and political events that impact humanity in today's world, as well as for understanding the developments and changes related to these events (Arslan, 2020). Nilson (2011) defines AI as a field that encompasses advanced functions unique to human intelligence, such as learning, establishing relationships between concepts, perception, thinking, problem-solving, decision-making, reasoning, and communicating by drawing conclusions from these processes. Aydın (2017) defines AI as the modeling of human cognitive abilities and the functioning of the human brain to impart learning capabilities to machines.

Artificial intelligence is used in a wide range of fields, including education, healthcare, engineering, the job market, entertainment, law, politics, and the military. With the advancement of technology, AI has begun to be utilized in the field of education, just as it has in many other areas. Software developed using AI techniques has gained significant importance in education. Materials used in the educational process are being transformed by AI techniques into materials that can mimic the cognitive abilities of the human brain, adapt to different conditions, and communicate effectively (Uğur & Kınacı, 2006). The use of AI in education is often perceived as the integration of "robot teachers" into the educational process, but the reality is somewhat different from this prediction. AI can be categorized into three main approaches based on its area of focus: data-based, knowledge-based, and logic-based AI approaches. The educational applications of AI from the 1980s to the 2000s were predominantly based on a knowledge-based approach (Sleeman & Brown, 1982). During this period, AI research areas were primarily organized into three modules under the umbrella of intelligent tutoring systems: the domain module, which defined the subject area to be learned; the student module, which tracked the student's learning and knowledge status; and the pedagogical module, which presented learning materials to the student through an interactive and adaptive interface (Woolf, 2009). When examining today's AI studies in education, it is evident that AI supports education not only through knowledge-based applications but also through data-based and logic-based applications. These include individualized education, dialogue-based systems, exploratory learning, student paper analysis, intelligent agents, chatbots, data mining in education, education for children with special needs, child-robot interaction, AI-based assessment systems, and automated test creation systems (Holmes, Bialik, and Fadel, 2019). Robots that can assist students with homework and provide solutions to the problems they encounter are being developed. There

are also robots used in classrooms to facilitate the learning process, provide coding education to students, and assist teachers within the classroom (Raaflaub, 2021).

Artificial intelligence has brought significant changes to education by utilizing evolving and changing technologies. It can also be anticipated that this change will continue at every stage of the teaching process. It is believed that AI will develop around the principle of "one-on-one learning," which is emphasized in all educational approaches. With the use of AI technology in education, students will have the opportunity to receive more efficient education through personalized guidance tailored to their needs (Çelik, Oduncu, Güdekli, & Doğankaya, 2023).

In summary, it can be said that AI will contribute to the educational process in several ways: providing individual support to students in teaching and learning, introducing a new dimension to assessment and evaluation through tests and evaluations for both students and educators, enabling more effective and widespread use of differentiated learning, and applying the instant feedback system, which holds an important place in education and teaching.

The predictions for artificial intelligence in the healthcare sector include genetic manipulation within about 20 years, the transformation of all hospitals into smart hospitals, the production of artificial organs, and the reduced role of doctors. Expert systems, one of the AI methods, have been developed to provide effective and rapid solutions to problems in the healthcare field. These systems can offer medical diagnoses and treatment methods by checking patients' health records and medications (Babalık & Güler, 2007).

Another area where AI is utilized is in entertainment and games. Deep Blue, designed by IBM in 1996, became the world chess champion by defeating all its opponents. Additionally, computer programs that play against opponents are available for games like checkers. The Sims game can also be cited as an example of AI usage in the entertainment sector (Aydın, 1991).

AI also holds a significant place in the field of communication. With the shift from traditional methods to online systems, AI has started to offer many usage opportunities in communication. AI is actively used in fields where communication is crucial, such as public relations, advertising, and journalism. In sales and marketing, public relations experts use influencers to promote products, and AI is utilized to select the most effective influencer for product promotion (Ilıcak & Aydınalp, 2020).

The successful applications of AI in various fields have quickly led to the initiation of studies in the military sector. The success of AI technology in many areas, the increasingly complex nature of military operations, the rapid development of potential conflicts, and the growing knowledge of military personnel about AI techniques for solving military problems have directed attention to AI research in the military sector (Kocabaş, 2017).

AI is also utilized in the legal system, which represents human rights. In China, by 2017, all decisions within the legal system were stored and preparatory work was done for AI-generated robotic judges. Since then, robotic judges have started to conduct trials in China. These AI-developed robots make decisions based on precedents derived from the stored legal decisions. Between 2017 and 2019, robotic judges made more than 3 million decisions. Moreover, while the decisions of robotic judges can be sent to human judges if necessary, only 2% of the decisions were sent to human judges during the four-year period. The

Chinese government aims to transform the entire judicial system into smart courts. However, due to the unequal access to technology, this does not seem very feasible in the near future (Kaya & Şahin, 2021).

The use of AI in multiple fields has led to numerous research studies on AI. Based on the findings of these studies, it is expected that developing some recommendations will improve the quality of AI usage. The growing use of AI in the education sector has brought additional areas such as teachers, students, and educational processes into focus. Every study conducted on this topic contributes to the field. In this article, the synthesis of studies conducted over a specific period is aimed to explain trends in AI and education within the framework of common results.

3. Method

In the study, meta-synthesis method, one of the qualitative research designs, was preferred since it was aimed to reach generalizable results of the studies conducted on artificial intelligence and education in the last five years and to examine the studies focused on similar topics. Noblit and Hare (1988) defined the meta-synthesis method as a research method that aims to develop a new and broader understanding by comparing and combining the findings of different studies. Sandelowski and Barroso (2007) explain meta-synthesis as a systematic method in which qualitative research findings are reconstructed and interpreted, helping to develop new themes and theories. In this direction, using the meta-synthesis method, the qualitative characteristics and findings of 20 studies accessed from databases such as Google Scholar, Academia, TÜBİTAK ULAKBİM, Dergipark were synthesized.

4. Data Collection

Polat and Ay (2016) listed the steps to be considered in a meta-synthesis study as follows.

- Determining the research question.
- Conducting a literature review by determining a keyword related to the subject of the study.
- Accessing the sources, identifying and evaluating the sources by reviewing them.
- Determining the inclusion and exclusion criteria based on the criterion sampling of the research and selecting the studies.
- Analyzing the studies selected as a result of the evaluation and reaching common themes and sub-themes. Identifying similarities and differences.
- Synthesizing the findings within the framework of the determined themes and making inferences.
- Reporting and presenting the whole process and findings

Based on these steps, the data collection phase of the research started with the step of determining the research question. The problem statement of the research was determined as "What is the trend in academic research on artificial intelligence and education conducted in Turkey in the last five years?". Answers to the following sub-problems were sought in the focus of the determined problem statement. Studies;

- What is their distribution according to the years they were published?
- What is their distribution according to the place of publication?
- How is their distribution according to their aims?
- How is their distribution according to the sample/study group?

- How is their distribution according to data collection tools?
- How is their distribution according to the method used?
- How is their distribution according to the results obtained?

Then, the keyword "artificial intelligence and education" was determined in accordance with the subject of the research and the literature review phase was started. While conducting the literature review, databases such as Google Scholar, Academia, TÜBİTAK ULAKBİM, Dergipark, etc. were utilized. Criterion sampling was used to access articles related to the research topic from the databases. In this context, the articles were determined based on the criteria of addressing artificial intelligence and education together, being written between 2020-2024, and having findings related to education. Based on these criteria, 21 studies were reached. The studies were analyzed and common themes and sub-themes belonging to these themes were reached. Similar and different aspects of the studies were revealed. The findings obtained in the context of the determined themes were synthesized and inferences were reached.

5. Data Analysis

While analyzing the data of meta-synthesis studies; line coding, creating descriptive themes, and developing analytical themes should be followed (Thomas & Harden, 2008). In this context, before analyzing the data, the articles included in the study were sorted according to the year of publication and coded as M1, M2, M3.... Common themes were created by analyzing the coded studies. Following the creation of common themes, sub-themes related to these themes were obtained. The relationship between themes and sub-themes was determined and presented in a table. After presenting the relationships between the studies, the similarities and differences between the studies were identified. The general characteristics of the studies included in the research, the themes and sub-themes identified, the methods and models used in the studies, the measurement tools used and the findings were presented in tables. In the last stage, all the data obtained were synthesized and expressed. In Figure 1, all the steps of the study are visualized and presented.

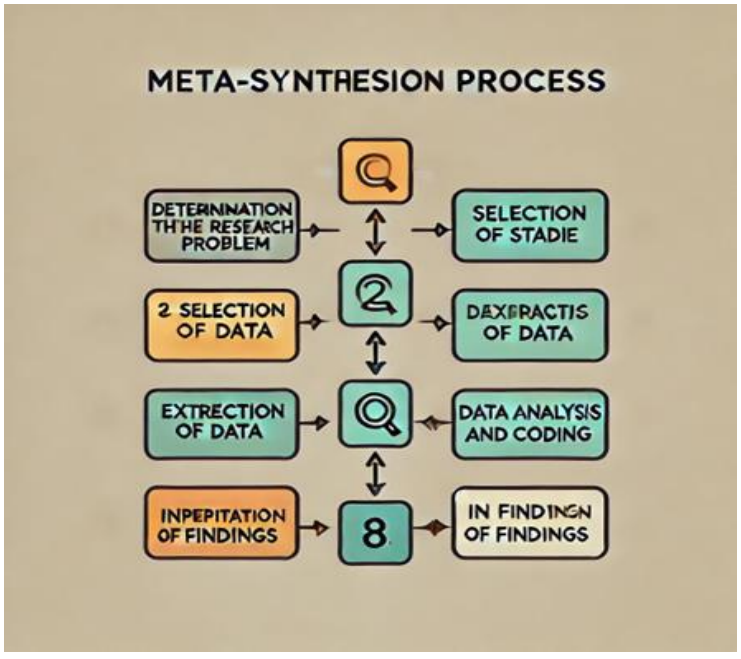

Figure 1: Meta synthesis process

5.1.Studies Included in the Research and Their Codes

Table 1 lists the studies included in the criterion sample and the codes given to the studies.

Table 1: Studies Included in the Research and Their Codes

Study Title	Year	Code
Perceptions of Mathematics Teachers Regarding Their Competencies in Using Artificial Intelligence in Mathematics Classes	2024	M1
Teachers' Perceptions of the Use of Artificial Intelligence in Education	2024	M2
Teachers' Opinions on the Use of Artificial Intelligence Technologies in Education	2024	M3
An Application for Using ChatGPT Artificial Intelligence in Course Content	2024	M4
Preschool Teachers' Opinions on Artificial Intelligence	2024	M5
Teachers' Opinions on the Integration of Information and Communication Technologies in Education Institutions into the Teaching Process in the Context of Artificial Intelligence	2024	M6
Examination of Teachers' Opinions on the Applicability of Artificial Intelligence in Education from the Perspective of Industry 4.0	2024	M7
Investigation of the Relationship Between Preschool Teacher Candidates' Attitudes Towards Artificial Intelligence and Artificial Intelligence Literacy	2024	M8
Analysis of Science Group Teachers' Use of Artificial Intelligence During the Distance Education Process	2023	M9
Opinions of School Principals and Teachers on the Use of Artificial Intelligence in Education	2023	M10
The Importance of Artificial Intelligence in Education According to Teachers' Opinions	2023	M11
Teachers' Opinions on the Use of Artificial Intelligence Technologies in Education	2023	M12
Teachers' Opinions on the Use of Artificial Intelligence in Schools	2023	M13
Applications of Artificial Intelligence in Preschool Education Institutions: Opinions of Administrators and Teachers	2023	M14
The Use of Artificial Intelligence in Education: A Descriptive Content Analysis Study	2022	M15
The Role of Digitalization and Artificial Intelligence in School Administration	2022	M16
Determining the Awareness of Pre-	2021	M17

Service Teachers Regarding Artificial Intelligence Technologies		
Determining the Awareness of Pre-Service Teachers Regarding Artificial Intelligence Technologies	2021	M18
A New Paradigm in Education: 'Artificial Intelligence in Higher Education'	2020	M19
Natural Language Processing on the Path to Artificial Intelligence Teaching Turkish	2020	M20

According to the table 1, 8 studies (M1, M2, M3, M4, M5, M6, M7, M8) from 2024, 6 studies (M9, M10, M11, M12, M13, M14) from 2023, 2 studies (M15, M16) from 2022, 2 studies (M17, M18) from 2021 and 2 studies (M19, M20) from 2020 were included in the research.

Validity and Reliability

The criteria of clarity, compatibility, scope, structure and generalizability are very important concepts in ensuring the quality, accuracy and validity of the findings of qualitative research (Bondas & Hall, 2007). As Yıldırım and Şimşek (2021) stated, the concept of controllability is another concept that should be considered to ensure the validity and reliability of the studies. In this context, validity and reliability aims to ensure that the research questions are addressed correctly and that the data collected are appropriate for the purpose of the research. For this purpose, in order to ensure the validity and reliability of the research, the articles included in the study were meticulously examined and the coding process for the studies was carried out many times. The studies were re-coded by another field expert. The codings of different researchers were rechecked as a whole. All these steps increased the validity and reliability of the study and ensured that the results obtained were reliable and verifiable.

6. Findings

7.1. Distribution of the Studies Included in the Meta-Synthesis by Publication Year

Table 2: Studies Included in the Research and Their Codes

Year of Publication	Code of the Study
2020	M19, M20
2021	M17, M18,
2022	M15, M16
2023	M9, M10, M11, M12, M13, M14
2024	M1, M2, M3, M4, M5, M6, M7, M8

In Table 2, the studies conducted between 2020 and 2024 are presented with their codes in order to facilitate the understanding of the trends and intensities in the research area. According to the table, 2 studies were conducted in 2020, 2 in 2021, 2 in 2022, 6 in 2023 and 8 in 2024.

7.2. Distribution of Studies Included in Meta-Synthesis According to Place of Publication

Table 3: Journals where the studies included in the research were published

Journal Name	Code
Journal of Social, Humanities and Administrative Sciences	M1
International Journal of Social and Humanities Research	M2
National Education Journal	M3
International QMX Journal	M4
Journal of Primary Education Research	M5
Academic Social Resources Journal	M6
Istanbul Commerce University Journal of Entrepreneurship	M7
Edutech Research	M8
Buca Faculty of Education Journal	M9
ISPEC International Journal of Social Sciences & Humanities	M10
Journal of Social, Humanities and Administrative Sciences	M11
National Education Journal	M12
National Education Journal	M13
International Social Mentality and Researcher Thinkers Journal	M14
Karadeniz Technical University Journal of Social Sciences	M15
International Leadership Studies Journal	M16
International Leadership Studies Journal	M17
Mustafa Kemal University Journal of Social Sciences	M18
Journal of Management Information Systems	M20

Table 3 provides information about the journals in which the articles included in the study were published. As can be seen from the table; 10 articles were published in journals published in the field of Social Sciences, 5 in journals published in the field of Educational Sciences, 3 in journals published in the field of Administrative Sciences and Management, and 2 in journals published in the field of Leadership and Management.

7.3. Distribution of the Studies Included in the Meta-Synthesis by Purpose

Table 4: Distribution of the Studies Included in the Study According to Their Purposes

Purpose of the Study	Kodu
To determine teachers' perceptions of the use of artificial intelligence in education	M1, M2
To determine teachers' opinions on the use of artificial intelligence in education	M3, M5, M6, M7, M10, M11, M12, M13, M14, M17,
To understand the role of artificial intelligence in the field of education and to examine factors that may shape future educational environments	M4
To examine the relationship between the attitude levels of preschool teacher candidates towards artificial intelligence and their artificial intelligence literacy	M8

To determine teachers' levels of using artificial intelligence	M9
To analyze studies on the use of artificial intelligence in education	M15
To determine the effects of artificial intelligence on school administration	M16
To determine pre-service teachers' awareness of artificial intelligence	M18
To determine the positive and negative aspects of using artificial intelligence in higher education	M19
To analyze the current state of natural language processing studies in the context of Turkish	M20

Table 4 presents information about the purposes of the articles included in the study. As can be seen from the table, various studies aiming to examine the perceptions and attitudes of teachers and school administrators on the use of artificial intelligence in education were included. Under the category of "Perceptions and Opinions on the Use of Artificial Intelligence in Education", how teachers perceive artificial intelligence in education (M1), the role of artificial intelligence in education (M4), teachers' opinions (M3, M5, M6, M7, M10, M11, M12, M13, M14, M17), and pre-service teachers' awareness levels about artificial intelligence (M18) are discussed. Under the title of "Artificial Intelligence and Applications in Education", the levels of teachers' use of artificial intelligence (M9), the relationship between artificial intelligence literacy and attitude levels of pre-service preschool teachers (M8), and the analysis of studies on the use of artificial intelligence in education (M15) are examined. In addition, under the title "Artificial Intelligence and Administration", the effects of artificial intelligence in school administration (M16) are investigated, and under the title "Artificial Intelligence in Higher Education", the positive and negative aspects of artificial intelligence in higher education (M19) are evaluated. Finally, under the category of "Natural Language Processing and Turkish", the current situation is analyzed in the context of natural language processing studies in Turkish (M20). These articles aim to illuminate the potential and effects of artificial intelligence in education from various perspectives.

7.4. Distribution of the Studies Included in the Meta-Synthesis by Sample / Study Group

Table 5: Distribution of the Studies Included in the Study According to Sample/ Study Group

Sample/Study Group	Code
Teacher	M, M2, M3, M5, M6, M7, M8, M9, M11, M12, M13, M17, M18
Student	M4
Administrator/Teacher	M10, M14
Document	M15, M16, M19, M20

Table 5 presents information about the sample/study groups of the studies included in the research. As can be seen from the table, there are 13 studies (M1, M2, M3, M5, M6, M7, M8, M9, M11, M12, M13, M17, M18) that aim to reveal the role of artificial intelligence in education and the artificial intelligence awareness of pre-service teachers and whose study group consists of teachers. There is 1 study (M4) in which a study was conducted with students to understand the role of artificial intelligence in education. In the studies where the study group consisted of administrators and teachers (M10, M14), the effects of artificial intelligence in school administration were discussed. There are studies (M15, M16, M19,

M20) that include existing literature and analysis on the use of artificial intelligence through document review. The studies in these categories aim to develop a comprehensive understanding by evaluating the effects and applications of artificial intelligence in education from various perspectives.

7.5. Distribution of Studies Included in Meta-Synthesis According to Data Collection Tools

Table 6: Distribution of the Studies Included in the Study According to Data Collection Tools

Data Collection Tool	Kodu
Scale	M1, M14
Interview Form	M2, M3, M4, M5, M6, M7, M9, M10, M11, M12, M13, M18
Scale and Interview Form	M8
Academic Database	M15, M16, M19, M20

Table 6 presents information on the data collection tools of the studies included in the research. As can be seen from the table, the data collection tools used in the studies examining the effects of artificial intelligence on education differ according to the purpose of the research. In the studies where scales were used as data collection tools (M1, M14), it was aimed to measure the perceptions and attitudes of teachers and administrators. Interview forms were used to collect data in in-depth interviews with teachers, students and pre-service teachers to determine their views and opinions on the use of artificial intelligence in education (M2, M3, M4, M5, M6, M7, M9, M10, M11, M12, M13, M18). The combination of both scale and interview form was applied to assess pre-service preschool teachers' AI literacy and attitude levels (M8). Finally, academic databases were used to collect data from literature review and documents (M15, M16, M19, M20). These tools were strategically selected to provide comprehensive and reliable data from a variety of perspectives.

7.6. Distribution of the Studies Included in the Meta-Synthesis According to the Method Used

Table 7: Distribution of the Studies Included in the Study According to the Method Used

Research Methodology	Code
Quantitative	M1
Qualitative	M2, M3, M4, M5, M6, M7, M9,M10, M11, M12, M13, M14, M15, M16, M18, M19, M20
Mixed	M8

In Table 7, the methods used by the studies included in the research are categorized and presented. As can be seen from the table, different research methods were used to examine various aspects of artificial intelligence in education. In the study conducted with quantitative method, it is aimed to examine teachers' perceptions of competence towards the use of artificial intelligence in mathematics lessons (M1). In qualitative research, teachers' and students' perceptions and attitudes towards the use of artificial intelligence in education are evaluated using a wide range of data collection tools (M2, M3, M4, M5, M6, M7, M9, M10, M11, M12, M13, M14, M15, M16, M18, M19, M20). The mixed-method study comprehensively examines the relationship between pre-service preschool teachers' attitudes towards artificial intelligence and artificial intelligence literacy with both quantitative and qualitative data (M8). This diversity of methods offers a comprehensive approach to understanding the effects of AI in education in a multidimensional way.

7.7. Distribution of the Studies Included in the Meta-Synthesis According to Their Results

Table 8: Distribution of the included studies according to their results

Categories	Results	Code
The Future of AI in Education	Widespread adoption of AI in education is anticipated	M11, M12, M13, M14, M16, M18
Application of Certain AI Tools in Education	Positive reception of ChatGPT in education	M4
Benefits of AI	Perceived ease of teachers' work Impact on student achievement Influence on student motivation Making life easier Saving time Providing personalized learning opportunities Making the learning process enjoyable Providing rich educational materials Assisting in time management Offering different perspectives Promoting multidimensional thinking Encouraging collaboration Providing feedback Identifying students' strengths and weaknesses Facilitating learning and knowledge transfer Ensuring equal opportunities in education Evaluating student performance Creating new job positions Simplifying administrative tasks	M1, M2, M3, M4, M7, M11, M12, M13, M13, M14, M14, M15, M16, M17, M18
Concerns about AI	Concerns about AI potentially replacing teachers Inability to ensure data security Lack of privacy for teachers' and students' information Injustice in technology usage Causing screen addiction Leading to excessive stimuli Decline in thinking skills Encouraging laziness Limiting creativity Causing detachment from real life Replacing student-teacher interaction Lacking emotional connection Being an expensive implementation Dehumanizing effects of AI Disappearance of certain professions	M1, M2, M3, M4, M5, M7, M10, M11, M12, M13, M14, M15, M17, M18, M20
Ethical Issues	Failure to use artificial intelligence in accordance with the principles of ethics and justice	M2, M6, M7, M11, M12, M13, M17, M19
Use of AI without Teachers in Education	Effective use is not possible without a teacher Replacing the teacher	M4, M18, M20, M10 M20, M10
Needs Related to AI	Need for specialized personnel and training	M2, M7, M9, M11, M13, M14, M16

	Users need training on ethics and privacy Ensuring artificial intelligence and human harmony Providing technological infrastructure	M10
Use of Robot Teachers	Supporting students Improving student performance	M20

In Table 8, the results of the studies on the use of artificial intelligence in education are presented under various categories. As can be seen from the table, there were studies that provided clues on how to integrate artificial intelligence into education more effectively and predicted the wide use of artificial intelligence in the field of education (M11, M12, M13, M14, M16, M18). In the study where it was determined that the use of artificial intelligence applications such as ChatGPT in education was perceived positively, it was revealed how the integration of artificial intelligence into educational processes was perceived (M4). In the results of various studies, the benefits of artificial intelligence in education were found (M1, M2, M3, M4, M7, M11, M12, M13, M14, M15, M16, M17, M18). These benefits include many positive effects of AI such as easing the workload of teachers, increasing student achievement, providing motivation, saving time, providing personalized learning, and providing rich course materials. In addition, there are also some studies that show that there are concerns that artificial intelligence may replace teachers, create data security problems, cause screen addiction, cause excessive stimuli and limit creativity, and put some professions at risk of extinction (M1, M2, M3, M4, M5, M7, M10, M11, M12, M13, M14, M15, M17, M18, M20). In addition to these concerns, some studies emphasized the necessity of using artificial intelligence in accordance with the principles of ethics and justice. These studies point to the importance of considering the ethical aspects of artificial intelligence applications (M2, M6, M7, M11, M12, M13, M17, M19). Among the results of the two studies analyzed, the results reached by discussing whether it is possible to use artificial intelligence effectively without teachers are included. These studies emphasize the importance of the role of teachers in AI technologies (M4, M18, M20, M10). Another category is related to the results of the studies regarding the needs of the participants regarding artificial intelligence. In this category, the results of the studies addressing issues such as the need for specialized personnel and training, training of users on ethics and privacy issues, ensuring the harmony between artificial intelligence and human, and technological infrastructure requirements were included (M2, M7, M9, M11, M13, M14, M16). How robot teachers can be used to support students and improve student performance is a topic discussed among the results of study M20.

8. Conclusion / Discussion / Recommendations

This study aimed to conduct a meta-synthesis of academic research on artificial intelligence and education between 2020 and 2024, evaluating general trends, findings, and future research areas in this field. The analyzed studies revealed how AI technologies are perceived in education, their impacts on teachers, students, and administrators, as well as the opportunities and challenges these technologies present. The articles written between 2020 and 2021 represent early-stage research aimed at exploring the potential of AI technologies in education. These studies include foundational research focused on understanding the effects of AI in education. The articles from 2022 are observed to address more specific

aspects of AI integration into educational processes. During this period, the role and impact of AI applications in education were examined in greater detail. When the articles from 2023 are reviewed, it is evident that AI technologies began to be more widely used in education, with in-depth investigations into the effects of these technologies on teachers, students, and educational administrators. The studies conducted in this year are noted for providing significant findings regarding the effectiveness of AI applications in education. As for the articles from 2024, they are predominantly observed to explore various applications and strategies for the use of AI in education. During this period, comprehensive studies were conducted to fully understand the potential of AI in education. These studies play a crucial role in shaping the future integration of AI applications into the education system. The intensified focus on this topic after 2020 may be due to the widespread adoption of AI technologies, which began to be used in almost every aspect of life. Another reason could be the widespread adoption of remote education during the pandemic, increased use of technology, and the growing recognition of AI technologies (Grassini, 2023; Lo, 2023; Maqbool, 2021; Yeşilyurt, Dündar, and Aydın, 2024).

The journals in which these studies were published cover a wide range of both national and international levels. Research has been published in various national journals in Turkey as well as in some international journals. These journals span multiple disciplines, including social sciences, educational sciences, leadership studies, and management information systems. It is observed that research on AI and education is concentrated in educational sciences journals in Turkey. Therefore, it can be said that the impact of AI technologies in education has become an important research area in Turkey as well. Additionally, articles related to this topic have been published in disciplines such as management information systems. From this, it can be inferred that AI technologies have become a significant research topic not only in the field of educational sciences but also in other disciplines.

When examining the purposes of the articles included in the research, it is generally concluded that these studies were written with the aim of understanding how artificial intelligence is perceived in education and in which areas and how its integration into educational processes occurs. The studies aim to reveal teachers' attitudes towards AI technologies and their thoughts on integrating these technologies into educational processes. The current role of AI in education and the factors that could shape future educational environments have been examined. There is also an article written to evaluate developments in the context of natural language processing studies specifically in Turkish, aiming to analyze the current situation and understand the role AI could play in language education and teaching. Additionally, the pros and cons of AI usage in higher education have been examined, with analyses on how these technologies can be applied in higher education institutions and their potential outcomes. The fact that the articles were written for various purposes and conducted on different sample groups can be said to provide a comprehensive evaluation of AI's effects on education.

The use of various data collection tools in these studies allows for a comprehensive and multi-dimensional perspective. In some of the studies, scales were used to measure teachers' and other participants' perceptions and attitudes towards AI. The use of scales enabled the collection of quantitative data and the statistical analysis of these data. There are also studies in which interview forms were used to collect in-depth data. Interview forms were effectively

used to reveal participants' detailed views, experiences, and perceptions regarding AI technologies. This method provided qualitative data to understand participants' individual experiences and thoughts. In some of the articles, both scales and interview forms were used. This combination allowed for the collection of both quantitative and qualitative data from participants, thus enabling a more comprehensive analysis. This method provided a multi-dimensional approach to understanding both general trends and individual experiences.

The methods used in the articles included in the research comprise qualitative, quantitative, and mixed methods. Overall, it can be said that the variety of methods in these studies allows for evaluating the effects of AI technologies in education from different perspectives. Quantitative methods reveal general trends and statistical results, while qualitative methods allow for in-depth individual analyses. The mixed method combines the advantages of both approaches, offering a richer and more comprehensive understanding. This diversity has increased the depth and validity of the research on AI and education. When looking at the findings of the research, it is observed that most of the articles were written using qualitative methods.

When evaluating the future-oriented findings of studies on the use of artificial intelligence in education, it can be concluded that AI has great potential, particularly in offering personalized learning experiences, better responding to students' individual needs, and optimizing teaching processes. Turan and Akdağ (2020), in their study on the use of AI in the Turkish education system, stated that AI applications have significant potential to enhance student achievement and improve educational processes. The anticipated widespread use of AI in education could lead to profound changes in educational processes in the future. Chen et al. (2020) indicated that personalized learning systems, using AI to enhance student performance, have been successfully implemented. Another study concluded that AI-based systems contribute to equal opportunities in education by providing personalized learning experiences for students with special educational needs (Zhang & Wang 2021).

The findings suggest that AI applications are effective in improving student achievement, reducing teachers' workload, and making the learning process more engaging and efficient. Akgün and Kılınç (2020), in their study on the effects of AI on personalized learning, concluded that AI-based learning systems used in Turkey could be effectively employed to increase student achievement. Additionally, the use of AI in education is expected to contribute to a more qualitative evaluation of student performance. Brown (2019), in his study, demonstrated that AI's accuracy and speed in exam assessments are far superior to manual evaluations. AI also offers pedagogical benefits such as fostering multidimensional thinking skills and encouraging collaboration among students.

While AI's use in education is seen as having potential benefits, some concerns have also been raised. Particularly, issues of data security and the potential increase in students' technological dependence are important considerations in the integration of these technologies. Smith (2020) emphasized in his study that AI-based educational systems have significant deficiencies in data security and privacy. Kaya and Şahin (2021), in their study on the challenges of data security in AI-based educational tools in Turkey, revealed that many AI-based systems have considerable shortcomings in terms of data security. Concerns also exist regarding the possibility of AI replacing teachers. Johnson et al. (2019) found in their study that the increasing use of AI in education could weaken the pedagogical roles of teachers.

Similarly, Demir and Yıldırım (2019) expressed concerns in their study about the potential negative impacts of AI on the traditional roles of teachers in educational processes.

The necessity of using AI applications in accordance with ethical principles is highlighted as an important emphasis in studies conducted in this field. Demir and Kaya (2021), in their study on AI applications and ethical issues in Turkey, found that ethical principles are not sufficiently considered during the development and use of AI technologies in Turkey. Aydın and Kılıç (2019), in their study, indicated that the disregard of ethical principles in AI applications could harm fundamental values such as justice, trust, and social cohesion in society. Additionally, the need for expert personnel and education to effectively use AI technologies is another topic that has been particularly emphasized. Ersoy (2021), in his study, concluded that universities do not sufficiently offer AI-related courses and programs, and students experience knowledge gaps in this area. Furthermore, Köksal and Yıldız (2020) also found in their study that AI users do not have sufficient knowledge in this field. The results of these studies support the finding that there is a knowledge gap on this issue and that various educational interventions are needed.

Overall, the findings of this study reveal that research on AI and education has been published across a broad spectrum and has garnered significant academic interest both nationally and internationally. This indicates that the role of AI in education is increasingly being recognized and that the integration of these technologies into educational processes will likely continue in the future. The role of AI technologies in education is not only limited to in-class applications but also carries great importance in educational management and decision support systems. However, for these technologies to be successfully integrated, there are ethical, technical, and social issues that need to be carefully addressed. Maintaining the balance between AI and the role of teachers, ensuring that teachers adapt to these technologies, and maximizing the opportunities offered by AI could enhance success in educational processes.

Future research should delve into the long-term effects of AI applications, their contributions to students' learning processes, and how these technologies can be more widely used in education. Specifically, more research is needed on how ethical issues and data security will be managed. This study is expected to contribute to the holistic evaluation of research on AI and education and to serve as a guide for future studies. Based on the results obtained, the following recommendations can be made to researchers and practitioners:

- Comprehensive training programs should be developed to improve teachers' perceptions of AI technologies and increase their proficiency in using these technologies.
- Resources that support the integration of AI technologies should be provided to make these technologies more widely used in classroom applications.
- Projects aimed at implementing AI-based tools in schools should be developed, and efforts should be made to evaluate and disseminate the results of these projects.
- Trainings should be organized to raise awareness about AI and ethical principles.
- Interdisciplinary research in AI and education involving fields such as educational sciences, computer science, psychology, and sociology should be encouraged.

- Current studies often focus on short-term outcomes. Future research should examine the long-term effects of AI technologies in education and evaluate their lasting impact on student achievement, teacher-student interaction, and educational processes.

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Extented Abstract

Itroduction

Artificial intelligence (AI) is defined as systems that mimic human cognitive functions such as learning and problem-solving, capable of improving themselves using accumulated data (Nabiyev, 2016; Çelebi & İnal, 2019; Obschonka & Audretsch, 2020). AI's growing capabilities enable it to solve increasingly complex tasks, potentially reshaping various sectors, including industry, agriculture, healthcare, and education (Wang, Rau, & Yuan, 2023). Recent advancements in AI technology have catalyzed significant changes in education, influencing teaching methods, assessment processes, and student support services (Lee & Kim, 2019; Thompson, 2022). AI applications in education include automated assessment systems, personalized learning platforms, and responsive educational tools that cater to both academic and emotional needs (Luckin et al., 2016; Evans, 2023). However, integrating AI into educational environments presents challenges related to technical, ethical, and accessibility issues, necessitating further research and analysis (Alkan, 2024). This article aims to present a meta-synthesis of research on AI in education conducted over the past five years, synthesizing existing literature to offer a comprehensive perspective and guide future research.

Methods

This study employs a meta-synthesis approach to analyze research on AI in education conducted in the past five years. Meta-synthesis is defined as a method for integrating and comparing findings from multiple studies to develop a broader understanding (Noblit & Hare, 1988). According to Sandelowski and Barroso (2007), meta-synthesis involves restructuring and interpreting qualitative findings to generate new themes and theories. The study systematically reviewed 28 research articles sourced from databases such as Google Scholar, Academia, TÜBİTAK ULAKBİM, and Dergipark. The research process followed these steps: identifying the research question, conducting a literature search using relevant keywords, selecting and evaluating studies based on predefined criteria, and synthesizing findings to identify common themes. The data were coded, themes were developed, and relationships between themes were analyzed to draw comprehensive conclusions.

Title

The analysis revealed that recent studies on AI in education have predominantly focused on its applications in teaching and learning processes, including personalized education, automated assessment, and educational management systems. Trends indicate a growing interest in exploring the impact of AI on various educational aspects, such as teacher perceptions, student engagement, and educational outcomes. The meta-synthesis identified several key themes, including the effectiveness of AI tools in enhancing learning experiences, the challenges associated with AI integration, and the ethical considerations of AI use in education. Comparative analysis of the studies highlighted both similarities and differences in findings, providing insights into the current state and future directions of AI research in education.

Conclusion

The meta-synthesis underscores the transformative potential of AI in education, offering both opportunities and challenges. AI technologies have shown promise in personalizing learning experiences and improving educational management, yet they also raise significant concerns regarding ethics and accessibility. The study highlights the need for continued research to address these challenges and optimize AI's integration into educational settings. Future research should focus on refining AI tools, developing ethical guidelines, and exploring the long-term impacts of AI on education. By synthesizing recent research, this study provides valuable insights for educators, policymakers, and researchers aiming to harness AI's potential while addressing its limitations.