

REVIEW ARTICLE

## Artificial Intelligence (AI) and Education: Contributions Opportunities and Challenges\*

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### Abstract

Artificial Intelligence (AI) is one of the most important actors of the rapid transformations taking place in every aspect of life in our age. Studies on its structure, operation and functions clearly reveal how great the impact of AI is in every area of life and that this impact will deepen. While most of these impacts are positive and include contributions/opportunities for humanity, the challenges they bring with them that must be overcome are not to be ignored. The purpose of this article is to examine the contributions of AI, the opportunities it offers, the challenges it brings and the ways that can be used to solve them, based on literature in terms of different sectors in general and the field of education in particular. In this respect, the article is a compilation article. In the first part of the article, firstly the general structure and historical development of AI are examined. After explaining the contributions and opportunities of AI to society and the business world, the challenges it brings and the solutions that can be used to overcome them are discussed. It is thought that this article will contribute to the relevant literature in terms of the content examined.

**Key Concepts:** Artificial Intelligence, Sectors, Education, Opportunities, Challenges.

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## **Artificial Intelligence (AI)**

Artificial Intelligence (AI) refers to a field of science that began with the goal of developing machines that can perform tasks requiring human intelligence, such as understanding natural language, recognizing patterns, and making data-based decisions by imitating human intelligence, and is currently the scene of major scientific and technological developments. AI is the ability of machines to adapt to new situations, solve problems, answer questions, create plans, and perform other intelligent functions typically associated with humans. AI refers to the field of computer science that involves creating computer programs that can imitate intelligent behaviors, learn from the information they collect, and develop human-like abilities (Russell and Norvig, 2010; Naqvi, 2020). AI works by combining large-scale data with intelligent algorithms and iterative processing. In this process, patterns or features of the processed data enable AI to automatically learn. AI with various functions works with different methods and technologies such as machine learning, artificial neural networks, deep learning, cognitive computing and graphics processing units (Bozkurt, 2023; GTECH, 2021). Especially in the post-2020 period, relevant AI platforms and AI-supported tools developed by these platforms have begun to be used in all areas of life, from industry to health, from commerce to education, and have brought about a great change with the contributions and opportunities they offer. Developments in the field of AI, which has great potential for humanity, continue at an incredible pace. In this process, it is inevitable that issues such as the social effects of AI, workforce transformation and ethical responsibilities will come to the agenda and be discussed. In this context, it should not be forgotten that the responsible development and use of AI and related tools is of critical importance to make the best use of the potential offered by this technology.

### **Development History of Artificial Intelligence**

The historical development of AI has been shaped by the contributions of many scientists and technological innovations in a process extending from the mid-20th century to the present day. The foundations of AI were laid during World War II with advances in computer science and cryptography. In his article published in 1950, British mathematician Alan Turing discussed whether a machine could think like a human and introduced the concept known as the Turing Test. This test was accepted as a criterion for determining whether a machine could demonstrate human-like intelligence (Turing, 2009).

A conference held at Dartmouth College in 1956 considered the official birth of AI. At this conference, pioneering scientists such as John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon discussed the basic concepts of AI and created a roadmap for the development of this field (Dick, 2019). The first AI systems developed during this period were based on logic and rule-based programming. For example, the program called ELIZA, developed by Joseph Weizenbaum in 1966, was written to simulate human-machine interaction. However, systems in this period are quite simple due to limited AI processing power and lack of data (Berry, 2023).

The 1970s are known as a difficult period for AI research. During this period, despite high expectations from AI, no significant progress was made due to technological limitations and

financial inadequacies. This period of stagnation is called the "AI Winter" and caused many research projects to be stopped (Toosi et al, 2021).

Towards the end of the 1980s, AI research began to revive. During this period, systems known as expert systems that provide solutions to problems requiring expertise in a particular subject were developed. In addition, new methods such as learning algorithms and neural networks began to be investigated during this period (Öztürk and Şahin, 2018).

The 1990s were the period when significant progress was made in areas such as data mining and machine learning. In 1997, the chess computer called Deep Blue, developed by IBM, demonstrated the potential of AI by beating world chess champion Garry Kasparov (Say, 2018).

The period after 2000 was one of the periods when AI developed rapidly. During this period, concepts such as deep learning and big data were at the center of AI research. In particular, the great success of a deep learning model called AlexNet in the ImageNet competition in 2012 increased the popularity of deep learning (Se, 2024).

GPT-3, developed by OpenAI in 2020, has aroused great interest in the field of AI. GPT-3 was introduced as the largest language model of that period with 175 billion parameters. Its outstanding performance in understanding and producing human language has enabled it to be used in many areas such as writing, creating dialogues, and writing programming codes. This model has revolutionized the field of natural language processing (NLP) and paved the way for many new applications. The success of GPT-3 has once again demonstrated the importance of big data and computational power in training language models. This development has offered great opportunities to relevant individuals and institutions in areas such as automation of text-based interactions, content production and customer services (OpenAI, 2023).

In recent times, significant progress has been made in areas such as natural language processing, image recognition, and autonomous systems. Major technology companies such as Google, Amazon, Microsoft, and Facebook have made major investments in AI research, contributing to the rapid spread of innovations in this field. Especially in 2020 and beyond, the developments have led to revolutionary innovations in many sectors with the rapid advancement of technology. This period has witnessed significant developments in areas such as big data, machine learning, deep learning, and natural language processing. This period has witnessed major developments in AI technologies such as natural language processing, speech recognition, image recognition and processing, autonomous vehicles, affect detection, data mining for prediction, and artificial creativity (Miao et al, 2021). During this period, model architecture called transformers has gained great popularity in the field of deep learning. Especially in the fields of image processing and computer vision, transformer-based models have surpassed classical deep learning methods and reached high accuracy rates. Models such as Vision Transformers (ViT) and Swin Transformers have become new standards in processing visual data (Alharthi and Alzahrani, 2023; huggingface.co, 2024). These developments have provided higher performance and reliability in applications such as autonomous vehicles, facial recognition systems, and medical image analysis. Great advances have been made, especially in technologies such as autonomous vehicles and drones. During this period, companies such as Tesla and Waymo have started to test their autonomous vehicles on public roads and use them commercially in limited areas. The development of autonomous systems has affected not only the transportation sector, but also many sectors such as agriculture, logistics, and defense. AI-supported drones have begun to be

used in areas such as increasing agricultural productivity and disaster management (tesla-mag, 2024).

Again, in the post-2020 period, research on the potential integration between quantum computing and AI has accelerated. The capacity of quantum computers to process large datasets and perform complex calculations rapidly has the potential to increase the capabilities of AI (Efe, 2022; Okçu and Düz, 2023). Technology giants such as IBM, Google and Microsoft aim to open new doors for AI applications by making significant investments in the field of quantum computing. It is thought that quantum computing will offer revolutionary solutions, especially in areas such as optimization problems, materials science and drug development (Genç, 2023).

The historical development of AI encompasses a long process shaped by scientific innovations and technological advances. This journey, from simple experiments at the beginning to today's complex and powerful AI systems, has gained incredible speed in recent years and continues to develop day by day.

### **Opportunities Offered by Artificial Intelligence**

AI offers great opportunities to relevant individuals and businesses in areas such as automation, access to information, content production, text writing, automatic translation, customer services and data analysis, in the context of more effective, efficient and economical work with relevant tools and applications. For example, AI-supported tools such as ChatGPT can communicate effectively and fluently with people by understanding complex expressions in natural language (*effective communication*). Depending on these features, such tools can be used effectively in areas such as chat, information provision, technical support and personal assistant/consultancy services (Pythonogren, 2024). AI-powered tools such as Hix.AI, Google Translate, and DeepL have the capacity to perform very fast automatic translations between different languages. In this way, language barriers between people are eliminated and global collaborations are facilitated (*automatic translation and overcoming language barriers*). Such tools have greatly increased the access of businesses and individuals to content in different languages (Güner, 2023; hix.ai, 2024). AI-supported virtual assistant applications such as Amazon Alexa, Google Assistant, etc. play an important role especially in customer service and support processes (*personalized customer experience and automation*). Chatbots and virtual assistants can instantly respond to customers' questions and provide customized services according to their needs. This increases customer satisfaction and reduces the operational costs of businesses (Atlı, 2023; ypyzka, 2024). AI-supported tools such as Captions, Wisdom AI, Recraft, PikaLabs, Attentive, can analyze texts and make sense of them, and produce automatic content (*automatic content generation*). This offers great opportunities, especially for the media, marketing, and publishing sectors. For example, news agencies can quickly produce data-driven content such as sports reports or financial analyses with these tools. In this way, content production processes are accelerated, and costs are reduced (enzeka, 2024; Güzeldemirci, 2024). AI-supported tools such as Neuralens, Datalab, Echobase, Pandas AI can easily extract meaningful information by analyzing large amounts of textual data (*advanced data analysis and meaning extraction*). In this way, for example, businesses can analyze customer feedback, social media interactions, and market trends. AI-supported text mining and sentiment analysis tools examine this data and use it to make strategic decisions. For example, a company can improve its products or services by analyzing customer

comments (Atalay and Çelik, 2017; McFarland, 2024). Supporting search engines such as Perplexity, Gemini, and Bing with AI algorithms has made significant contributions to the effectiveness of access to information (*search engine optimization and information access*). In this way, users can access the information they want more quickly and accurately (Saritaç, 2024; hix.ai, 2024; ypyzka, 2024). AI-powered applications such as Docalysis, ChatDoc, Sharry AI can analyze large amounts of documents quickly and effectively (*document analysis*). This makes it easier for law firms, for example, to review case files, analyze contracts, and conduct legal research. Similarly, financial institutions can use these tools to evaluate client reports, market analyses, and investment opportunities (Erden, 2024; Efe, 2022b).

OpenAI, Microsoft Azure, Google Cloud, IBM Watson, Natural Language Toolkit, MonkeyLearn, SpaCy, StanfordCoreNLP, MindMeld, Amazon Comprehend, TextBlob, Gensim are some of the most effective AI platforms that provide services in this context (aimojo.io, 2024; Paz, 2024). As emphasized above, with the AI-supported tools and applications offered by the relevant platforms, many tasks/processes that require a long time and effort can be completed in a short period of time. Some of the tools that offer innovative solutions to those interested in various fields and the areas in which they are used are exemplified below (Tekin, 2024).

**Consumer Field:** 1. *Entertainment:* Chai, CharacterAI, Inflection. 2. *Avatar Generators:* Remini, Lensa. 3. *Music:* Endel, Okio, Suno, Harmonai, Aiva, TuneFlow. 4. *Medical Advice:* MedPalm, XYLA. 5. *Personal Assistant:* Milo. Gaming: Scenario, LeonardoAI, Layer, Unity.

**Enterprise Field:** 1. *Search/Knowledge:* Glean, Cohere. 2. *Marketing:* Attentive, Jasper, Twain, Rytr, Anyword, CopyAI, Writesonic. 3. *RPA/Automation:* Zapier, Forge, Adept, Axiom.AI Kognitos. 4. *Sales:* Clari, Telescope, DayAI. Unify, Lavender, Clay, Tavus, HubSpot. 5. *Design:* Figma, Adobe, Modify, Kitty, Canva, Picsart. 6. *Software Engineering/Code Generation:* GithubCopilot, Replit, Cody, Cursor, Factory, Codeium, Magic. 7. *Data Science:* CodeInterpreter, Wisdom AI, Hex Magic, Turntable, Looker, Customer Support, MovenAGI, SalangAI, Genesys, Cresta, Zendesk. 8. *Productivity:* Notion, Tome, Microsoft 365 Copilot, Google, DuetAI. 9. *Healthcare:* Ambiance, Memora Healt, DeepScribe, Abridge, Nabla, Glass, Athelas, Latent, HippocraticAI.

**Prosumer Field:** 1. *General Search/Knowledge:* ChatGPT, Anthropic Claude, Perplexity, Google Bard, Poe, You. 2. *Virtual Avatars:* Synthesia, D-ID. 3. *Autonomous Agents:* Open Interpreter, AutoApt, BabyAGI. 4. *Voice:* ElevenLabs, Wellsaid, MurfAI, PlayHT, Descript. 5. *VideoCreation/Editing:* Runway, VeedIO, PikaLabs, Captions, Dream, Loom. 6. *Browser Copilots/Automation/Assistant:* REwind, MultiON, MinionAI. newCOMPUTER. 7. *Image Creation/Editing:* Figma, StabilityAI, Ideogram, Midjourney, Lexica, Piscart.

## Contributions of Artificial Intelligence to Different Sectors

With the rapid development in the field of AI, business processes have transformed into many sectors, productivity has increased, and new business models have emerged. With the new developments in the field of AI, it seems inevitable that new developments will occur in almost all sectors. Therefore, understanding the potential and effects of AI in different sectors is of great importance in terms of making strategic decisions for the future. The contributions of AI to some sectors are briefly explained below.



Medical and healthcare sectors: This sector is one of the sectors most affected by AI. AI is used in many areas such as disease diagnosis, treatment planning, drug discovery and patient management. AI shows great success in the analysis of medical images (x-ray, MRI, CT scans). Deep learning algorithms are used in the early diagnosis of serious diseases such as cancer, heart disease and neurological disorders. For example, the AI model developed by Google Health has reached higher accuracy rates than radiologists in breast cancer diagnosis. AI is used to create personalized treatment plans by analyzing patients' genetic data, lifestyle and medical history. In this way, more effective treatments with minimized side effects can be provided to patients. While traditional drug development processes can take years, AI plays an important role in accelerating this process. AI can identify potential drug candidates by analyzing chemical components and biological data and determine compounds suitable for clinical trials (Par, 2024; Yenikaya and Oktaysoy, 2023; Yiğit et al, 2023).

Finance sector: The finance sector is one of the areas that benefit the most from the potential of AI. AI is used in many critical areas such as risk management, fraud detection, customer service and investment strategies. AI can detect abnormal activities, and possible fraud attempts by analyzing large datasets. Banks and financial institutions can instantly detect suspicious movements and prevent fraud attempts by monitoring customer transactions. Investment strategies can be developed, and algorithmic trading can be carried out by analyzing large amounts of financial data with AI. This provides great advantages to investors by enabling faster and more accurate analysis of financial markets. Banks and financial institutions can easily solve potential customer problems by widely using AI-based chatbots in customer services and can quickly perform simple daily banking transactions (Yıldız, 2022; Özdemir, 2023).

Transportation and logistics sectors: AI has made significant innovations in the transportation and logistics sector, increasing operational efficiency and safety. Autonomous vehicles are one of the most striking application areas of AI. These vehicles use AI algorithms to perceive their surroundings, comply with traffic rules and travel safely. Tesla, Waymo and other automotive companies have made great progress in this field by developing autonomous driving technologies. AI plays an important role in reducing traffic congestion by optimizing traffic flow in cities. Traffic signaling systems are adjusted in real time by analyzing the data obtained from traffic cameras and sensors, and thus road safety can be increased. AI is used in the logistics sector, especially to regulate supply chain management. Delivery times can be shortened, and costs can be reduced by using AI-supported big data analytics in processes such as inventory management, demand forecasting and route optimization (Ece, 2024; Şen and Gür, 2024).

Agriculture and food sectors: AI is primarily used in the agricultural sector to increase productivity, optimize resource use, and ensure sustainability. AI allows farmers to manage their agricultural lands more efficiently. For example, AI-based systems can regulate irrigation, fertilization and harvest timing by analyzing weather data, soil analyzing and crop growth patterns. AI-supported drones can be used to monitor agricultural lands and plant health. Diseases, pests, and water stress can be detected with high-resolution images, and farmers are offered the opportunity to intervene quickly. AI also plays an important role in the automation of food production processes and in ensuring food safety. With AI-based systems used in production lines, product quality can be controlled, and possible contamination risks can be detected (Varnalı, 2024; Yilmazer and Tunalıoğlu, 2024).

Energy sector: AI makes significant contributions to the energy sector in the processes of energy production, distribution and consumption. AI analyzes past energy consumption data, weather forecasts and other variables that may be relevant, allowing energy providers to predict demand fluctuations in advance. With such predictions regarding energy demand, energy production and distribution can be managed more efficiently. AI plays a critical role in the management of smart grids. AI-based systems minimize energy losses by optimizing energy distribution. Again, these systems can detect anomalies in advance and prevent energy outages. Another area of use of AI in the energy sector is the integration of energy resources. Especially in the management of variable resources such as solar and wind energy, AI-based systems improve energy production estimates and optimize energy storage solutions (Aydın et al, 2024).

Media and entertainment sectors: AI has revolutionized many areas in the media and entertainment sector, from content production to consumer experience. For example, personalized content recommendations can be provided based on viewer preferences with AI algorithms, allowing users to access content more suitable to their interests. In addition, deep learning and natural language processing techniques developed with AI automate creative processes in film and music production and enable the emergence of new art forms (Ateşgöz, 2023).

Retail and e-commerce industry: AI is used in the retail and e-commerce industry to improve customer services, increase sales and increase operational efficiency. For example, instant responses to customer questions and problems are provided with AI-supported chatbots and sales processes are accelerated. In addition, demand forecasts made with AI in areas such as stock management and supply chain optimization help businesses make the right decisions. With these services, costs are reduced, and customer satisfaction is increased (Güven and Güven, 2023).

Law: AI also makes significant contributions to the field of law. AI-based software can quickly analyze large amounts of legal documents and speed up the research processes of legal professionals. It also makes business processes more efficient in terms of case analysis and automatic preparation of legal documents. This reduces the costs of legal services and ensures that legal processes are completed faster (Efe, 2022b).

Construction and engineering sectors: In the construction and engineering sectors, AI is used extensively in the planning, management and implementation of projects. Making cost estimates of projects, determining needed materials and optimizing workforce planning are some of the processes in this process. In addition, it is possible to monitor and ensure the security of construction sites with AI-based image processing systems. This allows projects to be completed faster and safer (Atahan, 2024).

## **Challenges of Artificial Intelligence and Solution Suggestions**

These effects of AI, which is effective in many areas from health to education, from production to the service sector, are generally evaluated as positive. However, it is necessary not to ignore some of the negative effects that AI brings. Challenges such as employment losses, privacy and security issues, ethical challenges and deepening social inequalities reveal the need for responsible development and use of AI. For AI technologies to be directed for the benefit of humanity, it is of great importance to consider ethical, legal and social dimensions. The steps to be taken to carefully address the problems and produce solutions are of great importance for the future of societies

(Yılmaz et al, 2021; blog.tekhnelogos, 2024). Some of the negative effects-challenges of AI and the methods and strategies that can be used to reduce and manage these effects are discussed below.

**Employment and Unemployment:** One of the most obvious negative effects of AI is the loss of employment due to increased automation. Workers who perform routine and repetitive tasks can be replaced by AI systems, which leads to increased unemployment rates in many sectors. Many people working in areas such as automotive, manufacturing, and customer service face the risk of losing their jobs due to AI's ability to perform these jobs more efficiently and at lower costs. This problem can lead to economic imbalances and social tensions, and should be emphasized (Sheikhi, 2022).

To minimize the negative effects of AI-based automation on the workforce, new training programs that allow people to acquire new skills should be designed and implemented. Governments, educational institutions, and the private sector should cooperate in providing individuals with the necessary skills and ensuring their adaptation to technology. Strengthening social safety nets and providing transition support for individuals who lose their jobs are important steps that can be taken to solve the problem. Mechanisms such as short-term income support, unemployment insurance, and referral services to new job opportunities are among the methods that can alleviate the problems that will be experienced during the transition process. Creating new employment areas by taking advantage of the opportunities offered by AI can be an effective solution to the unemployment problem. New jobs will emerge in areas such as the development and control of AI. With investments and incentives aimed at these sectors, the workforce can be directed to these new areas (Erdoğan, 2019; Sheikhi, 2022).

**Privacy and Security:** AI works using large amounts of data, and privacy and security issues may arise during the collection, processing, and storage of this data. The collection of personal and corporate data and the analysis of this data by AI algorithms can pose serious threats to individuals' privacy. In addition, the potential vulnerability of AI systems to cyber-attacks increases risks such as data theft and identity fraud (Eryılmaz, 2023).

Strong legal regulations and policies should be established to protect individuals' data. Comprehensive data protection laws such as the European Union's General Data Protection Regulation (GDPR) can be an effective tool to prevent privacy violations. Anonymizing the data used in AI systems and protecting it with strong encryption techniques plays a critical role in preventing privacy violations. Individuals' privacy can be protected by anonymizing personal information before data processing. Advanced cybersecurity measures should be taken to make AI systems resistant to cyber-attacks. Regular security audits, attack simulations and remediation of detected security vulnerabilities will make significant contributions to ensuring data security (Akbulak, 2022; Mijwil et al, 2022).

**Social Inequality:** Access to AI technologies is often limited to large companies and wealthy countries. This can further deepen social inequalities by preventing the benefits of AI from being shared across the population. Inadequate access to AI applications, especially in underdeveloped or developing countries, can reduce the competitiveness of these countries and increase global income inequalities (Etiye, 2023; Joyce and Cruz, 2024).

Universal access policies should be adopted to reduce inequalities in access to AI technologies. To this end, more investment should be made in education and technological infrastructure, and



more people should be able to benefit from AI. Care should be taken to ensure that the economic benefits of AI are distributed fairly within society. Different segments of society should be involved in the development and implementation of AI. Policies and practices that encourage diversity can help AI become more inclusive and fairer (Adaş and Erbay, 2022).

**Control and Security Risks:** The fact that AI has a certain level of autonomy also brings with it concerns about loss of control. Technologies such as autonomous vehicles, drones or AI-supported weapon systems can make decisions without human intervention, and this can pose serious risks. Especially in military fields, if AI makes wrong decisions, this can lead to undesirable consequences. Human control and transparency are important in the decision-making processes of AI systems. The decisions made by autonomous systems should be understandable and controllable by humans. This can help prevent errors or malicious use. International security protocols and standards should be established to ensure the safe operation of AI-supported systems. These standards can provide guidance in increasing the security of AI systems and minimizing the risks of misuse. Comprehensive risk assessments and scenario analyses should be conducted before AI projects begin. These analyses can make it easier to predict potential risks and take preventive measures against these risks (aracbilgileri, 2024; Yurtsever, 2024).

**Ethical Issues:** In areas such as justice, health or personnel selection where AI-based systems are used, it is possible for the system to make biased or unfair decisions because of learning from past data. This situation can reinforce gender, race or class-based discrimination. The autonomous nature of AI can lead to the development of systems that are difficult to control, especially in terms of armament. The cheating behaviors of individuals, especially in research and learning environments, may increase. These situations cause serious concerns (Darı and Koçyiğit, 2024; Li et al, 2019; Zlateva et al, 2024). Ethical rules and principles should be determined for the development and application processes of AI and these rules should be strictly followed. This can help prevent ethical issues such as discrimination, prejudice and injustice. Independent ethics committees should be established to evaluate the ethical dimensions of AI-related projects. These committees may be responsible for evaluating the social impacts of AI and intervening when necessary. Social dialogue and information activities should be organized about ethical issues related to AI. This will contribute to the prevention of possible ethical problems that may arise (Turan et al, 2022; Zlateva et al, 2024).

## **Artificial Intelligence and Education**

AI has brought about many innovations and changes in the field of education, as in many areas of life. With its features such as individualized learning, automated feedback, adaptive learning, educational content development, virtual teaching, virtual assistance, AI has brought about a major transformation in the learning and teaching process. Providing equal opportunities and accessibility in education, creating an inclusive educational environment, contributing to data analysis and data-based decision-making processes are some of the important opportunities offered by AI in this process. Again, it offers powerful opportunities to education managers in terms of automation of administrative tasks, resource management, estimation and risk management. The rapid development in the field of AI has shown that AI will become more effective in education, learning and teaching processes in the future. It is of great importance for

educators and relevant individuals to understand the potential of AI, acquire the relevant skills and use this technology in the best way in terms of increasing the quality of the education process (Arslan, 202; Bulut et al, 2024; Chaushi, 2024; Harry and Sayudin, 2023; İncemen and Öztürk, 2024; Salas and Yang, 2022; Saputra et al, 2019).

The role of AI in learning-teaching and management processes, which are the basic components of the education field, its contributions to the relevant parties in this context, possible problems and explanations regarding solution suggestions are presented below.

### **The Role of Artificial Intelligence in Learning and Teaching Processes**

Individualized learning, automatic assessment and feedback, development of educational content, student tracking and analytics, increasing access to learning, and supporting teachers are the main contributions of AI at this point. Explanations for these contributions are given below. (Chaushi, 2024; Chen et al, 2020; Chiu et al, 2023; Harry and Sayudin, 2023; Mikropoulos and Natsis, 2011; Moorhouse et al, 2023; Murphy, 2019; Pokrivcakova, 2019; Salas and Yang, 2022; Yörük, 2024).

**Individualized learning:** One of the most important contributions of AI to education is the ability to provide students with individualized content and learning experiences. Each student has a different learning pace, interests, and abilities. It is very difficult to take these individual differences into consideration in the traditional classroom environment. However, AI-supported learning platforms/applications can meet individual needs by providing content, materials, and tasks that are appropriate for each student's learning style. This allows students to learn more effectively and increase their success.

**Automated assessment and feedback:** It is not always possible for teachers to effectively manage the measurement, evaluation and feedback process due to reasons such as the large number of students, the variety of measurement applications, and lack of time. The ability of relevant AI applications to automatically evaluate exams, assignments and projects and provide feedback enables teachers to effectively carry out this process. Automated feedback systems allow students to see their mistakes immediately and correct them. Applications developed for these purposes offer great opportunities to teachers and students in the process of accelerating and reinforcing the learning process.

**Development of educational contents:** Identifying the areas where students have difficulty with a particular subject and quickly creating new/effective teaching materials specific to these areas is now possible with AI applications. Again, at this point, AI-supported tools can offer teachers different suggestions for optimizing lesson plans and developing more effective learning methods.

**Student tracking and analytics:** Providing critical information to those concerned to make educational processes more efficient with analytics is one of the important roles undertaken by AI. The data created by students throughout their learning and teaching processes is analyzed by AI and converted into meaningful information. Analyzes help students optimize their learning strategies by identifying their strengths and weaknesses and learning tendencies. These processes allow the learning process to be managed consciously and effectively. Thanks to analytics, administrators and teachers can make more targeted interventions for students and shape the educational process according to individual needs.

**Increasing access to learning:** One of the important contributions of AI in the context of learning processes is that it provides equal opportunities to students. Especially through online learning platforms, AI-powered educational materials become accessible from all over the world. This creates a great opportunity for groups that are disadvantaged in education due to geographical or economic limitations. In addition, it provides global learning opportunities by making it easier to receive education in different languages with AI-based language learning applications.

**Adaptive learning:** Adaptive learning is one of the important applications of AI in the learning process. Adaptive learning systems offer the most appropriate difficulty level for each student by dynamically adapting learning materials according to the student's performance. Such systems increase student motivation and make the learning process more interesting. Students can progress quickly in subjects they are successful in, while having the opportunity to practice more in areas where they have difficulty.

**Supporting teachers:** Supporting and developing teachers' professional competencies is one of the important contributions of AI. AI-based professional development platforms allow teachers to develop themselves in the areas they need individually. These platforms offer personalized training to teachers on topics such as new teaching methods, classroom management, and the use of technology in education. Additionally, AI-based teacher support systems instantly respond to the challenges teachers face, guide them and increase their efficiency in the teaching process. Through these platforms, teachers can renew and enrich their course content, respond more quickly to the needs of students arising from their individual differences, and make their educational strategies more effective. All of these allow teachers to provide more qualified education and training services to more students.

**Teacher-student interaction:** AI also has an important role in terms of its contribution to teacher-student interaction, which is an important part of the learning process. As emphasized above, AI can easily and quickly collect and analyze data about student characteristics that have an impact on learning. Similarly, it can automatically perform a number of routine tasks. All of these allow teachers to spend more time interacting with students one-on-one.

## **The Role of Artificial Intelligence in Management Processes**

AI significantly improves the efficiency, effectiveness and decision-making processes of educational institutions with its contributions to management processes in the field of education. It offers powerful opportunities to education managers in areas such as data-based decision making, automation of administrative tasks, resource management, forecasting and risk management. AI technologies used in the management of educational institutions not only facilitate the achievement of strategic goals of these institutions, but also play a critical role in increasing student success and ensuring equality in education. The main contributions of AI to management processes in the field of education are discussed below (Akay et al, 2024; Miao et al, 2021; Salas and Yang, 2022; Igbokwe, 2023; Nkedishu and Okonta, 2024).

**Data-based decision-making and strategic planning:** One of the greatest contributions of AI to education management is the development of data-based decision-making processes. Educational institutions produce large amounts of data, from student records to teacher performance

evaluations, from budget management to student success rates. By analyzing this data, AI provides administrators with critical information to make effective decisions. For example, an AI system that analyzes student failure rates can identify which classes or subjects require additional support. This type of information guides managers through the strategic planning process and makes it easier for educational institutions to achieve their goals.

**Automation of administrative tasks:** Management processes in educational institutions involve many administrative tasks. Tasks such as student registration, attendance, reporting, budget tracking, and human resources management can be time-consuming and error-prone processes. AI alleviates the workload of managers and administrative staff by enabling the automation of such administrative tasks. For example, an AI-based system can automatically record student attendance, organize teacher performance reports, and identify potential savings areas in budget management. These automations ensure that administrative processes are carried out faster, more efficiently, and more accurately.

**Student and personnel management:** AI also plays an important role in student and personnel management. Large datasets belonging to students, such as student records, achievement status, absences, and behavioral data, can be analyzed by AI and used in student management processes. These analyses can be used to monitor students' academic performance, determine the support services they need, and improve their overall well-being in the school environment. Similarly, teacher and staff performance evaluations are analyzed by AI-supported systems, allowing more developmental decisions to be made in human resources management. Such analyses allow educational institutions to develop strategies that support staff development.

**Resource management and optimization:** Educational institutions often work with limited resources, and effective management of these resources is of great importance. AI optimizes resource management processes, allowing budgets to be used more efficiently. For example, an AI-based system can monitor a school's energy consumption and identify areas where savings can be made. Additionally, by monitoring the use of instructional materials, AI can identify which resources are most effective and which materials need to be updated or replaced. These types of optimizations help educational institutions make the best use of their resources.

**Forecasting and risk management:** AI also makes significant contributions to educational administrators in the process of forecasting and risk management. By analyzing past data, AI can make predictions about future student enrollments, budget requirements, or possible crisis scenarios. Such predictions allow educational institutions to be more prepared for the future and allow proactive measures to be taken to reduce the effects of possible risks. For example, by analyzing student achievement trends, AI can predict future school dropout rates and help plan education and resources accordingly.

**Monitoring student success and support systems:** AI provides administrators with important information about monitoring and supporting student achievement. By monitoring students' academic performance, absenteeism, and behavioral tendencies, AI systems can identify which students need additional support. This information allows school administrators to make timely interventions to ensure students are successful. It can also analyze students' interests and talents and suggest appropriate career and educational paths. These types of support systems are important tools for increasing student success.

Communication and interaction management: AI also improves communication processes between educational institutions and students, parents, and staff. For example, AI-based chatbots can instantly answer frequently asked questions by students and parents, provide information about registration processes, or share updates on academic calendars. They can also communicate with parents regularly, provide feedback on student status, and increase interaction between the school and parents. These types of communication tools help educational institutions establish a stronger bond with all their stakeholders.

### **Challenges Created by Artificial Intelligence in the Field of Education and Solution Suggestions**

While AI and related technologies offer revolutionary opportunities in education, they have also brought with them serious challenges that need to be overcome. The role of teachers, inequalities in education, data privacy, pedagogical quality, ethical issues, and student motivation are the main challenges that need to be considered in the effective use of AI in education. To overcome these challenges, education policies need to be developed in line with technological developments and in accordance with ethical values. The creative and responsible use of AI in education will benefit all stakeholders, especially students and teachers.

The main general problems created by AI in the field of education and the solution suggestions for these problems are examined below (Chaushi, 2024; Dignum, 2021; Rasul et al, 2023; Harry and Sayudin, 2023; Mosaiyebzadeh et al, 2023; Saputra et al, 2023; Sincar, 2023).

**The diminishing role of teachers:** The integration of AI technologies into education may lead to a gradual diminishing of the role of teachers in the teaching and learning process. AI-based tools have the potential to replace teachers, which may call into question the professional identity of teachers and their importance in educational processes.

The human element that students interact with one-on-one is of critical importance in the learning process. Therefore, it is necessary to produce policies that ensure that AI and related technologies are used as a tool to support teachers' work rather than replacing teachers. At this point, it is of great importance that teachers are trained in how to integrate AI technologies into pedagogical processes and how to use them effectively.

**Inequality and the digital divide in education:** While AI and related technologies provide equal opportunities in education, there is also a risk of increasing inequalities. Access to these technologies can vary greatly, both internationally and nationally, depending on economic and geographical differences. While institutions and students with high-cost AI technologies can benefit from these tools, those in low-income areas may not have access to these opportunities. This situation can deepen the digital divide and further increase existing inequalities in education. Inequality of opportunity in education may become even more difficult due to developments and widespread use of AI.

To eliminate the potential risk of inequality of opportunity, international organizations such as the United Nations and national institutions such as ministries of education should be ensured to develop effective policies on equitable access to relevant AI technologies. This may include increasing technological infrastructure investments for educational institutions and students in



low-income countries and regions. Providing AI-based educational tools free or at low cost to institutions and students in disadvantaged countries and regions may also be an important step to reduce the potential risk of inequality.

**Data privacy and security issues:** AI technologies often require large amounts of data, and this data may include student information. Privacy and security issues may arise during the collection, storage and processing of student data. Violations of student privacy may increase the risk of misuse of sensitive personal data. In addition, AI systems are vulnerable to cyberattacks, which may lead to theft or manipulation of student data.

The first step to take to solve the problem is to develop strict legal regulations and policies regarding data privacy and security. In this context, educational institutions should apply the highest security standards to protect student data and make data collection processes transparent. At this point, data encryption and anonymization techniques can be used to increase the security of student information.

**The decrease in the human factor in education:** The widespread use of AI in education may cause the human factor to gradually decrease. Student-teacher interaction plays an important role in developing students' social skills and providing emotional support. However, AI-based teaching systems may limit such human interactions. The increasing role of AI in education may cause students to experience social isolation and negatively affect their emotional development. The decrease in the human factor may also negatively affect the development of students' skills such as empathy, cooperation and communication.

One of the possible solutions to the problem is to see AI systems as a supportive and complementary tool for teachers and adopt this understanding. Student-teacher interaction should be kept active in schools, and teachers should be encouraged to continue to provide emotional and social support to students.

**Pedagogical problems and decreased quality of education:** The fact that education and training practices depend on the idea that the services provided by AI-based systems are accurate and qualified poses a potential pedagogical risk. If the AI tools used are trained with incorrect or biased data, these systems may cause students to acquire incorrect information and decrease the quality of education.

To eliminate this possible problem, AI-based education systems can be designed to support pedagogical diversity. In this context, to ensure the accuracy and impartiality of AI systems, the diversity of the data sets on which these systems are trained should be increased and constantly updated. In addition, the pedagogical effects of these systems should be tested regularly.

**Student motivation and dependency:** Student motivation and addiction: AI-based systems can undertake these processes on behalf of students without allowing them to develop their thinking and problem-solving skills. This can lead to students becoming passive learners and losing motivation to learn on their own. Furthermore, excessive use of AI-supported learning tools can cause them to become overly dependent on technology.

To avoid possible loss of motivation and addiction problems, the integration of AI in education should be balanced in a way that supports students' active learning processes. To prevent possible addiction, they should be encouraged to develop problem-solving and critical

thinking skills under the guidance of teachers. In this process, it should be emphasized that AI is only an auxiliary tool and should not replace learning on its own. In addition, to prevent technology addiction, the use of AI-based systems should be kept within certain limits and educational programs should be implemented to reduce technology addiction among students.

**Ethics and impartiality problems:** Ethical issues that arise during the development and implementation of AI systems can also cause serious concerns in the field of education. At this point, care should be taken to ensure that AI systems are developed and implemented in accordance with ethical standards. To ensure impartiality and justice principles, AI models should be trained with diverse and reliable data sets. Independent audit mechanisms should be established to evaluate the ethical impacts of AI applications in education. In addition, the transparency of AI systems should be increased, and the decision-making processes of these systems should be made clearly understandable.

**AI and the problem of cheating in education:** The ability of AI applications to answer questions in many different subject areas correctly in seconds has made these tools an indispensable element of the cheating process in exams (Lee et al, 2024). Similarly, studies that require writing research-based texts, creating content, and presenting them as a report, such as homework, term projects, and theses, which have an important place in the evaluation of student success, can now be completed in a very short time with AI tools. Therefore, students who are prone to cheating now prefer to have AI tools to do these types of studies that require great effort and time and present them as if they did them themselves instead of doing them themselves (Lee et al, 2024; Sweeney, 2023; Klyshbekova and Abbott, 2024). This situation reduces the reliability and validity of the measurement results (Atilgan et al, 2016; Atkin, 2001; Nitko, 2004) and negatively affects the accuracy of decisions made about students, teaching, administration by using these results as criteria. On the other hand, the existence of cheating behavior causes the questioning of academic honesty, which is indispensable for educational institutions, and causes loss of prestige (Susnjak & McIntosh, 2024). It should not be forgotten that where academic integrity is compromised, individual, institutional and social degeneration is inevitable (Bajinath and Singh, 2019; Özalkan 2021; Xie et al, 2023).

The following methods can be used to prevent cheating using AI. Preventing the use of other tabs on computers in online exams, taking screen recordings, and ensuring that cameras are on. Ensuring that the content of homework, term projects, etc. given to students is original. Organizing relevant studies in a way that requires students to use high-level mental skills such as creativity, critical thinking, etc. Holding interim meetings at every stage of the preparation process of homework, term projects, etc. given to students, checking and guiding what is done. Determining the similarity rate of the studies prepared by students (homework, term projects, thesis, etc.) with plagiarism detection tools. Organizing training for all stakeholders (administrators, academic staff, students, administrative staff) within educational institutions on academic honesty, academic fraud, cheating, and ethics. Providing detailed information about the scope of behaviors that disrupt academic honesty, such as cheating, and the penal sanctions to be applied to these behaviors in the student disciplinary regulations of educational institutions (Chirikov et al, 2020; Malgwi and Rakovski, 2009).

## Discussion and Conclusion

AI, as a rapidly developing part of modern technology, is at the center of social and industrial changes. The definition of AI and explanations of its operation (Russell and Norvig, 2010; Naqvi, 2020) show how big the role of this technology in our lives is. It is obvious that in the coming years, AI applications will become more widespread, and this technology will continue to have profound effects on every aspect of society. In this context, the correct understanding and effective use of AI is critical for future success and sustainability.

When we look at the development history of AI, it is seen that this technology is the result of scientific studies that have been going on for many years. Important turning points in the development process have made significant contributions to AI reaching its current state. In the light of these developments, AI will continue to provide the scientific infrastructure necessary to produce more complex systems in the future. However, ethical and social dimensions should not be ignored in this process. The evolution of AI in a way that contributes to humanity and society in addition to technological advancement is one of the most important issues that should be taken into consideration in this process (Koçyiğit and Darı, 2024; OpenAI, 2023; Se, 2024; Toosi, 2021; Turing, 2009).

AI has significantly increased efficiency and productivity thanks to the opportunities it offers in areas such as automation, data analysis, and modeling human behavior. AI-supported solutions in every field, from education to health, from industry to finance, create faster and more effective processes. In the future, the sectoral contributions of AI will deepen even more. However, to fully utilize these opportunities, AI technologies must be properly integrated into the relevant sectors and justice must be ensured in terms of access to these technologies. When AI and the opportunities it offers are managed correctly, it will greatly contribute to economic growth and increased social welfare (Doruköz and Uslu, 2023; Kavut, 2024).

In addition to the contributions of AI, the challenges it brings and must be overcome should not be ignored. Concerns about job losses that may arise in the labor market, data privacy violations, and the impartiality of algorithms make it difficult to implement this technology smoothly. Solution suggestions include using AI focused on social benefit, making strong legal regulations, and providing the necessary training for employees to adapt to this technology. AI technologies, when managed carefully, can minimize negative effects and benefit society in general (Etike, 2023; Joyce and Cruz, 2024; Sheikhi, 2022; Yılmaz et al, 2021).

The opportunities offered by AI in education span a wide range from individualized learning experiences to automated assessment systems. While AI has the potential to make learning processes more dynamic and personalized, it also allows teachers and students to work more efficiently. However, for these technologies to be used successfully in education, teachers and education administrators need to adapt to these systems. The opportunities offered by AI in education can increase the quality of education in the long term with careful planning (Chaushi, 2024; Harry and Sayudin, 2023; İncemen and Öztürk, 2024; Salas and Yang, 2022).

AI has the capacity to make learning and teaching processes more efficient. Personalized learning programs, course materials optimized according to student performance, and automatic feedback mechanisms reveal the potential of AI in this area. However, the human factor in these processes should not be ignored. Teachers' guidance and emotional support will play a

complementary role in the contributions of AI. Therefore, the balance of AI and human collaboration in teaching processes is one of the most important issues to be considered (Chiu, 2023; 2022; Mikropoulos and Natsis, 2011; Murphy, 2019; Pokrivcakova, 2019).

AI in education management offers significant advantages in optimizing school and classroom management processes, improving resource allocation and accelerating decision-making processes. It especially relieves workload in matters such as student records, success analysis and teaching material management. However, becoming overly dependent on AI in management processes may reduce the importance of human decision-making processes. Therefore, AI technologies in management should be seen as a supporting tool and final decisions should be made in a human-oriented manner (Akay et al, 2024; Igbokwe, 2023; Nkedishu and Okonta, 2024).

Among the problems created by AI in the field of education, digital inequalities, data privacy, and ethical concerns stand out. The differences in students' and teachers' access to AI technologies make it difficult to use these technologies equally and fairly in education. Concerns about data privacy reveal that stricter measures should be taken regarding how student information is protected. Increasing digital literacy programs, ensuring the transparency of AI applications, and strengthening legal regulations on privacy are some of the possible solutions to these problems (Dignum, 2021; Rasul et al, 2023; Harry and Sayudin, 2023; Mosaiyebzadeh, 2023; Saputra et al, 2023; Sincar, 2023).

Ultimately, the use of AI, which is an important part of life, should be carefully planned, regardless of the sector and purpose it serves, and the opportunities offered by this technology should be carefully managed by considering the problems encountered.

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