The Use of Artificial Intelligence in Education

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Introduction

While the number of developments in the field of information technologies is increasing day by day, it also makes our lives easier. In recent years, there have been significant developments in the field of artificial intelligence. The use of artificial intelligence in many sectors such as transport and logistics, health, automotive, education, cyber security, agriculture, mining and media is becoming increasingly widespread. Recently, artificial intelligence has paved the way for great transformations in the field of education as in many fields. When the literature is examined, it is seen that artificial intelligence applications are also used in the field of education. Artificial intelligence is used in many different areas such as evaluating student performance, personalising teaching materials, providing feedback to students, and making teacher activities more efficient. In this way, it is aimed to make the education process more effective and efficient.

Artificial Intelligence

John McCarthy, Marvin L. Minsky, Nathaniel Rochester and Claude E. Shannon first mentioned the concept of artificial intelligence in their studies presented at the Dortmund Conference in 1956. However, John McCarthy is accepted as the first person to use the concept of artificial intelligence (Alpaydın, 2013). According to McCarthy (2004), artificial intelligence is defined as the science and engineering of producing human-like intelligent machines and intelligent computer programmes.

It is possible to encounter various definitions of artificial intelligence in the literature. Some of these definitions are as follows: Artificial intelligence is a computer-controlled technology developed for the realisation of behaviours such as feeling, thinking, decision-making, reasoning and learning similar to human behaviours, which can perform behaviours and movements similar to human behaviours, created with artificial tools without using a living being (Nabiyev & Erümit, 2020). Artificial intelligence is a branch of computer science that enables the automation of intelligent behaviour and machine learning (Luger, 1998). Artificial intelligence can surpass human intelligence in repetitive and not very complex tasks (Teng, 2019). In general, when the definitions of artificial intelligence are examined, it is emphasised that various human-specific features are performed by computer-controlled machines.

There are various fields for the use of artificial intelligence. Commonly used artificial intelligence techniques are expert systems, fuzzy logic, genetic algorithms, artificial neural networks and intelligent agents (Öngöz, 2020). In addition to these, there are also areas where artificial intelligence is frequently used such as machine learning, deep learning, natural language processing, computer vision (Kalafat, 2022).

When the literature is examined, artificial intelligence is encountered in three stages: narrow artificial intelligence (Artificial Narrow Intelligence or ANI), general artificial intelligence (Artificial General Intelligence or AGI) and super artificial intelligence (Artificial Super Intelligence or ASI).

Narrow artificial intelligence (ANI) is defined as a type of artificial intelligence in which a technology performs better than humans in tasks with a narrow scope. Narrow artificial intelligence cannot solve problems in other areas independently, but they can perform better than humans in a specific area (Kaplan & Haenlein, 2019). Narrow artificial intelligence cannot establish a cause-effect relationship and can make reasoning. For this reason, narrow artificial intelligence can only solve limited problems (Nabiyev & Erümit, 2020).

General artificial intelligence (AGI) allows a machine to apply its knowledge and skills in different fields and in a variety of applications. This type of autonomous artificial intelligence is more representative of human intelligence with its ability to establish cause-effect relationships and problem-solving skills (Davidson, 2019; Nabiyev & Erümit, 2020). AGI can independently solve problems in other domains and outperform humans in various domains. The transformation of Siri into a humanoid robot with a wide range of abilities such as voice recognition, coffee preparation and writing skills can be given as examples of such AI applications (Kaplan & Haenlein, 2019). General artificial intelligence can transfer the information it obtains to other situations, cooperate and think. Examples of general artificial intelligence are virtual assistants, applications that can produce relevant text and visuals that can organise information according to questions and requests. AGI aims to fulfil any task that a human can do. AGI is often depicted in science fiction films in situations where humans interact with machines that are conscious, sentient and can act with self-awareness (Delipetrev, Tsinaraki & Kostic, 2020).

Super artificial intelligence (ASI); It models human intelligence and thinking skills and produces even solutions that humans cannot foresee (Nabiyev & Erümit, 2020). They can quickly solve problems in other fields and outperform humans. ASI is expected to surpass human intelligence in terms of creativity, genius and problem solving. Many scientists are concerned about ASI. Currently, ASI belongs to science fiction (Delipetrev et al., 2020).

Historical development of artificial intelligence

Although artificial intelligence has been on the agenda more recently, its history is quite old. It has been revealed that various ideas about humanoid robots were carried out in ancient Greece. An example is the work of Daedelus, who ruled the wind mythology, to create artificial human beings. Modern artificial intelligence has emerged with the aim of philosophers to explain the human

thought system. The year 1884 is very important in terms of artificial intelligence. Charles Babbage tried to create a mechanical machine capable of intelligent behaviour on this date, but as a result of these studies, he understood that he could not make a machine that would exhibit behaviours as intelligent as a human (Mijwel, 2015). Artificial intelligence studies continued to develop slowly until the early 60s (Mijwel, 2015). The emergence of artificial neural networks and deep learning processors has further increased the effectiveness of artificial intelligence technologies. Currently, artificial intelligence applications are effectively used in almost every aspect of life (Altun, Uçar Altun & Kutlu, 2023).

At the centre of artificial intelligence studies is the Turing Test put forward by Alan Turing. In 1950, Alan Turing mentioned the idea of artificial intelligence with some human-like characteristics in his work 'Computing Machinery and Intelligence'. This idea is also present in the works of John McCarthy. Turing proposed a test to answer the question of whether machines can think. This test, also known as the 'imitation game', includes the following approach: When it is not known whether a machine or a human performs a task, the machine passes the test (Smith, Ting Huang, Yang & McGuire, 2006).

The period between 1965 and 1970, when developments in artificial intelligence were too few to be tested, is considered to be a dark period for artificial intelligence. Unrealistic expectations and a hasty, optimistic attitude led to the idea that it would be easy to produce machines with intelligence. However, the idea of creating intelligent machines by simply uploading data did not succeed. Between 1970-1975, artificial intelligence studies accelerated. Artificial Intelligence started to be used in large projects as of the 1980s (Mijwel, 2015). Today, artificial intelligence is used in many fields to eliminate problems in daily life.

Ethical and legal principles of artificial intelligence

The idea that AI systems should be prepared in a way that respects human values so as not to violate human rights and not be biased is commonly referred to as 'trustworthy AI (TRA)' (Efe, 2021). In 2018, the European Commission commissioned the High-Level Expert Group on AI (HLEG) to prepare ethical guidelines for trustworthy AI (Delipetrev et al., 2020).

An AI system should have three characteristics to be trustworthy (HLEG 2019):

1. Comply with all laws and regulations,

2. Committed to ethical principles and values,

3. It must be both technically and socially reliable.

Because even with good intentions, an AI can cause unintentional harm. Because even with good intentions, an AI can cause unintentional harm.Each of these characteristics is necessary but not sufficient on its own. Ethical principles prepared for AI often support and reproduce legal norms and principles (Carrillo, 2020).

The Role of Artificial Intelligence in Education

AI is one of the effective methods used to customise the experiences of different educational stakeholders (Churi, Joshi, Elhoseny & Omrane, 2023). AI technologies can enable the creation of a qualified educational environment. The widespread use of the general network has made AI an indispensable part of daily life. The needs in education have increased the importance of applications of AI that can be used in education. Smart books, web browsers and learning platforms in all areas of education are among the examples of these applications (Çinici, 2023).

Artificial Intelligence in Education (AIED) includes AI-supported exploratory learning, analysis of student writings, intelligent agents in game-based environments, AI-supported chatbots, individualized instruction and dialogue, controlling students' individual learning processes (Holmes, Bialik & Fadel, 2019; Chiu, Xia, Zhou, Chai & Cheng, 2023). The aim of using AI in the education process is to prepare a more effective and personalised learning environment for students (Chen, Chen, & Lin, 2020).

Artificial intelligence technologies can improve the educational process through the use of intelligent tutoring systems, chatbots, robots, learning analytics dashboards, adaptive learning systems and automatic assessment. Chatbots are developed with the help of technologies such as natural language processing (NLP), machine learning, deep learning and artificial neural networks. With these technologies working in harmony with each other, chatbots can interact with humans, understand human language and respond to humans (Chen et al., 2020). ChatGPT, one of the AI technologies used in many fields in recent years, is frequently used in education. ChatGPT is a chatbot offered by the OpenAI company. ChatGPT is based on the GPT-3.5 model used in natural language processing (Birer, 2023).

The impact of AI in education is not fully known (Holmes, Hui, Miao & Ronghuai, 2021). More research is needed to understand whether and how AI can be useful in education. The low awareness of AI technologies makes it difficult to use them in schools and universities (Hussin, 2018). Over time, concerns about AI in education have decreased and classical methods have gradually been replaced by AI (Churi et al., 2023). However, Jimenez and Boser (2021) stated that the use of qualified teaching materials and effective teaching methods with the help of AI increases students' achievement and helps them learn faster.

Use of artificial intelligence in education in the world

The development and popularity of artificial intelligence technologies affect all areas and thus the whole society. Therefore, it is necessary to consider artificial intelligence systems when planning the education systems of countries (Demir, 2019). Countries are affected by artificial intelligence technologies even if they do not use them directly. The USA, Russia, China and European countries, which are leading in AI development, are making large investments in the field of AI (Aydın, 2019). Zawacki-Richter, Marín, Bond & Gouverneur (2019) stated in their research that the countries with the highest number of publications on the use of AI in education are the USA,

China, Taiwan and Turkey, respectively.

In Russia, artificial intelligence courses have been included in the curriculum in schools as of 2021. In China, elective artificial intelligence courses are taught in primary and secondary schools and books on artificial intelligence are taught in many schools (Nabiyev & Erümit, 2020). SquirrelAI, an artificial intelligence-supported adaptive education programme in China, ALEKS, an adaptive artificial intelligence programme developed by McGraw-Hil in the USA, Watson, an artificial intelligence programme designed by IBM in the USA, provides students with personalised learning, and the 'third space learning' artificial intelligence programme in the UK allows students to have online lessons with a teacher (İşler & Kılıç, 2021).

In Turkey, artificial intelligence trainings are provided by the Ministry of National Education and there are departments and programmes in universities that provide education in the field of artificial intelligence. In addition, many institutions and organisations organise artificial intelligence trainings and carry out studies in this field. Artificial intelligence supported digital assistant, MEB Assistant and EBA applications have been developed by the Ministry of National Education. These applications aim to support teachers, students and parents in educational processes. It provides digital course materials to teachers, homework and exam information to students, and information about the academic status of students to parents.

Stakeholders of artificial intelligence in education

Artificial intelligence technology is leading to major changes in education. Students, parents, teachers, and educational institutions, which are the stakeholders of AI in education, should understand the importance of AI tools, because as the world changes, the understanding and methods of education in schools will also change (Baker & Smith, 2019). How and Hung (2019) stated in their study that AI assists teachers and should be used in education to improve learning outcomes.

Student-oriented AIED consists of software that responds to the personal needs of the student, which they use to receive and understand new information. Learner-facing tools are often referred to as 'intelligent tutoring systems' or 'adaptive', 'personalised' or 'differentiated' learning platforms. These student-oriented tools should have features such as developing teaching materials in line with the needs of the student, identifying the strengths and weaknesses of the student, providing automatic feedback, and enabling collaboration between students.

AIED for teachers helps teachers to lighten their workload, gain insights about students and innovate in their classrooms. AIED applications for teachers should include features such as automating tasks (assessment, plagiarism detection, management or feedback, etc.), providing insights about a student or class, providing opportunities to improve the teacher's role, supporting teachers to experiment and innovate in their teaching processes, creating classroom seating plans to reduce behavioural problems, and creating small groups to work with collaborative learning (Baker ve Smith, 2019). AIED is a technology that aims to assist teachers instead of trying to replace them (Zhao & Liu, 2019). Teachers are free to choose when and how to use AIED tools (Luckin, 2018).

System-oriented AIED helps education managers and school administrators to make educational decisions. Usually system-oriented AIED tools require data sharing between schools. Although system-oriented AIED tools are the least developed category, they are used for a wider distribution of tasks than educator- or student-oriented tools, from preparing syllabuses to conducting inspections (Baker & Smith, 2019).

In terms of school management, teachers, students and parents, AEID provides some facilities to the stakeholders. In terms of parents, AEID can be used, for example, by working parents who have a child with special educational needs and can establish interactive interactions between parents and their children (Alanoğlu and Karabatak, 2020).

When AIED is examined according to recent years, the area that has seen the most improvement among the educational organisation, parents, teachers and students is the student and the learning process (Çetin & Aktaş, 2021). Loeckx (2016) suggested that AIED can be an effective learning tool that eases the burden of both teachers and students and provides effective learning experiences for students.

Impact of artificial intelligence on the learning process

When the studies on AIED were reviewed in the literature, it was encountered that most of the studies were conducted in the student-oriented field (Baker & Smith, 2019). Chen et al. (2020) stated in their study that AI applications are used in various ways to promote student learning. Individualisation of the curriculum in line with the needs and abilities of the student is one of the important points used by AI to improve learning (Mikropoulos & Natsis, 2011). Approaches that provide students with a more enjoyable, inclusive and experiential learning environment generally create a more effective learning process. A learning environment prepared in this way generally increases students' motivation and interest in learning and ensures that the information learnt is permanent (Mikropoulos & Natsis, 2011; Wartman & Combs, 2018). AIED can create a global learning environment through online and web-based platforms by increasing access to learning opportunities across national and international borders (Sharma, Kawachi & Bozkurt, 2019; Mikropoulos & Natsis, 2011).

Some AI platforms enhance the student's learning experience by enabling individualisation of content, retrieval and storage of information. Knewton application personalises course materials or content according to students' needs (Chassignol, Khoroshavin, Klimova & Bilyatdinova, 2018). Pokrivcakova (2019) stated that AI applications such as Cerego, Immersive Reader and CALL improve student learning and provide students with a more customised, interactive and efficient learning environment.

The role of teachers in the use of artificial intelligence in education

The role of teachers in the use of artificial intelligence in education is very important. By using AI applications correctly and effectively, teachers can support students‘ learning processes, provide customised learning experiences in line with their personal needs and customise teaching

materials according to students' interests.

AI will lighten the workload of teachers and enable them to use their time efficiently in the teaching process. In addition, it also supports teachers to plan classroom activities, monitor student achievement performance and evaluate assignments. AI-supported materials can facilitate the learning process by developing up-to-date and appropriate content on the subjects learnt. At the same time, by going beyond simple methods with effective content, it gives the opportunity to keep the student's interest alive (Aşık, Yıldız, Kılınç, Aytekin, Adalı, & Kurnaz 2023; Bulut, Davarcı, Bozdoğan, & Sarpkaya, 2024). The preparation and control of homework and exam content with the help of automated systems enables teachers to make their time more efficient. Thus, teachers can communicate with more students one-to-one and provide more support to them. In addition, with the help of automated systems, students can be given immediate feedback and their deficiencies can be detected and corrected faster (Bulut et al., 2024). Chen et al. (2023) stated that AI technologies contribute to the interaction between teachers and students and the learning process.

Teachers' roles have been changing recently due to the impact of AI technologies. Teachers can take on more roles than transferring traditional knowledge. AI, teachers' mentoring and guiding roles allow students to discover and develop their individual capacities more effectively (Yolcu, 2024). In this way, students become aware of their own skills. The use of AI technology in individualised learning can improve the quality of education by supporting teachers' professional development. Artificial intelligence offers teachers the opportunity to create more effective teaching materials and strategies with the ability to respond more carefully to student needs (Tapalova & Zhiyenbayeva, 2022).

In traditional teaching environments, teachers usually try to teach by taking into account different student profiles in the classroom. However, AI technologies can make this process even more effective. By tracking student performance, AI can provide feedback to students and adjust the teaching process according to their individual needs (İşler & Kılıç, 2021).

With the help of AI, teachers can use various digital tools and platforms to improve students' creativity, critical thinking skills, and problem-solving abilities (Darwin, Rusdin, Mukminatien, Suryati, Laksmi, & Marzuki, 2024; Yolcu, 2024). For example, programming platforms such as Scratch offer students the opportunity to develop their coding skills. In addition, interactive quiz applications such as Kahoot help students make learning fun.

Advantages and disadvantages of using artificial intelligence in education

In recent years, societies accustomed to technologies have largely adopted artificial intelligence-supported tools with the influence of social media. The adaptation of artificial intelligence to education brings both existing advantages and some disadvantages that need to be considered.

AI provides an individualised approach, especially in different countries or when one-to-one instruction is costly and difficult to access (Chen et al., 2020; Kengam, 2020; Leoste, Jõgi., Õun, Pastor, San Martín López & Grauberg, 2021). With the use of AI, learning gaps are identified,

pedagogical methods are developed, content to be taught can be customised and students are provided with learning experiences to increase their academic achievement (Kengam, 2020). In her study, Pokrivcakova (2019) stated that artificial intelligence provides the possibility of developing and using intelligent learning systems and individualised content for the learning needs and abilities of each student. For example, simulation teaching and learning prepared with virtual reality (VR) technology positively affects the learning process. The studies of Rus, D'Mello, Hu, & Graesser (2013) mentioned that intelligent tutoring systems support deep learning and encourage students to express themselves well with conversational tools, thus supporting learning by facilitating information retrieval and retention. In summary, the use of AI technologies helps to deepen learning processes and create more effective learning environments.

AI ensures that learnt information is regularly reviewed, retained in long-term memory and not forgotten (Owoc, Sawicka, & Weichbroth, 2019). AI supports teachers in the process of grading assignments, identifies students' learning gaps and helps to make suggestions on these issues (Mikropoulos & Natsis, 2011; Kengam, 2020).

AI-enabled systems provide a variety of learning opportunities for individuals who speak different languages and have hearing or visual difficulties. Applications such as presentation translator can translate speech into text or subtitles using AI technologies. Voice assistants such as Google Assistant, Cortana, Siri and Alexa help students to speak directly to educational materials on the internet and on installed devices without any intervention from their teachers (Kengam, 2020).

The use of AI and other new technologies brings with it various concerns. These concerns include privacy violations, data security risks, bias and discrimination (Pisica, Edu, Zaharia & Zaharia, 2023). The cost of AI technologies is usually high as specialised personnel, high-tech equipment and software are required to develop, implement and continuously update AI systems (Kengam, 2020; Al-Tkhayneh, Alghazo & Tahat, 2023). Therefore, the limits of the use of artificial intelligence should be carefully determined and the outputs should be supervised and controlled (Uyan, 2023). A joint effort by educators, researchers, and policy makers is required for the use of AI technologies in accordance with ethical principles in education (Adıgüzel, Kaya, & Cansu, 2023). It is of great importance to comply with the principles of ethics and responsibility during the use of AI technologies (Adıgüzel, Kaya, & Cansu, 2023; Uyan, 2023).

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