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Yapay Zekâ: Eğitimdeki Rolü ve Potansiyeli

Ayşe ALKAN[1]

Öz

Son yıllarda büyük ilgi gören yapay zekâ (YZ) pek çok alanda olduğu gibi eğitim alanında da yaygın olarak kullanılmaya başlanmıştır. Eğitimde YZ, eğitsel veri madenciliği ve öğrenme analitiği konularını gündeme getirmiştir. Eğitsel veri madenciliği (EVM) öğrencilerin öğrenme süreçlerini iyileştirmek, öğretmenlere destek sağlamak ve daha kişiselleştirilmiş bir eğitim deneyimi sunmak amacıyla kullanılmaktadır. Öğrencilerin öğrenme süreçlerini geliştirmede YZ, adaptif öğrenme sistemleriyle önemli bir rol oynamaktadır. Bu sistemler, öğrencilerin bireysel ihtiyaçlarını değerlendirerek onlara uygun öğrenme materyalleri sunar. EVM aynı zamanda öğrencilerin performansını izleyerek, zayıf yönlerini belirlemekte ve bu alanlarda ek destek sağlamaktadır. Böylece, öğrencilerin daha etkili bir şekilde öğrenmeleri ve potansiyellerini tam anlamıyla ortaya çıkarmaları sağlanmaktadır. Öğretmenlere destek olarak, EVM öğretmenlerin sınıf yönetimini kolaylaştırmakta ve zamanlarını daha verimli kullanmalarına yardımcı olmaktadır. Otomatik değerlendirme sistemleri, öğretmenlerin ödevleri ve sınavları hızlı bir şekilde değerlendirmelerine olanak tanırken, geri bildirim sağlama sürecini de iyileştirir. Ayrıca, EVM öğretmenlere öğrencilerin ilgi alanlarını ve öğrenme stillerini anlama konusunda da yardımcı olmakta ve böylece daha kişiselleştirilmiş bir öğretim sunulabilmektedir. EVM'nin eğitimdeki bir başka önemli kullanım alanı ise öğrenci danışmanlığıdır. EVM tabanlı danışmanlık sistemleri, öğrencilere kariyer seçimleri, üniversite başvuruları ve akademik planlama gibi konularda rehberlik edebilir. Bu sistemler, öğrencilere uygun kariyer seçenekleri sunabilir, başvuru sürecinde destek sağlayabilir ve gelecekteki hedeflerini belirlemelerine yardımcı olabilir. Sonuç olarak, eğitsel veri madenciliği, öğrencilerin öğrenme süreçlerini geliştirmek, öğretmenlere destek sağlamak ve daha kişiselleştirilmiş bir eğitim deneyimi sunmak için büyük bir potansiyele sahiptir. Bu çalışmada; YZ konusu eğitim başlığı altında genel bir çerçevede incelenmiş ve EVM'nin eğitimdeki rolü tartışılmıştır. Eğitim alanında YZ'nin öğretmene ve nasıl kullanabileceğini ortaya koymasıyla alana katkı sağlayacağı düşünülmektedir

Anahtar Kelimeler: Teknoloji, Eğitim, Bilişim, Yapay Zekâ, Eğitsel Veri Madenciliği.

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[1] Doç.Dr., Samsun Bilim ve Sanat Merkezi, ayse.alkan55@gmail.com/ORCID: 0000-0002-9125-1408

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Artificial Intelligence: Its Role and Potential in Education

Ayşe ALKAN[1]

Abstract

Artificial intelligence (AI), which has attracted great attention in recent years, has begun to be widely used in the field of education, as in many other fields. AI in education has brought the issues of educational data mining and learning analytics to the agenda. Educational data mining (EDM) is used to improve students' learning processes, provide support to teachers, and provide a more personalized educational experience. AI plays an important role in improving students' learning processes with adaptive learning systems. These systems evaluate the individual needs of students and offer them appropriate learning materials. EDM also monitors students' performance, identifies their weaknesses and provides additional support in these areas. Thus, students are enabled to learn more effectively and fully reveal their potential. In support of teachers, EDM facilitates teachers' classroom management and helps them use their time more efficiently. Automated evaluation systems allow teachers to quickly evaluate assignments and exams while also improving the process of providing feedback. Additionally, EDM helps teachers understand students' interests and learning styles so that more personalized instruction can be provided. Another important use of EDM in education is student counseling. EDM-based advising systems can guide students on issues such as career choices, college applications, and academic planning. These systems can offer students suitable career options, provide support during the application process, and help them identify their future goals. As a result, educational data mining has great potential to improve students' learning processes, provide support to teachers, and deliver a more personalized educational experience. In this study; The subject of AI was examined in a general framework under the title of education and the role of EDM in education was discussed. It is thought that AI will contribute to the field by revealing to teachers and how they can use it in the field of education.

Keywords: Technology, Education, İnformatics, Artificial Intelligence, Educational Data Mining Education.

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[1] Assoc. Prof., Samsun Bilim ve Sanat Merkezi, ayse.alkan55@gmail.com/ORCID: 0000-0002-9125-1408

Introduction

Rapid developments in information technologies are becoming an indispensable part of our lives. The origins of the British computer scientist Alan Turing's 'Can machines think?' Artificial intelligence (AI), which dates back to the 1950s (Turing, 1950), is one of the important developments brought by technological progress. After the start of the Industry 4.0 process, AI studies gained momentum and started to be accepted as the technology of the future. The history of the AI field is deeply rooted and includes important milestones. Events such as Alan Turing's Turing Test, the Dartmouth Conference, the development of expert systems and deep learning are important milestones. AI is constantly advancing, with new techniques, algorithms and applications being developed.

AI, which deals with the design and development of machines that can perform complex tasks such as data analysis, pattern recognition, natural language processing, problem solving, decision making and learning, is an ongoing science by examining human intelligence and the working system of the brain. AI; It is a computer simulation of the ability to perform tasks related to mental processes such as thinking, reasoning, learning, interpreting, generalizing and learning from previous experiences, with information processing systems created by imitating the working principles of the human brain or central nervous system through artificial neural networks. (Akyürek, 2013). According to another definition; AI refers to the use of reasoning and predictive power, which are the characteristics of human intelligence, by machines in solving complex problems and making decisions considering changing conditions (Öztemel, 2003; Obschonka & Audretsch, 2020).

Thanks to the learning feature of artificial neural networks, the ability to produce solutions for the relevant event by making associations from the examples at hand forms the basis of the intelligent behavior model of artificial neural networks (Yılmaz, 2012). Computers equipped with AI in this way have now reached the capacity to make decisions about events and solve the relationships between them (Atasoy, 2012).

Today, as a result of AI research, applications such as expert systems, artificial neural networks, natural language processing solutions, robotic systems have entered our daily lives. Although we are not aware of it, AI has spread to all areas of life and appears in many parts of life. AI has many application areas. Developed AI products are becoming widespread in industry, hospitals, military, music, games, quantum science schools and many other sectors (Wong and Bressler, 2016; Shabbir and Anwer, 2018).

One of the areas of use of AI that has received great attention in recent years is education. In today's world, where it is emphasized that it is possible to develop the most suitable education model with the development of smart software and its use in the field of education, it is predicted that the use of AI in education will assume various roles (Pehlivan, 2018). The increase in artificial intelligence applications in the field of education has led to an increase in the subjects of educational data mining and learning analytics. This study aims to create an understanding of educational data mining by emphasizing the potential advantages of artificial intelligence.

Use of Artificial Intelligence in Education

Current technological developments have brought about the need for revisions in education. Many reasons such as eliminating time and space boundaries, offering students individual learning opportunities, keeping track of students, and facilitating communication have led individuals to benefit from technological opportunities. Modern education systems are faced with new opportunities regarding the implementation of innovative technological decisions in education. AI also takes its place in the field of education as one of the current developments in the field of information technologies. The use of AI in education emerged in the 1970s when people wanted to create applications that could help them learn (Kay, 2015). UNESCO (2017) defined AI as a way to improve education in a more individualized, flexible, inclusive and engaging way by processing real-time data.

Each student has a different learning style and level. While some students can learn slowly, some students can learn faster. At this point, AI provides a great advantage. Thanks to AI, the differences between the personalized educational content and the students can be determined beforehand, and arrangements can be made in the teaching content. Kupreko (2020) stated that thanks to the algorithm models supported by AI, individualized education processes can be provided to individuals. In addition, early solution suggestions for students with different learning speeds are supported by AI (Fahimirad & Kotamjani, 2018). Karaca and Telli (2019) also state that thanks to AI applications, processes such as personalized training programs, individual performance monitoring, course content preparation, and determining the teaching model increase the quality of education. The active use of AI in fields such as distance education and online learning (e-learning), which has become a necessity with the COVID 19 pandemic and whose importance is increasing (Tuğluk & Gök-Çolak, 2019), once again emphasizes the importance of the use of AI in the field of education. Sağdıç, Z. A. & Sunagül, S. B. (2020) also stated that with AI, content, environment and materials can be individualized according to the individual characteristics of students, can offer adaptive and different solutions to problems, and additional help can be provided to students with special educational needs.

In the 21st century, individuals must have certain qualities in order to be successful and take part in the changing world. These features can be listed as: critical thinking and problem solving, communication and collaboration, global and cultural awareness, information and technology literacy, flexibility and adaptability, personal and social responsibility, and learning skills. The education system should focus on developing these skills and enable people to acquire versatile competencies. With AI, some transformations have begun to occur in the functioning of education. The stakeholders of education are of great importance in the positive reflection of this transformation on the goals of education.

Stakeholders of education may consist of various actors such as educational institutions, teachers, students, parents, local governments, employers, other segments of society and even institutions that determine education policies at national and international levels. Education stakeholders can work together to improve the quality of the educational process, support student success, and make the education system more effective. Working together ensures that education progresses better and supports students in

having a better educational experience (Romero & Ventura, 2013). Demir (2019) also emphasizes that all stakeholders involved in the education system should have the skills to use AI systems and work in harmony with AI systems. Osetskyi, Vitrenko, Tatomyr, Bilan and Hirnyk. (2020) stated the positive and negative aspects of the use of AI by stakeholders in Table 1 as follows:

Table 1. The pros and cons of using artificial intelligence to all interested stakeholders

	PROS	**CONS**
Universities	Personality verification, remote control of exams, lifelong learning, Protection of student personal data	Low confidence in the new system,Experiencing students in the evaluation phase of their work potential problems, Concerns in maintaining classroom discipline, System collapse or probability of being attacked
Students	Monitoring the learning process, Integration with new technologies, accessibility	Communication problems between teacher and student. motivation issues
Teachers and lecturers	Ease of managing students and creating content. Fast and backnotification, student performance tracking. It helps to preserve and amplify the strengths of teachers.	It may be the reason for raising the professional competence level of teachers. can replace teachers
Parents	Provides real-time feedback. It creates opportunities for personalized learning and support for children with autism. may become more accessible to low-income families	with a lack of communication and interaction dehumanization.

As shown in Table 1; The integration of artificial intelligence technologies into the education system brings with it a number of advantages and disadvantages. While there are advantages such as monitoring students' learning progress, providing rapid feedback to teachers, and providing personalized learning opportunities, there are also disadvantages such as low trust in new systems, potential problems in evaluating student performance, concerns about maintaining classroom discipline, and possibilities of system crashes or attacks. While these technologies may also reduce teachers' workload, they may raise concerns that they may replace teachers by increasing their level of professional competence. For parents, while there are advantages such as real-time feedback and greater access to low-income families, disadvantages such as lack of communication and reduced interaction may arise.

Baker et al. (2019) examined educational AI tools from three different perspectives, which are the stakeholders of education: student, teacher and system.

- ***Learner-facing AI***

Software that responds to individual needs that students use to receive and understand new information. Learner-oriented tools are often referred to as "intelligent teaching systems", "adaptive", "personalized" or "differentiated" learning platforms. These platforms have the following features:

- Organizing learning materials according to a student's needs
- To identify the student's strengths and weaknesses.
- Provide automatic feedback.
- Facilitate cooperation among students.

- ***Teacher-facing AIE***

AI for teachers can help teachers reduce their workload, gain insight into students, and innovate in their classrooms. For example:

- Automate tasks such as assessment, plagiarism detection, management or feedback.
- To provide insight into the progress of a student or class.
- Helping teachers innovate and experiment

- ***System-facing AI***

System-oriented AI can help make decisions made by those who run and administer schools or our education system as a whole. System-oriented tools can be used for a wider range of tasks, with applications ranging from editing schedules to estimating inspections.

Kharbat and Alshawabkeh (2020) grouped AI-based technologies used in educational environments: machine learning, artificial neural networks, natural language processing, intelligent personal assistant, deep learning, Bayesian networks and intelligent pedagogical agents. Table 2 below summarizes these technologies used in education Kharbat and Alshawabkeh (2020).

Table 2: The main AI-based technologies used in education

AI-based technologies	Description
Machine learning	Machine learning is the general name of the discipline that enables computers to learn like humans, based on existing data, and to produce solutions to problems by analyzing data. Machine learning can be used to detect emotions from facial data.
Artificial neural network	Artificial neural network is a machine learning model inspired by biological nervous systems. Artificial neural networks are used to process complex data structures and recognize patterns. It can be used successfully in

	areas such as image recognition, natural language processing, voice recognition, predictive analysis and automatic driving.
Natural language processing	It is a discipline that enables computers to understand, interpret, produce and process human language. It can be used successfully in areas such as understanding a text, understanding at word level, analyzing grammatical structures, extracting semantic relationships, solving ambiguities, classifying texts, translating, and sentiment analysis.
Intelligent personal assistant	It is an AI-based application designed to assist users in their daily lives, providing information, performing tasks, and interacting with the user. It tries to understand and interpret users' speech using technologies such as natural language processing, text comprehension, voice recognition and machine learning.
Deep learning	It is a machine learning method based on complex structures such as artificial neural networks and deep neural networks. It can be used successfully in areas such as image recognition, voice recognition, natural language processing, emotion analysis, object recognition, language translation, game strategy and automatic driving.
Bayesian networks	It uses probability theory to represent causal relationships between variables and graphically displays these relationships. Bayesian networks are useful in modeling real-world problems involving uncertainty, thanks to the graphical structure and probability theory basis they provide.
Intelligent pedagogical agents	It is a kind of AI-based application used in the field of education. These agents are designed to provide individualized education to students, support learning processes and assist teachers. assess students' learning needs and abilities, provide them with appropriate learning materials and content, and track their progress. In addition, they can analyze students' performance, provide feedback, and intervene by detecting deficiencies.

As shown in Table 2, AI-based technologies such as machine learning, artificial neural network, natural language processing, intelligent personal assistant, deep learning, bayesian networks, intelligent pedagogical agents can be used in education. It is important to have knowledge in this field in order to choose the method suitable for the intended use.

Educational Data Mining and Learning Analytics

The widespread use of the Internet in the education system has popularized the use of different platforms such as electronic learning (e-learning), mobile learning (m-learning), online learning, web-based education, massive online open courses (MOOC). These platforms are designed to contribute to the teaching process, offer various contents, encourage individual learning and increase the quality and effectiveness of education (Bahçeci, 2015). The advantages of the distance education process, such as reducing inequality of opportunities in education, providing lifelong learning opportunities, offering an individual and free learning environment, offering alternative education models, and providing independence of time and place, have directed individuals to these platforms. In order to support face-to-face education, a distance education process in which mixed methods can be used can be preferred in order to provide equal opportunity to individuals who are excluded from current education for various reasons (Kocayiğit and Uşun, 2020; Yolcu and Wolf, 2021).

This popularity and opportunities have brought about an increase in the amount of data in parallel with the increase in the number of students studying in the digital environment. Learners leave digital traces as a result of transactions made in online environments, and these traces create large piles of data. When online learning environments are compared to traditional classroom environments, students' data can be recorded in databases (Greller & Drachsler, 2012). Although the data in the databases do not have meaning on their own, the connections revealed between the data processed by various data analysis methods can provide meaningful information. Researchers have recently turned to areas such as data mining, educational data mining and learning analytics, which are related to AI, in order to increase the efficiency of learning environments and analyze data such as student performance, class attendance, frequency of asking questions in order to predict possible failure situations (İbrahim & Rusli, 2007; Karabatak, 2008; Dekker, Pechenizkiy & Vleeshouwers, 2009; Mishra, Kumar & Gupta, 2014; Iatrellis, Savvasi, Fitsilis & Gerogiannis, 2021; Badal & Sungkur, 2023; Guleria & Sood, 2023; Chen & Zhai, 2023).

The increase in demand for e-learning platforms has led to an increase in the amount of data. The use of large data sets to increase efficiency in e-learning environments will ensure functional improvement of the environments, predictive and consistent prediction of student achievements, increased quality of education, and personalization of online learning. Digital records and traceability of information flows, such as the time students spend while using online tools and services, the time they enter and exit the system, and the click statuses while using the system, have played a role in the development of learning analytics (Fırat and Yüzer, 2016). Learning analytics is seen as a solution for the development of adaptive systems, thanks to the ability to make forward-looking predictions thanks to data about students, content and interaction (Somyürek et al., 2021). Learning analytics can offer opportunities not only on a student basis but also on an institutional and national basis. It has the potential to provide support to teachers in obtaining information about students and planning activities, to administrators in improving the quality of education, and to students in terms of their performance (Johnson et al., 2011; Long and Siemens, 2014).

Learning analytics and educational data mining both use similar methods to improve education quality by analyzing education-related data. However, while working on creating adaptive educational platforms in learning analytics, giving feedback to students and visualizing them; In educational data analysis, on the other hand, it is worked on automating the focused results with the available data (Polat, 2021; Yakupoğlu, 2018). Educational data analysis has objectives such as predicting behaviors with models developed for students, improving knowledge areas, examining pedagogical methods that will support student learning, and designing better teaching systems (Baker & Yacef, 2009).

Studies on the Use of Educational Data Mining

When the literature is examined in terms of educational data mining, there are studies that have been done to predict the academic success, attendance and school attendance of students. Erdoğan and Timor (2005), who examined the differences between students' university exam results and their achievements, stated that the departments and achievements of the students constitute five different clusters. Meskens, Vandamme, and Superby (2008) studied the estimation of university students' failure and absenteeism using different techniques. As a result of the study, high correct classification was obtained with 57.35%. İbrahim and Rusli (2007) tried to predict the graduation grades of university students and stated that the methods they used gave 80% accurate results. Karabatak (2008) examined the effect of different techniques to predict the final grades of university students studying on the open source Moodle platform, which is a learning management system (LMS), and an accuracy value of 95.5% was reached. In the study conducted by Dekker, Pechenizkiy, and Vleeshouwers (2009), they correctly predicted the attendance of students with 80% success. Bozkır, Sezer and Gök (2009), who studied the Student Selection Exam (ÖSS) student survey data in 2008, tried to determine the factors affecting the students' OSS success. Delen (2010) has worked to predict and explain the reasons behind college freshman attrition. As a result of the study, all of the methods used showed approximately 80% correct classification performance. Mishra, Kumar, and Gupta (2014) tried to predict the performance of university students with two different methods. As a result of the research, they reached an accuracy of 88.37% and 94.41%. Sara et al. (2015) obtained a high accuracy of 93.47% in their study to predict the dropout status of high school students. Sivakumar, Venkataraman, and Selvaraj (2016) worked on developing a model that predicts whether university students continue their education or not. As a result, they achieved a high prediction accuracy of 97.50%. Schatzel et al. (2011) examined whether students who dropped out of university education could continue their education later, and made suggestions according to clusters. Şen, Uçar, and Delen (2012) used different methods and reported that the most important predictive variable in secondary education placement exam success was the placement test scores that students entered two years ago. Djulovic and Li (2013) developed models using different algorithms to predict the attendance status of university freshmen. They achieved the highest overall accuracy with 86.27%. Iam-On and Boongoen (2017) worked to determine the dropout tendencies of university students and stated that the attendance status of students with a successful academic background is high as a result of the research. Chung and Lee (2019), working on the estimation of the dropout status of high school students, produced results with an accuracy rate of 95%.

Iatrellis, Savvasi, Fitsilis & Gerogiannis (2021) stated that high-fidelity predictions were produced with a two-stage machine learning approach in their study to predict the results of students in higher education programs. Badal & Sungkur (2023) obtained successful results with 85% and 83% for grade and participation prediction with student profile and interaction-related attributes in their study to predict students' performance and analyze the features of the online learning platform. Çakıt & Dağdeviren (2022) compared the success of different machine learning approaches in their study to estimate the percentage of student placement based on the academic reputation of the university, the facilities of the city where the university is located, the facilities and cultural facilities of the university. Guleria & Sood (2023) examined the performance of different machine learning approaches in their study where they proposed a framework for career counseling for students. Chen & Zhai (2023) used three different types of task-oriented training data to investigate the performance of machine learning methods in different application scenarios. As a result of their work, they examined the success of machine learning algorithms in experimental results.

Based on the results of the literature, research on predicting various student characteristics such as student success, absenteeism, graduation grades, exam performance and attendance in the education process is discussed. Various machine learning methods were generally used in the studies and it was stated that these methods achieved high accuracy rates.

Conclusion

As a result of rapid changes in information technologies, AI studies, which take place in all areas of our lives, provide many benefits in terms of social, economic and humanitarian as well as technological progress. AI algorithms can analyze large amounts of data, recognize patterns and make predictions. This can offer great opportunities for innovation and discovery in business, medicine, science, education and many other fields. Efficiency can increase thanks to the more efficient use of AI resources. AI can play an important role in decision-making processes; It enables large datasets to be analyzed and to provide information and recommendations to decision makers. This makes it possible to make better and more informed decisions. For example, in the education sector, it can make suggestions for teachers to get to know the student and to provide appropriate education and training services. AI also makes a significant contribution to social equality and justice, eliminating the boundaries of time and space and supporting personalized education. With its important advantages such as adaptive educational hyper-environment systems, smart private lesson systems, individualization and accessibility to education, AI has an important performance that will contribute to the principle of equality in education by providing education opportunities to individuals in need of special education. AI can offer opportunities not only on a student basis, but also on an institutional and national basis. It has the potential to provide support for teachers to obtain information about students and to plan activities, to increase the quality of education to administrators, and to support students on the status of their performance. The use of AI technologies, the selection of appropriate technological tools and equipment, and ethics and confidentiality are important elements that should raise awareness of education stakeholders.

For the purpose of this study, the potential of artificial intelligence in education was emphasized, and the developments in this field were examined by examining the basic artificial intelligence-based technologies used in education. The study aims to contribute to the existing literature and inform researchers who will work in this field. The following suggestions can be made to researchers in their studies:

• Experimental studies can be conducted to examine the effects of artificial intelligence-based educational applications on student success, motivation and learning processes in more detail.

• Research can be conducted comparing artificial intelligence-supported learning activities on students in different age groups.

• Studies can be conducted comparing the use of artificial intelligence in education systems in different countries.

• New algorithms and models can be developed so that artificial intelligence-based educational tools can adapt more precisely to student needs.

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