

REVOLUTIONARY CHANGES IN HIGHER EDUCATION WITH ARTIFICIAL INTELLIGENCE

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ABSTRACT

One of the main requirements for organising the educational process is the individual approach to each student. This requirement cannot be met through traditional forms of education. Artificial Intelligence (AI) is coming to offer a quality help in this. AI has been a buzzword in the tech industry for years, and its application has gone through a wide range of industries embracing the technology. One of these industries is higher education. So far, AI has been changing the way we learn, making it more efficient, personalized, and effective. This article is dedicated to the possible implementations of AI technologies in the field of higher education, i.e., its benefits, and the challenges, research and analyses of changes in the higher education environment; as a consequence, introducing modern digital and automated technologies in the higher education system. The perspective directions of using AI in the field of higher education are considered and analysed as well.

Keywords: learning, knowledge, educational process, higher education system, teaching methods, problems of robotization of the educational process, machine learning, deep learning, artificial intelligence.

INTRODUCTION

Education is one of the main preconditions for sustainable development of every society for the sake of the preservation and reproduction of human potential. The field of education is one of the most complex areas of human activities, constantly needing improvement. On the

other hand, one of the most discussed topics today is the use of Artificial Intelligence (AI) in various areas of human activity, as it has become an integral part of modern life, affecting almost all the aspects of social realm – from personal use to military purposes. The development of AI is increasingly integrated into economic life, which is an inevitable trend of the future. AI solves such problems as identity fraud detection, customer retention, diagnostics, various predictions (among others, those related to population growth or advertising popularity), different types of forecasting (for example, weather or market), and recommendations/guidance in preferences (for instance, YouTube, Amazon, etc.). In addition to those listed, AI is also used in solving complex problems such as real-time decisions, robot navigation, real-time threat detection, military offense and defence systems, and learning tasks. Education is also inseparable from the support of science and technology. It is an obvious fact that the penetration of AI into the educational system is inevitable, therefore, it is necessary to start researching the possibilities of its application in the educational system as soon as possible in order to increase the effectiveness of the learning process.

The **purpose** of this research is to study and analyze the possibilities of using AI in the higher education system.

This **theoretical** analysis highlights the main strengths and benefits of using AI in education. However, we can safely say that it is still a new direction, not fully researched, therefore it is difficult to draw concrete conclusions about the application of AI in education.

LITERATURE REVIEW

The potential amplification of students' learning outcomes and motivation can be attained through AI integrated in education, as substantiated by the plethora of corresponding research literature. The thorough acknowledgement and resolution of obstacles entailing data confidentiality, prejudice, and ethical deliberations hold significant weight in the actualization of AI's advantages in the educational domain. A comprehensive analysis of scholarly literature, pertaining to the application of AI in educational contexts, has uncovered various significant insights and recurring patterns in the subject-matter research. One prominent phenomenon in contemporary education is the employment of AI to individualize instructional strategies. The literature has corroborated the fact that AI-powered systems have the capability to adapt to the distinctive requirements and competencies of each scholar, providing tailored feedback and assistance (Koedinger et al., 2017; Penuel et al., 2016). An illustration of the utility of AI-based tutoring systems is their potential to tailor their content delivery and feedback methodology to the individual learning pace of students, as well as provide them with customized and precise instruction, as noted in the study by Rose et al. (2012).

One rising trend is the utilization of AI to augment student engagement and motivation in educational contexts. The empirical studies in the field seem to have proved the efficacy of AI-infused games and simulations to enhance students' motivation and engagement, specifically concerning science, technology, engineering, and mathematics (STEM) subjects. Notably, scholarly works published by Barab et al. (2009) and Wang et al. (2013) validate the aforementioned proposition. AI-based systems possess the capability of furnishing immediate feedback and rewards to learners which can augment their levels of motivation (Kirschner et al., 2013). In recent times, there has been a growing interest in AI-based assessment systems owing to their capacity to provide assessment methods that are more precise, effective and economical (Kulkarni et al., 2017; Chen et al., 2016). The inclusion of AI within the education ecosystem presents a promising prospect of transforming the discipline by providing tailored learning experiences, amplifying student involvement and drive, and introducing groundbreaking approaches to evaluating student performance. Notwithstanding, it is crucial to observe that in order to obtain comprehension of the enduring consequences of AI in education and to institute optimal methodologies for implementation, additional research is essential.

A nascent trend in the realm of AI integration within the educational domain pertains to the utilization of natural language processing (NLP) and machine learning (ML) techniques for analyzing the written and spoken statements of students. Natural Language Processing (NLP) and Machine Learning (ML) technologies have demonstrated the capacity for automated evaluation of student writing and furnishing feedback on diverse aspects including grammar, vocabulary, and style (Crossley et al., 2016; Heilman et al., 2016). Furthermore, the application of Natural Language Processing (NLP) and Machine Learning (ML) techniques facilitates the examination of students' oral expression for evaluation of their enunciation and fluency, as demonstrated in the works of Liu et al. (2018) and Xiong et al. (2020).

Moreover, AI is currently employed in generating virtual and augmented reality (VR/AR) settings aimed at fostering educational outcomes. The aforementioned technological innovations appear to be able to furnish learners with captivating educational encounters, which are both interactive and immersive in nature, thereby facilitating a more authentic and stimulating engagement with digital pedagogical resources (Haldrup et al., 2018; Klimmt et al., 2019). Within the adaptive learning domain, AI-guided systems are additionally utilized to construct customized educational trajectories tailored to individual students. Adaptive learning systems employ the performance data of students to modify the complexity and substance of educational material, thereby facilitating a customized pedagogical experience (de Freitas et al., 2017; Koedinger et al., 2017).

It is noteworthy to acknowledge that, notwithstanding the potential advantages of AI in the realm of education, there also exist apprehensions and obstacles that necessitate attention and resolution. A prominent apprehension pertains to the capacity of AI-driven systems to perpetuate biases and discriminatory practices, as contended by Bers and Schmidt (2019) and Edwards et al. (2020). Furthermore, there are apprehensions regarding the inadequate transparency and comprehensibility of AI-driven systems, inferring challenges for educators and education policymakers to understand the decision-making processes of such systems (Domingos, 2015). AI in education is expanding at an accelerated pace and holds the promise of enhancing both student knowledge acquisition and captivation. However, it is pertinent to examine and deal with the apprehensions and obstacles that one may encounter in implementing AI for educational purposes. Recent scholarly investigations have explored the utilization of AI technology in developing intelligent agents or digital assistants designed to facilitate and enhance students' learning. According to Chen et al. (2018) and Kim et al. (2019), these agents possess the capacity to offer individualized assistance and direction to learners, as well as to oversee their academic advancements and provide evaluations.

What is artificial intelligence? AI is the intelligence displayed by a machine, as opposed to the "natural" intelligence – specific to humans and animals. It is a branch of Computer Science that focuses on the development of intelligent machines that can “think” and “learn” like humans. In Computer Science, AI research is defined as the study of an "intelligent agent", any device that perceives its environment and takes actions that maximize its chances of successfully achieving a goal. It involves using algorithms and data to simulate human intelligence, such as reasoning, learning, perception, and problem-solving. Broadly speaking, the term "artificial intelligence" is applied when a machine performs "cognitive" functions such as "learning" and "problem-solving"(Norvig, 2021).

AI systems can be classified into 3 types:

1. *narrow or weak AI* - this type of AI is designed to perform narrow and specific tasks, such as knowledge representation, automated planning, Machine Learning (ML), Natural Language Processing (NLP), machine perception, object motion recognition and interaction, etc.,

2. *general or strong AI* (Artificial General Intelligence (AGI)) - AGI will be able to perform any intellectual task that a human can, that is, simultaneous analysis and solution of various problems. According to some experts, it is among the long-term goals of the sector's development,

3. *Artificial Super Intelligence* (ASI) - ASI refers to an AI that will surpass human intelligence and be able to solve problems beyond our comprehension.

There is a wide range of tools used in the field of AI: search and mathematical optimization, Artificial Neural Networks (ANN, Fig. 1), and methods based on statistics and probability theory. ANNs draw, compose poetry, write music, and even replace faces in videos.

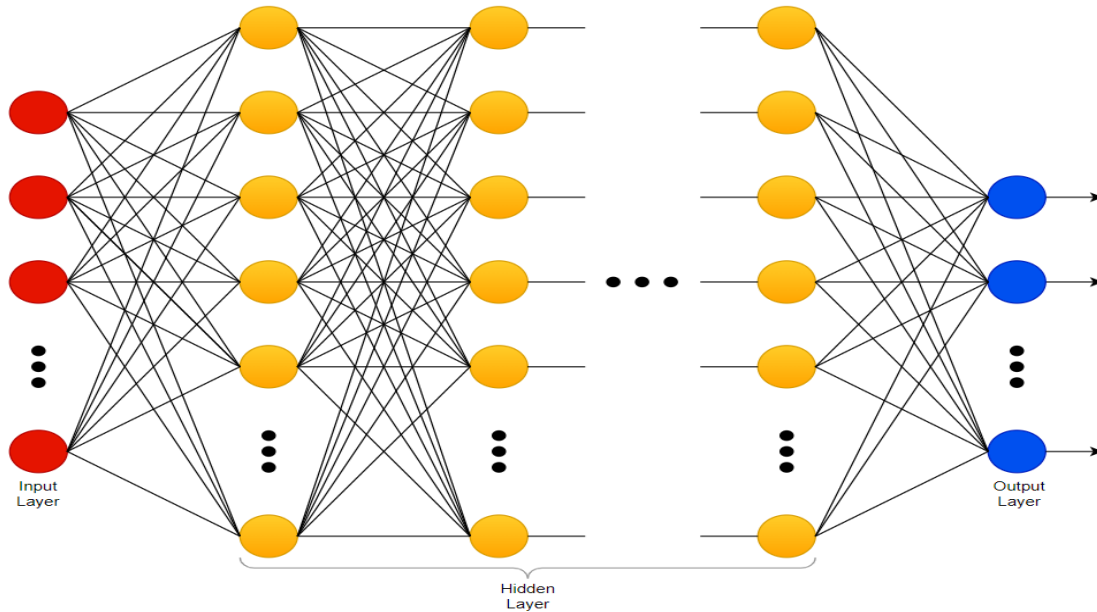


Fig. 1 Artificial Neural Network

AI development is based on computer science, mathematics, linguistics, psychology, philosophy, logic, game theory, and many other scientific fields. The continuous progress of modern information technologies is strictly connected with the presence of implemented AI techniques. For over 60 years of development, several AI-based approaches have appeared in almost all sectors of modern life. Therefore, one can talk about the new generation of AI, including the potential power of the current solutions and the variety of applied techniques. The crucial components of such an understanding of AI 3.0 are presented in Figure 2.

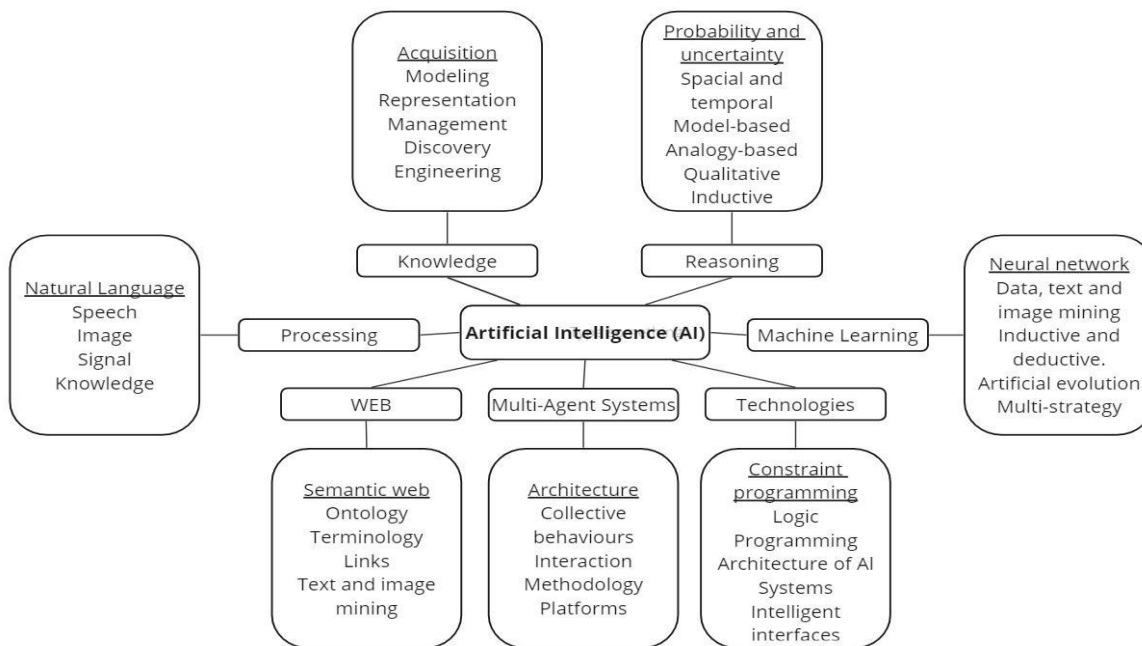


Fig. 2 The crucial components of AI

Here are some case studies that can be considered in the context of magical intelligence and revolutionary changes in higher education.

The main question raised is on *how AI can be used in higher education*.

Universities are not only carriers of academic traditions and system-wide efficiency but they also have an incredible potential for innovation and inventive initiatives. This awareness enables to realise the potential for transformations that the higher education system (Zawacki-Richter et al., 2019) is expected to offer. The use of AI technologies within universities facilitates the process of providing educational services and quality improvement. AI in higher education can also contribute to the work of all stakeholders involved: students, professors, as well as the administrative staff (for instance, in monitoring students' attendance). But, like any innovation, the introduction of AI in higher education assumes both advantages and disadvantages (Popenici & Kerr, 2017).

BENEFITS OF AI IN HIGHER EDUCATION

Considering the main recurrent issues in education, first of all, let us look at what solutions and opportunities AI could provide, referring to some promising areas AI application (Chatterjee & Bhattacharjee, 2020). The use of AI in higher education offers numerous benefits:

1. Adaptive and Personalized Learning

One of the most significant areas where AI can make an impact is adaptive and

personalized learning. It involves the selection of the necessary educational content for the needs of each student with different levels of progress, with the ability to track progress. AI allows the creation of an individual educational trajectory for each student for successful study at a university and further professional growth. AI can collect and analyse student data, such as their learning style, interests, and performance, to create a personalized learning experience for each student. This approach ensures that each student is taught in a way that is best suited to their needs, resulting in better learning outcomes and a more engaging educational experience.

2. Improved Efficiency

AI tools can also automate tasks such as grading/scoring and instructive content creation, better time and effort management. They can analyse and categorise large volumes of educational content, such as textbooks, research papers, and lectures, to create personalized content that is tailored to the needs of each student. This approach can save time and effort for educators, as well as enhance the quality of the educational content, ensuring that it is up-to-date and relevant.

3. Enhanced Student Engagement

AI can also be used to improve student engagement. AI-powered chatbots and virtual assistants can provide students with instant support and guidance, answering their questions and helping them to stay engaged and motivated, as well as overcome any challenges they may face. AI-powered virtual assistants can also help students to manage their time and stay on top of their workload.

4. Improved Assessment

Another area where AI can be used in higher education is student assessment. AI-powered assessment tools can analyse student responses to assessments and provide immediate feedback on student performance, enabling students to learn from their mistakes and improve their performance. AI can also grade student work, such as essays and assignments, saving educators time and effort.

5. Predictive Analytics

AI can analyse student data to predict their future academic performance, allowing educators to provide targeted support and guidance to help them succeed.

6. Cost Reduction

AI-powered tools are able to reduce the cost of higher education by automating tasks and enhancing efficiency. This approach can make higher education more affordable and accessible to a wider range of students.

CHALLENGES OF AI IN HIGHER EDUCATION

Students, schoolchildren and all who study and teach receive tools that can change the entire field of education. Nevertheless, the rapid development of technology, at its depth, is inevitably accompanied by numerous risks and complexities, which are far more frequent than the discussions on political regulation and the necessary regulatory framework. There are some problems that need to be solved before AI can be fully integrated into the higher education system, where comprehensive research from various points of view (social, economic, ethical, legal) on the implementation of AI technologies in education is of particular relevance. While the benefits of AI in higher education are significant, there are also challenges that need to be addressed. Some of these challenges include:

1. Cost

The implementation of AI in higher education requires significant investment in technology and infrastructure. Educational institutions may not have the financial resources to invest in AI systems and tools, which can limit their ability to take advantage of the benefits of AI.

2. Data Privacy and Security

The use of AI systems in higher education involves collecting and analysing large amounts of student data, including personal information, academic performance, and learning preferences, raising concerns about data privacy and security. This data must be protected from unauthorized access and theft, which can pose a challenge for educational institutions that may not have the necessary resources and expertise to ensure data privacy and security. Institutions must ensure that student data is protected and AI systems are secure.

3. Bias and Fairness

AI systems are only as good as the data they are trained on. If the data used to train an AI system is biased, the system may produce biased results, which can perpetuate existing inequalities and discrimination in higher education.

4. Ethical Considerations

AI systems may raise ethical concerns, such as using facial recognition technology and the potential for surveillance in the classroom. Educational institutions must ensure that the use of AI systems is in line with such ethical principles and values, as fairness, transparency, accountability, etc.

5. Lack of Expertise

AI technology is complex and requires expertise in computer science, data analysis, and Machine Learning. Educational institutions may not have the necessary expertise to develop and implement AI systems, which can limit their ability to take advantage of the benefits of AI.

6. Human Touch

While AI systems can enhance the efficiency and effectiveness of education, they cannot replace the human touch in education. Students still require interaction with teachers and peers to develop critical thinking, communication, and problem-solving skills, which are essential for success in the workforce.

DISCUSSIONS AND CONCLUSIONS

In summary, the advent of AI has resulted in significant paradigm shifts in the realm of higher education, effectively redefining the ways in which pedagogical practices and academic pursuits are executed. The utilization of AI technologies such as machine learning, natural language processing, and data analytics presents an opportunity to amplify different facets of higher education. These encompass personalized learning, student assistance, curriculum design, and administrative operations. The technologies possess the potential to enhance the availability, impartiality, and effectiveness of tertiary education, thereby rendering it more reachable and encompassing for varied communities of learners.

The influence of AI on higher education has been profound, attributable to the implementation of AI-powered tools and platforms that facilitate personalized and adaptive learning outcomes for students. Modern technologies have enabled the analysis of vast quantities of data to detect individual learning requirements, furnish personalized feedback, and tailor educational trajectories for students, resulting in improved academic outcomes. AI may offer the capacity to advance student support services, namely virtual advising and tutoring, fortifying student engagement and retention in the process.

Moreover, AI possesses the potential to innovate the process of curriculum development through the examination of student performance data, learning inclinations, and labour market tendencies, culminating in the formation of a pertinent and current curriculum. The implementation of this practice may serve as a means to assure that tertiary education establishments are adequately equipping their learners with the requisite competencies and expertise essential to adapt to the dynamic exigencies of the occupational landscape. Additionally, the implementation of AI-based administrative tools has the ability to optimize administrative activities such as enrolment management, scheduling, and grading, accordingly mitigating administrative workload and granting faculty additional time to prioritize their pedagogical and scholarly pursuits.

Notwithstanding the potential benefits of incorporating AI in higher education, the utilization of this technology also entails moral and social deliberations. The issues encompassing data privacy, algorithmic bias, equity and fair distribution, as well as influence

on the workforce for individuals involved in the field of education constitute noteworthy concerns in the realm of technology. Higher education institutions must undertake conscientious consideration of these concerns and actively resolve them to guarantee the conscientious and ethical application of AI within the educational sector.

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