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# Artificial Intelligence in Education: A Review

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**Abstract:** *Today, there is almost no activity that is in no way related to the use of computer technology. The application of advanced technologies such as artificial intelligence (AI) opens up new possibilities, potentials, and challenges in educational practice. With the help of artificial intelligence, which simulates human intelligence in making conclusions or predictions, computer systems can provide personalized guidance, support, or feedback to students and teachers in the educational process. The paper aims to identify the impact of artificial intelligence on the educational process, present some of the applications of AI in education, and highlight the perceived benefits of the application.*

**Keywords:** *artificial intelligence; AI; education*

## 1. INTRODUCTION

Artificial Intelligence (AI) is one of many technologies used successfully in many industries today. It is attracting more and more attention every day with the successful projects in recent years. AI concept has recently begun to be accepted as the technology of the future at the global and national levels, and is nowadays considered as the driving force of computer engineering and technology. The goal of AI is to imitate human intelligence through computers, in that sense, by allowing computers to learn. It is also one of the key technologies that are ready to transform education [1]. Traditional education seems to be fixed in terms of time, place, and prescribed activities, and learning process is continuous, especially at younger students. Traditional educational systems are known to be inflexible, but they are now changing to adapt to the technological advances of today's world [2]. The use of AI in education has attracted attention in the following ways [3]:

- Automation - the simplest use of AI often brings the most immediate benefit: by automating simple tasks, such as grading, classifying digital resources, or schedule, teachers can increase their time interacting with students.
- Adaptation - today's technology is an integral part of the educational and business environment. AI in schools will help students initiate technological change.
- Integration - AI solution can be integrated with other IT initiatives, such as intelligent technology and managed IoT networks, to provide appropriate solutions for teaching students.

- Constraint - student needs and curriculum priorities are constantly changing, ensuring that the content provided by teachers is relevant and practical. AI-led analytics in education helps identify key trends, extract key markers, and help teachers develop the most effective classroom that drives digital transformation.
- Identification - data analysis allows us to understand that adaptive AI solutions will identify important areas for students.

The application of AI in education has been the subject of large number of research in the last 30 years. Experts predict that the use of AI in education will increase by more than 45% by 2024 [4]. Amid the COVID-19 crisis, the global market for AI in Education was estimated at US\$1.1 billion in the year 2020, and is projected to reach a revised size of US\$12.6 Billion by 2027, growing at a CAGR (Compound Annual Growth Rate) of 41.4% over the period 2020-2027 [5].

## 2. LITERATURE REVIEW

Based on the review and detailed analysis of available scientific and professional papers, several relevant ones from the area of AI in education have been singled out.

Sadiku et al. [2] explain the concept of artificial intelligence as the ability of a computer system to perform human tasks (such as thinking and learning) that can usually only be achieved through human intelligence. AI technology in education provides a degree of flexibility and adaptation that has never been possible before. This is revolutionizing schools and classrooms, making the job of a teacher much easier. AI is ready to

revolutionize education. The paper considers different applications of AI in education.

Joshi et al. [3] first state that the use of AI is now observed in almost all areas of our lives. Artificial intelligence is an advanced technology that transforms all aspects of our social interaction. In education, it will develop new learning solutions that will be tested in a variety of situations. Educational goals can be better achieved and managed by new educational technologies. The paper analyzes how AI can be used to improve teaching outcomes, providing examples of how AI technology can help teachers use data to improve equity and education rankings in developing countries. It aims to examine the perception of teachers and students about the use and effectiveness of AI in education. Further research on the generational and geographical diversity of teacher and student perceptions can contribute to the more effective implementation of AI in Education (AIED).

[6] describes how artificial intelligence can be used and how it is used in the education sector. According to the 21st International Conference on Artificial Intelligence in Education held in 2020, AIED is one of the currently emerging areas of educational technologies. The use of AI by teachers remains unclear on how to achieve pedagogical advantage on a broader scale and how AI can influence teaching and learning in higher education. The paper presents the impact of AI in education and its advantages and disadvantages. The author also describes a specific way of developing a platform for education based on AI, and finally the additional effects of AI in education.

[7] states that the use of AI in education is no longer science fiction, but is becoming a reality in these times of unprecedented dynamic change. This field encompasses a wide range of techniques, algorithms, and solutions that can solve current adversities and problems in today's classroom. The paper discusses how an existing world-supporting AI can be extended to the fields of education and addresses the existing challenges of using AI in classrooms across Singapore.

[8] assess the impact of AI on education. Assuming a narrative and assessment framework for the AI identified from the preliminary analysis, the scope of the study was limited to the application and effects of AI in administration, teaching, and learning. A quality research approach, which used literature review as a design and approach to research, was used and effectively facilitated the achievement of the purpose of the study. AI is a field of study and resulting innovations and developments that have culminated in computers, machines, and other artifacts that have human-like intelligence characterized by cognitive abilities, learning, adaptability, and decision-making ability. The study found that AI was largely adopted and

used in education, especially in educational institutions, in various forms. AI was initially in the form of computers and computer technologies, moving to intelligent education systems based on the web and network, and finally with the use of embedded computer systems, along with other technologies, the use of humanoid robots and web chat. Using these platforms, instructors were able to perform a variety of administrative functions, such as reviewing and grading student assignments more effectively and efficiently, in achieving higher quality in their teaching activities. On the other hand, since the systems support machine learning and adaptability, the curriculum and content are adapted and personalized following the needs of students, thus improving the student experience and the overall quality of learning.

[9] enables stakeholders in the education sector to understand the extent to which artificial intelligence will be used in education and its perceived benefits. The paper offers examples of the use of AI in education, especially in developing countries such as India, where education for all is considered one of the goals of sustainable development. First, the paper gives the reader an overview of artificial intelligence. It has been observed that AI has evolved from simple rule-based systems, through data-based systems, to context-based systems that have advanced capabilities. Next, the paper discusses the approach of using AI in education to improve learning outcomes. As a new technology, artificial intelligence in education will bring about changes in the "learning experience" by having an adaptable learning environment that creates a "personalized learning experience". Finally, the paper presents some examples of the use of AI technology in the education sector to improve the learning experience and the quality of learning.

Huang et al. [10] emphasize that the emergence of innovative technologies has an impact on teaching and learning methods. With the rapid development of AI technology in recent years, its use in education is becoming increasingly apparent. The article first describes the application of AI in the field of education, such as adaptive learning, evaluation of teaching, and virtual classroom. Then its impact on teaching and learning is analyzed, which has a positive impact on improving teaching levels and learning quality. Finally, the challenges that AI applications may face in education in the future are presented and references are given to AIs to promote education reform.

### 3. METHODOLOGY

When choosing scientific and professional papers, the emphasis is placed on narratives, because they are more suitable for achieving the ultimate goal - to see the presence of artificial intelligence in the field of education. The main research questions to be answered are:

- How does artificial intelligence affect the education process?
- What are the applications of artificial intelligence in education?
- What are the benefits of using artificial intelligence in education?

Electronic databases were used to search for papers that will be the subject of analysis as the most efficient way to search the necessary literature, specifically, ResearchGate, Google Scholar, and ScienceDirect. The focus is on papers published in the period from 2018 to 2021 in journals and collections of papers, papers written in English and based on qualitative and quantitative methods. To narrow the search for papers to only relevant ones in the desired field, the phrase "Artificial intelligence in education" was used for the search.

After the search, fifteen papers suitable for analysis and answering the research questions were selected. Selected papers were synthesized based on the title of the paper, the name of the author, the year of publication, the purpose of the paper, and the aspect of the research.

#### 4. RESULTS AND DISCUSSION

All fifteen papers presented in Table 1 are closely related to the subject of research. The papers analyze the data using mainly qualitative methods. Years of publication of papers indicate a gradual and stable pace of research on the application of artificial intelligence in education.

**Table 1.** List of selected papers

Title	Author(s)	Year	Purpose of work	Research aspect
<i>Artificial Intelligence in Education</i> [2]	Sadiku M., Ashaolu T., Ajayi-Majebi A., Musa S.	2021	Consider different applications of AI in education	• Application of AI in education
<i>A Review on Artificial Intelligence in Education</i> [10]	Huang J., Saleh S., Liu Y.	2021	Describe the application of AI in education, analyze its impact on teaching and learning, and present the challenges that AI applications may face in education in the future	• Application of AI in education • Influence of AI on the education process
<i>Artificial intelligence in education: The three paradigms</i> [11]	Ouyang F., Jiao P.	2021	Explain the paradigmatic changes that <i>AIED</i> has gone through in its short history	• Influence of AI on the education process
<i>Artificial Intelligence in Education</i> [12]	Flogie A., Aberšek B.	2021	Answer many general social and ethical questions such as: do AI models systematize existing prejudices? What will AI do when he enters education?	• Application of AI in education
<i>Artificial Intelligence in Education</i> [6]	Kengam J.	2020	Present the impact of AI in education and its advantages and disadvantages, describe the specific way of developing a platform for education based on AI, and finally the additional effects of AI in education	• Influence of AI on the education process • The benefits of applying AI in education

<i>Artificial Intelligence in Education (AIED)</i> [7]	Lee AVY	2020	Consider how existing world-supporting AIs can be extended to the fields of education, and what are the current challenges of using AIs in classrooms across Singapore	• Influence of AI on the education process
<i>Evaluating Artificial Intelligence in Education for the Next Generation</i> [3]	Joshi S., Rambola RK, Churi P.	2020	Analyze how AI can be used to improve learning outcomes, providing examples of how AI technology can help teachers use data to improve equity and education rankings in developing countries	• Application of AI in education
<i>Use of Artificial Intelligence in Education</i> [9]	Panigrahi A., Joshi V.	2020	Give an overview of artificial intelligence, explain the approach to the use of AI in education to improve learning outcomes, and present some examples of the use of AI technology in the education sector to improve the learning experience and learning quality	• Application of AI in education
<i>Artificial Intelligence in Education: A Review</i> [8]	Chen L., Chen P., Lin Z.	2020	Assess the impact of artificial intelligence (AI) on education	• Influence of AI on the education process
<i>Vision, challenges, roles and research issues of Artificial Intelligence in Education</i> [13]	Hwang GJ., Xie H., Wah B., Gasevic D.	2020	Present the definition and roles of <i>AIED</i> studies from the perspective of educational needs, and propose a framework that will show considerations of the application of <i>AIED</i> in different learning and teaching environments	• Application of AI in education
<i>Artificial Intelligence in Education: Current Insights and Future Perspectives</i> [14]	Goksel N., Bozkurt A.	2019	Examine current insights and future perspectives of artificial intelligence in different contexts, such as natural language processing, machine learning, and deep learning	• Application of AI in education
<i>Artificial intelligence in education - A promise, a threat or a hype?</i> [15]	Humble N., Moselius P.	2019	Analyze and discuss <i>AIED</i> from a teacher's perspective	• The benefits of applying AI in education
<i>Artificial Intelligence in Education</i> [16]	Guo Y., Xiao Y.	2019	Clarify what artificial intelligence is and why it is needed for education, what artificial intelligence would bring to education and how people in different industries should help apply artificial intelligence in education	• The benefits of applying AI in education
<i>Artificial Intelligence trends in education: a narrative overview</i> [17]	Chassignola M., Khoroshavin A., Klimova A., Bilyatdinova A.	2018	Present a possible picture of how artificial intelligence (AI) will reshape the educational landscape	• Influence of AI on the education process
<i>Artificial Intelligence and its Implications in Education</i> [18]	Subrahmanyam V. Swathi K.	2018	Consider the role of artificial intelligence in the education sector, its impact on education, and case studies of its current presence in education (smart content, intelligent, and teaching systems, virtual learning environments, etc.)	• Influence of AI on the education process

A detailed analysis of selected papers was performed using the descriptive analysis technique. The papers were analyzed from the aspect of the impact of AI on the educational process, the application of AI in education, and the benefits of the application of AI in education. The results of the analysis are translated into answers to research questions, which are presented in the form of special subheadings in the continuation of the paper.

#### **4.1. Influence of artificial intelligence on the educational process**

AI is slowly entering almost every area of human life and work, including the education. AI tools have already been implemented to some extent in many parts of the educational process, including content development, teaching methods, student assessment, and communication between teachers and students, so AI technology is obviously changing traditional education and teaching and presenting educational institutions and teachers new ideas for teaching reform.

The application of AI in education, in different forms and with different functions, has had a great impact on the performance of administrative and managerial functions in education. Namely, it enabled teachers to perform their administrative functions, such as assessment, and to provide more efficient feedback to students. Also, AI has facilitated the performance of many tasks and improved the effectiveness and efficiency of teachers in providing instructions and guidance to students. Furthermore, intelligent teaching systems provide a wide range of functionalities that allow teachers to perform tasks such as assessment, promotion, plagiarism checking, and giving students feedback on areas for improvement. AI has significantly reduced the paperwork and workload of teachers by enabling them to focus on their core tasks and improving content and materials in line with the curriculum.

The use of AI for educational purposes or as a pedagogical tool has improved the effectiveness, efficiency, and quality of teachers' work. Efficiency and quality, in this context, are measured by the delivery of relevant content by the curriculum and following the specific needs and abilities of students, while effectiveness is assessed by students' implied acquisition and retention or achievement. AI has ensured improved dissemination of course content, from the curriculum development phase to the actual delivery of content or instructions, and more online and web-based learning platforms. It has also enabled the monitoring of learning progress, including knowledge and understanding, and uses reports to improve the system's ability to adapt content to the needs and abilities of students. It is important to emphasize that shortly, AI will be able

to work as an assistant who adapts to a wide range of learning styles to help teachers and students.

AI can assess students' daily and test performance based on large amounts of data and machine learning, and provide personalized teaching guidelines, shortening student learning time and improving learning efficiency. Adaptive learning technology can help implement individual teaching between machines and students. Artificial intelligence in education can reduce the burden on teachers and make them more efficient, because most of the time teachers spend evaluating homework and exam papers. These repetitive tasks take up teacher time and teacher-student interaction time. Intelligent tutoring systems, intelligent grading systems, and educational robots can help teachers solve many mechanically repetitive daily tasks. In general, AI technology is changing traditional education and teaching methods.

#### **4.2. Applications of artificial intelligence in education**

Most research on artificial intelligence in education focuses mainly on the application of AI technology. AI technology is driving several changes in the field of education, improving the efficiency of teachers 'work and students' learning experience. Some of the applications are discussed below [2] [3].

- Classroom application - AI can allow teachers to teach all AI assessment tasks so that teachers can spend more time with students. Also, artificial intelligence is useful for teaching. Since teachers cannot be available to students all the time, they need tutors.
- Personalized education - AI can provide a level of differentiation that adapts learning specifically to each student. Artificial intelligence helps to build a personalized learning schedule for each student, thus adapting learning to the specific needs of students. This opens up new ways of interacting with students with learning disabilities.
- Administration - AI can simplify administrative tasks. The technology can be used to automate assessment tasks where multiple tests are involved. This means that teachers would have more time for students.
- Universal access to global classrooms - AI can help remove boundaries, making it easier to learn any course from anywhere, anytime around the world. Artificial intelligence tools can help make global classrooms accessible to everyone, including those who speak different languages.
- Medical education - The speed with which new health AI technologies are being developed is being introduced into clinical practice.
- Marketing education - AI is transforming the marketing profession. These include sales

forecasting, personalizing your website experience, speech recognition, content creation, and chatbots.

Other applications include personalized guidance, support, feedback, assessment tools, virtual assistants, mobile games, intelligent teaching systems, educational robots, smart education, and engineering education.

The application of AI in education can be viewed in a slightly different way through adaptive learning, teaching evaluation, virtual classroom, smart campus, and intelligent teaching [10].

- Adaptive learning - AI promotes the development of adaptive learning, in which adaptive learning applies data mining, intelligent education systems, learning analytics, and real-time analysis.
- Teaching evaluation - AI technologies such as image recognition, prediction system, and computer vision provide convenience for teaching assessment.
- Virtual classroom - The development of virtual reality, augmented reality, hearing, and sensory technology is conducive to the reform of the teaching environment.
- Smart Campus - AI plays a key role in managing campuses and services. Face, hearing, and sensor recognition technologies are used to build a smart campus.
- Intelligent teaching robots - Educational robots have been specially developed for the educational field, to cultivate analytical, creative, and practical skills.

#### 4.3. Benefits of using artificial intelligence in education

Because artificial intelligence is becoming more sophisticated, the machine reads the student's facial expressions or gestures and uses them to find out if the student is trying to understand the lecture or needs to change the lesson so the student can easily continue to follow. Adaptation of the academic curriculum can be done using machines based on AI. Artificial intelligence tools can enable global classrooms, including those with impaired vision or hearing. Also, AI can help students who cannot attend classes due to illness. It also provides several resources for people who speak different languages or has hearing or vision problems. AI can help students with homework or prepare for home testing. For the needs of education, applications of artificial intelligence are being developed, such as mentors for students. These applications can also immediately evaluate student essays. Voice assistants help students to talk directly with the educational material that is present on the Internet and installed devices, without any participation of teachers. The use of this technology is expected to escalate in the coming years [6].

The application of artificial intelligence can effectively increase the individual attention of students, because it can provide students with personalized diagnosis and analysis. It can also provide data support for more efficient teaching management. AI is an iterative and progressive technology that can achieve real-time data processing and feedback in the interaction between teachers, students, and the system [16].

## 5. CONCLUSION

By comprehensive analysis of selected works, conclusions are drawn that indicate the factual situation described below. The facts are in line with the research issues addressed in this paper.

Schooling today is not as flexible as that which will be supported shortly by the use of artificial intelligence. Traditional learning methods are becoming obsolete and various educational institutions are slowly rejecting them. Smart systems are rapidly changing educational institutions at all levels of education, to help people learn effectively and meet their learning goals.

AI in Education is a computer technology that provides personalized, adaptable, and insightful teaching. It plays an important role in promoting personalized teaching and learning. AI changes the way teachers teach and the way students learn. You will be able to respond to a range of learning styles shortly. Thanks to artificial intelligence, teaching, and learning programs are becoming more advanced.

The wave of investment and increased interest in artificial intelligence will affect the education process in the times to come. AI is changing and reshaping the educational landscape, although it will not completely replace the traditional education system. It is wrong to try to completely replace it with AI, but AI technology should be added to the traditional learning process.

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