Embracing artificial intelligence in education: Shaping the learning path for future professionals

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Abstract The integration of artificial intelligence plays a key role in modern education, transforming the learning process and training of future specialists. The purpose of the present research is to analyze the role of artificial intelligence in education, define its goals and objectives, and apply various research methods to identify the main aspects of this integration. In the course of the research, existing technologies and methods of using artificial intelligence in education were analyzed, and integration goals were identified, including personalization of learning, improving accessibility and efficiency of education, and preparing students for modern labor market challenges. The research results have shown that the integration of artificial intelligence into education opens up new prospects for improving the learning process while also posing challenges related to data security and staff training. The integration of artificial intelligence is a significant breakthrough in the modern world, where technology is playing an increasingly important role in education. This guideline draws attention to the goals and objectives of integrating artificial intelligence into education, as well as to the various research methods used to study this issue. The advantages and challenges faced by educational institutions in implementing such technology are discussed, and the key aspects of cooperation between artificial intelligence and humans are highlighted. The present research is an important contribution to understanding the role of technology in modern education and identifying ways to use it optimally. The conclusion emphasizes the importance of developing a harmonious interaction between artificial intelligence and humans to ensure optimal learning and preparation for the future.

Keywords: artificial intelligence, education, personalization of learning, accessibility of education, learning efficiency, data security

1. Introduction

The interaction between humans and technology is becoming increasingly intense and inseparable in the modern information society. One of the key areas of this cooperation is the integration of artificial intelligence into education. It is a process that transforms educational practices, teaching methods, and approaches to developing students’ knowledge and skills. Currently, artificial intelligence plays an important role in modern education, performing a wide range of functions from supporting individualized learning to automating administrative processes. This research will focus on the role of artificial intelligence in modern education and its importance for the training of future professionals.

In an era of rapidly developing technologies and global challenges, education plays a key role in preparing future leaders, innovators and professionals. Every day, the level of information available to students increases, and with it, the requirements for the quality of education. In this context, the integration of artificial intelligence into educational processes becomes not just a necessity, but also a strategic direction for the development of modern education. Artificial intelligence offers unique opportunities to transform education. It not only improves access to knowledge and learning, but also redefines teaching methods, adapting them to the individual needs and abilities of students. The role of artificial intelligence in modern education is expanding from the automation of administrative processes to the creation of innovative educational platforms capable of personalizing learning and increasing its effectiveness (Khan et al., 2020). The development of modern education is also closely related to innovative technologies, and artificial intelligence occupies a central place in this process. One of its key roles is to create adaptive educational systems capable of analyzing data about learning processes and students to offer personalized learning programs. This allows teachers and lecturers to more effectively pay attention to the individual needs of each student, contributing to their successful development. In addition, artificial intelligence is used to create interactive educational...
platforms that make learning more interesting and accessible. Technologies of virtual and augmented reality, as well as chatbots and intelligent assistants help students gain knowledge in a more interactive and understandable way. However, the introduction of artificial intelligence in education also introduces some challenges and risks. It is important to consider these aspects and develop strategies for the effective use of such technology for educational purposes, while ensuring data protection and ethical aspects of its application. We will analyze the impact of artificial intelligence on the educational process, identify its potential for optimizing the educational environment, and prepare an overview of existing practices and prospects for introducing artificial intelligence into educational programs (Kuziomko et al., 2021; Blikstein, 2021).

The purpose of the present research is to study the role of artificial intelligence in modern education and to identify key goals and objectives related to its integration.

In order to achieve the purpose outlined, we set the following objectives for ourselves:

1. To analyze the existing technologies, methods and practices of using artificial intelligence in educational institutions in order to understand how they are used and what problems arise in the process of their implementation.
2. To identify and consider the main stages of the integration of artificial intelligence into education.
3. To evaluate and analyze the state of artificial intelligence in the education sector.

2. Literature Review


The use of data analytics in the educational process has been studied by such scholars as Blikstein (2016), who examines the use of data analytics to assess students’ behavior and predict learning success. Wang & Baker (2015) also study data analytics in education and compare the impact of learning content and social interaction on student success.


An overview of artificial intelligence in education was conducted by Chen et al. (2021). They provide an overview of using artificial intelligence in education, including intelligent learning systems. Arora & Dharni (2020) discuss the prospects for the application of artificial intelligence in education and the challenges involved. Khan et al. (2020) also present an overview of using artificial intelligence and data science in education.

Trends and future prospects for using artificial intelligence in higher education were studied by Siau (2021) and El-Halees & Aljamea (2021). They examine current trends and prospects for the application of artificial intelligence in higher education.

Witten, Frank & Hall (2016) introduce practical tools and techniques for machine learning and data analysis. Ren, Sun & Luo (2021) discuss the application of artificial intelligence in education based on the analysis of educational data.

Regional studies and the market analysis have been conducted by some scholars as Blikstein (2016), Henseruk, Tereshchuk, Sysoiev & Vasylenko (2023), and Hevko, Yashchyk, Savchyn & Hiltai (2023). The scientists represent the studies conducted at Volodymyr Hnatiuk University covering various aspects of education and its digital transformation. Global Market Insights, Inc. (2023) presents an analysis of the artificial intelligence market in education.

However, the issue of studying the integration of artificial intelligence into education and its role in modern education and training of future specialists in psychological and pedagogical culture has not been sufficiently explored.

3. Methods

In the context of studying the role of artificial intelligence in education and identifying the goals and objectives of its integration, the following research methods can be used:

1. Literature review. Conducting a review of the scientific literature on the topic of the research allowed us to get acquainted with previous studies, theoretical foundations and practical results in the field of integration of artificial intelligence in education;
2. Data analysis. Processing and analyzing data obtained from various sources, such as learning platforms, statistical reports, etc. will help identify trends, patterns, and features of using artificial intelligence in education.
3. Software for data analysis. The use of specialized software tools for processing and analyzing large amounts of data collected from various sources allows identifying hidden patterns and trends. SQL (Structured Query Language) allowed us to query data, aggregate information, and combine data from different tables. Microsoft Excel’s powerful features, such as filtering, sorting, and pivot tables, have made it possible to use it for basic data analysis and report generation.
4. Long-term observation. Organizing long-term research projects to track the dynamics of changes in the use of artificial intelligence in education and its impact on studying and learning outcomes.
4. Results

The personalization of learning is one of the key advantages of integrating artificial intelligence into education. Machine learning-based systems can adapt to the individual needs of each student, taking into account their level of knowledge, pace of learning, and unique learning style. This helps create curricula that meet the needs of each student to the fullest extent possible, which in turn contributes to more effective and high-quality learning. Another important aspect of the role of artificial intelligence in modern education is its ability to provide feedback and analyze students’ progress. Platforms that use artificial intelligence can automatically grade completed assignments, analyze students’ responses, and offer recommendations for improving knowledge. In addition to enabling students to learn more effectively, it also gives teachers the ability to more accurately track each student’s progress and adjust learning materials according to their needs (Klochan et al., 2021).

It is important to note that artificial intelligence both optimizes the learning process and expands its boundaries (1). It makes it possible to create innovative educational technologies, such as virtual and augmented reality, interactive training programs, etc. These technologies make learning more exciting and interesting as well as contribute to deeper assimilation of the material being memorized. Moreover, artificial intelligence plays an important role in training future professionals in various fields (Guriev et al., 2020; Popov et al., 2021). For instance, artificial intelligence is used by medical professionals to simulate surgical operations or analyze medical images. In technical education, machine learning helps study programming, design, and automation of production processes. Thus, students acquire not only theoretical knowledge but also practical skills that they can apply in their future professional activities.

However, despite all the benefits, artificial intelligence in education also faces certain challenges. One of them is the need to ensure data security and confidentiality of students’ personal information. It is also important to bear in mind that such technology should be used as a tool, not a substitute for the role of the teacher. The interaction between artificial intelligence and humans must be harmonious and balanced to ensure optimal learning (Siau, 2021).

Let’s present a comparative table of the integration of artificial intelligence into education, considering the positive aspects, disadvantages, and prospects.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Benefits</th>
<th>Drawbacks</th>
<th>Prospects</th>
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<tbody>
<tr>
<td>Individualization of training</td>
<td>Artificial intelligence makes it possible to adapt curricula to the individual needs of each student.</td>
<td>The risk of creating overly simplified educational programs that do not take into account the depth and complexity of the material.</td>
<td>The development of increasingly accurate algorithms for analyzing students’ needs and abilities.</td>
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<tr>
<td>Efficiency of training</td>
<td>Automation of task verification and real-time feedback can increase the efficiency of learning.</td>
<td>Potential reduction of interaction between students and teachers, which can reduce the quality of learning.</td>
<td>Development of hybrid learning models that combine the benefits of artificial intelligence and human contact.</td>
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<td>Accessibility of education</td>
<td>Artificial intelligence can make education more accessible to remote and low-income regions.</td>
<td>High initial costs of using artificial intelligence technologies in educational institutions.</td>
<td>Reducing the cost and improving the availability of educational technology through scaling and optimization.</td>
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<tr>
<td>Automation of tasks</td>
<td>Automation of routine tasks, such as verification of exams and management of administrative processes.</td>
<td>Risk of job losses for teachers and administrative staff.</td>
<td>Development of new professional roles in education related to technology management and data analysis.</td>
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<tr>
<td>Personalized training</td>
<td>The possibility for students to work at their own pace, getting the material that best suits their level of knowledge and learning style.</td>
<td>The lack of an emotional and social component in learning, which is difficult to reproduce with artificial intelligence.</td>
<td>The integration of artificial intelligence with tools for the development of social and emotional skills.</td>
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This table provides a general overview of how the integration of artificial intelligence into education can bring significant benefits and challenges. At the same time, the development prospects are aimed at eliminating these shortcomings and strengthening the positive impact on the educational process.

The integration of artificial intelligence into education goes through several stages, each of which has its own features and challenges. Let’s analyze the main stages of the integration of artificial intelligence into education (Figure 1).

Stage 1. Familiarization and preparation. The first stage of the integration of artificial intelligence into education begins with the familiarization of the teaching staff with the basic concepts, principles, and examples of applying artificial intelligence in the educational process. At this stage, educational institutions and teachers get acquainted with the concept and capabilities of artificial intelligence. Existing technologies are studied; the benefits and risks of their use are discussed. Educational seminars, trainings, and courses are held to ensure that personnel are ready to use artificial intelligence in the educational process.

Teachers receive training on basic skills of working with software and tools that support the use of artificial intelligence in the educational process. This stage also includes the analysis of existing educational needs and the identification of areas...
where the application of artificial intelligence can bring the greatest benefit. Staff training also includes awareness of ethical and social issues related to the use of artificial intelligence in education, as well as the development of strategies to address them. At this stage, a team of specialists is formed that will be responsible for implementing and supporting artificial intelligence in the educational environment. The development of an action plan and training schedule for the following stages of artificial intelligence integration into the educational process is an important part of this stage (Klochan et al., 2021).

Stage 2. Pilot projects and experiments. Pilot projects and experiments are implemented at the second stage of the integration of artificial intelligence into education to test the effectiveness of artificial intelligence in the educational process. The pilot projects include the creation and use of curricula enriched with artificial intelligence elements, such as individualized tasks, adaptive materials, and personalized learning approaches. Experiments can also include testing automated knowledge assessment systems based on artificial intelligence data analysis, as well as the practice of adaptive learning, where systems can adapt to the student’s individual needs. Pilot projects are conducted within a limited framework, which allows for a deeper study of the efficiency of artificial intelligence in specific educational scenarios. In the course of the experiments, data on the results, reactions of students and teachers are collected, which makes it possible to assess the practical applicability and potential for scaling the use of artificial intelligence in education. This stage is important for forming the basis for further successful implementation and expansion of the use of artificial intelligence in the educational environment.

Stage 3. Scaling and dissemination. The third stage of integrating artificial intelligence into education involves scaling up and disseminating successful pilot projects. After confirming the effectiveness of artificial intelligence in the educational process, successful models and technologies are implemented on a wider scale in various educational institutions. This includes the development of standards and methodology for the use of artificial intelligence in education to ensure uniform approaches to its integration. Educational platforms and resources supported by artificial intelligence are also created to facilitate learning and adapt to the student’s individual needs. Extensive training of teachers and staff on the use of innovative technologies is also conducted at this stage, which contributes to their successful implementation and application in the educational process. The goal of this stage is to create a stable and supported environment in which artificial intelligence is an integral part of education, contributing to the efficiency and accessibility of learning for all education seekers.

Stage 4. Permanent improvement and adaptation. The fourth stage of the integration of artificial intelligence into education focuses on ongoing improvement and adaptation. The use of artificial intelligence in education requires a systematic collection of feedback from students and teachers. This feedback is the basis for analyzing data on learning outcomes and the effectiveness of artificial intelligence in the educational process. Based on this data, the algorithms and technologies of artificial intelligence are constantly being improved to more accurately meet the needs and goals of the educational environment. Responding to changes in the educational environment and labor market requirements is also an important part of this stage. Innovations in education supported by artificial intelligence must be able to adapt to new requirements and challenges in order

Figure 1. Main stages of the integration of artificial intelligence into education.

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to continue to effectively support the learning process. Therefore, permanent improvement and adaptation play a crucial role in the successful integration of artificial intelligence into education, ensuring its efficiency and relevance in the long term.

Each of these stages plays an important role in the successful integration of artificial intelligence into education. They enable educational institutions and teachers to master new technologies, determine the best methods of their application, and ensure high-quality and effective training using modern tools and approaches. For instance, the first stage involves familiarizing the teaching staff with the basics of artificial intelligence, training staff, and identifying educational needs. The second stage includes pilot projects and experiments to evaluate the efficiency of artificial intelligence in the educational process. The third stage is related to scaling up successful models and technologies to a broader level in different educational institutions, as well as creating standards and training for staff. The final stage involves ongoing improvement and adaptation of the application of artificial intelligence in education based on feedback, data analysis, and changes in the educational environment (Jana & Seetha, 2021).

In general, the successful integration of artificial intelligence into education requires a systematic approach, attention to students’ and teachers’ needs, and flexibility to adapt to the changing conditions and requirements of the educational environment. Artificial intelligence plays a significant role in modern education, providing unique opportunities and tools to improve the educational process. One of the key functions of artificial intelligence in education is to personalize learning. Machine learning algorithms can analyze data about students and offer individualized materials and tasks that meet their needs and level of knowledge.

Artificial intelligence is also used to create interactive educational platforms and applications that make learning more engaging and fun. Technologies for speech recognition and natural language processing make it possible to develop intelligent assistants that can answer students’ questions and explain complex concepts. Artificial intelligence helps teachers evaluate the effectiveness of their teaching methods and identify areas that require additional attention by analyzing data. Such technologies can also predict students’ academic performance and identify dropout risks, which allows for timely measures to support vulnerable students (Hevk, 2023).

In addition, artificial intelligence is actively used in the development of adaptive educational systems that can dynamically change their teaching methods according to the reactions of students. This provides an opportunity to effectively adapt learning materials to the unique needs of each student, improving their understanding and memorization of the material. Artificial intelligence technologies are also implemented in the process of automating the assessment of students’ work. Algorithms can analyze essays, tests, and other assignments, detect errors, assess the quality of answers, and provide feedback to students and teachers. This helps reduce the time spent on verifying the work and increases the objectivity of the assessment. In addition, artificial intelligence supports the development of online education by providing tools for creating virtual classrooms, webinars, and educational platforms. This is especially relevant in the context of the widespread use of distance learning when access to quality education is becoming more important than ever (Klochan, 2021).

Thus, artificial intelligence plays an integral role in modern education, contributing to its development, improving accessibility, and enhancing the quality of education.

The use of artificial intelligence in the education sector is growing and developing significantly. According to statistical data from HolonIQ (Global Market Insights, 2023), the adoption of artificial intelligence in educational organizations has increased: 25% of respondents reported successful investments and deployments of artificial intelligence in 2022, compared to 14% in 2019. The main focus is on the integration of machine learning and 38% of educational organizations are implementing it in their activities. The main reason for implementing artificial intelligence cited by respondents was to improve customer (student) outcomes, emphasizing the shift to personalized learning and support to increase student satisfaction and learning outcomes.

In 2022, the market size of artificial intelligence in education reached 4 billion USD and is projected to grow at over 10% CAGR from 2023 to 2032. This increase is driven by a growing preference for personalized learning, the expanding integration of intelligent education systems into the learning process, and the growing implementation of cloud services. The integration of artificial intelligence with technologies such as virtual reality (VR) and augmented reality (AR) also contributes to the creation of immersive and interactive learning experiences, further stimulating market demand.

In addition, the segment of artificial intelligence solutions in the education market is expected to increase significantly due to the development of sophisticated platforms and investments in expanding the portfolio of technology companies. The deployment of cloud-based artificial intelligence solutions in education is set to see record-breaking growth, driven by the widespread adoption of cloud computing technologies due to their simplicity and flexibility. Europe is expected to account for a significant share of the global artificial intelligence revenue in the education market by 2032, driven by the growing implementation of artificial intelligence, the rapid development of the Edtech sector, and significant investments in artificial intelligence.

5. Discussion

The development and integration of artificial intelligence in education raises many discussions and debates. The debate on ethics and transparency in using artificial intelligence in education is relevant, namely, how to ensure the ethical use of artificial intelligence in education and what measures should be taken to protect students’ data and ensure transparency of the algorithms of this technology. The role of the teacher in the era of machine learning is also debatable: how the role of the teacher will change in the context of the spread and use of artificial intelligence in education and whether teachers will be able...
to adapt to the changes and what skills they will have to develop (Albashrawi & AlSahari, 2021). One key perspective is that the use of artificial intelligence in education can significantly improve access to education, personalize learning, and increase its efficiency and effectiveness. However, there are debates about data privacy, the ethical use of artificial intelligence for educational purposes, and the potential for widening the gap between educated and uneducated students due to uneven access to technology. It is important to discuss how the implementation of artificial intelligence in education can affect inequality in educational opportunities and access to knowledge. Some discussions are related to the fact that without proper regulation, the use of artificial intelligence could lead to a widening of the gap between educated and uneducated sections of the population. Ultimately, it is important to discuss what the future of education will look like with the widespread use of artificial intelligence (Goel & Joy, 2018). What trends and opportunities are opening up for the educational field with the development of artificial intelligence technologies and how can society best adapt to these changes?

All these aspects are the objects of active discussion among scientists, practitioners and the public in general, and their consideration in the development of strategies for the use of artificial intelligence in education is extremely important to ensure the effective and ethical application of technologies in this field.

6. Conclusions

Therefore, the integration of artificial intelligence into education plays a significant role in the development of modern education and the training of future specialists. Artificial intelligence contributes to more effective and high-quality studying by personalizing learning, providing feedback, and expanding the boundaries of the educational process. The integration of artificial intelligence into education is a multi-stage and complex process that requires careful planning and coordination. There are four main stages in this process: familiarization and preparation, pilot projects and experiments, scaling and dissemination, and permanent improvement and adaptation. As technologies advance, artificial intelligence promises even greater opportunities to improve education and create highly qualified professionals in various fields. Based on the conducted research on the role of artificial intelligence in education, its goals and objectives, as well as the applied research methods, it can be argued that artificial intelligence plays a crucial role in modern education. Its use makes it possible to personalize learning, provide feedback, improve accessibility of education and expand the boundaries of the learning process. The introduction of artificial intelligence into education can serve various purposes, such as increasing the efficiency of learning, adapting the educational process to students’ individual needs, improving accessibility of education for all groups of students, and preparing students for future labor market challenges. The key objectives of the integration of machine learning into education include ensuring data security and confidentiality of students’ personal information, staff training, development of adaptive educational programs, and creation of harmonious interaction between artificial intelligence and humans.

Ethical considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

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