Model of Educational Process Organizing Using Artificial Intelligence Technologies

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Abstract

An overview of common artificial intelligence (AI) technologies, as well as the main trends of their application in the field of education, was carried out. The perspectives of personalization of lifelong learning have been analyzed. The prospects of modern LMS universities' implementation in globalized educational intellectual ecosystems are revealed. The results of a survey of higher education institutions teachers regarding the expected increase in the efficiency of LMS use due to the implementation of AI elements were analyzed. An analysis of the possibilities of modeling the educational environment in higher education institutions was carried out. It is proposed to use the triad of models "student – educational subject – educational process" to analyze the application of AI technologies in education. Based on the model of organizing the educational process, a scheme for calculating the AI use effectiveness integrated indicator is proposed. An approach to choosing the optimal knowledge assessment system based on available opportunities is suggested. A mathematical model of the generalized knowledge assessment algorithm is given. At the level of the student model, an optimization model of student training has been developed in the phase space of knowledge, taking into account the possibilities of applying AI technologies.

Keywords

Education, learning management system (LMS), artificial intelligence (AI), efficiency, mathematical model, personalized learning (PL), model of the student, model of the educational process, model of the educational subject, optimal learning trajectory.

1. Introduction

The middle of the 20th century was marked by the beginning of the intensive development of the global electronic information environment. The widespread of high-speed computer technology and the rapid development of ICT has opened fundamentally new broad horizons for the innovative development of human society in general. In the 21st century, the expansion of the Internet of Things [1] created prerequisites for the creation of digital copies of the real society in every segment of human activity, from production to finance, health care, education, transportation, robotics, etc. The availability of access to all information resources without restrictions on the time and place of access created conditions for working with the information application model in real-time.

The COVID-19 pandemic has played the role of a catalyst for the mass adoption of new ICTs to support remote work in almost all spheres of human activity. According to UNESCO experts, the pandemic created problems for educational processes for about 1.6 billion students in more than 190 countries of the world, which in turn led to the accelerated development and application of modern educational technologies [2]. In turn, new educational technologies had to be adapted to use in different classrooms with different levels of professional and computer literacy, which led to the introduction of learning methods based on artificial intelligence (AI) [3; 4]. The accelerated

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implementation of new ICTs is confirmed, for example, by the following data. International Data Corporation (IDC) predicted that "the volume of the technology industry will exceed 5.3 trillion dollars in 2022" [5]. A distinctive feature of such revolutionary transformations was the intensive spread of the number of communications carried out, which in turn led to the development of AI systems. It is predicted that by 2028 the world AI market will be "641.30 billion dollars with an average annual growth rate of 36.1%" [6]. Remote workplace models are getting closer to the real world through the use of virtual world tools.

Today, the implementation of AI elements is massive and spontaneous. As the analysis showed, numerous scientists, pay attention to the issues of expanding the scope of AI and the development of digital technology learning platforms using AI. Their implementation is determined by empirical judgments. This situation is because AI technologies are developing so quickly that the use of retrospective analysis is very problematic. It can be stated that insufficient attention is paid to the issue of modeling processes involving AI technologies in education, and there are some unresolved problems in this area.

In our opinion, the improvement of educational processes should involve the approbation of changes using AI models, especially if it concerns the implementation of AI elements. The purpose of this work is to develop rational approaches to the application of AI technologies, as well as a model of their rational use. According to the above, the purpose of the research is to solve the following tasks:

- to determine the prospects of implementing modern AI technologies in educational processes;
- to outline the areas of the AI technologies application formalization;
- to develop a model for evaluating the efficiency of the AI technologies implementation in educational processes.

2. Related works

The COVID-19 pandemic has accelerated the integration of innovative ICTs into the education sector. The processes of introducing innovative digital technologies into educational processes, and AI [7], in particular, accelerated especially intensively. According to MarketsandMarkets analytics in 2022 the global AI Market reached USD 86.9 billion. It is projected to grow at a CAGR of 36.2% during the forecast period to reach USD 407.0 billion by 2027. The growth of data-based AI and advancement in deep learning and the need to achieve robotic autonomy to stay competitive in the global market are the major growth drivers [8].

At the beginning of 2023, Microsoft and Google introduced chatbots based on AI into their search engines [9].

The penetration of innovative ICTs is increasingly expanding the scope of AI. Among the famous researchers in the field of using AI in the educational process, it is worth mentioning such as: O. Zawacki-Richter, V. I. Marín, M. Bond, F. Gouverneur [10], S. A. D. Popenici, S. Kerr [11], I. Roll, R. Wylie [12]. In particular, Rudolf Urbanek [13] cited the following main areas of using AI to improve educational processes: individualization of learning, involvement of intellectual assistant tutors, automated detection of knowledge gaps, assistance in choosing educational institutions, and smart schools.

The systematization of scientific sources [7; 14] makes it possible to highlight the following factors that determine the need for a radical renewal of the education system:

- insufficient consideration of students' interests;
- the passivity of teaching methods, which are out of touch with dynamic changes in society;
- the need for periodic retraining or even a change of profession;
- reducing the need for specialists in the field of maintenance of traditional industries, where mechanized robotic systems are increasingly used;
- dynamic change in the needs of specialists in various fields;
- increasing the need for specialists who can make creative decisions in various spheres of activity;
- insufficient attention to the development of student's creative abilities.

In addition, the intensive mass distribution of technologies threatens the quality of educational processes, as it enables students to prepare papers or perform consultations in an operational mode. For example, according to Forbes "…Considering that 90% of students are aware of ChatGPT, and 89% of survey respondents report that they have used the platform to help with a homework assignment, the application of OpenAI's platform is already here. More from the survey: 48% of students admitted to using ChatGPT for an at-home test or quiz, 53% had it write an essay, and 22% had it write an outline for a paper…" [15].

The modern global information and educational environment is formed based on ICTs and is aimed at the formation of professionally significant and socially important personality qualities in the conditions of the digitalization of society [16; 17]. According to O. Prokopenko, R. Holmberg, V. Omelyanenko [18], O. Hrynkevych, O. Sorochak, O. Krayevska [19], the main elements of such an informational and educational environment should include:

- information and communication subscriber nodes and connections between them;
- means and technologies for collecting, storing, processing, and transmitting information and knowledge;
- audiovisual information reproduction means;
- organizational structures and power institutes of support and maintenance of educational processes.

The modern informational and educational environment of each university should provide:

- informational and methodological support of the educational process;
- planning and support of educational processes and resource support;
- monitoring of educational processes and their results;
- information support of educational processes;
- support of a specialized communication environment in the global network.

As already mentioned, modern education should reorient itself to the formation of a specialist with increased adaptability, the ability to effectively form communications, and be oriented towards lifelong learning.

Based on the above requirements for the training of specialists, such an information environment should be as flexible and adaptable as possible not only to consumers of educational services in general but also to take into account public needs [20; 21], based on the socio-economic environment [22]. This situation leads to the increasingly massive use of AI elements. For example, the elements of AI as a separate intelligent agent can be easily replicated and thus switch learning from the mass to the individual student [23; 24].

The diversity and multifunctionality of existing ICTs form a multifaceted educational environment that has a large number of degrees of freedom. The most common technologies include natural language processing, machine translation, pattern recognition, intelligent learning, AI probabilistic planning, intelligent agents, game engines, and adaptive user models in a personalized learning environment.

A review of literary sources [7; 10; 11; 12; 18] made it possible to highlight the following main AI technologies in education: Internet of Things (IoT), Smart graphics, Big Data, Data Science, Data Analytics, Computer Vision (CV), Natural Language Processing (NLP), Deep Learning (DL), Intelligent Virtual Agents & ChatBots, Gamification & serious games.

To organize an educational virtual environment, educational institutions began to widely use the learning management system (LMS) [25] for complex centralized management of educational processes, which is used for the development, management, and distribution of online educational materials with the provision of shared access. The most well-known LMSs are [26; 27; 28; 29]: 360Learning, TalentLMS, Absorb LMS, Skyprep, iSpring Learn, Adobe Captivate Prime, D2L Brightspace, Trakstar Learn (formerly Mindflash), Canvas LMS, Docebo, Cornerstone, Web site LMS, Moodle. The most popular system in the world is Moodle. According to the experts of the eLearning Industry platform, "By 2024, it is expected that 47% of LMS tools will be enabled by AI capabilities" [27]. A typical functional content of learning management system (LMS) is shown in Figure 1.

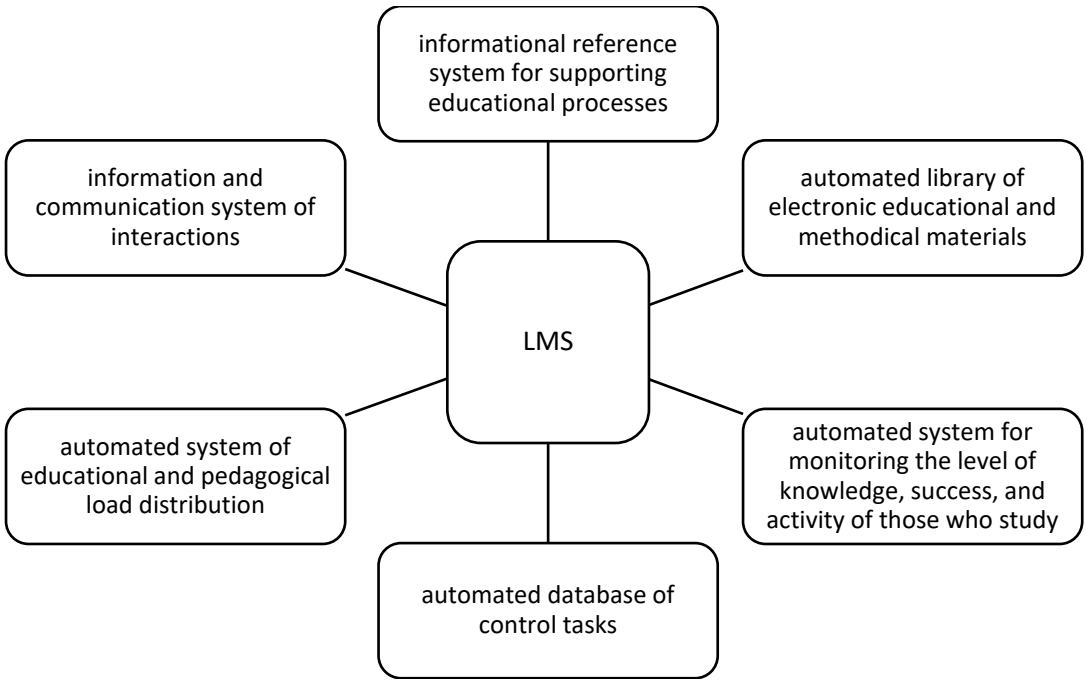

Figure 1: Functional content of learning management system (LMS)

The spread of the pandemic in the world, on the one hand, contributed to the enormous expansion of the scope of such systems for distance learning, and on the other hand, it showed their weakness due to the strict automation of service procedures.

General aspects of the modernization of educational organizations in the conditions of globalization were considered in works [4; 14]. Scientists are paying more and more attention to the improvement of professional training at universities [17]. There is a growing trend of creating corporate-sponsored research structures within universities. In such laboratories, applied research and development are carried out in the interests of the sponsoring company. Modern research universities, which are characterized by a high level of scientific production, play a crucial role in the training of high-class specialists [30] and the production of innovations [31]. In particular, P. Altbach [32] examines the range of different types of research-oriented tertiary education institutions. Of course, a modern university plays a huge role in the development of society, both within the framework of the multi-university concept and as a consulting center, accumulation, and preservation of society's memory. The expanded formulation of the university's mission can be presented as "dissemination, preservation, interpretation, and creation of new knowledge" [33]. It is quite difficult to find the optimal balance between teaching and research, which brings the university to a qualitatively higher level of efficiency. A research university consumes a lot of information resources, which in turn leads to the widespread use of AI technologies.

3. Methods

AI technologies have begun to be intensively implemented in the educational sphere. The use of adaptive intellectual structures in the LMS will contribute to the deployment of a flexible system of interactions of educational institutions, including cooperation and competition, the provision of this or that service. The complex LMS technology with implemented elements can be attributed to the ASI class. After all, such an educational ecosystem will ensure flexible adaptation to technological and structural changes in the organization of educational processes. In perspective [34] "In the lifelong learning model ..., universities will codesign curricula in full partnership with employers and learners… they will have to sit down with learners to map out their professional needs and outcomes candidly. Just as important, they will respond to changes in the workplace by inviting employers to discuss their business demands".

The formation of an intellectual educational ecosystem is possible in the conditions of a developed digital society. Let us show in Figure 2 the conceptual structural and graphic model of its functioning.

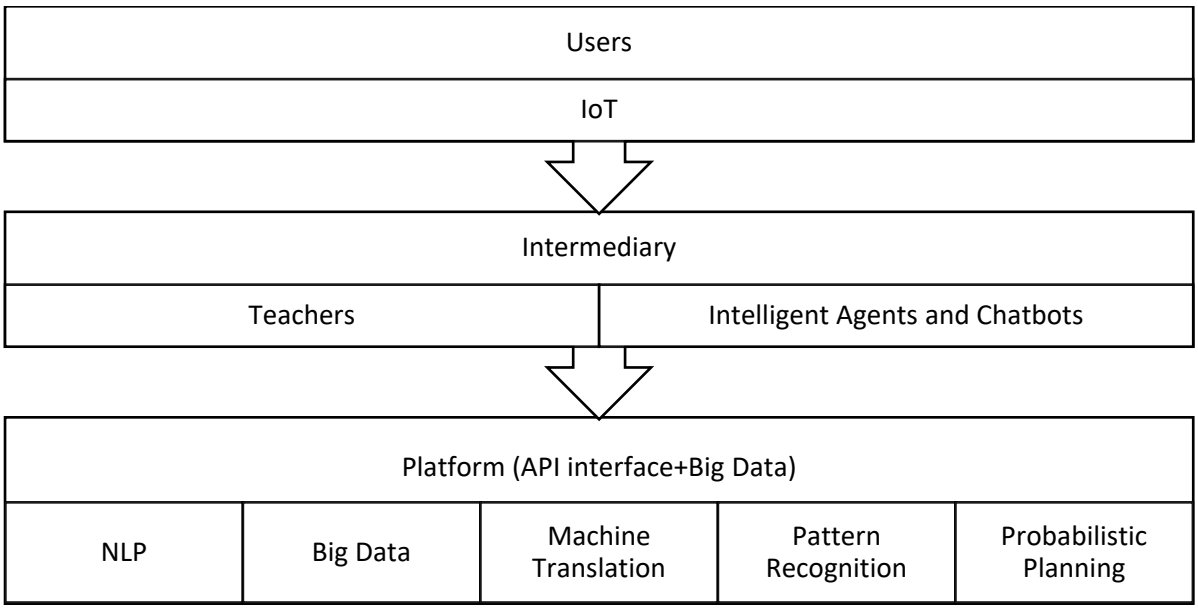

Figure 2: The work's structure of the intellectual education ecosystem

The intellectual educational ecosystem, in addition to various structural organizations, includes integrated network and cloud infrastructure, systems, software, and applications that use analytics, AI, and machine learning to provide digital personalized interaction, as well as a variety of IoT devices and sensors. The value of such a solution lies in the prompt solution of specific educational tasks, and openness to connecting new participants. It is appropriate to make an opinion of Joseph E. Aoun [35] "...the multi-university network is a multilocation entity existing across multiple states and even multiple countries. Each node of the network is connected to the other, such that learners can circulate through it to take advantage of academic programs, learning resources, and experiential learning opportunities. In many ways, it is the next logical iteration of a university, taking into account the forthcoming need to serve a growing population of lifelong learners".

A properly selected research methodology for the introduction of AI into the educational process allows scientists to develop a scientific approach to studying the organization of the educational process, using AI as a tool for data collection and processing. Applying the right research methodology helps scientists identify problematic questions that need to be investigated; collect and analyze data and develop a theoretical model for organizing the educational process using AI. Correctly used research methodology allows scientists to obtain accurate and objective research results and helps to ensure the correspondence of the obtained results to real learning processes.

For the formation and description of the theoretical Model of Educational Process Organizing Using AI Technologies in institutions of higher education, the authors used general scientific methods, in particular:

- survey and questionnaire methods. These methods allowed us to collect data from students and teachers about their experiences using AI in education. Studying the views and opinions of the participants of the educational process helped to conclude the efficiency of introducing AI into the educational process. Data was also collected among teachers to determine the expected increase in the efficiency of LMS use due to the introduction of AI elements;
- an experimental method that, based on the results of a survey of teachers of higher education institutions, made it possible to obtain conclusions about the expected increase in the efficiency of the use of the LMS due to the introduction of AI elements. Flexibility, completeness of the task, and ease of interaction became the summary evaluation criterion. Statistical methods were used to analyze the data obtained regarding the survey of teachers and find regularities in the educational process;

- method of system analysis. This method consisted in considering the learning process as a system and investigating its elements and the interaction between them using AI in the relationship. Using the observation method, the authors observed the educational process, collected data on the efficiency of the use of AI at various stages of education, and obtained a more complete picture of the organization of the educational process. As a result, a Complex Model of Educational Process Organizing was formed.

Modeling of educational processes should be built on a student-centered basis. The use of AI technologies ensures a high level of flexibility and adaptability of educational processes. The organization of educational processes can be presented in the form of Figure 3.

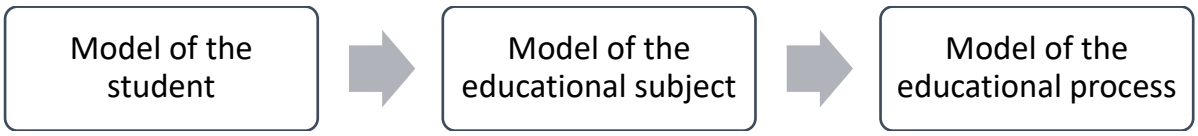

Figure 3: Complex model of educational process organizing

The formalization of the organization of educational processes is due to a practical need, as it allows automation of the entire complex learning process, diagnosis of the quality of results, document management, and record-keeping in the cloud storage. A student in such a smart environment can learn, coordinate interactively and communicate both with real teachers and Intelligent agents in online modes.

4. Experiment

In recent years, the process of implementing AI technologies has accelerated due to the significant intensification of the spread of forms of distance education due to the COVID pandemic. More and more teachers and students strive to work at a convenient time, which is often impossible due to the established work schedules of the educational institution's staff. The involvement of AI elements will make it possible to qualitatively increase active interaction with the educational environment. During November-December 2022, a survey was conducted among teachers of higher education institutions regarding the expected increase in the efficiency of LMS use due to the introduction of AI elements. The evaluation was carried out on a 10-point scale, where 1 is no efficiency, and 10 is the maximum level of efficiency of LMS use due to the introduction of AI elements. Flexibility, completeness of the task, and ease of interaction became the summary evaluation criterion. The survey results for each indicator are shown in Figure 4-12.

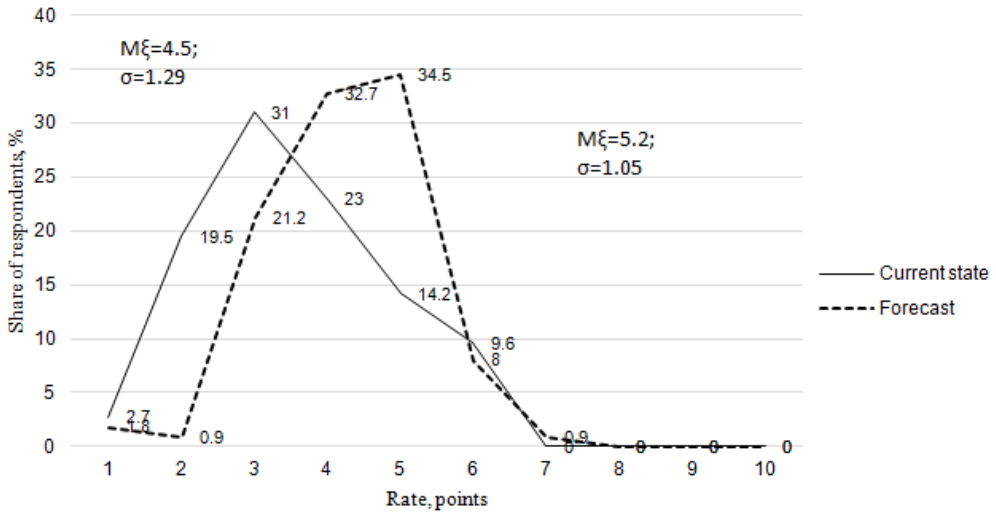

Figure 4: Analysis of the prospect of using AI to support the infrastructure of an educational institution

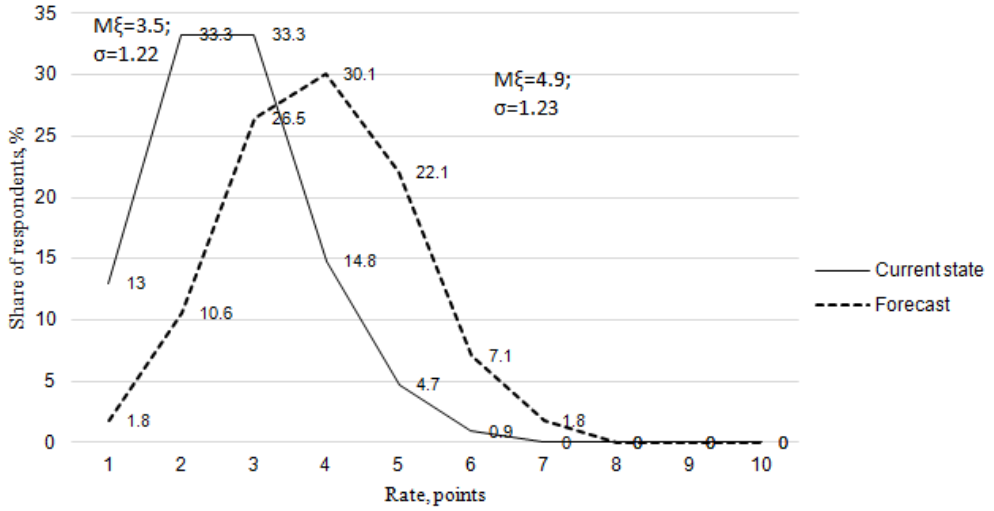

Figure 5: Analysis of the prospect of using AI for university activity planning

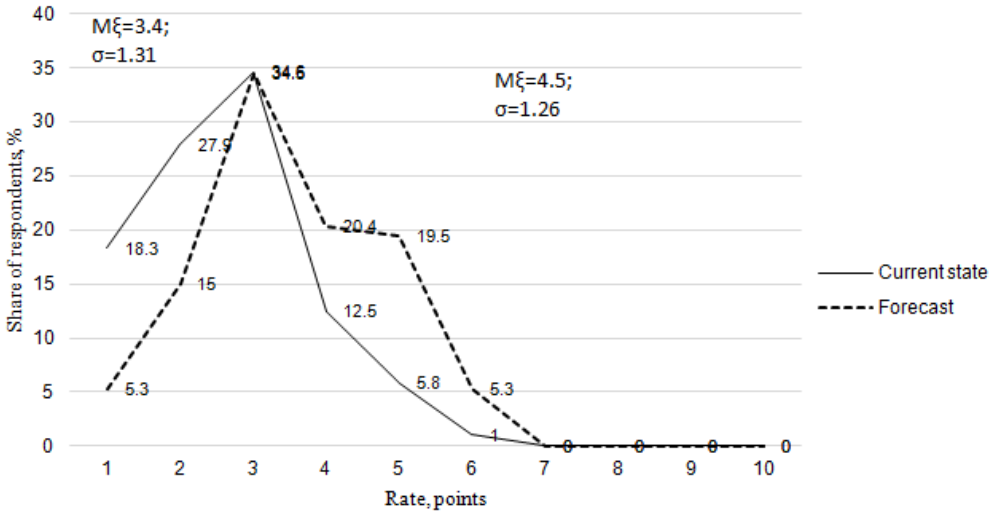

Figure 6: Analysis of the prospect of using AI for operational support of educational processes

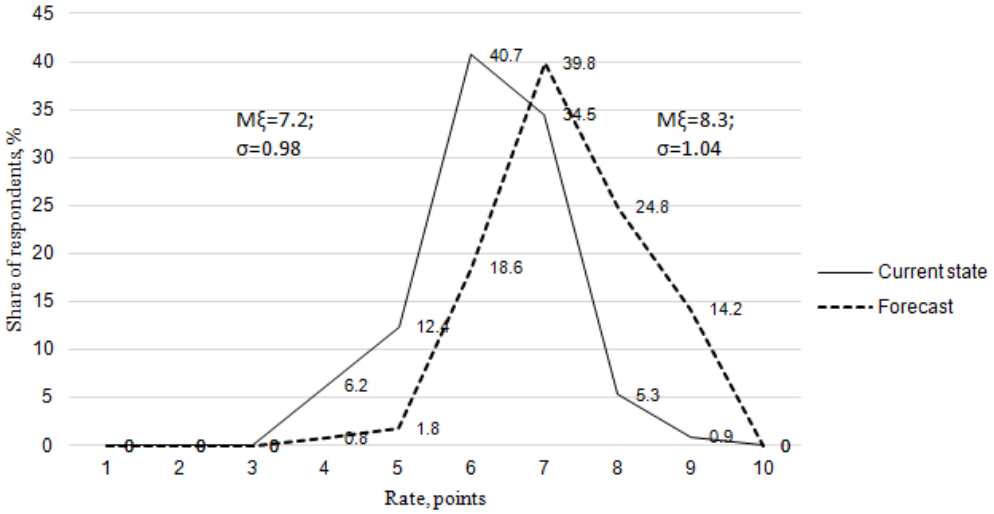

Figure 7: Analysis of the prospect of using AI to document student training

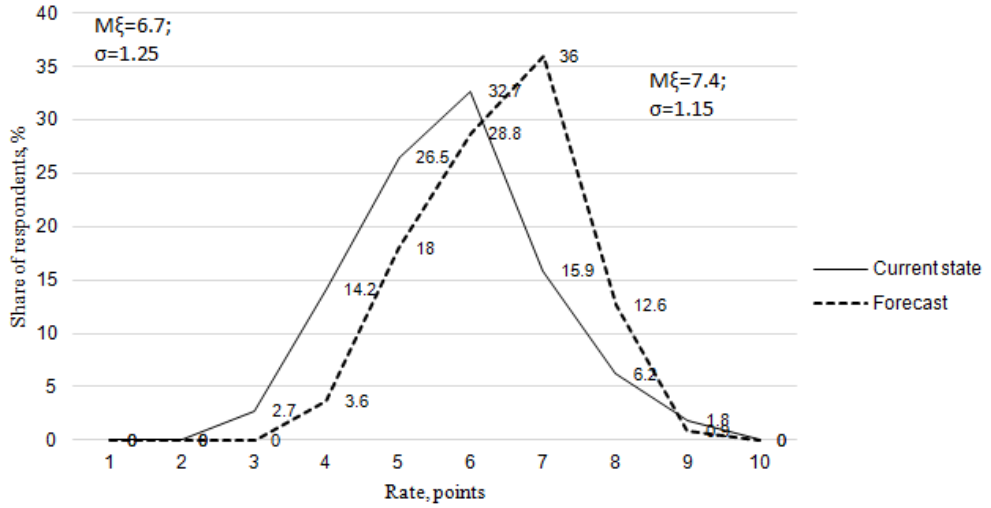

Figure 8: Analysis of prospects for the use of AI for the development of educational programs, subjects, and their information content

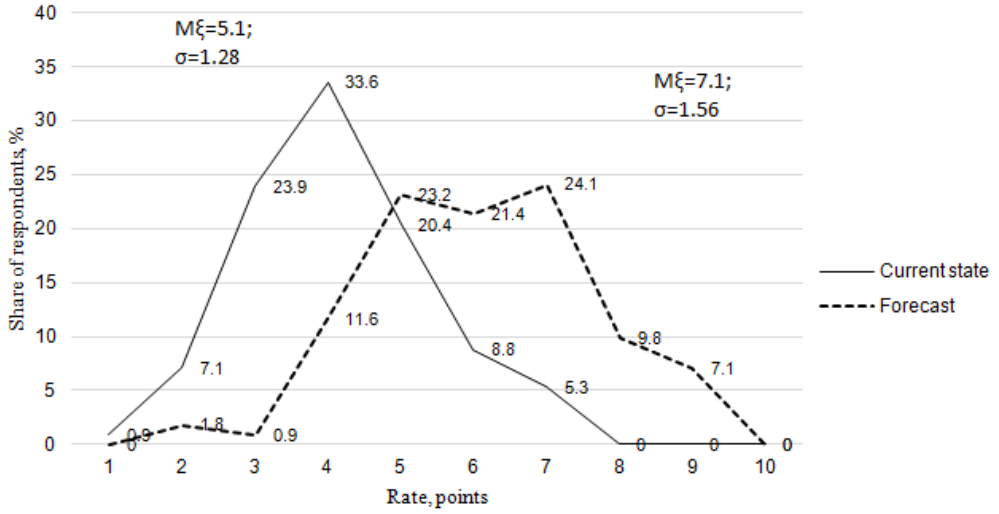

Figure 9: Analysis of the prospect of using AI to support personnel potential

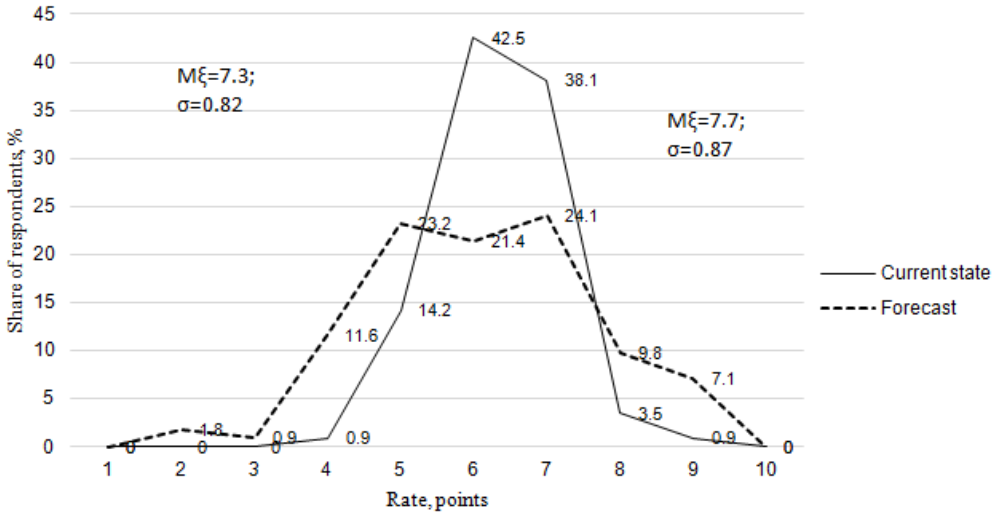

Figure 10: Analysis of the prospect of using AI to support distance learning technologies

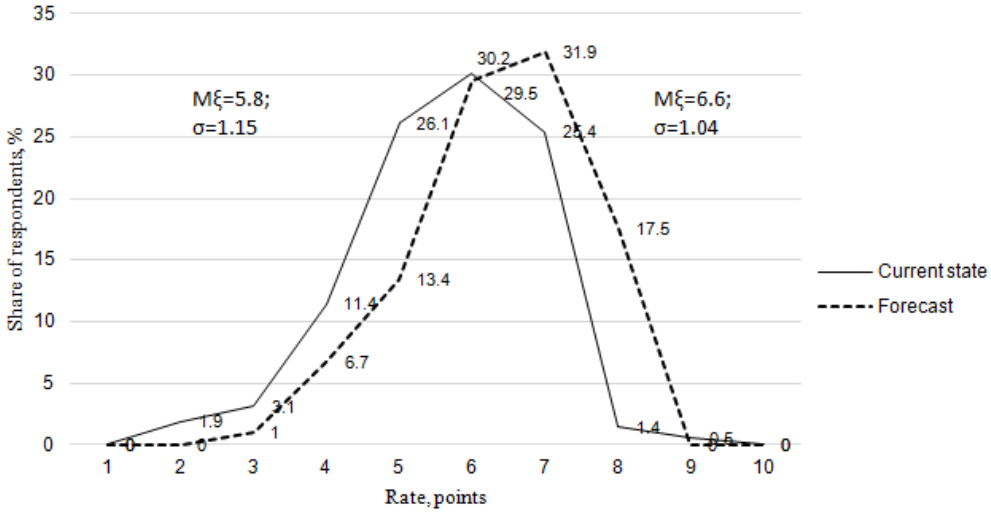

Figure 11: Analysis of the perspective of the use of AI for control measures

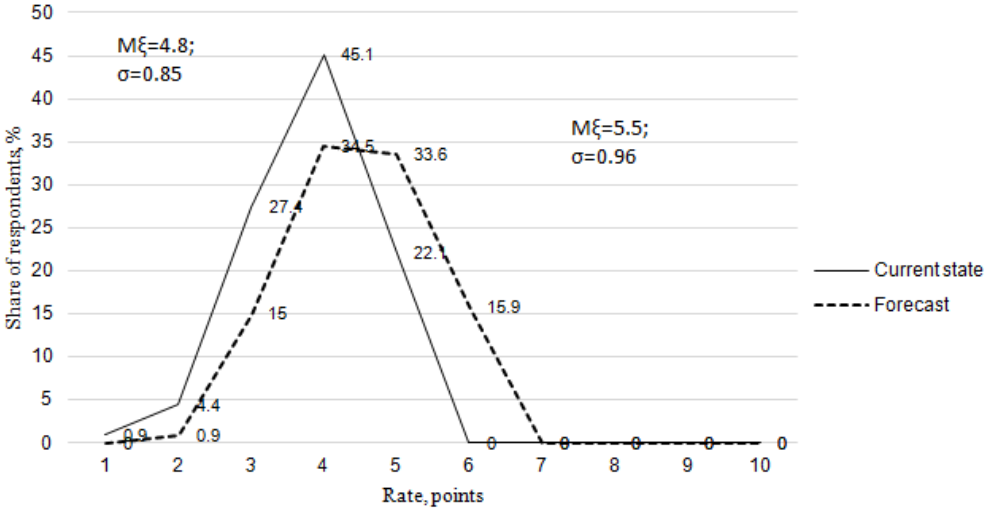

Figure 12: Analysis of the prospect of using AI to support independent work

The summary characteristics of the model of the educational process with the obtained estimates of the prospects for the use of AI elements are shown in Table 2.

5. Results

5.1. Model of the student

The main task of the Model of the student is to most accurately reflect the student's learning trajectory using feedback mechanisms to optimize learning outcomes. Building a highly adaptive student-centered education system is a complex task, which necessitates the use of modeling methods for analysis. The foundation for building mathematical models of the educational process can be considered the work of R. Douady [36], in which the main provisions of didactic engineering were formulated.

The basic element of student evaluation is such criteria as objectivity and integrity in the system-functional sense, the essentiality of characteristics, the clarity and consistency of the property of the object display, the specified level of accuracy, and the unambiguity of the scientifically based method

of calculating the criterion. To evaluate students, you can use B. Bloom's [37] extended taxonomy by supplementing the scale with skills (Figure 13).

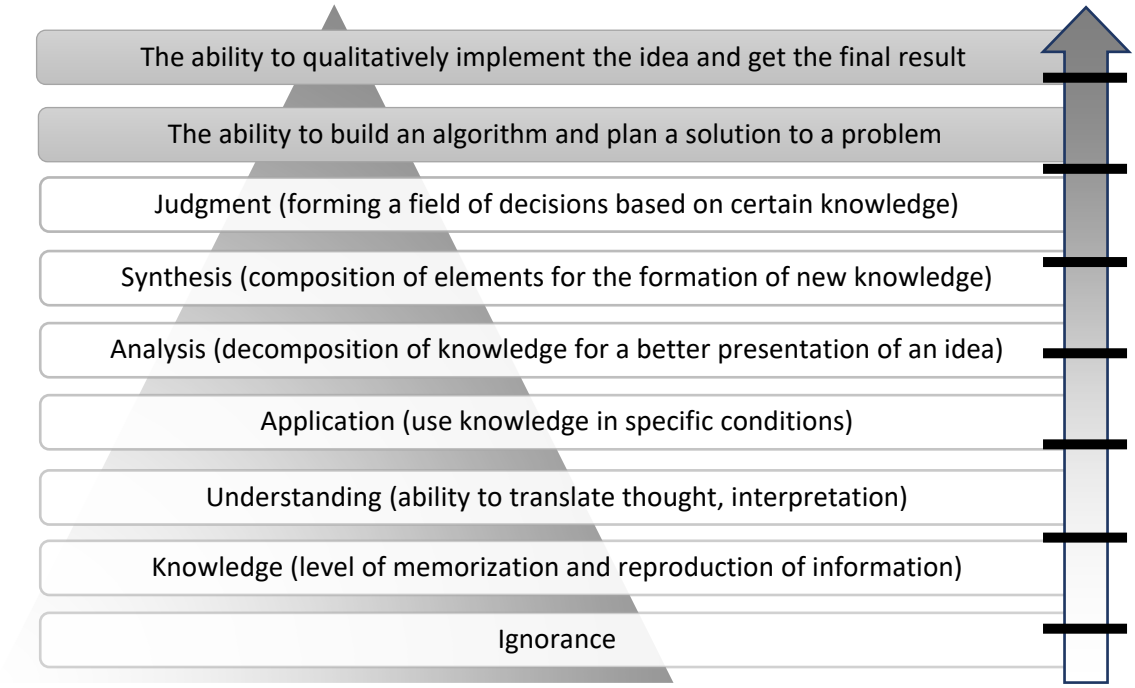

Figure 13: The student's knowledge assessment scale

In the simplest case, a student's knowledge can be displayed on certain scales. In a formalized form, the assessment of knowledge control can be represented by the formula:

$$\text{Rating: } Student \times Subject \Longrightarrow Result, \quad (1)$$

where *Rating* – the operator of the student's knowledge control results interpretation; *Student* – the student's knowledge of the main phase planes of assessment; *Subject* – constructive block of knowledge control according to the given structure of knowledge verification; $Result$ – the documented result of the student's knowledge control.

When the mapping is discrete one-dimensional, then we will get the usually integrated point estimate. An example of the presentation of the results of *Result* is the student's knowledge assessment scale. Note that the given knowledge and skills are manifested in different degrees and different combinations.

The learning process is dynamic, and the results of the learning process for each student undergo stochastic deviations in such phase planes as the student's activity, the level of knowledge assimilation, the completeness of knowledge, the depth of knowledge, and the ability to apply knowledge [38] or students have disabilities or chronic diseases [39].

Therefore, the trajectory of the educational process must be adjusted in the specified phase planes. In terms of didactic engineering, the task of managing the educational process can be formulated as maximizing the functionality that reflects the educational process:

$$F = \int_{t_0}^{T_0} f\left(x_1(t); x_2(t); x_{31}(t); x_4(t); x_5(t); y_1(x_1(t)); y_2(x_2(t)); y_3(x_3(t)); y_4(x_4(t)); y_5(x_5(t))\right) \cdot s(t)\, dt \to max, \quad (2)$$

where F – objective function learning for the student; $x_1(t)$ – the student's activity at a moment in time t; $x_2(t)$ – the level of assimilation of knowledge at the moment of time t; $x_3(t)$ – completeness of knowledge at the moment of time t; $x_4(t)$ – depth of knowledge at a moment in time t; $x_5(t)$ – the ability to apply knowledge at the moment of time t; $y_k(x_k(t))$ – adjustment function by parameter $k=1,2,3,4,5$; $s(t)$ – the weight of the impact at a moment in time t.

For modern learning conditions, when slices of knowledge are carried out at separately given moments, a simplified mathematical model can be applied:

$$F = \sum_{t=t_0}^{T_0} f\left(x_1(t); x_2(t); x_{31}(t); x_4(t); x_5(t); y_1(x_1(t)); y_2(x_2(t)); y_3(x_3(t)); y_4(x_4(t)); y_5(x_5(t))\right) \Delta s_t \to max. \quad (3)$$

The use of modeling methods allows a critical approach to the application of AI technologies, taking into account the capabilities of the educational institution, its level, and industry direction.

5.2. Model of the educational subject

Model of the educational subject represents a pedagogically adapted system of concepts about phenomena, regularities, laws, theories, methods, etc. of any field of activity with the determination of the required level of formation of those who study, a certain set of abilities and skills. The main conceptual approaches to building a model of an educational discipline can be a semantic model of an educational discipline in a convenient form for comprehension; a quality system for the presentation of teaching and methodical materials; a toolkit for presenting teaching and methodical materials in a digital environment; the mechanism for controlling the conduct of control classes (exams), etc.

Let's consider the model of the educational discipline from the standpoint of performing control classes, taking into account the adaptability of the knowledge control mechanism. The use of AI technologies is due to the need to eliminate such negative features of automated control as the subjectivity of knowledge assessment due to the pattern of developed test tasks, as well as due to non-compliance with ethical rules, and academic dishonesty of students. A comparison of different methods of assessing student performance using AI technologies is given in Table 1.

Table 1

Comparison of methods of assessing student performance using AI technologies

	Control method	The result of the assessment	The time of the event	Assessment of adaptability of models (high, medium, low, absent)		
				educational process	educational subject	student
1	Strict test sequence	discrete	Defined periodic	absent	absent	absent
2	A random sampling of tests	discrete	Defined periodic	absent	absent	absent
3	Combined method taking into account the educational subject model parameters	discrete	Defined periodic	low	low	low
4	Random sampling taking into account of the model of student parameters	structured	Random periodic	low	low	medium
5	Control based on the student's answers	structured	Random periodic	low	medium	medium
6	Control based on the educational material model	structured	Permanent discrete	medium	medium	medium
7	Modular rating method	structured	Permanent discrete	medium	medium	medium
8	Control by a model of the student	historical structured	During training	medium	high	high
9	Control by a model of the student and the educational material	historical structured	During training	high	high	high

The choice of a specific control model depends on the educational institution's ability to ensure the required level of adaptability and flexibility of the corresponding automated knowledge control system due to AI technologies. A similar approach with other relevant parameters can be applied to other components of the educational discipline model.

5.3. Model of the educational process

The modern model of the educational process can be represented as a set of interconnected automated information systems with implemented AI technologies (Table 2).

Table 2
Algorithmic functional filling of the educational process model

Automated information system	Functional direction	AI technologies	Current state	Forecast for 5 years
Support of the educational institution's infrastructure	Development, placement, and support of infrastructural resources (educational materials and documents), as well as providing educational, social, and psychological support, ensuring students' access to electronic communication channels	LMS + *Big Data*	4.5	5.3
Planning of university's activities	Planning of educational processes at the university level, taking into account the student's choice of field of study. The further development of universities will allow choosing not only disciplines, teachers, and schedules, but also changing the educational institution	LMS + *DL, Data Science*	3.5	4.9
Operational support of educational processes	Support of a consistent and continuous trajectory of student learning, organization of current training sessions, control measures, determination of student performance evaluation systems	LMS + PL, *DL,* CV, *Data Science*	3.4	4.5
Documentation of student training	Documented support of the student, full reflection of the student's academic and non-academic records based on academic transcripts of educational organizations or certificates, including (Massive Open Online Course (MOOS)	LMS + PL, *Big Data*	7.2	8.3
Development of educational programs and their information content	Development, approval, monitoring, and updating of educational programs, curricula, and their linking in a logical sequence. Preparation of educational materials	LMS + PL	6.7	7.4
Support of personnel potential	Support for the mechanisms of transparent and competitive involvement of teaching staff and control over compliance with academic ethics	LMS + PL, *DL, Data Science, Big Data*	5.1	7.1
Support for distance learning technologies	Support and improvement of distance learning technologies, development of software and hardware for teachers and students	LMS + PL, *Gamification,* CV	7.3	7.7
Carrying out control measures	Organization of control measures to assess students' knowledge (identity verification, monitoring of student behavior, etc.)	LMS + PL, CV	5.8	6.6
Support for individual work	Supporting the work of advisory centers, providing access to educational and methodological materials	LMS + *DL,* CV	4.8	5.5

The effectiveness of the educational process model can be represented by the formula:

$$I = \sum_{k=1}^{9} \alpha_k \mathrm{Y}_k(x_1; x_2; x_3; \dots x_n), \quad (4)$$

where I – an integral indicator of the efficiency of the educational process model; Y_k – a calculated value of the efficiency of the implementation of the AI technology k; a_k – the weight of the function k; $x_1; x_2; x_3; \dots x_n$ – AI technologies used.

6. Discussions

The relevance of radical transformations in educational processes is primarily due to changes in requirements for employees. These changes can be interpreted as a transfer of emphasis from static knowledge within the framework of stability of operating conditions to the ability to creative work with constant improvement of qualifications or even professional reorientation [40]. It is possible to state the actualization of preparation for working in a group [41; 42], the ability to communicate

effectively [43], and professional competence. The spread of the developmental approach in professional education and the expansion of the use of AI are obvious.

The mass emergence of innovative digital educational tools affects and transforms all areas of the education system, which, as a result of technological changes, is undergoing an academic revolution. Traditional studies in the field of education got additional opportunities. Both in Ukraine and abroad, it has become quite natural to use distance learning systems that provide the organization and conduct of classes provided by educational processes, and access to prepared specialized electronic sources of information. We emphasize that this use of innovative AI technologies ensures the achievement of the fourth global goal of sustainable development [44], adopted by the leaders of the UN member states at the 70th session of the UN General Assembly in September 2015 "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all".

The real implementation of AI technologies should be based not only on specific realities but also take into account development trends. The use of these technologies is primarily determined by the level of their implementation in human activity. It is appropriate to indicate three generally accepted levels of development of AI technologies [10; 11; 23; 26]:

- Artificial Narrow Intelligence (ANI) in education is characterized by the permanent and spontaneous application of various autonomous household AI technologies (for example, text recognition). In the future, these technologies were improved and mechanisms of individual adjustment within the framework of the local office were built into them. Technologies of this level are not capable of automatic customization or self-development.
- Artificial General Intelligence (AGI) in education covers AI technology that replaces the knowledge of a specialist tutor. Working with the end user involves taking into account his/her condition, potential, limitations on cooperation in time and space, etc. Such AI technologies are capable of improvement using self-development algorithms built into them.
- Artificial Super Intelligence (ASI) involves the formation of an eco-educational environment for the educational training of the user, which is oriented toward lifelong learning. The use of such a level of intelligence will dramatically increase their educational efficiency. However, the emergence of the consciousness of AI technologies causes additional risks (for example, the ethical plan of equating computer self-awareness with a person).

The proposed model of educational process organizing using AI elements can be applied under the following conditions:

- availability of qualitative and quantitative data. The model requires a complex of relevant and reliable data about students studying, information about their progress and answers to tasks, educational programs, educational materials, pedagogical methods, etc.;
- availability of appropriate information and technical infrastructure. Working with the model requires appropriate information and technical infrastructure, including computing power and software that can ensure the optimal operation of the model;
- compliance with ethical and legal standards. When applying the model of organizing educational processes, it is necessary to observe ethical and legal standards, especially taking into account the privacy of the data of students and other participants of the educational process;
- availability of AI specialists. Experts in AI and machine learning are needed to develop and apply the model. They must have the appropriate knowledge and experience to develop, train and organize educational processes in higher education institutions.

The advantages of the proposed model of educational process organizing using AI elements compared to traditional models proposed by other scientists [45] are:

- assistance in identifying the individual needs of students and adapting the educational process to their needs and level of knowledge;
- facilitating the collection, processing, and analysis of data, which makes it possible to make more accurate forecasts and improve the organization of the learning process;
- improved tracking of student progress and reporting on academic achievement.

However, there are some potential disadvantages associated with the use of the educational process organizing model, in particular: dependence on the quality and accuracy of the data collected and processed; vulnerability to errors related to data sampling and analysis; decrease in interpersonal interaction between students and teachers; privacy and data security issues, etc.

7. Conclusions

The education system and the educational process develop concerning society and technological progress. In recent years, due to the COVID-19 pandemic and russia's aggression, the system has undergone a grandiose transformation following the rapidly changing situation.

The most promising direction in the qualitative improvement of the higher education system is the widest possible implementation of AI technologies in the information systems of universities, which is aimed at providing conditions for adaptive personalized lifelong learning. The primary task is to consolidate the assimilation of knowledge, for which it is advisable to monitor and correct the student's learning trajectory, for which the methods of predictive analytics of success and psychodiagnostic according to their "digital footprint" should be applied.

It is important to consider that the technologies of AI in education are just beginning to be applied and therefore are used fragmentarily. However, it should be expected that in the future AI will become an integral part of educational programs, and it will be impossible to present education without the participation of AI, which will control all stages of the educational process.

However, the implementation of AI technologies in educational processes is determined by the following factors:

- a wide range of modern AI technologies with different functional directions;
- development of educational information systems is a creative process that is unique for each educational institution;
- rather a complex process of implementation of new digital technologies, which often requires the transformation of educational and methodological standards;
- there is a bias toward decisions made using AI.

We should add that the cost of implementing AI technologies is quite high, and therefore their implementation projects must be well-founded. The results of this work are aimed at the development of various mechanisms for predictive justification.

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