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Application of Software Robots Using Artificial Intelligence Technologies in the Educational Process of the University

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***Abstract*—The use of artificial intelligence (AI) in education has gained interest due to its increasing application in various fields. This study explores the potential of AI-based software robots in higher education and their ability to revolutionize educational methodologies. The research purpose is to examine the positive impact of the use of software robots in educational settings. The study focuses on evaluating the prospects of expanding the use of AI-based software robots in higher education. The research uses a combination of observational techniques and practical case studies. It includes an experimental investigation of the basic principles of developing an AI-based robot teacher, with the aim of eventually implementing it in educational processes. The research findings indicate that integrating AI-driven software robots into university education can provide substantial benefits and significant improvements over traditional teaching models. These robots can enhance the educational process and address various developmental challenges. The study highlights the transformative impact of AI-based software robots in modernizing university education. The findings demonstrate the potential of these technologies to reshape the current higher education system.**

Keywords—Higher Educational Institution; AI-Based Teaching Tools; Robotic Systems; Informatization; Digital Transformation.

I. INTRODUCTION

The integration of artificial intelligence (AI) and robotics into education has rapidly developed, offering potential benefits for higher education. AI-powered robots provide personalized and adaptive instruction, automate administrative tasks, and gather data to optimize student outcomes [1], [2]. However, the integration of intelligent robots in higher education raises concerns regarding the human role of educators, costs, training requirements, ethics, and access [3]. As AI and robots take on more functions in higher education, institutions must evaluate how to best leverage these technologies to augment human capabilities while proactively addressing the associated challenges. Several companies, including Robolink, Movia Robotics, and Learning Robots, offer innovative AI and robotics solutions to transform education [4]. The AlphAI robot from Learning Robots is designed for teaching artificial intelligence. It combines a robot that accumulates simple and impressive learnings, a graphical interface to manipulate AI algorithms, and a pedagogy that introduces the concepts one by one [5]. Although AI has the potential to revolutionise the education industry, it is unlikely that robots will completely replace teachers. Education involves more than just the transfer of information; it is about human connection and emotional support, which AI cannot provide.

The problem of this scientific research lies in a great increase in the importance of robotization processes in the modern high school system in the angle of the spread of the positions of the "Fourth Industrial Revolution" (Industry 4.0) [6]. Today, the development of robotic technology affects all spheres of the development of the country, contributing to the solution of its key task – diversification [7], [8]. At that, application of software robots using AI technologies in the educational space is becoming increasingly important in the country's higher education system. It should be remarkable that the process of implementation software robots into the educational space of Kazakhstan is at the start of development. The country has practically no experience of using software robots in the higher education system, while it is planned to open a university to study artificial intelligence in Almaty [9]. Planning for the opening of this educational institution is dictated by the relevance of the tasks of developing a digital society in the Republic of Kazakhstan, which is due to the provisions of the Digital Kazakhstan state program adopted at the national reality. In this context, attention of the society should be paid to the preparation of the teachers and other staff of higher educational institutions of Kazakhstan for the implementation of software robots with artificial intelligence systems in the educational space, as well as the expansion of the scientific and technical base, in order to properly ensure this process.

The development of modern robotic technology is increasingly affecting new areas of application of artificial intelligence systems [10]. According to the authors, artificial intelligence robotic systems are increasingly being used in the educational sector of the country, and this concerns the development of modern intelligent robotic systems designed to solve various learning problems, as well as the creating of robotic teachers that provide effective remote studying for students of higher educational institutions. In turn, the research [11] draws attention to the fact that the improvement of scientific and industrial progress determines the need to transform the country's higher education system. In this context, artificial intelligence technologies play an important

role in developing the process of open remote learning and maintaining the standards of the higher education system at the proper level.

At the same time, a joint scientific study of the current state of implementation of artificial intelligence technologies in education [12] concluded that these technologies have significant potential to solve the problems of the modern education system. According to the authors, future education and training systems should provide students with core competencies in the field of artificial intelligence systems, including an understanding of the specifics of collecting and managing data through the use of systems of this kind, as well as skills to ensure the security and protection of personal data. For their part, in the study of the main trends in the transformation of higher education in the context of digitalization and informatization, it was noted that the introduction of digital technologies today has fully affected the system of the high school in Kazakhstan [13]. This leads to new challenges for the education system, taking into account modern trends in the application programs based on artificial intelligence in the educational sphere of modern higher educational institutions. In the scientific work about problematic sides of the use of artificial intelligence systems in developing the process of gaining high education, R. M. Zulunov and A. O. Tallavoldiev [14] note that the current phase of development of society is characterized by the urgent need to introduce artificial intelligence technologies into the educational process of a modern higher school. This requires appropriate tools and training materials, as well as professionalism of the teaching staff.

Previous studies suggest that AI has the potential to revolutionize remote learning and uphold educational standards. However, practical applications of AI-based software robots in Kazakhstan's universities remain underexplored. This research aims to bridge this gap by examining the application of such robots in Kazakhstan's university settings, offering insights to enhance teaching and learning in this evolving digital landscape.

The objective of this research is to explore the practical application of AI-based software robots in university settings, with a particular focus on their roles and benefits as robotic teachers. The study involves analyzing global instances of AI robots used in teaching, as well as designing and developing an AI robotic teacher experimentally, to evaluate their potential in enhancing the educational process. The study investigates how AI robots can address key challenges in modern university education, such as personalization and efficiency. It contextualizes the integration of these robots within Kazakhstan's higher education system, aligning with the national “Digital Kazakhstan” program. The aim is to predict the transformative effects of AI robots in Kazakhstan's universities and offer strategic insights for their effective implementation in higher education, balancing benefits and risks. This work will significantly contribute to the knowledge, perspectives, and guidance surrounding the integration of AI robots in higher education, with a particular focus on the opportunities and considerations within the Kazakh university landscape.

II. MATERIALS AND METHODS

This research study is based on combination of the method of empirical observation and the study of the existing experience of the practical application of AI-based software robots in the space of modern high education of a state university with an experimental study of the key principles of developing a robotic teacher suitable for its further use in the educational process. The experiment comprised modelling, developing and building a flow chart of a software robot, indicating the main functional units and subsystems. The research basis of this scientific work was the conclusions of the analysis of another works aimed at studying the available practical experience in using software robots with artificial intelligence in the educational space of a modern high school institutions, as well as in the educational system as a whole, at all its levels.

Empirical observation involved studying examples of AI robots used in university teaching settings over the past five years (2017-2022). This was achieved through analysis of published reports, news articles, and manufacturer documentation. Detailed observations were made of three major implementations at universities in Japan, Russia, and Japan. Data from observations and experiments were collected through note-taking, screen recording, and logging model outputs. Quantitative performance metrics were used to validate model outcomes. Qualitative feedback from demonstrations was used to identify areas for improvement. All data was synthesized to derive key insights on developing an effective AI teaching assistant. The application of the observation method and studying of the examples of practical use of software robots with artificial intelligence in the learning process of the university enabled determining the main advantages of using such devices in developing the teaching process in a higher educational organization compared to the traditional model involving the teaching staff of a university. In the context of this scientific research, observation suggests the possibility of further experimental modelling of the process of creating a robotic teacher in order to confirm and substantiate the information received. In addition, the key functions of robotic teachers with artificial intelligence used in the presentation of program disciplines were identified. The practical experience of using robotic teachers in the educational process of schools and universities was analyzed, the main positive trends in the applications of AI-based systems in the development of the process of teaching program disciplines in educational institutions were noted.

The practical application of the method of experimental modelling of design and development of a robotic teacher capable of directly participating in the educational process made it possible to develop a flow chart of a software robotic teacher based on artificial intelligence for use in the learning space of a university. The experiment was based on the analysis of a previously published scientific study by M. F. Baimukhamedov et al. [10]. The analysis enabled identifying the main expert systems, the interaction of which ensures the high efficiency of the process of functioning of a software robot. In addition, the application of these systems ensures the sequence of effective functioning of the algorithm for the

interaction of a robotic teacher with students during the educational process.

The experiment using materials from the theoretical base included the definition of the key units of the software robotic teacher model, as well as the subsystems included in these units. The criteria for the functional units were developed based on an analysis of key functions needed for a robotic teaching assistant at a university. The subsystems for each unit were derived from the technical capabilities required to execute those functions. Input from computer science experts helped refine the model design. A functional flow chart of this robot was developed during the experiment. The creation of this model flow chart involved consideration of the sequence of interaction of expert systems that ensure the effectiveness of the algorithm for the interaction of a software robot with students during the educational process, as well as the identified problems of the modern higher education sphere and the prospects for their solution through the use of artificial intelligence systems in the educational process. The goal of the experiment was to prove the fundamental possibility of creating a software robot with artificial intelligence for its use in the learning process of a higher educational organizations.

III. RESULTS

The integration of AI in education presents significant benefits as well as notable challenges. AI provides personalized learning experiences tailored to individual styles and paces, aids in content development, automates routine tasks for teachers, enhances data analysis for better insight into student performance, and provides instantaneous feedback [15], [16]. However, integrating AI into education poses certain challenges. Over-reliance on AI may hinder the development of critical thinking skills in students [17], [18]. Moreover, the ease of generating academic content using AI may lead to academic dishonesty, which raises concerns about intellectual integrity. Privacy issues also arise as the use of AI involves handling sensitive student data, which may be at risk of misuse or breach [19]. AI systems may perpetuate biases in their training data, leading to unfair educational outcomes. Additionally, ensuring equitable access to AI tools and resources remains a significant challenge, as disparities in access can exacerbate existing educational inequalities.

AI robots can be integrated into higher education curricula in various ways. Educational robots promote active engagement, problem-solving, and critical thinking among students [20], [21]. Institutions should consider integrating AI more extensively into higher education curricula to prepare learners for the new world order of AI. Academic professionals should be well-trained in artificial intelligence to provide learners with the necessary skills to handle future care concerns. When teaching AI, academics should prioritize ethics and humanity [22]. AI poses a threat to humanity without these ideals. AI and robotics have the potential to reshape higher education, prompting the need for adaptation to educate people to operate in a new economy and potentially for a different society [23], [24]. Social robots can also be used in learning to personalize student and campus services. However, the high cost of advanced robotic systems could worsen the digital divide between schools with access to resources and those without.

From 2017 to the present, there have been a number of successful experiences in the practical application of robotic teachers in the improvement of the learning process at a university. In particular, at Tokyo Nishogakusha University, a robotic teacher was used to lecture on literature. This android had a high degree of human resemblance, and its appearance was copied from the writing teacher Natsume Soseki [25].

In addition, an autonomous service robot developed by Promobot gave lectures to students of the Moscow Institute of Physics and Technology Lyceum in Dolgoprudny in 2015. The robot has its own name – Alatim. He had a full conversation with students, answered questions and joked. The robot's memory included over 100 thousand language modules, which allows it to pick up intonations and recognize emotions [26]. The robotic teacher is also able to remember those with whom he talked as well as recognize them when they meet again. This allowed the robot from Promobot to easily remember the audience, for whom he conducted the lesson in order to later check homework. The use of a robotic teacher of this kind opens up new opportunities in teaching program disciplines at a modern university, since the data collected by it have a higher degree of reliability than a questionnaire or survey of a different kind [27]. Through this experiment, the developers plan to experimentally determine how ready people are for the emergence of robots in everyday life and how effectively robots can replace people.

Since the beginning of 2019, the Ministry of Education of Japan has planned to introduce artificial intelligence robots into schools to teach English. With the successful development of this experiment, it is planned to gradually introduce robotic teachers into the learning space of a high school organizations in the future [28]. The feasibility of such innovations lies in the tasks of a lack of qualified teaching staff, since teachers require high wages, while the operation of robots is much cheaper [29]. About 230 thousand dollars has been allocated by the country's government for the implementation of this project. The country already has a positive experience of using robotic teachers in schools. In primary and secondary schools, robotic systems have already proven their effectiveness in 2018, when their use has contributed to a significant improvement in the quality of teaching English.

According Hiroshi Ishiguro, Head of the Intelligent Robotics technical laboratory at the University of Osaka (Japan), in the near future, AI-based robotic teachers will be able to successfully and permanently conduct lectures and workshops in schools and universities. At the same time, it is noted that the participation of robots in teaching the humanities and literature is especially appropriate and effective, since students are much more willing to enter into a dialogue with a robot than with an ordinary teacher [29]. In addition, robotic teachers do not experience fatigue, do not show unnecessary emotions, and can work for as long as the battery charge lasts [30]. Their main tasks include delivering lectures on specific program disciplines, ensuring quality control of the pronunciation of words in foreign languages

through a comprehensive database containing a wide range of pronunciations and intonations. They are also able to answer students' questions, assign homework and monitor the quality of its completion. In addition, these robotic educators excel at adapting tasks to each student's individual level and ability, providing a personalized learning experience.

AI-based software robots can add variety to the teaching of software disciplines at the university, making them much more interesting for students [31]. The result will be an increase in the active participation of students in the learning process, which, in turn, will positively affect growth of their professionalism [32]. The introduction of AI-based software robots in the university learning space has a number of advantages compared to the generally accepted system that involves the use of teaching staff [14], [33]. These robots allow for customized instruction at a pace that is suitable for each student, ensuring a more personalized learning experience. They can quickly identify individual educational needs and offer prompt solutions to complex educational challenges. This technology also simplifies administrative processes, reducing bureaucratic hurdles within the university's educational space. Furthermore, it enables a more efficient allocation of curriculum time, improving the overall quality of the learning process. The innovations also improve the working conditions of all participants in the learning process. Swift analysis of incoming information enhances the speed and accuracy of decision-making, leading to better planning of the educational process. This planning considers the abilities and learning pace of students, ensuring a more effective and adaptive education. AI robots assist in selecting the most effective practices and techniques to improve the educational process, thereby enhancing the effectiveness of individual learning experiences.

The integration of AI robots as teaching assistants in university classrooms offers several advantages compared to traditional instructional methods. Robotic teachers provide personalized and adaptive learning by customizing teaching to individual student needs and abilities. In contrast, human instructors in large lecture-style classes face difficulties in tailoring their teaching. AI robots are also not limited by fixed time durations, enabling continuous learning. Students can access robotic tutors outside regular class hours. In addition, automated data collection and analysis by AI systems allows for data-driven improvements in teaching practices and resource allocation.

Table I presents the main problems of education at a modern university and options for solving them through the application of software robots with AI.

AI grading bots can help alleviate the heavy workload on lecturers in assessing assignments and exams. The literature and experimental models demonstrate that AI robots have the potential to transform higher education by enhancing personalization, expanding access, optimizing processes, and improving analytics. ChatGPT and other emerging AI systems demonstrate the potential for AI robots to deliver customized learning content, provide interactive teaching, and automate administrative tasks, complementing human instructors. The thoughtful integration of these technologies can improve the quality, engagement, and equity of higher education.

TABLE I. MAIN PROBLEMS OF EDUCATION IN A MODERN UNIVERSITY AND OPTIONS FOR THEIR SOLUTION [14], [34]

Problem	Possible Solutions
Presence of generally accepted educational standards that are not adapted to the needs of participants in the learning process	Development and implementation of personalized AI-based learning systems
Time limits of the educational process	Personalized virtual teachers with unlimited time access
Impossibility of covering all the issues that arise among the participants in the educational process	Virtual assistants from among software robots
Difficulties in personal contact with the teacher due to the large number of students	Ability to quickly respond to all emerging questions through communication in a chat bot
Selection of the best students in study groups	Ability to apply AI to selection with criteria based on multiple input parameters
High dropout rate of students during the educational process	Using artificial intelligence technologies to analyze the mood of a classroom
Difficulties with weeding out learning skills	Application of AI allows the introduction of effective parameters for monitoring student progress, taking into account all potentially achievable skills.
Difficulties with the analysis of the effectiveness of the educational process	Expanding the range of learning analytics, providing timely data on student progress, difficulty and needs, that can be used to create learning experiences
The need for teachers to spend time on paperwork regarding the organization of the educational process	Ability to apply AI as an intelligent server to store and sort all the necessary educational information.
The need to develop and implement a test approach to assessing students' knowledge	Using AI to analyze the level of knowledge of students and assess the quality of mastering the educational material
Generation of new ideas that are difficult to separate from baseline estimates	AI can be used to analyze existing sources of information in order to compare them, which contributes to the search for new ideas for better understanding

Creation of the structure of a robotic teacher requires developing an effective process of interaction between the main expert systems [10], [35]. These include a problem-solving expert system in the relevant academic field, a system for effective management of the educational process, and a system for assessing student knowledge through tests. The complex practical application of the mentioned expert systems determines the development of a software algorithm for the interaction of this robot with students [36].

This interaction involves several elements, including organizing remote video and audio conferences using tools such as Zoom and GetCourse platforms, presenting material in the language of the audience with voice communication capabilities, and using instant messengers such as Telegram, Viber, and WhatsApp for feedback. After the presentations, students can ask questions, which are addressed using voice and visual communication systems. The robotic teacher manages the learning sequence through a speech definition program [37], [38]. This program analyses the received information on a specific discipline, selects relevant answers from the robot's knowledge base, and transmits them in voice

format. The interaction between the robotic teacher and students is dynamic, adapting to the number of questions and lecture materials. This algorithm is repeated as necessary.

Currently, the development of teaching robots and their implementation in the university learning space is among the most important areas of studying in the field of technologies based on artificial intelligence and robotics [39]. The expansion of the use of software automatic teachers in higher education institutions will lead to large-scale transformations in the field of higher education and will contribute to the changes in the level of teaching in almost all university academic disciplines and forms of education [40]. Fig. 1 shows a flow chart of a software AI-based teaching robot for use in a university learning environment.

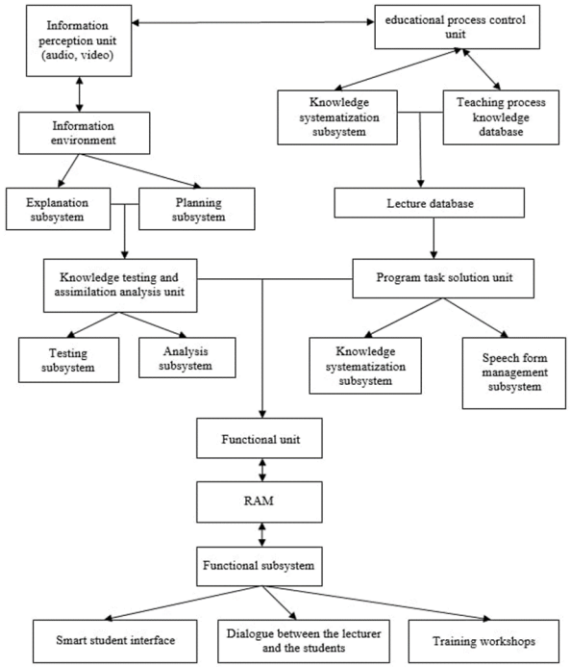

Fig. 1. Flow chart of a software AI-based teaching robot for application in the learning space of a university [10], [41]

The flow chart shows the operation of a robotic teacher used in university curricula, highlighting its integral components. It starts with the information perception unit, which records relevant information for specific program disciplines, receiving content in video or audio formats. Then, the educational process control unit takes over, organizing knowledge within the scope of the program discipline and correlating it with models for presenting lecture material. Following the program disciplines, the knowledge testing and assimilation analysis unit collects data on students' absorption of the material and evaluates the overall effectiveness of their learning. The program task solution unit is responsible for organizing knowledge related to program discipline assimilation and overseeing speech functions to ensure high-quality material presentation.

The information perception unit has its own information environment, which is based on the explanatory subsystem and the planning subsystem. All incoming information constituting the program material within the framework of a separate academic discipline is identified and prepared for presentation within the framework of lectures. The educational process control unit includes a knowledge systematization subsystem and a knowledge base about the teaching process. All program information is systematized according to the relevant sections and distributed in accordance with the main program sections of the academic discipline. The knowledge testing and assimilation analysis unit includes subsystems of the same name. They perform the functions of checking the level of knowledge of the educational audience and storing information about the degree of assimilation of the program discipline. The program task solution unit includes subsystems for systematizing knowledge and managing speech forms. They perform the functions of correcting the process of teaching program disciplines, taking into account various options for presenting parts of program material.

The "Digital Kazakhstan" government program was approved by the Decree of the Government of the Republic of Kazakhstan No. 827 "On Approval of the "Digital Kazakhstan" State Program" [42]. The use of software robots with artificial intelligence in the educational sphere of a university meets the declared objectives of this program in the field of increasing the digital literacy of the population and creating conditions for high-quality training of specialists in various areas of the situation in the economy of the country. Further expansion of the range of application of software robots in the educational space of a modern university can make fundamental changes in the planning of the learning process of a higher educational organization and the higher education system of the Republic of Kazakhstan in general. This will contribute to the development of the digital transformation of education [43], which will allow each student to achieve the necessary results through personalized learning using artificial intelligence technologies.

The results clearly demonstrate the significant benefits intelligent robots can provide in higher education settings while also highlighting important considerations regarding effective and ethical integration. The observed implementations and literature review reveal AI robots excel at delivering personalized and interactive instruction, automating administrative tasks, and collecting learning analytics. The experimental model further confirms the technical viability of AI teaching assistants. However, concerns related to costs, training, biases, privacy, and dehumanization underscore the need for policies and practices that ensure robots enhance human capabilities and access. Thus, the results provide a nuanced understanding of how higher education institutions can harness the advantages of AI robots while proactively addressing their challenges through holistic strategies.

IV. DISCUSSION

The discussion of the results in relation to previous scholarly works reveals strong concordance as well as opportunities for further expansion regarding the integration of AI-powered software robots in higher education.

In a scientific study of the role of digital innovations in fundamental organizational changes, D. A. Skog [44] draws attention to the fact that modern large-scale digitalization significantly changes the business and technological environment, presenting new opportunities for the

implementation of current tasks. According to calculations, the usage of robots with artificial intelligence in the educational space of higher educational institutions opens up additional opportunities for improving the educational process, since it allows introducing changes to it as the robotic systems improve. The opinion of the scientist demonstrates results obtained in this scientific research in the context of the prospects for improving the educational process of a modern university through the modernization of the robots applied.

In a joint scientific study of key trends in design and change of robots, the team of scientists represented by H. Mahdi and other researchers [45], note that there have been no systematic assessments of the activities of social robots in the last two decades. According to scientists, due to the fact that social robotics is a relatively new area of scientific research, the issues of practical application of artificial intelligence systems in the educational space of modern high school institutions have not been studied enough, which opens up additional opportunities for studying the prospects for the use of software robots in modern higher education. The findings of the researchers significantly expand the understanding of the availability of additional opportunities for studying software robots in the education system due to the presence of a sufficient number of scientific publications on the practical systems of artificial intelligence in the higher education structure.

In turn, in a scientific study of the prospects for the development and implementation of a navigation system for androids [46], it was noted that the development of software robots with artificial intelligence requires the creation of autonomous navigation in a complex environment with a distribution of roles, which, in turn, implies the need to adapt these systems to social rules and regulations. With regard to robotic systems based on artificial intelligence, functioning in the educational space of a modern university, this means the planning of their actions, taking into account the concepts and personal spaces of interaction, including combinations of human-robot, human-human or human-object. The statements of the scientists are fully consistent with the results that were gained in this scientific study while revealing additional prospects for conducting scientific work in the direction of studying the possibilities of adapting social robotic systems to changes in the external conditions of interaction.

For their part, in joint scientific research to assess the impact of educational robotics on the technical and social skills of higher education learners, as well as their attitude to science in general, M. Kandlhofer and G. Steinbauer [47] draw attention to the fact that there has been an increase in the interest of the students in robotics in the last few decades. According to the authors, the usage of robots based on artificial intelligence in modern higher education institutions will increase the motivation of students, which will positively affect the quality of their mastering of program disciplines. Conclusions of the scientists do not contradict the results of this scientific research, expanding it in the sphere of assessing the impact of software robots on students' interest in the learning system.

At the same time, in a scientific paper devoted to the study of multi-agent robotic interaction systems, the scientists [48] note that research on human-robot interaction (HRI) in the past few decades has contributed to the active introduction of robots into human space. At the same time, attention is paid to the fact that there is a change in the trend of this interaction in the learning sphere of higher educational institutions due to the gradual assimilation by robots of a whole range of functions characteristic of teachers, which inevitably entails the transformation of the interaction between a robot and a person in the educational space [49]. The results of the authors are fully confirmed by the results gained in this scientific research, while affecting the actual problematic aspects of the prospects for transforming the interaction of the robotic teacher with students during the educational process.

In a joint study, the team of scientists [50] addressed the usage of robotics during the COVID-19 pandemic. According to scientists, the pandemic has demonstrated significant benefits of using software robots with artificial intelligence in the development the educational process in an educational institution during remote learning. The conclusions of scientists correlate with the results obtained in this scientific work, in the context of evaluating the effectiveness of the practical significance of software robots in the development of remote learning sessions.

Integrating AI robots into higher education curriculum presents several challenges. One of the main obstacles is the high cost of implementation, including the purchase and maintenance of the robots. Another challenge is the limited training schemes for teachers and professionals in developing AI competencies [51]. Besides, ethical implications of AI must be considered in the development and implementation of programs. Privacy concerns may arise when AI is used for surveillance or tracking in school education [52], [53]. AI and robotics have been researched for decades, and there are already mature applications, making it difficult to fully understand their potential implications for higher education. It is crucial to prioritize ethics and humanity when teaching AI, as it poses a threat to humanity without these values. To address the challenges of integrating AI robots into higher education curricula, institutions can take several steps. Firstly, institutions should extensively integrate AI into higher education curricula to prepare learners for the new world order of AI [54]. Secondly, academic professionals should be well-trained in artificial intelligence to equip learners with the necessary skills to handle future care concerns [55]. Thirdly, institutions should ensure that AI serves humanity rather than dehumanizing it. Fourthly, institutions should prioritize ethics and humanity when teaching AI, as AI poses a threat to humanity without these values. Fifthly, institutions should explore ways to harness the potential of AI to automate administrative tasks and improve efficiency. Finally, institutions should take into account the privacy concerns that may arise when implementing AI surveillance or tracking in school education [56].

The integration of artificial intelligence in STEM education has the potential to transform learning experiences through personalized and adaptive instruction, customized learning pathways, enhanced teacher efficiency, increased

accessibility and collaboration, data-driven interventions, and alignment with emerging career landscapes [57], [58]. AI-powered systems can offer personalized support and guidance to each student based on their individual needs and strengths. This includes breaking down complex concepts and delivering content in a style that suits their learning preferences [59]. By automating repetitive administrative and evaluative tasks, AI frees up teachers' time to focus on high-value creative instruction and mentorship [60]. In addition, features such as text-to-speech can promote inclusivity by making content accessible to a wider range of learners [61]. However, to realize these benefits, it is necessary to overcome several challenges, such as inadequate teacher training, biased algorithms, privacy risks, ethical implications, and disruption of traditional educator roles. Therefore, thoughtful policies and practices are required to develop teacher fluency in AI applications, audit algorithms for fairness, implement data protections, prioritize human connections, and evaluate when automation may compromise learning objectives [62]. The capabilities of AI to increase personalization, efficiency, collaboration and innovation make its integration in STEM education worthwhile. However, it is important to ensure that this integration is done in an equitable, transparent and prosocial manner to avoid any negative consequences.

In a scientific study aimed to the research of the classification of the quality of lesson plans using software robots in the learning space of a modern university, the authors [63] note that planning a lesson with the participation of AI-based robots requires paying attention to the specifics of this kind of teaching, in particular, the response of participants in the learning process and their ability to assimilate program material. If necessary, changes should be made to the educational process in a timely manner that can improve the quality of students' perception of program material [64]. The viewpoints of the researchers are consistent with the results obtained in this scientific work, while drawing attention to the need for further study of trends in improving the quality of students' learning of program material through the use of robots with artificial intelligence.

The topic is developed by S. Atmatzidou and S. Demetriadis [65] in a joint scientific paper, which considered the basic principles of developing students' computational thinking skills with the help of educational robotics. According to scientists, robotics in the field of education is an effective and flexible learning tool that contributes to the development of students' skills in programming and managing the educational process. The development of computational thinking of students of a modern university, in relation to conducting training sessions using software robots with artificial intelligence, is one of the most important tasks of the modern higher education system [66]. The results of scientists expand the results of this scientific research in terms of assessing the role of robots with artificial intelligence in the development of programming skills of students of modern universities.

In a scientific paper devoted to the study of the problematic aspects of the use of artificial intelligence technologies in the modern system of higher education, Y. Wang [67] notes that artificial intelligence is one of the varieties of computerized system algorithms, the principle of which, in terms making decisions, is similar to human intelligence. For this reason, when using AI-based software robots, when building the educational process of a modern university, the peculiarities of the perception of program disciplines by both individual students and entire educational groups should be taken into account [68], [69]. The conclusions made and formulated by the researcher expand the results obtained in this scientific paper in the context of assessing the need to take into account the peculiarities of students' perception of program disciplines, for the study of which software robots with AI are involved.

Consonance and vivid confirmation of the idea proposed by the author in the article is the explosive popularity of the ChatGPT system. ChatGPT is a neural network implemented as an artificial intelligence chatbot created by OpenAI and able to function in a conversational mode that supports queries in a variety of languages [70]. ChatGPT was launched on November 30, 2022 and attracted attention with a wide variety of features: the ability to translate text in a timely manner and with high quality, get correct answers to questions, and use the context of the dialogue for answers, although its real accuracy was in doubt. In early February 2023, Reuters, citing the Swiss holding UBS, informed the public that the audience of active ChatGPT users reached 100 million people in 2 months. This application has set an unexpected record for the rate of increase in users [71].

Integrating Chat GPT into educational settings has transformative potential, primarily through its capacity to facilitate personalized learning experiences as Chat tailors its responses by analyzing individual learning patterns, thereby enhancing engagement and effectiveness in education. It is a useful tool for immersive language learning, enabling students to practice and improve their language skills through interactive dialogues. Instant feedback enhances their learning curve [72]. Additionally, it plays a significant role as a virtual teaching assistant in promoting accessibility by providing immediate assistance and clarification to students, including those with disabilities [73]. In the field of administrative tasks, Chat GPT's capacity to aid in automated grading is a benefit for educators. This streamlines the assessment process and provides timely feedback, freeing up teachers to focus on more nuanced educational roles. Furthermore, its ability to generate high-quality educational content, including lectures and study materials, represents a significant time-saving advantage. In addition to delivering content, Chat GPT also fosters the development of critical thinking and analytical skills among students by prompting them to scrutinize information and seek deeper understanding [74]. However, integrating such technology is not without challenges; concerns such as overreliance on technology and the risk of academic dishonesty are significant. To navigate these challenges effectively, educators must strike a delicate balance. They should ensure that Chat GPT is used in a way that safeguards its educational integrity and enhances the learning experience, rather than detracting from it. This balanced approach is crucial in harnessing the full potential of AI in education, mitigating risks while maximizing benefits [75].

In fact, ChatGPT is a software robot-professor, whose knowledge is not limited to one academic subject in one particular subject area (academic discipline). This opens up wide opportunities for the implementation of software robotic teachers in specific disciplines of the humanities and technical profile, because the scope of one academic discipline is much less than the available knowledge in the ChatGPT system, which means they (robotic teachers) can be more accurate, faster, with more complete knowledge databases [76]. The emergence of such artificial intelligence systems and control over their use for the purpose of teaching students is a positive step in the development of the educational model of higher education. This motivates professionals to develop curricula that focus on understanding and evaluating information rather than memorizing it. This is a more correct paradigm, where the educational result will be supported by knowledge [77], [78], [79], [80].

The findings align with and build upon recent scholarly discussions regarding opportunities and risks arising from the integration of AI robots in education. The observed advantages for adaptive learning, task automation, and data analysis corroborate results of previous studies exploring the pedagogical applications of robotic technologies. The experimental model also reinforces prior technical implementations of AI teaching assistants. However, the concerns raised echo ongoing debates regarding the need to carefully evaluate the social and ethical implications of automation and AI in education. The results contribute novel evidence and perspectives to these conversations through an in-depth investigation of AI robot integration in higher education specifically. This work synthesizes complementary insights from real-world observations, literature analysis, and hands-on modeling to inform policies and practices to maximize the benefits of AI robots while minimizing risks.

The integration of AI-powered software robots presents significant opportunities to enhance teaching and learning in higher education. However, this research has limitations that provide avenues for future studies. Firstly, as AI technology continues to advance rapidly, findings from current implementations may quickly become outdated. Therefore, further research is needed to continually evaluate emerging AI capabilities applicable to education. This study was limited to modelling a software-based robotic teacher. Future work could involve developing and testing physical robot prototypes tailored for classroom environments.

V. CONCLUSIONS

To date, considerable experience has been accumulated in the practical application of software robots with artificial intelligence in the learning space of higher educational institutions in various countries. This experience clearly demonstrates the capabilities of robotic systems of this kind in the development of the educational process, as well as indicates the significant advantages of using robots in the educational space of the university, compared with the typical learning model in higher education.

The expansion of the range of application of AI-based software robots in the learning space of a modern university can eventually lead to fundamental changes in the higher education of the Kazakhstan. One of the options for transformations of a similar kind could be the gradual closure of higher educational institutions in the country that have insufficient pedagogical, scientific and technical potential, as well as with a weak material base that does not correspond to the realities of today. In addition, the largest universities can be reformed over time into fully robotic educational institutions of an open type, fully implementing the remote learning model, which does not require the participation of the teaching staff in the same volume and in the same format of interaction. Improving the learning process at universities, in which software robots with artificial intelligence will be widely used in the development of the educational process, can be oriented towards the training of specialists in specialties that will become most in demand in the future. In general, the use of software robots with artificial intelligence in the system of higher education can significantly increase the level of teaching program disciplines and open up additional opportunities for improving the professional competencies of university graduates.

Prospects for subsequent scientific research in the sphere of application of software robots based on artificial intelligence in the space of a modern university are determined by the further expansion of the range of application of AI in the educational field and the associated need to evaluate the effectiveness of the practical application of various models of software robots to effectively solve the problems of the development of an educational process in a higher educational institution.

Further extensive trials are necessary to quantify the effects of AI robots on metrics such as student performance, engagement, and satisfaction across various subjects, student demographics, and classroom settings. Research partnerships with schools and universities to run pilot programs would generate rich data sets for analysis. There is also a need for more research into the social, ethical and legal implications of AI robot teachers in order to formulate policies that maintain the quality and integrity of education. Investigating teacher and student attitudes through surveys and interviews could provide valuable insights into developing collaborative instructional models between humans and AI.

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