USE OF VIRTUAL AND AUGMENTED REALITY IN TEACHING ENGINEERING DISCIPLINES

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ABSTRACT

The integration of information technology (IT) into the educational process of engineering specialties in higher education institutions is a key area of development of modern education. The introduction of IT helps to improve the efficiency of training through the use of interactive and digital tools, such as learning management systems, virtual laboratories, simulations and online courses. These technologies improve the perception of complex engineering disciplines, improve the quality of training specialists and provide deeper practical training. An important aspect is the development of digital competence of students, which facilitates adaptation to the rapidly changing requirements of the labor market.

Keywords: Information Technology (IT), Engineering Education, Virtual Laboratories, Computer Aided Design (CAD), Educational Technologies, Electronic Learning (E-learning), Online Learning, Mobile Learning (M-learning), Digital Transformation of Education.

INTRODUCTION

Modern society is characterized by the rapid development of information technology, which has a significant impact on various spheres of activity, including education. The integration of information technology (IT) into the educational process has become one of the key trends in the education of future engineers, as it allows to significantly improve the quality of education by making it more flexible, interactive and accessible. Computer-aided design (CAD) systems, virtual laboratories, simulators, and e-learning platforms are already actively used to train engineering students. These technologies provide not only theoretical training but also practical application of knowledge, which is an important element of engineering education. Virtual laboratories and simulations, for example, allow students to conduct experiments and simulate various technical processes, enabling them to deepen their understanding of complex technical concepts without the need for access to expensive equipment. The global digitalization of the engineering profession places new demands on the ability to work with modern technological tools and software. Accordingly, education should evolve towards the introduction of these technologies to prepare students for future professional challenges [6]. The use of IT helps to adapt the educational process to changes in the technological environment, improving the quality of graduates' training. The aim of this study is to investigate the processes of IT integration into the educational process of engineering specialties, analyze their impact on students' learning outcomes and motivation, and identify the main barriers and prospects of their use. The introduction of IT into the educational process opens new opportunities for students, but requires a comprehensive approach, including teacher training, modernization of educational infrastructure and development of new pedagogical methods.

LITERATURE AND METHOD (LITERATURE REVIEW)

“Integration of Information Technology in Engineering Education Process” can be conducted using various methods that will help to study the impact and effectiveness of information technology (IT) implementation in the educational process. Here are some possible approaches:

Publications by leading researchers such as Gail Fuller, Karen Robinson and other scholars in journals like "Journal of Engineering Education", "IEEE Transactions on Education", "International Journal of Educational Technology in Higher Education" emphasizes important milestones from the advent of spreadsheets and graphics packages in the 1970s to modern artificial intelligence, big data and simulation tools [1,2]. Numerous studies confirm that virtual labs are becoming an important tool for engineering students because they allow them to conduct experiments remotely and repeat them without additional costs, articles describing the use of virtual labs in mechanical, electrical and chemical engineering. The use of CAD systems allows students to create and test models, which helps develop design and prototyping skills. Literature emphasizes the importance of these technologies in the training of engineers. Online courses, video lectures, and learning platforms such as Coursera and Udemy are actively used in engineering education, providing access to materials anytime and anywhere allows to highlight the main directions, advantages and challenges of integrating information technology into the educational process of engineering specialties, as well as suggests ways to solve current problems [3].

The aim of this study is to develop and substantiate methodological approaches and technologies that promote effective integration of information technologies (IT) in the educational process of engineering specialties in order to improve the quality of training of future engineers, their professional competencies and competitiveness in the modern labor market [4].
The main tasks to achieve the goal are:

1. Analyzing the current requirements for engineering personnel in the digital economy and identifying the key competencies necessary for effective work in high-tech industries.
2. Research of current methods and tools for using information technologies in engineering education, including online platforms, virtual laboratories, simulations and other digital solutions.
3. Development of models and methods of IT integration into the educational process aimed at improving the efficiency of theoretical knowledge assimilation and practical skills acquisition by engineering students [5,7].
4. assessment of IT impact on the quality of education and training of specialists, analysis of opportunities for personalization of learning with the help of digital educational platforms.
5. Development of recommendations for teachers on the effective use of information technologies in the process of teaching engineering disciplines, including the creation of interactive and adaptive teaching materials.
6. Assessment of the prospects of IT development and implementation in the educational programs of engineering specialties in the context of global trends and local peculiarities of the education system. The research is to create a methodological and technological base for active and effective application of information technologies in the training of engineers, which will improve the quality of engineering education and compliance of graduates with the requirements of modern digital production and technological environment.

RESULTS

Numerous studies show that the use of information technology (IT) in the educational process of engineering majors has a positive impact on students' academic performance. For example, the implementation of virtual laboratories and computer-aided design (CAD) systems promotes better understanding of theoretical concepts through hands-on assignments. In one study, students who used virtual simulations in mechanics courses performed 20% better compared

to a group that was taught without IT. Integrating IT into the learning process helps to increase students' motivation to learn. Engineering students

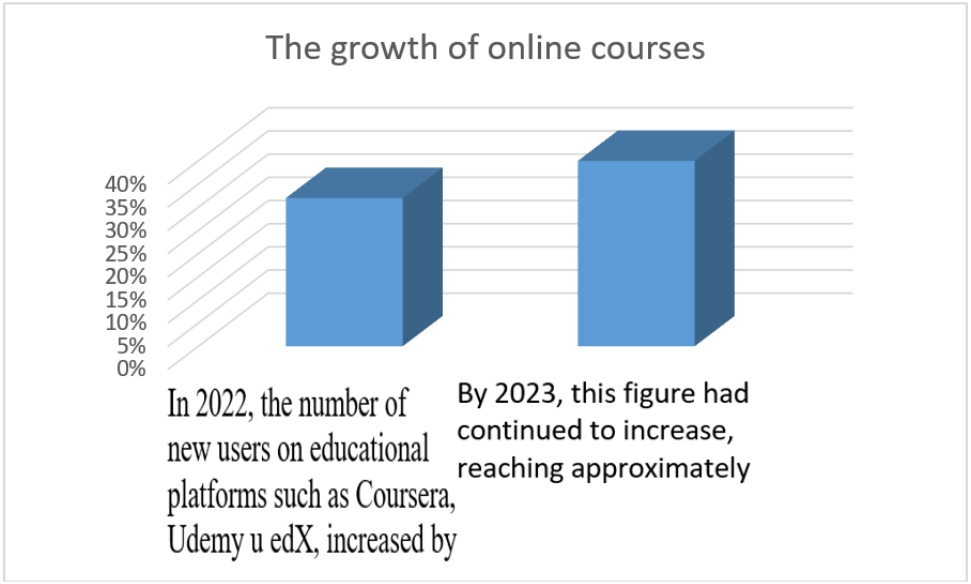
- Some students and teachers resist the introduction of new technologies due to conservative approaches or fear of new tools.
- Not all educational institutions have sufficiently developed IT infrastructure to implement virtual laboratories and other advanced technologies.

The introduction of IT forces teachers to change their approaches to teaching. Instead of traditional lectures and seminars, teachers are starting to use interactive teaching methods such as working with simulators, project work, and IT-enabled team teaching. The use of online simulators and virtual simulations in the construction technology course has better prepared students for real project work. Virtual laboratories such as LabView and others are widely used in training engineers to perform complex experiments. These technologies allow students to access laboratory facilities and conduct experiments without having to be physically present. Research papers are increasingly referring to the use of technologies such as augmented reality (AR), virtual reality (VR) and artificial intelligence

(AI) to create new forms of learning. These technologies enable the creation of deeper and more interactive learning environments that enhance learning, that the integration of information technology into engineering education has a positive impact on learning. The main benefits include improved learning outcomes, development of practical skills, increased motivation and flexibility of learning. However, there are also challenges such as technical barriers and the need for faculty development [8].

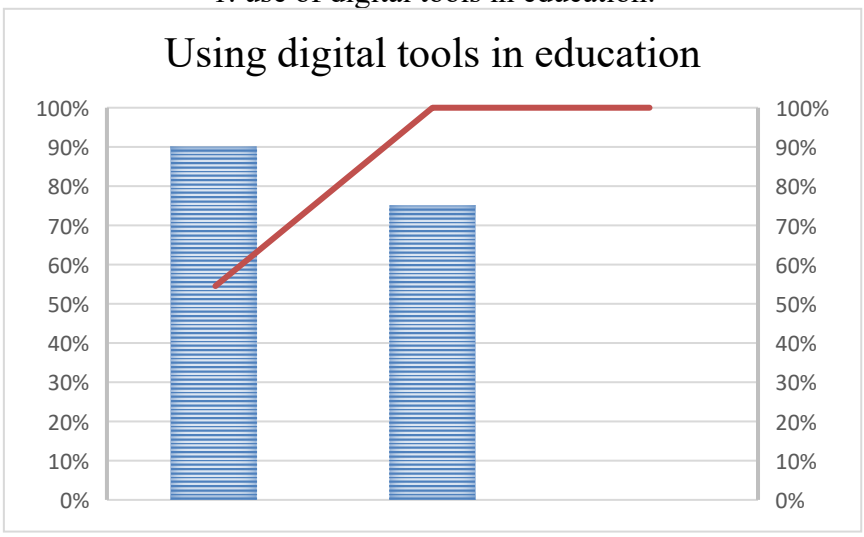
Over the past two years, accelerated access to information in educational institutions, and for engineering majors in particular, has increased dramatically due to advances in technology and online platforms. Here are the key statistics:

1. Growth of online courses:



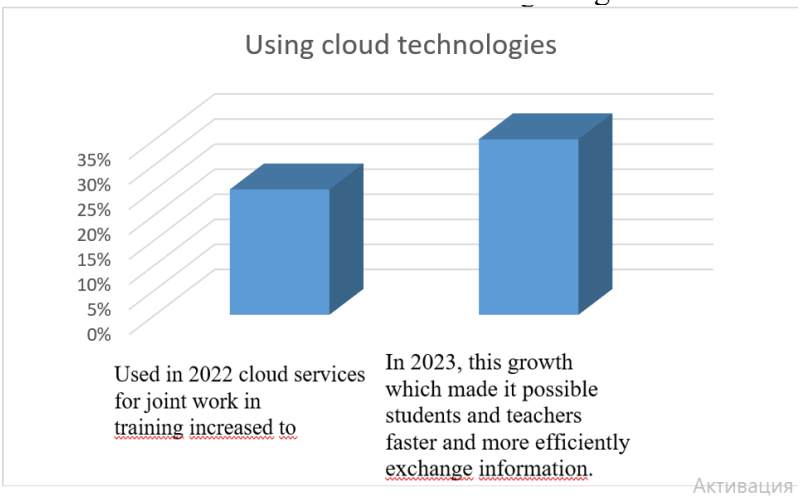
In 2022, the number of new users on educational platforms such as Coursera, Udemy and edX increased by 32%. By 2023, this continued to grow, reaching an approximate 40% increase in two years

1. use of digital tools in education:



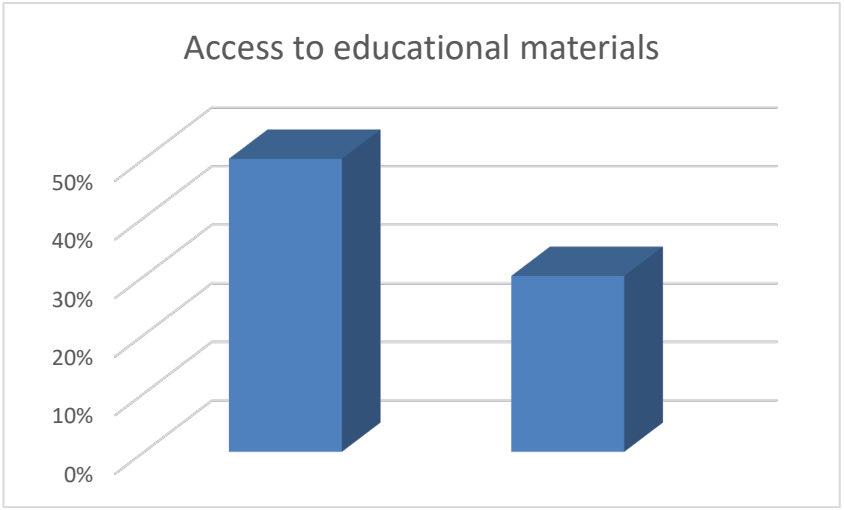
In 2023, about 90% of educational institutions have integrated digital platforms to organize the learning process (in 2021, the figure was about 75%) [9].

1. use of cloud technologies:



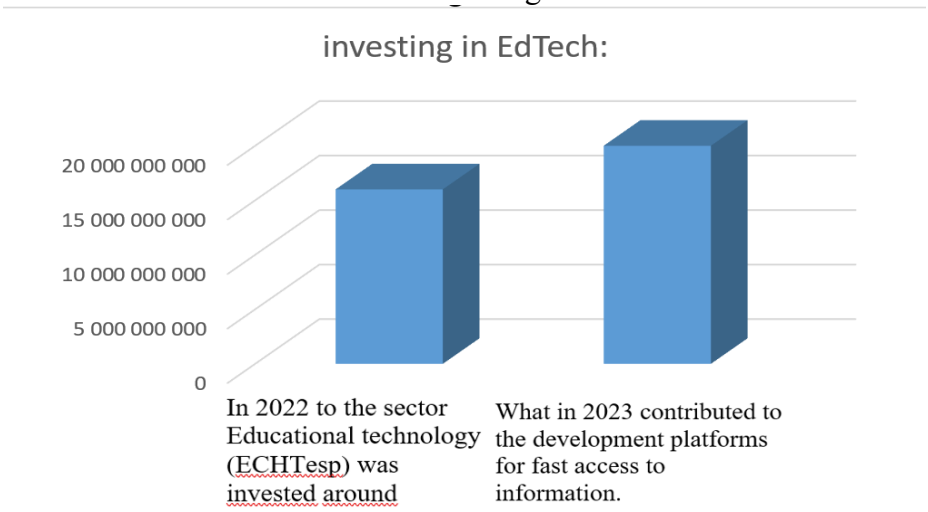
In 2022, the use of cloud services for collaborative learning grew by 25%. In 2023, this growth was already 35%, allowing students and faculty to share information faster and more efficiently.

1. Access to educational materials:



According to Google Trends, requests to access instructional materials through online libraries and databases increased by 50% between 2022 and 2023. Online libraries (e.g., JSTOR, IEEE Xplore) recorded a 30% increase in traffic over this period.

1. investing in EdTech:



In 2022, the education technology (EdTech) sector will invest about 16 billion dollars and in 2023, more than 20 billion dollars, contributing to the development of platforms for quick access to information.

These data show that over the past two years, students and teachers have gained faster and more efficient access to educational resources, which significantly accelerates learning and assimilation of information.

CONCLUSION

The use of IT in the learning process allows students to develop important practical skills that will be in demand in their future professional activities. For example, working with programs for modeling, programming, data analysis and simulation of real engineering processes helps to prepare students for real tasks in production and industry. This, in turn, makes engineering graduates more competitive in the labor market. The use of modern technologies has a positive impact on student motivation and engagement. Interactive learning resources such as online courses, game elements (gamification) and learning management systems (LMS) stimulate interest in the subject and make the learning process more flexible and accessible. Students can learn at their own pace, repeat material, and utilize additional resources for independent study, which increases engagement. However, successful implementation requires addressing technical and methodological barriers. With competent organization and adaptation of IT, engineering education can become more effective and relevant to modern challenges in science and technology.

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