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WAYS TO SOLVE THE COMPLEX PROBLEM OF INTRODUCING STEM-EDUCATION AND ARTIFICIAL INTELLIGENCE INTO THE EDUCATIONAL PROCESS AT UNIVERSITIES

Abstract. The main purpose of the article is to consider the main ways of solving the complex problem of introducing STEM-education and artificial intelligence into the educational process at universities. The ways of solving this problem discussed in the article will help universities to effectively implement STEM-education and artificial intelligence in the educational process, providing students with the necessary knowledge and skills for a successful career in these modern industries. The overall goal of all these ways is to create a favourable environment for successful learning and development of students in STEM-education and artificial intelligence that meets the requirements of the modern world. Another relevant goal of the issue under consideration is to ensure that universities are ready for the challenges of the modern world, where STEM-education (or STEM-disciplines) and artificial intelligence play an increasingly important role in providing students with high-quality and in-depth knowledge that will help them gain the necessary practical experience and relevant competencies for the labour market and competitiveness in employment.

Keywords: STEM-education, artificial intelligence, complex problem, implementation in the educational process, ways of solving, students.

Problem statement. There are several potential problems in the implementation of STEM-education and artificial intelligence in the educational process of universities, namely: lack of qualified teachers - this can be especially problematic in the case of rapidly developing technologies, where specialists with the latest and most up-to-date knowledge are needed; equipment and infrastructure – as the implementation of STEM-education and artificial intelligence may require significant investments in modern equipment and infrastructure for laboratories, computer labs and research centres, etc.

Solving all these problems may require joint efforts of university administrations, teachers, students, and research and education partners of these universities to ensure the successful implementation of STEM-education and artificial intelligence in the university environment. This thematic article is dedicated to solving all these problems.



Analysis of recent research. Today, many domestic researchers are considering the issue of introducing artificial intelligence systems into the educational process at universities. These are the following scientists and researchers: Sharov S. [1-2], Hlybovets' M. [3], Zaychenko Y. [4], Mar'yenko M. [5], Somenko D. [6], Viznyuk I. [7], Pchelyans'kyu D. [8], Burdayev V. [9], Haharin O. [10], Tytenko S. [10], Desyatov T. [11], Dovbysh A. [12], Vasyl'yev A. [12], Kravtsova N. [13], Khodakivs'ka O. [13].

And the problems and analysis of methods of implementation of STEM-education in universities for various educational programmes are actively studied by such scientists and researchers as: Barna O. [14], Balyk N. [14], Yel'nykova H. [15], Yurzhenko V. [16], Chaykovs'ka H. [17], Vesela N. [18], Vodyanyts'kyu I. [19], Dereza O. [20].

Other well-known foreign scholars who consider this topic are: Del Cerro Velazquez F, Lozano Rivas F [21]; Pahnke J., O'Donnell C., Bascope M. [22]; Campbell C., Speldewinde C. [23]; Peters-Burton E., Lynch S., Behrend T., Means B. [24]; Morris B.J., Owens W., Ellenbogen K. [25]; Carnevale A. P., Smith N., Melton M. [26]; Hess F., Kelly A., Meeks O. [27]; Annemie Struyf, Haydee De Loof, Jelle Boeve-de Pauw [28].

But given that not all the issues and problems of introducing these subject areas into the educational process at universities were covered by them, we will try to summarise and supplement this topic in this article. Therefore, its relevance is undeniable.

Formulation of the purpose of the article. The main purpose of the article is to consider the main ways of solving the complex problem of introducing STEM-education and artificial intelligence into the educational process at universities.

The main part. For those who do not know or have forgotten, we will remind you of the basic definitions: "Artificial intelligence (AI) is the science and technology of creating intelligent machines (software systems) capable of taking on certain functions of human intellectual activity (for example, choosing and making optimal decisions based on previously gained experience and rational analysis of external influences)" [1, 2].

STEM (Science, Technology, Engineering and Mathematics) is an approach to organising the learning process that combines science, technology, engineering and mathematics [14-18].

The STEM approach to education was first proposed in 2001 by scientists from the US National Science Foundation. The methodology has been actively studied in many countries, implemented in leading European schools, and is now being actively implemented in Ukraine.

STEM-education and artificial intelligence are extremely relevant for university education for a number of important reasons, namely: labour market demand, i.e. the modern labour market increasingly requires



specialists with deep knowledge in STEM-disciplines and understanding of artificial intelligence, and the constant development of technology requires qualified personnel who can work with these new tools and methods; innovation and competitiveness, i.e. STEM-education and artificial intelligence stimulate innovation in the university environment (students who receive such education

Therefore, STEM-education and artificial intelligence are not only relevant, but also critical to university education to prepare students for future challenges and opportunities.

STEM-education and artificial intelligence also affect the educational process at universities in many ways: modernity and relevance of education – the introduction of STEM-education and artificial intelligence allows universities to meet the current requirements of the labour market (and students get access to the latest technologies, methods and approaches, which prepares them for a successful career in the digital world); development of critical thinking and problem solving – STEM-education promotes the development of critical thinking, as well as analysis and problem solving skills (which allows students to effectively use the scientific method and engineering approaches to solve complex problems).

In general, STEM-education and artificial intelligence significantly enrich the educational process at universities, developing key skills and preparing students for a successful career in the modern digital world.

Teaching these topics at universities faces a number of challenges. First of all, the rapid pace of development of these areas requires constant updating of curricula and existing equipment (materials). The lack of qualified teachers is also a problem. To address these issues, it is important to engage teachers with practical experience in the field, as well as to develop professional training programmes for academic staff. In addition, cooperation with industry and academia can provide students with access to relevant knowledge and practical experience. The development of interactive teaching materials and the use of new technologies, such as virtual reality or gaming platforms, can enhance the effectiveness of their teaching. Such approaches will help to prepare qualified professionals who can meet the challenges of the modern labour market. An additional problem is the heterogeneity of the level of preparation of students studying these topics. This is a challenge for teachers, who must ensure that all students are taught effectively, regardless of their prior knowledge and familiarity with the topic. To overcome this, an individual approach to each student can be used, as well as additional classes for those who need additional help. The development of adaptive learning systems and effective knowledge control can also help to solve this problem. In general, innovative teaching approaches aimed at combining academic knowledge with practical experience and individualised learning can ensure more



effective teaching of artificial intelligence and STEM at universities. Another problem is the lack of resources to support infrastructure and laboratory workshops, especially in artificial intelligence.

This limits the opportunities for students to gain practical experience in using various tools and methods. To solve this problem, it is necessary to attract additional financial resources through cooperation with industrial partners, grant organisations, donors, etc. The development of virtual laboratories and online resources can also provide access to the necessary equipment and materials for artificial intelligence and STEM education, even in the case of limited physical resources.

The introduction of STEM-education and artificial intelligence into the educational process of universities can be a challenge, but there are several ways to solve this problem. *Here are some approaches [11-20]:*

- development of specialised programmes and courses, i.e. universities can create specialised programmes in STEM-education and artificial intelligence that include both theoretical knowledge and practical skills (these programmes can be developed in cooperation with industrial partners to ensure that materials and market requirements are up-to-date);

- Integration of existing courses, i.e. universities can also integrate elements of STEM-education and artificial intelligence into existing courses, making them more modern and relevant (e.g. including modules on programming or data analysis in courses on health, marketing, management, agronomy, etc;)

- creation of laboratories and research centres, i.e. universities can invest in the creation of specialised laboratories and research centres for artificial intelligence and STEM-disciplines (and these structures can serve as platforms for students and teachers to research new technologies and develop new methods and interactive IT teaching technologies);

- support for teachers and students, i.e. universities can provide support for teachers and students who want to study STEM-disciplines and artificial intelligence (this may include training teachers in new technologies, creating platforms for sharing knowledge and practical experience, and providing access to specialised resources and tools);

- engaging external experts and industrial partners, i.e. universities can also engage external experts and industry representatives for cooperation in STEM-education and artificial intelligence (which may include joint research projects, internships for students in high-tech companies, and other forms of cooperation).

- training of qualified teachers, i.e. universities can provide training and professional development programmes for teachers in STEM-disciplines and artificial intelligence (which may include training teachers in new technologies, teaching methods and practical skills);



- Integration into related and allied curricula (i.e., universities should develop integrated STEM-education and AI programmes that cover various aspects of different disciplines and provide students with a comprehensive approach to such learning);

- Establishment of laboratories and research centres (i.e., universities can invest in the creation of modern laboratories and research centres for artificial intelligence and STEM-disciplines (which will allow students to gain practical experience with the latest technologies and ensure a link between the educational process and real-world challenges);

- partnerships with industry (universities themselves can establish partnerships with industrial enterprises for the joint development of curricula, student internships, joint research and projects);

- creation of online courses and open resources, i.e. universities can develop and provide access to online courses and open learning resources in STEM-education and artificial intelligence (which will expand access to education and provide distance learning for a wide range of audiences);

- support for student initiatives, i.e. universities can support student initiatives in STEM-education and artificial intelligence by facilitating the creation of student clubs, interest groups, hackathons and other events.

There are also additional ways to solve the complex problem of introducing STEM-education and artificial intelligence into the educational process of universities – if the main ways described above have proved ineffective.

They include: international cooperation - universities can develop international partnerships with academic institutions and research centres to share knowledge, experience and resources in STEM-education and artificial intelligence (this will help broaden horizons for students and teachers, as well as provide access to international training and research opportunities); stimulating student research – universities can actively encourage students to participate in research projects and competitions in STEM-disciplines.

Conclusions. All these ways of solving the problem discussed in the article will help universities to effectively implement STEM-education and artificial intelligence in the educational process, providing students with the necessary knowledge and skills for a successful career in these modern fields.

The overall goal of all these ways is to create a favourable environment for successful learning and development of students in STEM-education and artificial intelligence that meets the requirements of the modern world.

Another relevant goal of the issue under consideration is to ensure that universities are ready for the challenges of the modern world, where STEM-education (or STEM-disciplines) and artificial intelligence play an



increasingly important role in providing students with high-quality and in-depth knowledge that will help them gain the necessary practical experience and relevant competencies for the labour market and competitiveness in employment.

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ШЛЯХИ ВИРІШЕННЯ КОМПЛЕКСНОЇ ПРОБЛЕМИ ВПРОВАДЖЕННЯ STEM-ОСВІТИ ТА ШТУЧНОГО ІНТЕЛЕКТУ В НАВЧАЛЬНИЙ ПРОЦЕС В УНІВЕРСИТЕТАХ

Анотація

Основною метою статті є розгляд основних шляхів вирішення комплексної проблеми впровадження STEM-освіти та штучного інтелекту в навчальний процес у ВНЗ. Існує кілька потенційних проблем у впровадженні STEM-освіти та штучного інтелекту в навчальний процес університетів, а саме: брак кваліфікованих викладачів – це може бути особливо проблематичним у випадку швидко розвиваються технологій, де фахівці з найновішими та найсучаснішими. - потрібні сучасні знання; обладнання та інфраструктура – оскільки впровадження STEM-освіти та штучного інтелекту може вимагати значних інвестицій у сучасне обладнання та інфраструктуру для лабораторій, комп'ютерних лабораторій та дослідницьких центрів тощо.

Вирішення всіх цих проблем може вимагати спільних зусиль адміністрацій університетів, викладачів, студентів, науково-освітніх партнерів цих університетів для успішного впровадження STEM-освіти та штучного інтелекту в університетське середовище. Вирішенню всіх цих проблем присвячена ця тематична стаття.

Розглянуті в статті шляхи вирішення цієї проблеми допоможуть університетам ефективно впроваджувати STEM-освіту та штучний інтелект у навчальний процес, надаючи студентам необхідні знання та навички для успішної кар'єри в цих сучасних галузях. Усі ці шляхи вирішення проблеми, розглянутої у статті, допоможуть університетам ефективно впроваджувати STEM-освіту та штучний інтелект у навчальний процес, надаючи студентам необхідні знання та навички для успішної кар'єри в цих сучасних сферах.

Загальна мета всіх цих шляхів – створити сприятливе середовище для успішного навчання та розвитку учнів у STEM-освіті та штучному інтелекті, що відповідає вимогам сучасного світу. Іншою актуальною метою питання, що розглядається, є забезпечення готовності університетів до викликів сучасного світу, де STEM-освіта (або STEM-дисципліни) та штучний інтелект відіграють дедалі важливішу роль у наданні студентам високоякісних і в -глибокі знання, які допоможуть їм отримати необхідний практичний досвід та відповідні компетенції для ринку праці та конкурентоспроможності при працевлаштуванні.

Ключові слова: STEM-освіта, штучний інтелект, комплексна проблема, впровадження в навчальний процес, шляхи вирішення, учні.