LatIA. 2025; 3:300
doi: 10.62486/latia2025300
ISSN: 3046-403X

SYSTEMATIC REVIEW

Integration of Artificial Intelligence into the Curricula of Higher Education Institutions

Integración de la Inteligencia Artificial en los Planes de Estudio de las Instituciones de Educación Superior

Iryna Zinkiv[1], Iryna Konovalova[2], Iryna Polska[3], Olena Roshchenko[4], Tetiana Rozhnova[5]

[1]Lviv Academic Department of Music Theory, Faculty of Musicology, Composition, Vocals and Conducting, National Academy of Music named after Mykola Lysenko. Lviv, Ukraine.
[2]Theory and History of Music Department, Kharkiv State Academy of Culture. Kharkiv, Ukraine.
[3]Department of the Theory and History of Music, Faculty of Music Art, Kharkiv State Academy of Culture. Kharkiv, Ukraine.
[4]Department of History of Ukrainian and Foreign Music, Performance and Musicology Faculty, Kharkiv I. Kotlyarevsky National University of Arts. Kharkiv, Ukraine.
[5]Department of Pedagogy, Administration and Special Education, State Institution of Higher Education "University of Education Management". Kyiv, Ukraine.

Cite as: G Zinkiv I, Konovalova I, Polska I, Roshchenko O, Rozhnova T. Integration of Artificial Intelligence into the Curricula of Higher Education Institutions. LatIA. 2025; 3:300. https://doi.org/10.62486/latia2025300

Submitted: 16-05-2024 **Revised:** 07-12-2024 **Accepted:** 13-08-2025 **Published:** 14-08-2025

Editor: Dr. Rubén González Vallejo

ABSTRACT

Introduction: the study explored how artificial intelligence (AI) is transforming the teaching of scientific disciplines by enabling personalized learning and simplifying the understanding of complex concepts. Particular attention was given to the role of AI tools in providing individual academic support.
Method: a qualitative analysis was conducted based on 71 publications retrieved from Google Scholar, ResearchGate, and Scopus databases. The selected sources covered theoretical and empirical research on AI implementation in higher education curricula.
Results: the findings indicated that AI technologies enhanced students' engagement with the learning material and facilitated comprehension of abstract and complex phenomena across various disciplines. However, several barriers to integration were identified. These included insufficient technical infrastructure and inadequate teacher training, both of which limited the effective use of AI tools in many higher education institutions.
Conclusions: to ensure successful AI integration into educational programmes, it is essential to establish robust technological infrastructures and develop comprehensive professional development initiatives for academic staff. When effectively implemented, AI has the potential to support individualized learning experiences and significantly influence the broader educational ecosystem by fostering the evolution of student-centered thinking.

Keywords: Integration; Artificial Intelligence; Educational Programs; Higher Education Institutions; Technologies; Individual Learning Experience; Thinking.

RESUMEN

Introducción: el estudio exploró cómo la inteligencia artificial (IA) está transformando la enseñanza de las disciplinas científicas al permitir el aprendizaje personalizado y simplificar la comprensión de conceptos complejos. Se prestó especial atención al papel de las herramientas de IA en el apoyo académico individualizado.

Método: se realizó un análisis cualitativo basado en 71 publicaciones extraídas de las bases de datos Google Scholar, ResearchGate y Scopus. Las fuentes seleccionadas abarcaban investigaciones teóricas y empíricas sobre la implementación de la IA en los planes de estudio de la educación superior.
Resultados: los resultados indicaron que las tecnologías de IA mejoraron la implicación de los estudiantes con el contenido de aprendizaje y facilitaron la comprensión de fenómenos abstractos y complejos en diversas disciplinas. Sin embargo, se identificaron varios obstáculos para su integración, como la infraestructura técnica insuficiente y la falta de formación docente adecuada, lo cual limitó el uso efectivo de estas herramientas en muchas instituciones de educación superior.
Conclusiones: para garantizar una integración exitosa de la IA en los programas educativos, es fundamental establecer infraestructuras tecnológicas sólidas y desarrollar iniciativas integrales de formación profesional para el personal académico. Cuando se implementa de manera eficaz, la IA puede apoyar experiencias de aprendizaje individualizadas e influir significativamente en el ecosistema educativo al promover una evolución del pensamiento centrado en el estudiante.

Palabras clave: Integración; Inteligencia Artificial; Programas Educativos; Instituciones de Educación Superior; Tecnología; Experiencia Educativa Individual; Pensamiento.

INTRODUCTION

Integrating artificial intelligence (AI) into higher education programmes offers significant potential for improving the quality of education. Artificial intelligence rapidly develops in various fields, including pedagogy, education management, special education, healthcare, etc. This technology mimics human cognitive functions, offering tools to personalise learning, optimise administrative tasks, improve assessment methods, create interactive learning materials, and facilitate access to distance learning.[1]

AI enables learners to receive personalised support, access innovative learning resources, and enjoy more equitable learning opportunities. Interactive modelling and deep learning technologies simplify understanding complex abstract concepts, making learning more accessible and engaging. Including computational thinking, an important problem-solving strategy, helps develop learners' analytical skills.[2]

This article discusses the latest AI technologies that, when incorporated into curricula, can improve the teaching of pedagogy, administration, and special education, as AI's capacity to adapt learning experiences based on the level and pace of each student facilitates individual progress.

Today, virtual assistants and chatbots offer constant support in completing tasks, assessing progress, and providing automatic feedback that helps teachers adjust their teaching approaches.[3] Virtual laboratories based on artificial intelligence allow for experiments without expensive physical equipment.

Artificial intelligence (AI) integration in education has evolved significantly since the 1950s.[4] The first attempts to mimic human speech with programs such as ELIZA in 1964 paved the way for more sophisticated developments.[5] In 1967, the first intelligent tutoring system, SAINT, was developed and used to teach subjects such as mathematics. These early experiments established a thriving scientific arena.[6]

The 1980s marked a turning point, with assessment tools and intelligent learning becoming a new stage in personalizing learning pathways. 2008 saw the delivery of online learning on a scale that facilitated the integration of AI into adaptive learning platforms. Significant advances in deep learning marked the 2010s. The year 2011 was marked by the creation of virtual assistants.[7] In 2014, the introduction of Generative Adversarial Networks (GANs) allowed the conception of high-quality synthetic materials such as images, video, and audio, which opened new horizons for creating learning materials. In the following years, more and more effective intelligent tutoring systems have emerged that can adapt to the individual needs of each learner.[8]

Thus, a brief overview of the history of AI development shows that, over the past century, practitioners and researchers have been enthusiastic about using new technologies.[9] Other authors argue that they have not always been effective in education.[10] N. Ashykhmina updates the prospects for the application of artificial intelligence in education, emphasising the potential for personalising learning, automating feedback and expanding access to quality educational services in the field of music training, which is relevant in the process of integrating such technologies into the curricula of higher education institutions.[11] Today, most discussions of technology in education focus on the potential of artificial intelligence, although older technologies still play an important role.[12,13] In the context of education, previous technological tools have proved useful in numerous middle-income states throughout the COVID-19 pandemic.[14]

In the framework of developing technologies such as AI,[15] describe computer-based tutors or intelligent learning systems. These systems offer learners a learning practice where the system familiarises the learner with the performance according to a model or continuous assessment, a model of the subject matter to be studied and a model of the way to learn. The models can be either complex or elementary. A study note that intelligent tutoring systems today feature digital learning games that embed learning in the context of activities that are games.[16] The degree of gamification, according to the authors, ranges from activities that

integrate learning directly into the game (which does not even look like a learning activity, such as SimCity and Civilization games) to additional understandable education doings where the learner is rewarded for their achievements. Equally helpful, especially in medical education, in learning physics are simulations - computer-generated reproductions of a course or activity that is problematic or expensive to carry out in the real world as a learning activity.[17] Today, more and more students are using virtual laboratories to perform experiments that might otherwise be dangerous, expensive, or complex, as well as to receive feedback and help with their learning during these activities.[18]

In a similar study,[19] describe the benefits of using virtual reality in higher education. Virtual reality systems immerse learners in 3D representations of real-world activities. Like the simulation, they permit activities to be carried out at home or from a computer lab that would be expensive, dangerous, or impossible to perform in other ways. Augmented reality systems integrate supplementary data and experiences into real-world activities, whether it is contextual specifics that give the impression of being ambient (information available in an environment that doesn't require concentration) or the overlay of another world on top of the contemporary one. Augmented reality and virtual reality typically present visual information to learners through helmets.[20]

Objective of the study

To examine the integration of artificial intelligence into higher education programs.

METHOD

This methodology, PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), was used to ensure a structured and accurate approach to this paper's identification, analysis and synthesis. The systematic literature review ensured the reliability and validity of the findings based on a detailed review of existing sources. Systematic literature review systematised research on integrating artificial intelligence (AI) into higher education curricula. The research had three main stages: planning, conducting and documenting.

Planning Phase

The purpose of the systematic literature review (SLR) was to determine the aim and objectives of the study.

The development of the research protocol included setting research objectives, questions, inclusion and exclusion criteria, selected databases for searching, keywords and standards for assessing the quality of the research.

Conducting Phase

The paper assesses the relevance of each source by evaluating its relevance to the research objectives, questions and predefined inclusion and exclusion criteria.

The search and collection of literature included a comprehensive search of relevant databases to identify relevant research papers.

The selection of studies was based on a systematic appraisal and selection of studies according to predefined inclusion and exclusion criteria.

To ensure reliability and credibility, the quality assessment included an analysis of each study's methodological and scientific quality.

Documenting Phase

Report and present the SLR results clearly, concisely and comprehensively, including a thorough analysis.

Publish the SLR results.

Sample

In this study, 77 articles were selected from the initial pool of 561 records obtained from the relevant databases. The selected articles are concerned with the study of the use of artificial intelligence in higher education. The main goal was to identify existing research gaps and potential areas for further research to realise the topic better. To achieve this goal, three research questions were formulated. The literature review highlighted the strengths and weaknesses of existing research. It indicated areas that necessitate additional examination to increase the effectiveness and potential of AI applications, particularly integrating AI into higher education curricula. The selected papers covered publications from 2019, reflecting the growing interest in topics such as virtual and artificial intelligence in education, pedagogical methodologies, teaching strategies, educational policy, and assessment practices. This trend can be explained by the proliferation of artificial intelligence research in recent years, which encourages researchers to focus on current advances in the field.

Instruments and Procedures

The article aimed to analyse the role of integrating artificial intelligence into higher education curricula, its potential benefits and limitations, and its ability to improve the learning process. The research protocol was developed to study the integration of AI into higher education curricula.

The proposed study was conducted using the standards of transparency, reproducibility, and consistency recommended for reviews in the field of educational research. Objective criteria were used for the selection and analysis of the literature. This ensured consistency in screening, assessment of relevance, and inclusion of studies.

Inclusion criteria

Publications dated from January 2019 to January 2025.

Written in English.

Articles containing the following terms: artificial intelligence, new technologies, linguistic and cultural adaptation, linguistic variation and communicative competence, and thinking.

Full-text availability in the public domain.

Published in peer-reviewed journals or presented at relevant academic conferences.

Figure 1 presents a diagram illustrating the criteria for inclusion and the process of searching for related literature.

Exclusion criteria

Publications until 2019.

Review articles.

The publication is not in English.

Databases for searching

- Google Scholar.
- ResearchGate.
- Scopus.

Keywords: linguistic and cultural adaptation, language variation, communicative competence, thinking.

Quality assessment criteria

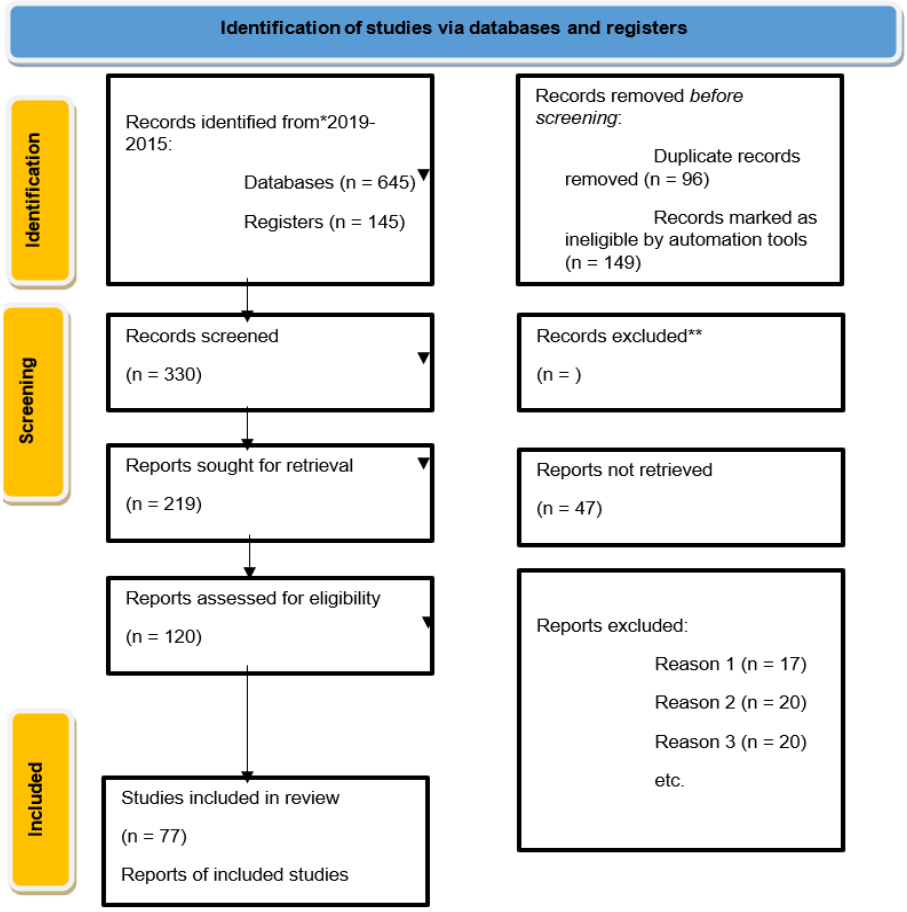

Figure 1. Stages of publication selection[32]

Removing all duplicate publications.

The findings are reliable and consistent with the aims of this paper.

The goals and purposes of the paper are clearly defined.

A general description of the methodology allows the study to be repeated.

The results of the literature review are presented in a narrative form. The systematic review protocol was registered at the planning stage in accordance with the recommendations for ensuring transparency, reproducibility and validity of scientific reviews in education. Figure 1 presents the PRISMA 2020 flow diagram, indicating the number of records identified from each database where feasible, and specifying exclusions made by authors and by automation tools.

RESULTS

Today, artificial intelligence systems in education integrate several functions that allow the identification of specific characteristics of the student, as well as provide tools for interacting with educational participants and responding to their needs (table 1):

Table 1. Search for thematic sources related to the proposed topic

Devadze et al.[1]	The work is dedicated to the use of artificial intelligence and virtual reality in education to increase student motivation.
Hasanova et al.[23]	The article deals with legal analysis, in particular, ethical aspects of the use of artificial intelligence in higher education.
Devterov et al.[3]	Philosophical dimensions of digital transformation and its impact on society and education.
Asaju et al.[24]	Work covering digital democracy and its impact on educational programmes.
Yurko et al.[25]	Innovation in AI and investment as a basis for economic sustainability.
Mushthoza, et al.[4]	Analysis of the impact of artificial intelligence on English language teaching.
Owan et al. [26]	A paper on the use of AI in assessing students' knowledge.
Chen et al.[29]	An article about AI-assisted assessment in the digital age.
Swiecki et al.[28]	A paper on the introduction of AI into work applications in the digital age.
Crompton et al.[29]	Analysis of the current state of artificial intelligence in higher education.
Paek et al.[30]	Study of global trends in the impact of AI on education.
Hartono et al.[31]	A study of the perception of the use of AI in English language teaching.
Kot et al.[32]	A paper on improving foreign language knowledge using AI in higher education.
Zhai, et al.[33]	Review of AI research in education (2010-2020).
Yang et al.[34]	Learning augmented reality to develop students' computing skills.
Irwanto et al.[35]	Trends in the use of augmented reality in science and education.
Zhang[36]	Prospects of integrating artificial intelligence technology in music education teaching.
Li et al.[37]	The role of artificial intelligence in music education
Hong Yun et al. [38]	A decision-support system for assessing the function of machine learning and artificial intelligence in music education for network games

The analysis of the processed data made it possible to formulate the main tenets of the integration of artificial intelligence into the curricula of higher education institutions.

Responsible use of artificial intelligence (AI) in higher education requires adherence to principles that ensure fairness, ethics, safety, and efficiency of implementing these technologies. The key aspects of such use are ensuring accessibility for all applicants, regardless of their capabilities, and preventing discrimination on any grounds.[39] AI must comply with the law, be transparent and understandable, and provide information about its purpose, methods of operation, and data sources. With the development of computer technology, artificial intelligence (AI) and machine learning (ML) are entering music education, one of the sectors where AI and ML have been applied and gained popularity in recent years. Both artificial intelligence and machine learning are used to create and control sounds in games, music and other applications. Innovative and sophisticated AI and machine learning approaches are used to improve music teaching.[40] Particular attention should be paid to the

privacy and protection of individual data of members in the instructional course, as well as to preventing the spread of harmful content. The use of AI in higher education should be based on ethical principles, involve a critical analysis of possible risks and ways to mitigate them, and ensure human control over the results of the systems' operation.[41] AI systems should support the achievement of learning goals, contribute to the quality of education, and serve as an auxiliary tool rather than a substitute for traditional teaching methods.[42] Teachers should guarantee that scholars develop the skills to use AI responsibly, promote critical thinking, and adhere to the rules of academic integrity. Using their autonomy, higher education institutions select and approve appropriate AI-based digital platforms and services, checking their compliance with the legislation on personal data protection.[43] It is also necessary to consider the interests of students with special educational needs, ensuring equal access to the educational process. Teachers independently determine the feasibility of using AI in the educational process and develop tasks focused on developing critical thinking and analytical skills. They also promote their qualifications in AI, organise information campaigns on technology literacy, and engage students in discussions of their benefits and risks.[44] Intelligence augmentation or decision support systems provide information to educators and other stakeholders to help them make decisions. They often offer insights through machine learning models, predictions, or recommendations if they can offer raw data. AI systems are mostly based on predictive analytics systems that make predictions about possible future student results and - in the best case - also provide the objective elements on which these predictions are based.[45] Swiecki et al.[28] detail efforts to improve personalised learning, providing a framework for automating personalised learning systems. Her chapter covers the shift from teacher-driven systems to computer technology that can play a more important role in real-time decision-making while following the directions and goals specified by the teacher. Today's latest AI systems are trained to detect and adapt to applicants' engagement and emotions.

According to Toosi et al.[46] , these systems can perceive these indicators in the student either from their relations and actions in the system or through physical and physiological sensors. Today, numerous examples of instructive technologies, such as mentoring systems and intelligent games, can distinguish a student who is uninterested, upset, or manipulating the system (trying to find tactics to complete tasks without learning) and motivate them. Thus, the latest technologies are not only a convenient tool for teachers or alternative entertainment for students, but they also contribute to new learning and teaching methods. The integration of artificial intelligence into higher education curricula is transforming pedagogical practices. Of course, previously, such practices were impossible without cutting-edge technologies. As mentioned, the main advantage is the personalisation of the learning process. However, it should be added that the impact of AI goes far beyond this aspect.[47,48] AI is changing the approaches to teaching and the interaction between teachers and students. Another advantage of integrating artificial intelligence into the curricula of higher education institutions is that AI provides access to a large amount of data on the performance and progress of students. Today, higher education institutions are actively using dashboards integrated into learning platforms that allow real-time analysis of assignments, identify knowledge gaps, and respond promptly to difficulties encountered by students (table 4):

Table 4. Control panels integrated into learning platforms that use artificial intelligence[49]

Learning Management Systems (LMS)	Canvas or Moodle; Blackboard Learn.
Platforms for automated learning analytics	EdTech platforms based on AI (DreamBox, Knewton, Aleks); Coursera for Campus.
Tools for data visualisation	Power BI or Tableau.
Software for analysing learning achievements	Starfish Retention Solutions; Brightspace Insights.
Specialised solutions based on AI	SALT (Student Analytics and Learning Tools); IBM Watson Education.
Voice Training Panels	Use AI to analyse vocal range, tone, and breath control for singers

Accordingly, AI technologies make it possible to rethink traditional homework assignments and grading approaches. AI provides an instant check, allowing teachers to obtain data on which topics cause difficulties for students before the start of the class and implement appropriate corrective measures in time.[50] Artificial intelligence helps to improve error handling. Teachers can analyse typical student mistakes and organise classroom discussions, involving everyone in analysing the right and wrong approaches to solving problems. This helps to develop critical thinking and stimulates students' active participation in the learning process (figure 2).[50]

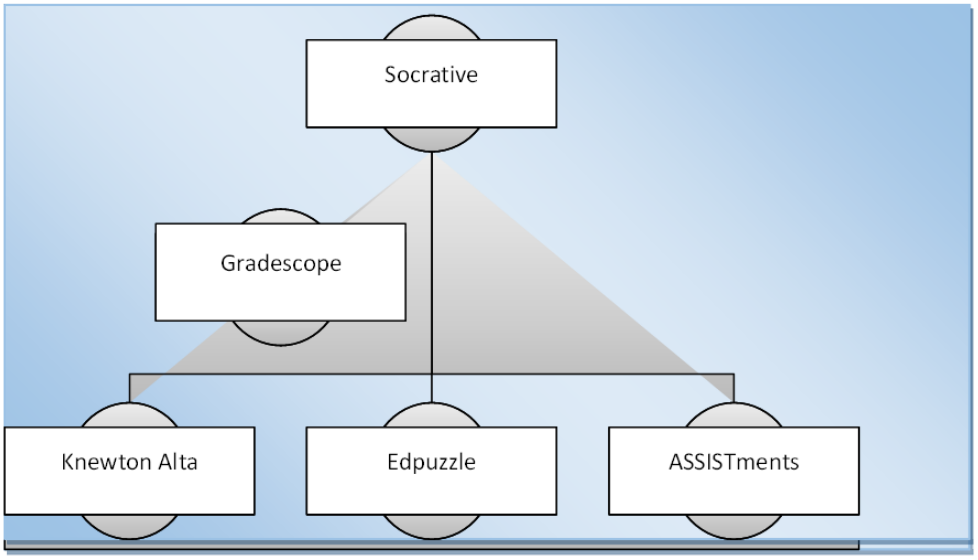

Figure 2. AI programs to instantly check assignments by popularity in higher education institutions[51]

Teachers can individualise student support by sending material and messages to those struggling to meet their assignment deadlines. Such solutions motivate them and help them return to active work. This approach increases engagement and contributes to the overall quality of education. AI in higher education is becoming a powerful tool for teachers, creating flexible and adaptive learning environments that meet modern challenges and needs. Formative assessment systems are becoming increasingly popular worldwide, especially in the context of high-stakes final exams. They allow teachers to assess students' key competencies, identify knowledge gaps, and identify topics for review. Platforms such as NWEA MAP offer basic tests to measure skills in maths and languages, while more sophisticated systems integrate assessments into gaming or creative activities.[52] The data collected helps teachers and parents find additional resources, although such platforms are rarely directly linked to assessment systems. The disadvantage is the time spent that could have been used for teaching. However, modern approaches based on classroom data analysis allow teachers to identify students' difficulties in real-time and direct efforts to support those who need it most.[53]

DISCUSSION

Artificial intelligence is not limited to supporting learning and teaching. Modern educational technologies bring significant benefits to higher education institutions. There are potentials and limitations in integrating artificial intelligence into the curricula of higher education institutions. In answering the first working question, what are the limits and potential of artificial intelligence in higher education? Chen C. H et al.[54] note that artificial intelligence expands the potential of higher education through a variety of applications. Early warning systems can predict student failure, offering timely support. They can reduce the risk of academic failure or expulsion from an educational institution.

In this context, ref X. Chen et al.[38] add that it is important to recognise that AI cannot replace teachers or create a one-size-fits-all solution for all situations. The main limited value of AI lies in its dependence on data quality and settings. Data protection and ethical issues are also important.

The next question in the paper was how artificial intelligence can change educational systems when integrated into higher education curricula. In a related study,[55] notes that the introduction of artificial intelligence into educational systems certainly has great potential. One of the most notable changes is the creation of early warning systems. They allow us to predict which students may face negative outcomes, such as dropping out or failing to pass their diplomas. In addition, such systems often offer reasons for the risks, such as low grades in a particular subject or disciplinary problems. This enables educators to intervene in time to help students. Latifi F et al.[56] AI is changing music education. This way, students can learn musical instruments and compose music easily and with fun. The effectiveness of teaching music with AI is proven by the author's empirical experience. The study included AI-based chatbots in piano lessons at seven music schools. The impact on student performance was assessed to be very effective. Dmitrieva E et al.[57] describe these systems already used in the United States. Artificial intelligence technologies help educational institutions to get an overall picture of the learning process. Dashboards allow administrators to see not only average grades but also to monitor disciplinary issues and the general climate in the institution and even predict future student performance. In continuation of this topic,[58] raise the issue of ethics and privacy. According to the authors, such systems operate based on large amounts of information, which comprise the personal data of applicants. The authors ask whether all this data is used ethically. Moreover, how is it ensured that artificial intelligence predictions do not cause discrimination? Hong Yun Z. et al.[59] considers ethical issues a serious

problem that needs to be considered. On the positive side, however, AI is also changing how educational institutions and parents communicate. For example, today's parental reports contain grades and detailed information about the student's progress, allowing parents to understand their children's strengths and weaknesses better.

The use of artificial intelligence in the admission and enrolment processes has also become very relevant. Algorithms help to allocate limited resources, such as university places. This allows for a balance between selectivity and fairness. Jafari F et al.[60] predict that education systems will be more efficient when such algorithms are integrated. However, in the scientific world, the decisions of such algorithms are still controversial.[27,61]After all, the fairness and transparency of their decisions must be impeccable to avoid bias. This issue is indeed recognized as a challenge. However, in general, artificial intelligence has already demonstrated its effectiveness in forecasting and optimizing educational processes. The key lies in ensuring its integration in a manner that allows all participants in the process to experience the benefits rather than the risks. In answering the final working question of whether higher education and learners' experience will be radically transformed by new technologies,[62] note that modern higher education already demonstrates the potential for significant change by integrating innovative systems. The authors cite the example of monitoring systems implemented to ensure exam security, which has already proven effective in many higher education institutions. During the COVID-19 pandemic, many universities have introduced systems that monitor students through webcams and use artificial intelligence algorithms to analyse their behaviour. [63] However, the authors wonder whether this will challenge students' privacy and trust in the educational process. [64,65] van Berlo ZM[66] note in the continuation of the topic that not only monitoring affects the educational ecosystem. The authors raise the issue of so-called "parental reports". Thanks to digital platforms, parents have deeper access to their children's learning data, such as absences or real-time grades. This increases their involvement, but can it contribute to excessive control and stress for students. So, it is clear that integrating technology into higher education opens up new opportunities but also brings many challenges. The question is whether higher education institutions will be able to strike a balance between technologisation and preserving a human approach, and ensure equality of access to these innovations.

CONCLUSIONS

Artificial intelligence in higher education shows uneven progress: early warning systems are widely adopted, while personalised learning and classroom tools remain underdeveloped. The study identified a fragmented AI ecosystem, lacking integration between technologies, educators, and stakeholders, which reduces overall effectiveness. Key challenges include insufficient collaboration among developers, limited teacher training, and the absence of user-friendly tools. Critical issues such as ethics, data privacy, and the lack of unified standards hinder broader adoption. The paper recommends comparative analysis of international best practices, development of modular AI platforms, and ethical safeguards. Future research should explore regulatory policies, cognitive effects of AI assistants, and long-term impacts on graduates' careers.

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FINANCING

None.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Iryna Zinkiv, Iryna Konovalova, Iryna Polska, Olena Roshchenko, Tetiana Rozhnova.
Data curation: Iryna Zinkiv, Iryna Konovalova, Iryna Polska, Olena Roshchenko, Tetiana Rozhnova.
Formal analysis: Iryna Zinkiv, Iryna Konovalova, Iryna Polska, Olena Roshchenko, Tetiana Rozhnova.
Drafting - original draft: Iryna Zinkiv, Iryna Konovalova, Iryna Polska, Olena Roshchenko, Tetiana Rozhnova.
Writing - proofreading and editing: Iryna Zinkiv, Iryna Konovalova, Iryna Polska, Olena Roshchenko, Tetiana Rozhnova.