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Transformation of Higher Education: the potentials and challenges of GenAI implementation

Abstract
This paper explores the possibilities and challenges of implementing generative artificial intelligence (GenAI) in higher education. Based on the analysis of relevant literature, the paper identifies the transformative elements of GenAI technology, focusing on its advantages and disadvantages. The research emphasises the potential for personalised learning, adaptive assessment, and virtual assistants, as well as ethical dilemmas, privacy concerns, and bias. The analysis has shown that GenAI offers the potential for personalised learning and more efficient evaluation, but at the same time raises issues related to bias and plagiarism. The conclusion is that embracing GenAI requires awareness of its capabilities and limitations, as well as the establishment of clear guidelines and standards to maximise its potential while minimising negative effects.

Keywords: *GenAI, Higher Education, artificial intelligence, transformative approaches to artificial intelligence.*

The development of Generative Artificial Intelligence (GenAI) is undoubtedly one of the socio-technological phenomena of our time that requires careful consideration. Continuous advancements in the fields of machine learning and computer systems have enabled a new leap in the development of artificial intelligence. Generative Artificial Intelligence (GenAI) focuses on generating new content through sophisticated algorithms and models that mimic human intelligence. The development of artificial intelligence dates back several decades (to the 1950s), while its application in education began in the 1960s.

Artificial intelligence (AI) can be spoken about from the moment when scientists gathered at a summer school in the American resort of Dartmouth to consider the possibilities of creating algorithms and machines which could imitate human intelligence. It was at that time, among other things, that the term "artificial intelligence" was coined (Russell and Norvig 2022). The de-

velopment of artificial intelligence has progressed in leaps, but what drew special attention was the victory of IBM's computer over then-world champion Garry Kasparov in chess, which strongly resonated in both the social and academic communities (Table 1) (Buchanan 2005). It was then already that we could anticipate the next major leap in the development of AI capabilities.

Table 1. *The development of artificial intelligence*

year	event	description
1956	The Dartmouth Summer School, marking the beginning of artificial intelligence development	Gathering of scientists working on research into the possibilities of 'creating' intelligent machines. The term "Artificial Intelligence"
1966	The first chatbot ELIZA	Developed by Joseph Weizenbaum, aimed at simulating conversations with humans
1997	IBM's Deep Blue defeats chess grandmaster Garry Kasparov	The first time a computer programme defeated the world chess champion
2012	Success of deep learning at the ImageNet competition	A model based on deep neural networks made significant progress in image recognition
2022	Rise in popularity of generative models like GPT-3 and DALL-E	Generative artificial intelligence becomes accessible to wider population

This paper assumes that the transformative potential of GenAI in higher education depends on the interplay between pedagogical innovation, ethical responsibility, and institutional readiness

Theoretical background: from Artificial Intelligence to Generative Transformation in Higher Education

The evolution of Artificial Intelligence (AI) from its conceptual beginnings in the 1950s to the emergence of Generative AI (GenAI) in the 2020s illustrates not only the progression of computing power but also a paradigm shift in how knowledge is created and shared. The symbolic and rule-based AI models of the mid-twentieth century sought to simulate reasoning processes, while the later advent of machine learning and deep neural networks enabled systems that could learn from data and autonomously generate new content. This transition from automation to generation represents a critical turning point with far-reaching implications for higher education.

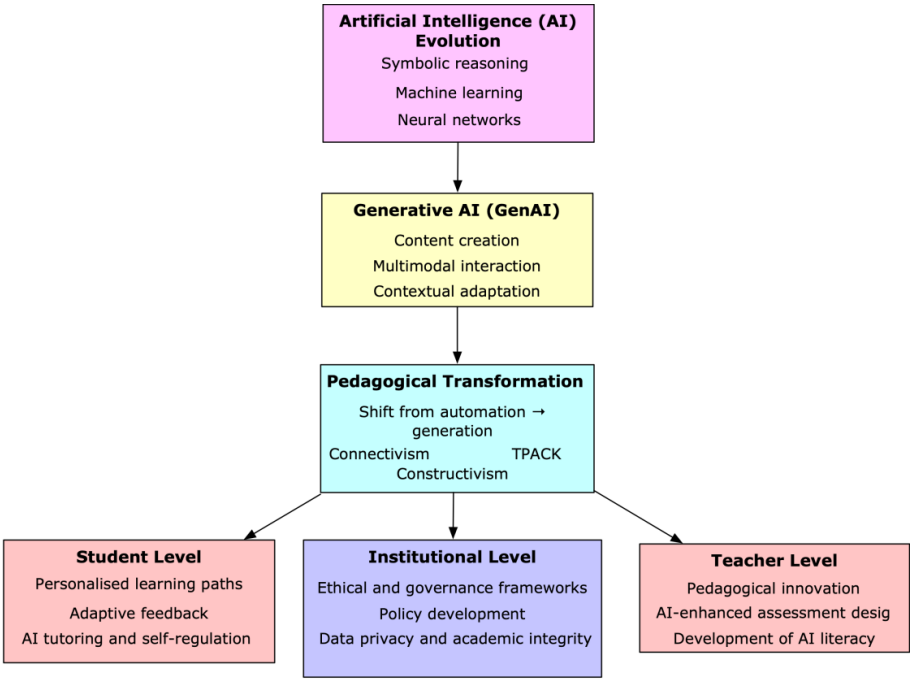
Generative AI, exemplified by large language models such as GPT, marks a qualitative transformation in the relationship between humans and intelligent systems. Unlike previous forms of AI that focused on pattern recognition and

decision support, GenAI enables the co-creation of knowledge through natural language, multimodal interaction, and context-sensitive output. Within the educational domain, this redefines how learners access, process, and construct knowledge.

The emergence of GenAI thus coincides with the shift from transmissive to learner-centred pedagogies. Theoretical foundations such as constructivism and connectivism (Siemens 2004) conceptualise learning as an active, networked, and socially mediated process—conditions now mirrored in GenAI environments where information is dynamically generated and negotiated. Contemporary frameworks such as TPACK (Mishra and Koehler 2006) and the Integrated Smart Learning Ecosystems (ISLE) model extend this perspective by emphasising the systemic interplay between technology, pedagogy, and context.

In this sense, GenAI should not be viewed merely as a tool for efficiency but as a transformative element that challenges traditional educational epistemologies. It prompts universities to reconsider the roles of creativity, authorship, and ethical responsibility in academic practice. The theoretical framework of this paper therefore positions GenAI as both a technological evolution and a pedagogical transformation—an intersection that frames the subsequent analysis of its potentials and challenges in higher education. The conceptual relationships discussed above are illustrated in Figure 1.

Figure 1. *Conceptual Framework of GenAI in Higher Education*



Source: author's elaboration (2025)

Figure 1 illustrates the conceptual relationship between the evolution of Artificial Intelligence and its transformative role in higher education. The framework emphasises the transition from traditional AI to Generative AI, which enables content generation and multimodal learning interactions. This transition fosters a pedagogical shift towards learner-centred, constructivist, and connectivist models of education. The right side of the diagram presents three interdependent levels of impact:

- Student level – personalisation, adaptive learning, and AI-supported self-regulation;
- Teacher level – innovation in pedagogy, assessment, and AI literacy;
- Institutional level – ethical governance, policy development, and data-protection frameworks.

Literature review

We live in a digital era where social and economic development are driven by information and technology. This statement places great expectations on education. The importance of education may have never been greater, making the way it is delivered especially significant. The Fourth Industrial Revolution is transforming industries and the labour market. Lifelong learning is now a reality rather than a necessity, and personalised learning ensures that learners are equipped with the skills and knowledge needed to thrive in a rapidly changing world, fostering adaptability and critical thinking(BaiDoo-Anu and Owusu Ansah 2023; Salih et al. 2025).

The traditional education system, still based on conventional curricula, traditional classroom environments, and outdated teaching methods, appears inconsistent with the dynamic and interconnected digital world. Nartey argues that the traditional educational model, which promotes rote learning and teacher-centred instruction, may not be effective in preparing students for the complexities of the modern world (Nartey 2025). Student-centred pedagogical approaches that integrate technology are necessary. Nartey further states that contemporary teaching pedagogy should leverage digital tools to foster critical thinking, creativity, and collaboration – skills that are essential in the digital age.

The Potentials and Challenges of Using GenAI in Higher Education

The adoption of GenAI offers several advantages in teaching and research efforts within the academic community. Researchers anticipate that GenAI will lead to innovative curricula and new or improved teaching

methods aimed at enhancing student and faculty engagement.One significant opportunity lies in educating graduates who meet societal needs, with the use of GenAI in business likely to become one of the key skills of the future. In academic research, the community can now use GenAI to discover new approaches that were previously inaccessible, create complex simulations, and analyse large volumes of data – whether textual, photographic, or video – much faster than was previously possible (Zhang and Zhang 2024).The methodology of this paper is based on a literature review aimed at exploring the perspectives, potential benefits, and drawbacks of GenAI and its related tools in higher education, particularly in the context of their transformative effects. The paper will examine sources from the IEEE Xplore and Wiley Online Library databases, due to their broad coverage of key journals relevant to this topic.

To define the scope of our search, we decided to analyse papers published during the year 2024. Since ChatGPT was introduced in 2022, and is still a relatively new technology, we believe its impact on higher education can only truly be observed in studies published in 2024.

After selecting the time frame, we proceeded to identify the key elements for our search and then for the analysis of papers based on the topic. For the analysis, we selected the most cited papers that included the following keywords: *GenAI in higher education*, *advantages*, *disadvantages*, and *implementation*. Within these search parameters, we reviewed around thirty articles that included the defined keywords. During the review process, we selected papers that, to a greater or lesser extent, addressed the topic of the positive and negative implications of using artificial intelligence in higher education.

Through the analysis of these papers, we classified the positive and negative implications, as shown in Table 2A/2B.

Table 2A. *Positive Implications of GenAI in Higher Education*

Dimension	Description	Illustrative Sources
Pedagogical	Personalised and adaptive learning; creation of customised content and simulations; support for multilingual and inclusive learning; increased student motivation through gamification.	(Duong, Vu, and Ngo 2023; Salinas-Navarro et al. 2024a, 2024b)
Ethical / Integrity	Development of awareness about responsible AI use; institutional adoption of ethical frameworks; fostering academic honesty.	(Böhm and Schedlberger 2023; Foltynek et al. 2023)11/11/2025 20:57:00

Dimension	Description	Illustrative Sources
Evaluation / Assessment	Adaptive testing aligned with student ability; data-driven feedback; efficiency in grading and formative assessment.	(Alam and Mohanty 2022a; Dumitru 2024)
Organisational / Institutional	AI-driven virtual assistants and chatbots; improved communication and administrative efficiency; enhanced institutional innovation capacity.	(Dai, Liu, and Lim 2023; Giannakos et al. 2025)

Table 2B. *Negative Implications of GenAI in Higher Education*

Dimension	Description	Illustrative Sources
Pedagogical	Superficial understanding and over-reliance on AI outputs; reduced creativity and critical thinking; student dependency on automation.	(Mariani and Dwivedi 2024; Ogunleye et al. 2024)
Ethical / Integrity	Bias in datasets and outputs; lack of transparency and explainability; privacy and data-protection risks; authorship and plagiarism dilemmas.	(Crompton and Burke 2023; Nguyen et al. 2023)
Evaluation / Assessment	Algorithmic bias in scoring; limited human judgment and contextualisation; accessibility issues for diverse learners.	(Duong et al. 2023; K Nartey 2025)
Organisational / Institutional	Insufficient governance frameworks; lack of clear policies; ethical uncertainty; institutional resistance to technological change.	(Strielkowski et al. 2024; Zhang and Zhang 2024)

Tables 2A and 2B present a synthesis of the positive and negative implications of GenAI implementation in higher education, organised across four analytical dimensions – pedagogical, ethical, evaluative, and institutional. The thematic categorisation reflects recurring concepts identified in the reviewed literature between 2022 and 2024.

The results show that the **pedagogical dimension** dominates both sides of the spectrum: while GenAI supports personalised and adaptive learning, it also raises concerns regarding creativity, critical thinking, and over-reliance on automation. The **ethical dimension** highlights the dual nature of AI integration – the emergence of institutional ethical frameworks on one hand, and persistent risks of bias, transparency, and privacy on the other. Within the **evaluation dimension**, adaptive assessment and AI-assisted feedback appear as promising innovations, yet issues of fairness and accessibility remain unresolved. Finally, the **institutional dimension** illustrates how universities benefit from AI-driven administrative efficiency but still lack comprehensive governance and data-protection policies.

These findings suggest that the transformative role of GenAI in higher education cannot be understood solely as a technological improvement. Instead, it should be interpreted as a systemic shift that demands new pedagogical strategies, ethical frameworks, and institutional adaptability.

Customised support through personalised learning could significantly reduce achievement gaps among students, considering their prior education and individual abilities. People have different learning styles – visual, auditory, etc. – as outlined in the VARK model and Dunn-Dunn model (Dunn n.d.; Fleming and Mills 1992). By using algorithms to adapt to individual learning needs, disparities in performance can be mitigated.

While most studies confirm the potential of GenAI to personalise the learning experience and improve engagement (Duong et al. 2023; Lahby 2024), some authors highlight that such effects are still largely theoretical and depend on the institutional capacity to collect high-quality learning data (Salih et al. 2025). Empirical studies conducted in Asian and Middle Eastern contexts, for instance, demonstrate greater readiness for AI-driven personalisation than those from European universities, which remain more cautious regarding ethical and privacy standards (Crompton and Burke 2023; Nartey 2025). These contextual discrepancies indicate that the transformative potential of GenAI cannot be generalised across higher education systems without considering local technological and cultural infrastructures.

Using sophisticated algorithms, generative artificial intelligence is capable of processing large volumes of data in a short amount of time – including student performance, preferences, and prior learning outcomes – in order to generate personalised content, recommendations, and assessments tailored to individual learning styles. This not only increases student engagement and motivation but also provides educators with valuable insights into student progress, enabling targeted interventions and support (Duong et al. 2023; Lahby 2024). With generative artificial intelligence in education, a new era of personalised and effective learning is within reach, ensuring that every student has the opportunity to thrive and reach their full potential.

As we delve deeper into the potential of generative artificial intelligence in education, the concept of enhancing learning through personalised algorithms emerges as a potentially transformative approach (Levi 2023). With reliance on the power of sophisticated algorithms, tailored learning experiences can be adapted to the individual needs and preferences of each student. These algorithms analyse vast amounts of data, including student achievement, learning patterns, and feedback. One of the fundamental issues is that very few systems collect high-quality data. Student monitoring

systems are often too limited – they do not gather enough data to support reliable predictions, which are essential for algorithms to make meaningful adjustments. Therefore, we can expect a growing need for the development of new information systems that collect real-time data on each student, such as Brightspace[1] or Blackboard[2]. What I personally see here is the need for a systematic solution within higher education institutions – one that adheres to ethical standards and complies with GDPR, at least within the framework of EU data protection regulations.[3]

Given the nature of higher education institutions and higher education itself, GenAI has transformative potential – primarily in adapting to the learning styles of each student, but also in building entirely new student models.

Artificial intelligence tools that facilitate student-centred learning include adaptive learning platforms (e.g., DreamBox[4], Knewton[5]) or intelligent tutoring systems (e.g., ASSISTments[6]). By creating new tools based on GenAI, which have the ability to process video content and new images, there will soon be the possibility to create rich multimedia content and multimedia-enriched simulations tailored for instructional materials (Mariani and Dwivedi 2024; Salinas-Navarro et al. 2024b). Based on student preferences, algorithms will be able to modify materials according to the learning styles of each student. This is where I see a great opportunity for progress, as enhanced algorithms will create multimedia content of a higher quality than what is currently produced by teachers. Researchers also expect significant advances in the use of virtual reality, augmented reality, and mixed reality. The progress and increased availability of these technologies will make them more accessible in education.

We are aware that traditional methods of assessing students are not tailored to individual student needs and that, due to their rigidity and inability to adapt, they can sometimes be completely ineffective. For example, the use of standardised tests follows a fixed format that does not account for variations in students' knowledge and skills. Adaptive assessments re-

1 https://www.d2l.com/brightspace/

2 https://www.anthology.com/products/teaching-and-learning/learning-effectiveness/blackboard

3 Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of Such Data, and Repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA Relevance), 2016.

4 https://www.dreambox.com

5 https://www.wiley.com/en-us/education/alta/features

6 https://new.assistments.org

present a paradigm shift in how we evaluate learning. These assessments use algorithms to generate customised tests that can adjust in real-time, providing students with questions that match their current abilities. As such, adaptive assessments are perfectly aligned with the goals of personalised learning (Dumančić 2019; Dumitru 2024).

Artificial intelligence models used in adaptive assessments must be trained and rigorously tested to mitigate bias and ensure fairness in evaluation (Alam and Mohanty 2022b). Bias in artificial intelligence models can result in inequality in assessment outcomes. The use of technology in assessment can present challenges regarding accessibility for inclusive students, but it can also significantly enhance and tailor it (Dumitru, 2024).

The introduction of adaptive assessment can change the role of the teacher, who may need to adjust their teaching strategies based on the results of the assessment. The use of tools such as Gradescope[7] or Turnitin[8], powered by generative artificial intelligence, represents a significant step toward achieving the goals of personalised learning.

Despite notable advantages of adaptive testing and AI-assisted feedback systems (Dumitru, 2024), several studies emphasise that algorithmic bias and a lack of human oversight can reproduce inequalities in assessment outcomes (Alam & Mohanty, 2022; Nguyen et al., 2023). In particular, automatic grading models tend to favour language proficiency and standardised expression, which may disadvantage non-native English-speaking students. The literature also reports divergent views on the acceptability of AI-supported grading: while some researchers view it as an efficient extension of formative assessment, others warn that it risks diminishing the teacher's role as an interpretive evaluator (Giannakos et al., n.d.).

Virtual teachers, or assistants[9] in the form of chatbots based on LLM, are now present in a large number of higher education institutions (Dai et al. 2023; Dumančić 2010).) Chatbots are one of the first applications of GenAI in the past three years – tools such as Jili Watson.[10] Their role is very simple, enabling communication between students and artificial intelligence that can be either institution-specific or open-ended. Institution-specific chatbots are typically trained on data and documents specific to the institution, aiming to assist and simplify various administrative and organisational tasks for students and professors. Students can learn about their rights, obligations, and other matters at any time, which provides them with easier

7 https://www.gradescope.com

8 https://www.turnitin.com

9 Virtual teacher or virtual assistant – the term 'teacher' is unacceptable to me because a teacher is much more than artificial intelligence; therefore, I prefer to call it an assistant.

10 https://dilab.gatech.edu/jill-watson/

access to studying and enhancing administrative efficiency(Giannakos et al. 2025). Through open access to the tool, ChatGPT provides students with access to a chatbot trained with a variety of materials such as books, encyclopedias, websites, communications, etc., positioning itself as a virtual assistant available to students 24/7 (Levi 2023). With each version, ChatGPT evolves into a more reliable virtual assistant, particularly when students need support, for example, in searching for information, simplifying complex texts, translating, practising writing, checking results, or brainstorming ideas. Researchers agree that ChatGPT's algorithms have issues with bias, stereotypes, and occasional hallucinations.

Chatbots and virtual assistants are among the most visible manifestations of GenAI integration in higher education. Studies in this domain reveal a mixed pattern of outcomes: increased administrative efficiency and student satisfaction (Dai et al., 2023) coexist with concerns about data privacy, superficial interaction, and emotional detachment from human mentorship (Levi, 2023; Böhm & Schedlberger, n.d.). These findings suggest that GenAI-based communication tools may enhance learning logistics but not necessarily learning depth, underscoring the need for balanced pedagogical integration rather than full automation.

It is particularly important to highlight the dilemmas faced by researchers and users of GenAI in education in general, especially in terms of ethical elements, which are of great importance (Foltynek et al. 2023). Privacy and data security are very sensitive areas, and in the process of personalising studying, algorithms should process student data. Therefore, it is crucial to ensure data security and limit its use solely for the educational purposes of learning personalisation. As already mentioned above, GenAI has issues when generating content, such as bias (Nguyen et al. 2023). Unfortunately, bias arises from the materials the systems are trained on. In the future, it would be important to use diverse data and test the materials used in the GenAI systems' learning process or algorithmically rearrange them. Furthermore, this is why transparency of the system is a key feature so that users can understand how the system arrives at certain decisions in deep neural networks. The issue of plagiarism and the ownership of generated works is a topic of ongoing debate aimed at preventing misuse. Incorrect "hallucinated" information and data, if not recognised, can negatively affect the learning process. Therefore, it is crucial that higher education institutions make additional efforts to raise AI literacy among students and teachers. The use of GenAI in higher education is closely tied to ethics, the authenticity of the academic experience, fairness, and accessibility (Böhm & Schedlberger, n.d.).

Ethical concerns remain the most frequently discussed issue across all reviewed publications. However, the literature shows a lack of consensus on how ethical principles should be operationalised in academic environments. For example, Foltynek et al. (2023) advocate for explicit institutional guidelines based on transparency and accountability, whereas Nguyen et al. (2023) and Crompton & Burke (2023) stress the importance of student and teacher AI literacy as the foundation for responsible use. This divergence highlights the current absence of a unified framework for ethical governance of GenAI in higher education.

Synthesising across the reviewed studies, it becomes evident that GenAI's contribution to higher education is context-dependent. Its benefits are maximised where institutional readiness, ethical frameworks, and digital competence are already developed. Conversely, in systems with low digital maturity or weak governance structures, the same technologies can exacerbate inequalities, raise data-protection risks, and challenge academic integrity. The discussion therefore confirms that the integration of GenAI is not a universal process but a negotiated transformation shaped by cultural, ethical, and pedagogical contexts. The integration of findings across these dimensions supports the proposed conceptual framework (Figure 1), which situates GenAI as a driver of pedagogical, ethical, and institutional transformation."

Conclusion

The analysis of recent literature confirms that Generative Artificial Intelligence (GenAI) is reshaping higher education through its potential for personalisation, adaptivity, and innovation, but also through its inherent ethical and organisational challenges. Rather than viewing GenAI as a technological tool alone, this study positions it as a catalyst of systemic transformation that simultaneously redefines pedagogical roles, assessment practices, and institutional governance.

At the **student level**, GenAI enables personalised learning environments, adaptive feedback, and multilingual accessibility. However, its effectiveness depends on the quality of educational data, ethical safeguards, and the development of students' critical and metacognitive skills. Over-reliance on automated assistance remains a notable risk, highlighting the importance of AI literacy and human oversight in learning processes (Dumančić 2011; Duong et al. 2023; Lahby 2024).

At the **teacher level**, GenAI fosters new forms of pedagogical innovation and assessment design. The reviewed studies show that educators

who integrate GenAI tools thoughtfully can enhance formative feedback and engagement (Dumitru, 2024; Nartey, 2025). Yet, the pedagogical benefits are moderated by teachers' digital competence, professional development, and institutional support. Without adequate preparation, AI-assisted teaching may increase workloads and reduce the interpretive dimension of assessment (Alam & Mohanty, 2022; Giannakos et al., n.d.).

At the **institutional level**, GenAI introduces opportunities for administrative efficiency, virtual support, and strategic innovation. However, this transformation also exposes universities to new risks related to bias, transparency, and data protection (Nguyen et al., 2023; Foltynek et al., 2023). The literature consistently calls for governance models that combine technological capacity with ethical accountability and cross-disciplinary collaboration between educators, technologists, and policy makers.

Overall, the reviewed evidence demonstrates that the integration of GenAI in higher education is context-dependent and cannot be generalised across educational systems. Its benefits emerge where ethical frameworks, institutional readiness, and AI literacy are already established. Therefore, the future of GenAI in academia lies in the creation of integrated, transparent, and ethically aligned ecosystems that strengthen — rather than replace — the human dimensions of teaching and learning. This review is limited to peer-reviewed studies published in English between 2022 and 2024; future research may expand the temporal and linguistic scope.

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Трансформација високог образовања: потенцијали и изазови примене генеративне вештачке интелигенције (GenAI)

Брз развој генеративне вештачке интелигенције (GenAI) представља један од најтрансформативнијих технолошких помака у савременом образовању. Високошколске институције суочавају се са све већом потребом за интеграцијом GenAI алата у наставне, истраживачке и управљачке процесе, што истовремено отвара нове могућности за иновације и носи ризике повезане са етиком и академским интегритетом. Овај рад истражује трансформативне потенцијале и изазове примене GenAI у високом образовању кроз структурирани наративни преглед литературе.

Циљ истраживања је двострук: (1) идентификовати и категоризовати главне педагошке, етичке и институционалне импликације усвајања генеративне вештачке интелигенције у високом образовању и (2) предложити концептуални тростепени оквир за одговорну и ефикасну интеграцију GenAI технологија на нивоу студената, наставника и институција. Истраживање се заснива на наративном прегледу литературе надахнутом PRISMA смерницама и обухвата тридесет рецензираних научних радова објављених у периоду од 2022. до 2024. године у релевантним базама података као што су IEEE Xplore и Wiley Online Library. Укључени су радови који се експлицитно баве генеративном вештачком интелигенцијом у високом образовању, док су публикације које се односе искључиво на традиционалну вештачку интелигенцију искључене.

Резултати истраживања показују да GenAI доноси значајне користи у областима персонализованог учења, адаптивног вредновања и виртуелне академске подршке путем интелигентних туторских система и четботова. Обрадом великих скупова података, GenAI алати могу да прилагоде искуство учења индивидуалним потребама, пруже подршку вишејезичним студентима и омогуће повратне информације засноване на подацима. Међутим, анализа је такође открила значајне етичке и методолошке изазове, укључујући пристрасност у скуповима података, недостатак транспарентности у алгоритамском одлучивању, питања ауторства и плагијаризма, питања заштите личних података студената и правичности аутоматизованог вредновања.

Прегледана литература синтетисана је у типологију импликација подељених у три кључне димензије: 1) Ниво студента – персонализовани путеви учења, вишемодалне повратне информације и самоусмерено учење уз AI туторе; 2) Ниво наставника – педагошке иновације, унапређени дизајн вредновања и развој AI писмености; 3) Институционални ниво – развој политика, етичких оквира и механизама управљања који обезбеђују одговорну интеграцију GenAI технологија.

Закључује се да успешно укључивање генеративне вештачке интелигенције у високо образовање захтева стратешки и етички утемељен приступ. Универзитети би требало да успоставе интердисциплинарне тимове који укључују наставнике, научнике из области података и етичаре, како би обликовали транспарентне смернице за примену вештачке интелигенције. Предложени оквир пружа основу за будућа емпиријска истраживања модела подучавања потпомогнутих генеративном вештачком интелигенцијом и доприноси актуелној научној расправи о дигиталној трансформацији високог образовања.

Кључне речи: *GenAI, високо образовање, вештачка интелигенција, трансформативни приступи вештачкој интелигенцији.*

Transformacja szkolnictwa wyższego: potencjały i wyzwania zastosowania GenAI

Szybki rozwój generatywnej sztucznej inteligencji (GenAI) stanowi jeden z najbardziej transformacyjnych przełomów technologicznych we współczesnej edukacji. Instytucje szkolnictwa wyższego stają w obliczu rosnącej potrzeby integracji narzędzi GenAI w procesy dydaktyczne, badawcze i zarządcze, co w jednej strony otwiera nowe możliwości innowacji, ale z drugiej niesie ze sobą ryzyka związane z etyką i integralnością akademicką. Niniejsza praca bada transformacyjne potencjały i wyzwania zastosowania GenAI w szkolnictwie wyższym poprzez usystematyzowany przegląd literatury.

Celem badania są dwa główne zadania: (1) identyfikacja i kategoryzacja najważniejszych pedagogicznych, etycznych i instytucjonalnych implikacji wykorzystywania GenAI w szkolnictwie wyższym oraz (2) zaproponowanie trzyetapowej koncepcji w zakresie odpowiedzialnej i skutecznej integracji technologii GenAI na poziomie studentów, wykładowców oraz instytucji. Badanie opiera się na narracyjnym przeglądzie literatury inspirowanym wytycznymi PRISMA i obejmuje trzydzieści recenzowanych artykułów naukowych opublikowanych w latach 2022-2024 w odpowiednich bazach danych, takich jak IEEE Xplore i Wiley Online Library. Uwzględniono tu tylko te prace, które wprost zajmują się GenAI w szkolnictwie wyższym, zatem publikacje dotyczące tradycyjnej sztucznej inteligencji zostały wyłączone.

Wyniki badań pokazują, że GenAI przynosi znaczące korzyści w obszarach spersonalizowanego uczenia się, adaptacyjnej oceny i wirtualnego wsparcia akademickiego poprzez inteligentne systemy tutoringowe i chatboty. Przetwarzając duże zbiory danych, narzędzia GenAI mogą dostosować doświadczenie nauki do indywidualnych potrzeb, wspierać studentów wielojęzycznych i zapewniać informacje zwrotne oparte na danych. Analiza ujawniła również istotne wyzwania etyczne i metodologiczne, w tym stronniczość w zbiorach danych, brak przejrzystości w algorytmicznym podejmowaniu decyzji, kwestie autorstwa i plagiatu, a także obawy dotyczące prywatności danych studentów i sprawiedliwości automatycznej oceny.

Wykorzystana w badaniu literatura została podzielona na trzy kluczowe wymiary: 1) Poziom studenta – spersonalizowane ścieżki uczenia się, wielomodalne informacje zwrotne i samokierowane uczenie się przy wsparciu AI tutorów; 2) Poziom wykładowcy – innowacje pedagogiczne, ulepszony projekt oceniania i rozwój kompetencji w zakresie AI; 3) Poziom instytucjonalny – opracowanie polityk, ram etycznych i mechanizmów zarządzania zapewniających odpowiedzialną integrację technologii GenAI.

Stwierdza się, że skuteczne włączenie GenAI do szkolnictwa wyższego wymaga strategicznego i etycznie ugruntowanego podejścia. Uniwersytety powinny powołać interdyscyplinarne zespoły, obejmujące wykładowców, naukowców zajmujących się danymi i etyków, aby opracować przejrzyste wytyczne dotyczące stosowania sztucznej inteligencji. Zaproponowana koncepcja stanowi podstawę do przyszłych badań empirycznych nad modelami nauczania wspomaganego przez GenAI i włącza się do aktualnej debaty naukowej na temat cyfrowej transformacji szkolnictwa wyższego.

Słowa kluczowe: *GenAI; szkolnictwo wyższe; sztuczna inteligencja; transformacyjne podejścia do sztucznej inteligencji.*

Transformacija visokog obrazovanja: potencijali i izazovi primjene GenAI

Brz razvoj generativne umjetne inteligencije (GenAI) predstavlja jedan od najtransformativnijih tehnoloških pomaka u suvremenom obrazovanju. Visokoškolske institucije suočene su sa sve većom potrebom za integracijom GenAI alata u nastavne, istraživačke i upravljačke procese, što istodobno otvara nove mogućnosti za inovacije i nosi rizike povezane s etikom i akademskim integritetom. Ovaj rad istražuje transformativne potencijale i izazove primjene GenAI u visokom obrazovanju kroz strukturirani narativni pregled literature.

Cilj istraživanja je dvostruk: (1) identificirati i kategorizirati glavne pedagoške, etičke i institucionalne implikacije usvajanja GenAI u visokom obrazovanju te (2) predložiti konceptualni trostupanjski okvir za odgovornu i učinkovitu integraciju GenAI tehnologija na razini studenata, nastavnika i institucija. Istraživanje se temelji na narativnom pregledu literature nadahnutom PRISMA smjernicama te obuhvaća trideset recenziranih znanstvenih radova objavljenih u razdoblju od 2022. do 2024. godine u relevantnim bazama podataka kao što su IEEE Xplore i Wiley Online Library. Uključeni su radovi koji se eksplicitno bave GenAI-jem u visokom obrazovanju, dok su publikacije koje se odnose isključivo na tradicionalnu umjetnu inteligenciju isključene.

Rezultati istraživanja pokazuju da GenAI donosi značajne koristi u područjima personaliziranog učenja, adaptivnog vrednovanja i virtualne akademske podrške putem inteligentnih tutorskih sustava i chatbotova. Obradom velikih skupova podataka, GenAI alati mogu prilagoditi iskustvo učenja individualnim potrebama, pružiti podršku višejezičnim studentima i omogućiti povratne informacije temeljene na podacima. Međutim, analiza je također otkrila značajne etičke i metodološke izazove, uključujući pristranost u skupovima podataka, nedostatak transparentnosti u algoritamskom odlučivanju, pitanja autorstva i plagiranja te zaštite osobnih podataka i pravednost automatiziranog vrednovanja.

Pregledana literatura sintetizirana je u tipologiju implikacija podijeljenu u tri ključne dimenzije: 1) Razina studenta – personalizirani putovi učenja, višemodalne povratne informacije i samousmjereno učenje uz AI tutore; 2) Razina nastavnika – pedagoške inovacije, unaprijeđeni dizajn vrednovanja i razvoj AI pismenosti; 3) Institucionalna razina – razvoj politika, etičkih okvira i mehanizama upravljanja koji osiguravaju odgovornu integraciju GenAI tehnologija.

Zaključuje se da uspješno uključivanje GenAI u visoko obrazovanje zahtijeva strateški i etički utemeljen pristup. Sveučilišta bi trebala uspostaviti interdisciplinarne timove koji uključuju nastavnike, podatkovne znanstvenike i etičare, kako bi oblikovali transparentne smjernice za primjenu umjetne inteligencije. Predloženi okvir pruža osnovu za buduća empirijska istraživanja modela poučavanja potpomognutih GenAI-jem te doprinosi aktualnoj znanstvenoj raspravi o digitalnoj transformaciji visokog obrazovanja.

Ključne riječi: *GenAI, visoko obrazovanje, umjetna inteligencija, transformativni pristupi umjetnoj inteligenciji.*