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Opportunities and Challenges of AI Language Models in Higher Education for Sustainable Development

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ABSTRACT:
Secondary processes in hospitals are causing a major part of hospitals' carbon footprint. At the same This article examines the contemporary opportunities and limitations of using large language models (LLMs), including ChatGPT, in higher education and scientific research. It outlines the technological foundations of LLMs, highlighting their capabilities for context-aware dialogue, language synthesis, automated assessment, and personalization of learning pathways, including applications in language learning and intercultural communication that can support learner autonomy and communicative competence. The study emphasizes the potential of AI to enhance the quality of education, support pedagogical decision-making, and improve the management of educational processes. At the same time, key risks are identified, including informational biases, reliance on training data, the potential generation of inaccurate content, threats to privacy, and challenges to academic integrity. Ethical considerations are discussed, focusing on algorithmic transparency, data security, researcher accountability, and the prevention of discriminatory effects. The article also presents key strategies for addressing these challenges, including the development of information and ethical literacy, the establishment of transparent university policies, clarification of scientific publication requirements, and implementation of guidelines for responsible LLM use. The study concludes that effective integration of LLMs into academic environments requires a balanced combination of innovative potential and ethical safeguards to ensure the integrity of education and scientific research.

Keywords: large language models (LLMs), higher education, personalized learning, academic integrity, artificial intelligence, digital literacy, sustainable development, ethical AI, communication

1. Introduction

The evolution of artificial intelligence language models has emerged as one of the key drivers transforming the contemporary system of higher education. The rapid increase

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in their cognitive complexity, contextual flexibility, and capacity to generate research-oriented texts has a profound impact on higher education. This impact extends to academic curricula, teaching methodologies, the organisation of students' independent learning, and the structure of scholarly communication. In particular, LLMs offer novel opportunities for foreign language acquisition, enabling immersive practice, context-sensitive exercises, and exposure to intercultural language variations, thereby directly enhancing the teaching and learning of foreign languages and intercultural communication. The shift from basic statistical algorithms to advanced multimodal models is shaping the development of new digital instruments within the university environment. This includes intelligent educational platforms, adaptive learning systems, and automated research-assistance tools. Consequently, the role of the instructor is being reoriented toward that of a knowledge moderator, academic mentor, and specialist capable of cultivating in students the skills of critical analysis and responsible AI use.

Alongside the potential for advancement, higher education faces a number of challenges. The most acute of these is the threat to academic integrity, which extends beyond teaching and learning to encompass the domain of scientific research. This underscores the need to foster a culture of responsible AI application, to update university ethical standards, to develop policies preventing algorithmic manipulation, and to strengthen competencies in research integrity as a prerequisite for sustaining the society's long-term intellectual development. Accordingly, the purpose of this analysis is to examine the benefits and risks of applying artificial intelligence language models in the context of educational transformation as a key factor of sustainable development. This objective entails identifying the specific features of LLM use within the educational process, analysing the challenges accompanying this process, and proposing effective mechanisms for the ethical deployment of LLMs in the contemporary academic environment.

2. Literature Review

The research problem determined a corresponding corpus of sources focused on scholarly publications examining the interrelations among artificial intelligence, contemporary educational technologies, and the culture of academic integrity. Notably, studies investigate the transformative impact of AI on educational processes, with particular emphasis on changes in assessment practices and the maintenance of academic integrity. Osadchyi (2024) examines current trends in the digitalisation of administrative processes in higher education, including the development of data analytics, cloud services, and AI technologies. Osadchyi further discusses how these tools reshape governance models, enhance transparency, and support more efficient decision-making, emphasising the importance of educators' digital competence and strategic planning for effective AI integration.

At the same time, the notion of "enhanced transparency" in AI-supported governance requires critical clarification. While digital administrative systems may increase the availability and speed of institutional data, transparency cannot be reduced to technical efficiency alone. Without clearly defined indicators such as explainability of algorithmic decisions, accessibility of decision-making criteria, or accountability mechanisms for automated recommendations, AI-driven governance may end up reproducing the very

opacity it is supposed to eliminate. The critical issue in this context is whether administrative AI tools expand participation and oversight in institutional decision-making, or whether they simply shift power to a small circle of technical experts and system designers. Addressing this tension from a policy perspective means developing regulatory frameworks that prioritize more than efficiency – frameworks that also ensure institutional accountability, ethical oversight, and governance practices that are substantively inclusive.

Building on these administrative and assessment perspectives, Ateeq et al. (2024) argue that traditional forms of performance assessment are losing effectiveness in environments saturated with AI-driven tools; therefore, they propose a transition toward holistic evaluation approaches that prioritise metacognition, creativity, and the learning process itself. Androshchuk and Malyuha (2024) examine the current state of AI application in higher education and outline key trends in its development. The authors analyse primary directions of AI integration into the educational process, including personalised learning, automated assessment, and the advancement of students' digital competencies. Special attention is devoted to potential risks and challenges that require regulatory oversight.

Balalle and Pannilage (2025) analyse the risks associated with automated plagiarism, inauthentic work, and challenges in verifying student submissions, while simultaneously highlighting the potential of AI to support academic integrity through educational tools, analytics, and feedback mechanisms. Mortlock and Lucas (2024) explore opportunities offered by generative AI models for simulations and task automation, concurrently delineating notable risks to academic integrity, including inauthentic responses and excessive student reliance on AI. Sevnarayan and Potter (2024) address the potential of AI to personalise learning and support independent study, while also describing associated risks ranging from potential misuse to the erosion of authenticity in student work. The authors emphasise the need for curricular adaptation and the development of digital ethics.

Several studies focus on the use of specific AI language models in educational processes. A systematic review by Guizani et al. (2025) synthesises research on the implementation of large language models in higher education. The authors analyse the impact of these models on assessment, learning support, feedback automation, and adaptive systems, providing comprehensive recommendations for universities in the context of fostering academic integrity.

Extending research on LLM implementation, the application of ChatGPT and other chatbots has also been extensively examined. Milakis et al. (2025) identify key benefits, including personalised learning, writing support, and the automation of administrative processes, alongside key risks concerning academic integrity and potential model errors.

Cotton, Cotton, and Shipway (2024) investigate the phenomenon of ChatGPT use in student work and the associated threats to academic integrity. They demonstrate that traditional plagiarism detection methods are increasingly ineffective in environments dominated by generative AI, and therefore propose a comprehensive approach involving the rethinking of assessment practices, enhancement of students' digital literacy, and the fostering of trust between instructors and learners.

Beyond practical applications, ethical considerations of ChatGPT and other large language models in academic settings have been explored by Almufarreh et al. (2025). The authors highlight issues of authorship, information reliability, accountability for content, and risks of manipulation. Their study proposes a framework for the ethical integration of LLMs into educational processes, including increased transparency, policy development, and the establishment of new academic norms.

The study by Islam and Islam (2024) analyses ChatGPT's potential to support academic activities, including scholarly communication, text generation, and the development of instructional materials. The authors demonstrate that language models can significantly enhance the efficiency of teaching and learning, while also posing challenges to academic integrity and critical thinking.

Extending this focus to language learning contexts, Oshchepkova and Tolstykh (2024) demonstrate AI's potential to develop language skills, simulate communicative situations, and enhance student autonomy, while simultaneously highlighting risks such as excessive dependence, decreased motivation, and potential ethical concerns.

Beyond instructional applications, several studies emphasise practical strategies for integrating AI while maintaining academic integrity in educational processes, grounded in digital literacy, transparency, and accountability. Ivannikova et al. (2025) concentrate on maintaining academic integrity in research, analysing types of violations, mechanisms for their identification, and the specifics of preventive measures within educational institutions. Khoruzha (2025) underscores the need to update ethical regulations and foster responsible research conduct in contexts of active AI use. Moskalyuk et al. (2023) examine the risks associated with implementing artificial intelligence in higher education, including ethical challenges, technology dependence, and potential algorithmic errors, emphasising the need for a balanced approach to AI integration in educational settings. Yakovleva, Prus, and Zinchenko (2025) conceptualise AI as a dual-faceted factor in the educational environment, necessitating comprehensive control policies and ethical governance. However, implementing "comprehensive control" in practice is rarely straightforward. Oversight mechanisms must address substantial risks: overreliance on AI systems, automated inaccuracies, and ethical misuse. Yet they must also preserve space for pedagogical experimentation and innovation. This tension runs through current debates on AI governance in higher education. Control in this context is not about imposing restrictions. It is about establishing governance arrangements that work at multiple levels and balance institutional guidelines with educator autonomy and ongoing ethical review. Achieving this balance remains complex. If governance frameworks become overly rigid, they risk constraining creative academic freedom or reducing AI integration to a purely compliance-driven process, thereby undermining its educational purpose.

In summary, contemporary scholarship highlights the advantages of generative AI language models in educational processes, while also emphasising the necessity of regulatory oversight, pedagogical support, new assessment formats, and ethical frameworks for AI use as prerequisites for sustainable development. The literature further underscores the importance of coordinated efforts by university leadership and the academic community to cultivate a professional culture of academic responsibility among all participants in the educational process.

3. Methods

The theoretical foundation of the study is grounded in the concepts of technological modernization of education, the educational dimension of the Sustainable Development Goals (SDGs), and contemporary approaches to academic integrity. The study employs a range of scientific methods, including the following: the system analysis method was applied to examine scholarly literature on the architecture of generative AI language models; the comparative analysis method was used to juxtapose different approaches for assessing the advantages and disadvantages of implementing generative AI language models in the educational process; content analysis was employed to review curricula and EU/UN policies regarding the integration of AI and the SDGs (SDG 4: Quality Education). The deductive method was applied to formulate the hypothesis that personalized learning through generative AI language models directly contributes to inclusivity and equality (SDG 4).

Among the empirical methods, a survey was conducted in October 2025. Participants included students from legal and humanities programs at Borys Grinchenko Kyiv University and students from the Faculty of Foreign Philology at Drahomanov Ukrainian State University. The total sample consisted of 250 students from first to fifth year, representing all regions of Ukraine. The mean age of respondents was 20 years. All participants were informed about the purpose of the study and the anonymity of their responses, and they voluntarily agreed to participate. Data collection was conducted via a written questionnaire administered through Google Forms (original content design). Quantitative and qualitative analytical methods were applied to process the data. The diagnostic information obtained was subsequently interpreted and synthesized during the final stage of the study.

One limitation of this study is the relatively narrow sample, consisting exclusively of Ukrainian students from humanities and legal programs. This focus may limit how widely the findings on student attitudes toward AI use and ethics can be applied. Future research should involve larger and more diverse student groups across STEM and social science disciplines and, where possible, include participants from other countries, allowing these initial insights into perceptions and behaviours to be tested and expanded.

4. Results and Discussion

4.1 AI Technologies in Higher Education

The widespread adoption of language and communication technologies has been enabled by artificial intelligence (AI) capabilities to recognise and synthesise speech, perform machine translation, analyse texts, and interpret contextual meaning. Among these technologies, Chat Generative Pretrained Transformer (ChatGPT) is a chatbot based on a large language model (LLM), developed by OpenAI and launched in November 2022. It generates responses to textual prompts in multiple languages, enabling near-instantaneous, real-time interaction. ChatGPT's development relies on LLMs with complex neural network architectures capable of interpreting a broad range of input data.

A key advantage of these models is their support for asynchronous communication, which enhances student engagement and collaboration by allowing learners to ask questions and discuss course material without the need for simultaneous

participation. In higher education, LLMs can personalise assessments by generating individualised tests and tasks tailored to each student's proficiency and learning needs. This functionality is particularly valuable in courses focused on language competence or critical thinking, as GPT-3 can create questions adapted to learners' proficiency, thereby facilitating effective demonstration of knowledge and skills (Cotton et al., 2024). Moreover, these technologies have significant potential in language learning and intercultural communication. For instance, LLMs can provide immersive practice in foreign languages, deliver context-sensitive exercises, and simulate intercultural interactions, thereby enhancing students' communicative competence and cultural awareness (Aleksandrova et al., 2024).

The integration of GPT-4 into ChatGPT Plus in March 2023 further expanded the model's contextual window and reduced bias, enhancing its suitability for complex educational tasks. Beyond automated assessment, LLMs support interactive learning assistants and language-learning platforms, offering adaptive and personalised education aligned with learners' strengths and weaknesses. They can perform a wide range of language-related tasks, including coherent text generation, question answering, and high-quality translation. GPT-4 extends these capabilities by incorporating multimodal inputs, such as text and images, further broadening the scope of potential applications. Language-learning platforms powered by LLMs provide immersive experiences, allowing users to practise language skills in conversational formats that closely simulate interactions with native speakers, thereby facilitating more effective language acquisition (Guizani et al., 2025).

As LLMs have become widely adopted in higher education, regulatory and ethical guidance has emerged at regional and global levels. In 2022, the European Commission issued the Ethical Guidelines on the Use of Artificial Intelligence and Data in Teaching and Learning, as part of the Digital Education Action Plan (2021–2027). These guidelines aim to support educators in understanding AI's potential in education and to raise awareness of associated risks (European Commission, 2022). The most advanced LLMs capable of performing a broad range of tasks include ChatGPT (GPT-3 and GPT-4 by OpenAI), Gemini (Google), and Claude (Anthropic). ChatGPT rapidly gained global attention, reaching 100 million users within just two months of its launch. In response to its widespread adoption, the United Nations Educational, Scientific and Cultural Organization (UNESCO) published ChatGPT and Artificial Intelligence: A Quick Guide, providing a comprehensive introduction to ChatGPT and its potential applications in higher education. The guide also addresses ethical issues, outlines associated risks, and offers practical recommendations for mitigation (UNESCO, 2024).

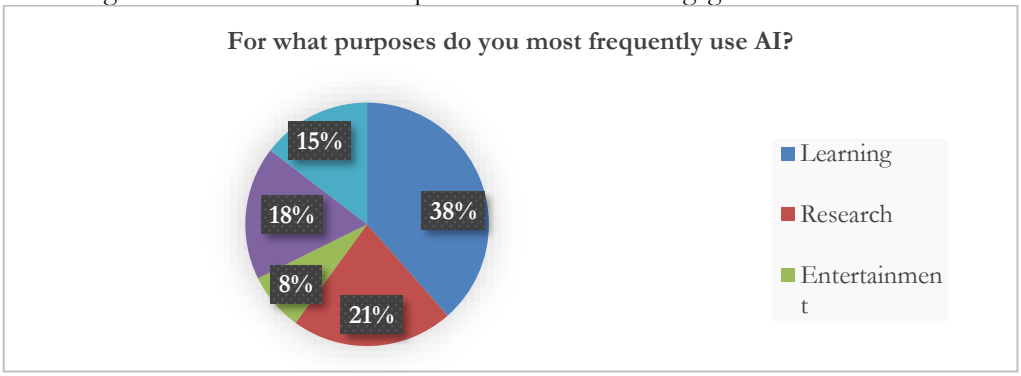
A defining feature of ChatGPT-style chatbots is their capacity for multi-turn, context-dependent dialogue. This enables them to function as intellectual partners in the learning process rather than merely providers of discrete fragments of information. Unlike rule-based systems, these models dynamically generate responses grounded in large-scale training corpora, allowing for nuanced interpretation of user input and personalised content development. ChatGPT supports dialogic interaction, intelligent tutoring systems, collaborative writing, question-and-answer formats, translation, summarisation, professional scenario modelling, and content generation. These functionalities mark a substantial departure from the constrained interactions typical of rule-based chatbots and

demonstrate the versatility of LLMs in addressing learners' cognitive, linguistic, and affective needs (Milakis et al., 2025).

Within the global scholarly community, research increasingly highlights the positive role of AI in personalising learning experiences, enhancing educational accessibility, and supporting instructors' pedagogical practices. Particular emphasis is placed on improving the quality of managerial decision-making, automating routine administrative processes, personalising educational trajectories, enabling forecasting and strategic planning, and optimising institutional resources and infrastructure. AI tools facilitate rapid processing of data generated within educational institutions, supporting analysis and insight extraction that enhance decision-making processes (Osadchyi, 2024).

Furthermore, AI is also transforming research management by improving data analysis, optimising workflows, and enhancing decision-making quality, thereby increasing the overall efficiency of scientific research and innovation. Scholars identify several advantages of AI use in education, including individualised learning, task automation, timely feedback provision, the creation of adaptive learning environments, and the provision of educational and psychological support for students.

According to the survey conducted in the present study, 38% of respondents use AI primarily for learning purposes, 21% for research activities, 18% for work-related tasks, and only 8% for entertainment. These findings highlight the growing role of advanced technologies in students' self-development and academic engagement.



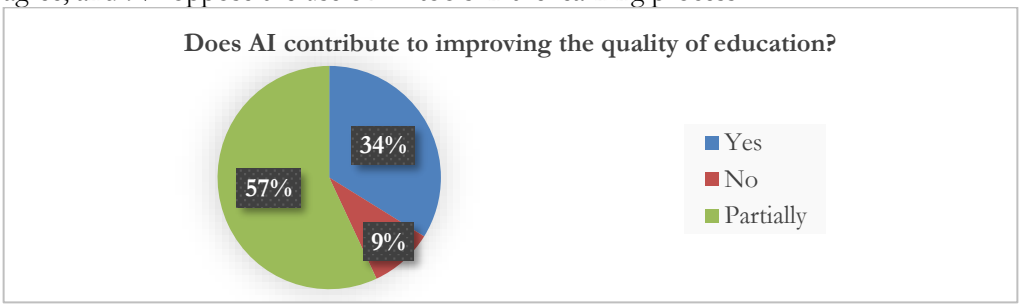
One of the key advantages of AI lies in its ability to create individualized learning pathways. Machine learning algorithms can analyse learners' abilities and skills and propose tasks and materials tailored to their specific needs. This approach allows students to learn at their own pace and focus on the most relevant content (Moskalyuk et al., 2023).

4.2 Student Learning and Ethics

AI-based assessment of learning outcomes involves analysing data related to a learner's academic performance within a particular topic or domain, as well as behavioural patterns, communication features, and feedback provision. When necessary, AI systems can generate targeted recommendations to improve learning outcomes for specific topics, tasks, or the overall learning process (Nazár, 2024). AI technologies can enhance student engagement and provide timely feedback, contributing to improved academic performance. Moreover, AI can reduce educational inequalities by expanding access to

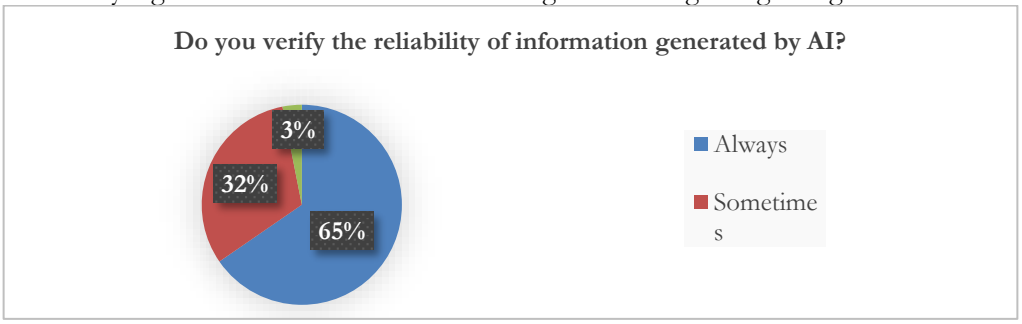
high-quality education in remote areas and by adapting educational content to meet the diverse needs of learners (Artyukhov et al., 2024).

Survey results indicate that students generally hold a positive attitude toward AI in education: 34% of respondents believe AI improves the quality of education, 57% partially agree, and 9% oppose the use of AI tools in the learning process.



Researchers argue that LLMs should not be perceived as a threat to traditional assessment methods. Educators can leverage these tools to enhance learning and assessment tasks. For instance, instructors may ask students to analyse and critique LLM-generated responses by evaluating their accuracy and relevance. Such practices promote the development of critical thinking skills while providing insights into the capabilities and limitations of generative AI (Mortlock & Lucas, 2024).

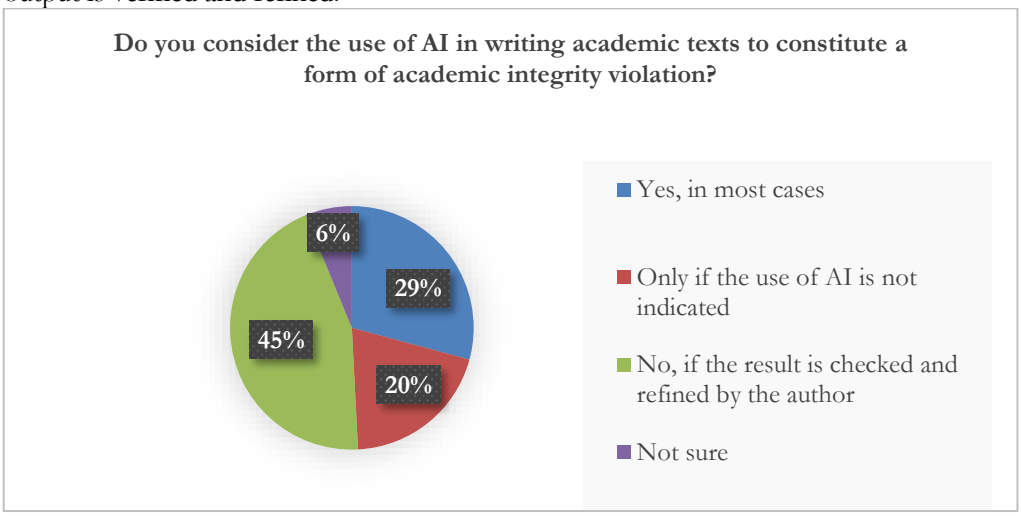
Survey data further indicate that 65% of respondents always verify information generated by AI, 32% do so occasionally, and only 3% never verify such content, reflecting a relatively high level of critical awareness among students regarding text-generation tools.



Oshchepkova and Tolstykh (2024) describe text-generation tools as multifaceted instruments enabling instructors to create a wide range of individualized learning materials, including essays, articles, dialogues, and exercises aligned with educational objectives, complexity levels, and thematic focus. These tools provide instructors with a diverse and up-to-date content repository for educational practices. Additionally, they include functionalities for rapid development of instructional guides and assessment materials, such as discussion questions.

While the use of ChatGPT for text generation should be subject to limitations, it should not replace original instructor creativity but serve as an additional resource for information retrieval (Hurin, 2025). This perspective is supported by survey respondents: 29% consider AI-assisted academic writing a violation of academic integrity, 20% consider

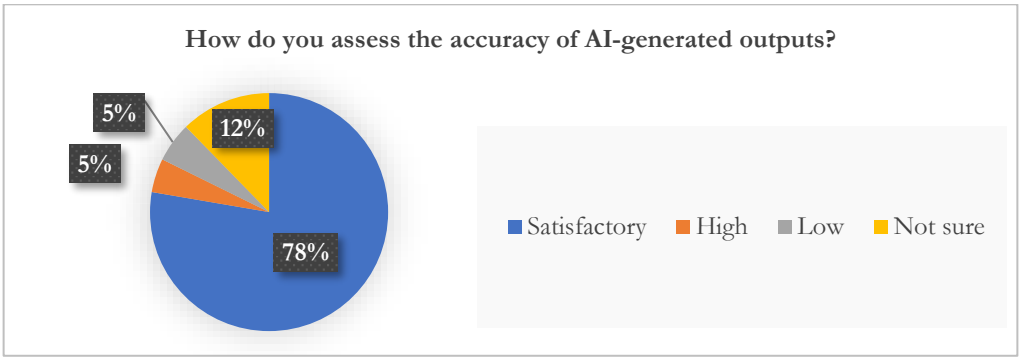
it a violation only if AI use is undisclosed, and 45% find it acceptable if the AI-generated output is verified and refined.



AI also facilitates the development of high-quality, adaptive learning resources tailored to students' needs and interests, promoting improved learning outcomes and enhancing motivation. AI technologies ensure accuracy, speed, objectivity, and efficiency in evaluating students' knowledge and provide feedback through error analysis, enabling corrections and refinements that contribute to better learning results (Iliychuk, 2024). Dynamic learning platforms capable of adapting to individual students' knowledge levels significantly enhance educational effectiveness. Such platforms can track progress, identify strengths and weaknesses, and adjust learning materials accordingly (Yakovleva et al., 2025).

However, notable differences exist between texts produced by humans and those generated by AI. Crockett and Howe (2024) emphasize the specific nature of LLM-generated text, noting that human-written content reflects an individual style, conscious lexical and structural choices, and iterative editing. In contrast, AI generates probabilistic text based on prompts, constructs sentences algorithmically, and lacks personal linguistic features. Predictability and content repetition combine with algorithmic variability, creating a text-generation dynamic distinct from human writing. Furthermore, model randomization produces new variants with each output, complicating reproduction and verification by instructors.

Survey results indicate that 78% of students evaluate the accuracy of AI-generated outputs as satisfactory.



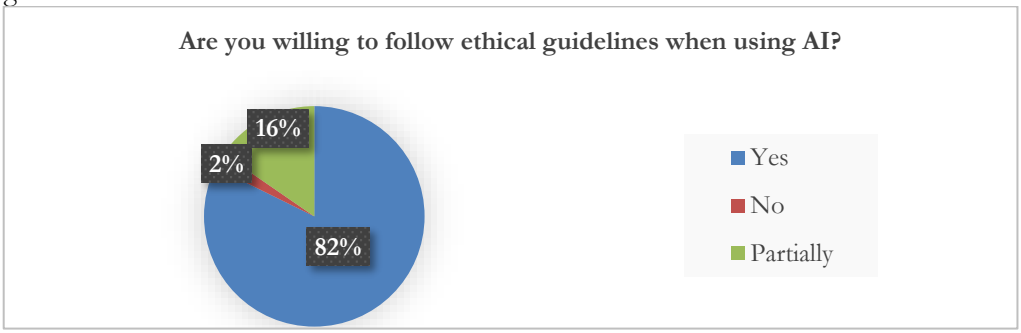
The diagram illustrates these perceptions across the sample. However, students' confidence in AI output may not fully reflect its documented limitations. The reliance of ChatGPT on various sources, combined with students' ability to evaluate the reliability of those sources, raises concerns regarding its trustworthiness as an educational resource. Sevnarayan and Potter (2024) identify four key issues: informational bias, AI's capacity for autonomous decision-making which can significantly impact outcomes, privacy concerns in the context of personal data exchange, and the potential for malicious use of AI. The difference between students' confidence in AI outputs and the actual limitations of these systems points to an important direction for future research. Investigating how the real accuracy of AI-generated educational content compares with students' perceptions across different disciplines could shed light on the ways learners interpret, trust, and use AI as a learning tool.

From an academic perspective, four broad dimensions – research, education, personal skill development, and social aspects – define the opportunities and limitations of ChatGPT within higher education. Educationally, ChatGPT can provide personalized learning experiences; however, it may deliver inaccurate information and cannot generate responses independently, as its outputs depend on training datasets that may contain errors. Regarding personal skill development, AI could hinder critical thinking and original content creation, but by offering practical reading and writing exercises alongside relevant materials, it can support the enhancement of language proficiency (Islam & Islam, 2024).

Cotton, Cotton, and Shipway (2024) recommend that instructors employ advanced technologies capable of analysing linguistic and stylistic features of texts, as well as machine learning algorithms to detect AI-generated content. At the same time, Avello and Aranguren Zurita (2025) highlight that academic integrity – defined as the commitment of all members of the academic community to honesty, trust, fairness, respect, responsibility, and courage – remains central to higher education. Yet, AI's extensive capabilities introduce additional opportunities for violations of these principles.

Rodrigues et al. (2024) identify several concerns: AI can produce fake texts, code, images, and other educational materials, complicating verification of students' knowledge and skills. Some students may erroneously claim AI-generated texts as their own intellectual work, thereby breaching academic integrity. Unauthorized access to educational tasks and the use of AI services may also result in exploitation of personal data without consent or adequate protection.

Survey results indicate that 82% of students support the implementation of ethical guidelines for AI use.



To mitigate these risks, Palamar and Naumenko (2024) propose comprehensive measures for ethical AI use in education. Students should bear personal responsibility for the work they submit, even when AI technologies are employed. They are accountable for inaccuracies, errors, or unreliable information, and must critically evaluate AI-generated outputs. Recommended measures include the development of new techniques for detecting falsified educational materials through machine learning and data analysis, the implementation of cybersecurity measures to protect assignments from unauthorized access (e.g., encryption and authorization), and the establishment of clear ethical principles for AI use in education. Importantly, employing AI for technical tasks – such as formatting, alignment, rephrasing one's own ideas, or structuring content – does not constitute a violation of academic integrity.

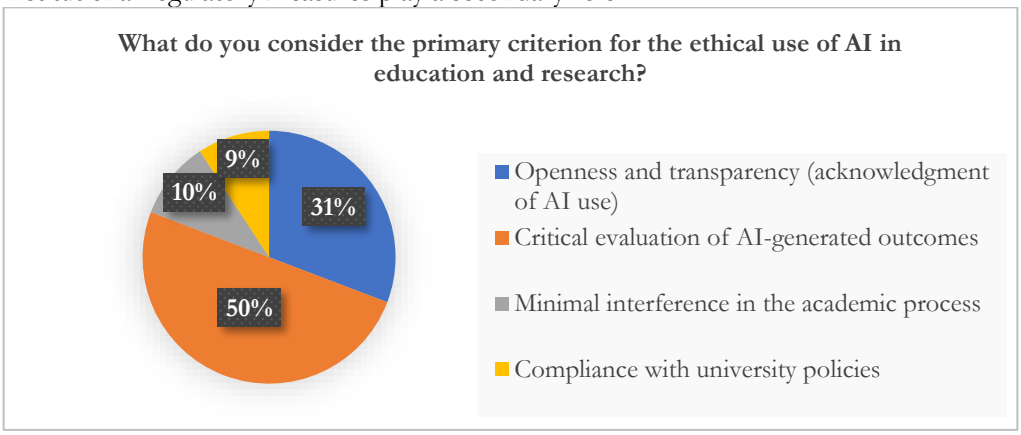
Implementing a comprehensive approach to assessment in education is critically important, prioritizing the development of authentic learning experiences over rote memorization. Given the substantial impact of educational approaches on academic achievement and the variability of outcomes depending on implementation, it is particularly essential for educators and policymakers to develop a deep understanding of these processes. Such understanding enables the design of effective strategies that enhance authentic learning and preserve the integrity of academic outcomes (Ateeq et al., 2024).

Lodge (2024) emphasizes that if AI usage is restricted, such restrictions must be clearly defined. Regardless of the regulatory model adopted by an educational institution, it is crucial that guidelines are transparent and accessible to all stakeholders. Moreover, it is necessary to distinguish between permissible use of AI in learning and requirements for assessed work, in which the portions completed independently by the student must be explicitly indicated.

It is also advisable to implement written declarations in which students confirm the authorship of their work and acknowledge that artificial intelligence has not contributed as a co-author. This measure promotes a responsible approach to academic activity and discourages the unethical use of AI language models (Cotton et al., 2024).

Balalle and Pannilage (2025) highlight that academic integrity must result from the collective efforts of both students and educators; it cannot be ensured solely through individual action. Achieving a high level of academic integrity requires consideration of factors such as cultural practices, personal characteristics, the nature of learning activities, the specifics of the educational ecosystem, and the organizational structure.

Survey results indicate that the primary criterion for ethical AI use in learning and research is critical reflection on AI-generated outputs (50%), followed by acknowledgment of AI usage (31%). In other words, respondents perceive that personal morality and responsibility of the user (whether a researcher or student) should take precedence, while institutional regulatory measures play a secondary role.



A distinct challenge in the use of artificial intelligence language models within the educational ecosystem concerns scientific research. Berdo, Rasiun, and Velychko (2023) highlight several key ethical issues associated with AI use in research. First, privacy and data protection require both technical and organizational measures to prevent unauthorized access. Second, transparency in AI decision-making, particularly in neural network models, must be ensured. Third, researchers must consider their responsibility for potential consequences arising from AI application. Fourth, discriminatory effects of AI models should be avoided. Finally, attention should be paid to the impact of AI on social interactions and the overall educational process.

4.3 AI in Scientific Research and Institutional Practices

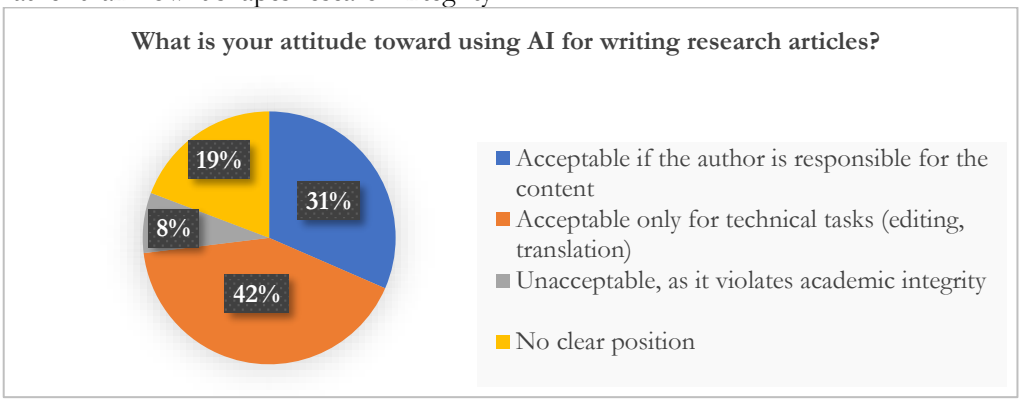
Analysis of the scholarly literature identifies several principal approaches to addressing these issues: enhancing information literacy and fostering a culture of academic integrity among researchers; promoting close collaboration between researchers and ethics experts; strengthening journal requirements for scientific publications; and establishing transparent university policies regarding the application of LLMs in research.

Artyukhov et al. (2024) propose that universities develop clear guidelines for the ethical use of AI in research, particularly regarding transparency in the use of algorithmic tools in data analysis, manuscript preparation, and publication processes. Researchers should be encouraged to disclose AI use in their methodology to ensure accountability and reproducibility of results. Collaboration with ethics experts can support the development of best practices for responsible AI use, and prioritizing ethical considerations and transparency will help maintain scientific integrity and foster trust within the academic community.

Recommendations for the use of generative AI in research include fostering critical thinking and verification of AI-generated results, mandatory editing of generated texts with the addition of the researcher's own analysis, and using AI primarily as an

auxiliary tool. Open disclosure of AI use in data analysis or text creation, ethical data collection, and maintaining participant awareness are essential. Peer-review policies should assess the novelty and independence of conclusions, and scientific journals should establish clear rules for AI application (Khoruzha, 2025).

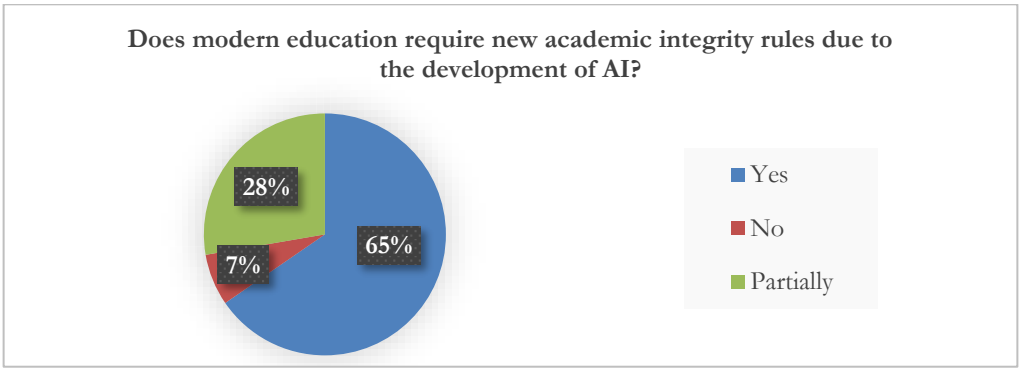
Respondents more readily accept AI in scientific research when confined to technical tasks (42%) or when human authors retain clear responsibility for final text (31%). This conditional acceptance reflects recent publisher policies emphasizing transparency and authorial accountability in AI-assisted research. However, the preference for technical applications may indicate a task-based rather than principle-based understanding of ethical AI use – where appropriateness depends on what the tool does rather than how it shapes research integrity.



Publishers have significantly revised their approaches to AI usage, introducing detailed guidelines for authors, reviewers, and editors. Some publishers, such as Elsevier, have developed proprietary AI tools that comply with ethical standards and data protection requirements. These technologies are implemented not only to detect plagiarism but also to monitor AI usage. Data protection and intellectual property safeguards have been strengthened. Elsevier's policy permits authors to use generative AI solely for language improvement, with mandatory disclosure of its use. The publisher screens manuscripts for AI use and employs secure tools throughout the editorial process (Zabolotna & Zahoruyko, 2025:228).

Almufarreh et al. (2025) emphasize the complex interplay of legal, technological, and ethical considerations in the use of LLMs in scientific research. Universities can adapt existing citation styles (e.g., APA, MLA) to ensure proper referencing of LLMs and implement comprehensive ethical measures. Establishing cross-functional ethics committees, involving administration, IT, legal experts, and educators, is recommended to regularly review policies. All interactions with LLMs should comply with data protection laws, and users should be informed about how information is processed. LLMs should function as supportive tools that encourage critical thinking and source verification. Institutions may invest in AI-detection tools, applying them judiciously to avoid excessive oversight.

Survey results indicate that 65% of respondents consider the development of new rules in response to AI advancements necessary.



The ethical use of artificial intelligence in scientific research emerges as a critical condition for ensuring quality, trust, and sustainable development within the academic environment. Privacy, transparency, non-discrimination, and accountability constitute fundamental principles that must be integrated into university policies. Developing clear guidelines, establishing cross-functional ethics committees, and adapting citation standards for accurate referencing of LLMs enhance accountability and reproducibility of research outcomes. Open disclosure of AI use, adherence to ethical data collection practices, and the cultivation of critical thinking minimize risks of algorithmic bias and misuse. This approach safeguards the integrity of the scientific process. It also aligns with sustainable development principles by fostering a responsible digital infrastructure oriented toward long-term security, inclusivity, and public trust. Universities that implement ethical AI standards thereby strengthen their contribution to the sustainable advancement of science and education.

5. Conclusions

The development of language models such as ChatGPT is profoundly transforming the educational ecosystem by introducing new forms of communication, personalized learning, and adaptive student support. Through their capacity for context-aware dialogue, asynchronous interaction, and generation of individualized tasks, LLMs enhance student engagement and facilitate the creation of flexible learning pathways. The integration of more advanced models, such as GPT-4, further expands multimodal processing capabilities and improves the quality of educational content. These technologies promote inclusivity, efficiency, and innovation in education, aligning with the core principles of sustainable development and preparing society to meet the challenges of the digital era. They are particularly impactful in supporting language learning and intercultural communication, enabling immersive practice, context-sensitive exercises, and simulation of intercultural interactions.

LLMs like ChatGPT have real potential in higher education, but they are not without problems. They can personalize learning and help students develop key competencies, but they also rely on source data that may be biased and sometimes produce inaccurate content more often than users expect. Most students in our survey evaluate AI-generated content critically, yet 82% still want ethical guidelines in place. Students appear

to value institutional oversight as a complement to their own judgment. Yet privacy concerns and academic integrity questions complicate institutional responses.

Awareness does not translate easily into practice. AI literacy and ethics belong in standard curricula, not optional modules. Faculty need professional development not only for their own use, but to guide students through ethical decision-making with these tools. Universities need transparent reporting mechanisms for problematic AI outputs or misuse. Accountability must function at multiple levels: departmental policies on AI use in assignments, institutional review when adopting tools broadly, and transparent procedures that distinguish experimentation from misconduct. All of this has to adapt to different disciplines and institutional contexts without abandoning basic ethical standards.

Within the framework of sustainable development, language models should be understood simultaneously as a resource and a challenge. Their incorporation into higher education can enhance knowledge accessibility, inclusivity, and innovation, yet it requires careful management, ethical regulation, and the promotion of moral responsibility and academic culture among all participants in the educational process. In instructional contexts, LLMs support personalized learning and adaptive resources, and the development of communicative competence and cultural awareness, while in research contexts, their use must ensure transparency, reproducibility, and accountability. Ethical use of AI in scientific research is critical for maintaining trust and supporting the sustainable development of the educational ecosystem. Ensuring transparency, data protection, non-discrimination, and accountability mitigates risks and improves the quality and reproducibility of research outcomes. Implementing clear university policies, reinforcing academic integrity, actively engaging ethics committees, and requiring disclosure of AI use in academic work collectively promote responsible and trustworthy practices. This approach contributes to the creation of a sustainable, secure, and resilient digital infrastructure that advances the long-term objectives of sustainable development in science and education.

References

Aleksandrova, O., Kolinko, M., Ishchuk, A., Kozlovets, M., Petryshyn, H., Hotsalyuk, A., & Taran, G. (2024). Understanding Intercultural Communication as a Condition for Sustainable Development. European Journal of Sustainable Development, 13(2), 261. https://doi.org/10.14207/ejsd.2024.v13n2p261

Almufarreh, A., Ahmad, A., Arshad, M., Onn, C. W., & Elechi, R. (2025). Ethical implications of ChatGPT and other large language models in academia. Frontiers in Artificial Intelligence, 8, Article 1615761. https://doi.org/10.3389/frai.2025.1615761

Androshchuk, A. H., & Malyuha, O. S. (2024). Use of artificial intelligence in higher education: State and trends. International Science Journal of Education & Linguistics, 3(2), 27–35. https://doi.org/10.46299/j.isjel.20240302.04

Artyukhov, A., Wołowiec, T., Artyukhova, N., Bogacki, S., & Vasylieva, T. (2024). SDG 4, academic integrity and artificial intelligence: Clash or win win cooperation? Sustainability, 16(8483). https://doi.org/10.3390/su16198483

Ateeq, A., Alzoraiki, M., Milhem, M., & Ateeq, R. A. (2024). Artificial intelligence in education: Implications for academic integrity and the shift toward holistic assessment. Frontiers in Education, 9, Article 1470979. https://doi.org/10.3389/feduc.2024.1470979

Avello, D., & Aranguren Zurita, S. (2025). Exploring the nexus of academic integrity and artificial intelligence in higher education: A bibliometric analysis. International Journal for Educational Integrity, 21, Article 24. https://doi.org/10.1007/s40979-025-00199-2

Balalle, H., & Pannilage, S. (2025). Reassessing academic integrity in the age of AI: A systematic literature review on AI and academic integrity. Social Sciences & Humanities Open, 11, Article 101299. https://doi.org/10.1016/j.ssaho.2025.101299

Berdo, R., Rasiun, V., & Velychko, V. (2023). Artificial intelligence and its impact on the ethical aspects of scientific research in Ukrainian educational institutions. Academic Visions, 22. http://dx.doi.org/10.5281/zenodo.8174388

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. Innovations in Education and Teaching International, 61(2), 228–239. https://doi.org/10.1080/14703297.2023.2190148

Crockett, R., & Howe, R. (2024). The inherent uncertainties of AI text detection and the implications for education institutions. In S. Mahmud (Ed.), Academic Integrity in the Age of Artificial Intelligence (pp. 175–198). IGI Global. https://doi.org/10.4018/979-8-3693-0240-8.ch010

European Commission. (2022). Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators. Publications Office of the European Union. https://doi.org/10.2766/153756

European University Association & Morrisroe, A., & Gaebel, M. (2023). The future of digitally enhanced learning and teaching in European higher education institutions: DIGI HE Final Report. European University Association. https://www.eua.eu/publications/reports/the-future-of-digitally-enhanced-learning-and-teaching-in-european-higher-education-institutions.html

Guizani, S., Mazhar, T., Shahzad, T., … et al. (2025). A systematic literature review to implement large language model in higher education: Issues and solutions. Discover Education, 4, Article 35. https://doi.org/10.1007/s44217-025-00424-7

Honchar, N., Tsegelnyk, T., & Shevchenko, O. (2025). Academic integrity in higher education institutions: Current approaches used to prevent plagiarism. Scientific Innovations and Advanced Technologies, 2(42), 1269–1281. https://doi.org/10.52058/2786-5274-2025-2(42)-1269-1281

Hurin, A. V. (2025). Academic integrity as the basis for a policy of using artificial intelligence technologies in higher education institutions. Pedagogical Academy: Scientific Notes. https://doi.org/10.5281/zenodo.15321735

Horban O., Babenko L., Lomachinska I., Hura O., Martych R. A knowledge management culture in the european higher education system. Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu. 2021. 3. P.173–177. https://doi.org/10.33271/nvngu/2021-3/173

Iliychuk L. Influence of artificial intelligence on the quality of education: Opportunities, challenges, and threats. Scientific Pedagogical Studies, 8, 232–248. https://doi.org/10.32405/2663-5739-2028-8-232-248

Islam, I., & Islam, M. N. (2024). Exploring the opportunities and challenges of ChatGPT in academia. Discover Education, 3, Article 31. https://doi.org/10.1007/s44217-024-00114-w

Ivannikova, M., Karpenko, N., Pedchenko, N., Strilets, V., & Birta, H. (2025). Academic integrity in scientific research. Scientific Bulletin of Poltava University of Economics and Trade, 1(115), 67–172. https://doi.org/10.37734/2409-6873-2025-1-24

Khoruzha, L. (2025). Scientific ethics and integrity in the embrace of artificial intelligence. Pedagogical Education: Theory and Practice. Psychology. Pedagogy, 43(1), 6–12. https://doi.org/10.28925/2311-2409.2025.43

Lodge, J. M. (2024, August). The evolving risk to academic integrity posed by generative artificial intelligence: Options for immediate action. Tertiary Education Quality and Standards Agency. Retrieved from https://www.teqsa.gov.au/sites/default/files/2024-08/evolving-risk-to-academic-integrity-posed-by-generative-artificial-intelligence.pdf

Lomachinska, I., Dobrodum, O., Ishchuk, O., Patlaichuk, O., Stupak, O., Shnitser, M. & Salo, H. (2025). Digital Citizenship and Knowledge Management in Education: Strategic Pathways to Sustainable Development. European Journal of Sustainable Development, 14(2), 747. https://doi.org/10.14207/ejsd.2025.v14n2p747

Milakis, E. D., Argyrakou, C. C., Melidis, A., & Vrettaros, J. (2025). ChatGPT and AI chatbots in education: An umbrella review of systematic reviews, scoping reviews, and meta-analyses. International Journal of Education and Information Technologies, 19, 100–119. https://doi.org/10.46300/9109.2025.19.11

Mortlock, R., & Lucas, C. (2024). Generative artificial intelligence (Gen AI) in pharmacy education: Utilization and implications for academic integrity: A scoping review. Exploratory Research in Clinical and Social Pharmacy, 15, Article 100481. https://doi.org/10.1016/j.rcsop.2024.100481

Moskalyuk, M., Moskalyuk, N., & Len, A. (2023). Artificial intelligence in higher education institutions: Advantages and disadvantages. Open Educational E Environment of Modern University, 15, 85–96. https://doi.org/10.28925/2414-0325.2023.157

Nazár, M. (2024). Artificial intelligence: At the beginning of an era of new possibilities for the education system. Bulletin of the National Academy of Pedagogical Sciences of Ukraine, 6(2), 1–4. https://doi.org/10.37472/v.naes.2024.6224

Osadchyi, V. (2024). Contemporary trends of digitalisation of management processes in higher education: Data analytics, cloud technologies and artificial intelligence. Educological Discourse, 1(44), 8–27. https://doi.org/10.28925/2312-5829.2024.11

Oshchepkova, T., & Tolstykh, O. (2024). Beyond ChatGPT: Roles that artificial intelligence tools can play in an English language classroom. Discover Artificial Intelligence, 4, Article 60. https://doi.org/10.1007/s44163-024-00158-9

Palamar, S., & Naumenko, M. (2024). Artificial intelligence in education: Use without violating the principles of academic integrity. Educological Discourse, 1(44), 68–83. https://doi.org/10.28925/2312-5829.2024.15

Rodrigues, M., Silva, R., Borges, A. P., Franco, M., & Oliveira, C. (2024). Artificial intelligence: Threat or asset to academic integrity? A bibliometric analysis. Kybernetes, 54 (5): 2939–2970. https://doi.org/10.1108/K-09-2023-1666

Sevnarayan, K., & Potter, M.-A. (2024). Generative Artificial Intelligence in distance education: Transformations, challenges, and impact on academic integrity and student voice. Journal of Applied Learning & Teaching, 7(1), 104–114 https://doi.org/10.37074/jalt.2024.7.1.41

UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC). (2024). ChatGPT and artificial intelligence in higher education: Quick start guide. UNESCO. Retrieved from : https://www.unesco.org/en/articles/chatgpt-artificial-intelligence-and-higher-education-what-do-higher-education-institutions-need-know

Yakovleva, O., Prus, N., & Zinchenko, O. (2025). Artificial intelligence as a threat and a tool of support for academic integrity in higher education. Information and Communication Technologies in Education. https://doi.org/10.5281/zenodo.17091970

Zabolotna, O., & Zahoruyko, L. (2025). Artificial intelligence and academic integrity: Questions without answers. Pedagogical Sciences: Theory, History, Innovative Technologies, 2(142), 221–230. https://doi.org/10.24139/2312-5993/2025.02/221-230