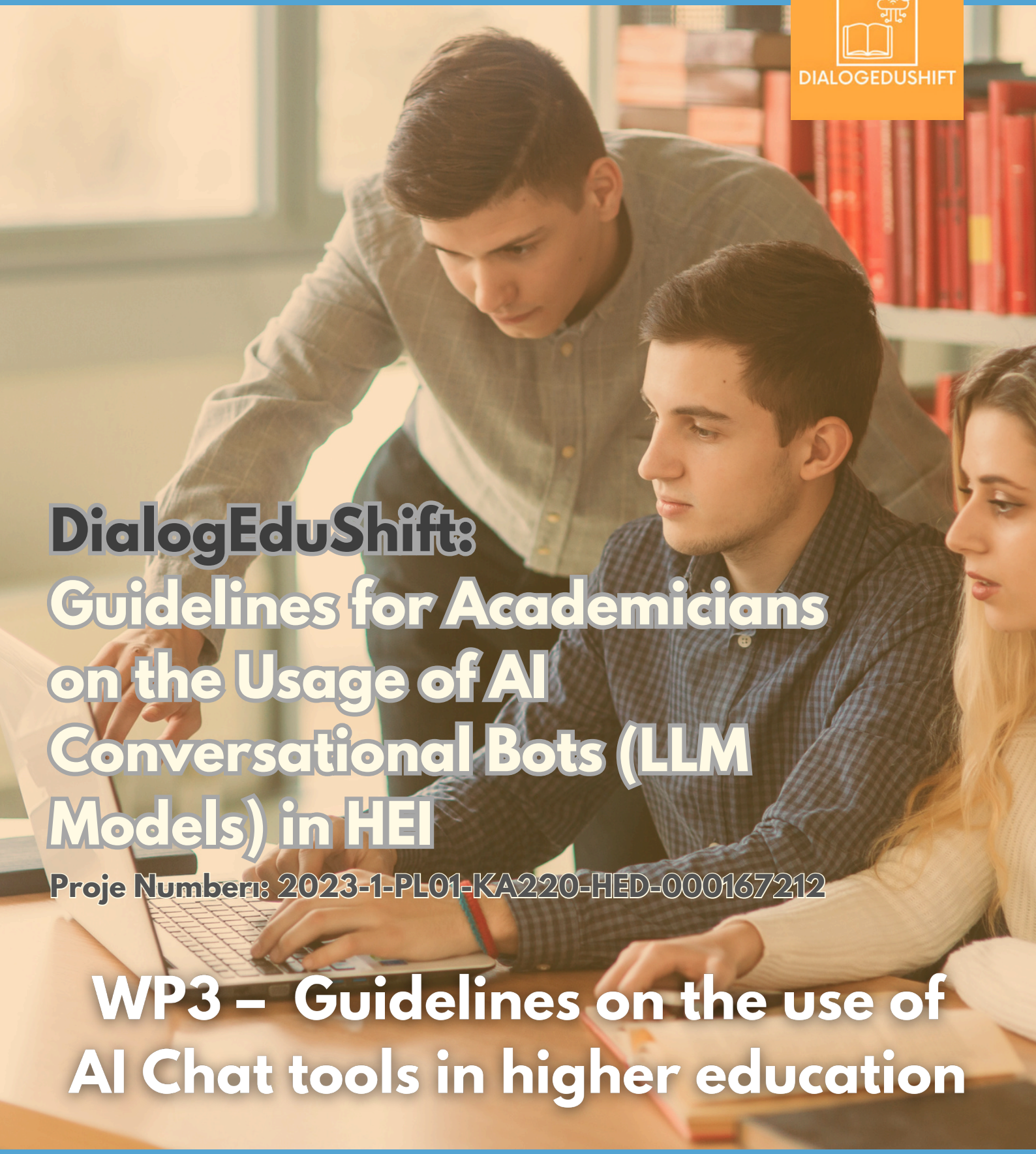

DIALOGEDUSHIFT

DialogEduShift: Guidelines for Academicians on the Usage of AI Conversational Bots (LLM Models) in HEI

Proje Numberı: 2023-1-PL01-KA220-HED-000167212

WP3 – Guidelines on the use of AI Chat tools in higher education

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"Transforming Higher Education Teaching and Evaluation Approaches in the Era of AI Chat Tools" (DialogEduShift)

No. 2023-1-PL01-KA220-HED-000167212

WP3. Guidelines for Academicians on the Usage of AI Conversational Bots (LLM Models) in HEI

2025

CONTENT

INTRODUCTION

Higher education directly and indirectly contributes significantly to the added value of the national economy, primarily through the multiplier effects generated by the application of citizens' skills, which enhance the productivity of other sectors. Despite the slow implementation of changes within the higher education sector, where, under stable policy and process conditions, transformations typically occur every five years, higher education remains a driver of innovation and novelty. The very environment of this sector fosters the emergence, development, and acceptance of new ideas and solutions.

Moreover, universities serve as hubs for human capital development, which is a key factor in long-term economic growth. They create the intellectual foundation for economic modernization and digital transformation. Through research systems and the implementation of scientific outcomes, higher education contributes to the improvement of production processes and products. University graduates not only enter the labor market but also help shape an entrepreneurial environment capable of generating new jobs.

The development of international cooperation in higher education promotes the transfer of advanced technologies and management practices into national economies. Higher education also influences the formation of a culture of sustainable development and social responsibility, which are critical for the modern economic model of national development. University ecosystems serve as platforms for the growth of startups and business incubators, thus enhancing economic dynamism. That is why effective change management in the higher education system is crucial for the sustainable development of a national economy.

Today, higher education is undergoing a transformation in how the learning process is organized and structured, under the influence of artificial intelligence technologies. On one hand, students actively use chatbots to solve academic tasks because they are widely available for free, and the paid versions are also relatively affordable. This leads to a dilemma regarding ownership

of the "results of the learning process." On the other hand, instructors employ AI tools in lesson preparation, delivery, and student performance assessment. As a result, the role of the teacher in the learning process is shifting.

These significant changes in the design of learning in higher education, driven by AI technologies, are real and are leading to the inductive development of AI usage approaches within the sector. In practice, this means that new AI usage methods and models are not always based on predefined regulations but rather emerge gradually through adaptation to specific challenges. Instructors experiment with AI tools, observe the results, and gradually derive effective strategies for their use. Meanwhile, universities establish internal policies that reflect local experience in AI integration.

This inductive nature is also seen in how policies and recommendations on AI usage are developed based on practical cases and examples, rather than imposed top-down. This creates a dynamic learning environment where students and educators jointly participate in shaping the new rules of the game in higher education. At the same time, costs are rising and the effectiveness of AI tools in education is decreasing, largely due to the absence of a unified standard for AI use in higher education.

The aim of Guidelines for Academicians on the Usage of AI Conversational Bots (LLM Models) in HEI under the project “Transforming Higher Education Teaching and Evaluation Approaches in the Era of AI Chat Tools” (DialogEduShift) No. 2023-1-PL01-KA220-HED-000167212 is to provide academicians with a standard AI conversational bots implementation into teaching activities with a focus on assessment, didactics, plagiarism, and other related concerns.

The specific objectives:

- ✓ Establish best practices for the integration of AI chat tools in academic settings
- ✓ Provide guidance on ethical considerations and academic integrity when using AI tools
- ✓ Offer strategies for leveraging AI chat tools to enhance teaching, assessment, and evaluation processes
- ✓ Facilitate effective communication and collaboration between students and academic staff using AI technologies
- ✓ Foster a culture of continuous learning and adaptation to new technological advancements within academia.

Standard AI conversational bots implementation into teaching activities includes:

- ✓ Issues of evaluating student works prepared with the use of AI chat tools;
- ✓ Issues of applying artificial intelligence tools in learning formats (lectures, practical classes, individual learning);

✓ Issues of using AI chat tools in course design;

✓ Issues of interaction and communication with the lecturer and classmates, questions of confidence.

he educational model for guidelines on using AI conversational bots in higher education is based on three key components: assessment, didactics, and academic integrity-communications (Figure 1).

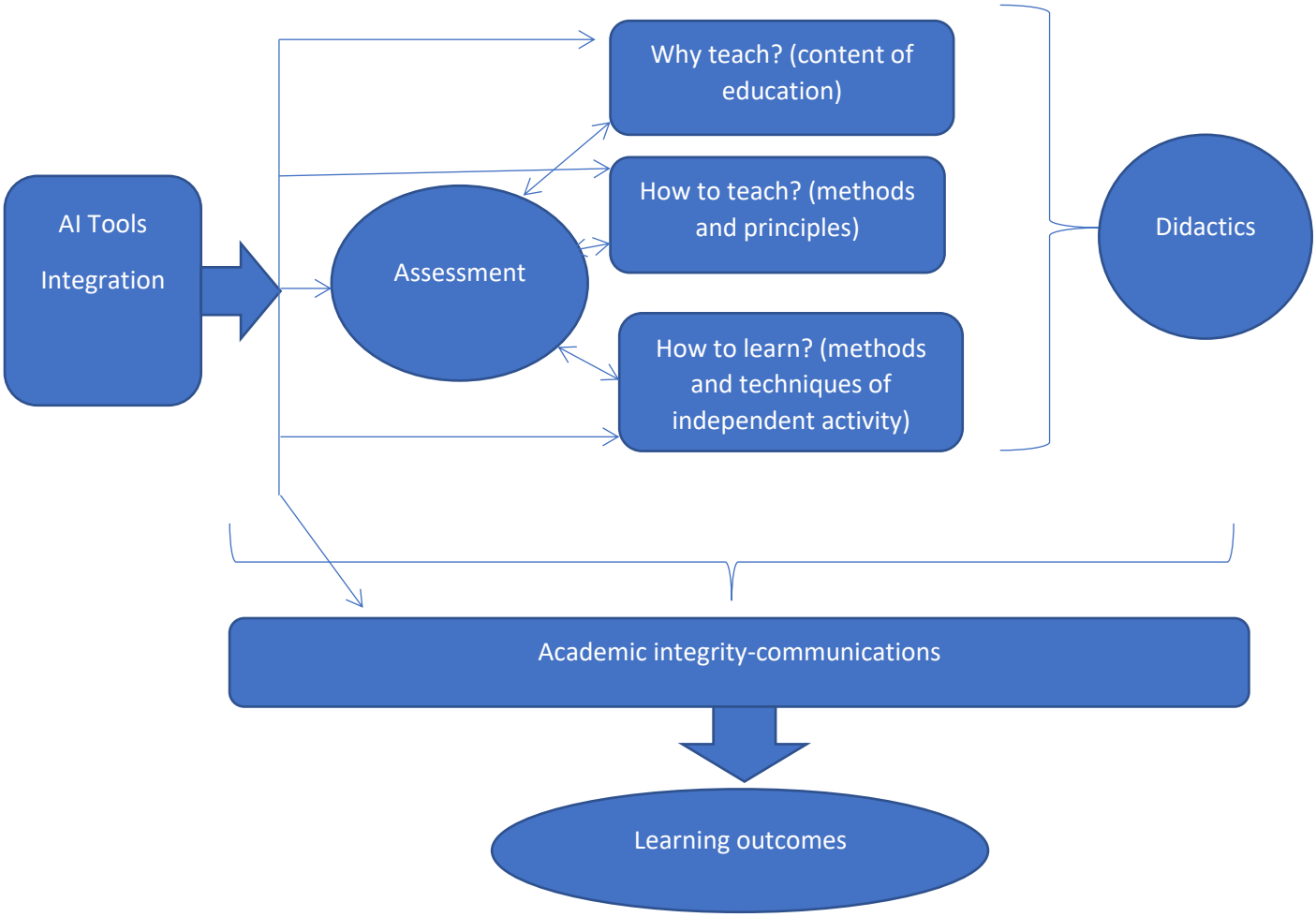

Figure 1. Model for guidelines on using AI conversational bots in higher education

There are three chapters in guidelines:

✓ Incorporating AI conversational bots in assessment and evaluation

✓ Integrating AI conversational bots in didactics and teaching methodologies

✓ Preventing and detecting plagiarism using AI conversational bots

Each chapter includes practical examples, tables, tests and structured recommendations demonstrating AI's implementation in education.

I. INCORPORATING AI CONVERSATIONAL BOTS IN ASSESSMENT AND EVALUATION

1) Designing Objective and Subjective Assessments with AI Bots

The assessment of students' work during their studies is one of the key components of the educational process, as it determines the level of material mastery and the effectiveness of learning. The relevance of this issue is growing due to the continuous development of technologies and new approaches to education that influence assessment methods. Modern assessment methods must take into account not only students' knowledge but also their ability for critical thinking, creativity, and independence. An important aspect is also ensuring the objectivity of the assessment, as traditional methods may be subject to the subjective influences of the instructor. Assessment should focus on the development of students and help them improve their skills, rather than just recording their mistakes. An essential part of the assessment process is also feedback, which allows students to understand their weaknesses and identify areas for improvement. Modern assessment approaches should integrate various aspects of learning, from knowledge to social and communication skills. Given these factors, the issue of assessing students' work remains extremely important for ensuring the quality of education in the context of changing educational standards and requirements.

Objective assessment is a form of knowledge evaluation based on clear and unambiguous criteria, where answers are automatically assessed and do not depend on the personal impression or subjective opinion of the instructor. These can include multiple-choice questions, true/false, fill-in-the-blank, or other types of tasks with one correct answer. Objective assessment involves evaluating responses where students' answers are clearly defined and unambiguous, without the possibility of interpretation or subjective evaluation by the instructor. Test tasks typically include multiple-choice questions, true/false statements, matching tasks, and other types of tasks where each answer has one correct solution. Objective assessment allows for the standardization of

knowledge testing and provides greater accuracy and speed in evaluation, as it is not influenced by the personal beliefs or preferences of the evaluator.

Subjective assessment is a type of evaluation where the instructor assesses a student's work based on personal judgment of its quality, depth, argumentation, and originality. This type of assessment is typically applied to tasks such as essays, research papers, projects, and other creative works, where there is no single correct answer. Subjective assessment involves a process of evaluation where not only the accuracy of the answer matters, but also the quality of its execution, the depth of analysis, creativity, and argumentation. Subjective tasks include essays, term papers, projects, presentations, and other types of work that require the instructor’s personal assessment. In this case, the student’s answer is evaluated not according to rigidly defined criteria, but through the instructor’s interpretation, which includes their own judgment regarding the logic, structure, originality, and creative approach to the task.

Objective and subjective assessments play important roles in the educational process, each with its advantages and functional characteristics. Let's take a closer look at the functions of each type of assessment and their interaction in the context of modern education.

Functions of Objective Assessment

Objective tests, including multiple-choice or matching tasks, are commonly used to assess students' knowledge, check their ability to memorize facts, and recall basic information. The main function of objective assessment is to standardize the evaluation process. This allows for equal conditions for all students, enabling comparison of results regardless of the instructor’s personal preferences or context. Due to clear and defined assessment criteria, objective tests eliminate the possibility of subjective interpretation of results, making them useful in contexts with large numbers of students or standardized exams.

Another important function of objective assessment is its efficiency and speed. Tests with automated grading allow for a significant reduction in the time required for evaluation. This enables instructors to provide students with feedback promptly, which is especially important in large courses. Such assessments are also scalable: large courses with numerous students can be evaluated without increasing the instructor's workload.

One of the main advantages of objective tests is the minimization of human error. Since evaluation of objective tests does not depend on the instructor’s interpretation, it ensures accuracy and consistency in results. It also reduces the likelihood of biased grading, which can be particularly important in multinational or international contexts. This makes objective assessment an essential tool for ensuring fairness in evaluating learning outcomes.

Equally important is the role of objective assessment in testing basic knowledge and skills. Since these tests focus on verifying facts and understanding fundamental concepts, they help students solidify the foundational knowledge and skills required for further learning. Therefore, objective assessment serves as an important tool for checking and reinforcing basic knowledge.

Functions of Subjective Assessment

Unlike objective assessment, subjective assessment has a broader range of functions related to deep understanding of material and the development of critical thinking. Evaluation based on open-ended tasks, such as essays, research papers, or projects, allows students to express their thoughts and opinions, as well as apply acquired knowledge in practice. Subjective assessment helps evaluate not only knowledge but also the student's ability to analyse and interpret material. This allows the instructor to assess the depth of understanding of the topic and the student’s ability for independent work and creative thinking.

One of the main functions of subjective assessment is the development of creative and analytical skills in students. Through such tasks, students have the opportunity to demonstrate their abilities to solve problems in original ways, create new ideas, and approach tasks from novel angles. For example, writing an essay or developing a project allows the student to dive deeper into the topic and produce unique work that reflects their personal views and ideas. It also stimulates the development of critical thinking since the student is required not only to absorb material but also to analyse it from different perspectives.

An important function of subjective assessment is also evaluating the student's communication skills. Since most subjective tasks involve writing texts or making presentations, the instructor can assess how the student expresses their ideas, how clearly and logically the argumentation is constructed, and how effectively appropriate terminology is used. This is an important aspect of developing not only academic but also professional skills that students will use in their future careers.

Subjective assessment also provides an opportunity to personalize the evaluation process. Each work can be assessed based on its uniqueness and the student’s individual approach. This allows the instructor to take into account not only the completion of the task but also creativity, novelty, and the depth of approach to problem-solving. In turn, this enables students to showcase their strengths and focus on aspects that might be absent in more standardized forms of assessment.

Additionally, subjective assessment allows instructors to provide personalized feedback. This gives students a detailed evaluation of their work, helping them understand where they can improve their skills and identify areas where they need additional help. Such feedback is crucial

for the further development of students and helps them realize how they can improve their knowledge and problem-solving approaches.

The interaction between objective and subjective assessment is crucial for providing a comprehensive and thorough evaluation of students' learning outcomes. Objective assessment allows for testing knowledge and understanding of basic concepts, while subjective assessment provides a deeper and more individualized evaluation, considering students' creative and analytical abilities. Combined, both types of assessments create a more accurate and objective picture of students' achievements and contribute to their overall development. For example, objective tests can be combined with subjective tasks that allow students to demonstrate their ability to creatively apply the knowledge they have acquired. This not only allows for checking facts but also evaluates how students can use those facts in real-life situations, bringing the evaluation process closer to real-world conditions.

Objective and subjective assessments are complementary components of the modern educational system. Each type of assessment has its unique functions, allowing not only the testing of students' knowledge but also the evaluation of their critical thinking, creativity, and independence. Together, these types of assessment provide a more accurate and comprehensive understanding of students' results, which is essential for their development and preparing them for successful professional careers. In the age of artificial intelligence, traditional assessment methods are gradually changing. Modern educational tools, including AI-based chatbots, offer instructors new opportunities to create effective, intuitive, and adaptive assessment systems. Thanks to these innovations, the evaluation process becomes more dynamic and personalized, as AI can account for both objective and subjective aspects of the learning process.

AI-based student work evaluation follows a systemic approach that includes multiple levels of analysis and assessment (Figure 2).

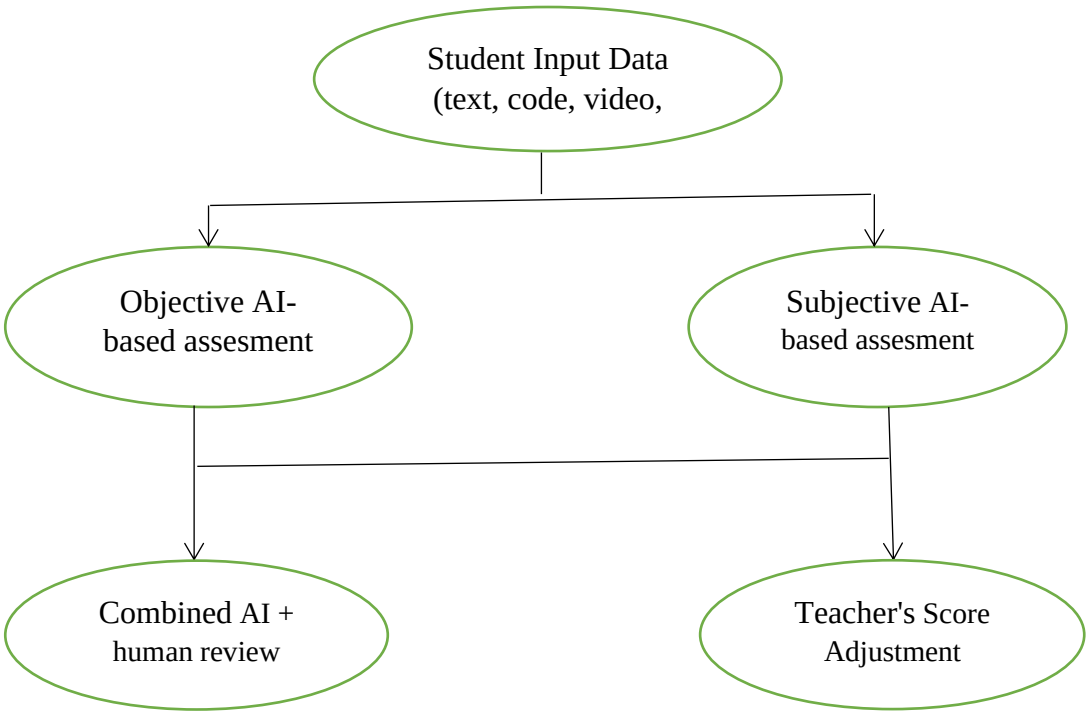

Figure 2. Scheme of Subjective and Objective AI-based Assessment (Developed by authors))

The assessment process begins when a student submits their work through a digital platform. This system can handle various types of input, including text documents, programming code, multimedia files, or structured reports. Before analysis begins, the system verifies the submission format to ensure compatibility with predefined requirements, such as supported file types, text length, or programming language. If needed, the system pre-processes the content by standardizing formatting, eliminating unnecessary characters, and converting it into a format optimized for AI evaluation.

Once the input is successfully uploaded, it undergoes two parallel evaluation processes: objective assessment and subjective assessment. The objective assessment focuses on measurable and factual elements, including fact-checking, plagiarism detection, and structural analysis. The AI compares the text against academic databases, research articles, and online sources to identify potential plagiarism, ensuring originality. It also evaluates factual correctness by cross-referencing statements with verified sources. Additionally, structural analysis examines whether the work follows a logical format, ensuring that key sections, such as the introduction, main body, and conclusion, are properly structured and connected. If the submission involves coding, AI tools check for syntax errors, logical consistency, and adherence to best programming practices.

Simultaneously, the subjective assessment evaluates the complexity of ideas, logic, creativity, writing style, and contextual appropriateness. Advanced natural language processing (NLP) models analyse how well the student constructs arguments and whether the reasoning follows a logical flow. The AI also identifies unique perspectives, original interpretations, and innovative problem-solving approaches to assess creativity. Writing style is examined for clarity, conciseness, and appropriateness to the academic context. Additionally, the AI determines whether the response aligns with the assignment's requirements, ensuring that students fully address the given topic.

After both assessments are completed, the system integrates the results into a final AI-human hybrid assessment. The AI generates a preliminary score based on weighted criteria from both the

objective and subjective evaluations. A structured feedback report is created, highlighting strengths, weaknesses, and areas for improvement. The report provides specific explanations for point deductions and includes confidence levels for each assessment category. If the AI detects ambiguities, inconsistencies, or elements that require nuanced interpretation, it flags them for human review.

At this stage, the teacher reviews and can adjust the AI-generated score if necessary. The educator receives a detailed report containing suggested scores and explanations of the grading rationale. If discrepancies arise, particularly in creative or highly analytical responses—the teacher can override AI assessments to ensure fairness and accuracy. This step ensures that subjective elements, such as argumentation quality and critical thinking, are fairly evaluated by incorporating human expertise.

Finally, the system generates a final score along with a detailed feedback report for the student. The student receives an evaluation that combines AI-driven analysis and human adjustments, ensuring a balanced and fair assessment.

The AI-based Assessment model could consists of several important elements that allow for comprehensive and objective evaluation of student work. Each element of this model serves a specific function, contributing to the accurate and effective analysis of submitted materials.

The first stage of evaluation is the structural analysis of the text, which aims to determine the logical sequence of its parts. This includes checking the division of the text into main structural elements: introduction, main body, and conclusion. An important part of this stage is identifying the presence of key theses and their connection with each other. If the text is logically structured, it indicates the student's ability to organize their thoughts and present information in a clear and coherent manner.

The next stage is linguistic analysis, which includes checking the morphological and syntactical correctness of the text. This analysis also evaluates the complexity of the language and the use of academic style, which is important for student work in higher education. Artificial intelligence automatically checks grammar, spelling, and punctuation, allowing students to receive instant feedback on language mistakes and improve their writing skills.

The stage of content relevance analysis focuses on checking the content relevance of the work to the assigned topic. Artificial intelligence evaluates whether the text corresponds to the specific theme and whether the level of argumentation meets the requirements for academic work. The analysis also checks for logical errors that might disrupt the connection between different parts of the work. An important aspect is assessing the depth of the topic's coverage and the use of facts to support arguments, which reflects the student's ability to independently analyse and conduct research.

One of the key aspects is the evaluation of academic integrity. Using AI, the system checks the work for plagiarism and external source borrowings. Additionally, it analyses the student's independence in completing the work, helping to determine how much the student worked on the topic independently and whether there are signs of dishonest practices, such as using other people's materials without proper citations.

Student work is graded using a multi-factorial grading scale, which allows for a comprehensive evaluation of different aspects of the assignment. Each stage of evaluation (structural analysis, linguistic analysis, content relevance, academic integrity) carries its own weight in the final grade, ensuring a fair and objective assessment. This grading system makes it possible to clearly highlight the strengths and weaknesses of the work, providing transparent feedback for students and opportunities for self-improvement.

The technical model of the AI-based assessment system includes the following elements:

1) submission interface;

2) pre-processing module;

3) content analysis module;

4) academic integrity checking module;

5) evaluation module;

6) feedback generation.

The first stage of the technical model is the submission interface, through which students upload their assignments to the digital platform. This interface must be simple and intuitive, allowing students to easily upload their work in formats supported by the system. The platform must ensure accessibility for all users and be adaptable to different devices, such as computers, tablets, and smartphones. A crucial part of this stage is data security, so the platform must have an appropriate level of protection to guarantee the confidentiality of student work. This stage is the initial step and determines the ease of submitting assignments, which impacts the effectiveness of the subsequent stages of evaluation.

Once the work is uploaded to the platform, the system proceeds to the pre-processing stage. At this stage, the text is cleaned of unnecessary symbols, such as extra spaces, formatting characters, or non-standard signs. The module checks the document's formatting, including the verification of fonts, paragraphs, numbering, and other structural elements of the text. This stage ensures the uniformity of the text, allowing for the avoidance of interpretation or evaluation errors due to non-compliance with formatting standards. Pre-processing ensures the accuracy of the subsequent analysis, as all assignments receive the same conditions for assessment.

The content analysis module examines the semantic consistency and logical structure of the text. Using NLP algorithms (Natural Language Processing), the system is capable of identifying

the main ideas of the text, checking for the presence of key theses, their logical connections, and sequence. At this stage, it is analysed whether the student adheres to the main topic and whether the material is logically presented. The system also evaluates how well the work meets the assignment requirements, checking if the text contains relevant arguments, examples, and evidence. Therefore, this stage ensures a high-quality analysis of the intellectual content of the work.

The academic integrity checking module compares the submitted work with existing databases, including other works, scientific articles, and online resources, to detect plagiarism or borrowing without proper citation. This stage is extremely important for ensuring fairness in the evaluation process and combating violations of academic standards. The system analyses the text for similarity with other sources, detecting potential plagiarized fragments. The results of this analysis can be used for further verification by the student and improvement of academic integrity. Importantly, this stage automates the verification process, saving time for instructors and improving the accuracy of detecting violations.

Based on the previous stages, the evaluation module calculates the final score for the assignment. Considering all aspects of the text, structural, linguistic, content-related, and academic integrity, the system determines the final score for the work. The evaluation can be determined using several formulas that take into account the importance of each element, from logical sequence to the depth of argumentation and the presence of integrity violations. Additionally, the system can automatically adjust the score, considering the importance of different parts of the assignment, such as the introduction, main body, and conclusion. This allows for an objective and fair evaluation of the assignment results.

In the final stage, after the evaluation is completed, the student receives detailed feedback with explanations and recommendations for improving the work. This feedback may include pointers on the strengths of the work and the aspects that need improvement. The system generates feedback that not only explains why the student received a particular grade but also provides specific advice on how to improve writing style, argumentation, or use of sources. This stage is important for students' development, as it gives them a clear understanding of their weaknesses and opportunities for self-improvement.

The systematic approach to assessing student work through AI ensures objectivity, standardization, and speed of evaluation. Automation of the process allows for the personalization of the learning experience and provides students with detailed feedback on their mistakes and ways to improve.

Objective Assessment through the Lens of AI

The use of AI for objective assessment is gaining increasing popularity in educational institutions, as it allows for the automation and acceleration of the process of evaluating student knowledge. Modern tools, such as AI-based chatbots, can create test tasks that account for the individual characteristics of each student, enhancing the quality and accuracy of assessments.

One of the main tasks when using AI for creating objective tests is the automatic generation of questions that meet the course requirements. This involves the use of machine learning algorithms, specifically natural language processing, which can analyse large volumes of educational material and, based on this, create test tasks that correspond to the students' level. Chatbots can create multiple-choice questions, matching tests, as well as fill-in-the-blank and completion questions.

Example: In a microeconomics course, where knowledge of supply and demand theory is evaluated, AI could automatically generate a question such as "Which of the following principles is fundamental to the supply and demand model?" with answer options:

A. Law of Demand

B. Law of Supply

C. Equilibrium Theorem

D. Law of Minimum Costs

The chatbot could also automatically determine the correct answer (e.g., "A. Law of Demand") and highlight the student's errors, providing explanations for each response.

Using Algorithms for Question Generation

Modern algorithms used to create such tests can be based on machine learning. For example, algorithms that work based on neural networks can use texts from lectures or textbooks to automatically generate question variants. They are capable of analysing a large amount of educational material and creating questions that not only cover various aspects of theory but also test students' understanding of the practical application of concepts.

It is important to use different types of questions to ensure the objectivity of the assessment. For instance, multiple-choice questions can be used to check general understanding, while matching or fill-in-the-blank questions help determine students' ability to apply knowledge in practice.

Methods of Automatic Test Evaluation

Once the test is created, it is important to ensure automatic evaluation of students' answers. For this purpose, AI-based chatbots can use analytical algorithms that compare the entered answer with the database of correct answers and automatically provide the student with a grade. The

algorithm can also determine whether the student correctly applied a concept, whether the correct calculation was performed in a problem, and offer explanations in case of errors.

Example: In the case of mathematical tasks, such as solving economic problems with calculations, the chatbot could automatically check the student's solution by comparing the student's calculations with the correct results. If an error occurs, the bot could provide a hint to help the student correct their approach.

One of the advantages of AI is the ability to personalize tests for each student. Based on data from previous student results, the chatbot can adjust the difficulty of tasks, increasing their level according to the achieved progress. This allows for the creation of adaptive tests that provide the most accurate assessment of a student's abilities at different stages of learning.

Example. If a student successfully answers a series of simple questions, AI could start including more complex tasks, based on the student's continued high performance in task completion. In contrast, for a student struggling with basic questions, the system could reduce the task difficulty and offer additional learning materials.

Subjective Assessment, AI as a Partner in Evaluation

An important element of the educational process is the assessment of subjective tasks, such as essays, research papers, creative projects, and more. In these cases, AI-based chatbots can significantly ease the work of teachers by providing an automated evaluation that considers not only grammar and spelling but also the structure of arguments, the logic of thought presentation, and the originality and creativity of the work.

Essay Evaluation with AI

Evaluating essays or written papers is much more complex than automatic test checking, as it requires not only fact-checking but also the assessment of stylistics, structure, and logic of presentation. For this, deep learning algorithms and neural networks are used, which analyse the text on several levels. For example, chatbots can check whether the text is logically structured, whether it has a clear introduction, main body, and conclusion.

Example: In a marketing course, a student might write an essay on the topic "How digital technologies are changing consumer habits." The chatbot can not only assess the correct use of marketing terms but also analyse the logical construction of the text, the level of topic coverage, the presence of specific examples and facts. AI can also evaluate the style of the presentation: whether the text is too dry or overly emotional, which could impact its effectiveness in business analysis.

Determining Coherence and Argumentation

Evaluating the coherence of a text is one of the most important components of subjective assessment. AI is capable of determining whether the text is logical and whether there is a connection between different parts of the essay. NLP-based systems can use algorithms to recognize the structural elements of the text, such as the introduction, the main body, and the conclusion, and assess how well they interact with each other.

To ensure accurate evaluation, it is important to develop clear criteria for each stage of essay writing. For instance, one could assess how many logical conclusions the author makes or whether the text contains excessive or unclear arguments.

Coherence is defined as the logical consistency of the text, which ensures a smooth transition between its components, facilitating the holistic perception of information. Argumentation, on the other hand, reflects the degree of persuasiveness and substantiation of the statements made, which is a key factor in scientific, journalistic, and analytical texts.

AI is capable of analysing a text for coherence, determining whether there is a logical connection between sentences, paragraphs, and sections. Modern natural language processing systems use algorithms to recognize structural elements of the text, such as the introduction, the main body, and the conclusion. This allows for assessing how well these parts interact, whether the text is clear and logically structured.

Methodology for Assessing Coherence and Argumentation

To ensure accurate assessment of coherence and argumentation, a structured approach is necessary, involving both qualitative and quantitative text analysis. The main steps of the methodology are:

1. Analysis of the logical structure of the text, which includes identifying the key structural elements (introduction, main body, conclusion) and checking the logical connections between them. To measure structural coherence, the coherence coefficient (CC) can be used:

$$CC=LC/TS, \quad (1)$$

LC is the number of logical connections between paragraphs;

TS is the total number of sentences in the text.

2. Assessment of argumentation, which involves determining the number of arguments and their relevance to the topic. The effectiveness of argumentation can be evaluated using the argumentation density coefficient (ADC):

$$ADC=A/S, \quad (2)$$

A is the number of arguments;

S is the total number of main statements in the text.

3. Using NLP algorithms that allow for automatic analysis of textual relationships, thematic relevance, and identification of stylistic features. One important parameter is semantic coherence (SC), which is determined by calculating the similarity between consecutive sentences or paragraphs using cosine similarity.
4. Quantitative and qualitative analysis, which involves calculating the overall coherence score of the text by integrating several indicators, such as structural connectivity, logical sequence, and argument relevance.

The application of such a methodology allows for objective assessment of the coherence and argumentation of a text, combining classical analysis approaches with the capabilities of artificial intelligence and NLP technologies.

2) Ensuring fairness and accuracy in AI-generated assessments

Fairness in AI-generated assessments refers to the principle that all students, regardless of background, demographics, or prior experiences, should be evaluated on equal grounds. This involves eliminating biases that may disadvantage certain groups and ensuring that AI-driven decisions are transparent and equitable.

Accuracy pertains to the AI system's ability to correctly evaluate student responses, minimizing false positives (incorrectly awarding points) and false negatives (incorrectly deducting points). Accuracy is crucial for maintaining the credibility and validity of AI-assisted grading.

Both fairness and accuracy are interdependent; an inaccurate system can lead to unfair results, while an unfair system inherently reduces accuracy by misrepresenting students' true abilities.

Ensuring fairness and accuracy in AI-generated assessments is a critical aspect of implementing AI technologies in education. As AI-based systems play an increasing role in evaluating student performance, it is essential to establish mechanisms that guarantee the reliability and transparency of assessments. The first step in ensuring fairness is the design of the AI algorithm itself. AI models must be developed and trained on a diverse and representative dataset to avoid bias. A model trained on data from a single demographic or specific academic context may inadvertently favour certain groups of students over others. For instance, an AI system

trained on English-language academic texts might not accurately assess a student's performance if they are writing in a non-native language.

Another factor affecting fairness is the continuous evaluation and updating of the AI models. The accuracy and fairness of an AI system can degrade over time if it is not regularly monitored and retrained. In addition to frequent updates, the involvement of educators in the validation of AI-based assessments is necessary. Educators' expertise helps ensure that the AI system remains aligned with educational goals, standards, and expectations. Teachers can also provide insights into areas where the AI model might be failing to accurately assess students, especially in more subjective areas like creativity and critical thinking.

Transparency is a vital principle in ensuring fairness. Students should be fully aware of how their work is being assessed by the AI system. Providing students with a clear understanding of the evaluation criteria, such as how their text is analysed for grammar, logic, and structure, allows them to trust the system. Additionally, transparent feedback on how the AI arrived at a particular grade gives students the opportunity to understand the reasoning behind the assessment and identify areas for improvement. This transparency also helps address any concerns students might have regarding the objectivity of AI in evaluating their work.

Furthermore, the AI system must be designed to handle edge cases and exceptional situations where human judgment is required. While AI can process large amounts of data and make rapid decisions, it may not always be able to account for nuances in students' submissions that require human insight. For example, a student may present an argument that challenges conventional academic viewpoints, and while the AI system might classify it as incorrect, an educator's subjective analysis could recognize the originality and validity of the argument. Therefore, a hybrid approach that combines AI with human oversight is crucial in ensuring that complex or ambiguous cases are fairly evaluated.

The use of diverse evaluation metrics is also important to ensure accuracy in AI assessments. A single metric, such as grammar or structure, may not fully capture the quality of a student's work. AI systems should use multiple criteria to assess different aspects of a submission, including content quality, logical flow, argumentation, and creativity. By using a multi-dimensional approach, AI systems can provide a more balanced and comprehensive evaluation. Furthermore, fairness can be promoted by ensuring that AI assessments are aligned with the learning objectives of the course. The system should assess the students' ability to meet the specific goals set for the course rather than providing a generic evaluation.

Another critical element is to prevent the over-reliance on AI for assessing students' performance in all areas. While AI is efficient and consistent in certain types of evaluation, such as checking for spelling and grammatical errors or ensuring logical structure, it may not be as

effective in evaluating more subjective or abstract qualities such as creativity or innovative thinking. In these cases, human assessors can complement AI by providing nuanced judgments and evaluations that consider the broader context of the work.

Moreover, ensuring fairness also requires protecting student data. Since AI-based assessments often involve collecting and analysing student data, it is essential that this data be stored and processed securely. Strict data privacy policies should be in place to prevent unauthorized access to personal information. Additionally, students should be informed about how their data is being used and have the option to opt-out if they are uncomfortable with AI-based evaluation methods. Ethical concerns regarding data usage and surveillance should also be addressed through transparency and consent mechanisms.

In order to further enhance the fairness and accuracy of AI assessments, regular audits and evaluations should be conducted. This includes assessing the impact of the AI system on diverse student groups to ensure that it does not inadvertently disadvantage certain populations. For example, students from different cultural backgrounds or those with disabilities may interact with the AI system in different ways, and it is crucial to identify and address any disparities in the outcomes of the assessment. These audits should involve feedback from students, educators, and technologists to ensure that all perspectives are considered.

Finally, the integration of AI assessments within a broader educational ecosystem that includes human-driven assessments is key to creating a balanced and equitable system. While AI can automate many aspects of evaluation, human instructors provide an essential layer of subjective judgment, creativity, and empathy that AI cannot replicate. By combining the strengths of both AI and human assessment, educational institutions can create a more accurate, fair, and comprehensive assessment model that benefits all students.

In conclusion, ensuring fairness and accuracy in AI-generated assessments requires a multi-faceted approach. It involves transparent algorithms, diverse evaluation metrics, regular updates, the involvement of educators, data security, and human oversight. By adopting these strategies, AI can become a valuable tool in the educational process, offering more accurate, objective, and personalized feedback to students while minimizing potential biases and inaccuracies. Ultimately, the goal is to enhance the learning experience and foster a fair environment where all students are assessed based on their true abilities.

The theoretical model for ensuring fairness and accuracy in AI-generated assessments includes several key elements that ensure the reliability and objectivity of evaluations, as well as compliance with ethical and academic standards. The main elements of this model are: algorithm transparency, inclusiveness and diversity of training data, regular updates and adaptation of the model, human involvement in the evaluation process, context assessment and adaptation,

plagiarism and academic integrity checks, generation of objective feedback, and system monitoring and auditing.

Algorithm transparency is fundamental for ensuring fairness in assessments. All students should have access to clear information about the evaluation criteria, algorithms used to assess their work, and how artificial intelligence interacts with the data. This transparency allows participants in the educational process to understand how grades are determined and reduces the potential for unfair or erroneous grading due to the unpredictability or complexity of algorithms.

To ensure accuracy and fairness in assessments, algorithms should be trained on diverse datasets that include representatives from different age, gender, nationality, social status, and other characteristics. The use of homogeneous or limited datasets can lead to biased evaluations, where the system tends to favour one type of student or work. This also involves the necessity of including different academic contexts and language variants, allowing the system to be sensitive to various learning styles and expressions.

To ensure fairness and accuracy, algorithms must be regularly updated and adapted to changes in curricula, student writing styles, and new academic requirements. This process includes regularly checking the system for potential biases or accuracy issues. Updates should also consider feedback from students and teachers regarding their experience with AI assessment systems and identify potential shortcomings.

Artificial intelligence has limitations when evaluating more complex or subjective aspects of work, such as creativity, critical thinking, or originality. Therefore, it is important to combine automated assessments with human oversight. Human instructors can help correct automated evaluations concerning complex, non-standard situations, such as original ideas or interpretations. This allows the system to be more flexible and fairer, providing a more accurate evaluation of creative works.

Another important aspect is ensuring that the system can account for the context in which the work was performed. This relates not only to academic requirements but also to cultural, linguistic, and social differences that may influence the style and content of the work. AI must be able to adapt to different grading standards that vary depending on the cultural context, avoiding shortcomings or errors caused by neglecting these factors.

A key component of the theoretical model is ensuring academic integrity through plagiarism checks and the detection of uncredited borrowing. Artificial intelligence should have built-in mechanisms to compare texts with external databases, enabling the detection of any signs of copyright violations and academic standard breaches. This element ensures fairness and accuracy, protecting the reputation of educational institutions and upholding ethical principles in the educational process.

Work evaluations should be accompanied by objective and detailed feedback. Students must receive a clear explanation of why their work received a particular grade, as well as specific recommendations for improvement. This ensures fairness in the evaluation process and allows students to refine their skills. Feedback should also be personalized and focused on the student's individual weaknesses, helping to more accurately pinpoint areas for improvement.

An important element in ensuring fairness and accuracy is the regular monitoring of the system's operation and conducting audits to identify potential biases or errors in evaluation results. These checks may include both technical analysis of algorithms and studying results based on specific student groups, helping to identify possible fairness violations in the assessment of different categories of students.

TESTS

1. What is the main purpose of assessing students' knowledge?

a) To determine whether students are ready for work

b) To assess the level of material mastery and learning effectiveness

c) To check how well students perceive the information

d) To determine how much time students spent studying

2. What is an important component of objective assessment?

a) The personal opinion of the instructor

b) Identifying correct and incorrect answers

c) The student's creative approach

d) The quality of writing an essay

3. What characterizes subjective assessment?

a) Clearly defined evaluation criteria

b) Evaluation based on the instructor's personal judgment

c) The use of automated tests

4. What is a function of subjective assessment?

a) Standardizing the assessment process

b) Checking the student's basic knowledge

c) Developing students' creativity and analytical skills

d) Evaluating only factual accuracy

5. How does subjective assessment help in students' development?

a) It checks how much the student has absorbed factual knowledge

b) It determines whether the student completed the task correctly

c) It helps develop critical thinking and analytical skills

d) It evaluates only knowledge, without considering skills

6. What is an important part of subjective assessment?

a) Using clear criteria for evaluation

b) Using an automated grading system

c) Providing personalized feedback from the instructor

d) Evaluating only factual knowledge

7. What is the main purpose of the objective assessment process in AI-based evaluation?

a) To evaluate creativity and originality

b) To check for plagiarism and fact-check content

c) To assess the writing style and clarity

d) To provide personalized feedback to students

8. Which of the following processes is part of the objective assessment of student work?

a) Checking the depth of the topic

b) Evaluating structure and logical sequence

c) Analyzing writing style

d) Determining the originality of arguments

9. What does the subjective part of the assessment focus on?

a) Factual accuracy

b) Structural correctness

c) Idea complexity, creative approach, logic, and writing style

d) Consistency with other works

10. What does the academic integrity module in the AI system check for?

a) Checking for grammatical errors

b) Comparing the student's work with databases to detect plagiarism

c) Evaluating the correctness of logical conclusions

d) Checking for compliance with the work format

ANSWERS

1) b; 2) b; 3) b; 4) c; 5) c; 6) c; 7) b; 8) b; 9) c; 10) b.

3) Addressing Potential Biases in AI Assessment Tools

AI-driven assessments, while offering scalability and efficiency, are vulnerable to biases that may lead to unfair or inaccurate evaluations of student's work. These biases arise from multiple factors, including the data used to train AI models, the design of algorithms, and the limitations of AI in handling complex human responses.

There are key areas where bias and inaccuracies can develop (Figure 3).

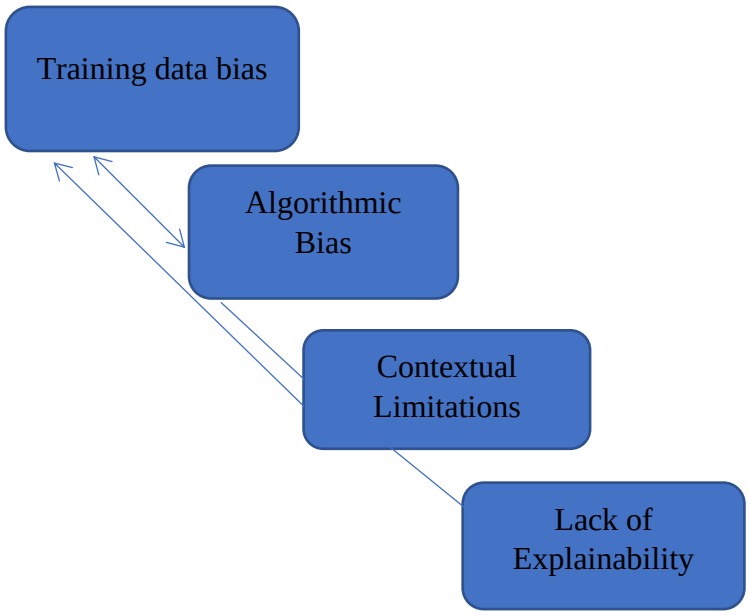

Figure 3. Key Areas of Potential Biases in AI Assessment Tools (Developed by authors)

Training data bias occurs when AI models learn from datasets that do not adequately represent the diversity of student populations. If certain demographics, linguistic groups, or educational backgrounds are underrepresented in the training data, the AI model may fail to fairly assess responses from those groups.

For example, an AI-based English writing assessment tool trained primarily on essays written by native English speakers may systematically miss grammatical structures commonly

used by non-native speakers. This could result in lower scores for certain groups, not due to poor writing skills but because of the AI's inability to recognize linguistic variations.

For potential biases in AI assessment tools could be used different mitigation strategies:

1. Curating diverse and representative training datasets that include various cultural, linguistic, and socio-economic backgrounds. To ensure the effectiveness and accuracy of an AI model, it is crucial to create training datasets that reflect the diversity of cultures, languages, and socio-economic contexts. This helps to avoid biases that may arise when assessing the work of students from different groups. Using a wide range of examples enables the model to better understand and process texts written in various linguistic styles and social contexts.

It is important to consider diversity not only in language variations but also in the terms used across different cultures. Incorporating diverse types of data allows for the creation of more inclusive and effective evaluation algorithms. For instance, when dealing with international students, the model should be able to adapt to different linguistic and cultural contexts. Such a dataset reduces the risk of biased assessments and helps ensure a fairer evaluation for all students.

Adding diverse examples also contributes to a better understanding of global learning trends. This enhances the AI's ability to be more universal and fairer in assessing student work. Thus, a well-selected and diverse dataset improves both the accuracy and fairness of the system.

2. Regularly updating datasets to ensure that AI models reflect current language usage and educational standards. Since languages and educational standards are constantly evolving, regularly updating training data is a key strategy for maintaining AI relevance. Models must reflect the latest changes in linguistic environments and educational practices to ensure they remain up-to-date and effective.

For example, new terms, slang expressions, or shifts in scientific terminology should be incorporated into the training material so that models can recognize and use them correctly. Updates also allow AI to adapt to changes in educational standards, such as new assessment criteria or modifications in institutional policies. Models that are not updated may begin to produce outdated or inaccurate evaluations, negatively affecting assessment quality.

Regularly updating databases helps prevent biases related to technological or cultural lag. For instance, integrating new linguistic structures or policy changes enables AI to maintain its effectiveness and accuracy. Another crucial aspect of updating is adapting to global shifts in education, such as new approaches to digital learning or evolving assessment methods.

Regular updates not only enhance relevance but also contribute to more objective and precise results. Thus, continuous data updates are an essential component for the successful operation of AI in the educational environment.

3. Implementing fairness audits to detect disparities in scoring across different demographic groups. Implementing fairness audits is a necessary step in identifying potential differences in assessments among various demographic groups. These audits help detect biases that may influence student evaluations based on their background, gender, ethnicity, or socio-economic status.

During an audit, assessment results are analysed to determine whether there are statistical discrepancies in grading across specific student groups. This helps identify whether the model tends to assign higher or lower scores to certain groups. Such an audit may also include testing algorithms for their sensitivity to different linguistic variations or cultural differences.

If significant disparities in assessments are found, this signals the need for model adjustments to ensure equal opportunities for all students. Periodic audits also help eliminate potential biases that may arise in the automation of assessments. For instance, certain words or phrases may be misinterpreted by the model, leading to inaccurate evaluations.

Fairness audits allow for the identification of such issues and enable algorithm corrections to ensure accurate and unbiased results for all groups. This is a crucial step in promoting transparency and equity in AI-driven assessment systems, contributing to a more inclusive and fairer educational environment.

Another is of potential biases in AI assessment tools is algorithmic bias. Algorithmic bias arises from the way AI models process information and make predictions. Certain algorithmic choices, such as weighting specific features over others, may inadvertently introduce discrimination. For instance, an AI system that evaluates student responses based on sentence length may favour verbose answers over concise but well-reasoned ones.

Another example is in multiple-choice question grading, where AI models may over-rely on statistical patterns rather than true comprehension. If students from certain backgrounds are more likely to answer in a specific way, AI may incorrectly assume their responses are incorrect, reinforcing existing disparities.

We propose mitigation strategies:

1. Using fairness-aware algorithms that actively detect and correct biased scoring patterns. The use of fairness-oriented algorithms is a key approach to identifying and correcting biased assessment models. These algorithms actively analyse data to detect patterns of biased evaluations that may arise due to factors such as gender, ethnicity, or students' socio-economic status.

During the assessment process, the algorithm examines grading patterns to identify potential discrepancies between groups, detecting deviations from ideal fairness. For instance, if the algorithm finds that one group of students consistently receives lower scores compared to another,

it can automatically adjust the evaluations. These algorithms utilize specialized fairness metrics, such as equal opportunity or equal outcomes, to prevent bias in the assessment process.

Applying such methods ensures that all students have equal opportunities to achieve high scores, regardless of their background or social factors. Fairness-oriented algorithms also incorporate mechanisms to adjust scores when disparities are detected. They can adapt to new data, continuously improving the assessment process.

This approach helps create a more inclusive educational environment and reduces the risk of negative consequences for certain student groups. Ultimately, such algorithms contribute to fairer evaluations and minimize bias in automated grading systems.

2. Applying adversarial testing techniques, where intentionally diverse test cases are introduced to evaluate AI performance across different groups. The application of adversarial testing methods is an effective strategy for evaluating AI performance across different student groups. This approach involves introducing deliberately diverse test cases that represent various social, cultural, or linguistic groups to examine how AI handles these variations. It helps identify potential issues and biases that could affect students' scores from different backgrounds.

For example, test cases may include texts written by students from different linguistic or cultural contexts to assess how the model responds to these differences. This method allows AI to be tested in real-world scenarios where students may use different writing styles or terminology.

Adversarial testing also helps detect system failures that could lead to inaccurate grading for certain groups. It is essential to ensure that AI is not overly sensitive to specific characteristics that may reduce grading accuracy. These techniques verify whether assessments are fair, regardless of the context in which they were produced.

Such testing ensures the proper functioning of the evaluation system across diverse cultural and linguistic variations. This approach is widely used to test algorithms before their implementation in real educational settings to mitigate bias risks. Through these tests, AI algorithms' performance and fairness can be significantly improved.

3. Implementing multi-metric evaluation approaches that balance various factors in assessment rather than relying on a single metric. The implementation of assessment approaches using multi-factor metrics is crucial for achieving a more objective and fair evaluation of student work. This approach involves considering several different factors during assessment, providing a completer and more accurate picture of the student's performance. For example, in addition to classic evaluations of grammar and text structure, other aspects such as argumentation, originality, and the level of research can be considered.

Many assessment models that use only one metric may be biased or fail to account for all aspects of the student's work. The use of multiple metrics allows for a balance between different

factors, avoiding excessive focus on one aspect and reducing the likelihood of erroneous evaluations. For instance, if a model focuses solely on grammar, it may result in a lower score for a student who uses unconventional but original ideas.

Multi-factor approaches allow for a better assessment of both creativity and technical aspects of the work. This enables a more precise evaluation of student performance, considering all its important components. Such an approach helps maintain objectivity when assessing creative or complex tasks, where a single metric cannot adequately assess the full range of qualities.

The application of multi-factor approaches also enhances the inclusivity of assessments, accounting for various approaches and styles in task completion. As a result, these strategies contribute to a fairer and more accurate evaluation of student outcomes.

Contextual limitations are additional potential biases in AI assessment tools. AI struggles with accurately interpreting subjective or creative responses, which can lead to inconsistencies in grading. Unlike human assessors, AI lacks contextual understanding and the ability to appreciate nuance, such as sarcasm, humour, or abstract reasoning.

For example, an AI system used for essay grading might focus primarily on grammatical accuracy and structure while failing to evaluate deeper critical thinking, originality, or argumentation strength. Similarly, in creative subjects like literature or philosophy, AI may misinterpret unconventional but valid responses as incorrect.

We propose mitigation strategies:

1. Combining AI evaluation with human review, especially for complex or subjective assessments. The use of AI for assessment has significant potential, but in many cases, it needs to be combined with human analysis. This is particularly important for complex or subjective evaluations, such as essays, creative projects, or oral responses. A human expert can consider the context, individual writing style, and unconventional approaches to solving tasks, which may be overlooked by algorithms. For example, AI can automatically assess grammar and text structure, while the instructor checks the logic of the argumentation and the depth of analysis. This ensures a balance between the efficiency of automated checking and the nuance of human judgment.

Such an approach also helps prevent unfair grade reductions due to the technical limitations of AI. Additionally, the system can alert instructors to potential errors or unusual cases that require further attention. This allows for more accurate analysis and reduces the risks of automated biased assessment.

The combination of AI and human expertise contributes to improving the quality of the educational process. As a result of this strategy, students receive more objective and fair evaluations that better reflect their true knowledge and skills.

2. Designing AI models that incorporate natural language processing techniques capable of better understanding context and meaning. The use of natural language processing technologies in AI models significantly improves the quality of student assessment. Conventional algorithms are often limited in their ability to analyze context and may misinterpret certain phrases or logical connections. NLP models enable AI to understand the content of the text more deeply, distinguishing sarcasm, metaphors, and other linguistic features. This is especially important when assessing analytical or creative tasks, where simply counting correct answers does not provide a complete picture. For instance, NLP can analyze the argumentative structure of a text and determine how logically the student's reasoning is built.

Such models can adapt to different writing styles and educational contexts, reducing the likelihood of unfair grading. The use of NLP also improves the analysis of responses from students in different languages, which is particularly important for international educational programs. Moreover, these algorithms can detect bias in texts or identify instances of implicit plagiarism.

Integrating NLP into educational systems enhances the accuracy of assessment, bringing it closer to the level of human expertise. This makes the educational process more adaptive and student-centered.

3. Utilizing AI-assisted rubrics, where AI suggests scores but final grading decisions remain with educators. The use of AI-assisted rubrics makes the assessment process more structured and transparent. In this approach, AI analyzes student work according to defined criteria and proposes a preliminary grade, which is then reviewed by the instructor. This significantly reduces the time spent on grading, allowing educators to focus on aspects that require human judgment. For instance, AI can automatically check factual accuracy, grammar, and style, while the instructor evaluates the depth of the argumentation and creativity.

This approach helps eliminate human bias, as the AI's preliminary analysis is based on objective criteria. However, the final decision rests with the instructor, ensuring flexibility in cases where a student's work goes beyond the standard criteria. AI can also provide analytics on general trends in student responses, helping instructors improve teaching materials. This is particularly useful when grading large groups of students, where manually reviewing all submissions would take considerable time.

By using this approach, the objectivity and consistency of grading are enhanced, reducing the likelihood of random errors.

Lack of explainability is additional potential bias in AI assessment tools. Many AI models function as “black boxes,” meaning their internal decision-making processes are opaque and difficult to interpret. When students receive AI-generated scores, they may not understand why they received a particular grade, leading to concerns about fairness and transparency.

For example, if a student receives a low score on an AI-scored exam but cannot see a clear rationale for the deductions, it undermines trust in the system. The inability to challenge or appeal AI-generated grades further exacerbates fairness concerns.

We propose mitigation strategies:

1. Using explainable AI (XAI) models that provide clear reasoning behind grading decisions. The use of explainable AI models (XAI) allows students and teachers to better understand how grades were assigned. Regular AI algorithms often function as "black boxes," which makes it difficult to verify the fairness of decisions. XAI models provide transparent explanations, such as which criteria were considered and how each one influenced the final score. This enhances trust in automated grading and helps students improve their work. If a student receives a lower grade, they can analyse the AI's explanation and understand which aspects of their work need improvement.

For instructors, this is also a useful tool, as they can check whether any technical or conceptual errors occurred during the evaluation process. Such models are especially important in disciplines where grading is subjective, such as in the humanities or arts. Explainable AI also helps reduce bias, as it allows for checking if there are any unjust patterns in the algorithm. Additionally, understanding how AI works motivates students to critically assess the results they receive, rather than accepting them as unquestionable truths. This fosters a more conscious approach to learning and grading.

2. Implementing decision logs that track AI-generated scores, allowing educators to review and justify outcomes. The implementation of decision logs allows instructors to review, analyze, and correct automated AI grading. These logs record all stages of the grading process, including intermediate calculations and the criteria considered. This helps avoid situations where the system mistakenly or unfairly lowers or inflates grades. The instructor can review the log file and check whether the AI has made systematic errors or exhibited bias towards certain student groups. It also provides an opportunity to explain to students how their grade was assigned, promoting greater transparency in the learning process. In the case of disputes, the instructor can make adjustments or initiate an additional review of the work.

Decision logs are also useful for improving grading algorithms, as they allow for the identification of problematic areas and the adaptation of the system in accordance with changes in educational standards. Additionally, they can serve as the basis for developing new teaching strategies, based on general trends in student responses. The use of such logs helps reduce the risks of automated errors and increases trust in digital educational technologies. It also gives instructors more control over the grading process, reducing the risks of technical malfunctions.

3. Creating feedback mechanisms where students can request human reassessment if they believe the AI has misjudged their work. The implementation of feedback mechanisms gives students the opportunity to contest the results of automated grading if they believe the evaluation is unfair. In such cases, a student can submit a request for a re-evaluation of their work by a human expert. This is especially important for tasks that require deep analysis or a creative approach, where AI might misinterpret the content of the response. The presence of such a system increases trust in automated grading, as students understand that they have the right to an objective review of the result. Upon receiving a review request, the instructor can not only change the grade but also provide detailed feedback, explaining to the student the strengths and weaknesses of their work. This contributes to more effective learning, as students receive valuable feedback for further developing their skills.

This strategy also prevents potential misuse or technical malfunctions in the grading system. It encourages students to analyse their work more carefully and pay attention to the reasoning behind the grading. Additionally, the review mechanism fosters a culture of responsibility and academic integrity. Overall, this approach helps balance automated grading with human expertise, making it fairer and more flexible.

Developing Soft Skills to Address Biases in AI Assessment Tools

Developing soft skills is essential because these skills bridge the gap between technology and human-centered teaching. AI tools, while powerful, lack the emotional intelligence and ethical judgment that educators bring to the classroom. Without these skills, AI tools may unintentionally reinforce societal biases or overlook the unique needs of individual students. However, when educators possess soft skills like critical thinking, communication, empathy, and adaptability, they can engage with AI tools more effectively and ensure that these systems benefit all students.

Moreover, soft skills enable educators to remain proactive in addressing AI biases. Rather than passively accepting the results generated by AI, educators with these skills will actively question, test, and refine AI systems to ensure fairness and inclusivity. By fostering an environment where technology and human expertise work together, soft skills help maintain a balance between technological advancement and human-centric teaching practices.

Skills Classification by Decay Period

The classification of skills by decay period is crucial for identifying which skills remain relevant over time and which need updating or adaptation due to changes in technology, society, or the labour market. It helps us understand how to properly navigate learning, career development, and personal growth.

There is classification of skills by decay period (Figure 4).

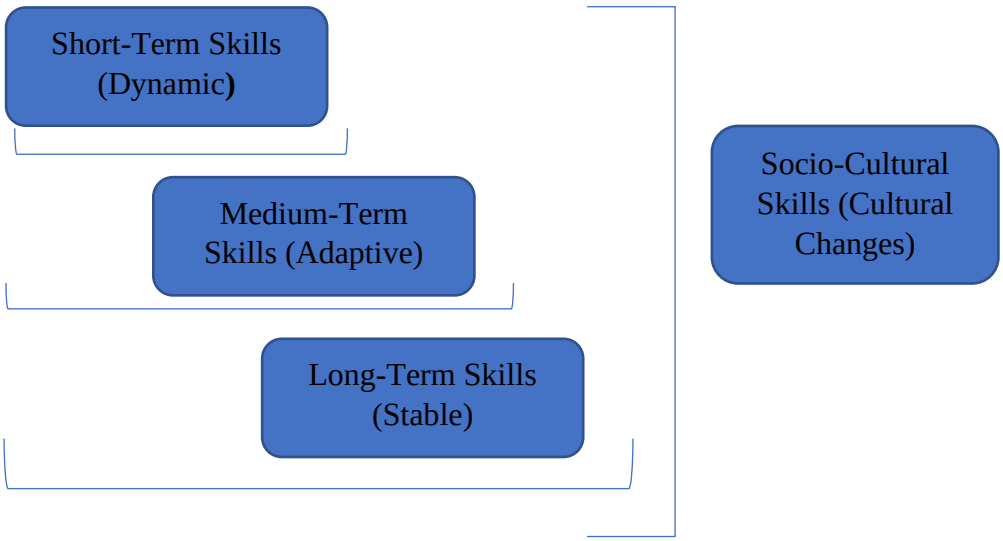

Figure 4. Classification of Skills by Decay Period (Developed by authors)

Long-term skills are fundamental and remain stable over time. They are rooted in basic aspects of personal development and interpersonal communication. For example, empathy (the ability to understand and share the feelings of others) remains crucial and relevant throughout life. Communication skills, such as the ability to listen effectively and convey information, also remain stable and are not significantly altered by new technologies or societal changes. Problem-solving abilities, such as the ability to tackle complex challenges and adapt to new circumstances, are also relevant throughout one's life.

These skills are important not only for professional development but also for a harmonious social life. They provide the foundation for other, more specific skills and can be applied in various situations over an extended period, without the need for significant changes or adaptations.

Medium-term skills evolve or adapt depending on changing conditions that may shift over shorter periods. These are skills that need to be updated or adjusted over time. One such skill is adaptability (the ability to change one's approaches or behaviours based on new circumstances or challenges). In today's world, where change happens quickly, it is essential to be able to adapt to new realities, whether they are shifts in the economy, technology, or social conditions.

Teamwork skills are another example of medium-term skills. With the development of new work forms, such as remote work, blended learning, or projects using digital platforms, ways of interacting within a team are changing. Furthermore, critical thinking, which allows us to assess situations and make decisions based on analysis, is also a key medium-term skill. This skill

requires continuous improvement, as new technologies and information flows create new challenges in decision-making.

Short-term skills change quickly and can become obsolete due to the impact of new technologies, innovations, or shifts in the labour market. For instance, technical skills, such as programming or using certain software, may no longer be necessary with the advent of new tools or technologies. What was relevant just a few years ago can lose its importance because of the rapid development in the tech industry.

Skills associated with new tools or platforms serve as examples of rapidly changing skills. For instance, knowledge of specific digital platforms or programs can quickly lose relevance when newer, more efficient, or user-friendly tools emerge. Therefore, it is essential to regularly update these skills as new innovations arise.

Socio-cultural skills change depending on societal and cultural shifts. Skills related to social norms, etiquette, and interaction across cultures may evolve based on how society develops. What was acceptable in a particular social context several decades ago may now be viewed unfavourably. For example, inclusivity and diversity have become important aspects of modern work environments. Cultural shifts occurring in society force us to change how we communicate, manage, and interact with others.

Among these, skills related to inclusivity and diversity are particularly important. Society is increasingly striving for greater openness and inclusivity, which in turn changes the expectations around personal communication and leadership skills.

The classification of skills by decay period allows us to properly navigate their development, learning, and application in a rapidly changing world. Long-term skills remain relevant throughout life, medium-term skills require regular updating and adaptation to new realities, while short-term skills quickly change due to technological and social trends. Cultural skills also evolve with societal and cultural transformations. Understanding this classification helps individuals plan their professional development and adapt to the challenges of the modern world. Soft skills belong to the long-term category. These skills remain relevant over time and are not significantly affected by technological or social changes. They include communication, critical thinking, emotional intelligence, empathy, teamwork, adaptability, and other aspects that contribute to effective human interaction and successful performance in various settings.

Since these skills are universal and applicable across different professions and life spheres, their development is essential at all stages of one’s career. They help individuals better adapt to changing circumstances, interact effectively with others, and solve tasks either individually or in a team. Soft skills form the foundation for developing other, more specific professional skills and can help individuals succeed in various situations.

As artificial intelligence becomes increasingly integrated into education, particularly in the realm of assessment, it introduces new opportunities and challenges. One significant challenge is the potential for biases within AI systems, which may inadvertently perpetuate existing inequalities in educational outcomes. In this context, developing essential soft skills, such as critical thinking, communication, empathy, adaptability, and ethical decision-making, becomes crucial for educators, students, and AI developers alike. These soft skills play an instrumental role in identifying, addressing, and mitigating biases in AI assessment tools, ultimately ensuring that these technologies are used in a fair and equitable manner.

The foundation of addressing AI bias in assessment tools lies in critical thinking. Educators must be able to think analytically and question the data and algorithms that power AI systems. A teacher who possesses critical thinking skills is more likely to evaluate how an AI tool functions, how data is collected, and whether it appropriately represents all students. For example, an educator may notice that an AI system is giving lower scores to students from a specific ethnic group or socioeconomic background. With strong critical thinking abilities, the educator can raise concerns about how the data might be skewed or whether the AI model is unintentionally favoring one demographic over others.

Self-reflection is another critical aspect of this skill. Educators should regularly reflect on their own biases and how they might influence their interactions with AI tools. For instance, if a teacher has preconceived notions about a particular group of students, they might inadvertently support AI tools that reinforce those biases. Self-reflection helps educators identify their personal biases, allowing them to engage more critically with AI tools and advocate for fairer systems.

Method. Encourage regular critical evaluations of AI tools. Educators can engage in activities like peer reviews or group discussions where they reflect on the fairness and accuracy of AI systems. Regularly revisiting the algorithms used in assessments and analysing their potential biases ensures that educators remain proactive in addressing potential issues.

Example, a teacher could organize workshops where they and their colleagues critically assess AI tools used in grading. They might review how diverse student data is represented and compare AI assessment outcomes to human judgment to uncover hidden biases.

Effective communication is essential when addressing biases in AI systems. Teachers and administrators need to communicate clearly about the potential impacts of AI biases on students' education. For instance, if a teacher identifies a bias in an AI tool used for grading, they must be able to articulate this issue to the developers or decision-makers in a way that leads to meaningful change. Communication skills also help educators explain AI biases to students and colleagues. By fostering discussions about the potential drawbacks of AI assessment tools, teachers can create an open space for feedback and collaboration.

In practice, a teacher could use communication to foster transparency. They might explain to their students how AI is being used to assess their work, what data the system collects, and how it affects their grades. By doing so, the teacher promotes trust and ensures that students understand the role of technology in their learning process. Moreover, open communication helps in advocating for modifications to AI systems when biases are discovered, ensuring that everyone involved in the educational process has a voice in shaping AI applications.

Method. Educators can practice articulating concerns about AI biases through role-playing exercises. These exercises simulate meetings with AI developers or administrators, where educators advocate for changes in AI systems, encouraging clarity, transparency, and inclusivity.

Example. A teacher may initiate a discussion with students about how AI tools assess their work, asking for their input on whether they feel the system reflects their abilities. This open dialogue can help identify gaps in AI fairness and promote understanding across the school community.

Empathy, a core component of emotional intelligence, is vital when recognizing how biases in AI assessment tools can disproportionately affect certain groups of students. For example, students from lower-income backgrounds may not have access to the same technological resources as their wealthier peers, which could impact the data used by AI systems. Teachers who are empathetic can better understand the challenges these students face and advocate for AI tools that address these disparities. This ability to understand students' diverse backgrounds is crucial for creating equitable learning environments.

Empathy also drives ethical decision-making. Teachers with strong empathy are more likely to challenge AI systems that may unintentionally marginalize certain groups. For example, if an AI system is grading students based on writing patterns that favour one culture's way of expression, an empathetic educator will recognize this as problematic and call for adjustments to ensure fairness for all cultural backgrounds. This empathy-driven approach leads to the ethical use of AI, ensuring that assessments reflect the varied needs of a diverse student body.

Method. Develop empathy through workshops and training that focus on the lived experiences of diverse student populations. Educators can also engage in exercises where they role-play as students from different backgrounds and perspectives to deepen their understanding of how biases in AI affect individuals.

Example. A teacher could use case studies where AI tools disproportionately impact students from marginalized groups (e.g., students with disabilities or non-native speakers) and work through solutions to adjust the system for inclusivity. Educators could also design lessons on ethical decision-making in AI development, reinforcing the importance of fairness and representation.

The use of AI in education is still evolving, and educators must demonstrate adaptability to integrate these systems effectively into their teaching practices. As AI tools develop, new biases may emerge, and educators must be flexible in their approaches to address these issues. For example, an AI tool may be updated to include more diverse data sources, but it may introduce new biases related to gender or ethnicity. Educators must be adaptable enough to recognize these changes and make adjustments to their teaching methods accordingly.

Adaptability also involves modifying the way in which AI assessments are used in the classroom. Teachers may need to change how they incorporate AI feedback into their grading or use it to tailor individual learning plans for students. For instance, if an AI system is found to be overly harsh on students who struggle with language proficiency, the educator may adapt their use of AI feedback to provide additional support and encourage students without relying solely on the automated grading.

Method. Foster adaptability by encouraging educators to keep up with emerging AI tools and provide continuous professional development opportunities. Teachers can also participate in pilot programs where new AI systems are tested, allowing them to adapt their teaching methods based on real-time feedback and updates.

Example. A teacher could modify their teaching strategies when a new AI tool is introduced in the classroom, ensuring that it is inclusive for all students. For instance, if the system becomes biased against a particular group, they could adjust the lesson plan to ensure fairness while the system is corrected.

Addressing AI bias is not an issue that can be solved by one individual alone. It requires problem-solving and collaboration among educators, AI developers, students, and administrators. For example, if an AI assessment tool is found to be biased against students with learning disabilities, a teacher might collaborate with developers to redesign the system, ensuring that it accommodates students' unique needs.

Through collaboration, educators can engage in interdisciplinary discussions that incorporate multiple perspectives. A teacher working with an AI developer might suggest adjustments to the algorithm based on feedback from students who feel unfairly evaluated by the system. By bringing together a team of educators, developers, and researchers, schools can create AI systems that are not only more effective but also more inclusive. Collaboration also promotes shared accountability for identifying and addressing biases in AI systems.

Method. Promote interdisciplinary collaboration by creating task forces that include educators, AI developers, students, and administrators. These groups can engage in ongoing dialogue about the effectiveness of AI systems, pinpoint biases, and brainstorm potential solutions. Collaboration should also involve student feedback to ensure the tool works for all groups.

Example, teachers can collaborate with AI developers to modify grading systems based on input from students who report feeling unfairly graded by the algorithm. For instance, a teacher may invite developers to meet with students who have learning disabilities to understand how AI tools might be better adjusted to meet their needs.

As AI becomes a central part of education, ethical decision-making will become increasingly important. Educators must be equipped to make decisions that ensure AI systems are being used in ways that align with values such as fairness, transparency, and accountability. For instance, if an AI tool is providing scores that disadvantage students from certain backgrounds, educators must be prepared to raise concerns and advocate for changes.

Teachers with strong ethical decision-making skills will question AI systems that may reinforce discriminatory patterns. They will push for systems that provide fair assessments based on diverse student needs and abilities. Ethical decision-making ensures that AI in education is used responsibly, with an emphasis on creating inclusive and equitable learning environments.

Method. Engage educators in decision-making scenarios that highlight the ethical implications of AI tools. Use case studies or simulations where educators are forced to make decisions about AI systems that may inadvertently reinforce biases or discrimination.

Example, a teacher could be faced with a situation where an AI system is found to penalize students for incorrect writing mechanics that are influenced by cultural differences. In this case, the educator would need to decide whether to advocate for changes to the algorithm or continue using it. Using role-playing or simulated dilemmas in workshops can help educators navigate such situations and prepare them to make responsible, ethical decisions.

Addressing biases in AI assessment tools is not only a technical challenge but a deeply human one. The development of soft skills in educators plays a vital role in ensuring that AI tools are used ethically and effectively. By enhancing critical thinking, communication, empathy, adaptability, and ethical decision-making, educators can help identify and address biases in AI tools, ensuring that these systems support, rather than hinder, equitable learning outcomes. In this way, soft skills empower educators to create more inclusive, fair, and effective AI-driven educational environments.

4) Monitoring Student Progress and Providing Personalized Feedback through AI Bots

Monitoring student progress and providing personalized feedback through AI bots is a powerful method for enhancing learning experiences in modern education.

The integration of AI in education can be compared to the ancient Roman system of governance and management, particularly with its focus on maintaining control, ensuring progress, and providing personalized guidance to citizens. Drawing on the Roman model, we can explore how AI bots can function similarly to the governing institutions in ancient Rome, highlighting the benefits of systematic monitoring, personalized feedback, and progressive intervention.

The Roman System of Governance. The Role of the "Censors"

In Ancient Rome, the censors played a pivotal role in monitoring and maintaining the moral and social health of Roman citizens. Censors were responsible for overseeing the census, regulating public morality, and ensuring that individuals adhered to the legal framework. They conducted regular assessments of citizens, recorded their details, and tracked their progress within society. Based on these evaluations, citizens were either promoted or demoted, and their participation in certain public duties was adjusted according to their performance.

Similarly, AI bots in modern education function as "censors" by monitoring student progress through continuous assessment. AI bots collect data on various aspects of student behavior, such as participation in lessons, completion of assignments, and engagement in activities. This data is used to evaluate each student's performance, allowing for the identification of strengths and weaknesses, much like the Roman censors monitored the progress of citizens.

The Roman Senate. Personalized Guidance and Oversight

The Roman Senate was responsible for advising the Consuls, overseeing legislation, and ensuring that Roman citizens were properly guided in their civic duties. Senators provided counsel based on extensive knowledge of Roman laws and customs, offering personalized guidance to the Consuls and the people. This system ensured that citizens were not only assessed but also provided with the support and resources needed for their advancement.

In modern education, AI bots play a similar role by offering personalized feedback based on the student's progress. Just as the Roman Senate advised on laws and policies, AI bots provide tailored recommendations and feedback to students, suggesting areas for improvement and offering resources specific to each student's learning needs. This personalized guidance ensures that students do not face obstacles without assistance and are directed toward educational resources that will enhance their skills.

The Roman "Cursus Honorum". A Systematic Approach to Progression

In Ancient Rome, the Cursus Honorum was a structured path of public office that allowed Roman citizens to progress through various stages of responsibility, based on merit and seniority. This hierarchical progression ensured that individuals were rewarded according to their achievements and capabilities, and it provided opportunities for advancement at each level.

AI bots can similarly create a structured learning path for students, akin to the Roman Cursus Honorum. By analysing student data, AI bots can track each student's progress and suggest the next steps in their educational journey, ensuring that students move forward based on their individual abilities and achievements. If a student excels in certain areas, the AI can recommend more advanced tasks, similar to how Roman citizens would ascend to higher offices once they had proven their skills. Conversely, students struggling with particular concepts can receive additional resources or support, ensuring that no one is left behind.

The Role of Roman "Tribunes" in Supporting Citizens

In Roman society, tribunes were elected officials who protected the rights of the plebeians and worked to ensure that all citizens had the opportunity to voice their concerns and receive protection from unfair treatment. Tribunes played a vital role in ensuring that citizens were not ignored or left behind in the civic process, providing intervention when needed.

In a similar way, AI bots act as personalized support agents for students, offering interventions when performance drops or when students are at risk of disengagement. If a student begins to struggle or falls behind in their coursework, the AI bot acts as a modern-day "tribune," sending reminders, offering additional resources, or even suggesting strategies for overcoming academic challenges. This constant support helps students stay on track and ensures that no one falls through the cracks, much like the Roman tribunes worked to ensure that citizens were not neglected by the system.

The Roman "Paterfamilias". The Role of Educators as Guides and Mentors

The Paterfamilias in Roman society was the head of the family, responsible for the welfare and guidance of all members of the household. The Paterfamilias provided instruction, discipline, and support to ensure that the family's needs were met, and the household functioned efficiently. This figure of authority was crucial in shaping the future of Roman citizens by overseeing their moral and practical development.

In modern education, educators play a similar role to the Paterfamilias, guiding and mentoring students. While AI bots provide personalized feedback based on data-driven analysis, educators offer emotional and intellectual support, offering mentorship and addressing the complex, nuanced questions that arise in the learning process. AI bots complement this role by

providing timely feedback, while educators ensure that students' overall well-being is considered. Together, they create a balanced system of support that mirrors the guidance of the Paterfamilias in ancient Rome.

The Roman "Acta Diurna". Continuous Reporting and Feedback

The Acta Diurna, or "Daily Acts," was a Roman public record that provided citizens with regular updates about governmental decisions, laws, and decrees. This system of continuous reporting ensured that citizens were always informed and could adjust their actions accordingly. The Acta Diurna acted as an ongoing feedback loop, where citizens could learn about their social and political standing in the Roman world.

AI bots similarly offer continuous feedback loops in modern education. By constantly tracking student progress and offering real-time feedback, AI bots serve as a modern-day Acta Diurna, providing students with the information they need to adjust their learning strategies. Just as Roman citizens relied on the Acta Diurna to understand their societal position, students today rely on AI bots to understand their academic standing and adjust their learning behaviour for success.

The Roman "Vox Populi". Collective Insights and Group Feedback

Roman leaders, especially emperors, would often seek the Vox Populi (the voice of the people) to gauge public opinion and ensure that the needs of the population were met. This democratic principle ensured that leaders acted in the interest of the people, based on collective feedback and engagement.

In education, AI bots can help provide group-based feedback by monitoring group projects and collaborative learning activities. By analysing collective data, AI bots can assess how well students are collaborating, whether some students are contributing more than others, and how effective group dynamics are. In this way, AI bots act as a tool for collective insight, ensuring that group performance is monitored and personalized feedback is offered to enhance collaboration.

The comparison between the Roman system of governance and the use of AI bots in education reveals several key similarities. Both systems emphasize monitoring progress, personalized feedback, and support for advancement. The Roman institutions of censors, tribunes, and senators each played a role in guiding citizens based on their individual needs and performance. Likewise, AI bots in education track student progress, provide tailored feedback, and offer continuous support to foster student success.

Thus, the Roman model's emphasis on structured progression, individual rights, and constant feedback provides a valuable framework for understanding how AI can effectively

monitor and support student learning. By drawing on these historical principles, we can ensure that AI in education fosters fairness, support, and progression, much like the Roman system aimed to achieve within its societal structure.

Feedback through AI Bots

The integration of AI into this process enables more efficient tracking of individual progress and allows for the timely delivery of feedback tailored to each student's needs.

The first step in using AI bots for monitoring progress is data collection. AI systems can automatically track students' interactions with the learning platform, including time spent on each task, the accuracy of answers, participation in discussions, and completion rates. This data is then used to create detailed profiles for each student, providing insights into their strengths and weaknesses.

AI bots are able to analyse student performance on various tasks, such as quizzes, assignments, and projects, and identify patterns in their learning behaviour. For example, if a student consistently struggles with specific topics, the system can highlight these areas for improvement and suggest targeted learning resources to address these challenges.

Another key feature of AI-based monitoring is the ability to assess not only the outcomes of tasks but also the process students follow in solving problems. By analysing their approach to tasks, AI bots can offer insights into students' critical thinking skills, time management, and problem-solving techniques, providing more nuanced feedback.

AI systems can also provide real-time feedback to students. Unlike traditional methods where feedback may take days to be delivered, AI bots can offer instant suggestions, corrections, and encouragement. This immediate response is valuable for students as it helps them understand their mistakes in the moment and adjust their approach before moving on to new material.

In addition to real-time feedback, AI bots can send personalized messages and reminders to students, helping them stay on track with their assignments. For instance, if a student is falling behind on a task, the AI bot can send a reminder or suggest additional resources to help them catch up.

Moreover, AI bots are capable of adapting to different learning styles and paces. Some students may prefer visual learning aids, while others may benefit from detailed text explanations. AI bots can personalize feedback based on the student's preferred learning style, ensuring that the feedback is delivered in the most effective way for each individual.

AI-powered feedback can also be designed to be constructive and motivating. Rather than merely pointing out errors, AI bots can offer praise for progress made and suggest incremental

steps for improvement. This helps create a positive learning environment where students feel supported and encouraged to continue their academic journey.

The use of AI bots to monitor student progress and provide feedback can also save educators significant time. Instead of manually assessing each student's performance and providing feedback, AI bots can handle repetitive tasks, allowing teachers to focus on more complex aspects of teaching, such as engaging students in discussions or providing additional help where needed.

One of the strengths of AI feedback systems is their ability to provide consistent, unbiased evaluations. Unlike human evaluators who may unintentionally introduce bias or subjectivity, AI bots deliver feedback based solely on objective criteria, ensuring fairness in the evaluation process.

Additionally, AI bots can track long-term progress over time, allowing students and educators to see trends in performance and learning progress. By comparing students' current performance with their past results, AI systems can highlight areas of improvement and help identify students who may need extra support.

Another significant advantage is that AI bots can offer personalized learning paths. Based on the ongoing monitoring of students' progress, the system can suggest different pathways through the course material, ensuring that each student moves at their own pace and receives content suited to their level of understanding.

AI-powered tools also provide opportunities for collaborative learning. Bots can monitor group activities, track team performance, and provide feedback not only to individuals but also to groups as a whole. This helps improve group dynamics and ensures that all members contribute to the task at hand.

Furthermore, AI systems can integrate with other educational tools, such as learning management systems and communication platforms, allowing for a more comprehensive approach to monitoring and feedback. By combining data from various sources, AI bots can offer more holistic insights into a student's progress and provide richer, more personalized feedback.

The data collected by AI systems can also be used for predictive analytics. Based on a student's current performance, AI bots can predict future outcomes, such as the likelihood of passing or struggling with certain subjects. This allows for proactive intervention, such as offering additional resources or adjusting the course material to better suit the student's needs.

AI feedback systems also help identify students who may be at risk of disengagement or failure. By analysing engagement patterns and performance trends, AI can spot early signs of disengagement and suggest personalized strategies to re-engage the student, such as sending motivational messages or offering tutoring.

The effectiveness of AI in monitoring progress and providing feedback also depends on its ability to continuously learn and improve. As AI bots interact with more students, they become

better at tailoring their feedback and suggestions, refining their understanding of what works best for each individual.

One potential challenge is ensuring that AI feedback does not replace human interaction entirely. While AI bots provide valuable insights and support, human educators play a critical role in fostering emotional connections, offering moral support, and addressing complex questions that require nuanced understanding. The ideal solution is to combine AI-driven feedback with the human touch, creating a blended learning environment.

In conclusion, AI bots offer an innovative approach to monitoring student progress and providing personalized feedback. By automating the process of data collection, analysis, and feedback delivery, AI systems help students receive timely, relevant, and tailored guidance that supports their learning journey. However, their success depends on a balance between technology and human involvement, ensuring that students receive both the advantages of AI and the personal attention of educators.

TESTS

1.What is training data bias in AI models?

a) The bias that occurs when AI models are tested using outdated data

b) The bias that occurs when AI models fail to represent the diversity of student populations

c) The bias that occurs when AI models are too advanced for students' understanding

d) The bias that occurs when AI models are too diverse

2.Which of the following is an example of training data bias?

a) An AI model trained only on essays from native English speakers failing to recognize the writing style of non-native speakers

b) An AI model updating its training data to reflect the latest trends in education

c) An AI model conducting fairness audits to check for biases in grading

d) An AI model creating personalized assessments based on the individual student's needs

3.What is the main goal of implementing fairness audits in AI systems?

a) To test the efficiency of the AI model

b) To detect disparities in scoring among different demographic groups

c) To measure the accuracy of student responses

d) To analyze the speed of the AI model's response

4. How do fairness audits contribute to AI-driven assessment systems?

a) By checking the economic background of each student

b) By correcting biases and ensuring equal opportunities for all students

c) By collecting personal data from students

d) By speeding up the grading process

5. What is algorithmic bias in AI assessment tools?

a) A model that evaluates student responses based on sentence length

b) A model that equally weights all features in the evaluation process

c) A model that adjusts its behavior based on student backgrounds

d) A model that only considers grammar in assessing student responses

6. What is one strategy to mitigate algorithmic bias in AI assessments?

a) Using fairness-aware algorithms that detect biased scoring patterns

b) Training AI models only on perfect student responses

c) Ignoring linguistic and cultural differences in assessments

d) Limiting AI evaluation to multiple-choice questions only

7. Which of the following is considered a "long-term" soft skill in the context of addressing AI biases in educational assessment tools?

a) Programming skills

b) Communication skills

c) Knowledge of specific digital platforms

d) Knowledge of machine learning algorithms

8. How can a teacher use communication skills to address biases in AI assessment?

a) Explain to students how AI is used to assess their work

b) Remain silent about potential issues in assessment

c) Only communicate with other teachers

d) Engage with AI developers about potential algorithmic issues

9. Which of the following is a critical aspect of self-reflection when addressing AI biases in assessment tools?

a) Ignoring personal biases to focus solely on technology

b) Regularly reflecting on how personal biases might influence the use of AI tools

c) Always accepting AI-generated results without questioning them

d) Focusing only on the technology, not on how it is used in the classroom

10. What is the role of adaptability in developing soft skills for addressing AI biases?

a) Adapting to new technologies without questioning them

b) Being able to adjust methods and behaviours based on the evolving nature of AI and education

c) Sticking to traditional methods and ignoring technological changes

d) Relying solely on human judgment without the use of AI tools

ANSWERS

1) b; 2) a; 3) b; 4) b; 5) a; 6) a; 7) b; 8) a; 9) b; 10) b.

II. INTEGRATING AL CONVERSATIONAL BOTS IN DIDACTACS AND TEACHANG METHODOLOGIES

1) Using AI bots to facilitate personalized learning experiences

The study personalization concept

The study personalization concept was introduced by B. S. Bloom in 1984. The researcher considered the two-sigma problem when there was the study performance comparison between a

conventional class and a tutor. The latter case turned out to produce better results. Therefore, the conventional class approach is not so effective as it can seem [9].

According to A. Shemshack and J. M. Spector, personalized education is a learning complex adaptable to individual knowledge, experience and interests. It contributes to promotion and support of students' desired results [10]. H. V. Tkachuk notes the main distinctive feature of personalized study is adaptation of its processes, technologies and styles to interests of each student [11]. O. A. Chemerys and L. M. Kibenko argue the personalized model aims at students' goals and new study products. Here, students can coordinate the knowledge and skill acquisition. They may select tasks by difficulty and content, develop flexible and hard skills as well as obtain proper feedbacks [12].

G. Quandeng analyzed stages of personalized study integration in terms of education performance and possible disadvantages. In particular, he offers pupils diagnosing and dividing into four groups by their abilities and skills. Also, it is relevant to provide individualized methods, tasks and their control. Inclusion of individual and psychological values is also significant in personalized study [13].

Therefore, traditional education is characterized by a unified approach to students' mastering the curriculum. As information consumers, students are passive in study. On the contrary, personalized education is flexible and creative. It offers a convenient study mechanism with a focus on individual needs and peculiarities of each student. The latter becomes a producer of new information (Table 1).

Table 1 – Comparison of traditional and personalized education (Developed by authors)

Criterion	Traditional education	Personalized education
Definition	Focus on information memorization and retrieval	Focus on creative thinking, communication and practical preparation
Approach to study	Ready study model. Informational proposal corresponds to a single standard	Basic study model. It is supplemented with elements according to students' needs
Study methods	Totalitarian or authoritarian	Democratic
Students' role in study	Students are study subordinate objects	Students are subjects that participate in developing study approaches and satisfy own learning needs
Lecturers' role in study	Lecturers reproduce and distribute study material	Lecturers participate in developing an active student personality, determining his individual and social goals. They act as consultors or mentors
Interaction between lecturers and students	Lecturers define all study aspects. Students perceive, analyse and reproduce the	Lecturers initiate study, make students become active learning subjects, provide individual

	information they got from lecturers	feedbacks. Students learn the material and reproduce information acquired from different sources
Control features	Formal, non-individualized, hard control	Flexible, individualized control. Self-control, reflection
Creativity	Only lecturers are creative. Students perceive ready-made information	Both lecturers and students are creative
Study results	Acquired knowledge	Acquired knowledge and skills with their creative use in practice
Planning	Structured environment as fixed groups with curricula and schedules	Dynamic student groups according to changeable study needs. Compilation of respective individual courses
Multimedia role	Secondary. Written content and printed books prevail	Primary. Digital content prevails to track study performance
Study pace	Students study in an identical moderate pace, which is defined by their lecturer	Students select a necessary study pace independently (as to material understanding)
Assessment methods	Final assessment as periodical tests. Unified written tasks for all students	No fixed assessment. Study performance is regularly checked after each lesson

Therefore, the education personalization concept changes roles of students and lecturers. The former are active subjects with responsibility for study. The latter are advisors rather than information reproducers and study managers. It means that lecturers assist in material revision as well as accept innovative and creative decisions of students. The main advantage of personalized study is increase of students' motivation.

R. Felder and L. Silverman supplement the personalized study concept in analyzing assessment and perception methods in engineering education. They underline most educational components are parallel to one another. Students of visual thinking prefer diagrams, tables and figures. Students of intuitive thinking prefer abstract notions to concrete ones. A debatable problem of study personalization is impossibility of adjustment to each student in the lecture room. The researchers constructed an alternative model of studying and teaching styles that are adapted to most students (Table 2) [17].

Table 2 – Model of studying and teaching styles by R. Felder and L. Silverman [17, p. 675]

Dominant studying style		Respective teaching style	
Intuition	Perception	Concrete	Material content
Sensor unctions		Abstract	
Visua perception		Visual	Presentation

Audial perception	Input information	Verbal	
Induction	Organization	Induction	Organization
Deduction		Deduction	
Active	Processing	Active	Student's participation
Reflexive		Passive	
Consecutive	Understanding	Consecutive	Prospect
Global		Global	

Therefore, personalized education is characterized by a more flexible study approach to individual and psychological qualities as well as interests of students. However, this approach realization requires more time and other resources from lecturers and educational institutions. Nevertheless, application of technologies provides new possibilities to unfold an adaptive and interactive study environment.

Use of technologies in higher education

The COVID-19 pandemic has converted the technological basis of the education system. Via introduction of educational online platforms, students may get new knowledge regardless of their residence.

Active interaction of students and lecturers with study technologies is called as the term "Edtech" [18, p. 19; 19, p. 4; 20, p. 1-18; 21, p. 338-339]. According to T. Tymoshchuk, Edtech is the architecture that uses Internet possibilities and ensures a personalized approach to each student [22].

R. Raja and P. C. Nagasubramani note that study technologies comprise curriculum components, study tools, auxiliary means of providing information, factors of education improvement. Via technologies, institutions can make education interactive and lively rather than passive and reactive [23, p. 34]. B. Herold argues that modern technologies may support the personalized study concept. In particular, educational software and digital systems are more adaptive to needs of each student. It determines students' performance with educational adjustment to their study pace and even emotional state [24]. Besides, technologies assist in searching for information sources, which makes tasks diversified [25].

L. Major, G. A. Francis and M. Tsapali state that low-income and middle-income regions may employ personalization and technologies to enhance students' performance in mathematical and linguistical sciences [26]. According to A. Bartolomé, L. Castañeda and J. Adell, there are two approaches of students' involvement into study: linear and branched. The former offers the same

material learned with different speed many times. The latter proposes various material differing in achieved students' performance [27].

Thus, technologies raise study personalization. One of such technologies is artificial intelligence (AI) [28-31].

AI influence on study personalization

Most researchers believe AI tools contribute significantly to study conversion into a personalized form [32-38].

International organizations like UNESCO, OECD and EU adopted principles of AI educational use. They comprise transparency and clarity, anthropocentrism and justice, inclusive and sustainable development, welfare, reliability and security, accountability [39, p. 69].

Ethical rules of AI educational use for the European Network for Academic Integrity were considered by T. Foltynek et al. The authors argue that interaction with students must focus on oral answers and group assignments to apply analytical and creative skills. AI should generate curricula, check tasks and control study performance [40].

K. F. T. Chiu et al. discuss a generalized idea of the AI educational role. They note that personalized study is possible via adaptation of content, teaching methods, assessment and administration to individual needs and abilities of each student. It is achieved due to AI [41]. C. K. Y. Chan defines key topics to enhance standards of AI educational use: academic integrity and ethical dilemmas, data privacy, AI access, assessment and testing, development of AI use skills, AI use influence monitoring [42].

M. A. Cardona, R. J. Rodríguez and K. Ishmael analyze main problems of AI educational integration as to four influence spheres: study, teaching, assessment and research. According to detected problems, the authors single out the AI use rules (anthropocentrism, justice, security, ethics, performance, transparency). Also, they provide recommendations to development of the AI educational use policy. Humans make important study and control decisions to ensure security, performance and reasoning. Therefore, the AI integration model should correspond to desired goals and set principles. Besides, it should ensure cultural resilience, justice, inclusion and improvement of student competences. Guidelines, preventive educational measures and plans of AI trust promotion among academic communities must be adopted. Academic members are involved on each stage of research and development as well as educational technology integration [43].

M. Marienko and V. Kovalenko state that AI is effective in automated assessment and performance monitoring. Simultaneously, AI can decrease lecturers' roles, inhibit creative and critical thinking skills, divide students by their social and economic status [44, p. 50-51].

According to V. Božić and I. Poola, ChatGPT promotes academic fraud: it generates a text based on many papers without any references [45].

I. O. Ushakova and O. A. Pedan state that the efficient AI use depends on quantity of information sources in the base. It defines current quality and accuracy of algorithm execution [46, p. 31].

M. Sullivan, A. Kelly and P. McLaughlan confirm that the main problem of AI use (like ChatGPT) is denial of their study integration. In particular, most articles have negative statements about academic integrity violation and recommendations for students' AI refusal. Least works provide a clear institutional policy of ChatGPT use [47, p. 3]. However, modern AI technologies are partially integrated into education. There is an increasing trend among students to employ AI tools for study needs [48, p. 73].

R. S. Berdo, V. L. Rasiun and V. A. Velychko focus on methods and mechanisms of AI use to construct respective standards in future. AI is regarded as a potentially efficient educational tool in case of its ethical application [49, p. 4-6]. In particular, the authors explained key AI integration issues at educational institutions: data privacy, transparency, responsibility, antidiscrimination, social interaction and influence on education.

S. O. Kulieshov discusses the AI educational impact at American institutions. The most efficient way of AI use in personalized education is creation of systems as virtual assistants and tutors [50, p. 152-153]. C. Mehner and L. Köbis state that AI may serve as an advisor to ensure personalized education. The researchers established interrelation between advisorship and AI [51].

O. V. Spivakovsky et al. generated the study interaction model among lecturers, students and AI systems. The model is based on partnership between lecturers and students as well as formation of certain logical AI queries [52]. AI study problems are also considered: academic integrity, ethical norms, data privacy, potential social and economic threats. O. V. Panukhnyk argues that AI misuse may lead to decrease of cognitive abilities among students and lecturers [53]. Simultaneously, N. V. Bakhmat notes that AI integration can solve problems of traditional study: restricted access to study resources, optimized administration, distance learning [54].

A. Jungherr analyzes advantages and disadvantages of ChatGPT use in thesis preparation. Also, he gives recommendations about AI use to teach students [55]. R. Jürgen et al. argue that interaction between students and lecturers, as to the ChatGPT use, must be based on mutual trust [56].

Therefore, the above-mentioned works define advantages, disadvantages and possible consequences of the AI and ChatGPT use in higher education. Most researchers believe that education reforming via AI tools is inevitable.

According to O. Sodel, one of the main AI educational use advantages is an opportunity to provide personal experience among students. AI ensures individual feedback so that students can reconsider their attitude to study [57]. C. Mötteli, K. Reusser, U. Grob and C. Pauli investigated the personalized education impact on middle-school pupils' satisfaction with study. The authors have established key features of personalized education: pupils' suffrage, briefing and emotional support among lecturers [58].

H. Dumont and D. D. Ready note that personalized education can solve the justice issue. Usually, the technological approach to personalized education does not include social and emotional needs. Thus, low-performance students get a great academic load, which leads to insufficient activity or knowledge non-correspondence to offered tasks [59].

Besides, scientists describe key elements of the best personalized study practice: focus on students' profiles, flexible study paths, preference of study process to test results, competence and mastership, students' initiative, decisions based on acquired data, no attachment to study place, development of carrier skills [60-63].

I. Yuyun and D. Suherdi proposed such components of personalized education: inclusion of study, individual and cognitive styles, development of self-control and self-regulation among students, study pace flexibility, provision of intellectual study environment and respective tools, use of intellectual teaching systems, data analysis, wearable devices [64].

R. Culatta represents another idea of personalized education elements: availability of student' own devices, real-time feedback, students' access to own data, use of regular occurrences [65].

The above-mentioned features were summarized to provide a general AI impact on personalized study in higher education (Table 3). To assess it, we employed a binary scale (0 – absent impact; 1 – present impact).

Table 3 – AI impact on personalized study in higher education (Developed by authors)

№	Feature of personalized study	Impact (0 – absent impact; 1 – present impact)	Mechanism of impact
1	Personalized study path	1	Synchronic and a synchronic virtual classes. Generative AI reproduces personalized study content (as to students' needs)
2	Real-time feedback	1	Automated assessment and administration for lecturers' focusing on interaction with students. Chat bots analyze own progress and improve skills

3	Focus on students' profiles, their study styles	1	Internet of things and intellectual algorithms analyze mass data on study styles, abilities and weaknesses of students. Possible recommendations to produce individual education plans
4	Independence of study place	1	Online platforms and AI-based tutoring systems
5	Data analysis and study analytics	1	Analytical data track students' performance, methods and sources for content adjustment
6	Availability	0	Possible AI unavailability due to skills absence, technical restrictions, lack of data or negative perception
7	Cognition, career ambitions, creative and critical skills	1	Game-like and interactive tasks based on analysis of students' characteristics
8	Students' initiatives (suffrage, self-control, self-regulation)	1	Interactive virtual assistants attract students to discussions, model situations and analyse progress. Machine learning evaluates input data on students and offers necessary tasks
9	Students' promotion via competence and mastership	1	Computer-aided adaptive learning assesses material understanding and corrects study paths
10	Satisfaction of social and emotional needs	0	Tight connection between lecturers and students. The technological approach minimizes social interaction between students and lecturer's role in emotional support
Total		8	

Consequently, AI impacts on 8 of 10 features of personalized study (72.7% of influence, that is the medium level).

Therefore, AI tools satisfy most needs of personalized study. However, not all people have an access to AI technologies: there can be a lack of practical skills, experience and resources [70]. That produces a gap in study possibilities among students with different social and economic statuses. Besides, AI cannot satisfy social and emotional needs of students. It underlines the lecturer's role in support for students to acquire social and cognitive skills. Simultaneously, future plans of AI technology development in the study sphere may be predicted.

AI's Impact on Didactics

Didactics is the science of the teaching and learning process, which includes the theories and principles of organizing the educational process. It studies how to best convey knowledge to students, taking into account various aspects, from the content of the curriculum to the means, methods, and forms of organization.

Teaching methodologies are practical approaches to implementing didactic principles. They include a variety of strategies applied to improve learning effectiveness and may focus on specific aspects (for example, methodologies for learning languages, mathematics, or sciences).

Didactic principles of teaching in higher education

The educational process in higher education institutions is based on a set of didactic principles that ensure the quality and effectiveness of education. One of the key principles is scientificness, which involves using up-to-date scientific achievements, critical analysis of information, and research methodologies. Another important principle is systematization and consistency, which ensures the logical structure of material presentation, facilitating deep knowledge acquisition and understanding interdisciplinary connections.

Since modern education is aimed at forming professional competencies, the connection between theory and practice is necessary. This is realized through the application of case methods, project-based learning, internships, and research activities. At the same time, the educational process must be grounded in academic freedom and autonomy, providing both teachers and students with the opportunity to choose teaching methods, form their own educational trajectories, and engage in scientific research.

Education in higher education institutions is closely integrated with research activities, realized through the principle of integration of education and science. This fosters the development of critical thinking and innovation among students. Moreover, personal-oriented learning is essential, considering individual student characteristics, interests, learning styles, and preparedness levels.

The modern world requires a broad interdisciplinary approach, so the principle of interdisciplinarity takes on special importance. It helps students form a comprehensive worldview and the ability to solve complex problems by using knowledge from various fields. At the same time, in the context of rapid changes in the labour market and the fast-paced development of technologies, education must be flexible and adaptive to meet contemporary challenges and ensure the relevance of educational programs.

In view of the digital transformation of society, the principle of digitalization is significant, including the use of digital technologies, blended and distance learning to increase accessibility and effectiveness of education. Furthermore, globalization of education emphasizes the need for

international cooperation and mobility, which involves participating in academic exchange programs, international projects, and obtaining dual degrees.

All of these principles together form the foundation of modern higher education, aimed at preparing highly qualified specialists capable of adapting to current challenges, thinking critically, and applying knowledge in practice.

Artificial intelligence (AI) is changing the approaches to teaching and learning. One of the main changes is the enhancement of the principle of personalization, as AI is capable of analyzing students' knowledge levels and offering adaptive learning paths. This strengthens the principle of flexibility, as the educational process becomes more variable and tailored to individual needs. The application of AI also elevates the principle of digitalization to a new level. Educational platforms utilizing AI can automate knowledge assessment, provide instant feedback, and support students in the learning process. At the same time, the principle of interactivity becomes more pronounced with the use of chatbots, virtual assistants, and simulators that create the effect of real interaction.

AI also impacts the principle of interdisciplinarity by allowing knowledge from various fields to be integrated and using analytical tools to solve complex problems. The principle of connecting theory with practice becomes more significant because AI can model real production processes, analyse data, and predict outcomes. The principle of autonomy and self-directed learning expands as students gain the opportunity to learn at their own pace, using AI as a personal mentor. This also fosters the implementation of the principle of scientificness, as AI can process vast amounts of data and assist students in their research.

The principle of creativity gains new dimensions as AI helps generate ideas, analyse trends, and even create artistic or technical projects. At the same time, the principle of evaluation changes, as traditional testing methods are complemented by adaptive systems that analyse individual student progress. The implementation of AI also alters the principle of social learning. Analytical tools can form optimal student groups for collaborative work, analyse their interactions, and suggest effective communication strategies. The principle of learning through research receives new opportunities, as AI aids in the rapid analysis of data, searching for academic literature, and modelling complex phenomena.

The principle of inclusivity becomes important because AI can adapt educational materials for students with various needs, including those with disabilities. It also influences the principle of feedback, as AI allows for detailed analytical reports on student performance and provides recommendations for improving the learning process.

Teaching Methodologies in Higher Education

Teaching methodologies in higher education are based on contemporary pedagogical approaches aimed at developing students' critical thinking, independence, and integrating new technologies into the learning process. One of the key methodologies is the lecture method, which remains the fundamental form of knowledge transmission. Lectures can be traditional, interactive, or problem-oriented, stimulating students to actively engage with the material.

Seminar learning is also essential, involving active student participation in discussions, case analyses, and the exploration of theoretical and practical issues. Seminars promote the development of analytical skills and the ability to express opinions logically. Practical lessons aim to consolidate knowledge by solving tasks, completing assignments, and using educational simulations.

Modern universities actively implement research-based learning, which is grounded in the "learning through discovery" principle. Students engage in scientific research, analyse data, and create their own projects. This approach develops information literacy and fosters a culture of academic integrity.

The case study methodology is widely used in business education, medicine, and law. It involves analysing real or simulated situations to develop effective solutions, allowing students to understand complex interrelationships and apply knowledge in practice.

Project-based methods also play a significant role in modern education, where students work on long-term tasks requiring integration of knowledge from different disciplines. Project activities stimulate teamwork, planning, and creative thinking.

The development of digital technologies has contributed to the spread of online learning. Platforms like Moodle, Coursera, or EdX enable students to learn at their own pace, receive instant feedback, and participate in webinars. This enhances the flexibility of the learning process.

Gamification is another effective method, where elements of gaming are used to increase student motivation. This can include educational quests, rating systems, or simulation games that aid in better understanding the material.

The use of artificial intelligence in education opens up new possibilities for adaptive learning. Intelligent systems can analyse students' progress and suggest individual learning pathways. Finally, an important approach is collaborative learning, where students work in groups, share experiences, and solve complex tasks together. This develops communication skills and fosters social responsibility.

Artificial intelligence is transforming teaching methodologies in higher education, making them more adaptive, personalized, and effective. One of the main changes is personalized learning, where AI systems analyse a student's progress and offer individual learning paths. Traditional lectures are complemented by AI assistants that can provide explanations to students,

answer questions, and adapt the material to their level of knowledge. This makes learning more interactive and convenient.

Online learning is becoming more flexible, as AI allows the creation of intelligent assessment systems that analyse not only the correctness of answers but also the students' reasoning. These systems can automatically generate new tasks based on the student's needs. The implementation of chatbots to support students allows them to instantly receive consultations regarding courses, deadlines, or learning resources. This significantly relieves teachers and improves information accessibility. The methodology of gamification with AI reaches a new level of development. Intelligent algorithms can create personalized gaming scenarios that adapt to the student's level, increasing motivation and engagement.

Case studies and practical learning are enhanced by generative AI, which can create dynamic scenarios, changing the conditions of tasks in real-time depending on the student's decisions. This provides an opportunity to better prepare for real-life challenges.

Using learning data analytics allows for predicting potential learning issues and offering recommendations for improving teaching methods. Project-based learning methodologies are changing through the integration of AI tools for automatic analysis of large data sets, generating reports, and supporting creative thinking. AI promotes the development of adaptive tests that adjust the difficulty of questions in real-time based on the student's preparation level. In practical classes and laboratory work, the use of augmented reality and virtual reality with AI helps create realistic simulations, allowing students to practice skills without risking equipment or safety. AI also helps automate the assessment of written works by recognizing style, argumentation, and text structure. This allows teachers to spend more time on analytical work with students. The methodology of collaborative learning becomes more effective as AI can analyse each student's contribution to the group project and offer recommendations for role distribution. Using conversational AI allows students to practice language skills in real-time, which is especially useful for learning foreign languages.

Universities can implement digital mentors based on AI that will help students create personalized learning plans, recommend courses, and analyse career prospects. Teaching methods are becoming more skill-oriented as AI can automatically assess practical competencies and offer additional tasks to improve them.

The approach to the didactic design of courses is changing as intelligent systems can automatically structure learning materials, making them logical and accessible to students of varying levels of preparation. AI also contributes to the development of emotionally sensitive learning, where systems can analyse the student's emotional state and adjust the presentation of material to avoid overload. The use of automatic translators and real-time subtitles makes

educational content more accessible to students from different countries and supports the internationalization of education. AI can replace traditional textbooks by generating adaptive learning materials that update in real-time based on current scientific achievements.

Learning methodologies are becoming more self-directed, as AI allows students to form their own pace and style of learning and define priority areas for development. Intelligent systems help combat academic dishonesty by detecting plagiarism, automatically analysing works for uniqueness, and assessing the quality of argumentation. AI helps create an inclusive learning environment, assisting students with special needs through voice assistants, automatic text reading, and material adaptation. Universities can create smart classrooms where interactive systems automatically adjust the learning environment to the needs of specific student groups. Additionally AI helps teachers in preparing materials by automatically selecting sources, creating data visualizations, and suggesting effective methods of explaining complex concepts.

Learning methodologies are becoming more dynamic, as artificial intelligence allows courses to be adapted to changes in professional fields, creating learning programs that meet current market demands. Intelligent systems make it possible to work more effectively with large datasets, which is crucial for research-based learning and preparing students for academic work.

In the future, AI may even change assessment methods, using multidimensional skill analysis that includes cognitive abilities, emotional intelligence, and creative thinking.

Theoretical Model of AI Bots Integration in Didactics and Teaching Methodologies

The theoretical model of AI bots integration includes three main levels: didactic, methodological, and operational. Each of these levels incorporates specific elements that interact to ensure effective use of artificial intelligence in the learning process.

At the didactic level of the model, the elements are personalization of learning, content adaptability, and interactivity of the educational process. Personalization of learning means that AI bots can adjust the learning process according to the individual needs of each student. Through the analysis of behaviour and learning outcomes, artificial intelligence can create personalized plans for each learner, enabling them to study at a pace that suits them. Content adaptability ensures automatic changes in the difficulty level of tasks, allowing for more effective learning while considering the student's progress in real time. The interactivity of the learning process, supported by AI bots, allows students to engage with learning materials through questions, dialogues, and other forms of active participation, which stimulates critical thinking and a deeper understanding of the subject matter.

At the methodological level, important elements include adaptation of learning materials through AI, automated assessment, and gamification. AI-based adaptation of learning materials

enables the creation of tasks, videos, and other resources that align with the student's knowledge level and interests. This approach significantly increases learning effectiveness, as students receive materials that best suit their needs at each stage of their studies. Automated assessment, in turn, reduces the workload for instructors and provides rapid feedback for students. AI bots can evaluate both tests and more complex tasks, such as essays, with scoring based on predefined criteria. Gamification through AI can create interactive learning environments where students achieve new learning levels by completing tasks in a game format, which increases motivation and encourages active participation.

At the operational level, the model involves using AI assistants for learning, AI bots for collaboration and communication, and support for self-directed learning. AI learning assistants help students study complex topics, explain material, and answer questions, allowing students to work outside the classroom. This increases the accessibility of learning and enables students to work anytime and anywhere. AI bots for collaboration and communication support group work, promote effective idea exchange, and facilitate the organization of joint projects. They can act as coordinators for group tasks, reducing the organizational load on instructors. Self-directed learning support through AI includes creating personalized learning plans, recommending additional materials, and motivating independent study. AI can analyse student interests and achievements, providing resources to help improve their results.

The interaction between these levels creates synergy in the learning process. For example, adaptation of learning materials at the methodological level is directly dependent on personalization of learning at the didactic level. This allows AI bots to create materials that best fit the student. At the same time, the support for self-directed learning and interactivity at the operational level interact, enabling students to participate in the learning process in an interactive format while receiving recommendations and support in real time. Feedback from automated assessment provides immediate correction of the learning process, optimizing the student's next steps.

Thus, the theoretical model of integrating AI bots into didactics and teaching methodologies is based on three levels, each with its specific elements. The interaction between these levels ensures the integrity and effectiveness of the learning process, providing students with personalized and interactive learning, while instructors can optimize their activities through automation and adaptation of processes.

2) Employing AI bots to support collaborative learning and group activities

Methodology for using AI bots to support collaborative learning and group activities in higher education is a promising approach that is actively being implemented in educational processes. The main goal of this methodology is to create an interactive learning environment where students can interact with each other, work in groups, and simultaneously receive assistance from artificial intelligence. AI bots facilitate the organization and coordination of group tasks, analyse participant interactions, provide feedback, and help solve learning problems. The use of such technologies improves the effectiveness of group projects and optimizes the learning process.

One of the key aspects is the possibility of automatically creating working groups based on the analysis of students' interests and skills. AI bots can analyse student profiles and suggest optimal groupings, ensuring balance and effective collaboration. Additionally, AI bots can monitor student progress in group projects, providing timely feedback and recommendations for further steps. This reduces the workload on instructors who previously served as coordinators of group activities.

Another important part of the methodology is the interactive environment for collaboration, which gives students access to shared resources, tools for discussions, and task execution. AI bots can create chats or forums for task discussions, helping students communicate effectively and exchange ideas. AI can also act as an intermediary, ensuring that discussions are constructive and contribute to solving learning tasks.

An important element is the automation of assessment and monitoring processes for group tasks. AI bots can evaluate each member's contribution to the overall result, analyse activity during task completion, and provide accurate feedback. This helps identify the strengths and weaknesses of each student, which is useful for adjusting learning plans and further group work.

The integration of AI bots in group activities also involves gamification of the learning process, where students can earn points, badges, and other rewards for their activity and achievements within the group project. This motivates students to engage more deeply and actively in their learning. AI bots can also organize competitions and quizzes, fostering team spirit and creative thinking.

Another important aspect is supporting inclusivity in the learning process. AI bots can adapt materials for students with different levels of knowledge and needs, providing equal opportunities for all participants in group activities. They can assist students with special needs, for example, by supporting language translation or adapting content.

The use of AI bots also helps reduce the psychological barrier for students who may feel insecure in a traditional learning environment. AI bots create a sense of safety and support, allowing students to work at their own pace and receive assistance at any time. This reduces stress and contributes to more effective learning.

AI bots can also stimulate critical thinking and analysis by asking provocative questions, offering alternative perspectives, and helping solve complex problems. This promotes the development of analytical skills and the ability to work with information. With such tools, students can come up with new ideas for problem-solving and approach tasks creatively.

The analysis and feedback provided by AI bots form the foundation for optimizing the learning process and student development. They help identify gaps in knowledge, adjust the learning approach in a timely manner, and achieve better results. AI bots also contribute to increasing student autonomy by allowing students to independently find resources and receive help without the constant intervention of instructors

Methodology for Using AI Bots to Support Collaborative Learning and Group Activities in Microeconomics Teaching

The methodology for using AI bots to support collaborative learning and group activities in microeconomics teaching involves organizing the learning process in such a way that students can effectively work in groups while maintaining individual development. The use of artificial intelligence at various stages of learning allows for the adaptation of tasks and materials to the students' needs, optimizing group interactions, and supporting active participation from each participant. Based on this methodology, students will be able to work on practical cases, discuss economic theories, apply mathematical models to real situations, and thus effectively assimilate the material.

In the first stage, AI bots create student profiles based on their prior knowledge and skills. To do this, they analyse responses to initial tests, activity in forums, and previously completed tasks. For microeconomics, this stage might involve assessing students' understanding of concepts like supply and demand, elasticity, or market structures. Students who demonstrate high results at the outset will be directed toward more complex tasks, while beginners will receive tasks that help them better understand basic economic concepts. This enables effective group organization based on students' knowledge levels, forming heterogeneous groups for optimal task performance.

Key performance indicators include productivity in group tasks and interaction between students of varying knowledge levels.

Next, AI bots create group tasks, adapting them to students' knowledge levels. For the course "Microeconomics," these might include tasks like market analysis, building supply and demand curves, or solving elasticity models. For advanced students, a task might involve applying game theory to determine optimal strategies in a monopolistic market, while beginners work on more basic tasks such as analysing competitive equilibrium markets. This ensures that the level of

difficulty of tasks corresponds to the students' knowledge level, promoting a deeper understanding of the material.

Key performance indicators include timely task completion and the quality of responses, particularly for tasks requiring a deeper understanding.

After task creation, AI bots automatically provide students with the necessary resources for task completion. For "Microeconomics," these might include textbooks, articles, videos, interactive charts, or simulations. For instance, if the task involves analysing market crises, the bot might provide materials explaining how markets react to changes in supply or demand. AI also offers additional resources if a student needs more time to master a specific topic. This ensures students have the resources tailored to their needs, facilitating effective material absorption.

Key performance indicators include the number of students accessing provided materials and the time spent studying resources.

In the fourth stage, communication spaces are created. AI bots help organize online spaces for communication, where students can discuss tasks, ask each other for advice, or seek help from the instructor. These might be group chats, forums, or interactive boards for solving joint tasks. For microeconomics, this is especially important, as discussing concepts like demand elasticity or market structure theory can help students better understand complex concepts by applying them in practice. This encourages students' active interaction and collaboration, which is key to deeper material assimilation.

Key performance indicators include the number of participants in discussions and student interaction in debates.

In the fifth stage, progress monitoring takes place. AI bots monitor students' progress while completing tasks, providing result interpretations and offering recommendations. They also remind students about approaching deadlines. For example, if a student has not completed a certain task, the AI bot may send a reminder or offer assistance in solving specific economic models or problems. This allows for timely adjustments to task completion, ensuring students finish them within the set timeframe.

Key performance indicators include time spent on tasks and the number of missed deadlines.

In the sixth stage, AI bots automatically assess each student's contribution to group work. For microeconomics, this might involve evaluating participation in market model analysis, the quality of completed calculations, or the effectiveness of discussions. If a student actively participates in debates, helps solve tasks, or correctly solves economic models, their contribution will be evaluated accordingly. This allows for the evaluation of each student's individual contribution to group work, avoiding situations where one person does most of the work.

Key performance indicators include the level of individual contributions to group tasks and grades for participation and collaboration.

In the next stage, AI bots can adapt tasks to the specific needs of students, such as those who require extra time or have difficulty with certain aspects of the material. For microeconomics, this might involve providing additional materials for students struggling with mathematical models or graph analysis. This ensures equal opportunities for all students, offering support to those who need it.

Key performance indicators include the number of students using adapted materials and improved results after utilizing additional resources.

In the eighth stage, AI bots can integrate gamification elements to boost student motivation. These might include points, achievements, or rewards for successfully completing tasks. For example, a student might earn points for constructing accurate demand and supply economic models or conducting a precise elasticity analysis. This motivates students to actively engage in the learning process by introducing competition and rewards.

Key performance indicators include student participation in gamification tasks and changes in student motivation.

AI bots can also detect issues that arise in groups, such as conflicts or insufficient participation from some members. For microeconomics, this might involve a situation where one student struggles with a task involving demand and supply curve analysis. The bot can offer a solution or notify the instructor about the problem. This allows for quick responses to group difficulties and ensures support for students when needed.

Key performance indicators include problem resolution time and the number of conflicts resolved in groups.

After completing tasks, AI bots provide students with a final analysis of their results, including the correctness of economic calculations, model quality, and their alignment with theoretical foundations, as well as an analysis of completed discussions. They also provide feedback to the instructor regarding group work results. This allows for summing up each group's and each student's performance and identifying strengths and weaknesses in the learning process.

Key performance indicators include the quality of final reports and student feedback.

AI bots adapt tasks and materials to the students' knowledge level, ensuring an individual approach and optimizing group interaction. An important aspect is the creation of a communication space for discussions, which contributes to a deeper understanding of the material. The integration of gamification and progress monitoring helps maintain high student motivation. All these stages are interconnected and allow students to work as efficiently as possible in groups, applying theoretical knowledge in practice.

TESTS

1. What is the focus of didactics in education?

A) Research methods

B) How to organize the educational process

C) Financial aspects of education

D) Teaching technology tools

2. Which teaching methodology aims to improve learning effectiveness by applying various strategies?

A) Educational simulations

B) Didactic principles

C) Teaching methodologies

D) Gamification

3. What is the key principle that ensures the logical structure of material presentation in education?

A) Personalization

B) Systematization and consistency

C) Interdisciplinarity

D) Digitalization

4. What principle fosters critical thinking and innovation among students?

A) Integration of education and science

B) Scientificness

C) Personal-oriented learning

D) Digitalization

5. Which principle emphasizes using digital technologies to improve the accessibility of education?

A) Academic freedom

B) Digitalization

C) Globalization

D) Interdisciplinarity

6. How does AI change the approach to personalization in teaching?

A) It allows for immediate feedback

B) It generates group projects automatically

C) It adapts learning paths based on the student's knowledge level

D) It creates virtual classrooms

7. What does AI elevate in teaching methodologies?

A) Flexibility

B) Scientific research

C) Autonomy

D) Evaluation

8. How can AI help in the principle of creativity?

A) It offers personalized learning

B) It analyzes trends and generates ideas

C) It assists with research data

D) It organizes group tasks

9. What is the role of AI in project-based learning?

A) It automates administrative tasks

B) It generates reports and supports creative thinking

C) It replaces traditional teachers

D) It eliminates the need for practical tasks

10. What does the operational level of AI bots integration involve?

A) Personalizing student learning

B) Creating adaptive learning materials

C) Supporting self-directed learning and group collaboration

D) Automating administrative work

ANSWERS

1) B; 2) C; 3) B; 4) A; 5) B; 6) C; 7) A; 8) B; 9) B; 10)C.

3) Implementing AI bots to enhance communication between students and instructors

The integration of AI bots in didactics and teaching methodologies addresses several challenges faced by educators and learners alike. Traditional communication channels between students and instructors often suffer from inefficiencies such as delayed responses, high workload for faculty members (Henderson et al., 2019), and lack of personalized feedback (Perera et al., 2008). By offering instant help, simplifying boring tasks, and encouraging interactive learning experiences, AI robots can solve these problems (Doğan et al., 2024).

Challenges in Student-Instructor Communication

Though several barriers may interrupt this interaction, good communication between students and instructors is absolutely vital for academic success. Particularly in online and hybrid learning setups as well as in conventional classroom ones, these challenges are obvious.

Key challenges in student-instructor communication:

Blended Learning Environments: Forming a common understanding in blended learning calls for instructor presence, coherent communication rules, good feedback, and cultural sensitivity (Krasnova, 2023).

Emergency Remote Teaching (ERT): The shift to ERT during crises like the COVID-19 pandemic reduced access to informal interactions and support, impacting student-instructor relationships. Suggested policies include real-time feedback systems and informal communication lines (Šinko et al., 2024).

Power Dynamics: The inherent power differential between students and instructors can affect communication. Workshops focusing on peer feedback and conflict resolution can help manage these dynamics (Goodboy & Bolkan, 2011).

Instructor Communication Styles: Successful teaching practices, like clarity and immediacy, are associated with improved student learning results. Clear instructions boost cognitive learning, and nonverbal immediacy can enhance student engagement (Bolkan et al., 2017).

Relationship and Engagement: A solid relationship between lecturers and students boosts classroom engagement and involvement, which are vital for successful learning (Parnes et al., 2020).

Aggressive Communication: The aggressiveness of an instructor negatively influences students' opinions of comprehension and the instructor's credibility, whereas non-aggressive argumentativeness could enhance credibility (Schrodt, 2003).

Several factors including the learning atmosphere, power dynamics, and different communication styles create communication obstacles among students and instructors. Addressing these problems depends on promoting clear, encouraging, and culturally sensitive communication means, arranging informal interaction, and competently negotiating power structures.

AI Chatbots in Student-Instructor Interaction

Chatbots driven by AI can act as liaisons between learners and instructors by delivering immediate answers, promoting dialogue, and supplying assistance beyond regular class times. These computer systems can handle typical questions, schedule meetings, and forward tailored notices about homework deadlines.

In educational settings, AI chatbots function as digital teaching aids helping students discuss course materials, offering immediate response, and stimulating conversation. Supporting many different teaching methods, they can be implemented into independent applications, messaging systems, or learning management systems (LMS).

Research has shown that using AI chatbots helps students to be more engaged and motivated. In K-12 environments, chatbots combined with instructor support and student knowledge in self-regulated learning and digital literacy can improve natural motivation and competence (Chiu et al., 2023). Research including students (Wang & Xue, 2024) show that chatbots in higher education allow for customized and interactive learning experiences, therefore raising academic engagement.

AI chatbots are instrumental in enhancing teaching methodologies. For teachers, interacting with chatbots can improve their engaging ability to teach responsively by improving observations and questioning methods (Lee et al., 2024). This indicates that chatbots can be valuable assets in the training and professional growth of instructors.

The future of AI chatbots in education includes making use of their transformative power and addressing the challenges linked with their use. Emphasis one is on developing local responses

that meet students' needs and qualities while also upholding ethical standards. Moreover, cumulative research is absolutely necessary to assess over different educational settings the long-term consequences of these techniques (Wang & Xue, 2024). More study should look into how well chatbots can mimic human interactions and therefore boost academic performance (Pérez et al., 2020).

Enhancing involvement, perfecting teaching styles, and offering custom learning experiences will help AI chatbots to significantly change the interactions among students and instructors. Still, using these tools effectively in academic settings calls for dealing with concerns about ethics, privacy, and trust. Fully realizing the benefits of AI chatbots while minimizing any drawbacks depends on a committed attention to research and development.

While they have several benefits, generative AI chatbots suffer significant obstacles in higher education including worries regarding the precision of AI-produced material and student unease with unfamiliar technology. Overcoming these challenges will require the development of responsible AI frameworks, clear usage guidelines, and a thoughtful approach to ethical considerations (Akpan et al., 2024). See Table 1 for advantages and challenges of AI bots in didactics.

Table 4 - Advantages and Challenges of AI Bots in Didactics (OpenAI, 2025)

Advantages	Challenges
Immediate Assistance: AI bots provide students with instant responses, reducing dependency on instructor availability.	Accuracy and Reliability: AI responses may sometimes lack contextual depth or accuracy.
Personalized Learning: Adaptive AI systems customize responses according to the progress and learning preferences of students.	Data Privacy: A major worry is safely managing sensitive student information.
Efficiency for Educators: Automates repetitive duties like responding to frequently asked questions and assessing quizzes, enabling teachers to concentrate on advanced teaching methodologies.	Student Engagement: Excessive dependence on AI chatbots could diminish personal interactions, which are vital for social learning.

Various universities and educational establishments have effectively used AI chatbots to support the academic road trip and drive student participation. By saving teachers administrative tasks, providing quick answers to student concerns, and customizing the learning experience, these technologies enhance academic success.

One of the effective cases is Pounce, Georgia State University 's AI assistant, which was created to guide candidates through the admissions and enrolment process. Research shows (Georgia State University, 2022) that by giving fast and correct answers to inquiries about academic criteria, financial aid, and application, it has greatly increased student retention.

Higher education is increasingly including generative AI chatbots, which present both possible advantages and difficulties. By offering individualized support and improving learning experiences, these AI technologies, like ChatGPT, are changing academic paradigms. However, their use also raises questions about privacy, academic integrity, and information accuracy.

Through generative artificial intelligence, Open Universities Australia reaches out to potential students. LivePerson's generative AI chatbots provide a more satisfying experience, therefore enabling students to fast and pleasantly evaluate their educational needs and goals. Compared to the regular natural-language understanding bot, the generative AI chatbot has more than doubled lead qualification and has tripled engagement levels beyond mere browsing (LivePerson, 2024).

Within the educational field, artificial intelligence chatbots have many uses – they improve discussions, answer student inquiries, and help with course organization. Often first – response level, they give quick responses to regular questions before passing more demanding problems to teachers. Operating as digital assistants, these bots handle issues related courses, projects, and deadlines so that students get quick and exact feedback. AI apps also make dynamic discussions possible by controlling speech and guiding students through complex material.

AI chatbots offer several modern features that enhance support and engagement in academic settings. A well-known use is virtual office hours, where AI bots imitate instructor availability by answering common student questions, therefore guaranteeing that students have help outside standard hours. AI-driven automated feedback tools also offer students a fast means to identify areas requiring improvement by providing instant observations on homework, tests, and discussion engagement. Another important use is in moderating discussion boards, where AI chatbots help constructive talks by filtering inappropriate material and directing debates toward relevant interaction. Taken as a whole, these abilities help to produce a more engaging, efficient, and accessible learning environment where teachers and students may maximize their time and focus on critical academic objectives.

Generative AI chatbots are largely viewed approving by both learners and instructors, as many acknowledge their ability to enhance educational experiences. Nevertheless, issues related to trust, privacy, and the reliability of the information offered continue to be critical. Elements like technological skills, user demographics, and gender affect the implementation and perception of these tools, underscoring the necessity for customized deployment strategies that effectively cater to various user requirements (Saihi et al., 2024).

Generative artificial intelligence chatbots might have positive effects on student motivation and engagement. Research finds that young people who interact with AI-powered chatbots are motivated, but there are large differences in their learning experiences. Student involvement can

be improved, teaching systems can be simplified, and support to research and administrative operations given. Nonetheless, challenges such as user input understanding and efficient resource allocation need to be addressed to maximize their effectiveness (Liu & Reinders, 2024).

Table 5 - Comparison between Traditional Approach and AI Chatbot Integration in Education (*authors' own work*)

Feature	Traditional approach	AI chatbot integration
Availability	Limited to working hours	24/7 accessibility
Response time	Slow (manual response)	Instant (seconds)
Personalization	Limited (depends on the conditions)	High (AI adapts to student needs)
Instructor workload	High	Reduced
Student engagement	Variable, passive	Increased (interactive learning)

Table 5 compares two approaches in the educational system: the traditional approach and AI chatbot integration. It highlights key differences in availability, response time, personalization, instructor workload, and student engagement. The traditional approach offers limited availability and slower response times, while AI chatbots provide 24/7 access and instant responses. AI integration offers high personalization, adapting to student needs, reducing instructor workload, and increasing student engagement through interactive learning.

Recommendations

Use AI chatbots for regular communication to handle scheduled, frequently asked questions, and other mundane tasks.

Educators and students should be given targeted training programs that introduce them to AI chatbot features and guide them in maximizing their performance in academic environments.

Set up routine evaluation systems to keep an eye on AI chatbot performance, so guaranteeing accuracy, relevance, and adaptability to changing educational demands.

Adhering to local and worldwide privacy rules, put strong safeguards in place to guard institutional and student data, therefore ensuring data privacy and security compliance.

Include adaptive learning features: Improve chatbots with changing algorithms to tailor reactions depending on specific student progress and learning preferences.

Equip AI chatbots with multilingual skills to help varied student bodies and guarantee inclusivity by enabling multilingual support.

Support ethical artificial intelligence through developed guidelines.

Foster student feedback: Proactively seek input from students and teachers to enhance AI chatbot features and fulfill any unaddressed requirements.

Give easy and accessible chatbot interfaces that meet diverse levels of tech competence top priority.

Combine AI tools with traditional methods: Use AI chatbots as supplementary tools, balancing technology integration with the preservation of human interaction in learning environments.

Conclusion

It is recommended that educational institutions implement AI chatbots as supplementary tools to enhance the learning experience, rather than replacing human interaction entirely. AI bots should complement the role of instructors, supporting students in a way that does not replace the value of human guidance.

Ongoing evaluation and enhancement of the AI algorithms are essential to maintain the precision and efficiency of the chatbot's replies. Frequent updates and modifications will enable the AI system to remain relevant and reliable in meeting student requirements.

Organizations must also implement strict data privacy policies to protect students' personal information. Maintaining confidence and following privacy regulations depends on the security of sensitive data. Although generative AI chatbots offer great promise for enhancing higher education, it is vital to carefully consider ethical, privacy, and integrity issues. Higher education institutions may create a more efficient, effective, and creative learning environment by addressing these challenges and leveraging the benefits of AI technologies.

Discussion questions

How can AI chatbots be used in your course for communication? If you have experience, please share! Do you have any ideas on how to incorporate them effectively?

4) Utilizing AI bots to assist in knowledge retention and reinforcement

The integration of AI chatbots into knowledge retention and reinforcement is a hot field. AI chatbots and reinforcement learning are crucial in creating personalized, adaptive learning experiences that can significantly improve knowledge retention after training. The utilization of AI in higher education presents many benefits, such as tailored self-paced learning, better performance forecasting, and enriched learning experiences via intelligent tutoring systems. AI-driven tools, like chatbots, help generate personalized resources for collaborative learning and participation, thus maximizing resource efficiency and enhancing retention strategies (Banerjee &

Bhattacharya, 2024). These resources also help students to generate predictive analytics and assistive technologies.

AI Chatbots for Knowledge Retention

Given the fast-changing environment of education, students need to keep the material they learn so that they can attain academic success and long-term learning results. Issues related to student engagement and the effectiveness of information retention often challenge traditional instructional techniques. Encouragement of active learning, use of data-informed insights, and custom feedback all offer possible artificial intelligence response for these issues.

Retention of knowledge is essential in the learning journey since it guarantees that the information students obtain remains accessible over time. It allows learners to implement their knowledge in practical situations and to expand upon earlier learning, establishing a strong base for continued education. In the absence of effective retention, the time and energy devoted to grasping new ideas diminish in worth, obstructing both academic advancement and overall understanding (Kooloos et al., 2020).

Due to several key limitations, traditional learning approaches generally do not effectively address the problem of knowledge retention. Introduced by Hermann Ebbinghaus, one of the most significant problems is the Forgetting Curve, which demonstrates that people forget a large amount of freshly learned data over a brief time if it is not actively reviewed or strengthened (Ebbinghaus, 1885). Without constant reinforcement, therefore, students might soon forget the knowledge they have mastered. Passive learning, where students absorb information without actively interacting with it, is an additional obstacle to overcome. In these usual surroundings, students usually passively interact with their education rather than actively engage themselves. The low probability of knowledge lasting long-term is further reduced by this lack of engagement.

The Forgetting Curve shows how memory retention falls gradually after time. Including AI chatbots in educational systems enables organizations to use spaced repetition techniques – conscious revisits of learned material at intervals. This approach improves memory retention by reviewing material just before the student is expected to forget. Develop customized review schedules tailored to the needs of each student from monitoring distinctive learning styles by AI chatbots (Gerlich, 2025). By improving the learning environment, this adaptive feedback system enables students to strengthen their memory retention over time.

Active involvement, achieved using interactive review methods (De Moraes et al., 2024), is one of the most effective means of ensuring knowledge retention. AI chatbots simplify this process by giving interactive quizzes, flashcards, and instant criticism. By embedding quizzes and assessments at regular intervals, AI chatbots will help to ensure students are regularly interacting

with the material, therefore improving their knowledge. Furthermore, AI-powered customized evaluations adjust question complexity based on learner performance so students are presented with the appropriate level of challenge (Chang & Chien, 2024). Students who always run into questions that match their present knowledge would have a better understanding and retention of information from this personalized testing approach.

In academic settings, AI chatbots provide a ground-breaking approach to knowledge maintenance. AI tools foster active engagement, customized learning paths, and continual reinforcement of critical ideas by going above and beyond traditional, sluggish learning approaches. AI chatbots fight the Forgetting Curve by means of spaced repetition and personalized quizzes, therefore guaranteeing that students retain and make great use of their knowledge. Using this technology in educational systems improves intellectual performance and promotes a more personal, interactive, and engaging learning environment.

AI Chatbots for Knowledge Reinforcement

By serving as interactive learning tools, AI chatbots are changing the educational field, therefore improving knowledge retention and reinforcing vital ideas. AI-powered exams, task automation, and cognitive reinforcement techniques give these bots a customized and adaptive learning path for children.

By offering a variety of interactive tools designed to improve the learning experience, artificial intelligence chatbots act as strong academic partners. These chatbots can create personalized tests, simplify jobs, and use cognitive reinforcement methods to encourage active student engagement with the material. By creating custom questions based on student responses, AI chatbots create an environment that lets students focus on their problems and improve their knowledge by means of intentional repetition and practice.

AI chatbots have one major advantage in their capacity to adjust the difficulty of questions depending on the learner's progress (Du et al., 2024). If, for instance, a student is having trouble with a single concept, the AI chatbot can provide easier inquiries to improve the student's confidence and knowledge base before gradually raising the difficulty. Moreover, a major feature of AI chatbots is their capacity to do automatic error analysis (Izadi & Forouzanfar, 2024). This feature enables the chatbot to detect patterns in the mistakes of the learner and offer individualized help. For example, the AI chatbot can quickly offer explanations, guidance, or further materials if a student keeps making errors in a given subject to help their knowledge of the topic in great depth. Particularly in strengthening ideas kids find challenging, personalized help is absolutely necessary

for effective learning. AI chatbots help to keep students up by offering quick, tailored criticism and therefore provide the fast support they need.

Gamification and microlearning methods help AI chatbots raise student engagement and memory. By incorporating game elements into academic environments in grading systems, incentives, and challenges, games make learning more fun and inspiring (Benner et al., 2024). On the other hand, microlearning stresses the delivery of knowledge in short, easily consumable bites, thus helping students to grasp material in less amount. Incorporating game elements into the educational system helps AI chatbots motivate students to participate more in their learning journey. With things such leaderboards, points, and achievements, a condition is created whereby students are encouraged to keep learning and developing. Transforming learning into a more engaging and fun experience, these gamification features help students to develop problem-solving abilities.

For everyday tasks and brief study sessions, microlearning is ideal. AI chatbots offer brief learning modules or mini-lessons that students can complete in only a few minutes. Used, this method helps students continuously engage with the material, boosting their sluggish memory and understanding levels without agitating them.

AI chatbots are changing the way we deliver knowledge support across the educational field. Improvement in information retention and student performance relies critically on their ability to analyze errors, offer quick input, and generate personalized learning opportunities. For STEM subjects, where understanding is absolutely needed, AI chatbots offer a fresh and powerful way of reinforcing learning and ensuring that students not just grasp but also remember and apply the material they have learnt.

Practical Example

For instance, a program that incorporates an AI chatbot within the educational framework. After every meet-up, the AI chatbot offers a series of little tests or customized questions connected with the material discussed. The AI grades the student's responses and identifies weaknesses. This ensures that the student gets focused reinforcement by means of rather changing future assessments to focus more on those particular weaknesses. Moreover, helping to avoid the Forgetting Curve, this spaced repetition also supports the material in the student's long-term memory.

Duolingo is a language-learning platform that uses AI for customized tests, instant feedback, and interactive game-like features. It offers support for many languages and keeps learner motivation up via daily chores, rewards, and interactive events (Duolingo, 2025).

Khan Academy’s Khanmigo AI serves as a kind of virtual tutor and teaching assistant, offering customized learning plans, flexible evaluations, and quick feedback. It promotes self-paced learning and conforms to ethical AI standards (Khan Academy, 2025).

Google Classroom integrates Google Bard, an AI assistant, to provide 24/7 support for student queries, automated feedback on assignments, and enhanced collaboration features. It ensures data privacy and helps to simplify communication between educators and learners (Google, 2025).

Microsoft Teams includes Copilot, an AI solution designed to improve collaboration and organization. It helps with personalized study scheduling, small learning, and real-time feedback while still meeting worldwide privacy standards (Microsoft, 2025).

Recommendations

Integrate AI chatbots with spaced repetition algorithms. By providing material at intervals based on the student's advancement, use AI-driven spaced repetition systems to maximize learning results. By making sure students go over material just before they are likely to forget it, this technique improves memory retention and reinforces learning over time.

Develop personalized learning plans. Use AI chatbots to design tailored learning paths that address the particular assets and shortcomings of every student. AI programs may change content delivery, recommend personalized materials, and offer exercises targeting particular learning deficits by examining personal performance data.

Continuously evaluate AI chatbot effectiveness. Set daily evaluation strategies to measure how well and how effective AI chatbots affect knowledge retention. Ensure that the chatbot's features are aligned with student requirements and educational objectives by monitoring performance and making iterative improvements based on student input and learning analytics.

Implement adaptive quizzing for dynamic learning. Make use of adaptive quizzing, where the AI bots dynamically adjust question difficulties according to a student's performance. This ensures students are challenged just enough to avoid frustration and boredom while encouraging continuous learning.

Use gamification to enhance motivation. Supplement the learning process with gamification elements like leader boards, rewards, and challenges. AI-driven learning games can increase student motivation and engagement and enhance memory retention.

Facilitate microlearning for efficient knowledge reinforcement. Use microlearning techniques by breaking learning materials into bite-sized units that can be managed. AI chatbots can push students daily with quizzes, flashcards, or minute-long assignments, which provide consistent exposure to the material without overwhelming them.

Promote active learning with real-time feedback. AI chatbots also provide instant feedback on quizzes and assignments so that students can correct mistakes immediately. This active learning technique encourages students to take responsibility for their own learning and make improvements as they go along, which reinforces understanding and retention.

Offer multilingual support for diverse learners. Mentor multilinguality in AI chatbots to facilitate support and inclusivity for students of diverse linguistic backgrounds. Offering learning materials in various languages will help close learning gaps and create an inclusive learning system.

Encourage ongoing student and educator feedback. Collect feedback from students and educators regularly to improve the functionality and usability of AI bots. Feedback will indicate what the chatbot is doing effectively and where it needs to improve, assisting in ensuring that the technology is achieving educational goals and user needs.

Design intuitive and user-friendly interfaces. Prioritize user-friendly and intuitive interfaces that appeal to a wide range of technological skill levels. Making the AI chatbot easy to use will encourage its uptake and efficient application by students and teachers alike.

Combine AI chatbots with traditional learning methods. The mixed model ensures that technology complements, and does not replace, human interaction, and offers a more holistic and efficient learning process.

Implement continuous updates and improvements. Regularly update AI chatbots to keep them in line with the latest educational research and technological advancements. Continuous improvements based on data analysis and emerging trends will help ensure the chatbot remains effective and relevant.

Promote ethical AI use. Create ethical standards to stop any partiality in AI chatbot reactions and guarantee that AI is employed conscientiously in education. Central to the development of AI chatbots should be ethical concerns, therefore guaranteeing that the technology benefits every student equitably.

Following these guidelines would enable educational institutions to use artificial intelligence chatbots to significantly improve knowledge retention and reinforcement and provide students with a customized, interactive, and meaningful learning experience.

Conclusion

By including AI chatbots in knowledge retention and reinforcement, education experience becomes personalized, adaptable, and revolutionary, therefore overcoming the limitations of traditional approaches. These resources ensure that knowledge is regularly strengthened over time by using methods including spaced repetition and dynamic quizzing that fight the Forgetting

Curve. By engaging students in interactive material, providing instant feedback, and offering customized support, artificial intelligence systems enable active learning and help them to focus on particular areas that need improvement.

Particularly for students with limited schedules, gamification and microlearning increase motivation and access, therefore making the learning experience more enjoyable and efficient. Furthermore, artificial intelligence-based systems give predictive analytics, which helps teachers to identify trends and challenges in student instruction and helps students to improve their scores through targeted support.

By providing multilingual support and following ethical standards, AI-driven learning materials help to create inclusivity. However, their greatest impact is only realized when carefully aligned with traditional learning methods, thus emphasizing the balance between human involvement and technical support. Ongoing updates, regular feedback, and data privacy are essential for keeping AI a reliable, fair, and powerful partner in education as schools embrace these developments.

By utilizing AI chatbots, instructors can design tailored, interactive, and enduring educational settings, promoting lasting knowledge retention and empowering students to succeed both academically and professionally.

TESTS

1. How can AI chatbots enhance student engagement in educational settings?

A) By offering personalized learning experiences

B) By decreasing the number of assignments given

C) By eliminating the need for instructor feedback

D) By removing human interaction in learning environments

2. What role do AI chatbots play in teacher training and development, according to the text?

A) They replace instructors in training programs

B) They assist in enhancing responsive teaching skills

C) They act as primary teaching assistants in the classroom

D) They focus only on administrative tasks

3.What are some potential ethical concerns regarding the use of AI chatbots in education?

A) AI chatbots might become too advanced and replace teachers entirely

B) Issues related to data privacy and accuracy of AI-generated content

C) AI chatbots are not scalable for large class sizes

D) AI chatbots could lead to an increase in student procrastination

4. What is a key recommendation for educational institutions when integrating AI chatbots into their systems?

A) AI chatbots should be used as replacements for instructors

B) Limit chatbot usage to only administrative tasks

C) Avoid using AI chatbots to interact with students directly

D) Regularly assess chatbot performance and update algorithms

5. How can AI chatbots improve instructor workload in educational environments?

A) By completely replacing instructors in all teaching activities

B) By reducing the need for any form of communication with students

C) By automating repetitive tasks such as answering frequently asked questions and grading

D) By eliminating the need for instructors to create course content

6. What key concept introduced by Hermann Ebbinghaus describes the natural decline of memory retention over time?

A) Active Learning

B) Forgetting Curve

C) Knowledge Spiral

D) Cognitive Load

7. How do AI chatbots ensure personalized learning experiences for students?

A) By offering real-time feedback and adaptive quizzes

B) By replacing human instructors entirely

C) By standardizing learning materials for all students

D) By focusing only on high-performing students

8. Why is it important to balance AI chatbot usage with traditional learning methods?

A) To ensure technology replaces human instructors entirely

B) To promote inclusivity and fairness in education

C) To enhance human interaction and create a holistic learning environment

D) To reduce the need for ethical considerations in education

9. What feature of AI chatbots allows them to identify patterns in students' mistakes and offer tailored assistance?

A) Spaced repetition algorithms

B) Microlearning modules

C) Gamification techniques

D) Error analysis

10. What is one of the primary advantages of microlearning facilitated by AI chatbots?

A) Delivering lengthy lectures for deeper engagement

B) Reducing the need for student participation in the learning process

C) Breaking down material into manageable units for regular engagement

D) Replacing traditional classroom interactions entirely

ANSWERS

1) A; 2) B; 3) B; 4) D; 5) C; 6) B; 7) A; 8) C; 9) D; 10) C

III. PREVENTING AND DETECTING PLAGIARISM USING AI CONVERSATIONAL BOTS

1) Employing AI bots for plagiarism detection and prevention

The rapid advancement of artificial intelligence has revolutionized various fields, including education. However, the proliferation of AI-generated texts has raised significant concerns regarding authenticity, originality, and academic integrity. Tools designed to detect AI-generated content have emerged as essential solutions to address these challenges. These tools leverage advanced machine learning algorithms, linguistic analysis, and pattern recognition to distinguish between human-authored and machine-generated texts. This paper explores the functionalities, strengths, and limitations of several prominent AI detection tools, including Ivy panda AI-detector, Writer AI Detector, Sapling AI Detector, and others. By examining their methodologies and effectiveness, this study aims to provide a comprehensive understanding of how these tools contribute to maintaining content integrity in an era dominated by AI-generated materials.

AI-generated texts often exhibit distinct characteristics, such as predictable word sequences, low perplexity, and uniform sentence structures, which differentiate them from human writing. These features form the basis for detection mechanisms employed by AI detection tools. For instance, tools like Ivy panda AI-detector and Writer AI Detector analyze linguistic patterns and word predictability to identify AI-generated content. Similarly, Sapling AI Detector and Winston AI utilize perplexity and burstiness metrics to evaluate text authenticity. Despite their technological sophistication, these tools are not infallible. Challenges such as false positives, false negatives, and the evolving capabilities of AI models necessitate continuous updates and improvements to maintain detection accuracy. It needs to be acknowledged that AI-generated texts exhibit distinct limitations. Firstly, ChatGPT does not have access to real-time information, which means that it may provide outdated or incorrect data. Secondly, AI-generated citations often require manual verification, as they may be incorrect or entirely fabricated. Thirdly, AI-generated essays often follow a standardized format, which can make them identifiable upon close examination.

The growing reliance on AI-generated content in academic, professional, and creative domains emphasizes the importance of robust detection mechanisms. Tools like Crossplag AI Detector, Hive AI Detector, and Originality.ai have been developed to address this need. They offer features such as multi-language support, real-time analysis, and detailed reporting. However, the effectiveness of these tools varies depending on factors such as text length, language, and the specific AI model used for content generation. This paper critically evaluates the capabilities and

limitations of these tools, and emphasizes the need for complementary human judgment and ethical considerations in interpreting detection results.

1. The Ivypanda AI-detector

The Ivy panda AI-detector is a specialized tool whose aim is to help users determine whether a text has been generated by artificial intelligence, such as ChatGPT. This tool provides a structured approach to assessing text authenticity. It may serve as a practical aid for students, educators, and professionals who look to verify the originality of their documents. (Ivy Panda 2025)

The detector employs a unique color-coding scheme: texts predominantly highlighted in red and orange are likely AI-generated, while those with a mix of green and blue indicate greater originality. The tool does not provide a binary answer, but instead it offers an informed analysis based on word predictability and linguistic patterns.

Ivy panda AI-detector offers several advantages tailored to academic and research needs. First, this tool is specifically designed to recognize AI-generated text patterns, which makes it highly effective in detecting ChatGPT-produced writing. Secondly, the tool is accessible through Ivy panda's website and requires no technical expertise. Users simply input their text and receive instant results. Thirdly, the AI-detector presents an intuitive color-coded analysis alongside detailed statistics, allowing users to better understand how the tool reaches its conclusions. Rather than enforcing a strict classification, the tool allows users to interpret results themselves, providing insights that help them make informed decisions regarding AI-generated content. (Ivy Panda 2025)

Ivy panda's AI-detector operates on the principle that AI-generated texts rely on predictable word sequences. Unlike traditional plagiarism checkers that scan for content duplication, this tool analyzes linguistic structures and statistical word frequencies to determine AI authorship.

2. Writer AI Detector

The Writer AI Detector is a specialized tool that has been designed to identify AI-generated text. It provides users with a reliable method for distinguishing between human-written and machine-generated content. This detector aims to support academic, professional, and editorial integrity by analyzing text for linguistic patterns indicative of artificial intelligence authorship. (Writer AI detector 2025)

The Writer AI Detector operates through a multi-step analytical process. First, users input their text into the platform, after which the system examines various linguistic and structural features. The detector relies on advanced machine learning algorithms that assess sentence predictability, word frequency distributions, and stylistic inconsistencies that are commonly found

in AI-generated content. Unlike traditional plagiarism checkers, which compare text against existing databases, the Writer AI Detector evaluates text originality based on writing patterns and coherence.

The accuracy of the Writer AI Detector depends on the sophistication of both the detection model and the AI writing system that is being analyzed. It is highly effective in identifying content produced by popular language models such as ChatGPT, GPT-4, and other generative AI systems. However, as AI-generated text becomes more advanced, detection challenges may arise, which will require continuous updates to the model. (Writer AI detector 2025)

3. The Sapling AI Detector

The Sapling AI Detector is a machine-learning-based tool that is designed to evaluate whether a text has been generated by artificial intelligence models such as OpenAI's ChatGPT, Google's Gemini, or Meta's Llama. The detector employs transformer-based algorithms that analyze linguistic patterns, word probability distributions, and sentence perplexity. This approach enables the tool to identify AI-generated content with a high relatively degree of accuracy while minimizing false positives. (Sapling 2025)

The detection process consists of two primary components: an overall text analysis and a sentence-level evaluation. The system assigns a probability score indicating the likelihood that a text is AI-generated. Additionally, it highlights individual sentences that exhibit characteristics commonly associated with machine-generated content, such as low perplexity or excessive predictability. The tool is particularly effective when analyzing longer texts (above 50 words), as increased input length enhances detection accuracy.

The creators of the tool claim that Sapling AI Detector achieves a 97%+ detection rate for AI-generated content while maintaining a false positive rate of under 3% for human-written texts. However, its performance can vary depending on text structure and length. Shorter or highly generalized texts are more prone to misclassification. The tool is continuously updated to adapt to advancements in AI text generation and now supports large-scale processing of up to 100,000 characters for enterprise users. Furthermore, it offers API integration, browser extensions, and compatibility with file formats such as PDF and DOCX, making it accessible across various platforms. (Sapling 2025) Nevertheless, the detector is not infallible. False negatives and positives remain possible, which emphasizes the need for complementary human judgment when assessing content authenticity.

4. Brandwell AI Detector

The Brandwell AI Detector is a tool that has been designed to identify AI-generated text by analyzing linguistic patterns and probabilistic word predictions. Since its launch in 2022, the tool has been continuously updated to detect content produced by various AI language models, including ChatGPT, GPT-4, Claude Sonnet, and Google Gemini. Brandwell's system employs a sophisticated machine-learning approach that distinguishes between human-written and AI-generated text based on sentence structure, word choice, and coherence. (BrandWell 2025)

The detection process operates through multiple layers of natural language processing, semantic analysis, entity recognition, and search engine results page parsing. By leveraging these technologies, the AI Detector evaluates word sequences in a given text and assesses the probability that they were generated by an AI language model. This approach is grounded in the fundamental distinction between human and machine-generated text: while human writing is influenced by creativity, context, and lived experience, AI-generated text is constructed through mathematical predictions based on extensive pre-trained datasets. (BrandWell 2025)

To use the Brandwell AI Detector, users simply paste or upload their text into the tool, which then processes the input using its multi-layered analysis techniques. The system scans for AI-generated patterns, highlights sections of the text that are likely to be machine-written, and provides an overall probability score. The tool is optimized for English-language content and works best with longer passages, as AI detection accuracy improves with increased text length. Additionally, the detector differentiates between human and AI-written content by comparing the input text against known structures of large language models (LLMs).

Brandwell AI Detector's effectiveness is enhanced by its ability to analyze text at both the macro and micro levels. It provides an overall assessment of AI-generated probability and highlights specific sentences and phrases that exhibit robotic characteristics. This approach allows users to identify AI-influenced sections within otherwise human-written content. The tool might be beneficial for digital marketers, content creators, and SEO specialists, as it helps ensure that content remains authentic and undetected by search engines as AI-generated, which could negatively impact search rankings. (BrandWell 2025)

Just like the previous tools, the Brandwell AI Detector is not infallible and should not be used as a standalone measure for content evaluation. The developers emphasize the importance of human judgment and ethical considerations when interpreting results.

5. Crossplag AI Detector

Crossplag's AI Content Detector is a tool that has been designed to distinguish between human-authored and AI-generated text. It addresses the growing prevalence of AI-produced

content in various domains. Upon analysis, the tool provides a percentage indicating the likelihood of the text being AI-generated. (Crossplag 2025)

Crossplag's AI Content Detector is designed for a diverse range of users who need to verify the authenticity of textual content. It might be beneficial for educators and academic institutions—professors, teachers, and universities can use the tool to detect AI-generated assignments and maintain academic integrity. Also, writers and content creators—Journalists, bloggers, and professional writers can check their work to ensure originality and avoid AI-generated content that could affect credibility.

The AI detector effectively distinguishes between human-written and AI-generated text, with continuous improvements to enhance performance. Furthermore, the tool is simple to use—users only need to paste text into the input field to receive results. The output is divided into "Human", "Mix", and "AI", which helps users understand the level of AI involvement in a text. Unlike some competitors, Crossplag supports AI detection in multiple languages. (Crossplag 2025)

Nevertheless, while Crossplag offers a free version, it has restrictions on the number of characters or words that can be analyzed at no cost. What is more, like all AI detection tools, it may sometimes misclassify content, especially if it is edited AI-generated text or very formulaic human writing. Therefore, users must interpret the results critically and avoid relying solely on the detector for high-stakes decisions.

6. The Hive AI Detector

Hive AI Detector is a tool that has been developed by Hive Moderation to identify content generated by artificial intelligence across various media types, including text, images, and videos. The detection mechanism of Hive AI Detector is rooted in sophisticated machine learning algorithms. For text analysis, the system has been trained on extensive datasets comprising both human-written and AI-generated text, with a particular emphasis on genres like essays and academic assignments. This training enables the detector to effectively discern subtle differences in language patterns and structures characteristic of AI-generated text. (Hive 2025)

In the realm of image and video content, Hive's AI leverages deep learning models to analyze visual data, identifying artifacts or patterns indicative of AI generation. Studies have demonstrated that Hive's AI-Generated Image and Video Detection API outperforms both competitors and human experts in classifying art as human-created or AI-generated. The model's robustness is evident in its resistance to various perturbation methods, although it encounters challenges when processing images altered with tools like Glaze. However, such scenarios are

considered non-traditional use cases with limited training data, thus having minimal impact on the model's overall efficacy. (Hive 2025)

To enhance accessibility, Hive offers a free Chrome extension that allows users to detect AI-generated content in real-time as they browse the web. This tool simplifies the verification process, providing immediate insights into the authenticity of encountered content.

In terms of effectiveness, Hive's AI detection capabilities are noteworthy. The system's performance surpasses that of human experts in specific tasks, showcasing its precision and reliability. However, it is important to acknowledge that the detection system is infallible. The continuous evolution of AI models necessitates ongoing updates and refinements to maintain high detection accuracy. Hive addresses this by continually updating its models to keep pace with emerging generative techniques and evolving customer needs. (Hive 2025)

7. Winston AI Detector

Winston AI is an artificial intelligence content detection tool that has been designed to differentiate between human-written and AI-generated text. It leverages extensive machine learning techniques, linguistic analysis, and pattern recognition algorithms to provide accurate content assessments. Trained on a vast dataset that includes text generated by leading AI models such as GPT-4, ChatGPT, Jasper, and Claude 2, Winston AI is positioned as one of the most precise AI detection tools available. (WinstonAI 2025)

The detection process in Winston AI relies on two primary approaches: linguistic analysis and data training. Linguistic analysis examines the structure, coherence, and repetitiveness of a text to identify patterns associated with AI-generated content. Within this category, Winston AI specifically assesses perplexity and burstiness. Perplexity measures how predictable a text is—AI-generated text typically has lower perplexity due to its reliance on established language patterns. Burstiness, on the other hand, evaluates the variability in sentence structure and word usage, which tends to be more uniform in AI-generated content.

Additionally, Winston AI employs a probabilistic assessment, returning a probability score (0-100%) that indicates the likelihood of a text being AI-generated. The Human Score provides an additional layer of evaluation by estimating the probability that content was authored by a human. To enhance transparency, the AI Prediction Map visually highlights words based on their predictability, helping users understand which portions of a text align with AI-generated patterns.

According to the creators, Winston AI boasts an impressive 99.98% accuracy rate in detecting AI-generated content, making it one of the most reliable tools in the field. By continuously updating its training dataset to include emerging AI models, Winston AI ensures that it remains effective against the latest advancements in AI-generated text. (Winston AI 2025)

In addition to AI detection, Winston AI provides a Flesch-Kincaid Readability Score, which helps users evaluate the complexity and accessibility of their writing. This feature is particularly useful for content creators aiming to tailor their text to specific audiences. Furthermore, Winston AI distinguishes between traditional editing tools, such as Grammarly, and generative AI applications, ensuring that human-assisted content refinement is not mistakenly flagged as AI-generated.

While Winston AI offers exceptional accuracy, it operates within a probabilistic framework, which means that results should be interpreted alongside human judgment. As AI-generated content becomes more sophisticated, tools like Winston AI could be beneficial for educators, researchers, and professionals seeking to maintain authenticity and credibility in digital writing. (Winston AI 2025)

8. AIDP

AIDP (AI Detector Pro) is a tool that has been designed to facilitate the creation and refinement of human-sounding content generated by artificial intelligence (AI). Its primary functions are to detect AI-generated text and assist in humanizing it. The detection feature identifies portions of a document that trigger AI detection, helping users understand which elements are likely to be flagged by AI detection tools. Additionally, AIDP offers automated rewriting and humanization assistance to make AI-generated content sound more natural and human-like. (AIDP 2025)

AIDP supports text generated by various AI models, including well-known systems like GPT, Gemini, and Claude, as well as lesser-known language models. These models are commonly used in AI article generation tools and grammar checkers. The tool operates in multiple languages, including English, Arabic, French, Portuguese, Spanish, and German. However, humanization capabilities outside of English are currently experimental.

AIDP uses advanced machine learning algorithms to detect AI patterns in text. The detection process is based on the likelihood of certain words and structures appearing in AI-generated content. While AIDP provides high accuracy, it is not 100% precise, given the inherent variability of language models. For this reason, users are encouraged to adjust and modify content after running the AI detection and humanization processes. (AIDP 2025)

While the free version of AIDP includes limited functionality, the paid version offers more robust features, including increased character limits and access to full humanization tools. Despite its advanced algorithms, AIDP cannot guarantee complete accuracy in all cases, and users are encouraged to refine the results further for optimal outcomes. (AIDP 2025)

9. GPT Zero

GPTZero is an AI content detection tool that analyzes text to determine whether it was written by a human or generated by artificial intelligence. With AI-generated content expected to make up 90% of online material by 2026, tools like GPTZero are becoming crucial for maintaining content integrity and authenticity across various sectors. This includes education, where it helps uphold academic integrity, businesses ensuring brand authenticity, and journalism preventing the spread of misinformation. (GPTZero 2025)

GPTZero employs machine learning and natural language processing to analyze the structure, syntax, and meaning of a text. It relies on algorithms that recognize patterns, leveraging these techniques to differentiate between human and AI writing. A core feature of GPTZero is its use of perplexity and burstiness to evaluate writing. Perplexity measures how predictable the text is, with AI content typically being more predictable. Human writing often displays surprising elements. Burstiness looks at the rhythm of the text— human writing usually showes a mix of short and long sentences, whereas AI tends to produce more uniform text. By analyzing these factors, GPTZero assesses the "natural flow" of the writing, identifying when AI is likely involved.

Additionally, GPTZero integrates a multilayered detection system, which includes an advanced scan and sentence-by-sentence classification model. It also uses an internet text search to check if content has been previously found in online sources. As AI technology evolves, GPTZero continues to adapt, improving its ability to detect the latest AI models and prevent attempts to bypass detection. (GPTZero 2025)

According to the creators, GPTZero has 99% accuracy rate and a 1% false positive rate. Supposedly, it is highly effective at distinguishing AI-written content from human-authored material. It is particularly adept at detecting mixed documents that contain both AI and human-generated text, achieving a 96.5% accuracy rate in these cases. However, like all AI detectors, it is not without limitations. False positives or negatives can occur, particularly with texts that use AI assistance for minor tasks like grammar corrections. (GPTZero 2025)

GPTZero is trained predominantly on English-language content, which may affect its performance when analyzing multilingual texts. As AI evolves, so too does GPTZero, with constant updates to ensure high accuracy in detecting AI-generated content while minimizing errors. However, it should be used as a complementary tool alongside human judgment, particularly in contexts where the consequences of false positives or negatives could be significant.

10. Originality.ai

Originality.ai is an AI content detection tool that has been designed to identify whether a piece of text was generated by a human or an artificial intelligence. The tool's core is built on a

modified version of the BERT model (Bidirectional Encoder Representations from Transformers), a widely recognized AI system for natural language processing developed by Google. As AI-generated text continues to improve in quality and sophistication, distinguishing between human-written and AI-generated content has become increasingly challenging. Originality.ai addresses this issue by utilizing machine learning (ML)-based detection techniques, making it a crucial tool for content verification. (Originality.ai 2025)

The tool employs a two-phase training approach. Initially, a novel pre-training language model based on Transformer architecture is trained on 160GB of text data using a generator-discriminator setup akin to the ELECTRA technique. This approach allows the model to distinguish between genuine and AI-generated text more effectively. The model is then fine-tuned using millions of samples to enhance its accuracy in detecting AI-generated content.

According to the developers of the tool, in terms of performance, Originality.ai has achieved high accuracy rates. The Lite version of the tool boasts 98% accuracy, while the Turbo version surpasses 99%. The system demonstrates strong results in detecting text produced by advanced AI models like GPT-3, GPT-J, and GPT-Neo, with success rates of 94.06%, 94.14%, and 95.64%, respectively. Despite the difficulty of identifying text generated by increasingly powerful models, Originality.ai's robust design and large dataset help ensure high detection precision. (Originality.ai 2025)

The detection process is based on a binary classification model, where the system evaluates the likelihood that a given text was generated by AI. The tool uses a threshold score to classify the text, ensuring minimal false positives or negatives. For shorter texts, which are often more challenging to assess, the model has been enhanced to improve detection accuracy.

11. Copyleaks

Copyleaks is a plagiarism detection tool designed to help users identify duplicate or copied content in various types of writing, from academic papers to professional documents. The tool is powered by AI-based technology, providing real-time, highly accurate results for detecting plagiarism. Copyleaks works by breaking down text into smaller, semantically related phrases and then using sophisticated algorithms to compare the content against a vast database of online sources, including millions of websites. (Copyleaks 2024)

The process begins when users submit their text, either by copying and pasting it into the tool, uploading a file, or entering a URL. Once submitted, the tool analyzes the content, checks for plagiarism, and generates a detailed report. This report highlights the percentage of plagiarism and uniqueness in the text, as well as the sources where the plagiarized content is found. Users can

customize the search to exclude specific sections, such as references or quotes, from the plagiarism check.

Copyleaks offers a user-friendly interface that is accessible on both desktop and mobile devices, making it convenient for professionals, students, and writers alike. The tool is particularly beneficial for academic users, helping them ensure their work is free from plagiarism and meets the required standards for originality. For professional writers and SEO agencies, Copyleaks is beneficial in maintaining the quality and authenticity of content, ensuring that it does not include any duplicate text that could affect rankings or credibility.

The effectiveness of Copyleaks is apaprent in its ability to detect various forms of plagiarism, with highly accurate, phrase-by-phrase analysis. The tool provides a clear, comprehensive report that is easy to understand, which makes it a reliable choice for anyone looking to maintain the integrity of their work. Although there are no strict guidelines for acceptable plagiarism percentages, Copyleaks helps users maintain low levels of duplication, offering insights into acceptable levels of similarity depending on the context. (Copyleaks 2024)

12. AI detection in Poland

In response to the growing popularity of AI-powered text generation tools, such as ChatGPT, and the rising concerns about their misuse in academic settings, the Polish National Information Processing Institute (OPI) has enhanced the Unified Anti-Plagiarism System (JSA) by incorporating AI detection capabilities. Since February 2024, all academic institutions and doctoral schools in Poland can utilize this feature free of charge to verify whether submitted theses have been generated with artificial intelligence. The introduction of this tool marks a significant step in the fight against academic dishonesty, addressing concerns about the increasing reliance of students on AI-generated content. The JSA, which has been in use since 2019, has already streamlined the plagiarism detection process by providing a standardized evaluation framework across all higher education institutions. By incorporating AI detection, the system now adapts to new challenges posed by machine-generated texts, ensuring that academic integrity is maintained at all levels of education. (MNiSW 2024)

The AI detection mechanism in JSA operates on the principle that highly structured and predictable texts are more likely to be AI-generated. The system employs a metric known as Perplexity, which measures the randomness of word choices in a given text. A lower Perplexity score suggests a higher probability that the content was produced by artificial intelligence. While JSA does not provide absolute certainty in determining AI-generated texts, it offers a probability-based assessment, leaving the final judgment to academic supervisors. OPI experts continue to refine the system, expanding reference databases and incorporating user feedback to enhance

detection accuracy. Given the lack of a universally reliable AI detection tool—even from developers of AI models themselves—the integration of this functionality into JSA represents a critical advancement in academic oversight. With over 400 institutions and 100,000 users relying on JSA, its continuous development emphasizes the commitment of Polish academia to uphold ethical research practices and combat emerging forms of plagiarism. (MNiSW 2024)

Comparison of AI detection tools

Based on the above-mentioned AI tools, below is the summary of their pros and cons (Table 6).

Table 6 - Comparison of AI detection tools (Author's own compilation)

Tool	Pros	Cons
IvyPanda AI Detector	Free to use, no registration required Supports up to 4,500 characters per check Color-coded analysis highlights AI patterns Fast results	Beta version, not definitive (preliminary results only) Limited to text input, no file uploads May struggle with highly edited AI content
Writer	Free to use Supports up to 1,500 characters per check Simple, no-frills interface	Poor performance with newer AI models (e.g., GPT-4, Claude) Limited character limit
CrossPlag	Free plan with 10 credits (1,000 words) Multi-language support (30+ languages)	Lower accuracy (reported ~95%, unverified) Paid plans
Hive Moderation	Free tier available Supports up to 8,192 characters Strong English performance	Weak performance for non-English languages Limited advanced features in free tier
Winston	Free trial (2,000 credits/14 days) Supports file uploads (.docx, .jpg, .png) 99.98% claimed accuracy for English, French, German, Spanish	Limited language support beyond English Paid plans
AIDetector Pro	Free trial (3 checks) Can analyze websites and text Good English support	Paid plans Limited language support beyond English

GPTZero	Free tier (5,000 characters, 5 scans) Supports multiple file uploads Detailed analysis (sentence-level breakdown)	Average performance for some languages beyond English Paid plans
Originality.ai	Free trial (50 credits) Analyzes files and URLs 98% accuracy with GPT-4, Claude	Average support for some languages beyond English Paid plans
Copyleaks	Free trial Supports files, URLs, images Strong English other languages' support	Paid plans

Conclusion

The emergence of AI detection tools represents a significant step forward in addressing the challenges posed by AI-generated content. Tools such as Ivy panda AI-detector, Writer AI Detector, and Sapling AI Detector have demonstrated remarkable accuracy in identifying machine-generated texts by analysing linguistic patterns, perplexity, and burstiness. These tools provide valuable support for educators, researchers, and professionals who seek to maintain content authenticity and uphold ethical standards. However, it is essential to recognize that no detection tool is entirely infallible. False positives and negatives remain a concern, particularly as AI models continue to evolve and produce increasingly sophisticated content. Therefore, these tools should be used as part of a broader strategy that includes human judgment and critical evaluation.

The integration of AI detection capabilities into existing systems, such as Poland's Unified Anti-Plagiarism System (JSA), highlights the global effort to combat academic dishonesty and ensure the integrity of scholarly work. By leveraging metrics like perplexity and expanding reference databases, these systems adapt to the challenges posed by AI-generated texts. Nevertheless, the effectiveness of such tools depends on continuous updates and user feedback to enhance detection accuracy. As AI technology advances, detection tools must evolve in tandem to address emerging threats and maintain their relevance in various domains.

In conclusion, AI detection tools play a crucial role in safeguarding content integrity in an era dominated by AI-generated materials. While they offer significant advantages, their limitations emphasize the importance of using them as complementary tools rather than standalone solutions. Educators, researchers, and professionals must remain vigilant and employ a combination of technological and human-driven approaches to ensure the authenticity and credibility of written content. As the field of AI continues to evolve, ongoing collaboration between developers, users,

and policymakers will be essential to address the ethical and practical challenges associated with AI-generated texts.

2) Encouraging academic integrity through AI-assisted guidance and resources

The science field is no exception when it comes to the transformative impact of artificial intelligence. Science worldwide has experienced a significant rapid development with increasing access to knowledge. This evolution is driven mostly by the emergence of novel technologies such as advanced software's and the artificial intelligence. Although there are certain benefits that AI proposes to researchers like the availability of vast information and resources, it may also threaten the academic integrity. In recent years, there is a growing concerns about academic integrity, which may be attributed to the increased cases of academic frauds worldwide. Although academic integrity is susceptible to different interpretations, it pertains to values, moral and ethical behavior and conduct of academics in all aspects of their practices (Macfarlane et.al., 2014).

The concerns and debates about academic integrity have existed since the beginning of science. Throwing back to past, intellectual property thefts were even present in the time of ancient Romans. Despite academic integrity has always been associated with plagiarism, the broader understanding of the academic integrity have been evolving, covering not just plagiarism but also other immoral academic behaviors such as ghostwriting and now, AI usage (Bin-Nashwan et.al., 2023). Academic integrity can be summarized as being honest in one's work, giving credit to others who have contributed to the knowledge creation. Also in an educational setting, academic integrity encompasses not only researchers but also students and teachers.

Digital technologies such as artificial intelligence take the challenges to academic integrity to a new level. The rapid emergence of AI-powered tools such as Deepseek, ChatGPT make no good for the academic field, further complicating the educational and research landscape. AI-powered writing tools require minimal human efforts, generating exhausting texts so rapidly, bringing serious concerns about the genuinely, authorship and integrity of academic work. Therefore, academic integrity is challenged in an unprecedented way in the digital age, fueled by the increasing convenience and availability of AI tools. The main harm of AI tools is that students and researchers might avoid writing, which will distort their writing skills, more importantly critical thinking capabilities and creativity. In essence, some students tend to skip the essential learning process, thus not struggling with the learning material. Students' reliance of AI to complete assignments will mean cheating themselves out of an education (Sullivan et.al., 2023). Furthermore, AI responses can sound impressively human and well-designed, which blurs the distinction between human-written and AI-powered texts.

Despite the AI technology is still in its infancy, it's impact on academic integrity is already felt and questioned. First and foremost, AI tools violates academic integrity by means of innovative technologies, which unprecedently hides the lines of misconduct (For example, academics can generate texts without proper attributions). In a similar vein, AI assistance tools harden the process of evaluating the learners' understanding and comprehension. Because in many cases students' performance may not truly reflect their actual knowledge level, making the teachers assessment job more complicated.

When the AI gets more prevalent, it is gradually getting harder to stay away from the AI tools. Especially, in a classroom where some students benefit AI-Assistance tools without being noticed, they can get an unfair advantage over those who don't use AI tools (Balalle and Pannilage, 2025; Currie, 2023). This unfairness will encourage students committed to academic integrity to remain competitive by using AI tools. Although, the learners know that AI usage is a kind of cheating, they may begin to use it to preserve their scholarships and remain competitive in the class (Xie et.al., 2023).

AI usage in higher education also leads to the erosion of traditional academic values. For instance, AI poses a significant challenge to traditional assessment methods such as essay writing and analytical thinking. Because AI tools generate well-researched texts with minimal human efforts, the reliability of essays as a means of assessing student's performance is disrupted. In other words, AI has challenged the traditional education system which is famous for prioritizing the original work based on learning and critical thinking, and individual's intellectual contribution (Eke, 2023).

Challenges on the Road to Ensure Academic Integrity

Having put forward the AI-related challenges in the academy, in this part, some positive aspects of AI for academic integrity will be discussed. In essence, AI is not always particularly dangerous; in contrast, AI may offer various integrity-enhancing benefits to the field of research. For instance, AI can help students and researchers improve their academic writing skills, thus ensuring the academic integrity of students of higher education organizations.

Development of AI Ethical Guidelines

AI applications allow for the rapid detection of plagiarism and other unethical practices. In this respect, students and academics are becoming more sensitive and knowledgeable about AI mis practices and the mitigation strategies. Therefore in the long run, the easier detection of unethical practices powered by AI tools will benefit academic honesty in the long run. However, educational institutions should hold a pivotal position instilling an academic culture that values ethical conduct, moral practices. In essence, the rapid diffusion of AI tools in the research, training,

and education field left no time for the development of ethical and regulatory frameworks, creating ambiguity both for researchers and students.

In the absence of clear AI policies, students and academics may unintentionally violate academic integrity. For instance, in case policies don't mention particular AI-powered tools, some students may believe that it is safe to use paraphrasing and translation tools, committing a misconduct (Roe et.al., 2023). Thus, there is an urgent need for comprehensive ethical guidelines for use of AI tools for academic purposes such as, learning, research, writing, and assessment etc (Currie, 2023; Eke, 2023; Sullivan et.al., 2023). Higher education organizations and research institutes will have to pioneer this transition by enabling open dialogues about the AI implications. The new academic integrity frameworks will have to identify acceptable and unacceptable uses of AI in academic work, particularly addressing some unethical misuse of AI. Also, consequences of misconducts should be clearly outlined and circulated across the students and other academic staff. Development of clear guidelines will help the rise of a common understanding about AI and foster a culture of academic integrity.

In the process of ethical guidelines development for academy, European Union's Framework for Ethics Guideliness for Trustworhty AI must be considered (See Figure 1). According to the EU's framework, every AI system must be ethically monitored, modified and updated via 7 key elements listed as:

"Human agency and oversight: Including fundamental rights, human agency and human oversight

Technical robustness and safety: Including resilience to attack and security, fall back plan and general safety, accuracy, reliability and reproducibility

Privacy and data governance: Including respect for privacy, quality and integrity of data, and access to data

Transparency: Including traceability, explain ability and communication

Diversity, non-discrimination and fairness: Including the avoidance of unfair bias, accessibility and universal design, and stakeholder participation

Societal and environmental wellbeing: Including sustainability and environmental friendliness, social impact, society and democracy

Accountability: Including auditability, minimisation and reporting of negative impact, trade-offs and redress." (European Commission, Ethic Guideliness for Trustworhty AI, 2019, p.14)

Academic institutions and policy makers are suggested to adopt the seven principles and dynamic approach amended by the European Commission. In essence, especially to be able to reach a generalizable and coherent AI ethical guideline for the scientific world, the particular needs of the European Union shouldn't be overlooked. In sum, AI ethical guidelines for academy should

be human-centered, envisioning various unexpected events, prioritizing researchers' privacy such as their affiliations. While the guideline should be transparent, clearly articulating what is expected from the researchers, publishers and other stakeholders. Finally, it must ensure that the AI tools function inclusively and focus on societal and environmental wellbeing, rather than only scholarly output.

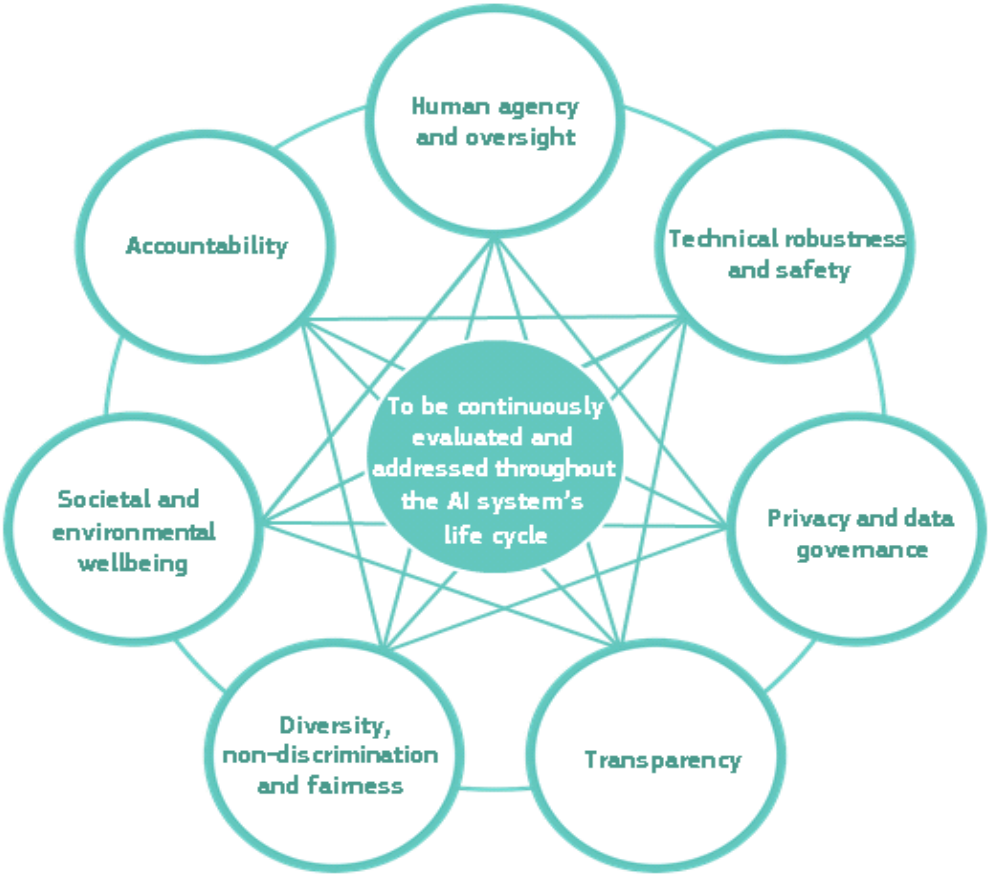

Figure 5. Ethical Requirements from an AI System

Training on Ethical AI Use

To effectively and ethically use AI-powered tools to enhance academic integrity, students need to be trained on the ethical use of AI. Furthermore, they should be trained to understand what AI can and cannot do and the negative consequences of academic misconduct. Likewise, faculty members in research and instructor positions should be trained, enabling them to operate flawlessly with AI tools (Mortlock and Lucas, 2024). In this respect, they can better identify AI misconduct in students' assignments and integrate their AI knowledge into teaching and assessment methods. In short, AI training will encompass ethical AI principles in academic settings, tapping various crucial factors such as plagiarism, data privacy, and accountability related to AI. Furthermore,

institutions should develop and put into practice digital literacy courses and programs that can counterbalance the challenges brought by artificial intelligence (Fowler, 2023).

Collaboration Between Stakeholders

The integration of Artificial Intelligence (AI) in academic field also necessitates collaboration among various stakeholders. Because academic integrity can be achieved only with the collaboration between students and faculty staff (Khatri and Karki, 2023; Balalle and Pannilage, 2025). Institutes should establish mechanisms, encouraging collective responsibilities and cooperation to foster academic integrity. Furthermore, the need for collaboration goes beyond students and educational institutes to ensure academic integrity. In fact, policymakers and the software industry should also be incorporated to combat AI-assisted misconduct (Xie et.al., 2023). Higher education organizations are advised to develop close ties with tech companies that can help them identify and detect harmful AI content that may otherwise ruin academic integrity. Therefore, multi-stakeholder cooperation should be founded, including large language model creators, to create strategies and methods to improve and maintain academic integrity (Bin-Nashwan et al., 2023).

International Collaboration to Enhance Academic Integrity

The stakeholder cooperation should be on an international level. In today's world, globalization shapes nearly everything and educational organizations are no exception. Therefore, academic integrity can only be ensured if the educational systems align with ethical codes cross-culturally and culture plays a pivotal role (Maral, 2024). In essence, there is a notifiable difference in the academic integrity research across different cultures, where the UK, USA, Australia and Canada have been recognized as the most active and productive nations in academic integrity research (Perkins and Roe, 2024). However, the number of research focusing on AI and academic integrity studies is very limited in the developing nations including Egypt, Jordan and Saudi Arabia etc (Farahat, 2022). Besides, studies have revealed a significant discrepancy in the deployed academic integrity policies across different countries, showing that a new definition of academic integrity is needed with the advance of artificial intelligence (Mathrani et al., 2021). This raises concerns about equal understanding of academic integrity and AI usage cross-culturally. In essence, academic cooperation seems limited between the developed and underdeveloped nations adding up to the problem of mutual understanding of AI and academic integrity (Maral, 2024). In short, the growing adaptation of AI in academia brings unprecedented problems, which urges nations to work together for transparent and culturally sensitive guidelines for AI implications in academy.

Individual Researchers Approach and Responsibility

Despite the collaborative efforts and policy implications to ethically adapt AI-tools in academy, individual researchers also play a significant role in this breaking-edge transformation. First and foremost, researchers and students using AI tools should accept in advance that they have the full responsibility for the outputs created by AI, as well as clarifying where and how the AI used in the scientific work. In other words, they should not over rely on AI-generated content (Currie, 2023). Thus, researchers are expected to transparently report which AI tools are deployed, explaining where AI-generated content is embedded in the original work (Gulumbe et al., 2024). Because AI is not a human entity, they can not assign authorship role to AI, which means that AI can not be a co-author in any research (Hosseini et al., 2023).

Second, although AI can be used as an assistant tool, researchers must ensure that the AI content is accurate and does not manipulate the findings. Regardless of the extent of help received by AI, the researchers will always remain responsible for the genuinely of their work (Bin-Nashwan et.al., 2023). This approach helps researchers to prevent accusations of any AI misconduct. In a similar vein, researchers must acknowledge that they interpret their findings responsibly and ethically, not making superficial assumptions just based on AI-generated recommendations and predictions. For instance, researchers must ensure that the AI-generated suggestions do not deviate from the available data (Currie, 2023).

Researchers are also advised to keep up with the rapidly evolving nature of AI tools along with ethical concerns they bring. Thus, rather than staying away from these developments and undermining their development; they should carefully adapt AI practices in light of the new ethical AI guidelines (Gustilo et al., 2023). Researchers are recommended to be aware of and competent in the ethical use of AI, protecting their academic integrity. In other words, although the technological advancements may shape the academic environment, the core part of scientific research is still centered on human intellect and genuine scholarly insights (Gulumbe et al., 2024).

Preserving these core values (e.g., transparency, novelty, originality, ethical and moral conduct) will always remain the main responsibility of researchers, not letting AI to compromise these foundational principles. Thus, researchers remain responsible for ethically and effectively balancing the potential AI benefits and the requirements of academic integrity, upholding the highest core principles of academic rigor and ethical scholarship (Rodrieges et al., 2024).

AI-Powered Tools for Proactive Integrity Enhancement

Despite the philosophical aspects mentioned above pertaining to the influence of AI on academic integrity, there are some practical implications of AI that may enhance academic

integrity at various levels in higher education organizations and academic world. In essence, the significant and rapid adoption of AI-tools requires a change in the scholarly mindset, urging academic world to shift to proactive strategies, leveraging AI to create learning and research environments to bolster academic integrity. These opportunities that AI proposes is explained in the following sections

Personalized Learning

The main advantage of AI-tools lies in its capability to cater individual needs. As opposed to traditional teaching methods, integration of AI to the higher education helps tailoring to students' particular needs (Currie, 2023). By deeply analyzing students capabilities, talents, personality and learning style, AI may allow the deployment of different teaching methods that suit the individual needs of students (Khatri and Karki, 2023). To do so, AI can evaluate and analyze extensive data regarding the student's learning styles and track their learning progress, which later be used to modify and tailor the learning materials (Xie et al., 2023). Especially in some collectivist cultures in which students prefer to be silent not to confront the group dynamics, AI-powered teaching materials can be more appropriate. It may provide a comfort zone for some students who don't feel comfortable in a project team and let them freely interact with the learning material at their own pace. In fact, students differ from each other in many ways as some students need an isolated environment for a deeper understanding rather than a socially interactive classroom atmosphere (Zaman et al., 2024).

Another main strength of AI is that it can provide personalized and timely recommendations to students (Fowler, 2023). Especially for crowded classes, it is nearly impossible for the teacher to evaluate every single student's weaknesses and special needs. However, the fact that AI can quickly analyze vast amount of institutional and course-related data, it provides constant and fast feedback, enhancing student's commitment and academic integrity (Khatri and Karki, 2023). Nowadays, it is also not rare to see students having language barriers which may be attributed to the forced migration or students' desire to find a better place for education. In this respect, AI-powered training methods will help students who may not be much proficient in the local language, providing them an opportunity for self-development. By harnessing the potential of AI, this adaptive learning system may help to build supporting and superior learning environments, which are inclusive, adaptable and responsive to individual students' needs (Nguyen et al., 2023).

AI-Assisted Ethical Writing

Despite negative perceptions attached to AI-assisted writing tools, AI, in fact, can turn out to be very useful to aid individuals in writing, enhancing academic integrity. There are a variety

of AI-assisted writing tools and technologies, including digital writing assistants (DWAs), automated paraphrasing tools (APTs), machine translators (MTs) along with sophisticated large language models (LLMs), such as ChatGPT, DeepSeek, etc (Xie., 2023). Some famous DWAs such as QuillBot and Grammarly do not necessarily violate the ethical codes but improve grammar, typos, and clarity (Roe et.al., 2023; Yeo, 2023; Gustilo, 2024). AI tools can also translate scientific content to a variety of languages, increasing the reach and penetration of scientific knowledge. Therefore, DWAs can be very useful for the accurate transfer of scientific knowledge cross-nationally, which helps enhance academic knowledge and integrity.

Similar to other AI-based technologies, APTs can assist researchers or students, especially non-English speakers, by allowing them to restructure their writing and inducing efficient, high-quality writing (Gustilo et.al., 2024). Last but not least, LLMs can help researchers and students generate new ideas and overcome the feeling of being stranded when writing an article or a project paper. By generating outlines and answering questions based on the prompted queries, AI can actually be mind-opening while exploring a new theory and topic. Last but not least, AI can assist in time-consuming but less value-adding activities while writing a scholarly paper (Maphoto et.al., 2024). For instance, AI tools can assist researchers with citation management by generation citation lists and bibliographies, saving time to be used in more valuable tasks (Currie, 2023). In short, the ethical use of AI tools can improve the quality of researchers' output, which helps the improvement of theory and eventually academic integrity. Last but not least, future developments in AI technology can help researchers identify unintentional errors. AI could analyze the manuscripts and warn the author if the cittions are not clear or forgotten. This feature will help students and researchers avoid unintentional plagiarism and writing errors (Weber-Wulff et al., 2023).

AI-Enhanced Peer Review Process

AI-assisted peer review can enhance academic integrity in several ways, including the review process of academic journals. First and foremost, AI tools can help detect inconsistencies and misconduct thanks to their high processing capabilities, which would be otherwise impossible for many reviewers (Kousha and Thelwall, 2024). In particular, any discrepancies in data, reporting, or methodology can be easily discovered, which will eventually enhance the integrity of the published work. AI tools can also turn out to be helpful for scholarly journal editors because they can quickly scan if there is any plagiarism or relevant misconduct in the submitted manuscripts (Rodriques et.al., 2024). In essence, AI algorithms are capable of evaluating the content in comparison to the existing body of literature, ensuring that the submitted work aligns with academic ethical codes and integrity.

There is a general claim among some researchers that reviewers may not be equally objective toward research coming from particular countries or demographics (Tvina et al., 2019; Helmer et al., 2017). For instance, political problems between countries, affiliations and/or the gender of the authors may threaten the objective review process, especially when the paper is by the editor (Checco et al., 2021). If editorship and peer review can be delegated partially to the AI tools, hidden biases can be uncovered. Eventually, the impartiality of AI tools can help the academic community progress toward a more just and fairer evaluation process, which is the pivotal and foundational element of academic integrity.

AI as a Reliable Partner to Tackle Ghostwriting

Ghostwriting also known as contract cheating refers to write an article book for another person under her or his own name. In the context of AI, it pertains to using AI tools to generate academic work but submitting it as an original work. Although AI makes the ghostwriting easier, it also brings new methods to detect the unethical ghostwriting practices.

Nowadays, many plagiarism detection software's emerge to help identifying AI writing, distinguishing between AI-generated and human-written text. For example, Turnitin has generated a new algorithm that is capable of detecting complex forms of plagiarism such as the AI-generated texts (Padillah, 2024). Likewise, although some of them still have much way to go, there are other AI-powered tools aiming at detecting AI-ghoswriting practices, namely GPT Zero, OpenAI AI Text Classifier, Copyleaks AI Content Detector, Crossplag etc (Uzun, 2023; Xie et al., 2023). However, the problem remains hard to solve because the detection tools are not always reliable and may have a tendency to perceive AI-ghostwritings as human-written texts (Chata, 2024). Nevertheless, it shouldn't be forgotten that the advancement of AI technologies still continues. Thus AI system will offer significant opportunities for the enhancement of AI-powered ghostwriting detections, which paves the way for academic integrity worldwide.

Ensuring Data Integrity via AI

Unlike its proposed risks, AI can be central to enhancing data integrity efforts in various contexts. For example, an AI-based tool named "Proofig AI" is considered to be used by academic journals in finding image manipulation at scale and depth, thus ensuring the academic integrity of visual data included in the research (Chauhan and Currie, 2024). In fact, AI's main advantage comes from its capability to analyze extensive literature and data to identify interactions, patterns, and trends. This novel ability can be utilized to find any discrepancies and abnormalities in the presented research data by comparing it to similar related data and variables. Similarly, AI can find the missing data problem, which could otherwise compromise the dataset integrity. If trained

accordingly, AI tools can detect inconsistencies between methods and results, and the plausibility of output with the given research method, data, and time bond (Chauhan and Currie, 2024). Last but not least, AI tools can run an N-gram analysis of survey responses. Inconsistencies in participants' responses can be revealed by analyzing the sequence and relation between the responses of the whole sample. This procedure will improve the data quality and stand against the response biases problem (Gustillo et al., 2024). In short, AI systems can be functional in dealing with academic integrity problems, and as learning systems, they can be trained to enhance data accuracy, contributing to overall scientific integrity.

Conclusion

AI technologies have triggered rapid rapid development in science by increasing access to vast amount of scientific knowledge along with simplifying the research processes. Because AI tools can conduct complicated analyzes beyond the human capabilities, AI tools are started to be used predominantly in the academic world. The utilization of AI in the academic world is a double-edges sword, offering advantages but also raising serious concerns related to academic misconducts and plagiarism. Despite these criticisms, this chapter focuses on how AI technologies can benefit the science and education world and enhance academic integrity. In essence, there is a body of research, highlighting that AI-tools can be useful to establish and uphold high ethical standards in the academic world.

Due to its capability of analyzing extensive amount of data and libraries, AI can contribute to the academic integrity in a multifaceted way. First, AI-powered writing assistants can improve students' writing skills, especially for those who are not proficient in Engish. By this way, AI helps the share of and extend scientific knowledge across different cultures (Roe et.al., 2023; Yeo, 2023; Gustilo, 2024). AI can also help especially unexperienced researchers pinpoint unintentional errors that could be otherwise treated as academic misconduct (Weber-Wulff et al., 2023). Also from the students' viewpoint, AI can foster students' engagement with the course content by adjusting to learners' special requirements and pace (Currie, 2023; Khatri and Karki, 2023; Xie et al., 2023; Zaman et al., 2024). AI can also be used to design new courses and training content to enhance students and junior researchers' understanding of academic integrity and ethical AI practices (Javed et al., 2024). From the publishes' perspective, AI tools can be a reliable partner helping journal editors to streamline their review processes. Using AI tools can help reviewers avoid their personal biases and detect inconsistencies and animalities in data, methods and research outputs (Kousha and Thelwall, 2024; Rodriques et.al., 2024; Tvina et al., 2019; Helmer et al., 2017; Checco et al., 2021). Similarly, AI-powered tools will help journals to detect ghostwriting,

plagiarism, data manipulation in the reporting etc., which could be otherwise impossible to discover (Chata, 2024; Padillah, 2024).

Although, the literature highlights various opportunities for academic integrity, academic integrity in the AI-prevalent academy necessitates every stakeholder's participation. In this regard, educational institutions and publishers need to generate and agree upon clear guidelines, and educators should be ready to promote a culture of academic integrity. However, the stakeholder cooperation should be on an international level, reducing the gap in approach and understanding between underdeveloped and developed nations (Khatri and Karki, 2023; Balalle and Pannilage, 2025; Xie et.al., 2023; Bin-Nashwan et al., 2023; Perkins and Roe, 2024; Mathrani et al., 2021). In conclusion, harnessing AI for a honest science should be an international collaborative responsibility, involving policymakers, institutions, higher education organizations, educators and students.

CONCLUSIONS

Standardization of the educational process in higher education is an important process. If we look at this process in terms of market economy criteria and characteristics, the presence of standards ensures that consumers receive products and services of the expected quality, while reducing the costs of production. Accordingly, the standardization of AI usage in the educational process in higher education allows for a unified approach to the application of technology, ensuring effective teaching and learning conditions. It also helps reduce costs when implementing AI tools into the learning process. In other words, the standard enables more efficient integration of artificial intelligence into educational programs.

These methodological recommendations include an introduction, three main sections, conclusions, a bibliography, and evaluation maps. The introduction reveals the role of higher education in the development of the national economy. Emphasis is placed on the changes occurring in higher education under the influence of artificial intelligence, particularly chatbots, in terms of organizing learning, assessment, and academic integrity. It is noted that with the accessibility of AI tools, the role of the teacher is changing, and there is a need for new approaches to assessing learning outcomes and forming internal university policies. The aim of the recommendations is to offer a standardized approach for teachers to implement AI chatbots into the educational process, particularly regarding assessment, didactics, plagiarism, and ethical aspects of usage.

The first section addresses the integration of AI chatbots into the assessment and knowledge control process. Specifically, it analyzes the possibilities of using such tools to create objective and subjective forms of assessment, ensure accuracy and fairness of results, prevent potential biases, as well as monitor student progress and provide personalized feedback.

The second section focuses on methods of applying chatbots in teaching and didactics. It discusses ways to personalize learning, support teamwork, improve communication between students and teachers, and strengthen knowledge through interactive tools.

The third section is dedicated to academic integrity. It covers the use of chatbots to detect and prevent plagiarism, as well as ways to cultivate a culture of ethical academic writing through AI-generated recommendations and tips.

Each section contains practical advice that can be adapted to the specifics of academic disciplines and the needs of teachers.

Evaluation maps are provided at the end of the recommendations to gather feedback from teachers regarding the effectiveness of the proposed approaches, the practicality of examples, and their relevance to the educational process. The maps include both quantitative and qualitative assessments of the materials, as well as open-ended questions for suggestions and comments.

The recommendations also propose a system-based approach to evaluating student work using artificial intelligence, combining both objective and subjective methods of analysis. A model of assessment is described, which includes checking the format of submitted materials, structural, linguistic, and content analysis, academic integrity verification, as well as evaluating the complexity, logic, and creativity of the text. Additionally, the recommendations suggest key stages in the AI evaluation model, including the technical structure of the system: submission interface, preprocessing module, content analysis module, academic integrity verification module, assessment and feedback generation module. The functions of each module are detailed.

The recommendations further justify the need for integrating a human-machine approach to assessment, where the final grade is based on the prior AI analysis and expert review by the teacher. This approach ensures the consideration of both technical and contextual aspects of the work, particularly for creative or analytically complex tasks. Moreover, a methodology for evaluating the coherence and argumentation of student work is proposed. This includes both qualitative and quantitative text analysis, particularly checking the logical structure, evaluating the argumentation, and using coherence coefficients and argument density. The methodology involves integrating multiple indicators for an objective assessment of text quality, allowing for more accurate analysis.

By analogy, the recommendations develop a comparison between modern AI bots and Roman governance institutions, such as censors, senators, and tribunes, who performed functions of monitoring citizens and providing personalized assistance. The Roman governance system can serve as a framework for understanding how AI bots can support students by providing personalized feedback, recommending next steps in their learning, and helping them progress. A comparison is made with the Roman concept of "Vox Populi" in the context of group work among students. AI bots can monitor group projects, assessing the dynamics of cooperation, the level of contribution from each student, and the effectiveness of teamwork. This ensures adequate support not only on an individual level but also on a collective level.

An additional value of these recommendations is the developed theoretical model for integrating AI bots into didactics and teaching methodology, which includes three main levels: didactic, methodological, and operational. Each of these levels contains specific elements that interact with each other to ensure the effective use of artificial intelligence in the educational process. The interaction between these levels creates synergy in the learning process. For example, the adaptation of teaching materials at the methodological level depends on the personalization of learning at the didactic level, allowing AI bots to create materials that best meet the needs of the student. Support for independent learning and interactivity at the operational level ensures the participation of students in the learning process in real-time, while receiving recommendations and support.

The proposed recommendations provide unification of approaches to the integration of AI technologies, which not only enhance the effectiveness of learning but also reduce the costs of implementing such technologies. With the development of technology and improvements in AI tools, these recommendations may become the foundation for creating new methods of assessment and teaching.

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EVALUATION CARDS

Evaluation Card 1

• Is the Guidelines clearly structured?

- Yes

- Partially

- No

• How easy is it to apply the recommendations in your teaching practice?

- Very easy

- Moderately

- Difficult

• What should be clarified or added?

Evaluation Card 2

• Do the examples reflect realistic AI use scenarios?

- Yes

- Partially

- No

• How effectively does the section explain fairness and accuracy in AI-generated assessments?

- Very effectively

- Moderately

- Poorly

• Are the included tests useful for educators?

- Yes

- Partially

- No

• Your recommendations or remarks

Evaluation Card 3

• Do the proposed methods in the Guidelines align with your teaching needs?

- Yes

- Partially

- No

• What methods from the Guidelines you would like to implement in your course?

Evaluation Card 4

• Is the role of AI in preventing plagiarism convincingly presented?

- Yes

- Partially

- No

• Are the proposed integrity strategies practical and realistic?

- Yes

- Partially

- No

• What else would you like to see in the Guidelines about using AI in preventing plagiarism (tools, case studies, etc.)?

_____

Evaluation Card 5

• Is enough attention given to ethical considerations in the Guidelines?

- Yes

- Partially

- No

• Does the content demonstrate how AI enhances communication between students and instructors?

- Yes

- Partially

- No

• Do you have concerns about integrity or transparency in AI use?

- Yes

- No

• Suggestions for improvement about ethical considerations in the Guidelines

_____

Overall rating of the Guidelines (1 to 5) ___

DIALOGEDUSHIFT

DialogEduShift:

WP3. Guidelines for Academicians on the Usage of AI Conversational Bots (LLM Models) in HEI

dialogedushift.eu

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