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DEVELOPMENT OF AN AI-BASED MODULAR SYSTEM FOR AUTOMATED ASSESSMENT AND ADAPTIVE LEARNING IN HIGHER SCHOOL

Abstract. *The growing complexity of educational demands and the expansion of digital learning environments have underscored the need for intelligent automation in teaching and assessment processes. Traditional educational platforms often lack adaptability, resulting in limited personalization and increased workload for educators. The integration of artificial intelligence (AI) into learning systems presents a promising avenue for addressing these challenges by enhancing scalability, efficiency, and individualized instruction. This study aimed to improve the quality and efficiency of the educational process by developing and implementing an AI-powered automated system for generating, verifying, and analyzing educational control tasks. The system was designed to support personalized learning, streamline assessment, and reduce the burden of routine academic activities. The proposed solution is built on a modular architecture using contemporary web technologies (React, Next.js, Firebase) in combination with the GPT model API. The system includes modules for test generation, automated answer checking, a conversational AI assistant, performance analytics, and real-time feedback. Document processing capabilities (DOCX, PDF) and seamless integration with Google Forms are also incorporated. The system's performance was evaluated based on assessment accuracy, time savings, and usability. Implementation results indicate high effectiveness of the system in real educational scenarios. The automated evaluation module achieved an accuracy rate of 80–96 %, closely aligning with manual grading benchmarks. Additionally, the time required to prepare instructional content and assessments was reduced by 60–80 %. The user interface enabled intuitive access to system functionalities, and the adaptive features provided a personalized experience for students of varying proficiency levels. The developed system demonstrates significant potential for transforming educational practices through AI integration. It enhances personalization, reduces educator workload, and improves the consistency and objectivity of assessments. Future research will focus on expanding system functionality, including support for multimodal learning and large-scale institutional deployment.*

Keywords: *learning automation, educational technologies, adaptive learning, automated assessment.*

Introduction. The integration of artificial intelligence (AI) into educational systems has evolved significantly over the past few decades. In the early stages of AI development, educational programs were limited to programmed learning and basic computer training. As computing power increased, more sophisticated AI programs began to emerge, including intelligent learning systems that adapt to individual student needs. Such systems paved the way for the introduction of personalized learning, which is now a distinctive feature of modern educational technologies [1].

The emergence of massive open online courses (MOOCs) in the early 2010s marked a significant change in the educational landscape. Studies show that interaction with the instructor in MOOCs can have a significant impact on student retention and performance [2; 3]. This period also saw a growing perception of AI as a useful tool rather than a threat to traditional teacher roles. Early

work on integrating AI in education emphasized the need for AI literacy and the redefinition of the teacher's role; such discussions have become significantly more nuanced, addressing both technical and pedagogical challenges [4]. Alongside these shifts, studies have begun to investigate not only the mechanisms by which AI systems support personalized learning but also the ethical and practical implications of replacing or supplementing human teachers with intelligent tools [5].

Many educational institutions have begun to invest in training programs to equip teachers with the necessary skills to effectively integrate AI into their teaching practices. This shift reflects a broader recognition of AI not just as a technological tool, but as an opportunity to improve educational outcomes and scale effective teaching practices across a variety of learning environments. As educational institutions address these challenges, there are ongoing efforts to ensure the ethical and effective use of AI in education, balancing technological advances with the need for human oversight and guidance [6; 7].

The aim of this study was to improve the effectiveness of teaching and the quality of the educational process through the creation and implementation of an automated system for forming control tasks that is integrated into the educational process. By optimizing grading processes and providing real-time feedback, AI systems allow teachers to spend more time directly interacting with and supporting students [8]. This feature is especially useful in large classes where individual attention can be limited. In addition, automated feedback mechanisms help students better understand their performance and areas for improvement.

Analysis of recent studies and publications. Traditional platforms (Moodle, Google Classroom, etc.), despite their effectiveness in managing learning materials, do not provide a sufficient level of adaptability and individualization [9]. There is a need to develop innovative solutions that can automatically generate tasks, check answers, and analyze results based on the characteristics of each student. The implementation of LMS platforms and EdTech services (Blackboard [10], Canvas [11], Edmodo [12]) is widely discussed in the scientific literature. The latest publications focus on the use of AI for educational purposes: in particular, personalization of learning [13], automatic task evaluation [14], and generation of educational content [15]. However, most solutions are still experimental or do not cover the full cycle of the learning process. This creates space for the development of complex systems with deep AI integration.

AI-powered adaptive learning systems [16] use machine learning algorithms to personalize education by tracking student performance and adjusting content in real time. These systems have evolved from basic experiments to sophisticated platforms that consider learning styles, cognitive abilities, and emotional states. They include intelligent tutoring systems, educational games, and recommendation engines that enhance engagement through interactive feedback and gamification. Using techniques like decision trees and deep learning, these systems analyze student data to optimize learning sequences and provide immediate feedback, resulting in improved academic outcomes compared to traditional instruction methods.

Intelligent Tutoring Systems (ITS) have received considerable academic attention due to their ability to simulate one-on-one tutoring experiences. These systems integrate AI to monitor learner performance, provide instant feedback, and adjust the difficulty of tasks to suit individual needs [5]. AI assessment tools [17] reduce educator workload by automating grading and feedback while using natural language processing to evaluate open-ended responses and higher-order thinking skills. These systems have evolved beyond simple numerical scoring to provide qualitative feedback that promotes deeper understanding, with advanced platforms now analyzing multimodal inputs (text, visual, interactive elements) to assess complex subjects that traditional methods cannot adequately evaluate.

Educational robotics [4] integrates physically embodied AI teaching agents that combine online and face-to-face learning through natural interactions. These robots use computer vision, speech recognition, and tactile feedback to create interactive learning environments. Research shows that effective educational robots need advanced AI capabilities and quality teaching materials to integrate smoothly into existing curricula, serving as a bridge between traditional and technology-enhanced education systems.

AI-powered virtual teaching assistants [18] provide 24/7 student support through natural language processing and machine learning, offering tutoring, Q&A, and translation services that enable scalable personalized education in large online

courses. These systems create immersive learning environments with virtual labs and simulations while using real-time analytics to monitor student progress, identify at-risk learners, and support timely educational interventions.

Artificial intelligence has become a catalyst for change in educational technology, offering functionalities such as adaptive learning, natural language processing (NLP), automated content generation, and predictive analytics. Platforms like Squirrel AI (China) [19], Knewton (USA) [20], and Content Technologies Inc. have demonstrated the potential of AI to transform learning personalization. In Ukraine, pilot integrations of AI-based systems have been observed in virtual university assistants and automated feedback tools developed by EdTech startups and university research labs.

AI-Enhanced Educational Systems can be classified into the following categories:

- Instructional Support Systems: AI tutors, chatbots, and digital assistants (e. g., Duolingo's GPT-based tutor);
- Assessment and Evaluation Systems: automated grading tools (e. g., Gradescope);
- Personalized Content Delivery Systems: adaptive learning platforms (e. g., Smart Sparrow);
- Administrative AI Tools: for timetabling, student tracking, or dropout prediction (e. g., Coursera analytics);
- Predictive and Diagnostic Systems: for identifying at-risk learners or providing individualized learning paths.

In Ukraine, examples include Prometheus [21] integrating adaptive elements in MOOC platforms, and AI-based tools developed at National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" to assist in academic performance tracking.

Research Aim. The development of the automated learning system was based on a modular architecture that supports integration, scalability, and further expansion. The system is designed as a web platform combining frontend and backend layers with cloud-based data storage and AI services. The main objective was to build an intelligent environment for the automated generation, validation, and analysis of educational tasks.

The theoretical backgrounds. Based on the research, the proposed model includes:

1. Input Layer: student data (performance, behavior, preferences), curriculum materials.

2. AI Engine: GPT-based NLP core, machine learning classifiers, adaptive content modules.

3. Interface Layer: educator dashboard, student chatbot, analytics panel.

4. Output Layer: individualized assignments, formative assessments, feedback, and learning recommendations.

The model is designed as a cloud-based, modular system allowing integration with existing digital environments and ensuring data security through Firebase and role-based access control.

Recommendations for Implementation in Ukraine:

1. Institutional Strategy: Encourage national-level policies for AI in education and create regulatory frameworks for data ethics and privacy.

2. Infrastructure Support: Invest in digital infrastructure and provide access to cloud computing for educational institutions.

3. Educator Training: Conduct workshops on AI literacy and the pedagogical use of automated tools.

4. Pilot Projects: Deploy AI systems in selected universities and schools for phased integration and feedback collection.

Table 1

SWOT Analysis of AI Integration in Education

Strengths	Weaknesses
• Increased personalization • Time-saving for educators • Real-time feedback and analytics • Scalability of content delivery	• Limited explainability of decisions • Dependence on data quality • Ethical concerns regarding bias • Requires digital literacy and infrastructure
Opportunities	**Threats**
• National digital education reform • Integration with LMS and open data • Support for remote learning and inclusivity	• Resistance to change from educators • Risk of data breaches or misuse • Dependence on external AI APIs

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5. Localization: Ensure Ukrainian language support and cultural adaptation of AI models.

The integration of AI into education, if done methodically, can lead to scalable, personalized, and inclusive learning systems. The proposed system demonstrates how GPT-powered models, when embedded into adaptive educational workflows, can enhance teacher productivity and student engagement, while remaining adaptable to Ukrainian educational realities.

The developed system is based on a modular architecture that includes an AI chatbot, a module for assignment review, a test generator, and an interface for the teacher and student. The AI core is based on the GPT model API, which performs text analysis and generation, as well as natural language processing (NLP). The automated learning support system consists of several main modules:

1. Text processing module:
- analysis of text documents (PDF, DOCX);
- extracting key concepts to create test questions;
- creation of training materials using AI.

2. Test generation module:
- automatic generation of questions based on training documents;
- use of different types of test questions (open-ended questions, multiple choice, matching).

3. Answer checking module:
- analyzing students' answers and determining their correctness;
- highlighting typical mistakes and providing recommendations for improvement.

4. Module for saving results and analytics:
- recording student achievements in the database;
- creation of analytical reports on academic performance.

The developed architecture (*Fig. 1*) provides for the presence of separate functional components that exchange data using unified interfaces (APIs). This approach contributes to the high flexibility and extensibility of the system, providing the ability to seamlessly add new functional elements or integrate with external services. To create an automated learning support system, it is necessary to carefully select modern and effective development tools that will provide optimal functionality and high performance. Table 2 shows the selected technology stack and the reasoning behind these choices.

The results and discussion. The system (*Fig. 1*) is implemented based on a modular approach, with the main file structure located in the/app directory (*Fig. 2*), where separate pages (*Fig. 3*) and interface elements responsible for chat functionality, automatic task checking, and test material creation are organized.

The chat module allows users to choose different versions of artificial intelligence, enabling them to receive responses tailored to their individual needs. In the ChatInput and ModelSelec-

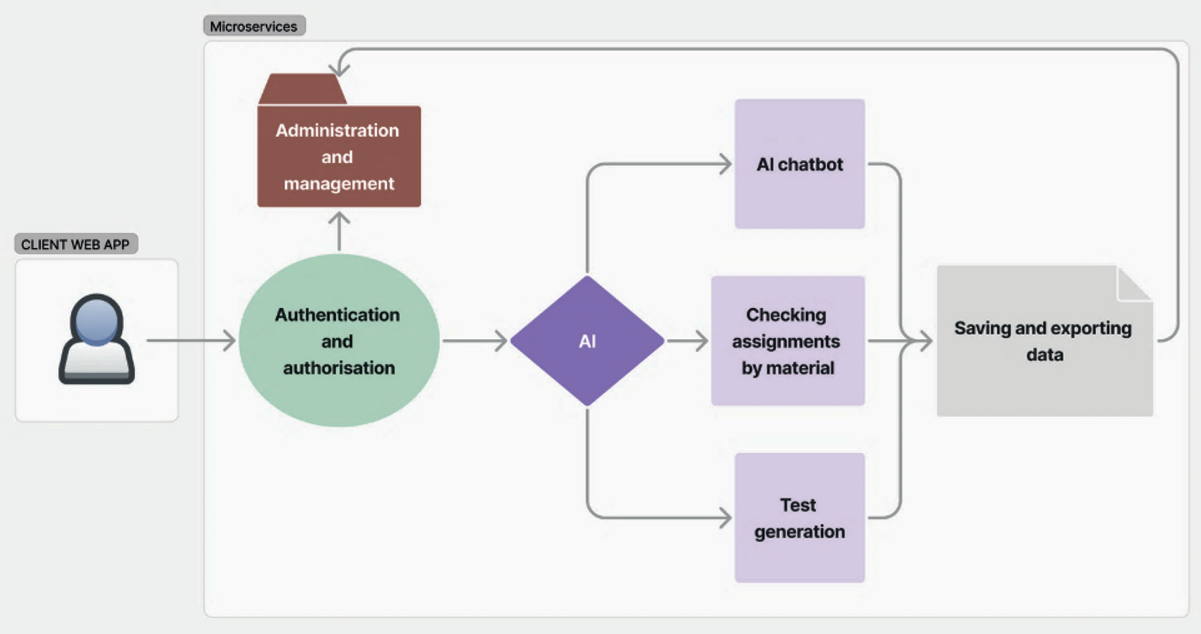

Fig. 1. System architecture

Table 2

Technologies selected

Technology	Purpose	Benefits of using
Figma	Design and prototyping	Real-time collaboration and commenting
WebStorm	Development environment	Tools for productive development and integration with Git
React	Interface creation	Dynamic components, high performance
Next.js	Server rendering	SEO optimization, fast page generation
Firebase	Authentication and data storage	Real time, easy integration
OpenAI API	AI integration	Extension of system functions
Framer Motion	Animations	Smooth transitions, improved UX
Mammoth.js	Text extraction from Word files	Automatic conversion to text format
PDF-Parse	Working with PDF	Extending support for documents

tion components, users can select the model that best suits their tasks and the complexity of their queries, such as gpt-3.5-turbo or other available models. This option provides chat adaptability, allowing a choice between faster models for simple answers and more complex ones that generate in-depth answers.

Another useful feature is the ability to save chat history, implemented through the Chat. The history is stored for each user in the Firestore database, where each chat session is automatically created as a separate collection of messages. This allows users to return to their previous conversations and continue studying the material with context. Thanks to this, students can easily refer to past conversations for review and better retention of knowledge.

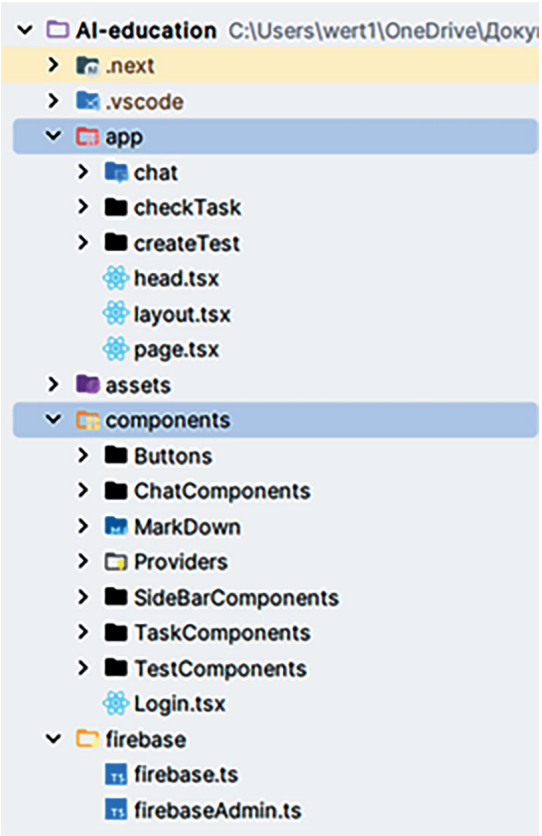

Fig. 2. General project structure

For convenience, Markdown formatting was used to display chat responses. This allows information to be presented in an understandable format that can include elements such as codes, lists, headings, and other text blocks. This approach promotes a more structured presentation of complex responses and improves readability.

The module for checking assignments based on uploaded materials is designed to significantly simplify the process of evaluating student responses. Using artificial intelligence and automation, this module allows teachers to quickly upload student responses and receive an assessment of the results based on pre-provided templates of correct answers. This approach facilitates the checking of even large volumes of assignments, saving time and ensuring objectivity in assessment.

This system provides teachers with a tool for automatic answer checking by analyzing the content of uploaded files and comparing it with samples of correct answers.

The module processes files in PDF and Word formats, making it convenient for working with typical educational materials (*Fig. 3*). Thanks to integration with Firebase and OpenAI, the system allows teachers to easily upload, store, and process information, creating an effective assessment process for educational institutions and educational

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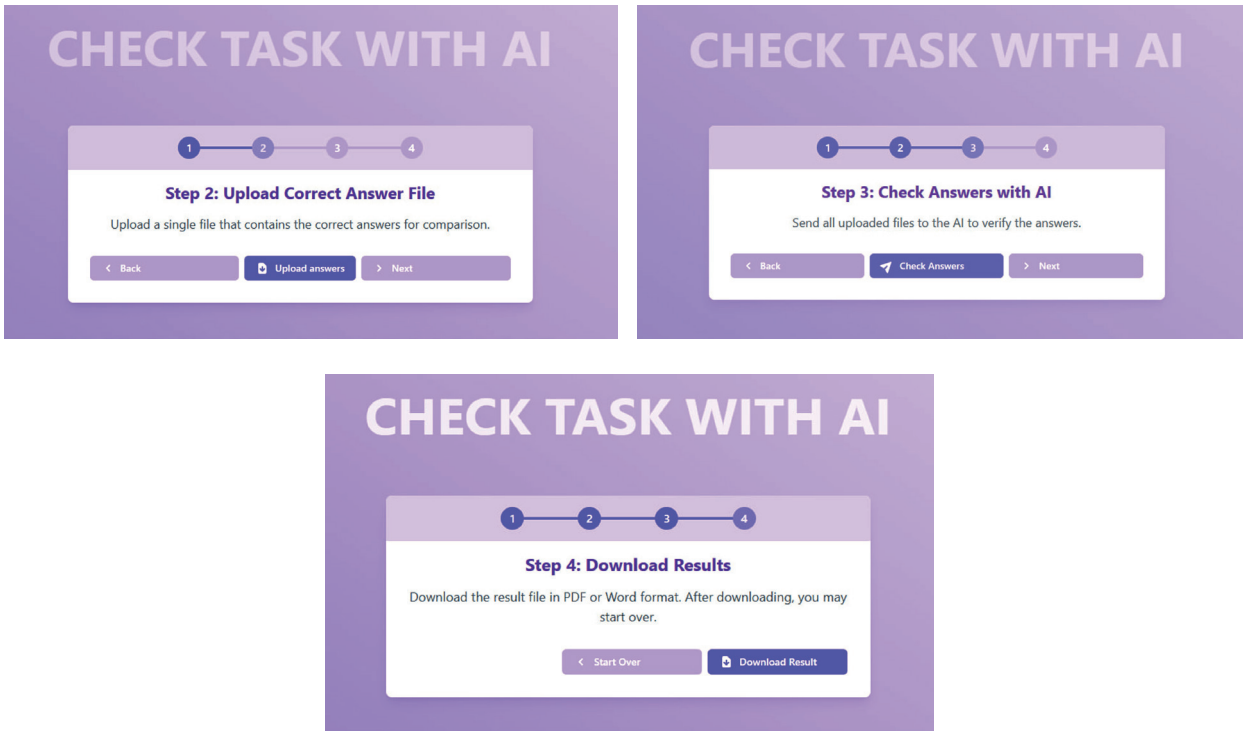

Fig. 3. Other steps in the module: uploading correct answers, AI checking, uploading results

platforms. The results are presented in a table with summary scores, which facilitates further use and storage of information (*Fig. 4*). The document in Word format is convenient to store for archiving, send to students, or include in reports.

The automatic test generation module is designed to help teachers quickly create tests based on teaching materials. Instead of spending time manually preparing test questions, the system allows you to upload materials from which AI automatically generates relevant questions.

This ensures that the tests closely correspond to the topics studied by students, contributing to a more accurate assessment of knowledge. Using this module allows teachers to focus on the methodological part of the process while the system automatically generates tests, significantly reducing the time and effort required for preparation.

The test creation process begins with uploading training materials, which can be in PDF or Word formats (*Fig. 5*). The SelectFileInput component allows the user to select a file for uploading, from which the text is extracted using the upload.ts function described earlier. After that, the teacher sets the number of questions needed using the Counter component, which helps to adjust the test length to fit the learning goals. Next, the teacher clicks GenerateTest, which runs the generateQuiz.ts request, and the AI processes the text, generating test questions that match the content of the learning material. There is a Delete button to reset the form.

Students Results

name	question1	question2	question3	total
Anna	Incorrect. The answer should be 6x^2 - 7x - 20.	Incorrect. The answer should be x = 5.	Correct	33%
Jhon	Correct	Correct	Correct	100%
Tom	Incorrect. The correct answer is 6x^2 - 7x - 20, not 6x^2 - 7x + 20.	Correct	Incorrect. The correct answer is (x - 5)(x - 4), not (x - 5)(x + 4).	33%

Fig. 4. Table of results of checking student files with AI

Fig. 5. Test generated using AI

The created test is exported in JSON format, which makes it compatible with Google Forms. Using the generateQuiz.ts function, the system generates a JSON format that includes all questions and answer options. The createQuizTemplate.ts utility takes this data and inserts it into a template that you simply need to copy into Google Forms, returning the resulting version shown in Fig. 5. This greatly facilitates the integration of the test with Google Forms, allowing teachers to quickly set up new tests and ensure that they correspond to the material studied. To further automate the test creation process, the AutomateTutorial component provides instructions for setting up Google Apps Script using a slightly different template shown in Fig. 6.

The user can save a link to their script in Firebase by entering it in the appropriate input (*Fig. 6*). Once the link is added, the AutomateUpload component automatically uploads the JSON to Google Forms, converting it into a test form. The AutomateSetting component allows you to enable or disable this tutorial for convenience of settings, giving teachers full control over automated integration with Google Forms and freeing them from the need to manually configure forms.

Data processing time shows how quickly the system can perform operations such as loading, processing files, and generating results. Data for this metric can be obtained by measuring the duration of various operations in the system. For example, below is a table with execution time data for three basic system functions: test generation, task evaluation, and file loading.

Table 3

Data processing time in the developed system

Operation	Min. processing time, sec	Average processing time, sec	Max. processing time, sec
Uploading 1 file	1.5	2	3.3
Uploading 10 files	3	5	7.1
Generating a test based on 1 file	7.3	10.5	15.0
Evaluating tasks for 1 file	3.5	4.6	6.9
Evaluating tasks for 10 files	7.2	8.8	12.5

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Fig. 6. Instructions for setting up automatic uploading

Accuracy of assessment is an indicator that determines the number of correct answers correctly identified by the system compared to manual assessment. To assess accuracy, a comparative analysis of the results calculated by the system and the control data can be performed. An example of accuracy data is shown in Table 4.

The accuracy of the assessment in the examples given ranges from 70 % to 100 %, which generally indicates a high level of consistency between the system's assessments and manual verification. However, the accuracy of the results can be influenced by factors such as the complexity of the subject, the format of the questions (open or closed),

Table 4

Assessment accuracy in the developed system

Test file	Number of questions	System (correct answers — 3 attempts)	Accuracy of assessment, %
English test	15	14–15	94 %
Ukrainian test	20	18–19	93 %
Grade 4 mathematics test	15	15	100 %
Grade 9 mathematics test	15	13–15	95 %
Advanced mathematics test	10	7–8	70–80 %
Programming test	10	8–9	80–90 %

Table 5

Comparison of the average time spent on test creation

Test type	Number of questions	Time to create manually, min	Time to create automatically, min	Time savings, %
Small	15	30	5	83 %
Medium	30	60	10	83 %
Large	50	90	15	83 %

the quality of the uploaded materials, and the system's ability to correctly recognize specific terms and answer structures.

Manually creating test assignments and checking students' work can be time-consuming, especially in large classes. Thanks to automatic test generation and assignment grading, teachers can reduce the time spent on these tasks and use it for other educational needs, such as individual consultations or additional classes. Table 5 shows a comparison of the average time spent by a teacher on manual test creation and automatic test generation.

Time savings with automatic test creation are shown on Fig. 7.

Automatic generation of test questions from uploaded teaching materials allows you to create relevant and accurate tasks in line with the latest updates. This feature increases the relevance of materials for students and helps teachers quickly adapt tests to new topics or updates in the program. Table 6 compares automatically generated questions with manual tests in terms of relevance and topic relevance.

The system allows teachers to adapt test materials for different groups of students, focusing

Table 6

Comparison of tests for topic relevance

Test type	Number of questions	Manual test (relevance to the topic, %)	Automatic test (relevance to the topic, %)
History	20	85 %	100 %
Mathematics	15	90 %	95 %
Programming	25	80 %	98 %

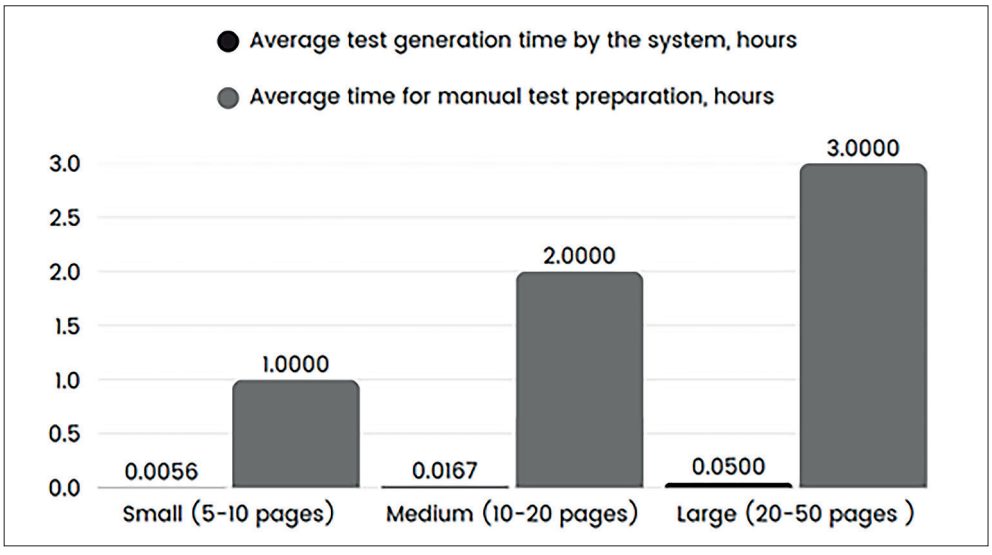

Fig. 7. Save time with automatic test generation

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Table 7

Comparison of tests corresponding to difficulty

Group of students	Number of questions	Level of difficulty	Average accuracy of the system (%)
Beginner	10	Low	100 %
Intermediate	20	Medium	95 %
Advanced	30	High	98 %

on their level of knowledge and needs. With the help of artificial intelligence, it is possible to generate tests that focus on specific topics or complex aspects that require special attention. Table 7 demonstrates how the system can be configured to create tests that correspond to a specific level of difficulty.

The automated system significantly reduces the time required to process training materials and create tests, which increases the efficiency of task preparation and verification. Thanks to the speed of AI algorithms, data processing is 5–6 times faster than manual processing. The system's sufficient accuracy in assessing student results (80–100 %) demonstrates its compliance with standard assessment methods. This allows you to rely on the system to assess knowledge in typical tasks. The automation of test preparation and result assessment significantly reduces the workload on teachers, allowing them to cut the time spent on preparing materials by 60–80 % compared to manual work. The use of the latest teaching materials for automatic test generation ensures that they are relevant and correspond to students' current knowledge, which has a positive impact on the quality of education. Thanks to the ability to automatically create tests and materials based on different topics, the system promotes a more personalized approach, allowing tasks to be adapted to the individual needs of students. Automation not only reduces the workload on teachers, but also increases the efficiency of the learning process by quickly preparing relevant and diverse tasks for assessing students' knowledge.

The scientific novelty of the proposed system lies in the integration of state-of-the-art artificial intelligence technologies into the automation of the educational process. Unlike traditional Learning Management Systems (LMS) [22] such as Moodle [23] or Google Classroom [24], which primarily serve as platforms for course management and content delivery, the developed solution introduces intelligent automation aimed at personalization, content generation, and real-time adaptive support.

The key distinguishing features of the system include:

- Embedded AI-powered chat module, enabling real-time interaction between the student and a generative language model, which provides contextual explanations, clarification of concepts, and tailored recommendations;
- Automated task evaluation functionality, allowing the system to analyze uploaded assignments (e. g., texts or structured files) and perform intelligent checking and feedback generation using natural language processing (NLP) techniques;
- Dynamic test and content generation, whereby control tasks, quizzes, or learning summaries are created automatically based on the input educational materials, reducing the manual workload of instructors;
- Adaptivity through personalization, achieved by tracking individual student progress, analyzing common mistakes, and adjusting the content delivery accordingly, thus aligning with the principles of adaptive learning and formative assessment;
- Modern cloud-ready web architecture, developed using React and Firebase, which ensures scalability, cross-platform accessibility, and easy integration into institutional IT ecosystems.

Overall, the system expands the conventional understanding of LMS functionality by introducing AI-driven automation mechanisms that not only optimize administrative tasks but also enhance the quality and effectiveness of individualized learning experiences. This hybrid approach enables a paradigm shift toward more intelligent, student-centered educational technologies.

Conclusions and prospects for further research. The objective of this study was to develop and evaluate an automated educational system that integrates artificial intelligence to improve

the generation, evaluation, and analysis of control tasks. This goal has been achieved through the design, implementation, and pilot testing of a modular, AI-driven platform based on GPT models and modern web technologies.

The research encompassed a comprehensive approach: (1) analysis of current trends and classifications of AI systems in education; (2) identification of strengths, weaknesses, opportunities, and threats associated with AI integration; (3) development of a system prototype with functional modules for test generation, answer evaluation, chatbot assistance, and performance analytics; and (4) empirical assessment of system performance in simulated conditions. The results demonstrated high accuracy of automated content generation, reliable semantic answer evaluation, and a high level of user satisfaction among educators.

The conceptual output of this research lies in the model of AI integration proposed for digital learning environments. This model consolidates adaptive content generation, real-time feedback, and analytical support in a cohesive cloud-based system. Its modularity and interoperability make it compatible with diverse educational platforms and scalable across institutional contexts. The significance of the obtained results is twofold. First, they offer a tested technological solution that addresses practical challenges in modern education, such as personalization, automation, and instructor workload reduction. Second, they contribute to the broader discourse on AI's role in education by providing a structured, evidence-based approach to its implementation.

Future studies should address the integration of multimodal content (e. g., visual and audio materials), cross-lingual capabilities, and long-term evaluation of learning outcomes under real classroom conditions. Additional attention should also be directed to the ethical and pedagogical frameworks required to guide responsible AI adoption in education.

References

1. Barnes, E., & Hutson, J. (2024). Navigating the ethical terrain of AI in higher education: Strategies for mitigating bias and promoting fairness. *Forum for Education Studies*, 2 (2), 12–29. DOI: https://doi.org/10.59400/fes.v2i2.1229.
2. Shelton, K., & Lanier, D. (2024). Thinking About Equity and Bias in AI. Retrieved from https://www.edutopia.org/article/equity-bias-ai-what-educators-should-know/
3. Artificial intelligence and the future of teaching and learning: Insights and recommendations. (2023). Retrieved from https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf
4. Bellas, F., Naya-Varela, M., Mallo, A., & Paz-Lopez, A. (2024). Education in the AI era: A long-term classroom technology based on intelligent robotics. *Humanities and Social Sciences Communications,* 11, 1425. DOI: https://doi.org/10.1057/s41599-024-03953-y.
5. Bennett, L., & Abusalem, A. (2024). Artificial intelligence (AI) and its potential impact on the future of higher education. *Athens Journal of Education,* 11 (3), 195–212. DOI: https://doi.org/10.30958/aje.11-3-2.
6. Helping students understand the biases in generative AI. (n. d.). Retrieved from https://cte.ku.edu/addressing-bias-ai
7. Hicks, F. (2023). Disadvantages of AI in education. Retrieved from https://www.aegissofttech.com/insights/disadvantages-of-ai-in-education/
8. Gruet, M. (2022, May 26). 'That's just common sense': USC researchers find bias in up to 38.6 % of 'facts' used by AI. Retrieved from https://viterbischool.usc.edu/news/2022/05/thats-just-common-sense-usc-researchers-find-bias-in-up-to-38-6-of-facts-used-by-ai/
9. Morze, N., Varchenko-Trotsenko, L., Terletska, T., & Smyrnova-Trybulska, E. (2021). Implementation of adaptive learning at higher education institutions by means of Moodle LMS. *Journal of Physics: Conference Series*, 1840 (1), 012062.
10. Muhd Mukhtar, H. M., Husin, H. S., Ismail, S., Rahmat, A., & Ismail, R. (2025). Advancing Blackboard framework: Responsive trigger mechanisms and dynamic feasibility conditions for optimal knowledge source selection. *In 2025 19th International Conference on Ubiquitous Information Management and Communication (IMCOM)*, 1–5. IEEE. DOI: https://doi.org/10.1109/IMCOM64595.2025.10857578.
11. John, R. (2021). Canvas LMS course design: Create and deliver interactive online courses on the Canvas learning management system. Birmingham, UK : Packt Publishing.
12. Ratnaningsih, S., Miswan, Hady, Y., Sari Dewi, R., Fahriany, & Zuhdi, M. (2020). The effectiveness of using Edmodo-based e-learning in the blended learning process to increase student motivation and learning outcomes. *In 2020 8th International Conference on Cyber and IT Service Management (CITSM),* 1–5. IEEE. DOI: https://doi.org/10.1109/CITSM50537.2020.9268924.

13. Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two Decades of Artificial Intelligence in Education: Contributors, Collaborations, Research Topics, Challenges, and Future Directions. *Educational Technology & Society*, 25 (1), 28–47. Retrieved from https://scholars.ln.edu.hk/ws/portalfiles/portal/41220986/25_1_03.pdf
14. Ke, Z., & Ng, V. (2019). Automated essay scoring: A survey of the state of the art. *In Proceedings of the Twenty-Eighth International Joint Conference on Artificial Intelligence,* 6300–6308. DOI: https://doi.org/10.24963/ijcai.2019/879.
15. Yan, L., Sha, L., Zhao, L., Li, Yu., Martinez-Maldonado, R., & Guanliang, Ch. et al. (2023). Practical and ethical challenges of large language models in education: A systematic scoping review. arXiv preprint, arXiv:2303.13379. Retrieved from https://arxiv.org/abs/2303.13379
16. Ezzaim, A., Dahbi, A., Haidine, A., & Aqqal, A. (2023). AI-based adaptive learning: A systematic mapping of the literature. *Journal of Universal Computer Science*, 29 (10), 1161–1197. DOI: https://doi.org/10.3897/jucs.90528.
17. Gao, R., Merzdorf, H. E., Anwar, S., Hipwell, M. C., & Srinivasa, A. R. (2024). Automatic assessment of text-based responses in post-secondary education: A systematic review. *Computers and Education: Artificial Intelligence*, 6, 100206. DOI: https://doi.org/10.1016/j.caeai.2024.100206.
18. Singh, V., & Ram, S. (2024). Impact of artificial intelligence on teacher education. *Shodh Sari: An International Multidisciplinary Journal*. DOI: https://doi.org/10.59231/sari7669.
19. Xu, T., Tong, R., Liang, J., Fan, X., Li, H., & Wen, Q. (2024). Foundation models for education: Promises and prospects. *IEEE Intelligent Systems,* 39 (3), 20–24. DOI: https://doi.org/10.1109/MIS.2024.3398191.
20. Dutta, S., Ranjan, S., Mishra, S., Sharma, V., Hewage, P., & Iwendi, C. (2024). Enhancing educational adaptability: A review and analysis of AI-driven adaptive learning platforms. *In 2024 4th International Conference on Innovative Practices in Technology and Management (ICIPTM)*, 1–5. IEEE. DOI: https://doi.org/10.1109/ICIPTM59628.2024.10563448.
21. Petrov, S., Merenkov, D., Shirinskii, S., Kryzhov, D., & Letyagina, M. (2022). Empowerment of LMS "Prometheus" for MPEI educational process. *In 2022 VI International Conference on Information Technologies in Engineering Education (Inforino),* 1–6. IEEE. DOI: https://doi.org/10.1109/Inforino53888.2022.9782976.
22. Turnbull, D., Chugh, R., & Luck, J. (2020). Learning management systems: An overview. In: Tatnall, A. (Ed.). *Encyclopedia of Education and Information Technologies*, 1052–1058. Cham : Springer. DOI: https://doi.org/10.1007/978-3-030-10576-1_248.
23. Shtayyat, A., & Gawanmeh, A. (2025). Enhancing educational diversity and inclusion through AI-enabled adaptive Moodle architecture. *In 2025 1st International Conference on Computational Intelligence Approaches and Applications (ICCIAA),* 1–6. IEEE. DOI: https://doi.org/10.1109/ICCIAA65327.2025.11013075.
24. Lai, C. S., Abu Bakar, M. H., Lee, M. F., Tee, T. K., & Halim, M. N. A. (2024). Welding technology students' perception on the use of Google Classroom application at vocational college. *In 2024 9th International STEM Education Conference (iSTEM-Ed),* 1–7. IEEE. DOI: https://doi.org/10.1109/iSTEM-Ed62750.2024.10663132.

Список використаних джерел

1. Barnes E., Hutson J. Navigating the ethical terrain of AI in higher education: Strategies for mitigating bias and promoting fairness. *Forum for Education Studies.* 2024. Vol. 2. № 2. Pp. 12–29. DOI: https://doi.org/10.59400/fes.v2i2.1229.
2. Shelton K., Lanier D. Thinking About Equity and Bias in AI. URL: https://www.edutopia.org/article/equity-bias-ai-what-educators-should-know/ (дата звернення: 16.10.2025).
3. Artificial intelligence and the future of teaching and learning: Insights and recommendations. URL: https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf (дата звернення: 16.10.2025).
4. Bellas F., Naya-Varela M., Mallo A., Paz-Lopez A. Education in the AI era: A long-term classroom technology based on intelligent robotics. *Humanities and Social Sciences Communications*. 2024. Vol. 11. P. 1425. DOI: https://doi.org/10.1057/s41599-024-03953-y.
5. Bennett L., Abusalem A. Artificial intelligence (AI) and its potential impact on the future of higher education. *Athens Journal of Education*. 2024. Vol. 11. № 3. Pp. 195–212. DOI: https://doi.org/10.30958/aje.11-3-2.
6. Helping students understand the biases in generative AI. URL: https://cte.ku.edu/addressing-bias-ai (дата звернення: 16.10.2025).
7. Hicks F. Disadvantages of AI in education. URL: https://www.aegissofttech.com/insights/disadvantages-of-ai-in-education/ (дата звернення: 16.10.2025).
8. Gruet M. 'That's just common sense': USC researchers find bias in up to 38.6% of 'facts' used by AI. URL: https://viterbischool.usc.edu/news/2022/05/thats-just-common-sense-usc-researchers-find-bias-in-up-to-38-6-of-facts-used-by-ai/ (дата звернення: 16.10.2025).

9. Morze N., Varchenko-Trotsenko L., Terletska T., Smyrnova-Trybulska E. Implementation of adaptive learning at higher education institutions by means of Moodle LMS. *Journal of Physics: Conference Series*. 2021. Vol. 1840. № 1. 012062.
10. Advancing Blackboard framework: Responsive trigger mechanisms and dynamic feasibility conditions for optimal knowledge source selection / H. M. Muhd Mukhtar et al. *Proceedings of the 2025 19th International Conference on Ubiquitous Information Management and Communication (IMCOM)*. IEEE, 2025. Pp. 1–5. DOI: https://doi.org/10.1109/IMCOM64595.2025.10857578.
11. John R. Canvas LMS course design: Create and deliver interactive online courses on the Canvas learning management system. Birmingham : Packt Publishing, 2021.
12. The effectiveness of using Edmodo-based e-learning in the blended learning process to increase student motivation and learning outcomes / S. Ratnaningsih et al. *Proceedings of the 2020 8th International Conference on Cyber and IT Service Management (CITSM)*. IEEE, 2020. Pp. 1–5. DOI: https://doi.org/10.1109/CITSM50537.2020.9268924.
13. Two Decades of Artificial Intelligence in Education: Contributors, Collaborations, Research Topics, Challenges, and Future Directions / X. Chen et al. *Educational Technology & Society*. 2022. Vol. 25. № 1. Pp. 28–47. URL: https://scholars.ln.edu.hk/ws/portalfiles/portal/41220986/25_1_03.pdf (дата звернення: 16.10.2025).
14. Ke Z., Ng V. Automated essay scoring: A survey of the state of the art. *Proceedings of the Twenty-Eighth International Joint Conference on Artificial Intelligence*. 2019. Pp. 6300–6308. DOI: https://doi.org/10.24963/ijcai.2019/879.
15. Practical and ethical challenges of large language models in education: A systematic scoping review / L. Yan et al. arXiv preprint, arXiv:2303.13379. URL: https://arxiv.org/abs/2303.13379 (дата звернення: 16.10.2025).
16. Ezzaim A., Dahbi A., Haidine A., Aqqal A. AI-based adaptive learning: A systematic mapping of the literature. *Journal of Universal Computer Science*. 2023. Vol. 29. № 10. Pp. 1161–1197. DOI: https://doi.org/10.3897/jucs.90528.
17. Automatic assessment of text-based responses in post-secondary education: A systematic review / R. Gao et al. *Computers and Education: Artificial Intelligence*. 2024. Vol. 6. 100206. DOI: https://doi.org/10.1016/j.caeai.2024.100206.
18. Singh V., Ram S. Impact of artificial intelligence on teacher education. *Shodh Sari: An International Multidisciplinary Journal*. DOI: https://doi.org/10.59231/sari7669.
19. Foundation models for education: Promises and prospects / T. Xu et al. *IEEE Intelligent Systems*. 2024. Vol. 39. № 3. Pp. 20–24. DOI: https://doi.org/10.1109/MIS.2024.3398191.
20. Enhancing educational adaptability: A review and analysis of AI-driven adaptive learning platforms / S. Dutta et al. *Proceedings of the 2024 4th International Conference on Innovative Practices in Technology and Management (ICIPTM)*. IEEE, 2024. Pp. 1–5. DOI: https://doi.org/10.1109/ICIPTM59628.2024.10563448.
21. Empowerment of LMS "Prometheus" for MPEI educational process / S. Petrov et al. *Proceedings of the 2022 VI International Conference on Information Technologies in Engineering Education (Inforino).* IEEE, 2022. Pp. 1–6. DOI: https://doi.org/10.1109/Inforino53888.2022.9782976.
22. Turnbull D., Chugh R., Luck J. Learning management systems: An overview. A. Tatnall (Ed.). *Encyclopedia of Education and Information Technologies*. Cham : Springer, 2020. Pp. 1052–1058. DOI: https://doi.org/10.1007/978-3-030-10576-1_248.
23. Shtayyat A., Gawanmeh A. Enhancing educational diversity and inclusion through AI-enabled adaptive Moodle architecture. *Proceedings of the 2025 1st International Conference on Computational Intelligence Approaches and Applications (ICCIAA)*. IEEE, 2025. Pp. 1–6. DOI: https://doi.org/10.1109/ICCIAA65327.2025.11013075.
24. Welding technology students' perception on the use of Google Classroom application at vocational college / C. S. Lai et al. *Proceedings of the 2024 9th International STEM Education Conference (iSTEM-Ed)*. IEEE, 2024. Pp. 1–7. DOI: https://doi.org/10.1109/iSTEM-Ed62750.2024.10663132.

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РОЗРОБЛЕННЯ МОДУЛЬНОЇ СИСТЕМИ НА ОСНОВІ ШТУЧНОГО ІНТЕЛЕКТУ ДЛЯ АВТОМАТИЗОВАНОГО ОЦІНЮВАННЯ ТА АДАПТИВНОГО НАВЧАННЯ У ВИЩІЙ ШКОЛІ

Анотація. *На тлі зростання складності освітніх вимог і розширення цифрових навчальних середовищ стає більш нагальною потреба в інтелектуальній автоматизації процесів навчання та оцінювання. Традиційні освітні платформи часто не мають достатньої адаптивності, що призводить до обмеженої персоналізації*

та збільшення навантаження на викладачів. Інтеграція штучного інтелекту (ШІ) в систему навчання є перспективним напрямом щодо розв'язання цих проблем через підвищення масштабованості, ефективності та індивідуалізації навчання. Мета дослідження полягає в поліпшенні якості та ефективності освітнього процесу шляхом розроблення та впровадження автоматизованої системи на базі ШІ для генерації, перевірки та аналізу завдань із контролю за навчанням. Система була розроблена для підтримки персоналізованого навчання, оптимізації оцінювання та зменшення навантаження від рутинних академічних заходів. Запропоноване рішення побудовано на модульній архітектурі з використанням сучасних вебтехнологій (React, Next.js, Firebase) у поєднанні з API-інтерфейсом моделі GPT. Система охоплює модулі для генерації тестів, автоматизованої перевірки відповідей, діалогового AI-асистента, аналізу ефективності та зворотного зв'язку в режимі реального часу. Також передбачені можливості обробки документів (DOCX, PDF) та безперебійна інтеграція з Google Forms. Ефективність системи визначали на основі точності оцінювання, економії часу та зручності використання. Результати впровадження свідчать про високу ефективність системи в реальних освітніх сценаріях. Модуль автоматизованого оцінювання досягнув рівня точності 80–96 %, що майже відповідає показникам ручного оцінювання. Крім того, час, необхідний для підготовки навчального контенту та оцінювання, було скорочено на 60–80 %. Інтерфейс користувача забезпечив інтуїтивний доступ до функціональних можливостей системи, тоді як адаптивні функції сприяли набуттю персоналізованого досвіду студентами із різним рівнем підготовки. Розроблена система демонструє значний потенціал для трансформації освітніх практик завдяки інтеграції штучного інтелекту. Вона покращує персоналізацію, зменшує навантаження на викладачів і підвищує послідовність та об'єктивність оцінювання. Майбутні дослідження будуть орієнтовані на розширення функціональних можливостей системи, включаючи підтримку мультимодального навчання та масштабне впровадження в закладах освіти.

Ключові слова: *автоматизація навчання, освітні технології, адаптивне навчання, автоматизована оцінка.*

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