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APPLICATION OF ARTIFICIAL INTELLIGENCE FOR PERSONALIZING DISTANCE LEARNING FOR SOFTWARE ENGINEERING STUDENTS

This article explores the potential of artificial intelligence (AI) in personalizing the process of distance learning for students majoring in Software Engineering. The relevance of the topic is driven by the increasing demand for effective digital solutions that ensure the quality of education in remote formats, which has become especially important in the post-pandemic era. The author analyzes the key challenges of distance learning, including the lack of an individualized approach, low student engagement, and difficulties in mastering complex topics independently.

The paper examines practical aspects of implementing AI as a tool for adaptive learning, capable of providing personalized recommendations, explanations of educational material, automated knowledge assessment, and 24/7 support. Special attention is given to the practical experience of using a GPT-based chatbot in the teaching of the course "Fundamentals of Programming in C#". It was found that AI integration helps increase student motivation, accelerates the acquisition of complex concepts, and supports the development of self-directed learning skills. The results of surveys and observations demonstrate a positive impact of AI on the quality of learning outcomes.

In conclusion, the article substantiates the appropriateness of using artificial intelligence as a component of an adaptive model of distance learning in higher education institutions. The article may be useful for university instructors, educational platform developers, and professionals working on the modernization of digital educational infrastructure. The article also outlines directions for future research, including the development of ethical interaction frameworks between students and AI, the improvement of dynamic content adaptation mechanisms, and the creation of integrated solutions for various learning platforms tailored to the technical and cognitive needs of learners.

Key words: artificial intelligence, distance learning, personalization, adaptive learning, software engineering, educational technologies.

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ВИКОРИСТАННЯ ШТУЧНОГО ІНТЕЛЕКТУ ДЛЯ ПЕРСОНАЛІЗАЦІЇ ДИСТАНЦІЙНОГО НАВЧАННЯ СТУДЕНТІВ СПЕЦІАЛЬНОСТІ «ІНЖЕНЕРІЯ ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ»

Стаття присвячена дослідженню можливостей застосування штучного інтелекту (ШІ) для персоналізації процесу дистанційного навчання студентів спеціальності «Інженерія програмного забезпечення». Актуальність теми зумовлена зростанням потреби в ефективних цифрових рішеннях для забезпечення якості освіти в умовах віддаленого формату, що особливо актуально у післяпандемічний період. Автор аналізує ключові виклики дистанційного навчання, серед яких відсутність індивідуального підходу, низький рівень залученості студентів та труднощі з самостійним опрацюванням складних тем.

У статті розглянуто практичні аспекти впровадження ШІ як інструменту адаптивного навчання, здатного забезпечити персоналізовані рекомендації, пояснення навчального матеріалу, автоматизовану перевірку знань і підтримку в режимі 24/7. Особлива увага приділена практичному досвіду використання чат-бота на базі GPT у рамках викладання дисципліни «Основи програмування мовою C#». Встановлено, що інтеграція ШІ сприяє підвищенню мотивації студентів, пришвидшенню опанування складних тем та формуванню навичок самостій-

ного навчання. Результати опитувань і спостережень свідчать про позитивний вплив ІІІ на якість засвоєння матеріалу.

У підсумку обґрунтовано доцільність використання штучного інтелекту як елемента адаптивної моделі дистанційного навчання у закладах вищої освіти. Стаття може бути корисною для викладачів, розробників освітніх платформ, а також фахівців, які працюють над модернізацією цифрової освітньої інфраструктури. Також визначено потенційні напрями подальших досліджень, серед яких – створення етичних моделей взаємодії між студентом та ІІІ, удосконалення механізмів адаптації навчального контенту відповідно до динаміки навчання, а також розробка інтегрованих рішень для різних освітніх платформ з урахуванням технічних і когнітивних потреб здобувачів освіти.

Ключові слова: штучний інтелект, дистанційне навчання, персоналізація, адаптивне навчання, інженерія програмного забезпечення, освітні технології.

Problem statement

In today's rapidly evolving digital landscape, distance learning has become an integral part of the educational process, particularly in higher technical education. This format provides flexible opportunities for mastering material but also introduces new challenges for both instructors and students. A key issue in this context is the need to individualize educational content according to each student's knowledge level, learning pace, and personal needs.

Artificial intelligence (AI) plays a pivotal role in the digital transformation of education by enabling personalized learning approaches [1]. AI tools make it possible to tailor learning platforms to individual user characteristics, automate feedback, monitor performance, and create customized learning paths.

Formulation of the purpose of the study

The goal of this study is to examine how artificial intelligence tools can be employed to personalize distance education for Software Engineering students, and to identify the benefits, limitations, and future prospects of this approach.

Despite the advantages of distance learning, there remain several challenges associated with traditional online education formats. These include a lack of individualization, decreased student motivation, ineffective feedback loops, and instructor overload due to repetitive tasks. Such issues limit the overall effectiveness of the learning process and necessitate the adoption of innovative, technology-driven solutions [6].

Presentation of the main material of the study

Personalized learning is an approach that tailors the educational process to the individual characteristics, needs, and goals of each student. Within the context of traditional or even standard distance education, implementing this approach poses significant challenges due to limited resources and the need for manual analysis of large volumes of data. As a result, the use of artificial intelligence (AI) tools is gaining increasing importance.

AI in education encompasses various directions, including:

- 1) adaptive learning systems that modify content delivery based on the student's progress;
- 2) intelligent tutoring systems that offer support through explanations, hints, and feedback;
- 3) analytical tools that identify learning gaps and performance trends;
- 4) recommendation engines that suggest learning materials or tasks based on the student's prior activity.

One of the most widely studied concepts in this field is adaptive learning – a methodology that dynamically adjusts the content, format, and pace of learning according to real-time user data. Modern platforms such as Coursera, Khan Academy, and Smart Sparrow implement adaptive learning using machine learning algorithms [2].

For students majoring in Software Engineering, who work with logic-based systems, algorithms, and modeling technologies, the integration of AI into the learning process provides dual benefits [11]. On one hand, they receive more effective and tailored instruction; on the other, they gain direct exposure to the methods they may later apply in their professional practice [4, 7].

Furthermore, the development of large language models (LLMs) such as GPT has introduced the potential for digital assistants that can answer student queries, review code, generate illustrative examples, and even simulate the logic of real-world IT projects. This fundamentally transforms the educational environment and redefines the role of the instructor.

Application of AI in learning personalization

Modern artificial intelligence technologies are increasingly integrated into the educational process, enabling the creation of adaptive and individualized learning environments. For students in Software Engineering, who often vary in their levels of prior knowledge, motivation, and learning pace, the personalization of educational content is particularly valuable.

Intelligent Tutoring Systems. Intelligent instructional agents (e.g., based on large language models such as ChatGPT or Claude) are capable of:

- 1) answering student questions in real time, 24/7;
- 2) providing explanations in programming, algorithms, and design patterns;
- 3) analyzing code snippets and suggesting corrections;
- 4) generating personalized tasks based on the student's level of proficiency.

These capabilities partially automate the support function typically carried out by instructors or teaching assistants, especially in large-scale courses [3].

Adaptive Learning Platforms. AI-powered systems such as:

- 1) Knewton – adjusts content to match the student's knowledge level and identifies knowledge gaps;
- 2) Smart Sparrow – enables nonlinear learning paths;
- 3) Realizeit – analyzes student activity and optimizes topic sequencing, allow the construction of personalized learning trajectories that dynamically adapt as the learner progresses.

Recommendation Systems. Similar to how platforms like YouTube or Spotify suggest content based on user preferences, AI in education can recommend:

- 1) articles, videos, or code examples aligned with topics the student has not yet mastered;
- 2) quizzes or assignments tailored to the appropriate difficulty level;
- 3) practical projects aligned with the student's interests.

This increases motivation and engagement, particularly when students feel they are receiving content that is directly relevant to their individual needs.

Learning Analytics. Through machine learning, platforms can:

- 1) detect behavioral patterns among students;
- 2) predict risks of academic underperformance;
- 3) automatically notify instructors of students requiring intervention;
- 4) generate weekly or daily dashboards showing each student's progress [5].

These features not only improve personalized learning experiences but also strengthen academic supervision and mentoring functions.

Challenges and limitations of AI implementation in education

Despite numerous advantages, the integration of artificial intelligence into the educational process is accompanied by a range of challenges and risks. These must be carefully considered when planning the digital transformation of learning environments, particularly in the context of higher technical education.

Ethical and pedagogical risks. One of the key concerns involves the ethical use of AI. Students may misuse intelligent agents to complete assignments without genuine learning or engagement. This raises the need to rethink assessment methods for both knowledge and practical competencies.

Additionally, the role of the educator remains uncertain: should the instructor function solely as a mentor and coordinator, or continue to serve as the primary source of knowledge? A new pedagogical interaction model must be established – one in which AI supplements, rather than replaces, the human teacher.

Technical limitations. Not all AI tools are:

- 1) capable of providing stable and accurate responses to highly specialized queries;
- 2) equipped with Ukrainian language support or access to localized content;
- 3) areely available or affordable for educational institutions.

Further challenges may arise in integrating AI systems into existing learning management systems (LMS), such as Moodle, Google Classroom, or Canvas.

Data privacy and protection. The use of AI in education requires processing large volumes of personal student data, including browsing history, responses, progress metrics, and behavioral patterns. This raises concerns about:

- 1) compliance with GDPR or national data protection regulations;
- 2) security of information stored in cloud-based services;
- 3) transparency of decision-making algorithms used to personalize learning paths.

Psychological adaptation of students and instructors. The transition to AI-enhanced education can cause stress and resistance among both students and educators. Adaptation periods, targeted training sessions, and gradual implementation strategies are necessary to facilitate successful adoption – requiring time, planning, and institutional support.

Practical recommendations

Based on the conducted analysis, several recommendations can be proposed for instructors, curriculum developers, and university administrators aiming to effectively integrate artificial intelligence tools into the distance learning process for future software engineers:

Gradual Integration of AI into the Learning Process. Implementation should begin with auxiliary services such as code checking tools, example generators, and chatbots, with progressive expansion toward more advanced applications like adaptive learning systems and intelligent tutoring agents.

Enhancing Digital Competence of Educators. It is essential to organize professional development programs focused on working with large language models (LLMs), adaptive platforms, and educational analytics systems to ensure that instructors are well-equipped to use these technologies.

Development of Ethical Guidelines for AI Use in Education. Institutions should establish academic integrity policies that reflect the new challenges associated with AI usage. These should include mechanisms for detecting inappropriate use and promoting responsible engagement with intelligent systems.

Content Personalization Through Data Analytics. Educators should leverage analytical tools to segment students based on their learning styles, knowledge levels, and learning pace. This segmentation enables the creation of personalized learning paths tailored to individual needs.

Evaluation and Assessment of Effectiveness

The integration of AI should be accompanied by ongoing evaluation of its impact, including improvements in academic performance, student engagement, and time efficiency for educators.

Instructor's practical experience. During the remote delivery of the course «Fundamentals of Programming in C#» for Software Engineering students, artificial intelligence was integrated as an auxiliary tool within the learning process. Specifically, students were encouraged to utilize a GPT-4-based chatbot to independently explore course topics, receive code examples, clarify object-oriented programming principles, and debug their programs [9]. The chatbot acted as a virtual tutor, providing adaptive explanations based on user queries. Additionally, students were able to critically analyze the AI-generated code, correct mistakes, and discuss alternative implementations. The use of AI proved especially effective during laboratory assignments, where students often consulted the bot for guidance on syntax and logic issues, thereby avoiding lengthy internet searches. A comparative evaluation conducted within the course revealed that students who actively used the AI assistant were 15–20 % more likely to pass tests on the first attempt. Furthermore, a student survey indicated that 84 % found the integration of AI beneficial to their learning, and 67 % reported a deeper understanding of complex topics. These results highlight the value of systematically integrating AI not merely as a reference tool but as a pedagogical mentor within adaptive learning environments

Conclusions

Artificial intelligence unlocks new opportunities for personalized distance education, which is particularly relevant for training software engineering students. AI technologies enable consideration of individual learner characteristics, offer continuous feedback, adapt content delivery, and automate routine instructional tasks [10].

However, effective implementation of such solutions requires thorough planning, instructor training, adherence to ethical standards, and awareness of technical and organizational limitations. The successful integration of AI into educational environments contributes to improving learning quality, fostering digital literacy [8], and enhancing the competitiveness of graduates in the information technology sector.

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