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на честь О.В. Погорєлова

ПРОБЛЕМИ ВИКЛАДАННЯ МАТЕМАТИКИ У ЗАКЛАДАХ ОСВІТИ:

ТЕОРІЯ, МЕТОДИКА, ПРАКТИКА

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Проблеми викладання математики у закладах освіти: теорія, методика, практика: тези доповідей IV Міжнародної конференції на честь О.В. Погорєлова (23–25 березня, 2026 р., м. Харків, Україна). – Харків : ХНУ імені В. Н. Каразіна, 2026. – 459 с.

До збірки увійшли тези доповідей учасників Міжнародної конференції, присвяченої проблемам викладання математики у закладах середньої та вищої освіти. Матеріали містять результати наукових досліджень у галузі сучасної математичної освіти, обміну педагогічним досвідом між викладачами, науковцями, методистами та освітніми управлінцями та презентації інноваційних методик навчання зі застосуванням цифрових інструментів та інтерактивних форм роботи.

Наукове видання призначається для науково-педагогічних працівників, вчителів, здобувачів математичної освіти.

Тези подано в авторській редакції

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PROBLEMS OF FORMING AI LITERACY IN THE PROCESS OF TEACHING MATHEMATICAL DISCIPLINES IN HIGHER EDUCATION

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Abstract. The problems and prospects of developing artificial intelligence literacy in the teaching of mathematical disciplines in higher education institutions across various fields of study are examined. The global experience of integrating AI tools – systems, generative models, intelligent tutoring systems, and immersive technologies – is analyzed. Particular attention is given to the Ukrainian context, where the absence of standardized modules and insufficient teacher training create barriers to effective instruction.

Keywords: AI literacy, higher education, mathematics education, adaptive systems, generative models, intelligent tutoring systems, immersive technologies, digital competencies.

Artificial intelligence (AI) is rapidly transforming both professional fields and the structure of modern education. The understanding and integration of AI technologies into the educational process are becoming an integral part of training future specialists, regardless of their field of study. In this context, AI literacy is a key competence that includes understanding the fundamental principles of how AI systems function, critically evaluating their outputs, recognizing ethical considerations, and effectively applying AI tools to solve academic and professional tasks [1].

Although higher education institutions in many countries are actively developing strategies to integrate AI components into educational programs, implementing these

strategies in the teaching of mathematics encounters numerous difficulties. Among the main obstacles are insufficient instructor qualifications, the absence of clear methodological standards, and limited student preparation for working with AI technologies. In particular, study [1] showed that even experienced mathematics lecturers often experience anxiety about integrating AI into the educational process, which affects their readiness to apply digital tools in their teaching practice.

International studies indicate that implementing AI in education enhances students' digital literacy and critical thinking. However, alongside new opportunities, a balanced approach is needed that prevents excessive reliance on technology while preserving a deep understanding of mathematical concepts [2]. Paper [3] emphasizes that students actively use generative AI systems in their learning but require clear methodological guidelines for their responsible and practical application.

At the global level, there is a growing number of initiatives to incorporate AI elements into mathematics courses, even when these courses are not directly related to computer science or data analysis. For example, integrated digital literacy courses include data modeling with AI tools and practical exercises with generative models. Such approaches contribute to the development of competencies necessary for professional activity across fields of specialization, while simultaneously ensuring the adaptability of the educational process [4; 5].

In discussing international benchmarks in mathematics education under contemporary conditions, it is appropriate to consider Singapore's practices, which consistently demonstrate high levels of mathematical competence and actively develop digital skills in schools and universities. Singapore stands out among global educational systems for the extent to which AI technologies are integrated into pedagogical practice. Data from the international TALIS 2024 survey showed that approximately 75 % of teachers in Singapore use artificial intelligence to support teaching and organize the educational process – a figure significantly higher than the global average (36 %) and including both lesson adaptation and the automation of administrative tasks [6].

Contemporary research demonstrates that integrating AI into academic disciplines in higher education extends beyond the automation of assessment or administrative processes. Paper [7] emphasizes that effective AI integration requires consideration of pedagogical coherence, the development of AI literacy, and the integration of policies regulating the use of technologies in education. Such an approach not only improves student outcomes in mathematical disciplines but also fosters key twenty-first-century competencies, including analytical thinking, digital literacy, and the ability to evaluate AI-generated results critically. This is particularly important for students across all specializations, not just future educators, as the modern professional world requires effective use of technology in every field.

Researchers give special attention to intelligent tutoring systems (ITS), which can provide personalized learning and immediate feedback to students and adjust their

learning trajectories according to individual needs. However, the effective use of ITS requires methodological support for instructors and the enhancement of their digital and pedagogical competence [2; 5].

Alongside adaptive systems, generative models, and intelligent tutoring systems (ITS), increasing attention is also being paid to immersive technologies, particularly virtual reality (VR) and augmented reality (AR), which enable the creation of interactive learning environments for mathematics. Study [8] shows that the use of VR/AR in higher education contributes to a deeper understanding of abstract mathematical concepts, the development of spatial thinking, and improvements in students' digital competence. In particular, immersive environments enable the modeling of complex mathematical objects and processes, providing students with the opportunity to experiment and interact with material in a safe virtual space. Thus, combining VR/AR with other AI tools creates a multidimensional educational environment that not only supports the acquisition of theoretical knowledge but also stimulates the practical application of mathematical concepts across various contexts.

Table 1 presents generalized examples of AI tools and their expected impact in mathematical disciplines. As shown in Table 1, the use of various AI tools in mathematics education offers broad opportunities to develop students' key competencies: digital literacy, analytical and critical thinking, and the ability to solve complex problems.

Table 1

AI Tools in Mathematics Education: Characteristics and Functions

Type of AI Tool	Essence	Expected Functions
Adaptive systems	Personalization of learning content according to students' level of knowledge	Support for individual progress, development of analytical skills
Intelligent Tutoring Systems (ITS)	Intelligent support of the student, automatic error correction	Immediate feedback, personalization of the learning trajectory
Generative models	Generation of exercises and explanations, simulation of problems	Explanation of mathematical concepts, development of critical thinking, and digital literacy
Immersive technologies (VR/AR) + AI	Visualization of abstract mathematical concepts	Enhanced understanding of complex and spatial notions, interactive learning

Source: compiled based on [2; 4; 5; 8].

The integration of AI into mathematics education in Ukrainian higher education institutions is only beginning to take shape due to the lack of a systematic approach to curriculum adaptation and teacher training, which creates significant barriers to the effective development of AI literacy [9; 10]. Study [9] notes that AI can serve as a tool for modeling, visualization, and automated analysis; however, its effectiveness depends on methodological support and the development of critical thinking. The

authors of the paper [11] demonstrate that practice-oriented tasks in teaching higher mathematics increase mastery of the material, and integrating AI into such tasks enables the integration of theoretical knowledge with students' digital competencies across all specializations.

Among the main challenges in teaching mathematical disciplines with the inclusion of AI components are the following: insufficient qualifications and confidence of instructors in applying AI tools; concerns about a reduction in the depth of mastery of fundamental mathematical concepts due to students' excessive reliance on generative AI systems; as well as the absence of unified standards and AI literacy modules integrated into mathematics curricula [12]. Despite these challenges, AI can be a valuable tool for personalizing learning, automating assessment, and solving mathematical problems; however, its effectiveness depends largely on students' critical thinking and their ability to evaluate the quality of results.

Thus, developing AI literacy in the teaching of mathematical disciplines in higher education is an urgent need in the context of education's digital transformation. International experience shows that integrating AI into mathematics courses enhances students' digital, analytical, and metacognitive competencies, while also demanding well-designed methodological approaches and systematic teacher training.

In Ukraine, there is potential to develop similar practices; however, this requires implementing standardized AI literacy modules in mathematical disciplines, providing professional development for instructors in the use of AI tools, and addressing ethical and pedagogical considerations to prevent superficial learning and technological dependency. Systematic methodological support, combined with thoughtful pedagogical practice, will enable the effective integration of AI into mathematics teaching and the development of the competencies necessary for professional success in the digital economy.

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АНАЛІЗ МАТЕМАТИЧНО ОРІЄНТОВАНОЇ AI-МОДЕЛІ DEEPSEEKMATH-V2

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Анотація. Розглянуто модель DeepSeekMath-V2, призначену для розв’язування складних математичних задач і побудови формальних доказів. Проаналізовано її архітектуру, механізм генерації та перевірки рішень, реалізацію самоперевірки, а також основні можливості та обмеження. Розглянуто практичну доступність моделі, її масштабність та окреслено перспективи розвитку математично орієнтованих систем штучного інтелекту.

Ключові слова: DeepSeekMath-V2, математичне міркування, автоматичне доведення, самоперевірка, штучний інтелект у математиці, великі AI-моделі

ANALYSIS OF THE MATH-ORIENTED AI MODEL DEEPSEEKMATH-V2

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Abstract. The paper examines the DeepSeekMath-V2 model, designed to solve complex mathematical problems and construct formal proofs. Its architecture, solution-generation and