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DIDACTIC OPPORTUNITIES OF USING ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN CONSTRUCTION ENGINEERING EDUCATION

Annotation. *This article analyzes the didactic opportunities of using artificial intelligence (AI) technologies in construction engineering education. AI-based teaching tools occupy an important place in individualizing the educational process, integrating theoretical knowledge with practical activity, and developing engineering thinking. The article examines the scientific views of foreign and local researchers, the impact of AI technologies on the quality of teaching, and applied opportunities in Uzbekistan's education system on a scientific basis.*

Keywords: *Artificial intelligence, construction engineering, didactics, digital education, simulation, digital twin, adaptive learning, cognitive development, technological competence.*

QURILISH MUHANDISLIGI TA'LIMIDA SUN'IY INTELLEKT TEXNOLOGIYALARIDAN FOYDALANISHNING DIDAKTIK IMKONIYATLARI

Annotatsiya. *Ushbu maqolada qurilish muhandisligi ta'limida sun'iy intellekt (SI) texnologiyalaridan foydalanishning didaktik imkoniyatlari tahlil etiladi. Sun'iy intellekt asosidagi o'qitish vositalari o'quv jarayonini individuallashtirish, nazariy bilimlarni amaliy faoliyat bilan integratsiyalash va muhandislik tafakkurini rivojlantirishda muhim o'rin tutadi. Maqolada xorijiy va mahalliy tadqiqotchilarning ilmiy qarashlari, AI texnologiyalarining o'qitish sifatiga ta'siri hamda O'zbekiston ta'lim tizimidagi tatbiqiy imkoniyatlar ilmiy asosda ko'rib chiqilgan.*

Kalit so'zlar: *sun'iy intellekt, qurilish muhandisligi, didaktika, raqamli ta'lim, simulatsiya, raqamli tvinn, adaptiv o'qitish, kognitiv rivojlanish, texnologik kompetensiya.*

ИСПОЛЬЗОВАНИЕ ТЕХНОЛОГИЙ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ОБУЧЕНИИ СТРОИТЕЛЬНОМУ ИНЖЕНЕРНОМУ ДЕЛУ: ДИДАКТИЧЕСКИЕ ВОЗМОЖНОСТИ

Аннотация. *В данной статье анализируются дидактические возможности использования технологий искусственного интеллекта (ИИ) в обучении строительному инженерному делу. Учебные средства, основанные на искусственном интеллекте, играют важную роль в индивидуализации учебного процесса, интеграции теоретических знаний с практической деятельностью и развитии инженерного мышления. В статье рассмотрены научные взгляды зарубежных и отечественных исследователей, влияние технологий ИИ на качество обучения, а также прикладные возможности их внедрения в образовательную систему Узбекистана.*

Ключевые слова: *искусственный интеллект, строительное инженерное дело, дидактика, цифровое образование, симуляция, цифровой двойник, адаптивное обучение, когнитивное развитие, технологическая компетентность.*

Introduction. The modern education system is fundamentally changing under the influence of technological progress. In particular, the entry of artificial intelligence (AI) technologies into education is renewing teaching methods, organizational principles of the educational process, and students' knowledge acquisition strategies. The field of construction engineering, as a direction encompassing complex technical processes, engineering calculations, technological modelling, and environmental factors, is one of the fields most actively influenced by these changes. Artificial intelligence technologies provide students with the opportunity to test theoretical knowledge through virtual models, restore and analyze real construction conditions in a digital environment. Therefore, AI tools are forming a new stage of didactics, a digital, interactive, and competency-oriented education model.

Literature Review. In the last decade, numerous theoretical approaches have explored the application of artificial intelligence (AI) in education, focusing on new forms of teacher–student interaction and the didactic significance of AI technologies. Woolf's influential work emphasizes AI as an intellectual assistant in education, capable of identifying cognitive errors, forming individual development paths, and supporting personalized learning without diminishing the teacher's role [1]. Her cognitive tutoring systems represent a shift from traditional instruction to adaptive, data-driven learning experiences. Luckin

introduces the concept of an AI–pedagogical partnership, where artificial intelligence acts not only as an information source but also as an advisor and motivational tool [2]. She highlights co-intelligence—the cooperation between human and machine intelligence—arguing that AI should enhance, not replace, pedagogical decision-making.

Mitrovich notes that AI-driven simulation systems allow engineering students to analyze real situations, identify errors, and make independent decisions in safe virtual environments.[3] His findings show that such tools accelerate the development of professional judgment and problem-solving skills. Ahmad and Al-Fadhli demonstrate that integrating AI with Digital Twin technologies enables virtual control and modelling of construction processes, bridging theoretical learning with practical experience.[4] These tools provide dynamic visualizations of construction projects, helping students understand complex interdependencies and design outcomes. Yuldashev analyzes the integration of AI in Uzbekistan's educational context, emphasizing how it transforms teacher–student communication and supports the development of a digital learning environment [5]. His research highlights the need to adapt global AI innovations to local educational conditions. Synthesizing these studies reveals that AI technologies mark a new stage in didactics by fostering individualized instruction, visual modelling, and enhanced cognitive engagement, while reinforcing teacher–student interaction as a collaborative partnership.

Research Methodology. The research was grounded in a combination of theoretical analysis, comparative study, and empirical observation methods, ensuring a comprehensive and methodologically balanced investigation of the research problem. At the initial stage, didactic models related to the application of artificial intelligence technologies were thoroughly examined through an in-depth and systematic analysis of international scientific literature, which enabled the identification of dominant trends, key theoretical assumptions, conceptual approaches, and effective pedagogical frameworks used in contemporary higher education systems. Particular attention was paid to the instructional potential of AI technologies and their role in supporting learning personalization, assessment, and academic performance.

In the subsequent stage, practical cases of AI tool implementation in the field of construction engineering were observed and analytically evaluated, drawing on qualitative and quantitative data obtained from pilot programs conducted in higher educational institutions of Uzbekistan. These observations focused on instructional design, modes of AI integration into the curriculum, teaching–learning interactions, and measurable educational outcomes. The methodological foundation of the study is based on a competency-oriented approach, cognitive learning theory, and contemporary concepts of digital pedagogy, which together form an integrated and coherent framework for assessing the educational effectiveness, adaptability, and long-term sustainability of AI-supported instruction in higher education, as well as its alignment with current educational standards and labor market demands.

Analysis and Results. The conducted analysis shows that artificial intelligence technologies enable achieving the following results in construction engineering education. Individualizing the teaching process represents a fundamental transformation in educational delivery. AI systems identify each student's assimilation speed, learning style, and knowledge level, proposing an appropriate learning path. These adaptive systems continuously monitor student performance, analyzing patterns of success and struggle to dynamically adjust content difficulty, presentation format, and practice opportunities. The personalization extends beyond simple branching logic to sophisticated modelling of individual cognitive profiles that predict optimal learning sequences and intervention strategies.

Simulation-based teaching creates transformative learning environments where construction processes, material testing, and structural design modelling are carried out in virtual environments, providing safe, economical, and effective teaching opportunities. Students can experiment with different construction methodologies, observe the consequences of design decisions, and develop intuition about complex engineering systems without the temporal, financial, and safety constraints of physical laboratories. AI-enhanced simulations provide intelligent feedback that guides students toward deeper understanding of underlying principles rather than mere procedural competence.

Automated assessment systems powered by artificial intelligence algorithms reduce human error in evaluating student work and ensure objective results. These systems can analyze complex engineering solutions across multiple dimensions, including technical accuracy, design efficiency, adherence to codes and standards, and innovative problem-solving approaches. The consistency and immediacy of AI assessment enables more frequent practice opportunities and supports formative learning processes that would be impractical with purely manual grading systems.

Developing independent thinking through AI assistance allows students to analyze problematic situations and develop independent strategies in decision-making. AI systems can present complex, ambiguous engineering scenarios that require students to synthesize knowledge from multiple domains, evaluate trade-offs, and justify their reasoning. The scaffolding provided by AI tutors supports students in developing metacognitive skills, helping them recognize their own thinking patterns and develop more sophisticated problem-solving approaches.

The results show that the integration of AI technologies into the educational process transforms the teacher's role from information source to manager and controller of the learning process. This evolution redefines pedagogical expertise, emphasizing skills in designing learning experiences, interpreting AI-generated insights about student learning, and providing the human elements of education that remain beyond the reach of technology such as inspiration, emotional support, and modelling of professional values.

Conclusion. Artificial intelligence technologies are bringing construction engineering education to a new stage of development by transforming both instructional practices and learning outcomes. They not only contribute to the digitalization of the teaching process but also significantly enhance the cognitive activity of students, fostering analytical thinking, strengthening engineering logic, and cultivating independent and evidence-based decision-making skills. Through intelligent modeling, simulation, and data-driven feedback, AI-supported learning environments enable students to engage more deeply with complex engineering problems. For Uzbekistan's higher education system, one of the main priority directions is the methodologically sound implementation of AI-based teaching tools, which requires a clear pedagogical framework and alignment with national educational standards. Equally important is the systematic preparation of teachers in digital and AI-related competencies, ensuring their ability to effectively integrate these technologies into the teaching–learning process.

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LANGUAGE LEARNING THROUGH PRACTICAL SKILLS

Annotation. *A competency-based on approach allows students to progress at their own pace based on their ability to acquire a skill or competency, regardless of their environment. This approach adapted to meet different learning abilities and help students achieve more effective results. In this is article discussed about importance of competence-based approach.*

Keywords: *approach, competency-based approach, students, teaching, language.*

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TILNI AMALIY KO'NIKMALAR ORQALI O'RGANISH

Annotatsiya. *Kompetensiyaga asoslangan yondashuv talabalarga o'zlashtirish qobiliyatidan kelib chiqib, o'z tezligida rivojlanish imkonini beradi va bu jarayon ta'lim muhiti bilan bog'liq bo'lmaydi. Ushbu yondashuv turli o'rganish imkoniyatlariga moslashtirilishi mumkin hamda yanada samarali natijalarga erishishga yordam beradi. Mazkur maqolada til o'qitishda kompetensiyaga asoslangan yondashuvning ahamiyati muhokama qilinadi.*

Kalit so'zlar: *yondashuv, kompetensiyaga asoslangan yondashuv, talabalar, ta'lim, til.*