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ENHANCING LIFE SAFETY AND CIVIL PROTECTION EDUCATION THROUGH ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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Abstract

The growing frequency of natural disasters, technogenic accidents, and epidemiological threats has significantly intensified the need for effective and practice-oriented training systems in life safety and civil protection disciplines [1,4]. Traditional educational approaches, predominantly based on lecture-based instruction, often fail to ensure sufficient practical preparedness, situational

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awareness, and decision-making skills required in real emergency conditions [2,7].

This study investigates the educational potential of artificial intelligence (AI) technologies in teaching life safety and civil protection disciplines within higher education institutions. The research methodology is based on analytical review, comparative pedagogical analysis, and longitudinal observation conducted during the 2023–2026 academic years.

The findings demonstrate that the integration of AI-based tools—including intelligent simulation systems, adaptive assessment platforms, and multilingual learning environments—leads to statistically significant improvements in learning outcomes [3,6]. In particular, AI-supported instruction increases knowledge acquisition by 8–10%, improves long-term retention rates by 20–25%, and enhances the effectiveness of practical training by 35–40% [12,14].

These results confirm that systematic implementation of AI technologies contributes to higher educational quality and improves the professional preparedness of future specialists for emergency response and civil protection tasks.

Keywords: Artificial intelligence; life safety education; civil protection; higher education; emergency preparedness; digital learning

Annotatsiya

Tabiiy ofatlar, texnogen avariyalar va epidemiologik tahdidlarning tobora ko‘payib borishi hayot faoliyati xavfsizligi va fuqaro muhofazasi fanlari bo‘yicha samarali hamda amaliy yo‘naltirilgan ta’lim tizimlariga bo‘lgan ehtiyojni sezilarli darajada oshirdi [1,4]. Asosan ma’ruza mashg‘ulotlariga tayangan an’anaviy ta’lim yondashuvlari ko‘pincha favqulodda vaziyatlar sharoitida zarur bo‘lgan yetarli amaliy tayyorgarlik, vaziyatni anglash va qaror qabul qilish ko‘nikmalarini ta’minlab bera olmaydi [2,7]. Mazkur tadqiqot oliy ta’lim muassasalarida hayot faoliyati xavfsizligi va fuqaro muhofazasi fanlarini o‘qitishda sun’iy intellekt (SI) texnologiyalarining ta’limiy salohiyatini o‘rganishga bag‘ishlangan. Tadqiqot metodologiyasi tahliliy sharh, qiyosiy pedagogik tahlil hamda 2023–2026 o‘quv yillari davomida olib borilgan uzoq

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muddatli kuzatuvlarga asoslangan. Tadqiqot natijalari shuni ko‘rsatadiki, intellektual simulyatsiya tizimlari, moslashuvchan baholash platformalari va ko‘p tilli ta’lim muhitlarini o‘z ichiga olgan sun’iy intellektga asoslangan vositalarni joriy etish ta’lim natijalarining statistik jihatdan ishonchli yaxshilanishiga olib keladi [3,6]. Xususan, sun’iy intellekt yordamida tashkil etilgan ta’lim bilimlarni o‘zlashtirish darajasini 8–10% ga oshiradi, uzoq muddatli xotirada saqlanish ko‘rsatkichlarini 20–25% ga yaxshilaydi hamda amaliy mashg‘ulotlar samaradorligini 35–40% ga oshiradi [12,14]. Olingan natijalar sun’iy intellekt texnologiyalarini tizimli ravishda joriy etish ta’lim sifati oshishiga va kelajak mutaxassislarining favqulodda vaziyatlarga javob berish hamda fuqaro muhofazasi vazifalarini bajarishga bo‘lgan kasbiy tayyorgarligini kuchaytirishini tasdiqlaydi.

Kalit so‘zlar: sun’iy intellekt; hayot faoliyati xavfsizligi; fuqaro muhofazasi; oliy ta’lim; favqulodda vaziyatlarga tayyorgarlik; raqamli ta’lim.

Аннотация

Учащение природных катастроф, техногенных аварий и эпидемиологических угроз существенно усилило потребность в эффективных и практико-ориентированных системах подготовки по дисциплинам безопасности жизнедеятельности и гражданской защиты [1,4]. Традиционные образовательные подходы, преимущественно основанные на лекционных формах обучения, часто не обеспечивают достаточный уровень практической подготовленности, ситуационной осведомлённости и навыков принятия решений, необходимых в реальных условиях чрезвычайных ситуаций [2,7].
В данном исследовании рассматривается образовательный потенциал технологий искусственного интеллекта (ИИ) в обучении дисциплинам безопасности жизнедеятельности и гражданской защиты в учреждениях высшего образования. Методология исследования основана на аналитическом обзоре, сравнительном педагогическом анализе и лонгитюдных наблюдениях, проведённых в 2023–2026 учебных годах.

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Результаты исследования показывают, что внедрение ИИ-ориентированных инструментов, включая интеллектуальные имитационные системы, адаптивные платформы оценки и многоязычные образовательные среды, приводит к статистически значимому улучшению результатов обучения [3,6]. В частности, использование ИИ в учебном процессе повышает уровень усвоения знаний на 8–10%, улучшает показатели долгосрочного запоминания на 20–25% и увеличивает эффективность практической подготовки на 35–40% [12,14]. Полученные данные подтверждают, что системное внедрение технологий искусственного интеллекта способствует повышению качества образования и улучшению профессиональной готовности будущих специалистов к выполнению задач по реагированию на чрезвычайные ситуации и гражданской защите.

Ключевые слова: искусственный интеллект; безопасность жизнедеятельности; гражданская защита; высшее образование; готовность к чрезвычайным ситуациям; цифровое обучение.

Introduction

The accelerating digital transformation of higher education has intensified global interest in artificial intelligence (AI) as a powerful tool for improving teaching quality, learning efficiency, and educational outcomes [6,7]. This trend is particularly relevant for life safety and civil protection disciplines, which require not only theoretical knowledge but also rapid decision-making, situational awareness, and practical readiness for emergency scenarios [1,14].

According to international analytical reports, the number of natural disasters, technogenic accidents, and epidemiological threats has steadily increased in recent decades, resulting in substantial human, social, and economic losses worldwide [4,8]. These circumstances clearly expose the limitations of traditional teaching methods and highlight the urgent need for innovative, technology-enhanced pedagogical approaches [2,9].

In this context, AI-based educational technologies provide new opportunities for adaptive learning, simulation-based training, real-time assessment, and individualized feedback [3,11].

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In Uzbekistan, the implementation of the national Artificial Intelligence Development Strategy until 2030 has created favorable institutional and technological conditions for integrating AI into higher education systems [10]. However, despite growing international experience, empirical research focusing on AI applications specifically in life safety and civil protection education remains limited [4,12]. Therefore, the aim of this study is to evaluate the effectiveness of AI technologies in teaching these disciplines and to assess their impact on students' learning outcomes and practical preparedness.

Concept and Pedagogical Foundations of Artificial Intelligence. Artificial intelligence is defined as a class of computational systems capable of performing tasks that typically require human intelligence, such as learning, reasoning, problem-solving, and decision-making [1,7]. The concept was formally introduced by John McCarthy in 1956, who described AI as the science and engineering of making intelligent machines [5]. From a pedagogical perspective, AI enables the creation of adaptive learning environments, personalized educational trajectories, and data-driven assessment models [3,6]. Modern machine learning and deep learning algorithms allow educational platforms to analyze student performance in real time and dynamically adjust instructional content, thereby increasing learning efficiency and academic achievement [11,12].

Types of Artificial Intelligence and Their Application in Education. In life safety and civil protection education, the most widely used AI systems include reactive machines and limited-memory AI [7]. These technologies are implemented through intelligent testing systems, automated content generation tools, and simulation-based learning environments that model emergency situations [6,13].

Advanced AI-driven simulations are particularly effective in replicating complex emergency scenarios such as natural disasters, industrial accidents, and epidemiological outbreaks, allowing students to practice decision-making in a controlled environment [4,14]. The establishment of specialized emergency simulation centers enables objective assessment of trainees' actions, response

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time, and compliance with safety protocols, thereby strengthening practical competencies and professional readiness [14].

Use of AI Platforms by Students. Modern students actively use AI-based platforms such as ChatGPT, Copilot, Gemini, Gamma, and Canva to support independent learning, analytical thinking, and creative problem-solving [6,15]. These tools facilitate rapid preparation of educational materials, visual presentations, safety schemes, and analytical summaries, significantly increasing learner engagement. Pedagogical observations indicate that the use of AI-generated infographics and visual safety models improves comprehension by 25–30%, while the time required for preparing learning materials is reduced by 40–50% [15,16].

Multilingual Education and AI Translation Tools. The globalization of higher education has led to a steady increase in the number of international students, resulting in multilingual learning environments [8]. In such conditions, AI-based translation technologies play a crucial role in ensuring accessibility, inclusivity, and effective communication [3,18]. Real-time AI translation tools facilitate understanding of lectures, practical exercises, and safety terminology, particularly in complex civil protection contexts [17]. Empirical studies show that AI-supported translation increases lesson comprehension by 25–30% and student engagement by 20–25% [16,18].

Impact of AI on Learning Outcomes. The effectiveness of AI integration was assessed through a comparative analysis of academic performance indicators and longitudinal pedagogical observations conducted over three academic years (2023–2026) [4,6]. The results demonstrate a consistent positive trend in learning outcomes following the phased introduction of AI-based educational tools. The quality indicator of students' knowledge increased from 75.0% in the 2023–2024 academic year to 79.8% in 2024–2025, reaching 86.0% in 2025–2026. Additionally, formative assessments revealed improvements in problem-solving accuracy, response speed in simulated emergency scenarios, and overall engagement during practical sessions [12,15]. These findings align with

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international research confirming the pedagogical effectiveness of adaptive learning systems and simulation-based training environments [3,14].

SWOT Analysis of AI Integration in Life Safety Education. A SWOT analysis indicates that the main strengths of AI integration include increased interactivity, personalized learning, and objective assessment [3,6]. Weaknesses involve high infrastructural requirements, limited digital competence among instructors, and the high cost of licensed simulation software [17,19].
Opportunities include training highly qualified specialists, expanding international academic cooperation, increasing Scopus- and Web of Science-indexed publications, and developing hybrid learning models [20]. Potential threats relate to data security risks, excessive reliance on technology, algorithmic bias, and insufficient regulatory frameworks [2,5].

National and Applied Research Context. In recent years, significant attention has been paid to applied aspects of life safety and civil protection education, particularly in the context of technological, environmental, and epidemiological risks. A number of studies conducted in Uzbekistan emphasize the importance of population protection measures in radiation-hazardous areas, emergency planning, and technological safety in industrial processes [21–24]. Research findings highlight that effective emergency preparedness requires not only regulatory knowledge but also practical skills supported by modern digital and simulation technologies [21,23].
Furthermore, studies addressing food safety, water resource protection, and chemical industry risks demonstrate that preventive education plays a crucial role in reducing emergency-related health consequences [22,25]. The integration of modern communication technologies and digital platforms into emergency-rescue operations has been shown to significantly improve coordination efficiency and response time [26]. Recent investigations also confirm the growing role of unmanned aerial vehicles, remote monitoring systems, and digital modeling tools in emergency management and civil protection planning [27,28]. These technologies align conceptually with AI-based educational platforms, as both rely on data-driven decision-making, real-time analysis, and predictive modeling. Therefore, the

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incorporation of artificial intelligence into life safety education can be considered a logical extension of contemporary emergency management practices, ensuring continuity between academic training and real-world professional requirements [21–28].

Conclusion

Artificial intelligence does not replace educators but significantly enhances their pedagogical capabilities [3]. The integration of AI technologies into life safety and civil protection education improves efficiency, interactivity, and personalization of learning processes [6,12].

As a result, students acquire stronger theoretical knowledge and practical skills necessary for effective emergency response and civil protection activities [1,14]. The findings of this study confirm that systematic implementation of AI technologies contributes to improved educational quality and supports the formation of a safer and more resilient society. Future research should focus on developing standardized methodological frameworks and evaluating the long-term outcomes of AI-assisted safety education [10,12].

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