

METHODOLOGICAL FOUNDATIONS OF DESIGNING A SYSTEM FOR THE DEVELOPMENT OF INFORMATION COMPETENCIES BASED ON ARTIFICIAL INTELLIGENCE

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Abstract

This article examines the development of pedagogical methods that, in the wake of advances in ICT (information and communication technologies) and AI, have evolved into a holistic approach that surpasses traditional teaching methods in terms of effectiveness. The aim of the study is to provide a theoretical foundation, develop, and describe the architecture of the innovative learning method CogniSynaps, which is based on the synergy of artificial intelligence systems and immersive environments. The work is based on a systematic analysis of existing AI technologies in the field of education. The study examined the possibilities of adaptive learning, dialogic intelligent systems (AI tutoring), and multimodal pedagogy. The methodological foundation for the development of the new technology is based on the integration of an intelligent adaptive e-learning system (AES) that encompasses diagnostic (KNN algorithms), generative (LLM models), simulative (sandbox environments), and analytical (NLP technologies) and is coupled with extended reality (XR) technologies.

Keywords: CogniSynaps, Adaptive Learning, AI Tutoring, multimodal pedagogy with AI.

Introduction

The relentless progress in information technology is leaving its mark on teaching methods. The use of artificial intelligence (AI) in education is pushing us to look for new ways to take learning to a new, innovative level. It is no secret that methods that were effective 10 years ago may now be less effective, and in some cases may not produce the desired results at all [1,2]. To create technology, we must first consider these innovative methods that should be used in AI-assisted learning.

Методы и методология. Using methods developed with the help of AI allows us to make learning highly personalised.

The first method: Adaptive Learning — adaptive learning that allows you to select individual tasks and the pace of learning in accordance with the student's abilities, based on their mistakes and successes.



The second method: AI Tutoring — learning through dialogue with AI, round-the-clock monitoring of learning with the help of AI. The student identifies a specific problem, which the AI helps to solve, and the skills are reinforced on artificial intelligence (AI) simulators on the given topic [3,6]. The third method: Multimodal pedagogy with AI, which allows you to select the right content for better perception of the material, such as audio, video, or multimedia selections for students.

The second group of methods using AI includes immersive methods that use AI technology to create a sense of presence and practical experience.

The first method: VR and AR (virtual and augmented reality), safe realistic experiments, visits to historical sites, anatomical analysis, which is impossible in real time.

The second method: virtual immersion in scientific concepts, creation of imaginary worlds, complex 3D models for visualising abstract ideas.

Third method: XR— assessment of augmented reality, assessment of practical skills in a simulated environment [4,5].

To ensure the systematic development of skills, an integrated ecosystem based on an Adaptive E-Learning System (AES) is required.

Table 1.

Architecture level	Technologies used	Role in competence development
Diagnostic level	Machine learning algorithms (for example, KNN)	Profiles the user's initial level of digital literacy and tracks the cognitive pace of learning.
Generative level	Large language models (LLM via API)	Dynamically adapts cases, scenarios, and generates instant feedback for gaps in a particular person's knowledge.
Simulation environment	"Sandboxes" for prompting (Sandbox)	A secure environment where users learn to test queries, verify AI facts, and map complex information flows.
The level of analytics	Natural Language Processing (NLP) technologies	Analyzes the semantic quality of the user's promptings and his essay reflections to assess the growth of analytical thinking.

By studying all the subtleties and possibilities of these groups of methods, which were developed on the basis of artificial intelligence, a new modified teaching method was created— CogniSynaps.

The name reflects the essence of learning through the integration of artificial intelligence and adaptive learning with augmented reality. Augmented reality includes both virtual reality and additional reality, which, when intertwined, allow students to develop practical skills in a simulated virtual environment that completely replicates the real world. This allows students to fully express themselves without limiting their cognitive abilities [6].

Results

The new learning technology will enable medical students to reach a new level. The CogniSynaps method allows students to develop the best skills for self-improvement of



knowledge gained both individually and directly in class. This method encompasses the acceleration of processing the huge databases currently available in virtual space, finding new information, and contributing one's own research results.

This method embodies the synergy of cognitive processes (provided by AI) and practical experience (through XR).

Discussion

The results of this study clearly demonstrate that rapid progress in the field of information technology is the main driver of transformation in higher education. At a time when traditional teaching models [1,2] are proving ineffective, higher education faces a complex challenge. This challenge lies not only in the need to modernise curricula, but also in the global trend towards the individualisation of higher education institutions themselves. The modern university can no longer function as a standardised conveyor belt; it is compelled to create a unique educational ecosystem that sets it apart in the market for educational services and research clusters.

The CogniSynaps method we have developed provides an inclusive technological response to this challenge, ensuring synergy between the cognitive potential of AI and immersive environments (XR). It is appropriate to divide the discussion of the practical significance of this technology into three strategic aspects: the AES architecture as a tool for inter-university differentiation, immersive customisation in medical education, and the metacognitive loop and the development of student agency.

The integration of the Intelligent Adaptive System (AES) allows universities to move away from the strict national standards of the "average student" towards the creation of flexible intra-university trajectories. The diagnostic (KNN algorithms) and generative (LLM via API) levels of the proposed architecture enable each specific university to brand and customize the "depth" of adaptability to its profile. For large research universities, the CogniSynaps method makes it possible to accelerate the training of research students by accelerating the processing of large-scale virtual databases. At the same time, regional or specialized universities can adapt the system to equalize the initial level of digital literacy of first-year students, reducing the academic gap. The method is of particular value for the individualization of medical universities, where the cost and accessibility of the clinical base often determine the prestige of the university. Traditional constraints (lack of time, bioethical framework, risks for patients) are offset by the creation of a customized simulation sandbox. Since the CogniSynaps method combines virtual and augmented reality (XR), the medical university gets the opportunity to simulate unique clinical scenarios, simulate rare pathologies and perform highly accurate anatomical analyses that are not available in real time. This allows a particular university to create its own digital atlases and simulation tracks, forming unique competencies among its graduates, which directly increases their competitiveness.

The introduction of an analytical layer based on natural language processing (NLP) technologies shifts the focus from passive information acquisition to the development of critical thinking. Assessment of the semantics of promptings and essay reflections stimulates the student to consciously form his own educational request. In the context of the individualization of higher education, this transforms the role of the teacher: from a translator of knowledge, he



turns into a tutor and navigator of individual educational routes, which corresponds to the transition from mass education to unique mentoring.

Conclusion

In the course of the research, the concept of an intelligent adaptive e-learning system (AES) was theoretically substantiated and practically detailed, which became the basis for the development of the innovative CogniSynaps method. Based on the synthesis of advanced achievements in the field of artificial intelligence and immersive technologies (XR), it was possible to form a qualitatively new educational architecture that meets the urgent needs of high-tech medicine.

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