ARTIFICIAL INTELLIGENCE IN PRIMARY EDUCATION

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Abstract: This article provides a comprehensive analysis of the role of artificial intelligence (AI) technologies in primary education, highlighting their advantages, implementation challenges, future prospects, and possible solutions. It examines the impact of AI on students' learning, teachers' methodological activities, pedagogical processes, and the overall quality and content of education. The discussion also covers technologies such as interactive robot teachers, virtual assistants, adaptive learning platforms, AI-generated learning materials, individualized testing systems, as well as risks arising in digital environments, socio-psychological issues, and preventive measures. The article also explores the current practices and future potential of AI integration within Uzbekistan's educational system.

Keywords: artificial intelligence, primary education, digital technologies, learning process, adaptive learning, virtual assistant, robot teacher, student motivation, differentiated instruction, algorithmic thinking, AR/VR education, algorithmic analysis, AI ethics.

Аннотация: В данной статье всесторонне рассматривается роль технологий искусственного интеллекта (ИИ) в начальном образовании, их преимущества, проблемы внедрения, перспективы развития и пути их решения. Анализируется влияние ИИ на усвоение знаний учащимися, методическую деятельность учителей, педагогические процессы, а также на качество и содержание образования в целом. Также обсуждаются такие технологии, как интерактивные роботы-преподаватели, виртуальные помощники, адаптивные обучающие платформы, учебные материалы, созданные на основе ИИ, индивидуальные системы тестирования, а также возникающие в цифровой среде риски, социально-психологические проблемы и меры их предотвращения. В статье подробно освещаются существующие практики и перспективы внедрения ИИ в образовательную систему Узбекистана.

Ключевые слова: искусственный интеллект, начальное образование, цифровые технологии, учебный процесс, адаптивное обучение, виртуальный помощник, робот-преподаватель, мотивация учащихся, дифференцированное обучение, алгоритмическое мышление, образование с использованием AR/VR, алгоритмический анализ, этика ИИ.

INTRODUCTION

In the last decade, the unprecedented development of information technologies has radically transformed the field of education. In this process, artificial intelligence (AI) technologies are taking a leading role. While AI is widely used in fields such as medicine, transportation, finance, and industry, it is now rapidly being introduced into education. Especially in primary education, these technologies are reshaping the content, methodology, and approaches to teaching. The

content of education at this stage encompasses the development of the child's personality, acquisition of basic skills, growth of logical and algorithmic thinking, and the formation of moral values. Therefore, the application of AI in primary education carries significant scientific and practical importance.

MAIN PART.The essence and fundamental principles of artificial intelligence
Artificial intelligence refers to computer systems that mimic human cognitive functions such as logical analysis, decision-making, learning, speech recognition, and communication. AI operates based on the following core technologies:
• Machine Learning (ML)
• Deep Learning (DL)
• Natural Language Processing (NLP)
• Computer Vision
• Big Data

When used in combination, these technologies create vast opportunities in educational processes. For example, AI can analyze a student's facial expressions to determine emotional states and provide appropriate tasks, or assess vocal tone to detect stress.

2. Types of AI technologies in primary education
a) Adaptive learning platforms
Systems such as Knewton, Smart Sparrow, Century Tech, and Squirrel AI tailor tasks and explanations based on students' responses, ensuring a personalized learning experience.

b) Virtual assistants and dialog systems
Virtual assistants like ChatGPT, Google Assistant, and Amazon Alexa help reinforce knowledge through question-and-answer formats, especially effective in language learning and reading comprehension.

c) Robot teachers
Robots such as NAO and Pepper (Japan) and iRobiQ (Korea) engage directly with students, assigning tasks, listening to responses, and providing feedback. These tools are particularly effective in language and mathematics education.

d) AI-based assessment systems
Modern assessment tools like Gradescope, Quillionz, and Edulastic use AI to quickly analyze student work, identify mistakes, and provide recommendations.

3. The experience of Uzbekistan
Uzbekistan has been actively promoting digital education and AI-based learning tools in recent years. In 2022, the "Digital Education Development Concept" was adopted. Current initiatives include:
• Edu.uz – a platform for online lessons and testing;
• Bilim.uz – offering online classes, tests, and video lectures;
• Digital Education Platform – integrating AI-managed instructional systems.

Some private institutions are piloting AI tutor systems. Teachers are being trained through "Digital Pedagogy" courses. From 2024, subjects such as AI ethics, data security, and technological culture are being gradually introduced into primary school curricula.

4. Advantages of AI in primary education
• Individualized learning: Content tailored to each student's level;
• Increased engagement: Gamified lessons increase student motivation;
• Efficiency: Rapid assessment and feedback systems;
• Reduced teacher workload: Automated analysis and grading;
• Monitoring: Continuous tracking of each student's progress;
• Social competencies: Collaborative problem-solving through AI support

5. Challenges and risks
• Digital inequality: Limited access to technology and internet in rural areas;
• Lack of trained personnel: Many teachers are not ready to work with AI;
• Data security: Risk of misuse of children's personal data;
• Overreliance on artificial interaction: Potential decrease in human communication;
• Excessive trust in AI: Algorithmic errors can negatively impact education.

6. Psycho-pedagogical approaches
The psychological and emotional state of young learners must be continuously monitored. AI systems can detect signs of fatigue, anxiety, or frustration through facial expressions and voice tone, and offer lighter exercises accordingly. This ensures a human-centered yet AI-enhanced learning process.

7. Integration of AI with AR/VR technologies
Combining AI with Augmented Reality (AR) and Virtual Reality (VR) allows students to learn in more immersive environments. For instance, students can explore the human body in 3D during biology lessons or visit ancient cities in virtual history classes.

8. Ethics and legislation
In applying AI in primary education, ethical issues must be considered:
• Respect for the child's personality;
• Data privacy and security;
• Transparency of AI systems;
• Human oversight of AI decisions.

While Uzbekistan's legal framework is still developing, laws such as "Digital Security" and "On Information Technologies" provide a foundation for regulation.

CONCLUSION
Artificial intelligence has the potential to radically reform primary education. It enables individualized learning, eases teacher workload, and aligns educational content with modern requirements. However, this requires investment in infrastructure, teacher training, digital literacy promotion, and strong safety measures. With proper and consistent integration, AI can significantly improve the quality of education in Uzbekistan.

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