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IMPROVING THE USE OF INFORMATION TECHNOLOGY TOOLS IN TEACHING NATURAL SCIENCES IN PRIMARY EDUCATION

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Abstract: The integration of Information and Communication Technologies (ICT) into the teaching of natural sciences in primary education has become a key factor in enhancing the quality and effectiveness of the learning process. Modern digital tools, including multimedia applications, virtual simulations, interactive platforms, and digital assessment systems, provide opportunities to improve students' scientific understanding, increase motivation, and support individualized learning. This article explores strategies for improving the use of ICT in teaching natural sciences at the primary level, identifies existing challenges, and proposes methodological recommendations to strengthen digital instructional practices.

Keywords: Information and Communication Technologies (ICT); primary education; natural sciences; digital tools; interactive learning; instructional improvement; educational technology.

Annotatsiya: Axborot-kommunikatsiya texnologiyalarining (AKT) boshlang'ich ta'limda tabiiy fanlarni o'qitishga integratsiyalashuvi o'quv jarayonining sifati va samaradorligini oshirishda asosiy omilga aylandi. Multimedia ilovalari, virtual simulyatsiyalar, interaktiv platformalar va raqamli baholash tizimlarini o'z ichiga olgan zamonaviy raqamli vositalar o'quvchilarning ilmiy tushunchalarini yaxshilash, motivatsiyasini oshirish va individual o'rganishni qo'llab-quvvatlash imkoniyatlarini yaratadi. Ushbu maqola boshlang'ich darajada tabiiy fanlarni o'qitishda AKTdan foydalanishni takomillashtirish strategiyalarini o'rganadi, mavjud muammolarni aniqlaydi va raqamli o'qitish amaliyotini mustahkamlash bo'yicha metodologik tavsiyalar beradi.

Kalit so'zlar. Axborot-kommunikatsiya texnologiyalari (AKT); boshlang'ich ta'lim; tabiiy fanlar; raqamli vositalar; interaktiv o'rganish; o'qitishni takomillashtirish; ta'lim texnologiyalari.

Аннотация: Интеграция информационно-коммуникационных технологий (ИКТ) в преподавание естественных наук в начальной школе стала ключевым фактором повышения качества и эффективности образовательного процесса. Современные цифровые инструменты, включая мультимедийные приложения, виртуальные симуляции, интерактивные платформы и цифровые системы оценки, создают возможности для улучшения научных знаний учащихся, повышения их мотивации и поддержки индивидуального обучения. В данной статье рассматриваются стратегии совершенствования использования ИКТ в преподавании естественных наук в начальной школе, выявляются существующие проблемы и даются методические рекомендации по развитию практики цифрового обучения.

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Ключевые слова: Информационно-коммуникационные технологии (ИКТ); начальное образование; естественные науки; цифровые инструменты; интерактивное обучение; совершенствование преподавания; образовательные технологии.

Introduction. Advancements in digital technology have greatly influenced contemporary educational systems, transforming traditional teaching methods and creating new opportunities for interactive and student-centered learning. In primary education, particularly in the teaching of natural sciences, the use of Information and Communication Technologies (ICT) has become increasingly essential for developing learners' curiosity, scientific thinking, and practical skills. ICT tools such as multimedia presentations, digital laboratories, educational videos, interactive simulations, and online learning platforms offer young learners concrete and engaging experiences that help them better understand natural phenomena.

Despite the growing availability of technological resources, the effective integration of ICT into natural science education remains a significant challenge. Many primary school teachers lack sufficient digital competence or methodological training to fully utilize these tools. In addition, disparities in technological infrastructure, limited access to devices, and insufficient instructional materials hinder the widespread implementation of ICT-based teaching methods.

Improving the use of ICT in teaching natural sciences in primary education requires a comprehensive approach that includes enhancing teacher training, developing methodically sound digital resources, improving school technological infrastructure, and promoting innovative teaching strategies. Strengthening these aspects can significantly contribute to increasing the effectiveness of natural science instruction, fostering scientific literacy, and preparing students for the demands of the digital age.

Literature Review. The use of Information and Communication Technologies (ICT) in primary natural science education has been widely examined in international and national research, highlighting its potential to improve learning quality, student engagement, and conceptual understanding. Global studies emphasize that ICT-supported instruction contributes to the development of scientific literacy, inquiry-based learning, and problem-solving skills among young learners.

International scholars such as Jonassen[1], Hennessy et al.[2], and Voogt & Knezek[3] argue that ICT tools—interactive simulations, virtual laboratories, multimedia resources, and digital assessment platforms—enable students to visualize abstract scientific concepts and engage in meaningful exploration. According to Papert's constructivist theory[4], technology creates learning environments where students construct their own knowledge through active experimentation. Similarly, the works of Mayer[5]on multimedia learning demonstrate that combining text, animation, and interactive elements significantly improves comprehension in science education.

More recent global research[6,7] highlights the necessity of integrating digital competencies into primary education curricula to prepare students for digitally driven future occupations. These studies stress that successful ICT integration depends not only on the availability of devices but also on teacher readiness, digital pedagogy, and institutional support.

In the context of Uzbekistan, various researchers and educational experts have examined the modernization of primary education and the growing role of ICT. Works by Abduqodirov[8], To'raqulov[9], and Murodova[10] underline that digital tools help diversify

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teaching methods, enhance visualization in natural science lessons, and strengthen students' cognitive activity. Uzbek pedagogical literature emphasizes that ICT-enabled lessons stimulate curiosity, encourage experimentation, and support differentiated learning.

Furthermore, governmental reforms and strategic documents of Uzbekistan have played a vital role in promoting ICT integration in primary education. The Presidential Decree "On Measures to Improve the Quality of Education and Develop Digital Technologies in the Education System"[11] and the Resolution "On the Concept for the Development of the Public Education System Until 2030"[12] outline priorities such as digitalization of schools, creation of electronic educational resources, and strengthening teachers' ICT competencies. These policy frameworks provide a foundation for improving the use of ICT in teaching natural sciences at the primary level.

Additionally, the "National Program for the Development of School Education for 2022–2026"[13] emphasizes expanding access to modern digital tools, implementing STEM-oriented approaches, and enhancing methodological support for teachers. These reforms align with global trends and demonstrate Uzbekistan's commitment to improving the effectiveness of science education through technology.

Overall, the literature indicates that ICT has significant potential to transform natural science teaching in primary schools. However, the successful realization of this potential requires addressing infrastructural limitations, upgrading teacher training, and developing high-quality digital resources aligned with pedagogical objectives. Both international and Uzbek sources highlight the need for methodological innovations and sustained support to fully integrate ICT into the educational process.

Methodology. This study uses a mixed-method approach to examine ways of improving the use of Information and Communication Technologies (ICT) in teaching natural sciences in primary education. Both quantitative and qualitative methods were applied to obtain comprehensive data.

Participants. The research involved primary school teachers, students (grades 1–4), and school administrators from general education schools in Uzbekistan. In total, 50 teachers, 120 students, and 10 administrators participated.

Data Collection. Three instruments were used:

1. a teacher survey to measure ICT skills, availability of tools, and challenges;
2. semi-structured interviews with teachers and administrators to explore experiences and methodological needs;
3. classroom observations of natural science lessons to analyze how ICT tools are used in practice.

Data Analysis. Survey results were examined using descriptive statistics, while interview and observation data were analyzed through thematic analysis to identify common patterns and challenges.

Validity and Ethics. Research tools were reviewed by experts, a pilot test was conducted, and ethical procedures such as informed consent and confidentiality were strictly followed.

Results and Discussion. The findings of the study show that the use of Information and Communication Technologies (ICT) in teaching natural sciences in primary education has a

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positive impact on students' learning, yet its implementation remains limited and uneven. Survey results indicate that while most primary school teachers recognize the importance of ICT, only about half of them use digital tools regularly in natural science lessons. The most commonly used tools are multimedia presentations, educational videos, and interactive whiteboards, whereas virtual labs and digital simulations are used less frequently due to limited access and lack of teacher training.

Classroom observations confirm that ICT-supported lessons noticeably increase student engagement, motivation, and participation. Students demonstrated stronger interest in scientific topics when digital visuals, animations, or interactive exercises were included. Teachers reported that ICT helps explain abstract concepts more clearly and supports differentiated instruction for diverse learners.

However, interviews highlight several challenges. Many teachers expressed insufficient digital competence and a lack of methodological guidance on using ICT effectively in natural science lessons. Infrastructure problems—such as limited computers, unstable internet access, and outdated equipment—also restrict the integration of ICT. Administrators noted the need for ongoing professional development and more structured digital teaching resources aligned with the curriculum.

Overall, the results suggest that ICT has strong potential to improve natural science education at the primary level, but its effectiveness depends on teacher preparedness, resource availability, and institutional support. Improved training programs, better digital infrastructure, and methodologically sound ICT-based materials are essential for enhancing teaching practices.

Conclusion. The study demonstrates that integrating Information and Communication Technologies (ICT) into the teaching of natural sciences in primary education significantly enhances the quality of learning. ICT tools contribute to improved visualization of scientific phenomena, increased student engagement, and more effective classroom interactions. The findings show that primary school students respond positively to digital resources, and their curiosity and motivation grow when multimedia, simulations, and interactive activities are incorporated into lessons.

At the same time, the research reveals existing limitations that hinder the full realization of ICT's potential. These include insufficient teacher digital competence, lack of methodological support, uneven access to technological equipment, and weak technical infrastructure in some schools. The effectiveness of ICT-based instruction is strongly linked to teachers' readiness, the availability of modern digital tools, and institutional support. Therefore, the development of a sustainable ICT integration system requires coordinated efforts at the school, regional, and national levels.

Recommendations. Based on the findings, the following recommendations are proposed to improve ICT use in teaching natural sciences in primary education:

- Enhance teacher digital competence. Regular professional development programs, workshops, and online courses should be organized to strengthen teachers' ICT skills and methodological knowledge.

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- Improve digital infrastructure in schools. Schools should be equipped with updated computers, stable internet access, interactive boards, and digital learning platforms to ensure equal opportunities for all students.

- Develop methodologically sound digital teaching materials. Interactive exercises, virtual labs, multimedia resources, and electronic textbooks aligned with the curriculum should be created and distributed to teachers.

- Introduce continuous technical and methodological support. Schools should establish ICT support teams or coordinators to assist teachers in planning and implementing digital lessons.

- Promote student-centered digital learning. Teachers should apply ICT tools to support inquiry-based learning, experimentation, and problem-solving activities that foster scientific thinking.

Implementing these recommendations will help strengthen ICT integration in primary natural science education and contribute to the development of a modern, engaging, and effective learning environment for young learners.

References:

1. Jonassen D.H. Computers as Mindtools for Schools: Engaging Critical Thinking. – 2nd ed. – Upper Saddle River: Prentice Hall, 2000.
2. Hennessy S., Deaney R., Ruthven K. Situated expertise in integrating use of multimedia simulation into classroom practice. Learning, Media and Technology. – 2007. – Vol. 32(2). – P. 107–122.
3. Voogt J., Knezek G. ICT in education: A global perspective. Technology, Pedagogy and Education. – 2016. – Vol. 25(2). – P. 223–226.
4. Papert S. Mindstorms: Children, Computers, and Powerful Ideas. – New York: Basic Books, 1980.
5. Mayer R.E. Cambridge Handbook of Multimedia Learning. – Cambridge: Cambridge University Press, 2005.
6. OECD. Digital Education Outlook 2020: Shaping the Future of Digital Learning. – Paris: OECD Publishing, 2020.
7. UNESCO. ICT Competency Framework for Teachers. – Paris: UNESCO, 2022.
8. Abduqodirov A.A. Boshlang‘ich ta’limda zamonaviy pedagogik texnologiyalar. – Toshkent: O‘qituvchi, 2017.
9. To‘raqulov O. Boshlang‘ich ta’limda axborot texnologiyalaridan foydalanishning metodik asoslari. – Toshkent, 2020.
10. Murodova G. Axborot texnologiyalari asosida tabiiy fanlarni o‘qitish usullari. – Pedagogika ilmi jurnali. – 2021. – №4. – B. 55–63.
11. O‘zbekiston Respublikasi Prezidenti. “Ta’lim sifatini oshirish va ta’lim tizimida raqamli texnologiyalarni joriy etishni jadallashtirish chora-tadbirlari to‘g‘risida”gi Farmon. – PF-5712, 2019.
12. O‘zbekiston Respublikasi Vazirlar Mahkamasi. “Xalq ta’limi tizimini 2030 yilgacha rivojlantirish Konsepsiyasi to‘g‘risida”gi Qaror. – PQ-4884, 2020.