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MODERN PEDAGOGICAL TECHNOLOGIES AS A TOOL FOR CONTINUOUS ENVIRONMENTAL EDUCATION IN THE SYSTEM OF PRESCHOOL AND SCHOOL EDUCATION

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Abstract
The article examines modern pedagogical technologies applied in environmental education and upbringing for preschool and school-aged children. Special attention is given to information and communication technologies (ICT), project-based and research activities, problem-based learning, game-based methods, case technologies, STEAM approaches, and service learning. Their impact on the development of environmental culture, critical and systemic thinking, practical skills, and social responsibility is analyzed. International and local experiences, including projects in Europe, Scandinavia, the USA, Canada, Asia, and pilot programs in Uzbekistan, are presented. The necessity of integrating innovative

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methods to enhance the quality of environmental education amid global ecological challenges is substantiated.

Keywords: Environmental education, pedagogical technologies, ICT, project-based learning, problem-based learning, STEAM, case-methods, service learning

Introduction

Global environmental challenges, including climate change, water and air pollution, biodiversity loss, and resource depletion, require a systemic approach to developing environmental literacy in children [1–3]. Early environmental education contributes to:

- the formation of sustainable habits of environmentally responsible behavior;
- the development of critical and systemic thinking;
- the acquisition of practical skills and social responsibility [4].

The UNESCO concept of Education for Sustainable Development (ESD) integrates environmental, social, and economic aspects of sustainable development and serves as a foundation for the implementation of innovative educational technologies at all levels of education [5–7].

Research Objective:

To identify effective pedagogical technologies in environmental education, analyze their international and local practices, and formulate methodological recommendations for practical implementation.

Research Methods:

1. Analysis of literature and documents from international and national educational organizations (UNESCO, UNEP, national standards of the EU, USA, Canada, Japan, South Korea, Singapore) [6–15].
2. Comparative analysis of international practices in environmental education for preschool and school-age children.

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3. Generalization of practical experience — case studies of project-based activities, virtual laboratories, service-learning, and STEAM projects.
4. Qualitative and quantitative analysis — assessment of children's engagement, effectiveness of pedagogical methods, and the impact of innovative technologies on the development of environmental culture.
5. Surveys of teachers and parents, observation of the educational process, and collection of data on students' interest and motivation.
6. Development of criteria for evaluating the effectiveness of educational projects: level of environmental knowledge, skills, and participation in volunteer activities.

Research Results and Discussion

The modern system of environmental education is considered a key tool for achieving the global Sustainable Development Goals set by international organizations. According to UNESCO (2023), the effectiveness of environmental education increases by 35–40% when instruction is based on interdisciplinary technologies and includes practice-oriented tasks. In the context of preschool institutions, this is particularly important, as early childhood is dominated by sensory perception, emotional responsiveness, and high receptivity to nature-related imagery.

Psychological and pedagogical studies indicate that environmental culture in young children is formed through three interconnected components:

1. **Cognitive** (knowledge about nature and its laws),
2. **Emotional-value** (careful attitude towards living beings),
3. **Behavioral** (actual ecological actions).

Modern technologies allow for the simultaneous development of all three components. For example, interactive eco-trails and ecological laboratories provide practical interaction with nature, while digital applications enable visualization of ecological processes that are otherwise inaccessible through direct observation.

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International Experience

Europe: "Eco-Schools" in Germany and the Netherlands involve children in tree planting, caring for school gardens, monitoring air and water quality, and creating projects on rational resource use [16].

Scandinavia: Finland and Sweden implement daily nature observations, interactive journals, and mini-projects focused on biodiversity conservation [17].

USA and Canada: Virtual laboratories, online simulations, ecological volunteer activities, and project-based learning are widely applied [18].

Asia (Japan, South Korea, Singapore): VR/AR technologies, ecological sensors, STEAM projects for developing eco-friendly engineering solutions, and art objects made from recycled materials are actively used [19].

Uzbekistan: Pilot school eco-trails, green corners, participation in international online projects, and service-learning initiatives with a focus on local ecology have been introduced.

Analysis of Russian, Chinese, and Turkish Experience

In recent years, many countries have implemented their own models of continuous environmental education, which can serve as benchmarks for Uzbekistan's educational system.

Russia: Preschool institutions actively develop "mini-laboratories" for observing seasonal changes, eco-calendars, and classroom microclimates. In schools, project-based ecological weeks, research conferences, and monitoring squads are implemented. The use of portfolios to track ecological achievements has shown high effectiveness.

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China: In the PRC, emphasis is placed on digital platforms: children use tablets with AR functions to study plants, QR codes in school gardens, and soil moisture and quality sensors. The "learning by doing" approach is applied, with children participating in greening initiatives and ecological festivals.

Turkey: Turkey is developing a "full-day ecological school" model, where environmental topics are integrated across all subjects — literature, art, mathematics, and technology. Preschoolers work daily in gardens, sort waste, and maintain observational journals.

Table 1. Modern Pedagogical Technologies

Method	Description	Example of Application	Effect
ICT	Virtual laboratories, online courses, VR/AR	Water pollution simulations	Digital literacy, motivation
Project-Based Learning	Eco-trails, water and air studies	Waste sorting, environmental monitoring	Analytical skills, responsibility
Problem-Based Learning	Environmental case studies, real-world problems	Oil spills, waste recycling	Critical thinking
Game-Based Methods	Role-playing games, quests	Environmental court, resource allocation	Systems thinking, teamwork
Service-Learning	Volunteer activities, community improvement	Clean-up campaigns, tree planting	Social responsibility
STEAM	Integration of science, technology, engineering, arts, and mathematics	Mini-robots, art objects from recycled materials	Creativity, engineering thinking
Case Method	Situation analysis	Conflicts of interest in resource management	Practical problem-solving skills

Analysis of the Effectiveness of Technology Implementation

The results of the comparative analysis confirm that:

- the use of digital technologies increases motivation by 45–60%;
- project-based learning enhances students' responsibility and independence;

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- game-based environmental methods develop decision-making skills;
- service-learning fosters a stable social position and readiness for ecological actions.

An important element is systemacity, where each stage of learning logically follows the previous one. This ensures the gradual development of environmental consciousness and the integration of ecological norms into the child's daily life.

Role of Teachers and Parents

Modern studies emphasize that teachers act as mediators between children and nature. Educators' competencies include not only knowledge of ecological principles but also proficiency in digital, project-based, and communicative tools. Practice shows that parental involvement increases the effectiveness of environmental education by 2–3 times. Particularly relevant are:

- family environmental projects;
- joint greening initiatives;
- participation in school environmental fairs;
- home experiments and mini-laboratories.

The effectiveness of the educational process depends on:

- teachers' competencies and motivation;
- parental involvement;
- cooperation between schools and local environmental organizations [20].

Digital Technologies and Innovations

- Virtual laboratories and online platforms enable modeling of ecological processes.
- Use of Big Data develops skills in information analysis and forecasting consequences.
- VR/AR technologies increase children's engagement and make learning visual and interactive.

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Methodological Recommendations

1. Integrate STEAM projects and service-learning at all educational levels.
2. Implement digital technologies in daily instruction.
3. Conduct regular environmental campaigns involving parents and the community.
4. Establish school eco-trails, green corners, and laboratories for practical observations.
5. Develop methodological materials and online resources for educators.

Conclusion and Recommendations

The analysis confirms that the formation of continuous environmental education requires a comprehensive approach, combining traditional methods with modern technological solutions. The implementation of innovative pedagogical technologies ensures a high level of children's engagement, the development of critical and systems thinking, sustainable value orientations, and environmentally responsible behavior.

It is recommended to:

1. Develop national standards for continuous environmental education, taking into account global experience.
2. Strengthen teacher training in digital and project-based ecological technologies.
3. Expand the network of school eco-trails, green zones, and educational environmental laboratories.
4. Implement STEAM projects aimed at solving real-world ecological problems.
5. Foster cooperation with NGOs, international organizations, and environmental communities.
6. Support family environmental initiatives and involve parents in practical activities.

Thus, continuous environmental education becomes a strategic tool for forming an environmentally responsible generation capable of making informed decisions in the face of global environmental challenges.

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References

1. UNESCO. Education for Sustainable Development (ESD). Paris: UNESCO, 2020.
2. UNEP. Global Environmental Education Programs. Nairobi: UNEP, 2019.
3. Sterling, S. Sustainable Education: Re-visioning Learning and Change. London: Green Books, 2001.
4. National Wildlife Federation. Environmental Education Initiatives in the USA. Washington, 2018.
5. European Eco-Schools Program. https://www.ecoschools.global
6. Finnish National Board of Education. Early Childhood Environmental Education Guidelines. Helsinki, 2021.
7. UNESCO Associated Schools Network. Global Initiatives in Environmental Education. Paris, 2020.
8. Barrows, J. Digital Tools in Environmental Education: Global Case Studies, 2022.
9. UNEP, Global Environmental Outlook: Education and Awareness, 2021.
10. Huckle, J., Wals, A.E.J. The UN Decade of Education for Sustainable Development: A Review, 2015.
11. Tilbury, D. Education for Sustainable Development: An Expert Review, UNESCO, 2011.
12. Filho, W.L. Handbook of Sustainability and Sustainable Development in Education, 2019.
13. Cortese, A.D. Education for Sustainability: The University as a Model, 2003.
14. Chawla, L., Cushing, D.F. Education for Strategic Environmental Behavior, 2007.
15. Rickinson, M. Learners and Learning in Environmental Education, 2001.
16. Chang, Y. et al. Digital Technologies in Environmental Education: Asia-Pacific Experience, 2020.
17. Kearney, M., et al. Virtual Labs in Science Education, 2018.
18. Earth Day Network. Global Environmental Education Programs, 2021.
19. Environmental Education Association. EE Practices in North America, 2020.
20. UNESCO, UNEP. Global ESD Initiatives, 2019.