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## Innovative technologies of environmental education students in the modern educational space

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**Abstract.** The article substantiates and systematizes innovative pedagogical technologies for the environmental education of primary school pupils in the contemporary educational space. The relevance of the study is driven by the escalation of global and local environmental problems and the need to form environmental culture from an early age. It is argued that primary school is a sensitive period for developing a value-based attitude toward nature, environmental responsibility, and behavior oriented toward sustainable development.

The paper examines the psychological and pedagogical characteristics of environmental education of children aged 6-10 and defines the structure of environmental culture, which includes cognitive, emotional–value-based, and activity-behavioral components. The results of a summative experiment conducted among primary school pupils indicate the predominance of medium and low levels of environmental education across all criteria.

Particular attention is paid to the effectiveness of innovative technologies, including project- and activity-based, research- and inquiry-based, STEM/STEAM-oriented, game-based, digital, nature-oriented, and partnership practices. It is shown that their systematic implementation through interdisciplinary integration, activity-based learning, and partnership pedagogy promotes the development of environmental competence, environmental thinking, and environmentally appropriate behavior in primary school pupils. Prospects for further research are linked to the development of integrated models of environmental education in the context of sustainable development.

**Keywords:** environmental education, environmental culture, primary school pupils, innovative pedagogical technologies, environmental competence, sustainable development.

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## Інноваційні технології екологічного виховання дітей у сучасному освітньому просторі

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**Анотація.** У статті здійснено обґрунтування та систематизацію інноваційних педагогічних технологій екологічного виховання учнів початкової школи в умовах сучасного освітнього простору. Актуальність дослідження зумовлена загостренням глобальних і локальних екологічних проблем, а також необхідністю формування екологічної культури з раннього віку. Доведено, що початкова школа є сенситивним періодом для формування ціннісного ставлення до природи, екологічної відповідальності та поведінки, орієнтованої на сталий розвиток.

У роботі проаналізовано психолого-педагогічні особливості екологічного виховання дітей віком 6-10 років і визначено структуру екологічної культури, яка охоплює когнітивний, емоційно-ціннісний та діяльнісно-поведінковий компоненти. Результати констатувального експерименту, проведеного серед учнів початкової школи, засвідчують переважання середнього та низького рівнів сформованості екологічної вихованості за всіма критеріями.

Особливу увагу приділено аналізу ефективності інноваційних технологій, зокрема проєктно-діяльнісних, дослідницько-пізнавальних, STEM/STEAM-орієнтованих, ігрових, цифрових, природоорієнтованих і партнерських практик. Показано, що їх системне впровадження в умовах міжпредметної інтеграції, діяльнісної спрямованості та педагогіки партнерства сприяє формуванню екологічної компетентності, розвитку екологічного мислення й закріпленню екологічно доцільної поведінки учнів початкової школи. Перспективи подальших досліджень пов'язані з розробленням інтегрованих моделей екологічного виховання в контексті сталого розвитку.

**Ключові слова:** екологічне виховання, екологічна культура, учні початкової школи, інноваційні педагогічні технології, екологічна компетентність, сталий розвиток.

**Introduction.** The current stage of human development is characterized by the intensification of environmental problems that are global in scale while also manifesting at the local level. Environmental pollution, climate change, biodiversity loss, and the depletion of natural resources are increasingly becoming factors that directly affect human quality of life and the sustainable development of society. In this context, the issue of forming an individual's environmental culture becomes particularly relevant. This involves not only possessing knowledge about nature, but also developing conscious, environmentally responsible behavior.

The education system plays a decisive role in this process, as it provides a purposeful influence on the worldview and value orientations of the younger generation. Primary school is a particularly important stage of environmental education, since early school age is a sensitive period for shaping attitudes toward the surrounding world, moral norms, and behavioral habits. During this period, children actively explore their environment, respond emotionally to natural phenomena, and demonstrate a readiness to adopt socially significant models of behavior.

**Analysis of research and publications.** In the National Doctrine for the Development of Education of Ukraine in the 21st Century, the Main Directions of the State Policy of Ukraine in the Field of Environmental Protection, Rational Use of Natural Resources and Environmental Safety, the Concept of Environmental Education in Ukraine, and a number of other regulatory documents [2; 4], it is emphasized that the key outcome of environmental education is the formation of an individual's environmental culture. An individual's environmental culture is manifested in a person's ability and readiness to build interaction with the natural environment in accordance with the objective

laws of nature's development, the cultural traditions of society, moral and ethical values, and one's own life experience.

The issues of the practical implementation of environmental education within school and out-of-school educational processes are reflected in the works of many educational scholars. In particular, these issues have been studied by N. Baiurko, O. Bida, T. Vasiutina, O. Hroshovenko, H. Pustovit, N. Pustovit, I. Stakhova, and others.

Problems of educational innovation in contemporary theory and practice are addressed in the works of prominent modern educators, including L. Vashchenko, N. Havrysh, L. Danylenko, T. Pirozhenko, O. Pometun, and many others.

An analysis of scholarly sources shows that, despite substantial theoretical developments and the availability of methodological recommendations, the problem of effective implementation of environmental education in educational practice remains relevant. Researchers emphasize the need to reorient the educational process from the reproductive acquisition of environmental knowledge toward the formation of value-based attitudes to nature, the development of environmentally appropriate behavior, and personal responsibility for the state of the environment.

At the same time, environmental education practice in primary school often remains fragmented and formalized. Traditional methods, primarily focused on information delivery, do not always ensure the formation of stable environmental beliefs and skills. This creates a need for the introduction of innovative pedagogical technologies capable of integrating the cognitive, emotional-value, and activity-based components of environmental education.

Traditional approaches to environmental education (episodic discussions, isolated «clean-up» campaigns, frontal presentations about nature) often fail to produce lasting effects, as they are mainly oriented toward informing rather than toward experiential engagement, active

participation, and reflection. Meanwhile, the contemporary educational environment is characterized by digitalization, the spread of blended learning, the strengthening of the competence-based approach, interdisciplinary integration, and partnership pedagogy. This opens opportunities for implementing innovative environmental education technologies that can transform «knowledge about nature» into «experience of responsible interaction with nature».

The problem lies in the need to scientifically substantiate, systematize, and describe effective innovative technologies of environmental education for primary school pupils, to determine the pedagogical conditions for their successful application, and to outline criteria for assessing the formation of environmental competence and a culture of behavior. Insufficient attention to the age-specific characteristics of children aged 6-10, the lack of a unified technological «framework» (what to apply, how, and in what sequence), as well as the formal nature of monitoring educational outcomes, necessitate a comprehensive study of this issue.

**The purpose of the article** is to provide a theoretical justification and systematization of innovative technologies for the environmental education of primary school students within the contemporary educational environment, as well as to identify the pedagogical conditions for their effective implementation in primary school.

**Presentation of the main material.** Environmental education in primary school is an integral component of a holistic educational process aimed at shaping a child's environmental culture. It is grounded in the ideas of humanistic pedagogy, the competence-based approach, and the concept of sustainable development, which emphasize harmonious

interaction between humans and the natural environment. During early school age, the foundations of worldview, moral beliefs, and socially significant patterns of behavior are formed; therefore, environmental education is of particular importance at this stage.

The psychological and pedagogical characteristics of children aged 6-10 determine the specific nature of environmental education. Primary school pupils are characterized by emotional responsiveness, visual-imaginal thinking, high cognitive activity, and a strong need for action and direct experience. Children of this age tend to imitate adults and are sensitive to the evaluation of their actions. For this reason, environmental education should rely not only on the transmission of knowledge but also on the formation of positive emotional experiences of interaction with nature.

Within the structure of the environmental culture of primary school pupils, it is appropriate to distinguish three interrelated components: the cognitive component, which encompasses basic knowledge about natural objects and phenomena, relationships within ecosystems, and rules of behavior in the natural environment; the emotional-value component, which reflects the child's attitude toward nature, the ability to empathize with living beings, and awareness of the value of the natural environment; and the behavioral component, which is manifested in practical actions and habits of environmentally appropriate behavior in everyday life.

The formation of these components requires the use of pedagogical approaches that ensure children's active participation in the educational process, stimulate their cognitive activity, and contribute to the consolidation of environmentally responsible patterns of behavior.

Environmental education in primary school should be considered as a systemic process aimed at the formation of:

– ecological concepts and knowledge, including

basic laws of nature and the relationships between humans, nature, and society;

- a value-based attitude toward the environment, including empathy for living beings, responsibility, and readiness to act;

- environmentally appropriate behavior, such as habits of responsible consumption, waste sorting, and careful treatment of plants and animals;

- experience in nature conservation activities, including age-appropriate practices of care, observation, and small-scale projects.

In early school age, visual-imaginal thinking, emotionality, the need for play-based and practical activity, as well as a high tendency toward imitation predominate. Therefore, technologies of environmental education should be based on an activity-based approach, in which the child learns through action; emotional experience and lived engagement, emphasizing not only knowing but also feeling; content integration, incorporating environmental themes into language and literature, mathematics, arts, technology, and information and communication technologies; social partnership, involving the family, community, out-of-school institutions, museums, and environmental centers; and safety and age appropriateness, ensuring tasks are manageable and avoiding both physical harm and the development of eco-anxiety.

The contemporary educational environment also transforms the role of the teacher, shifting it from a transmitter of knowledge to a designer of the educational environment, a facilitator, and a moderator of children's inquiries and projects.

Under these conditions, the teacher's ability to select and implement pedagogical technologies that respond to the challenges of sustainable development, emphasize

interdisciplinarity, practical orientation, and engage learners in active interaction with the natural and social environment becomes particularly significant. It is innovative approaches that create the prerequisites for renewing the content, forms, and methods of environmental education in line with current educational priorities.

Innovative pedagogical technologies in environmental education are understood as holistic systems of methods, forms, and tools of teaching and educational activity aimed at achieving qualitatively new outcomes in the formation of students' environmental culture. Their implementation is associated with a transition from a traditional reproductive model of learning to an activity-oriented one, in which the learner acts as an active subject of cognition and practical activity.

Innovative technologies of environmental education are focused on the formation of environmental competence, which includes the ability to recognize environmental problems, evaluate one's own activities from the standpoint of environmental appropriateness, and make responsible decisions in everyday life.

Innovative technologies of environmental education should be understood as systems of methods, forms, tools, and pedagogical techniques that:

- are oriented toward the formation of competencies and sustainable behavioral practices;

- ensure the active agency of the learner, including choice, participation, and co-creation;

- employ digital and/or interactive tools and modern didactic approaches, such as STEM/STEAM education, project- and inquiry-based learning, blended learning, and similar approaches;

- produce measurable outcomes, supported by defined criteria, indicators, portfolios, and observation.

It is important to note that innovation in primary school is not equated solely with the use of

digital gadgets. Innovative are also those technologies that transform the logic of learning: from explanation to discovery, from isolated episodes to a coherent system, and from learning about nature to acting for nature.

In order to identify the level of environmental awareness among primary school pupils, an experimental study was conducted in Grade 3, involving 32 pupils, at the Vinnytsia Lyceum No. 32 of the Vinnytsia City Council. The assessment was carried out according to defined criteria: the cognitive criterion, which included interest in nature, the level of environmental knowledge and concepts, and the ability to notice and assess environmentally hazardous situations; the emotional and value-based criterion, which encompassed the need for and motivation to interact with the natural environment and the expression of empathy toward living objects; and the activity-based and behavioral criterion, which reflected practical readiness to provide assistance to individual natural objects and the presence of concrete nature-protection actions.

Observation of pupils' activities during the ascertaining stage of the experiment made it possible to identify the main external manifestations of their behavior toward the environment, both in the school setting and during excursions into natural surroundings. An additional research method was conversation, as children of primary school age most fully reveal their inner world in the process of communication, express their attitudes toward the proposed problems, and justify their own views and judgments.

Given the insufficient number of specially designed methods for diagnosing environmental culture, there is a need to apply and adapt tools developed for other purposes. Within the framework of this study, an author-designed methodology was used, which

involved presenting pupils with real-life situations. Each situation contained several possible solutions, allowing pupils to choose a model of behavior ranging from environmentally harmful to actively nature-protective, while indicating the motives that determined their choice.

The levels of environmental awareness of primary school pupils across all criteria were converted into standardized scores: a high level was assessed at 6 points, a sufficient level at 4 points, a medium level at 2 points, and a low level at 0 points. For each pupil, a total standardized score was calculated, which made it possible to quantitatively assess the level of formation of environmental awareness.

Taking into account the essence of the concept of environmental education, its structural components, and specific features, we developed a questionnaire and a special methodology for studying the levels of environmental education among primary school children. This methodology included:

- imaginary situations and tasks aimed at identifying the type of interaction between primary school pupils and the natural environment, as well as assessing their ability to analyze actions and behavior;
- tasks that made it possible to evaluate children's capacity for empathy and appropriate behavior in nature;
- creative tasks that enabled the study of the type of attitude primary school pupils have toward the surrounding natural environment.

The first stage of the experiment was aimed at identifying indicators of the cognitive criterion. Within this stage, pupils' cognitive interest in nature and the level of their knowledge about the natural environment were assessed, including an understanding of relationships within the nature-human system, the necessity and possibilities of environmental preservation, protection, and rational use, as well as the ability to identify

environmentally hazardous situations.

For diagnostic purposes, questionnaire tasks were used, in particular the section «What I Know about Nature», as well as specially designed tasks that made it possible to

determine the level of primary school pupils' knowledge about the natural environment and the importance of its protection and improvement.

The results of the diagnostic assessment of the cognitive criterion are presented in Table 1.

*Table 1*

**Levels of environmental education of primary school pupils according to the cognitive criterion**

Indicators	Levels			
	high	sufficient	medium	low
cognitive interest in nature	6%	18%	27%	49%
level of environmental knowledge and concepts	4%	9%	35%	52%
ability to notice and assess environmentally hazardous situations	5%	8%	36%	51%

The analysis of the results of the first series of tasks within the developed methodology showed that the majority of primary school pupils have limited knowledge about nature. In situations where it is necessary to choose a model of behavior and specific actions, their actions may be ineffective or even harmful to environmental objects, while children often do not realize the potential consequences of their actions.

The second stage of the experiment was aimed at identifying indicators of the emotional and value-based criterion. Pupils were asked to

complete a questionnaire, in particular to respond to the set of questions titled «How I Relate to Nature». The analysis of the obtained data made it possible to conclude that most children form their attitude toward nature mainly from a consumer-oriented perspective. Pragmatism in interaction with the natural environment limits manifestations of real assistance to the environment, hinders awareness of its problems, and prevents the formation of intrinsic motivation for positive and mutually enriching interaction with nature. The results of the diagnostic assessment of the emotional and value-based criterion are presented in Table 2.

*Table 2*

**Levels of environmental education of primary school pupils according to the emotional and value-based criterion**

Indicators	Levels			
	high	sufficient	medium	low
need and motivation for interaction with the natural environment	8%	22%	36%	34%
expression of empathy toward living objects	6%	20%	24%	50%

Based on the results of the conducted study, it can be stated that utilitarian motives in attitudes toward nature prevail among the surveyed primary school children. A certain

decline in the significance of moral, ethical, and aesthetic orientations in interaction with the environment is observed. Children increasingly focus on the practical benefits of nature for humans,

which affects their perception of the surrounding environment and their ability to identify environmentally hazardous situations. As a result, a human-centered position is formed, in which the child increasingly perceives themselves as the sole owner of the environment.

The third stage of the experiment was aimed at identifying indicators of the activity-based and behavioral criterion. Within this

stage, pupils' readiness to provide assistance to individual natural objects and the presence of concrete nature-protection actions among primary school children were examined.

For diagnostic purposes, pupils were asked to complete the questionnaire section «How I Help Nature» and to perform specially designed tasks. The results of the diagnostic assessment of this criterion are presented in Table 3.

*Table 3*

**Levels of environmental education of primary school pupils according to the activity-based and behavioral criterion**

Indicators	Levels			
	high	sufficient	medium	low
practical readiness to provide assistance to individual natural objects	10%	13%	31%	46%
presence of concrete nature-protection actions	5%	10%	32%	53%

The analysis of the research findings indicates that the majority of pupils do not follow rules of appropriate behavior in nature, lack basic orientation skills in their immediate environment, do not demonstrate activity or initiative in interacting with the natural world, and do not possess fundamental skills aimed at providing real assistance to individual natural objects or to nature in general.

At times, children express a desire to help nature; however, due to insufficient knowledge of appropriate actions, their attempts may be

ineffective or even harmful. For example, a child may try to give milk to a pigeon or feed a puppy with sweets, which has a negative impact on the animals' health. In addition, younger schoolchildren generally do not know how to manage waste after spending time outdoors, which indicates a contradiction between the intention to help nature and the actual ability to implement it in practice. The summarized data of the survey conducted across all criteria of the formation of environmental awareness in primary school pupils are presented in Table 4.

*Table 4*

**Overall Assessment of the Criteria for the Formation of Environmental Awareness in Primary School Pupils (%)**

Indicators	Levels			
	high	sufficient	medium	low
cognitive	5%	12%	33%	50%
emotional-value-based	7%	21%	30%	42%
activity-behavioral	8%	11%	31%	50%

The conducted study demonstrated that issues related to the organization of environmental education activities for primary school pupils within the educational process of primary school are addressed insufficiently effectively. The lack of internal motivation for a positive perception of nature, as well as the predominance of utilitarian and pragmatic approaches in interaction with it, contribute to the formation of a consumer-oriented model of behavior. An insufficient number of examples of environmentally appropriate actions in nature available to children leads to an indifferent attitude toward the environment and an orientation toward adult instructions regarding interaction with nature.

The research results allow us to assume that the traditional organization of the educational process in general secondary schools does not ensure an adequate level of environmental awareness. In our opinion, the main reasons for this are:

- the absence of ready-made methodological materials for environmental lessons in natural science;
- formalism in planning environmental education work with primary school pupils;
- reducing children's participation to passive observation of environmental analyze results, and draw conclusions. Importantly, project-based activity contributes to the development of pupils' sense of responsibility for their own actions and awareness of the significance of even small steps in protecting the environment. Examples of topics include: «Eco Duty in the Classroom», «A Second Life for Paper», «A Safe Bird Feeder», «Water without Waste», and «The Green Corner of the Classroom».

Service learning has particular value as an

protection activities carried out by adults;

- the lack of systematic work on forming pupils' environmental culture through cooperation between school and family and through coordination of curricular and extracurricular activities.

The research results indicated the need to apply innovative technologies aimed at fostering environmental awareness in primary school pupils. Environmental education work with children of early primary school age should be carried out using a variety of innovative technologies:

1. Project- and activity-based technologies: eco mini-projects and service learning. Project- and activity-based technologies occupy a leading position within the system of innovative approaches to environmental education of primary school pupils. They involve engaging children in practically meaningful tasks, the outcome of which is a concrete product or a socially useful action.

An eco mini-project in primary school is a short-term (1-3 weeks) or medium-term (1-2 months) activity that results in a practical product and a change in behavioral practices. Eco mini-projects in primary school may address various topics, such as water and energy conservation, waste sorting, plant care, animal protection, and improvement of the school environment. In the process of implementing such projects, children learn to plan their activities, work in group approach that combines educational objectives with activities beneficial to the community. For primary school pupils, it is implemented in a simple format, such as caring for the school grounds, planting vegetation, or collecting recyclable materials with an explanation of where they will be sent and why this is important. The educational effect is strengthened through reflection: «What did we do? What benefit did it bring? How did I feel? What will I do differently next time?»

The advantages of applying these technologies

include the development of pupils' responsibility for the outcomes of joint activities, the acquisition of experience in collective interaction, and an understanding of the practical significance of the knowledge gained. Participation in joint environmentally oriented activities contributes to the development of social skills, increased motivation for learning, and the formation of readiness to apply knowledge in real-life situations.

At the same time, potential risks include the formalization of activities, when project implementation is reduced to performing individual actions for the sake of reporting, without awareness of their environmental content and value-based significance. The conditions for the effective implementation of such technologies include a clear definition of the purpose of the activity, alignment of tasks with pupils' age-related capabilities, ensuring a visible and socially significant outcome, and systematic reflective support aimed at interpreting the experience gained.

2. Research- and inquiry-based technologies: Inquiry-Based Learning and «children's science». Research- and inquiry-based technologies are grounded in the natural curiosity of primary school pupils and are aimed at developing the ability to observe, ask questions, formulate assumptions, and draw the formulation of a problem-based question (for example: «Why do leaves change color?»); pupils' formulation of assumptions regarding possible causes of the phenomenon; conducting observations or a simple experiment; recording the obtained results in forms accessible to children (a drawing, a table, a photo record); and formulating a conclusion and a practical rule aimed at understanding environmentally appropriate behavior (in particular, the need to protect trees and to avoid damaging branches,

elementary conclusions. Learning through inquiry makes it possible to form initial skills of scientific thinking in children and a conscious attitude toward natural phenomena.

In primary school, research activity should be as simple and safe as possible. It may include observations of seasonal changes in nature, plant growth, animal behavior, as well as simple experiments with water, soil, or light. An important element is the recording of results in the form of drawings, diagrams, tables, or short notes, which contributes to the development of reflection and awareness of the experience gained.

Research- and inquiry-based technologies foster primary school pupils' understanding of cause-and-effect relationships between human activity and the state of the environment, which is an important prerequisite for environmentally responsible behavior.

At the primary school age, the use of inquiry-based learning is appropriate, as it is grounded in children's questions, direct observations, and active exploration of the surrounding environment. This approach contributes to the development of pupils' cognitive initiative, the formation of research skills, and the development of elements of scientific thinking that correspond to children's age-related characteristics.

The implementation of inquiry-based learning involves a step-by-step organization of activities, including the emergence of a situation of surprise or etc.).

This sequence of actions ensures a connection between the cognitive and practical components of learning, promotes the formation of a value-based attitude toward nature, and supports awareness of personal responsibility for one's own actions in the natural environment.

The element of «children's science» may be implemented through micro-monitoring activities, such as observing birds near the school, keeping phenological diaries, measuring household water

consumption with parental involvement, or creating mini maps of noise [1] or litter along the «home – school» route. All tools should be adapted to children's capabilities and include simple scales, pictograms, and color coding.

The advantages of applying this approach include the development of pupils' scientific thinking, the formation of their ability to identify cause-and-effect relationships, and an increased level of attentiveness to the state of the environment. In the course of educational activities, primary school pupils gain experience in meaningful observation of natural phenomena, which contributes to a holistic perception of the environment and awareness of the interdependence of natural processes.

At the same time, a key condition for the effective implementation of this approach is a methodologically balanced presentation of educational material that avoids overloading pupils with excessive scientific terminology. Of particular importance is strengthening the emotional-value component of learning and focusing on the practical application of acquired knowledge in everyday activities, which ensures their comprehension and consolidation at the level of environmentally appropriate behavior.

3. STEM/STEAM approaches in environmental education. The STEM/STEAM

are reinforced through positive feedback rather than formal indicators.

Play is the leading learning mechanism for primary school pupils; therefore, environmental content should be presented through role-playing games («Forest Council», «Trial of Waste», «Environmental Patrol»), simulations (for example, how an ecosystem changes if pollinators disappear), quests and station-based activities (searching for «eco-mistakes» in the classroom or at home), and reward systems

approach in primary school opens broad opportunities for integrating environmental content with other educational fields. The inclusion of elements of natural sciences, mathematics, technology, and art makes it possible to address environmental issues in a comprehensive manner and to form a holistic worldview in children.

Within STEM/STEAM activities, primary school pupils may perform tasks related to modeling environmental processes, creating simple constructions, and analyzing resource consumption. The artistic component of STEAM promotes the development of creativity and emotional perception of environmental issues, which is especially important for younger children. Examples of learning cases include: «Energy in Our Classroom», «Clean Water», «A Home for Pollinating Insects», and «A Smart Windowsill Garden».

4. Game-based and gamification technologies. Game-based and gamification technologies are an effective means of environmental education for primary school pupils, as they correspond to their age-related needs and ensure a high level of motivation [3]. Through role-playing games, quests, and simulated environmental situations, children learn rules of behavior in nature and develop the ability to make decisions in the context of modeled environmental problems. Gamification makes it possible to transform environmental education into an engaging activity in which pupils' achievements

focused not on single actions but on behavioral consistency (a week of water saving, waste sorting, reuse).

It is important to avoid excessive «competition», which may demotivate some children. Collective goals («our class reduced paper use») and personal progress («I learned to turn off the lights») tend to be more effective.

5. Digital and nature-oriented technologies in environmental education. The contemporary educational environment is characterized by the

active use of digital technologies, which can effectively complement traditional forms of environmental education. Digital observation journals, virtual excursions, and interactive tasks contribute to increasing pupils' cognitive interest. At the same time, it is essential to combine digital technologies with direct contact with nature. Outdoor learning, ecological trails, and observations in natural settings ensure a deeper emotional impact and promote the formation of a value-based attitude toward the environment.

Digital tools are appropriate not as an end in themselves, but as a means of visualization, observation, and communication. Relevant practices include digital observation diaries (photographs of plants, brief notes, mini reports); virtual excursions to nature reserves and natural history museums; interactive maps of local environmental issues (marking «areas with a lot of litter» or «places where trees grow»); QR routes in the schoolyard, where a code placed near a tree provides brief information and a task; and short micro-videos (30-60 seconds) titled «Eco Tip of the Day», created by pupils with the support of teachers or parents.

For primary school, digital safety, reasonable time limits, and the availability of alternatives are critically important, as not all families have equal technical opportunities. Therefore, digital elements should be supplementary rather than the only means of learning.

6. Outdoor learning technologies: outdoor education and ecological trails. Learning in open-air environments provides a strong educational effect through direct contact with nature. Forms include ecological observation walks (10-20 minutes with a specific task), an ecological trail on the school grounds or in a

nearby park, phenological calendars documenting seasonal changes, and quiet practices (1-2 minutes of «listening to nature» to develop environmental sensitivity).

Success is determined by methodological clarity: a clearly defined goal, route, tasks, recording of observations, and a concluding discussion. Such activities are also effective for children with different learning styles.

7. Partnership-based technologies: family and community eco-practices. A child's environmental behavior is largely shaped within the family; therefore, an innovative condition is the pedagogy of partnership. This includes «Environmental Home Missions» carried out together with families, such as reducing plastic use, reusing items, and saving water; joint «School – Family – Community» events, including tree planting, flowerbed arrangement, and battery collection (where a reliable collection point is available); and engagement of local partners such as eco-centers, libraries, and municipal services through educational meetings.

An important aspect in the implementation of environmental education is adherence to a pedagogical approach that does not shift educational responsibility onto pupils' parents and does not require the completion of materially costly or resource-intensive tasks. The focus of educational activity should be on simple, systematic, and everyday environmental practices that are accessible to the majority of families regardless of their socio-economic conditions.

These practices should be integrated into daily educational interaction with pupils, with an emphasis on shaping environmentally appropriate behavior through repeated actions, awareness of their significance, and gradual consolidation as personal values. Such an approach ensures the sustainability of environmental education outcomes, promotes the development of a

responsible attitude toward the environment, and corresponds to the principles of equal access to quality education.

The effectiveness of innovative environmental education technologies is ensured by the systematic nature of their application (environmental topics should be present throughout the year rather than only on «Earth Day»), interdisciplinary integration (mathematics for calculating resource use, language studies for eco-stories and essays, art for posters, technology for products made from recycled materials, and informatics for digital journals), activity-oriented learning (the child performs feasible actions, sees the result, and can explain it), and partnership-based interaction among school, family, and community (fostering hope and belief in the ability to act rather than fear and helplessness). An important factor is also the teacher's professional readiness to implement innovations and to use formative assessment of environmental education outcomes.

**Conclusions.** Environmental education of primary school pupils in the contemporary educational space requires the purposeful implementation of innovative pedagogical technologies. Their use ensures the formation of environmental culture, a responsible attitude toward nature, and readiness for environmentally appropriate behavior. The systematic combination of project-based, research-oriented, game-based, STEM/STEAM-oriented, digital, and nature-oriented technologies within the framework of

partnership pedagogy contributes to increasing the effectiveness of environmental education in primary school.

It has been established that the introduction of innovative technologies activates the cognitive activity of primary school pupils, promotes the development of their environmental thinking, the formation of value orientations, and practical skills of interaction with the natural environment. Engaging pupils in research and project activities creates conditions for understanding cause-and-effect relationships within the «human-nature» system and for moving from theoretical knowledge to real environmentally appropriate actions.

An important factor in the effectiveness of environmental education is the integration of digital technologies, which expand the educational space, increase pupils' motivation, and provide access to modern forms of environmental information. At the same time, combining digital tools with direct experience of interaction with nature contributes to the formation of an emotional and value-based attitude toward the environment and helps prevent the formalization of environmental education.

Thus, innovative pedagogical technologies act as an effective tool for modernizing environmental education of primary school pupils, ensuring the integrity, practical orientation, and effectiveness of the educational process. Prospects for further research are seen in the development and experimental verification of models of integrated environmental education oriented toward sustainable development and active interaction among school, family, and community.

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