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GLOBAL SCIENTIFIC APPROACHES TO ENSURING ENVIRONMENTAL SUSTAINABILITY AND SECURITY: IMPLICATIONS FOR PRIMARY EDUCATION

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Abstract

The article analyzes the content of contemporary scientific issues related to ecological sustainability and environmental security, and highlights their impact on the primary education process. Methodological approaches, didactic opportunities, and pedagogical conditions for teaching global environmental issues, adapted to the age and psychological characteristics of young learners, are examined on a scientific basis. The importance of early development of environmental literacy for sustainable development is justified.

Keywords: ecological sustainability, environmental security, primary education, environmental literacy, environmental education, global environmental issues.

Introduction

In the twenty-first century, one of the priority directions of scientific development is addressing issues related to environmental sustainability and environmental security. Global warming, the decline of biodiversity, the rapid depletion of natural resources, waste management challenges, and environmental pollution are

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regarded as major obstacles to the sustainable development of humanity. Consequently, international organizations such as UNESCO, OECD, and UNICEF emphasize the formation of environmental culture at an early stage of education as a global strategic objective. This process not only contributes to the development of environmental awareness but also serves to cultivate learners' competencies in responsible decision-making. In this regard, UNESCO views education not merely as a means of knowledge transmission, but as a fundamental strategic tool for achieving sustainable development [1].

Primary education represents a crucial stage for laying the foundation of environmental literacy, as it enables students to comprehend natural phenomena through simple, practical, and real-life examples, thereby fostering a sense of environmental responsibility for the future. In particular, the high level of curiosity, observational ability, and readiness to acquire new knowledge characteristic of children of primary school age create favorable conditions for effective environmental education. From this perspective, direct interaction with nature, experimental activities, ecological games, project-based learning, and small-scale tasks aimed at identifying local environmental problems and proposing solutions within primary school lessons significantly enhance educational effectiveness.

Another essential aspect of environmental education lies in its role in shaping students' behavioral norms and personal attitudes. For instance, the early development of everyday skills such as conserving water and energy, properly sorting waste, and demonstrating careful attitudes toward flora and fauna constitutes a core element of environmental security culture. At the same time, ecological values play a significant role in students' social and emotional development, fostering qualities such as care for nature, responsibility, cooperation, and active engagement in environmental protection.

Contemporary educational practice increasingly emphasizes the integration of environmental knowledge through interdisciplinary approaches. Embedding

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ecological concepts into subjects such as language arts, mathematics, technology, visual arts, and even physical education broadens students' worldviews and promotes the holistic development of environmental awareness. Such an integrative approach equips learners not only with theoretical knowledge but also with the ability to apply ecological thinking to real-life situations.

Overall, the formation of environmental literacy in primary education constitutes a vital pedagogical process aimed at developing future generations' competencies related to environmental security, instilling the principles of sustainable development, and cultivating an active civic position in addressing global environmental challenges.

Research Object and Applied Methods

At the present stage of global development, the issue of living in an environmentally secure environment is becoming increasingly urgent for humanity. The relevance of this problem can be explained by several interrelated factors.

Climate change. Problems such as global warming, the melting of glaciers, rising sea levels, and the increasing frequency of extreme weather events are significantly complicating living conditions for human populations worldwide.

Depletion of natural resources. The reduction and contamination of vital natural resources, including water, forests, and soil, adversely affect human living conditions and may lead to future shortages of food and freshwater.

Environmental pollution. Air, water, and soil pollution exert harmful effects on human health, contribute to the spread of diseases, and disrupt natural ecosystems.

Population density. Global population growth and rapid urban expansion increase pressure on natural resources, intensify environmental pollution, and further exacerbate ecological challenges.

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To address the issue of living in an environmentally secure environment, the implementation of the following measures is essential:

Combating climate change: reducing greenhouse gas emissions, developing alternative and renewable energy sources, and implementing climate change adaptation strategies.

Management of natural resources: conserving natural resources, ensuring their efficient use, and developing recycling and reuse systems.

Environmental protection: preventing environmental pollution, improving waste management practices, and applying environmentally friendly technologies.

Population density management: regulating population growth, improving urban planning, and developing sustainable and eco-friendly transportation systems.

The issue of ensuring an environmentally secure living environment is a global problem that requires solutions at the international level. Addressing this challenge demands coordinated efforts among governments, international organizations, the private sector, and civil society.

Today, global warming, environmental risks, and rapid environmental changes are regarded not only by environmental scientists but also by specialists across various fields as one of the greatest threats to human development. For this reason, the global scientific community increasingly characterizes these processes as a “threat to the collective security of humanity.” The sharp increase in industrial emissions—particularly carbon dioxide (CO_2), methane (CH_4), and nitrogen oxides (N_2O)—has intensified the greenhouse effect and weakened the self-regulation and resilience mechanisms of ecological systems. As a result, phenomena such as the accelerated melting of Arctic ice, ocean acidification, and the rising incidence of forest fires in tropical regions further elevate the level of global environmental risk [2].

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The rapid acceleration of these hazardous processes places new responsibilities on the education system. This is because halting the ecological crisis cannot be achieved solely through technological or political measures; rather, it requires the education of generations endowed with environmental awareness, ecological responsibility, and a culture of sustainable development. In this context, the role of primary education is invaluable. Young learners are capable of understanding the causes and consequences of environmental problems through simple, clear, and life-related examples, while observation of natural phenomena initiates the development of scientific thinking.

Scientific research indicates that environmental values are most sustainably formed between the ages of 6 and 10. During this developmental period, children demonstrate emotional closeness to nature, curiosity, and a sense of care and responsibility. Therefore, presenting concepts of global warming and environmental security in an age-appropriate manner constitutes one of the most effective long-term strategies for sustainable development.

Another important aspect of this process is that comprehensive environmental literacy education in primary grades enables students to develop a scientifically grounded understanding of the "urgency of action." In other words, the notion that the ecological crisis is not a matter of the past or the future, but a pressing issue of the present, becomes embedded in students' thinking through simple yet profound logic. This, in turn, contributes to the formation of mature individuals who are capable of making environmentally responsible decisions and demonstrating a strong sense of ecological accountability in later stages of life.

Results Obtained and Their Analysis

The process of teaching environmental issues to primary school students is associated with a number of pedagogical challenges.

Abstract nature of concepts. Environmental processes are inherently complex; therefore, explaining them to young learners requires simplified, visual, and real-

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life examples. Abstract concepts such as climate change and the greenhouse effect are more effectively understood through hands-on activities and practical experiments.

Limited conditions for observation and experimentation. In many schools, there is a lack of eco-gardens, nature corners, and experimental equipment. As a result, students are deprived of opportunities to observe environmental processes directly, which reduces the effectiveness of experiential learning.

Low level of students' ecological activity. Elementary ecological behaviors—such as waste sorting, water conservation, and tree planting—are not practiced regularly or are not sufficiently understood by students as meaningful actions.

Teachers' methodological preparedness. Innovative approaches to environmental education, including project-based learning, STEAM integration, and nature-oriented research methods, are not yet widely or systematically implemented in primary education.

Scientific studies indicate that ecological thinking in young learners is most effectively developed through practical experience. Examples include demonstrating water filtration processes through simple experiments, maintaining observation journals for plant care, organizing schoolyard clean-up activities, and conducting lessons on separating plastic and organic waste. Such activities contribute not only to the acquisition of knowledge but also to the formation of environmentally responsible behavior.

Environmental projects based on the STEAM approach. International educational research highlights the effectiveness of STEAM integration in environmental education. Examples include projects such as "Solar-powered models," "Models created from recycled materials," "Mini water purification system models," and "Rational use of natural resources." These activities teach students to analyze environmental problems using scientific and technological perspectives while fostering creativity and problem-solving skills.

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Teaching based on local environmental issues. Environmental problems that are close to primary school students' daily experiences—such as pollution around the school area, changes in irrigation water quality, tree cutting, and seasonal changes in nature—are particularly effective as learning contexts. Observing these phenomena, documenting them through photographs, and creating simple problem maps make environmental education more accessible and meaningful for young learners.

Early environmental literacy contributes to increased care toward the surrounding environment, fosters responsibility and civic awareness among students, prepares them to consciously embrace the principles of sustainable development in the future, and helps them understand the interdependence between nature and society.

International studies demonstrate that up to 70% of environmentally responsible behavior is formed between the ages of 7 and 12. Therefore, primary education represents a foundational stage in the development of environmental security culture.

Conclusion

In contemporary scientific discourse, addressing issues related to environmental sustainability and environmental security is recognized as a multifaceted process, with the education system occupying a central role. The early formation of environmental knowledge and skills in primary education—through practical experiences, observations, STEAM-based projects, and instruction grounded in local environmental issues—creates a solid foundation for the development of environmental culture.

Accordingly, adapting primary education curricula to ecological priorities, strengthening teachers' methodological competence, and presenting environmental security culture to children in simple, practical, and age-appropriate forms constitute urgent tasks of modern education.

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