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THE ROLE OF THE STEAM APPROACH IN ORGANIZING ENVIRONMENTAL EDUCATION

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Annotion: This article analyzes the opportunities and significance of the STEAM (Science, Technology, Engineering, Art, Mathematics) approach in the effective organization of environmental education. It highlights methods for developing students' ecological thinking, problem analysis skills, creative thinking, and the ability to find practical solutions through interdisciplinary integration in the educational process. The research findings demonstrate that the STEAM approach plays a crucial role in fostering students' responsible attitudes toward environmental issues and in developing competencies for sustainable development.

Keywords: environmental education, STEAM approach, interdisciplinary integration, creative thinking, sustainable development, competence, practical education.

Currently, one of the most pressing challenges facing humanity is the ecological crisis. Rapid population growth, urbanization, limited natural resources, and accelerated industrial development are negatively affecting the balance of nature. Therefore, increasing environmental literacy and fostering ecological awareness and culture have become key priorities of modern education systems. From this perspective, the introduction of the STEAM approach in environmental education is recognized as an innovative direction in shaping students' ecological thinking. STEAM education integrates scientific, technological, engineering, and artistic approaches to environmental issues, enabling students to develop into creative, critical-thinking, and responsible individuals.

STEAM (Science, Technology, Engineering, Arts, Mathematics) is an interdisciplinary approach in modern education that promotes the development of creative thinking, problem-solving abilities, and practical skills among students. In the education system of Uzbekistan, STEAM is being implemented particularly within the framework of the "Modern School" program and in Presidential schools based on the Cambridge curriculum. Environmental education, in turn, aims to instill environmental protection awareness, teach the principles of sustainable development, and prepare students to address global environmental challenges such as climate change, biodiversity loss, and waste management.

The STEAM approach is essential in organizing environmental education, as it integrates theoretical knowledge with practical projects, encourages active student participation, and unlocks their creative potential. This article provides a detailed discussion of the key aspects, practical examples, methodologies, and recommendations for organizing STEAM-based environmental education in the context of Uzbekistan.

Advantages of the STEAM Approach in Environmental Education

The STEAM approach offers several advantages for the effective organization of environmental education:

Interdisciplinary Integration:

- Environmental issues are studied through the integration of natural sciences (biology, chemistry, physics), mathematics, technology, and art.
- Example: In studying climate change, students develop projects that combine biology (ecosystems), physics (greenhouse gas effect), mathematics (modeling), and art (environmental posters).
- Outcome: Students learn to analyze problems from multiple perspectives.

Practice-Oriented Learning:

- STEAM projects enable students to solve real-world problems, such as creating models from recyclable materials or designing water purification systems.
- Example: Students develop engineering projects focused on recycling plastic waste, incorporating mathematical calculations and technological solutions.

Use of Technological Tools:

- Environmental monitoring and analysis are conducted using sensors, software (such as Python or Arduino), drones, and mobile applications.
- Example: Measuring air quality using sensors and analyzing the data in graphical form.

Role of Creativity and Art:

- Art is used to visually express environmental issues (e.g., creating artworks from waste materials or designing environmental posters).
- This enhances students' emotional engagement with environmental problems and attracts public attention.

Sustainability and Social Responsibility:

- Within the framework of Uzbekistan's "Green Economy" strategy and the Sustainable Development Goals (SDGs) up to 2030, STEAM projects contribute to the development of environmentally friendly technologies.
- Example: Designing small-scale models that utilize solar energy.

Advantage	Example of Advantage	Impact
Interdisciplinary Approach	Studying the water cycle through biology, physics, and art	Deeper understanding of environmental problems
Practical Projects	Creating eco-house models from recyclable materials	Development of creativity and engineering skills
Technological Integration	Environmental monitoring using drones	Technological literacy and data analysis skills
Expression through	Creating artworks from waste	Development of

Advantage	Example of Advantage	Impact
Art	materials	environmental awareness

Here is your text translated into formal academic English for inclusion in a scientific article:

Stages of Organizing Environmental Education Based on the STEAM Approach:

To organize environmental education based on the STEAM approach, the following stages are implemented:

Planning and Programming

Objectives:

- To develop students' skills in understanding environmental problems and finding solutions to them.
- To integrate the principles of sustainable development into the curriculum.
- To enhance students' creative and critical thinking abilities.

Curriculum Structure:

- Preschool Education: Formation of environmental awareness through simple experiments and games (e.g., modeling the water cycle).
- Primary Education: Learning environmental issues through games and artistic activities.
- Secondary Education: Implementation of scientific projects, engineering design, and technological solutions (e.g., waste recycling systems).

Resources:

- Laboratory Equipment: Tools for conducting experiments (pH meters, thermometers).
- Technological Tools: Computers, sensors, and 3D printers.
- Eco-friendly Materials: Recyclable plastic, paper, and wood.

Integration and Methods

The STEAM approach requires the use of various teaching methods:

- Project-Based Learning (PBL):

Students work in groups to develop projects aimed at solving real-world problems.

Example: In the "Reducing Urban Waste" project, students calculate waste volume (mathematics), design recycling systems (engineering), and present results through posters or videos (arts).

- Experiments and Modeling:
  - In preschool education: Demonstrating water purification processes using simple filters.
  - In secondary education: Modeling climate change using programming tools such as Python or Scratch.
- Use of Technology:
  - Measuring air or water quality using sensors and analyzing the data.
  - Monitoring local ecosystems using drones.
  - Analyzing waste management systems through mobile applications.
- Integration of Arts:

- Expressing environmental issues through drawings, animations, or theatrical performances.
- Example: Creating artworks from waste materials or producing video projects on environmental issues.

Implementation and Assessment

Implementation:

- In the Classroom: Students develop environmental projects in groups (e.g., "Renewable Energy Sources" projects).
- Extracurricular Activities: Environmental campaigns such as tree planting, waste collection, and collaboration with local organizations.
- Preschool Level: Establishing playrooms and experimental stations.

Assessment:

- Portfolio: Evaluation based on collected projects, experiments, and creative works.
- Presentations: Group project results are presented at class or school level.
- Tests and Questions: Assessing ecological knowledge and STEAM competencies.
- Experimental Groups: Comparing results of STEAM-based groups with traditional education groups (e.g., level of understanding environmental issues and creativity of solutions).

Practical Examples and Current Situation in Uzbekistan

The integration of STEAM and environmental education is increasingly developing in Uzbekistan:

Presidential Schools:

- STEAM projects are implemented based on the Cambridge curriculum. For example, students design solar panels and create models using recyclable materials.
- Environmental education includes projects on "Sustainable Development," such as tree planting around schools or implementing waste sorting systems.

Government Programs:

- According to the Resolution No. 275 of the Cabinet of Ministers of the Republic of Uzbekistan (May 6, 2020), measures have been adopted to develop environmental education within the public education system.
- Within the "Green Economy" strategy, attention is given to studying environmentally friendly technologies in schools.

Research and Statistics:

- According to 2025 data, students' interest in natural sciences increased by 25–30% in schools where the STEAM approach was implemented.
- Environmental education projects improved students' problem-solving skills by 20% (data from the Ministry of Public Education).

Local Examples:

- In some schools in Tashkent, students are developing small projects on waste recycling, such as producing eco-bags from plastic.
- In a school in Samarkand, students conducted experiments on designing water purification systems using simple filters.

Conclusion.

Organizing environmental education based on the STEAM approach is one of the key reforms in Uzbekistan's education system. This approach not only fosters environmental awareness

among students but also develops them into creative, critical-thinking individuals capable of solving problems. Government programs, particularly the “Modern School” initiative and the “Green Economy” strategy, support this process. Through the integration of practical projects, technological tools, and arts, students are prepared to address global environmental challenges. Thus, STEAM-based environmental education serves as an effective tool for developing ecological thinking, technological literacy, and social responsibility among students.

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