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DIDACTIC POTENTIAL OF OUTDOOR EDUCATION TECHNOLOGY IN GENERATING STUDENTS' ECOLOGICAL KNOWLEDGE

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Abstract
This article examines the nature and stages of generating students' ecological knowledge and the didactic potential of Outdoor Education in environmental education. Ecological knowledge generation is considered a sequential process involving knowledge acquisition, practical application, critical evaluation, the development of innovative solutions, analysis, and application in everyday life. It is argued that observations and field-based learning in natural environments help connect theoretical knowledge with real-world ecological conditions. Drawing on the practical observations described in the source material, the article discusses the potential benefits and organizational limitations of this approach. As no quantitative experimental findings are presented, the conclusions are descriptive in nature.

Keywords: Ecological knowledge, knowledge generation, environmental education, Outdoor Education, field-based learning, critical thinking, ecological culture, practical observation.

Introduction

At the present stage of development, the rational use of natural resources, environmental protection, and the maintenance of balance between humans and nature have become pressing global concerns. Climate change, biodiversity loss, and intensifying environmental challenges underscore the need to improve ecological culture and strengthen educational systems. Higher education institutions have a particularly important role in this regard, as today's students will shape the future and therefore need to develop the requisite ecological knowledge and skills.

In the twenty-first century, changes across all spheres of social development have profoundly affected human–nature relationships. Population growth, industrialization, urbanization, and technological progress have disrupted natural balances, contributing to global warming, ozone-layer depletion, increasing waste generation, water and soil pollution, and the decline of biological species. An important factor in addressing these challenges is the ecological thinking, culture, and knowledge of the younger generation, particularly university students. Consequently, modernizing the content of environmental education and integrating knowledge delivery with contemporary educational technologies constitute urgent scientific and practical tasks.

Environmental education is closely associated with understanding the interrelationships among nature, society, and human beings, assessing the effects of human activities on the natural environment, and developing environmental responsibility. Ecological knowledge encompasses ecological-biological, biospheric, and socioeconomic relationships. Accordingly, higher education should move beyond the transmission of ready-made information and enable

students to analyze knowledge independently, apply it in unfamiliar situations, and connect it with practical decision-making.

M. Guerra Mota interprets the development of ecological knowledge as a process oriented toward the rational use of natural resources, analysis of the environmental consequences of human activities, and understanding the principles of sustainable development. S. A. Zhaukina emphasizes the responsibility associated with this process toward nature, society, and future generations. A. Kaasinen highlights an informed approach to understanding and addressing environmental problems. M. Kesler points to the interrelationship among ecological knowledge, environmental action, and attitudes toward nature conservation. Taken together, these perspectives indicate the need to consider the cognitive, practical, and value-based dimensions of environmental education in an integrated manner.

The aim of this article is to systematize the stages of generating students' ecological knowledge and elucidate the didactic potential of Outdoor Education in this process, based on the theoretical perspectives and practical observations described in the source material.

Research Materials and Methodological Approach

The article was prepared through a comparative analysis of the scientific and pedagogical perspectives presented in the source material, the systematization of stages of ecological knowledge generation, and the synthesis of descriptive observations concerning field-based learning. The source does not specify the number of experimental participants, control and experimental groups, measurement instruments, or statistical findings. Therefore, this work is presented as a theoretical and methodological analysis rather than as a study providing statistical evidence of empirical effectiveness.

Results and Discussion

Ecological knowledge is understood as a systematic body of empirically and theoretically grounded knowledge concerning natural processes in the biosphere; the composition, structure, and functions of ecosystems; and their interactions with human activities. Ecological knowledge generation, in turn, refers to the active processing, updating, and application of existing knowledge in new environmental situations. This entails not only recalling previously acquired information but also evaluating problems and developing solutions.

The framework presented in the source material identifies the following six stages of ecological knowledge generation:

1. Knowledge acquisition and comprehension. Students acquire fundamental concepts relating to ecology, natural resources, climate change, and environmental problems, and develop an understanding of terms such as the biosphere, ecological balance, and sustainable development.
2. Development of practice-based knowledge. Acquired knowledge is applied to everyday situations and practical activities, thereby fostering environmental literacy and an understanding of the consequences of environmental impacts.
3. Critical thinking and ecological assessment. Students analyze environmental situations from different perspectives, exchange views through case discussions, and propose alternative solutions to environmental problems.

4. Knowledge generation through creative and innovative approaches. Innovative and technological approaches are used to develop project ideas concerning environmental safety and sustainable development, while their feasibility is examined.
5. Knowledge analysis and renewal. Environmental conditions and changes are assessed, and new models and forecasts are proposed concerning the use of natural resources.
6. Application of ecological knowledge in everyday life. Students seek ways to apply their acquired knowledge and skills in real-life situations, evaluate outcomes, and improve practical activities.

This sequence of stages represents a progression from knowledge acquisition to independent environmental action. The stages are mutually reinforcing: for example, a single field observation may simultaneously stimulate comprehension, assessment, and practical application. In the source material, the framework is presented as Figure 1.1.

Didactic Potential of Outdoor Education Technology

Outdoor Education involves organizing learning activities outside the classroom—in gardens, forests, riverbanks, or other natural settings. Its defining feature is the opportunity to observe ecological phenomena directly, collect and analyze data, and compare observations with theoretical knowledge. As noted in the source material, following a field session, students compared theoretical concepts studied in the classroom with phenomena observed along a riverbank and independently identified certain discrepancies. Although this observation suggests a potential advantage of the method, systematic comparative research is required to demonstrate its superiority over other approaches.

The described didactic characteristics of this approach can be grouped into four dimensions: practical engagement (observation, data collection, and analysis); experiential learning (testing theoretical knowledge in real environments); group work (collaboration and communication); and connection with the environment (developing responsible attitudes toward nature).

The source identifies several forms of implementation: nature observation (observing plant and animal species and recording biodiversity); waste sorting (identifying and classifying waste in the environment); agricultural studies (examining agroecology, soil conditions, and irrigation systems); investigations of water sources (studying water quality, pollution levels, and biological indicators); and environmental monitoring (measuring parameters such as temperature, humidity, and air cleanliness).

Outdoor Education can be adapted to all stages of ecological knowledge generation. Field observations clarify fundamental concepts; data collection reinforces practical skills; explaining observed differences promotes critical thinking; proposing environmental projects stimulates creativity; and evaluating results and applying them to everyday decisions increases the practical value of knowledge.

Transportation and safety may constitute significant organizational constraints when arranging activities in natural environments. The observations presented in the source indicate that these issues were addressed through cooperation with the university administration. Classroom videos and simulations may offer organizational convenience, whereas direct field experience

enables students to observe changing ecological conditions. The two approaches may therefore be combined in a complementary manner.

Table 1. Stages of Ecological Knowledge Generation

Stage	Core content	Expected learning activity
Knowledge acquisition and comprehension	Ecological terminology, the biosphere, ecological balance	Explaining concepts
Practice-based knowledge	Connecting theory with practical situations	Observation and application
Critical thinking and ecological assessment	Analyzing environmental problems from multiple perspectives	Case discussion
Creative and innovative approaches	Proposing new projects and solutions	Project development
Knowledge analysis and renewal	Assessing environmental conditions and changes	Data interpretation
Application in everyday life	Applying ecological knowledge to real activities	Responsible practical decision-making

Table 2. Didactic Characteristics of Outdoor Education Technology

Characteristic	Description
Practical engagement	Observing nature, collecting data, and conducting analysis
Experiential learning	Connecting theoretical knowledge with direct experience
Group work	Activities based on collaboration and communication
Connection with the environment	Developing respect for and responsibility toward nature

Table 3. Forms of Outdoor Education Activities

Activity type	Practical example
Nature observation	Observing plant and animal species and recording biodiversity
Waste sorting	Identifying and classifying waste in the environment
Agricultural studies	Studying agroecology, soil conditions, and irrigation systems
Investigations of water sources	Studying water quality, pollution levels, and biological indicators
Environmental monitoring	Measuring parameters such as temperature, humidity, and air cleanliness

Conclusion

Generating students' ecological knowledge is an interconnected process encompassing theoretical knowledge acquisition, practical engagement, critical evaluation, the development of innovative solutions, and application in everyday life. The proposed six-stage approach may serve as a methodological framework for structuring environmental education systematically. Outdoor Education offers opportunities to connect theory with practice through the study of living organisms, biotic and abiotic factors, and ecosystem relationships under real-world conditions. To assess the effects of this approach on learning outcomes reliably, future studies should clearly specify the sample, diagnostic criteria, control group, and results of statistical analyses.

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