



METHODOLOGY FOR TEACHING THE COURSE “FUNDAMENTALS OF ECOLOGY” UNDER CONDITIONS OF INTERDISCIPLINARY INTEGRATION BASED ON INTERNATIONAL ASSESSMENT TASKS

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<https://doi.org/10.5281/zenodo.18280510>

Abstract

The article examines issues related to organizing the teaching of the course “Fundamentals of Ecology” in higher education institutions under conditions of interdisciplinary integration, using tasks applied in international assessment studies (PISA-type tasks). The content, structure, and practical effectiveness of a methodological system based on integrating ecology with biology, chemistry, geography, and the social sciences are described. The results of the experimental study demonstrated positive changes in students’ natural science literacy, their ecological thinking, and competencies in analyzing problem situations and making decisions.

Keywords: environmental education, interdisciplinary integration, international assessment tasks, natural science literacy, PISA-type tasks, competency-based approach.

Introduction

In the global educational context, international assessment studies play an important role in evaluating the quality and effectiveness of education. A particularly relevant task of environmental education is to develop students’ natural science literacy and prepare them to analyze and address real environmental problems. This process requires a transition from fragmented subject-based knowledge to an integrated system of knowledge formed through interdisciplinary integration. From this perspective, ensuring interdisciplinary integration in teaching the course “Fundamentals of Ecology” based on international assessment tasks constitutes an актуал scientific and pedagogical problem.

Research methodology

The methodology of this study is aimed at providing a scientific justification for a methodological system focused on developing students’ natural science literacy by using tasks from international assessment studies (PISA-type) in teaching the course “Fundamentals of Ecology” under conditions of interdisciplinary integration [1].





The methodology relies on modern pedagogical theories, the competency-based approach, the concept of interdisciplinary integration, and the principles of activity-oriented learning.

1. Methodological Approaches

1. Competency-Based Approach

The competency-based approach defines learning outcomes not as a set of students' knowledge, skills, and abilities, but as their capacity to apply acquired knowledge when solving real environmental problems [2].

Example: For the topic "Pollution of Water Resources" within the course "Fundamentals of Ecology," an interdisciplinary PISA-format task was developed. The task content included:

- from chemistry: the impact of nitrates and phosphates in water;
- from geography: the location of the water body and flow characteristics;
- from biology: effects on aquatic organisms;
- from ecology: the development of sustainable solutions.

Based on the provided data, students analyzed pollution sources and made scientifically grounded decisions. During task completion, competencies in analysis, interpretation, and decision-making were formed [3].

2. Interdisciplinary Integration Approach

Interdisciplinary integration ensures the acquisition of knowledge as a holistic system by aligning the content of ecology with the natural and social sciences.

Example: For the topic "Atmospheric Pollution," students were offered a complex PISA-type task integrating:

- chemistry: the composition of SO_2 and NO_x gases;
- geography: wind directions and relief;
- biology: impacts on human health;
- economics: the economic consequences of environmental damage.

3. Activity-Oriented Approach

This approach aims to form students not as consumers of knowledge, but as subjects of research and problem-solving activities [4].

- Example:* For the topic "Solid Household Waste," students:
- collected data on a local waste problem;
 - analyzed the composition of waste (chemistry);
 - assessed recycling opportunities (ecology and economics);
 - developed a project proposal.



This process contributed to the development of students' research, project, and creative skills [5].

2. Research Methods

1. Theoretical Analysis Method

National and international sources on environmental education, interdisciplinary integration, natural science literacy, and international assessment studies were analyzed.

Example: Components of the PISA natural science literacy model, such as: application of scientific concepts; evidence-based reasoning; drawing conclusions, were adapted to the content of the discipline "Ecology."

2. Observation Method

Within the educational process, the following were systematically observed: the level of students' use of interdisciplinary information; students' activity in solving tasks; students' ability to make independent decisions [6].

3. Questionnaire and Testing Methods

Diagnostic tools were developed to determine students' levels of natural science literacy.

Sample questions: "Can you use knowledge from chemistry and biology when solving environmental problems?"

"Did interdisciplinary information help you understand the problem better?"

4. Pedagogical Experiment Method

The experimental study was conducted in three stages:

diagnostic stage: determining the initial level of students' natural science literacy;

formative stage: organizing instruction based on interdisciplinary integrated international assessment tasks;

control stage: analyzing results and assessing dynamics.

5. Statistical Analysis Method

The obtained results were processed using mathematical and statistical methods [7].

Example: The results of the experimental and control groups were compared using mean indicators, and the growth dynamics of natural science literacy were determined.

3. Organization of the Methodological System

The developed methodological system included the following components:



Content component: environmental topics integrated on an interdisciplinary basis;

Activity component: analytical and problem-solving PISA-type tasks;

Assessment component: competency-oriented rubrics, tests, and portfolios.

Example: On the topic “Climate Change,” students:

analyzed scientific data;

compared geographic and environmental factors;

proposed solutions in the context of sustainable development.

Content and Structure of the Methodological System [8].

The methodological system included the following main components:

Content component: learning materials based on real-life contexts typical of international assessment studies and covering environmental problems;

Interdisciplinary integration component: alignment of ecology content with biology (ecosystems), chemistry (pollutants), and geography (physical-geographical factors);

Activity component: practical activities organized through analytical, research-based, and problem-solving PISA-type tasks;

Assessment and diagnostic component: a system of indicators and rubrics for assessing students’ natural science literacy.

Research results

The experimental study was conducted with the participation of students from higher education institutions. Interdisciplinary integrated international assessment tasks aimed at solving environmental problems were used in the instructional process. As a result, the following positive changes were recorded:

increased ability of students to apply natural science concepts on an interdisciplinary basis;

development of skills in analyzing environmental problems and generating solutions;

formation of competencies in independent thinking and decision-making.

The results of the statistical analysis confirmed that natural science literacy indicators in the experimental group were higher compared to those in the control group [9].

Discussion

The obtained results showed that the teaching methodology based on interdisciplinary integration and international assessment tasks strengthens the practice-oriented and competency-based focus of environmental education. This



approach increases students' ability to apply knowledge in real-life situations and meets the requirements of international educational standards [10].

Conclusion

Thus, the methodology for teaching the course "Fundamentals of Ecology" under conditions of interdisciplinary integration based on international assessment tasks ensures high effectiveness in developing students' natural science literacy. This methodology has significant scientific and practical value for improving environmental education in higher education institutions and aligning it with international requirements.

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