Cross-subject integration of biology and ecology in course work

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Abstract. The aggravation of the ecological situation on a global scale has led to the need for greening all areas, i.e. to the need to take into account the laws and requirements of ecology - in all sciences, production and in all human activities. However, ecology as a subject does not exist in the modern Russian school. The interdisciplinary optional course "Omsk Region - My Native Land" helps the children to broaden their horizons and gain knowledge about their region, about basic environmental concepts and patterns. The developed elective is an integrated course that incorporates the foundations of various disciplines of the natural science cycle. The purpose of the optional course is to motivate schoolchildren to acquire new knowledge in the field of ecology, biology and geography based on regional content, to stimulate and organize educational and research activities; to form ecological thinking and ecological culture among students of the basic school. Increasing the level of ecological culture of students in the process of formation of systemic natural science knowledge and familiarization with educational and research activities.

1 Introduction

The aggravation of the problem of the survival of mankind in harmony with the environment in the first quarter of the 21st century actualizes knowledge about the surrounding world and the human, the relationship between civilization and the surrounding nature. The need to prevent in our time many contradictions (environmental problems, crises, catastrophes) that are developing in the "humanity - Nature" system has led to the realization and, as a result, the proposal to modernize the fundamental goal of the education system. A worldview based on systematic and solid environmental knowledge is the foundation of a new ideology. The continuous process of forming a worldview is carried out in accordance with the main stages of ontogeny, often meeting the requirements of the individual at each stage of his development. Laying the foundations of a worldview in a young organism coincides with the process of maturation of schoolchildren.

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The basis of such a worldview should be systemic natural science knowledge that underlies values and behavior. Actual is the formation in adolescents of the foundations of a worldview based on biological and environmental knowledge, skills and abilities. Therefore, at the present stage of development of the Russian education system, it is so important to turn to the complex (systemic) discipline of ecology on the basis of its interdisciplinary integration with the disciplines of the natural science cycle, in particular, with biology. The issues of integration, which became widespread in the postclassical period of the development of science, have not lost their significance at the present time. Considering questions about the complex system of relationships between the human body and the environment, increased attention should be paid to the biological discipline. Hence the need to teach ecology on the basis of interdisciplinary integration with biology goes on. In the post-nonclassical period, the development of science is of great importance for the integration of various disciplines. Biology is an integrative discipline, it is associated with ecology, geography, physics, chemistry, computer science and other sciences [1,2].

Interdisciplinary connections are considered as a didactic system that reflects objectively existing relationships in school courses, provides through coordinated interaction of its educational components, carrying out a purposeful process of teaching students.

From the point of view of V.N. Maksimova and N.V. Gruzdeva "... intersubjectivity is a modern principle of education that affects the selection and structure of educational material in a number of subjects, strengthening the systemic knowledge of students, activates teaching methods, focuses on the use of complex forms of organization of education, ensuring the unity of the educational process. Interdisciplinary connections should naturally be included in the presentation of the educational material, not duplicating, but developing the basic knowledge of the students" [3].

In recent years, special attention has been paid to the relationship between living organisms and objects of inanimate nature. "The task of biological education at school is to form a natural-science picture of the world, to familiarize schoolchildren with the basic principles of the dialectical-materialistic methodology of cognition of living systems (systematic, historicism, integration, causality, etc.)" [3].

Pedagogical integration is a structural, expediently organized connection of the same type of parts and elements of content, forms and methods of teaching within the framework of the educational system, leading to self-development of students.

As applied in the system of education, the concept of "integration" can take several meanings:

Firstly, this is the creation of a holistic view of the world around the student (here integration is considered as the goal of learning). The result of such integration is that the student receives the knowledge that reflects the connectedness of individual parts of the world as a system in which all elements are connected.

Secondly, this is finding a common platform for convergence of subject knowledge (here, integration is a learning tool). At the junction of already existing traditional subject knowledge, students receive more and more new ideas about the phenomena of the world around them, systematically supplementing them and expanding them (moving in positions in a spiral).

Thirdly, integration as a result is the development of students. Integration in learning is characterized by the dialectical nature of the modern scientific style of thinking. In the early stages of students' cognition of the surrounding world through naturalistic observations, the observation of the object under study does not remain an isolated element. For students, the observation of the object being studied does not remain an isolated element. The student in the course of performing logical mental operations (comparisons, generalizations, classifications, etc.) thinks this object in an equilateral sphere of representations and concepts that are updated due to the versatile perception of this subject. Establishing links between

various forms of thought processes and objective action ensures the integrity of students' activities, its consistency [6].

Scientific research in the field of psychology and pedagogy makes it possible to assert that education based on the ideas of integration is not only possible, but also reasonably necessary for school age.

Thus, integration is not a simple union of parts into a whole, but a system that leads to quantitative and qualitative changes, reflecting different levels of personality development. it must have different levels. The process of forming the ecological culture of adolescents will be effective if one of the main pedagogical conditions is observed - the implementation of interdisciplinary integration of natural science disciplines, which contributes to the formation of scientific and cognitive relations, the establishment of holistic normative orientations of the adolescent in the environment, the development of practical skills to protect and improve the natural environment.

The intersubjectivity of environmental education involves the coordination of various aspects of obtaining environmental knowledge of human interaction with the environment, and not as a mechanical inclusion of environmental knowledge in the content of school subjects, but as a logical subordination of this content of knowledge to the main goal of environmental education - the upbringing of an environmentally literate person.

Integration as a process and result of combining knowledge, methods of cognition and activity contributes to a holistic perception of the surrounding world, awareness of the role and place of a person in the worldview system and the nature of his activity in the socio-natural environment. The interdisciplinary approach in the environmental education of adolescents is a variant of pedagogical modification and practical implementation of the ideas of a systematic approach.

Thus, in pedagogical science and practice, there is a need to overcome the contradiction between:

- pedagogically conditioned need to use interdisciplinary connections in teaching biology and ecology in a general education institution and insufficient use for the development of environmental culture and environmental thinking of schoolchildren in extracurricular work;

The identified contradictions determined the relevance of the research problem, which consists in answering the question: how is it possible to carry out interdisciplinary integration of biology and ecology, as well as to implement regional content in extracurricular work in biology, in an expedient and effective way?

The purpose of the study: to increase the effectiveness of the educational process in biology through the implementation of interdisciplinary connections of natural science disciplines on the example of biology and ecology in extracurricular work.

Object of study: the educational process in ecology in extracurricular work.

Subject of study: implementation of interdisciplinary integration of biology and ecology in an optional course with regional content.

Research hypothesis: it is possible to increase the level of formation of biological literacy and environmental culture among secondary school students if:

– carry out extracurricular work in accordance with the requirements of the Federal State Educational Standard of the new edition;

–to implement interdisciplinary connections of biology with other natural science disciplines in extracurricular work;

– to develop an integrative optional course with regional content for the basic school;

– to introduce this optional course into the educational process of a general educational organization.

Research objectives:

1. On the basis of a theoretical analysis of pedagogical and methodological literature, to clarify the concepts of "interdisciplinary connections", "integration" (on the example of

biology and ecology) and to determine the significance of integrative processes in the biological and, in general, natural science education of schoolchildren.

2. To develop an integrated optional course with regional content "Omsk region - my native land" for extracurricular work with students of the 7th grade.

3. To check in experimental work the success of using an integrated optional course with regional content in extracurricular activities.

The methodological basis of the research is integration processes in the natural sciences (M.S. Asimov, B.M. Kedrov, A. Tursunov, P.N. Fedoseev, M.G. Chepikov, P.Ya. Galperin, A.N. Leontiev, N.F. Talyzina); associative-reflex nature of mental activity (E.N. Kabanov - Miller, N.A. Menchinskaya, Yu.A. Samarin); scientific works on pedagogy (O.G. Gilyazova, I.P. Yakovlev, N.S. Serdyukova, G.A. Monakhova, V.K. Sidorenko, V.S. Bezrukova); study of the role of interdisciplinary integration in environmental education (I.D. Zverev, A.N. Zakhlebny, A.V. Teremov, G.T. Suravegina, V.N. Maksimova).

So, extracurricular work has great potential for establishing interdisciplinary integrative links between the disciplines of biology and ecology. In this regard, we have proposed the development of an elective course of integrated content with the implementation of the regional component [5].

2 Materials and methods

To achieve the goal and solve the tasks set, the following research methods were used:

- theoretical (analysis, comparison, generalization, design);
- empirical (observation, conversation, testing, questioning, pedagogical experiment);
- statistical (methods of mathematical analysis of the results of the pedagogical experiment).

3 Results and discussion

The experimental-transformative stage of the study included an experimental-experimental verification of the developed inter-subject optional course with regional content, used in extracurricular activities of students of the main school. The study was conducted in 7 classes, where the program of the optional course was implemented. Experimental training was carried out in extracurricular activities in optional classes. When conducting the optional course "Omsk Region - My Native Land", students' knowledge of their native land is deepened and systematized.

The teacher pays special attention to the study of plants and animals listed in the Red Book of the Omsk region. Conducting excursions into nature, organizing environmental events, making booklets, discussions, engaging in design and research work, using ICT (mobile technologies, augmented and virtual reality) allow students to consolidate the studied material in practice [4].

We used the following methods for diagnosis. A test was conducted on the level of ecological and biological knowledge of schoolchildren. Methods of psychological monitoring of the level of development of universal learning activities among students in grades 5-9 were also used for diagnostics. At the ascertaining stage, diagnostic methods were used.

1. Methodology for diagnosing motivation for learning and emotional attitude to learning (modified by A.D. Andreev).
2. Test "Ecological culture of students and students" (Asafova E.V.).
3. Test "Do you know your region - the Omsk region?" (Oparin R. V) [7].
4. My attitude to nature (Methodology of S. Glazychev).

To determine the action of meaning formation, aimed at establishing the meaning of the student's educational activity, a special questionnaire is used. The results of diagnosing the motivation for learning and the emotional attitude to learning at the ascertaining stage are shown in Figure 1.

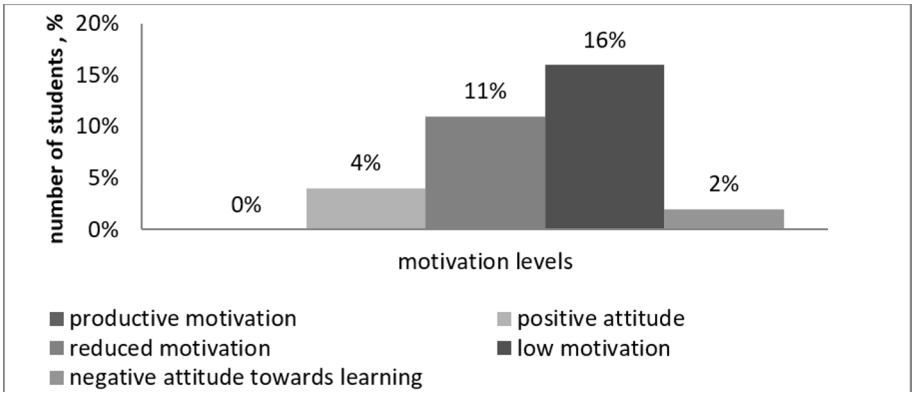

Fig. 1. Diagnosis of learning motivation and emotional attitude to learning.

The levels of learning motivation and their characteristics, following from the questionnaire, are presented in Table 1.

Table 1. Characteristics of learning motivation levels.

Level of motivation	Characteristics of the level
Level 1	Productive motivation with a pronounced predominance of cognitive motivation for learning and a positive emotional attitude towards it
Level 2	Productive motivation, positive attitude to learning, compliance with social standards
Level 3	Intermediate level with slightly reduced cognitive motivation
Level 4	Decreased motivation, experience of "school boredom", negative emotional attitude to learning
Level 5	Strongly negative attitude towards learning

The results obtained during the diagnostics testify to the low motivation of the students of the experimental class (16%). Productive motivation is diagnosed in 4% of students. Due to the fact that students have a reduced motivation, the teacher should approach the planning of the educational process in the elective class creatively. It is necessary to pay special attention to the design of classes in a non-standard form, for example, classes using quizzes, role-playing, business didactic games, projects, “investigation” cases, educational research. It is necessary to apply ICT (digital laboratories, electronic sensors, digital microscopes, immersive technologies) in combination with natural objects and traditional means of teaching biology and ecology.

A rating of subjects of the natural science cycle was compiled, which was obtained in the course of a survey of students. It is shown in Figure 2.

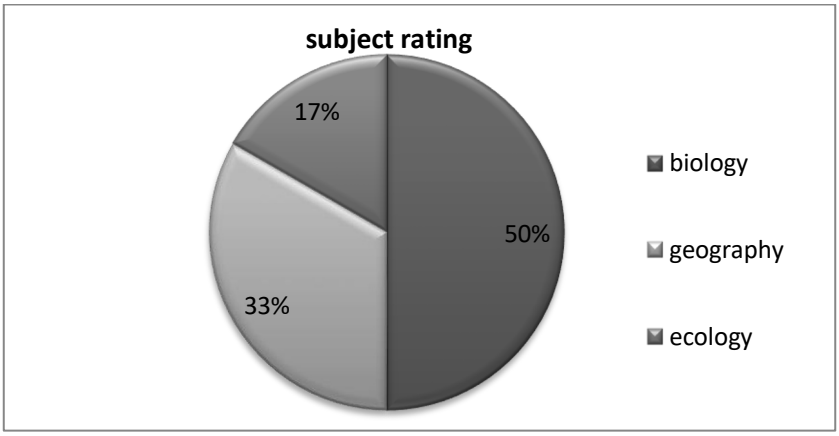

Fig. 2. Rating of educational tasks with content in the subjects of the natural science cycle.

Analyzing the presented rating of educational tasks with natural science content, it can be seen that students give their preference to knowledge in biology 50%, tasks in geography 33% and environmental knowledge 17%.

In the course of the ascertaining experiment, schoolchildren were offered a test for the study of ecological culture, on the basis of which it is possible to determine the level of development of the ecological culture of the individual. In accordance with the key for processing the test results, in addition to determining the level of general environmental culture as an integrative value, it was provided for the allocation of three main levels of environmental education, environmental consciousness and environmental activity. The results of the pedagogical experiment are shown in Figure 3.

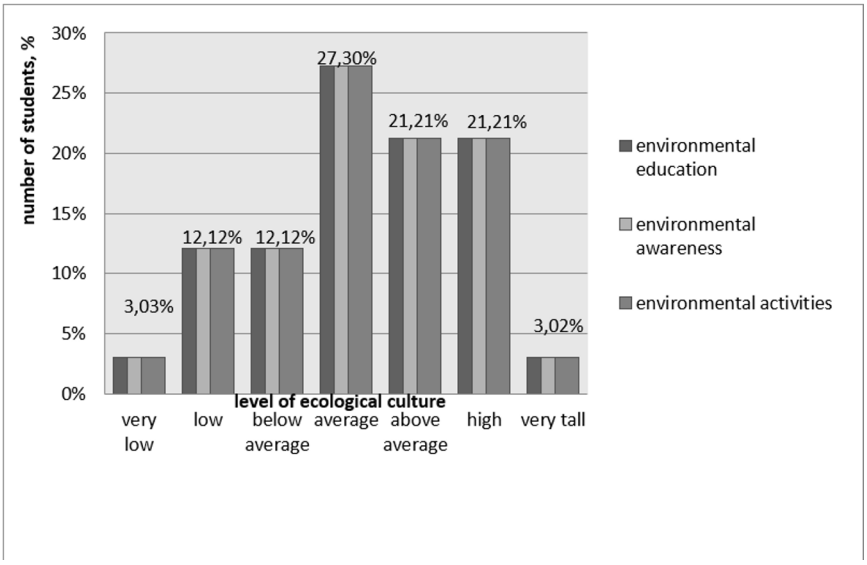

Fig. 3. General assessment of the level of environmental culture of students.

Based on the combination of the data in the diagram, we can say that the level of environmental culture in 27.3% of students is an average level, 21.21% each have students with a high level and above average.

Conducting a study of the quality of knowledge in biology, ecology and geography, the following results were obtained (Figure 4).

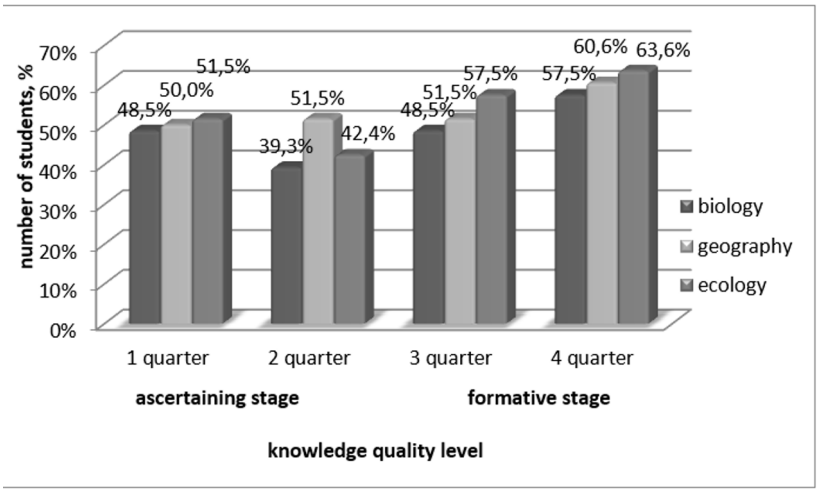

Fig. 4. The quality of knowledge of students in the experimental class for the 2022-2023 academic year.

The dynamics of the quality of knowledge during the experiment is characterized as positive. So, at the ascertaining stage, students, when performing test tasks, experienced difficulties in generalizing and systematizing. For some students, certain difficulties were identified in understanding the terminology - the conceptual apparatus of biology and ecology. At the formative stage, fewer of these difficulties were identified.

The test "My attitude to nature" at the formative stage of the experiment made it possible to determine the attitude of students to nature. The test result is shown in Figure 5.

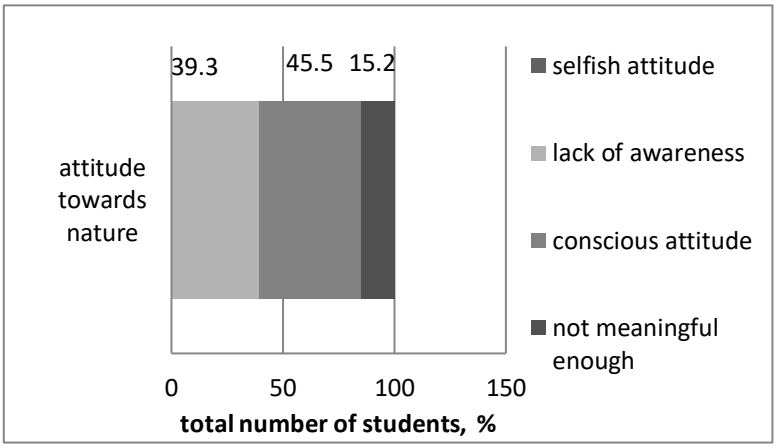

Fig. 5. The ratio of students' answers "My attitude to nature".

The results of this diagnostic show that in 39.3% of students the attitude to nature is little conscious and not very active, 45.5% relate to nature consciously, deeply and correctly, in 15.2% of respondents the attitude to nature is not sufficiently meaningful, emotionality makes it difficult to critically examine their thoughts, feelings, actions.

Thus, the results obtained by us in the study of the quality of knowledge of students in biology and ecology indicate the positive impact of the interdisciplinary optional course "Omsk Region - My Native Land" with regional content. During the experiment, the students' cognitive interest and the quality of knowledge increased.

The dynamics of the level of assimilation of knowledge about their native land among students during the experiment indicates the effectiveness of the educational impact within the framework of the presented elective.

4 Conclusions

1. The importance of the integration of biology and ecology, as well as geography on the basis of the implementation of interdisciplinary connections in the framework of the study by schoolchildren of an optional course with a regional content is shown.

2. An interdisciplinary optional course with regional content "Omsk Region is my native land" was developed and tested, including the following components: purpose, objectives, forms, methods and means of teaching, aimed at developing the level of knowledge of students, as well as positive motivation and positive emotional attitude to teaching and nature. During the implementation of the optional course, various types of activities were used: quizzes, games, investigations, research, excursions, discussions, and ICT were also used.

3. The results of the pedagogical research indicate an increase in the level of quality of knowledge in ecology (63.6%), biology (57.5%) at the formative stage of the experiment. The results of mastering knowledge at the formative stage of the experiment became 20% higher. The experiment shows that the level of formation of biological and environmental literacy of schoolchildren has increased due to the introduction of an interdisciplinary optional course with regional content into extracurricular work of schoolchildren.

4. The conducted research illustrates the need to put into practice intracycle interdisciplinary integration of biology and ecology. Cross-cycle integration is also effective, for example, the interdisciplinary connection of biology and geography. It is necessary to implement all types and types of interdisciplinary connections in the educational process of an elective, use interactive learning technologies, apply modern, including immersive ICT.

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