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An integrated approach to education content

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Abstract

Purpose research is the creation of the effective didactic system of interdisciplinary knowledge of natural science courses of environmental education with special emphasis on professional orientation. The methods of the analysis, synthesis of knowledge, educational experiment and mathematical statistics and also a new methodology as the integrated approach were used for the fulfilment of the purpose. The educational experiment on the implementation of the integrated approach has shown the effective results in improving the quality of students' knowledge. The levels, goals and meaningful lines of the integrated approach to students'–environmentalists' teaching are defined. As a result of research, the concept of the integrated approach of environmental education is developed, a specific of the teaching is defined and the efficiency of the methodical system of ecologists' preparation is introduced and experimentally checked.

Keywords: Environmental education, education content, an integrated approach.

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1. Introduction

The first quarter of the 21st-century accumulated multidimensional and quite wide complex of modern higher education problems which are actual, quite often inconsistent and rather difficult when deed reaches with a real solution of specific educational objectives. The philosophy of the educational process aims to system pluralism and a dialogue of different concepts. One of such key problems is the education content (Albareda-Tiana, Vidal-Ramentol, Pujol-Valls & Fernandez-Morilla, 2018; Bilyavsky & Bogolyubov, 2000; Fuertes-Camacho, Graell-Martin & Balaguer-Fabregas, 2019; Kofanova, 2012; Kremen, 2003, etc.). The content of education is a system of scientific knowledge, practical skills, as well as ideological and moral-aesthetic ideas, which should be mastered during the learning process. The content of education should be based on the interconnections between the different disciplines. The environmental education differs in versatility and breadth of knowledge, combining in its content different disciplines (UZ, 2018).

To the development of organisational and educational conditions of students' preparation of an ecology direction and to the content of environmental education, there are devoted research works (Mitryasova, 2015; Mitryasova, Pohrebennyk, Kochanek & Stepanova, 2017; Petruk, 2015; Rudyshin, 2009; Sherren, 2008; Simmons, 2004; Sterling, 2010; Stern, Powell & Ardoin, 2011; Tidball & Krasny, 2011; Van Poeck, Konig & Wals, 2018; Zhou, Xia Chen & Wen Huang, 2012). The preparation of students of this direction differs from other natural science educational specialties of a diversity and universality that focuses on technology on the creation of the education content on knowledge integration.

Purpose research is the creation of an effective didactic system of interdisciplinary knowledge of natural science courses of environmental education with special emphasis on professional orientation. The object is educational content of the students' preparation process, namely, students' training of the environmental specialty. The subject is the integrated approach to form education content in the students' preparation process (Karakok & Gokarslan, 2018).

2. Method

The methods of the analysis, synthesis of knowledge, educational experiment and mathematical statistics and also a new methodology as the integrated approach were used for the fulfilment of the purpose. The scientific methodology is based on the ideas of unity, the interconnection of man and nature, integration processes in science and education, concepts about the system, systemic method and the integrated approach. The main reason to carry out an educational experiment was that students' training does not provide proper motivation and profiling. The majority of students could not identify the links between fundamental and professional knowledge. To assess the quality of education coefficient of knowledge and skills, *Ka* is used (Bespalko, 1989, formula 1), which was defined as the ratio of correct answers of the test *a* to total test objectives *p*:

$$K_a = \frac{a}{p} \tag{1}$$

The completeness of students' knowledge and skills was defined by the ratio of the notions number of applied by students to the number of definitions that can be used. The tasks have consisted of their reproductive level of educational material. The quantitative characteristic of the completeness of the knowledge factor was the acquisition coefficient of knowledge by students. The formula 2 (Kyveryalg, 1980) used for this is as follows:

where

$$\overline{K} = \frac{\sum N_i}{n \sum N} \times 100\%$$

n—the total number of students who performed work;

∑*N*—the number of correct answers in the test;

∑*Ni*—the number of correct answers of students.

Previously, the validity of the test tasks had was tested. For this purpose, the coefficient of reliability and the correlation coefficient with the results of students' success were defined. Furthermore, the validity of the tests had been determined that the tests are to the educational programme and cover basic training material. A statistical calculation of the results was a computer programme Excel, taking the zero hypotheses, according to the sample in the same conditions and because of the differences between them caused by accidental causes. Furthermore, a new methodology as the integrated approach was used.

3. Results

For the majority of recent school graduates (54.7%), this ratio is 0.33, which corresponds to the low level of natural general training. A primary diagnostic poll of students founded that their training does not provide proper motivation and profiling. The vast majority of those polled could not identify the connections between fundamental and professional knowledge. This is due to the domination of the logic of the fundamental sciences to the content of educational material. Hence, it is actually to investigate the interdisciplinary connections and content of professional area learning. This is the reason to carry out an educational experiment among students. The following knowledge characteristics were investigated during the research: the completeness of students' knowledge and skills and systematisation and generalisation of knowledge and skills.

It is determined that the average completeness of knowledge in the experimental groups is 79%, and the completeness of students' knowledge in the control groups averaged is 64%, which corresponds to low satisfactory scholarship (Figure 1).

The ability of students to systematise and generalise the knowledge provided the four levels of systematisation and generalisation: notion, theme, interdisciplinary and problem. Therefore, we considered it necessary to compile the tasks that involve students' knowledge with the appropriate level of systematisation and generalisation (Al Hashimi, Mahdi, Al Muwali & Zaki, 2019). Out of the total number of students of the control and experimental groups, the percentage of students who have mastered the knowledge of the appropriate level is fixed. An indicator of systematisation and generalisation of experimental groups on the notion level is 83%,theme—78%, interdisciplinary—57% and problem is 54% (Fig. 2).

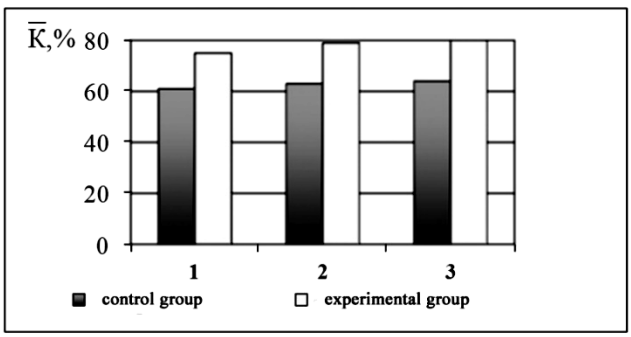

Figure 1. Comparison of completeness of students' knowledge and skills in the experimental and control groups

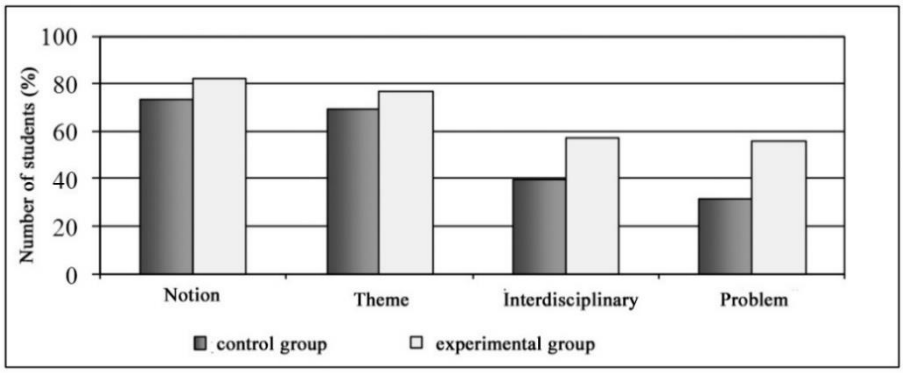

Figure 2. Diagram of systematisation and generalisation indicators of students' knowledge in the experimental and control groups

The analysis indicates that, during the study, the integrated course level of systematisation and generalisation of knowledge increases compared with control groups. The average growth level of systematisation and generalisation of students' knowledge of the experimental groups compared with control at the notion level is 10%, on the theme—9%, the interdisciplinary—16%and the problem—22%.

4. Discussion

The integration of modern scientific knowledge as one of the most important tendencies of science development has to find the reflection in the content of students'–environmentalists' preparation. The theoretical background of the environmental education theory is based on the integrated approach. The integrated approach to environmental education is a special type of designing its content which opens the system of interdisciplinary connections, and it also coordinates, unites and systematises knowledge about the main natural science theories, basic categories and principles of the modern natural science picture of the world.

The main tasks of the natural science education in the context of the integrated approach are to form:

- The fundamental (global) law concepts of nature and research methods that allowed them to discover; ideas about the most important milestones on the way to achieve a modern level of natural science; understanding of the most common theories that characterise the present level of natural science;
- Knowledge about the unity of living and inanimate nature and the unity of the developing world, which is provided by the fact that the physical form of the movement goes higher—chemical and biological forms of matter movement;
- A whole scientific world outlook, awareness of the students on the principles and regularities of the nature development—from the microcosm to the Universe and Human, as well as the development of ideas that in the transition of systems to a higher level of development at the same time increasing their diversity, the growing number of structural parts, there is differentiation, complicated by relationships, and simultaneously increases the integration.
- Students' skills to use the obtained knowledge of natural science disciplines during the solution of the professional orientation tasks.

In a wide sense, the integrated approach to the education is not a simple eclectic combination of scientific facts and concepts in the content of disciplines, but rather the coordination, combination and systematisation of knowledge regarding basic theories, leading categorical concepts and principles of modern natural science knowledge, aimed at shaping nature and the integrity of worldview (Jain, 2018). The integrated approach aims to resolve the following contradictions: between the content of

learning and life, between different ways of knowing the world, between the whole and the elements of the whole and between different disciplines. The levels of the integrated approach implementation are internal disciplinary and interdisciplinary of knowledge and the highest level—methodological synthesis (Figure 3). The internal and interdisciplinary integration is being implemented through selection into the content of education the facts, concepts, laws, methods and theories according to specialisation and humanisation. A dialectic category is set off at the level of methodological synthesis, for example, unit, system, structure, element, cause, consequence, content, form, causality, randomness and pattern.

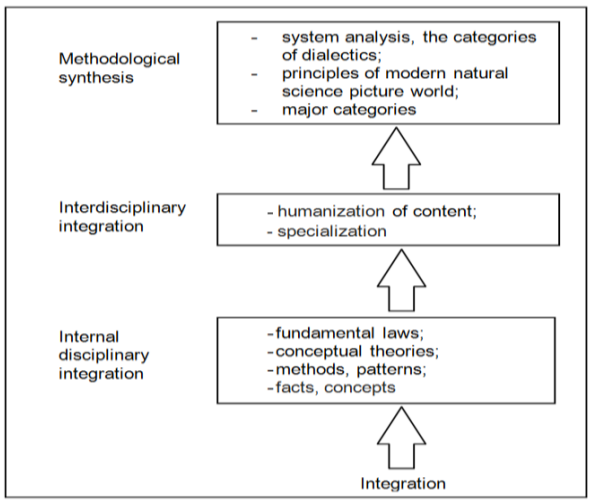

Figure 3. Levels and directions of the integrated approach implementation

The most important aspects of an integrated approach are component, functional and prognosis (Figure 4). The component aspect of integrated training responds to the question «what is integrated?». (The functional component of integrated learning manifests itself as the functioning of the intro- and interdisciplinary connections and responds to the question «how are integrated? ») (Unver & Cakir Ilhan, 2019). The prognosis aspect of integrated learning has two areas such as genetic and prospective, so it demonstrates basic and promising concepts and ideas.

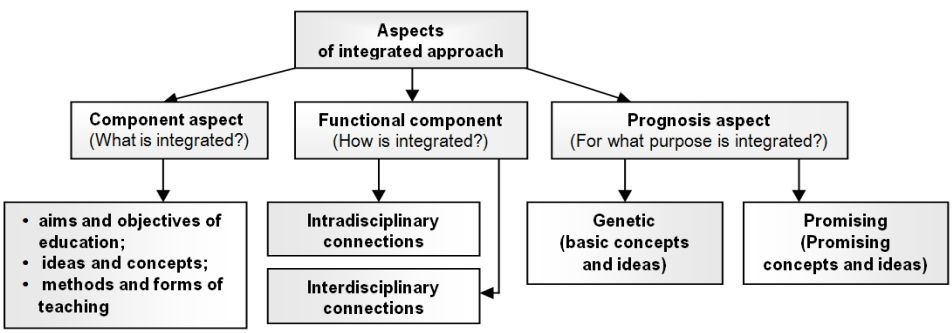

Figure 4. The most important aspects of integrated approach

The most important functions of the integrated approach to learning are methodological, forming and system. A methodological function is ineffectively developing in students about the aggregate skills of academic and scientific research through a variety of methods and techniques of knowledge: analysis, synthesis, induction, modelling, etc. Forming function provides basic concepts and laws to students (Soylucicek, 2019). The integrated approach enables to improve the content of knowledge

through the implementation of a wide range of interdisciplinary connections taking into consideration the specifics of the future professional activity of students and thus creates a deep understanding of the need to review many of the key issues from the natural knowledge amongst them. The system function is to form in students of integral knowledge, so the system of knowledge subjects to the consideration of the same concept or issue from the various sides based on the synthesis of the natural, applied and humanitarian science achievements.

The basic teaching principles of educational material selection to the formation of the content of learning are system (system factor is the purpose of the integrated training, as well as the fundamental theory,the key conceptual categories, principles of natural knowledge around which formed the content of training, as well as objects of study, which are objects of the environment),the principle of interdisciplinary connections, the principle of fundamental and professional orientation of education contents and the focus of training content onto disclosure of environmental problems.

The principles of selection and structuring of educational material for the preparation of students'–environmentalists' are defined and substantiated. First of all, these are the principles: systematic (systemic factors are the goal of natural education in the context of the integrated approach, leading laws, theories, basic categorical concepts, principles of natural science and objects of study), interdisciplinary connections, fundamental and professional of the orientation of the content of education and orientation of the content of training to the disclosure of environmental problems.

Training of natural specialty students differs by plurality and covers a wide range of humanitarian, social and natural sciences. Especially, there is a need to search for identifying and justify the major categories to serve as fundamental centres integrating various training courses at the graduate level of integrating knowledge − level of methodological synthesis. Such centres of integration for students–environmentalists' categories are as follows: life quality, environmental safety, the idea of coevolution and sustainable development of nature and person and exhaustion of natural resources.

The implementation of the integrated approach to build the content of education has been confirmed in the practice of training environmentalists by a university education. Several integrated training courses have been built, organised and implemented. For example, the integrated training course 'water security', which is implemented under the auspices of the programme EU Erasmus+ Jean Monnet Activities, includes the key elements of European environmental policy in the field of the water ecology, including the world's and EU's practices for sustainable development and the processes of environmental policy integration.

The course has been built by the integrated approach. This covers the topical issues that contribute to a better understanding of the environmental, economic, social, biophysical, technological and institutional influencers of current and future global water security to achieve the goals of sustainable development. Besides, it is the developed questions about climate change, water pollution monitoring, technology of water treatment, quality of drinking water and integration of environmental water politics into regional practices. Furthermore, the course includes issues to better understanding the nature and drivers of urban water demand and the potential for social and economic instruments to drive conservation efforts. Furthermore, the course comprises the international dimension, with the role of the EU in the international environmental motions (e.g., Kyoto Protocol, UNESCO Roadmap for Implementing the Global Action Program on Education for Sustainable Development, Sustainable Development Strategies), the International Water Security Network and so on and the impact of European policy on other regions of the world. The course is interdisciplinary and connects the policy and tools of water monitoring and management, principally addressing EU and Ukraine practices of water quality, water resources, biodiversity and fisheries and their progressive integration, basics of freshwater ecology. The best practices in water purification in the EU member states are the challenges for Ukraine in water security policy and practice due to association with the EU.

On discussing the results of students' training through the formation of certain outcomes, it is necessary to note the overall integrated nature of the 'outcome' or 'competence' notion regarding the

definitions of 'knowledge', 'ability' and'skills'. The result of the learning is the formation of certain types of competencies by the European TUNING project definition covering the knowledge and understanding of, the knowledge of how to operate and the knowledge of how to be. According to TUNING, there are three types of generic competences: instrumental competencies (cognitive, methodological, technological and linguistic abilities), interpersonal competences ('soft skills': individual abilities such as social skills, social interaction and co-operation), systemic competences (abilities and skills concerning the understanding of systems' whole) and instrumental and interpersonal competencies. Hence, the integrated approach to content education can be improved these types of generic competencies.

The main learning outcomes of students are understanding the difference between policies and tools of EU and Ukraine for water monitoring and management; explaining goals and system of water management at national, regional/EU and global levels; understanding and articulating the key environmental challenges to water management; articulating and understanding the evolution of system thinking, ecosystem thinking, ecosystem approach, ecosystem services and implication of this for the continued evolution of integrated water and environmental management contexts; understanding and using the topical and correct terminology related to the environmental management in the field of water security and ability to conduct analysis, synthesis, creative reflection, evaluation and systematisation of various information sources in researching in the field of water security. Such learning outcomes are equally important as knowledge of the basic principles, types, methods and means of environmental water monitoring and ability to assess and predict the state of the objects of the environment; understanding and explaining an influential quality of water to health, researching skills of water security and other crosscutting issues; understanding the water management system and procedures for the activities of enterprises to water security, its functions, tasks at the global and national levels; knowledge of the latest advanced technologies and innovations in the field of water security; discussing the evolving policy and tools of water monitoring and management and principally addressing EU and Ukraine practices of water quality, water resources, biodiversity and fisheries and their progressive integration.

5. Conclusion and Recommendations

The analysis of the main phases and forms of knowledge integration in educational sciences and results of research give grounds to determine new definition that the integrated approach to the content of students' ecologists' education is a special type of construction of its content, organisation and direction of which subordinated to disclosure a system of intra-and interdisciplinary connections, as well as coordination, combination and systematisation of knowledge concerning the basic natural science theories, leading to categorical concepts that aimed to form a complete picture of the world. Although the integrated approach is very well known in educational sciences, the novelty of this study is to develop the methodology of the integrated approach to the content of students' education. New in this exploration is the development of the methodological foundations of integrated learning through the definition of levels and trends of knowledge integration, goals, objectives, principles, functions and substantial lines of natural disciplines. Important in research was the evaluation of the effectiveness of the integrated training and determination methods of evaluation of students' knowledge.

Thus, the integrated approach to the content of students'–environmentalists' education promotes to the formation of concepts about fundamental (global) nature laws, understanding of natural unity and world development, formation of the complete scientific outlook and skills of use of knowledge in the course of the solution of professional tasks.The integrated approach to education is a special type of its content construction, organisation and direction of which subordinated to the disclosure of intra- and interdisciplinary connections system and also coordination, combination and systematisation of knowledge according to basic scientific theories, leading categorical concepts and principles of modern natural information which are aimed to form the holistic scientific picture of the world.

The result of research and experimental work is positive. We tested and confirmed the educational effectiveness of the training material content based on the integrated approach and the study of the indicators of the quality of students'–environmentalists' knowledge. The results of the experiment have determined that an implementation of the integrated approach into education content enhances the completeness of knowledge (79%/64% of the experimental and control groups, respectively) and systematisation and generalisation on the notion, theme, interdisciplinary and problem levels (83%/73%, 78%/69%, 57%/40% and 54%/32%, respectively).

However, it should be noted that the research does not exhaust all the aspects of the problem of the content integration of education for students–environmentalists. There is a sense in further developing of the integrated issues of education, namely, the improved methods of knowledge quality evaluation determine the students' competencies.

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