

The Selection and Structuring of the Content of Natural Science Education of Students of Humanitarian Direction Training

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Abstract: The methodological basis of modern natural science, which should be learnt by students-humanitarians, is considered in the article on terms of analysis of requirements to the results of basic professional educational programs of humanitarian directions training. The selection criteria of the content of natural science education in a higher school were represented. Fundamental principles, referred to the selection and structuring of integrated natural-science discipline, which provide the professional oriented natural-science education of students- humanists are revealed.

Key words: Natural-science education • The criteria of the content selection • Fundamental core of knowledge • Problem-subject field • Evolutionary-synergetic approach • Modular program • Seal of educational information

INTRODUCTION

Justification of principles and mechanisms of education content formation has always been and still is very relevant aim of pedagogical research in our country and abroad [1, 2]. The analysis of requirements of the results of mastering basic educational programs of humanitarian direction, represented as list of competences which every graduate should have, allowed to conclude: natural science education (NSE) of given students group is essential component of professional training. This is due to the fact that the common cultural competences, which are necessary for every professional activity is formed within the framework of NSE [3]; NSE provides the formation of students' integrated system of scientific knowledge about Outworld, developmental laws of Nature; promotes the formation the system of methodological knowledge; acquaints with scientific knowledge approach; forms the culture of thinking.

The content of NSE of humanitarian training direction students should be significantly differs from the NSE of students from nature-science, physico-mathematical and technical training directions. What should be included in the content of NSE? How it can be represented in educational process? How it should be structured? How it will be represented in training courses program? Our research is dedicated to the answer on all these questions.

General. Today the NSE content undergoes a serious change, connected with revision of the theoretical notion in consequence of investigations in fundamental natural sciences. The establishment of the correspondence between modern achievements of natural science and the content of natural-science disciplines is the principal direction of NSE renovation.

The consideration of modern condition of natural science allowed to define the common methodological basis of modern natural science, which must be learnt by students-humanitarians:

- Leaps and revolutionary conceptual changes are peculiar for natural-science knowledge and the whole development of science as well;
- The alternative theories in science of the same subject area are possible;
- The character of scientific knowledge is relative; because the conditions of learning influence the result and can't be excluded;
- The behavior of every system has the probable character; the world is ruled by the probability, not the necessity, the variety of casual events lies in the basis of probability;
- World is the complex of multilevel, super compound systems, which often include a human as one of the most important element;

- Using nonlinear equation, account the cooperative and resonance coupling are necessary for description of motion and interaction of objects of nature;
 - The principle of evolution has the universal character, the main goal of the global evolutionism is the establishment of directivity of self-organization processes and developmental processes;
 - Discoveries in the modern natural science lay on the boundaries of hard sciences, have the multidisciplinary character and demonstrate integration processes in natural science;
 - Theories of modern natural science are based on ideology of non-linear thinking, founded on fundamental role of occasion in the natural world [4].
- Make students to comprehend the world outlook, semantic and methodological problems of our time, help in the digestion of rational methods to solve them;
 - Have the value-orientation focus, personal importance for student;
 - Have practical focus, assumed the consideration of it in context of living and professional problems;
 - Include the reflection focused information, the consideration of which will help to form the new type of thinking (critical, non-linear).

According to these criteria teacher's activity in the process of selection of the nature science disciplines' content is developed in the following aspects:

The main idea of modern natural science lies in that fact that the laws of natural systems development are connected with laws of development of the society. That's why if you know the laws of nature development, it is easier to orientate oneself in choice of the way of human society development, to solve such global problems as problem of survival of individual and civilization in general, rational using of natural sources, rate of economic growth and many others.

The second problem, connected with the content, is what we can take as basis of the selection of the NSE content of students of humanitarian directions of training? About how diverse the natural sciences and how great the number of scientific theories and conceptions in modern natural science is well known nowadays for every person who graduated secondary school. Obviously, under the disciplines for students-humanitarians there is no possibility to dwell on all conceptions, ideas, theories of modern natural sciences, most of which are of panhuman apparent interest. It is connected not only with time limitation but also and may be primarily with special features and capabilities of students-humanitarians.

Analysis of the investigation of selection and structuring of education content [4] allowed to elaborate and systematize all aspects of projection of educational content and on the basis of it to define the main criteria of the selection of NSE content of students of humanitarian directions of training. The NSE content should:

- Correspond to the modern achievements of nature science;
- Include the common cultural and general scientific information, depicting unity and entirety of science and culture;

- The integration of nature science discipline content, which helps students to learn integrate knowledge and apply them for getting new ones and explanation of events, taking place in the world;
- Intensification of practical focus of study subjects' content;
- Learning the events, processes, objective, material, surrounding students in daily life;
- Managing the knowledge, which students apply from different information sources out of university.

On the basis of represented hereinabove methodological foundation of modern nature science, criteria of NSE content selection we identify key elements, connected with selection and structuring of the integrated nature science discipline content which provide professional-oriented nature-science training of students of of humanitarian directions of training. Let us reveal these elements:

Emphasizing the Fundamental Core Body of Language – the Basis of Scientific

Functional Literacy: According to FSES fundamental core body of knowledge defines: the system of basic national values, revealing in the education content; the system of basic concepts belonging to areas of knowledge represented in education; the system of key objective providing the formation of universal types of educational activity [5].

Preceding from that it can be assumed that the fundamental core body of language by integrated nature-science discipline has to include the following:

- Knowledge, illustrated the value of nature science as the most important element of modern culture, interaction and complementarity of nature-science and humanitarian culture, the behavior of a scientist in assertion of the scientific truth, his civil position, ambiguity of scientific and technical progress results for human and society, strengthening of ecological and emotional aspects of training;
- Basic concepts of nature science, leading ideas and conceptions, key experimental facts, fundamental theories, bases of nature-science world view;
- Methodological knowledge including the system of scientific knowledge, levels and methods of scientific cognition demonstrating the sustainable thinking style, the reasons of changing the paradigm of scientific thinking, providing the formation of generalized skills and work methods.

Fundamental core body of knowledge is that invariant which is necessary for every person of post industrial society.

- Presentation the content of discipline from problem-object field. For multivariate and non-linear development of educational discipline, we suggest, after L.A. Bordonskaya [6] to represent the informative component of the content from problem-object field, emphasizing 3 components in it: common-cultural, general scientific, scientific and objective and consider these components as complementary elements of the content, which are necessary for perceptual unit of nature science as the prime field of scientific knowledge.

The scientific objective component reflects the nature-science content: main ideas and approaches, the most common laws, the system of scientific notions, concepts and theories, the interrelation between nature-science and engineering, natural base of natural phenomenon and human, main direction of ecological problems solution. Considering current problems of modern nature-science from microcosm to mega world will provide the foundation of entire system of scientific knowledge of Outworld.

General scientific component reveals the methodology of scientific knowledge, acquaints with principles and methods of scientific research, criteria of scientific content knowledge and its difference from unscientific ones, demonstrates the unity of logical and illogical methods of scientific knowledge, expands the information about science as system, acquaints with

ideals and norms of research activity, which define its purposes and methods of pursuing them. The main goal of given sphere of problem-object field is the formation of methodological knowledge, the formation of culture of thinking, ability for perception, generalization, analysis of information.

Defining the common culture component in the discipline content allows to emphasize the unity of the world, to show the unity and entirety of culture. Nature science, being one of the leading sciences of modernity demonstrate the possibility of integrative approach to perception and absorption of the world, the possibility of interaction and complementarity of nature-scientific and humanitarian knowledge, the possibility of consideration of science in the context of culture, provide the comprehension of education as introduction to the culture. The consideration of these questions and also the questions of the history of science and technology in the context of culture, problems of conservation of cultural heritage will provide the increasing of common culture and professional competence's level.

The presentation of educational discipline content from problem-objective field is the realization of problem-integrative approach, having become the leader in all spheres of human activity. Problem-objective field of integrative nature-scientific discipline affords an opportunity to present the content from certain groups of problems, to choose the certain trajectory of studying the discipline on a basis of it, according to the specific targets, direction and profile of students' training, their interests and proclivity and peculiarities of cognitive activity.

- *Revealing the discipline content from the point of evolutionarily synergetic approach.* Evolutionarily synergetic approach demonstrates the evolution of nature-science as development of ideas, laws, theories, concepts, worldviews, composing it- is that methodological basis on which every evolutionarily learning is founded. The presentation nature-science questions of principle from the point of evolutionarily synergetic approach supposes the moving of students into new 1, non-classical level of thinking and nature perception, helps to form nature-science worldview.

In the frame of this approach it is reasonable to consider the discipline content from the point of global evolutionism on sufficiently large nature-science information base- from the birth of universe in the process of chaotic inflation up to the formation of cognitive

structures of human's brain as higher organization level of Universe matter. In this case it is possible to formulate and discuss such important questions as: description of emergence (formation) of an object, change with its age (the senescence) and its inevitable death. Said triad naturally assigns the "time arrow" of individual development for every given object or for whole class of common objects.

Evolutionary perceptions intimately connected with synergetics, because the bifurcational scenarios characterize specifically the evolution on its well developed stages. Revealing the community of events and processes of different nature, the consideration of variability, non-linear development of complex system, revealing the conditions of their sustainable development, representation of the reality as unbalanced, unstable, opened system, give the opportunity both teacher and student to open deep community of events and processes observed in nature, to descend from the comprehension of the development process as linear and one-directional to comprehension of its multivariance and possibility of alternative [7, 8].

- *Module structuring of education program and educational material content.* For the sustainable structuring of the material content of educational discipline it is necessary to use the block-module principle educational material making. The peculiarity of module principle of educational material making lies in fact that the studying material can be divided into individual modules, each of which is studying by completed circle. Modules in their turn consist of elements. By module is meant the complex of elements, characterized by completeness and relative independence to one another [9, p.7].

In the process of making the educational discipline content on the basis of module structuring of educational program a teacher may not only replace the elements of module but also change their number, combine the structuring elements in different ways according to the purposes and tasks of course, which are determined by the training direction of students. Module training certainly makes the good opportunity even for realization the individual educational route.

- *The reduction of educational information by its generalization and systemization.* Overwork of students, time limitation for learning the extensional integrated nature-scientific discipline determine the necessity to find the directions of intensification of

learning process, which allows to increase the scope of knowledge which is learning by students without increasing the time, providing for learning. One of these directions can be the usage of support synopsis, structural and logical schemes, frames, diagrammatic and signed models of representation of educational material content.

Structural and logical schemes, synopsis, tables represent the wireframe structure of basic idea of educational material of didactic unit, have a great intensity, give the opportunity visualize material content, allow to set the associative links between its elements, making the educational material more accessible. The detachment of essential the main of the educational material, the compression of educational material with the help of signs and symbols can be considered as form, method and instrument of training. Structural and logical schemes and synopsis are the most efficient form of compression of information by consolidation of didactic knowledge units in consequence of thoughtful generalization.

For system organization of teaching information the compression of teaching information by its summarizing and systematization, the exclusion of questions of private matter in every module should be foreseen. In this term the content of every didactic module is represented as Structural and logical schemes, synopsis, tables and other forms of educational material summarizing [6]. For their working out the great attention was paid to the development of internal logic in studying topic. By using the structural and logical schemes, synopsis the following circumstances should be taken into account.

Firstly, the structural and logical schemes and synopsis not fully reflect the educational discipline content and just define main structural and logical links, that is why every scheme is limited in some way.

Secondly, every scheme mostly is the author's reflection, it usually has the subjective imprint, which is defined by understanding of essence of questions, by methodological purpose of studying the discipline and esthetic taste of its creator, what means that every scheme is one of the variant of presentation the material content. It is important to make this schematic presentation of information help students to learn the study material.

Thirdly the main purpose of structural and logical schemes and synopsis usage is the orientation on rational (optimal) studying of course, help in systematization of study material, the exposure of interrelation between content elements, the reconstruction the integral picture of modern nature- science.

- *The allocation of invariant and variant element in structure and content of educational discipline.* In structure and content of educational discipline invariant and variant element should be allocated. Invariant element reflects the obligatory minimum of discipline content, in the framework of which the nature- science training (fundamental core body of knowledge) is accomplished. Variative part fits the specificity of training direction, also takes into account the students' future professional activity, their interests and aptitudes. The variative content of element, the sequence of its consideration, intensity and scope of study material, every student defines by himself, planning his own educational trajectory of learning the course [10]. From the invariant element of module the logic of exposition of study material content is retained. Variative part allows to consider the study material in the context of future professional activity due to the inclusion items of information from professional subjects and transfer the peculiarities of professional activity in educative process.

CONCLUSION

On the base of common aspects of the educational content projection the methodological foundations of modern nature science were emphasized, the criteria of NSE content selection were defined, the fundamental principles, related to selection and structuring of the content of integrative nature-science discipline, which provide the professionally oriented NSE of students of humanitarian direction of training and formation of common culture competence.

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