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STRUCTURING INFORMATION IN THE SYSTEM OF TRAINING MASTERS OF NATURAL SCIENCES

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Abstract

The article analyzes the philosophical, psychological, pedagogical, educational, and methodological literature on the research problem; the essence of the concepts “structuring of educational information”, “professional and pedagogical training of masters of natural sciences for structuring educational information” is revealed, methods of structuring educational information are analyzed, forms of presenting educational information are revealed.

Keywords: **information; masters; professional training; analysis; cognition; system**

Nowadays, there is a significant increase in the amount of knowledge, which has led to the discovery and accumulation of an extremely large number of new scientific data from various fields of life and thus put humanity in need of their evaluation and systematization. On the other hand, the growth of knowledge has made it difficult to assimilate, has revealed the ineffectiveness of many methods of their use in science and practice. The process of cognition itself is increasingly taking the form of transformational activity. In the scientific and pedagogic literature, methodological aspects of teaching the presentation of educational information by using various forms are not highlighted enough. There is no integral, scientifically proven, and tested

methodical system of teaching to structure educational information and present it through various forms, which should include content, goals, methods, organizational forms, tools, learning conditions, and expected results.

The specificity of man is a high degree of knowledge – rational knowledge. According to philosophers, in particular A.M. Averianov, P.K. Anokhin, etc., rational cognition is systemic. It consists of consecutive mental operations and forms a mental system that is more or less adequate to objective reality.

The practical activity of man is also systemic. In addition, the level of systematic practice increases with the growth of knowledge and experience. However, system cognition and transformation of the world has its peculiarity, which implies the need to:

1. Consider the object of activity (whether theoretical or practical) as a system, i.e., as a limited number of interacting elements.
2. To determine the composition, structure, and organization of elements and parts of any system, to identify the links between them, especially the major ones.
3. Identify the external connections of the system as a whole and highlight the major ones.
4. Determine the functions of the system and its role among other systems.
5. Analyze the dialectic of the structure and function of the system.
6. Identify according to these data patterns and trends in the system.

The system, as a specific type of reality, is in constant motion, it is undergoing numerous changes. However, there is always a state that characterizes the system as a limited material unity and integrity and is expressed in some form of movement. The forms of movement are divided into mechanical, physical, chemical, biological, and social, but there is also a hierarchy of forms of movement, in particular, the higher form of movement involves the inclusion of lower. Systems, in addition to their specific properties, have general properties independent of their nature. This commonality of properties allows denoting by the concept of "system" the most diverse sets [5].

It is also important that the system as a concept assumes the presence of two opposite properties: delimitation and integrity. Separation is an external property of the system, integrity is its internal property, which the system acquires in the process of its development. The system may be separated, but not integral (for example, unfinished house, incomplete education, etc.), but the more the system stands out, separates itself from the environment in which it is formed, the more it becomes internally organized, and therefore integral, individual, and original.

Accordingly, A.M. Averianov gives the following definition of a "system": "a separated, interconnected set that reflects the objective existence of specific individual interconnected sets of bodies, which has no specific restrictions inherent in individual systems".

This definition characterizes the system as a self-moving set and as an interconnection, while the interaction is a movement.

In the universal dictionary-encyclopedia "system" is defined as the internally organized structure of elements, which is a set and integrity of organizational principles, norms, and rules required for a particular industry (e.g., financial system, education system); a set of methods of action" .

One of the important problems in defining a system is the awareness of the essence of the forces that unite the plurality of its components into one system. The problems of how systems are formed, exist, and develop, how they retain their integrity, structure, form, and the feature that distinguishes one system from another remain unresolved. There are two directions for their solution.

The first is via natural science, which consists of the study of features, specifics, nature of system-forming factors in each of the analyzed systems (educators, for example, distinguish different specialties: mathematics, literature, physical education, etc.).

The second direction is characterized by attempts to determine the specificity and uniqueness of specific system-forming factors, a pattern inherent in all systems without exception, but one that manifests itself differently in multilevel systems (general pedagogical knowledge) [1].

From a philosophical point of view, there are several views on the search for the main factors in the formation of the system. Thus, P.K. Anokhin expressed the idea that the decisive and only factor is the result of the system functioning, which, being insufficient, actively influences the selection of such degrees of freedom from the components of the system, which, subject to their integration, determine further obtaining of a full result.

There is also an opinion that the system-forming factor is the goal: the elements of the system unite and function for one clearly defined purpose. This is more acceptable for social life [3].

OO Abdullina notes that in pedagogy the system of professional and pedagogical knowledge is their unity: on the one hand, the essence and content of pedagogical activity, on the other – scientifically sound ways of their organization [8].

Considering the professional and pedagogical training of masters of natural sciences of pedagogical universities as a holistic process of forming a system of basic knowledge and skills,

V.I. Shcherbakov identifies such a comprehensive criterion that would give a holistic description of the level of professional and pedagogical readiness of masters and reflect the relationship of knowledge and skills. Such a criterion, according to the author, is the systematic nature of this knowledge and skills. It is an integral indicator, which, firstly, reflects the unity of mastering the semantic, procedural, and motivational-value aspects of pedagogical activity; secondly, it reflects the relationship between knowledge and skills (knowledge is the theoretical basis of skills, skills are a form of functioning of knowledge); thirdly, it combines different characteristics of the quality of knowledge and skills (their completeness, awareness, strength, effectiveness, etc.); fourth, reflects the dynamics of knowledge and skills (their use in different conditions); fifth, shows the unity and relationship of cognitive and practical activities of masters.

According to MM Levina, the learning process is a self-regulating open system consisting of two activities: of the educator and students. The link between them is information .

The author believes that today the professional qualification of masters (specialists) is the ability to build information models, the possession of knowledge and skills that ensure the implementation of creative actions for the information design of the training process [3]. Modern masters of natural sciences need to be able to carry out logical analysis of educational material, “information structuring”, integration of interdisciplinary links, to determine the verbal and graphic structure of educational information.

According to V.I. Orlov , the information contains not only the essence of training but also other information that together with the content of the training form creates a fund of information exchange between participants of the educational process and contributes to the assimilation of this content and its practical application.

Theoretical and methodological principles of professional and pedagogical training of masters of natural sciences in a pedagogical educational institution are aimed at the formation of actions for information design, but they have not yet been the subject of special in-depth study. The conditions that ensure the integrity and systematization of professional and pedagogical training of masters in a higher pedagogical educational institution, as well as the formation of a system of professional and pedagogical knowledge, skills, and abilities, are not fully defined; no ways to implement the relationship between the process of formation of knowledge and skills of different types of information, the use of theoretical knowledge in practice were found.

Thus, there is still a disagreement between the social significance of the quality of training of masters of natural sciences in modern informatization of society and the level of theoretical development of professional and pedagogical training of masters of natural sciences on this issue. Therefore, an important task of our study is to develop a system of professional and pedagogical

training of masters of natural sciences, aimed at developing the ability to work with information, its design, and presentation, i.e., structuring.

To come to an understanding of the concept of "structuring", and in our study, it is the structuring of educational information, it is necessary to define the concepts of "structure" and "structuring" in the general and philosophical sense. "Structure is the construction and internal form of organization of the system, which acts as a unity of established relationships between its elements, as well as the laws of these relationships. The structure is an integral attribute of all existing objects and systems" [].

There is a dual understanding of structure in the literature. In a holistic sense, the structure is equated to a system. The system is understood as elements and connections between them. The second definition distinguishes between the concept of structure and the concept of system. The structure is interpreted here as the internal organization and order of the object. In both cases, the structure provides for dynamic and statistical measurements.

According to J. Piaget, a structure can be defined as a model adopted in linguistics, mathematics, logic, physics, biology, etc. and meets three conditions:

a) integrity: the subordination of the elements to the whole and the independence of the latter;

b) transformations: orderly transition of one substructure to another based on the product rules;

c) self-regulation: the internal functioning of rules within this system [5].

The development and functioning of the concept of structure in many sciences were influenced by the creation of semiotics, the ideas of F. de Saussure in linguistics, C. Lévi-Strauss in ethnology, L.S. Vygotsky and J. Piaget in psychology, as well as the development of metalogic and mathematics (G. Frege, D. Hilbert).

In the psychological dictionary, structuring is interpreted as "a strategy of organizing of disparate information in the process of its memorization, as a result of which the elements of material to be memorized are linked by content into a whole group or several such groups" [6].

Applying the word "structuring" in the professional and pedagogical training of masters of natural sciences, we mean the process of real, specific in content and form of compositional construction by the teacher of the educational information offered to masters. When the master independently acquires knowledge from various sources, he structures (selects, in a certain way mentally organizes) and assimilates the information necessary for the solution of the educational and cognitive task set by the teacher, using corresponding means and methods of training.

Structure due to structuring is not something external to people, it is most likely an "internal" element of activity – traces of memory, sample formulas, scenarios. A clear example is the knowledge of masters of natural sciences, which is the result of structuring educational information that is obtained in the learning process. Under the professional and pedagogical training of masters of natural sciences to structure educational information, we understand the formation of masters' skills to work with information, process it, and adapt to educational conditions, as well as fulfill their professional role in the need for these skills and professionally significant qualities.

Educators are particularly interested in structuring and compressing information because pedagogy can be defined as a science that studies the patterns of reception and transfer of knowledge, historical experience, research, and educational information.

Pedagogical science and educational work depend on solving problems of the selection of scientific information for educational purposes.

Pedagogical information, according to L.D. Kvirtiia [7], consists of scientific, educational, instructive, empirical-utilitarian, administrative, recommended information, etc. Educational information is often called educational and didactic information. The term "didactics" seems to strengthen the connection of educational information with science and gives it a scientific character. However, educational information is not scientific.

Educational information can be considered data about existing scientific knowledge. Its value is determined by the systematic presentation of facts (phenomena), the availability of content, and the adequacy of this information to the meaning of its sources. The level of information load of educational information is determined by the intellectual capabilities of the perception of information by its consumers. Educational information can be understood as information (knowledge) of scientific, technical, or educational nature, which serves as an explanation and serves to transfer scientifically proven experience, acquired knowledge about natural and social phenomena. Educational information varies by field of knowledge. According to its content, educational information is methodical or instructive. It is necessary to teach not only knowledge or skills to reproduce information, but also the ability to think. M.M. Levin supposes that educational information should contribute to the psychological development of learners, to carry content that encourages meaning-making [8].

Problems of information theory and practice organically merge in the structure of research of pedagogical processes of education and training. The functional characteristic of pedagogy itself is reduced to understanding the patterns of information activities: reception, processing,

storage, and transmission of historical experience, scientific knowledge. Without these logical and cognitive processes, neither pedagogical scientific theory nor educational activities can exist.

From a certain point of view, pedagogical and information theories are considered isomorphic scientific systems and directions; for the theory of education and training and the theory of information, the general preconditions of epistemological and organizational-methodological character are immanent. Moreover, any information that performs the functions of cognition and explanation has a pedagogical nature. One way or another, in organizational or non-organizational form, performs an educational or educational function, is included in the social system of exchange of social experience, accumulated knowledge.

The information aspect in the field of pedagogy includes problems of reception, selection, processing, storage, and transfer of scientific and educational information. To this are added the modern problems of determining the amount of scientific and educational information, the development of methods, and principles of their transmission. Accordingly, today the problem of volume and consolidation of pedagogical information has become extremely important.

Solving the problems of consolidation of pedagogical information is aimed at the organization of optimal documentary systems to improve the functional characteristics of scientific communication, the results of pedagogical research, and to increase the quality of educational and cognitive information.

It should be noted that educational and cognitive information in the didactic process of higher education is often identified with the concept of scientific information, so we consider them in conjunction.

Many authors-educators do not draw a clear line between the concepts of "information" and "knowledge". After analyzing the scientific and pedagogical literature, we concluded that knowledge is a generalized and systematized, structured information transmitted by teachers in the learning process.

Consider the essence and ways of structuring educational information, because of which students can gain deeper and stronger knowledge.

Under the compression of educational information, we understand the composition of physical and mathematical content, considering the psychological and pedagogical patterns of perception, memory, and thinking of recipients. Compression of educational information in courses of natural sciences is achieved using reference notes (V.F. Shatalov), operational schemes of action (P.Ya. Halperin), the idea of global, consolidated topics, which is presented in the form of "basic units of learning" (P.Ya. Halperin, D.B. Elkonin), the method of enlarging the didactic units (P.M. Erdniev) and the achievement of early generalization (V.V. Davydov, D.B. Elkonin).

Modeling educational information is a well-known way of structuring. For the most part, all models are divided into two groups: material (physical and analogical) and ideal models (intuitive and symbolic). In turn, mathematical modeling is especially distinguished in sign modeling.

Visualization of educational information includes knowledge of the functions of multimedia, hypertext, the role of the Internet in the didactic process of higher education.

Each of these ways of structuring educational information can have different forms of information presentation: logical, productive, frame, and semantic. Thus, an example of a logical form is a symbolic notation of mathematical axioms and theorems using the logic of predicates. The production form is represented by a set of rules or algorithmic orders to represent a specific problem-solving procedure. The semantic form is presented by knowledge with the use of graphs, block diagrams, drawings, etc. The frame form consists of several slot cells, each of which has its purpose. Examples of frames – tables, matrices, etc.

To form a system of professional and pedagogical knowledge, which contains knowledge and the ability to structure information and present it in a concise, easy to perceive and operate, it would be appropriate to introduce the necessary sections in the methodology of mathematics, physics, and computer science during the training of masters in pedagogical HEIs.

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