Scientific and methodological basis for teaching natural sciences and engineering in higher education

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SCIENTIFIC AND METHODOLOGICAL BASIS FOR TEACHING NATURAL SCIENCES AND ENGINEERING IN HIGHER EDUCATION

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FORMATION OF KNOWLEDGES SYSTEM IN EDUCATIONAL PROCESS

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Abstract. *In this work knowledges considered as an open self-organizing complex structural system. It was determined the main functions of conservative, metastable and active structural components in the dynamics of knowledge systems. It is shown that the link to the different structural formations serves people. It is suggested during the formation of educational plans and programs, taking into account the interdependence of structural groups of the system of knowledges in order to prepare mentally liberated professionals, who are adequate for the needs of the present.*
Keywords: *knowledge system, conservative, metastable, and active elements (substructure) structure.*

Introduction

Education and knowledge are the main productive force in the context of sustainable human development, while ensuring its comfortable existence. This predetermined objective necessity of the transition of industrial society into an information society. In the period of industrialization for economic growth comprehensive training of technically educated engineers is required. The transition to an information society is based on the change of the reactive mind, in which knowledge is created by storing, in the development of thinking skills, which can be implemented with interdisciplinary approaches. This involves the creation of new educational markets. Therefore, educational establishments, as producers and generators of knowledge and skills themselves become participants in these markets and make their own product — an open mind thinking information-rich, competitively capable professionals, about whom, Kant`s words, it was said that they must "be taught not thoughts, they must be taught to think". The implementation of such educational programs needs knowledge about knowledge to be formed. Knowledge of any objects, processes and phenomena is limited to what is contained in the knowledge system about them. Knowledge of any objects, processes and phenomena is limited to what is contained in the system of knowledge about them.

Knowledge representation in the form of the system suggests that the formation of ideas about the object, process or phenomenon occurs not only due to a trivial summation discovered facts, but by manifestation of emergent effects arising from intra interactions. The possible emergence of "new" knowledge of

the object puts the problem of analysis of conditions of interaction interconnectivity and interdependent structural components of the knowledge system. In this article, the object of the analysis refers to certain academic disciplines and especially those who are considered as masters.

Overview of the material on the subject. The XX century is full of events that are largely predetermined ideology of the world outlook of the XXI century. Textology of A.A. Bogdanov (Malinovsky), as a universal organizational science, is a harbinger of the work on systems theory of L. Bertalanffy and cybernetics of N. Wiener. Research of I.R. Prigogine laid the foundations for a structured approach and self-evolving systems with considering the synergy of G. Haken. The study of the mechanisms of formation of scientific ideologies and the role of science in the history of the theory of knowledge allowed T. Kuhn to introduce the concept of paradigm. It's time of shifting of the paradigm of receiving, collecting and using ~~of~~ knowledges, to the paradigm of their production. To this theme are devoted the works of K. Mainzer [1] R. Penrose and [2].

In work [3] it is stressed the need for establishment of paradigms, which allows the complex cognition. At the same time, special attention should be paid to educational systems in the multidisciplinary and multidimensional knowledge, considering, as a rule, not only less relevant principles of the context of globality, complexity and multidimensionality. On certain prejudices, of the specialized studies of individual academic disciplines is indicated in work [4]. About the necessity to consider the diversity of self-reinforcing growth, which leads to a global emergent property of complex systems, notes J. Petito [5] and I. Prigogine [6]. Despite thousands of years of trying to clear a single definition of "knowledge", it is stays, as stated in [7], essentially multi-valued and multi-faceted.

Presentation of knowledge in the form of the system allows you to emphasize its structural components, in a certain way to evaluate intra-structural and between-structural interactions, be closer to the possibility of accounting manifestation of the effects of new knowledge, to include elements of the system "subject-producer of knowledge" and "subject - user" of them. In addition, such a representation of knowledges allows you to update the basic ideas of mono-discipline based on their active participation in multidisciplinary methods of knowledge representation.

The goal is to determine specific structural components of knowledge systems and to evaluate their role in the formation of an unbiased expert thinking.

The methods adopted in the study.

In general, knowledge is the result of the knowledge of reality and its reflection in human thinking. Besides knowledge includes the collection of information, knowledge in different areas. The knowledge is produced by man and are for man. Therefore, the subject - the knower and the subject - consuming knowledge are essential elements of the structure of the system. The system is a set of elements that are in relationships and connections with each other, which form a certain comprehensive unity. The use of a systematic approach in the analysis of the meaningfulness of knowledges can reveal their integrity, to identify the variety of structural components, mechanisms of their interaction and mutual influence, to identify possible conditions for the appearance of new knowledge.

The main methodological procedures describe any of the primary system is the verbal method. As noted by I. Prigogine, a narrative method is the most promising and relevant in describing complex systems. In addition, the use of cognitive approaches, allows the use of metaphorical evaluating events, phenomena and processes. This, in turn, allows the method to attract certain analogies that can cause a number of associations. Collectively adopted technique allows us to describe and analyze the structural organization of knowledge systems.

Results and discussion.

Knowledge system is an open system that assumes its permanent self-renewal by building "information" structures that fill up a kind of library of cumulative knowledge. In such library, some knowledge eventually lose its relevance, some **knowledge** is unable to find the consumer, and some **knowledge** are in high demand. In addition, in the library some fragments of knowledge are distributed in different sections and folders. All this creates a certain multiple-choice of knowledge structure system. In general, in the system of knowledge can be distinguished conservative, metastable and active substructures.

Conservative subsystems contain basic general knowledge, which do not change for a long time within the existing paradigm. Metastable subsystem capable, while maintaining the basic "conservative" positions, self-development by synergetic, interdisciplinary influences. The dynamics and direction of the spontaneous self-knowledge systems define active sub-system capable of producing new knowledge that allows carrying them to auto-poetic systems [8]. A common structural element of subsystems for different purposes is the subject. Depending on its rooting in a sub-system it can simultaneously serve as

the subject- producer, the subject-consuming and the subject-producing. Thus, a necessary element of the knowledge structure of the system is the person himself and for himself, and ~~is~~ creates its own system of knowledge.

Appeared in this world a person becomes a member of the conservative subsystem (CS) since it enjoys unchallenged ideas and methods of imprinting (capturing) - the first lasting impression, perception, decision that forms the scientific ideology. The analysis showed that the CS has the following functions:

- Creates, upholds and protects the basic provisions adopted by the paradigms in all spheres of activity;
- Creates the range of activities and determines the conditions of preparation;
- Obligates to make training on the approved plans and programs with the help of textbooks, teaching aids, teaching materials, etc .;
- Creates a legislative and regulatory framework of state and departmental documents;
- Defines the priorities for the development of science and technology, socio-economic and human potential.

The essence of the CS is to make fine yesterday in excellent today. The main properties of the manual should include its inertia, on the one hand, it allows the system to accumulate knowledge unverified information, but on the other hand does not allow to get rid of the errors.

Metastable substructure (MS) contribute to:

- Expansion of existing information structures of CS;
- The creation of new structural groups of knowledge through the implementation of the potential of interdisciplinary approaches;
-Locally (partially) transforming of the basic models of the dominant paradigms;
-Formation conditions of occurrence of the need to develop knowledge about knowledge;
-Appearing and development of certain events, which are not adequate to the basic provisions of the manual;
-Displaying apparent actualization models of CS through the use of new methods of obtaining and processing information.

The main purpose of metastable structures can be reduced to the permanent need for more complete, taking into account the new competencies gained through interdisciplinary approaches, seek answers to three questions of I. Kant: "What can I know?", "What can I do?" " What can I hope for? ".

Conservative and metastable components (subsystems) system of knowledge structures form the scientific ideology of the existing paradigms. The presence of the MS creates, through interaction with the CS, the situations in which reconstruction of accepted models cannot be possible. The knowledge gained by manual methods, even considering the magnetic field effect, hinder cognitive development of the subject, caught in a passionate action field zone [9]. Having passionate impulse-knowing entity becomes a structural element of the active subsystem (AS) knowledge systems. The role of the AS:

- Encourages the increasing of the complexity of the system of knowledge;
- Is a source of deviations from the usual (lucky deflection disorganize the system of knowledge, reorganizing it);
-Creates new information structure;
- Promotes, *by* using the synergistic interactions unexpected manifestation that allows to bring in a system of knowledge effects of auto-poetic systems;
- Creates conditions for the realization of the Noah effect - teachings recognize omen for the purpose of preparedness for a possible offensive event;
- Makes the system of knowledge into a productive force;
- Causes a shift of paradigms, which leads to a restructuring of conservative and metastable components (subsystems).

Active elements objectively and necessary coexist and interact with conservative and metastable subsystems knowledge systems. Information on the role of the active components in the disclosure of the essential parts of individual general and special disciplines contained in articles and monographs. The active elements are relevant "here and now". They can further expand the horizons of ignorance, provoking the emergence of new knowledge as it was noted by V.V. Nalimov.

The co-existence of all structural components of the system of knowledge in one person suggests that in certain situations begin to dominate any components of the structure. These situations may include knowledge of control systems adopted in the curriculum. For example, the assessment of knowledge and skills in using the tests runs, usually thought jet aimed at storing the acquired information. In such situations, the conservative element works well. Obtaining positive results of assessment can create the illusion of successful educational plans. Prepared by a procedure specialist may not comply with the activities in modern conditions of shifting of the paradigms.

Thus, preparation of work programs should be based on rather complicated structural organization of system of knowledge of individual disciplines. This will place them in the appropriate directories of the library of the body of knowledges that will make it possible to create the conditions for inclusion in the work of interdisciplinary approaches.

Conclusions

The analysis showed that knowledge should be presented as the form of an open self-organizing complex structural system. The system of knowledge can be distinguished by their functional structural components in the form of conservative, metastable, and active elements (subsystems). The coexistence of the whole range of structural groups in the consciousness of the subject, the knower puts the problem of determining priorities shift orientation towards one structural component, which adequately meets the requirements of the current time. Therefore, training plans and work programs should be flexible, allowing implementing interdisciplinary approaches during the shift paradigms for training of specialists, who easily orient themselves in conditions of dynamic and acceleration of the developing world.

References translated and transliterated

1. K. Mainzer Complexity thinking: Matter, mind, humanity. The new synthesis. [Text]/K. Mainzer. - Moscow: Book House "LIBROKOM", 2009.-464p.

2. R. Penrose Emperor's New Mind: About the computers, thinking and the laws of physics [Text]/R. Penrose. - M .: Editorial URSS, 2003.-384p.

3. E. Moren Education in the future: seven urgent tasks //Synergetic paradigm, Synergetic of education. - Moscow: Progress-Tradition. 2007. - p.26-96.

4. Petiton J. La Semiophysique:De la Physique qualitative aux scinces cognitive// Passin des forms. Dynamique qualitative, semiophysique et intelligibilite. Paris: ENS Editions Fontenay – St. Claude, 1994. T.2. – p.499-545.

5. Petiton J. To the physics of the spirit: the humanities as the science of nature.//Facets of knowledge: science, philosophy, culture in the XXI century: In 2 books. Book 2 M:. Science, 2007-P.42-67.

6. I. Prigogine Creativity in the sciences and in the humanities: Exploring the relationship between the two cultures .//Synergetic paradigm. Man and society in unstable conditions. M:. Progress-Tradition, 2003.-p.99-105.

7. L.A. Mikeshina Discussions about a permanent state of

knowledge//Epistemology. Philosophy of Science. 2012. T.XXXIV, №4. - P.66-73.
8. U. Maturana The tree of knowledge: the biological roots of human understanding/U. Maturana, F. Varela - M. "Progress-Tradition" Publishing House, 2001,-224p.
9. L.N. Gumilyov Ethnogenesis and biosphere of the earth. / L.N. Gumilyov.- Leningrad: Punblishing house Gidrometeoizdatelstvo, 1990.-528p.

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IMPROVEMENT OF QUALITY OF MATHEMATICAL EDUCATION IN UNIVERSITIES FOR ACCOUNT OF CONTENT'S OPTIMIZATION OF MATH TEACHING

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Abstract. *In the article was considered an improvement of quality of mathematical education in Universities in connection with the reduction of academic hours for account of optimization of mathematical disciplines' content following the example of content optimization of course "Linear Algebra".*
Keywords*: modernization of education, optimization of content, teaching of math, linear algebra*

The main target of mathematical education's modernization is the improvement of its quality. The common way of modernization of mathematical education means the excluding from it the least important and the least actual topics and including new material, which provides first of all student's orientation on solving the tasks of applied content and also the requirements of other disciplines. Such discharging gives the opportunity to modernize the content of mathematical education where the most important questions are connected with real processes in the nature, technology and society, with visual view of their mathematical and computer model. The impossibility of decrease of requirements for quality of specialists' preparation leads to the necessity of reorganization of mathematical education's system depending on student's degree.

Lately there was a tendency for significant decrease of academic hours, which were given for studying of mathematical disciplines, with keeping the