

DIDACTIC PRINCIPLES OF EDUCATIONAL SYMBOLIC CHEMICAL MODELS

Jabborov Farkhod
Karshi State University

ABSTRACT

In this article, the essence of educational symbolic chemical models is given. Together with this, the description and explanation procedures of the educational process, the functions of educational symbolic models which are based by scholars, the visual character of educational symbolic chemical models are observed. Also, the role of educational symbolic chemical models in the implementation of the principles are analyzed.

Keywords: Educational symbolic chemical models, description, measurement, processing of empirical data, explanation, prediction, coordination of theories, interpretation, criterial function, general methodological base, epistemological function.

INTRODUCTION, LITERATURE REVIEW AND DISCUSSION

The didactic functions of educational symbolic chemical models are based on the consideration of the general methodological functions of symbolic models. The most important of them are considered the functions: descriptive, explanatory, prognostic, and the cognitive process control function [8; 10] V.K. Lukashevich divides them into the class of heuristic and criterial functions, in accordance with the inclusion of models in a particular or another process of the whole diversity of their functions in scientific knowledge (description, measurement, processing of empirical data, explanation, prediction, coordination of theories, interpretation and criterial function) and distinguishes functions of empirical and theoretical explanation of the empirical and theoretical truth criterion among them [8, p. 51]. There are various approaches to the consideration of the functions of educational symbolic models, however, most authors take the general methodological functions of the models as a base.

O. S. Zaitsev [5] writes that the description and explanation procedures are the most common in the educational process. Usually, the scientific description (reflection) of object is built in accordance with its structure. A description of multi-level target object should also be done at several levels. The need for multi-level description increases with the complexity of the object. The description of the target object is performed according to the scheme: an undivided whole - analysis of the object - secondary synthesis. The procedure of explanation can be equated to the method of scientific research, the immediate function which is to reveal the essence, the internal nature of the investigated object. The following types of explanations are distinguished: causal, investigative, structural (external and internal). In science, these types form a single structural and functional explanation.

Functions of educational symbolic models, which L. G. Peterson distinguished [9], illustrate the general methodological base for the separation of functions:

1. The epistemological function consists of the possibility of a simplified indirect study of objects of science, the direct study which is not possible because of certain circumstances.
2. The illustrative function consists of creating sensory supports for analysis and generalization.

3. Heuristic function. The model serves to gain new knowledge.

4. The integrative or integrating function consists of establishing a single norm of knowledge.

Educational symbolic chemical models in relation to replaced objects include:

- a means of description is noted with the help of special symbols of objects of study (research) and the relationship between them;

- a means of explanation reveal the essence of the studied object through the disclosure of the semantic meaning and structure of the symbolic model;

- a means of forecasting can be gained new knowledge about the original and / or unknown (at this stage of study) objects by exploring the content and links.

In the case of using educational symbolic chemical models as a means of implementing the functions of scientific knowledge, a descriptive function is considered as the part of this dissertation research; descriptive and explanatory function, as the process of establishing connections and relationships within educational symbolic chemical models are always preceded by its description, presentation as the means of visualization; descriptive, explanatory and prognostic, as the process of establishing prospects for the development of phenomenon using educational symbolic chemical models is always preceded by the establishment of the laws of the functioning of this system which is based on the disclosure of structurally meaningful relationships within it.

It should be emphasized that they are the means of realizing the didactic principles of chemistry education identifying the didactic functions of symbolic chemistry models. The principles of studying are considered in modern didactics as recommendations directing pedagogical activity and the educational process as a whole, as ways to achieve pedagogical goals. The essence of any principle is “a recommendation, a guideline in the ways of achieving a measure, harmony, productive interaction in a combination of some opposite sides, principles, and trends of the pedagogical process” according to the thought of V.I. Zagvyazinskiy [4]. In the textbook of G.M. Chernobelskiy the following generally recognized, fundamental principles are observed: scientific, accessibility, consistency, systematic, historicism, the relationship of learning with practice [12]. In our opinion, the role of educational symbolic chemical models in the implementation of the principles is most fully observed: visibility; systematic and consecution; consistency; strength; scientificness; the relationship between theory and practice.

The principle of visibility. Visibility is one of the most obvious features of educational symbolic chemical models. We note that memorizing a number of concepts which is structured in the symbolic form, is better, easier and faster than the same series, but in verbal form on the basis of rules, conditions and mechanisms of memorization [6]. The visual character of educational symbolic chemical models contributes to the formation of the most distinct and correct ideas about studied subjects and phenomena.

Ergonomic studies highlight a number of general principles for the construction of symbolic models [2]: conciseness, generalization and unification, emphasis on the basic semantic elements, autonomy, structurality, staging, the use of familiar associations and stereotypes.

The principle of systematic and consistency. Schemes, algorithms which are expressed in the form of flowcharts, oriented graphs and other types of symbolic models provide students with the assimilation of the knowledge system, and others, not only reflect the internal structure of the content elements of the educational subject, but also allow them to organize their operational assimilation. The educational symbolic chemical models are the excellent means

of expressing continuity in both content and educational methods among other didactic functions. It is important to organize activities using educational symbolic chemical models throughout the whole educational course: from the ability to extract information from the presented models to self-construction of alternative proposed symbolic models.

The principle of consistency. The presentation of educational symbolic chemical models in the form of graphs implements an important requirement of logicity, consecution and continuity, when each subsequent knowledge or skill is based on the previous one and continues it [7]. The inclusion in the educational process of educational symbolic chemical models allows students to formulate methodological knowledge [1].

The principle of strength. Knowledge and beliefs which are logically interconnected through the structure of educational symbolic chemical models, are acquired more firmly than disparate information. The ability of use educational symbolic chemical models exempts from unnecessary memorization in order to obtain information (new, additional, reference).

The principle of scientificness. When we talk about the possibility of educational symbolic chemical models in order to realize the principle of scientificness in teaching, first of all, it should be noted the ability of build both deductive and inductive education on their basis, and the use of abstraction, which allows to understand more concretely. The dialectical approach to the study of the school subject of chemistry, elements of scientific thinking are formed for creating the structure of educational symbolic chemical models, establishing a relationship between the elements of educational content on the basis of the logic of science.

The principle of the connection of theory with practice. Symbolic modeling can be one of the means of practical processing of theoretical knowledge which will entail the emergence of the new model. The theoretical knowledge can be applied in practice in solving problems, exercises, and performing laboratory experiments on the basis of familiar algorithms.

Different authors who have been exploring symbolic and symbolic-emblematic models, distinguish their various specific functions. In our opinion, the following functions will be characteristic for educational symbolic chemical models.

We note that educational symbolic chemical models are considered the means of developing abstract thought, referring to the dissertation research E.V. Bystritskaya [3].

The importance of implementing informative interdisciplinary connections between physics and chemistry [13, p. 48] is revealed in the monographes of A.V.Usova, M.D.Dammer, M.J.Simonova [11], in the doctoral dissertation of O.A.Yavoruk. We note on the basis of them that educational symbolic chemical models are considered the means of implementing meaningful - informational interdisciplinary connections of chemistry with subjects of both natural science and the humanities.

The experience of using educational symbolic chemical models in the process of teaching chemistry shows that the same symbolic model can perform different didactic functions depending on the educational situation. And at the same time, any iconic model almost never performs only one didactic function.

When we summarize the features of the manifestation of the functions of educational symbolic chemical models in the process of teaching chemistry, we note that educational symbolic chemical models exhibit a multifunctional character, they are at the same time a means of:

- structuring and presentation of subject relationships - on the level of knowledge - substant- information;
 - on the level of student activity - operational-activity;
 - on the level of teacher activity - organizational - methodological.
- formation of chemical knowledge in unity with their adequate chemical skills when they are included in the educational and cognitive activities of students.
- organization of management of cognitive and practical activities of students in the system of targeted actions of the teacher;
- implementation of teaching methods of chemistry.

Thus, the methodology for using educational symbolic chemical models are proposed as the multifunctional means of forming generalized chemical skills on the basis of structurally-substantive features of educational symbolic chemical models, the possibility of their multifunctional use in the process of teaching chemistry.

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