MODELS AND MODELLING IN CHEMISTRY EDUCATION IN THE HIGHER MEDICAL EDUCATION SYSTEM

ASSOS. PROF. DR. V. HADZHIILIEV
Department of Chemistry and Biochemistry, Medical Faculty,
Trakia University - Stara Zagora, Bulgaria;
vashi@abv.bg

Abstract:
The objective of this paper is to consider the "classical" forms of training in higher medical school and try to give a new reading of the organizational forms of training, updated by the modern requirements addressed to the higher education institutions in Bulgaria, after adoption of the credit accumulation and transfer system. The compulsory training, which meets the requirements of the MILC, shall be conditionally made module A. Under this module, students attend both forms of training – lectures and practical exercises. The second group of activities builds on the knowledge and skills to be included in module C. This activity is built only on a type A activity already carried out, including free-elective and optional preparation in Chemistry. The formation of scientific competencies is carried out through direct scientific work, including literature review, searching for a suitable methodology for work, drawing up an experimental plan, reporting and analyzing the results of a real experiment (module C). This activity builds on the previous two and includes elements of reproduction and creativity.
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Models and modelling.

The word "model" has a Latin origin, derived from "modus", which means image, measure, ability. The initial use is in construction (architecture) to denote different types of samples. Its use in Mathematics began after the creation of Analytic geometry by Descartes and Fermat. In Natural sciences (Biology, Chemistry and Physics), the term "model" began to be used to refer to the object a particular theory refers to or it describes. Dozens of definitions can be found for the models, as the one of the Shtoff, V. A. is: "Models are such mentally conceived or materially realized system that, by representing or reproducing the objects of study, are capable of replacing them so that studying the models provide new information about this objects." [1]

V. A. Venikov offers the following classification of models for the needs of technical modelling by typifyng them in five large groups:

I. Logical models which, based on certain physical ratios, analogies or equations, give an idea of the phenomenon studied. (the atom model, a model of the nervous system, different calculation programs, etc.).

II. Geometric patterns. These models reproduce various facilities, preserving geometric similarity, not the similarity of the phenomenon.

III. Physical models. These models according to V. A. Venikov can be complete (where the similarity is presented both in time and in space) and incomplete models (representing the similarity of a place, or just time, or just space).

IV. Mathematical models. This modelling uses the fact that quite different phenomena can have the same differential equations, characterizing the flow of processes in different conditions.

V. Digital models. Under digital models V. A. Venikov understands "machines which continually receive data for one or another phenomenon, which they process, and thus characterize a certain process." [2]

The process of building of models is called "modelling" and the definition I. B Novik gives of the method forms a good picture of its essence: "Under modelling, we understand the method of theoretical or practical operation with objects where not the object itself is directly

examined, but used is an auxiliary artificial or natural system (quasi-object), located in a certain objective line with the known object, capable of replacing it at certain stages of knowledge and finally giving information on the object being modelled itself." [3]

The modelling method is applied both on an empirical and theoretical level of study. Some authors such as B. A. Glinsky [4] state that at the empirical level it can be used to perform measuring, descriptive or other functions, and at the theoretical level - for the performance of interpretation, explanatory and predictive function, as well as for functions in the thought experiment. Moreover, as the author writes, at both levels (theoretically and empirically) it can perform criterion function. According to him, modelling can be used at all stages of the scientific research process. B. A. Glinsky rightly stresses that this diversity of epistemological functions, gives the modelling method a great significance and is one of the most important reasons for its increasing prevalence.

Didactical models are the result of research into the practice of learning. They offer teachers the thinking structure that arranges the complex factors in the training and helps the practice, offering clarity of the circumstances and forms of manifestation of the training. The didactic models put relevant performance criteria on the training participants. They are a prerequisite for the learning process to be considered and investigated by a different scientific-theoretical position, i.e. to be viewed through a different didactic perspective. For mastering the didactic competence for planning, reflection and model of behaviour, necessary is not only the experience gained in the teaching process, but also consultation and justification through theoretical concepts. Combining the theoretical with the experience creates the prerequisite for building the didactic competence for activity, i.e. building the didactic model of behaviour in the lecturers. Some authors point out that "modelling in training has a great importance in developing students' thinking, their skills for using it in predicting actions and operations in the complex process of learning different abstract concepts." Therefore, according to the author, the use of modelling is associated with great perspectives in the field of psychodiagnostics. [5]

Models and modeling in medical pedagogy.

Medical pedagogy is a type of professional pedagogy aimed at the medical professionals training. Subject of Medical pedagogy are the regularities of the process of instruction and education in the medical educational institutions – colleges, institutes, faculties, universities. The trends and prospects of developing higher medical education are analysed on this basis. The European equivalent term of the discipline "Medical pedagogy" is "Medical education" – a pedagogical field, justifying the scientific regularities of the process of instruction and education in the medical educational institutions. Medical pedagogy is based on the theoretical basis of General pedagogy, uses its concepts by analysing the individual pedagogical phenomena in view of the specifics of training and education in higher medical school. Given that medical personnel is being trained in higher medical schools for the needs of practical health care, medical education is defined as a type of professional pedagogy. The student in the higher medical school is not a student but an adult. Therefore, the planning and organisation of his/her training should be carried out in accordance with the requirements of the Andragogy and not the school pedagogy. The student in the higher school is not the subject f influence, but becomes a partner in the learning process. By taking responsibility for his/ her own learning, the medical student shows his/her preference for the objectives, tasks, content, methods and overall organization of the learning activity. The process of training in higher medical school as a binary process is presented through the subjective factor – *student-teacher*, with their specific learning activities – *teaching and learning*. The objective of modern medical training is to assist the student in self-mastery of knowledge, skills and habits, in mastering behavioural algorithms, evaluating relationships and embracing different styles of team communication. [6]

A number of authors point out that the models occupy an important place in the practical training of the medical higher school – working with phantoms, plaster casts, models of patients composed of ECM, models of patients, when the role of the patient is played by a specially trained instructor, etc. [7]

Didactical modelling and didactic models, although not models in the very sense of the word, perform certain cognitive functions. V. Nisheva offers three didactic models for conducting a training and practical session. For the first model (Model A), the training and practical session takes place with the leading role of the teacher. This classic form of practical exercises is traditional and does not create the necessary creative environment. Even the arrangement of the training halls is traditional - type "class-bus". For the second model (model B), the lecturer is more of a leader or a facilitator for the work of the group than an arbitrator or leader. The lecturer and the students are arranged a circle, seeing each other, avoiding the distance between the presenter and the participants, and this creates the impression of equal treatment. Students take on much of the control and responsibility for their own learning and initiative. This model is useful in clarifying different opinions, analysis and interpretation of facts and situations and leads to the formation of personal opinions, attitudes and values. The control over students activity is replaced by the management of this activity, with a reasonable and balanced distribution of power`s and responsibilities. For the third model (model C), the conduct of the practical activity is done under the leading role of a student-facilitator. This requires the advance preparation of the students appointed (written materials, slides, lantern-slides, etc.) for this role in order to be able to present certain problems to their colleagues. The role of the lecturer consists in preliminary discussion of objectives, methodology and other, the conduct of exercises, support during the very exercise and summarising the main points and conclusions of the exercise. The positive points of this model are that students are stimulated for additional self-preparation, responsibility to their own learning, formation of skills for oral presentation and discussion skills. [8]

Models and modelling in chemistry education at the higher medical school.

Chemistry as an academic discipline has its traditions in the system of higher medical education in Bulgaria. It was included in the curriculum at the opening of the Medical Faculty of Sofia University in 1918. Under the curricula of all medical higher schools, Chemistry is studied in the first course as a pre-clinical academic discipline. The curriculum includes lectures and exercises with a total workload of about 100 academic hours. The lecture course focuses on the new achievements of modern chemical science and is consistent with the needs and requirements of higher medical education. Practical exercises also give students a certain amount of theoretical knowledge, but the emphasis is on the creation and development of certain skills, observation and accuracy in students. Students prepare records, prepare themselves for seminars, colloquiums, practical exam, etc. [9]

Modelling and models in chemistry education allow more optimal handling with the visuals, as the learners are involved in their construction and in analyzing their features and characteristics. This enhances learners' interest, autonomy and creative potential. The good knowledge of modelling is the lever to the pedagogical creativity of the lecturer. [10] Especially appropriate in the training in "Medical chemistry" is the use of the so-called stereo models. They are perfectly suitable to present the mutual arrangement of atoms in space. The most illustrative are the models of the different variants of the stereo models of Briegleb-Stuart and Dreiding. The first models are spheres, the dimensions of which relate to the atoms in a certain respect. The latter are made of rods of length, corresponding to the interatomic distances. Using them, the length of the connections, as well as the valence- interplanar angles are more visually demonstrated. [11]

The didactic models of the organization of the Chemistry course in the higher medical school were proposed based on the theoretical analysis of the chemistry education course. These models can be referred to schemes that may occupy a different structural location in pedagogical activity, which means that modelling is considered here as a method of study in general and not as a method of training or a method of learning activities.

Analysed were the organizational forms of training in Chemistry and the object–subjective relationships that are accomplished between the participants in the educational process – teacher – student. [12] At the modern stage, organizational forms can be grouped into three categories – compulsory preparation (Type A model), additional training - elective and optional (Type B model) and scientific work (Type C model). The compulsory training covers the requirements of the MILC (minimum information level of competence). Students attend both forms of study – lectures and practical exercises, where the results of their activity are recorded through permanent and final control. A new moment related to the introduction of the "System of accumulation and transfer of credits in higher schools" is the introduction of the evaluation criteria, giving account of the year-round activity of students. Type A learning activity is an integral part of the medical students practical preparation in Chemistry. Adopted in the curriculum of the specialty "Medical Chemistry", it is implemented by the students and controlled and evaluated by the lecturers. Pointed out should be that in the higher school chemistry lecturers are usually more than one. They have established communication on the inter-departmental control and coordination of the educational content. Students` preparation before lectures implies: study of educational and additional literature on the topic, performing pre-assigned tasks (drafting of records, discussion of lectures, articles, and other studies, work with programmed materials for self-study and self-control, etc.). The individual work of this type – lecture and extramural is associated with the compulsory preparation in Chemistry under the curriculum of the specialty Medicine.

The second group of activities is the additional preparation in Chemistry (free elective and optional). This activity builds on knowledge and skills and is developed only on the already implemented Type A activity. It is characterized mainly by group, and often with individual organization of work, as well as with higher extramural engagement of students. It aims to deepen and broaden the theoretical and practical knowledge and skills of the students in Chemistry; formation of knowledge on the handling of additional educational and scientific literature; building skills for analysis, selection and evaluation of educational and scientific content; drawing of the essential moments on a given topic; drawing of referrals; preparation of presentations and their presenting; additional laboratory work aimed at completing and mastering of the laboratory habits and skills. This requires the teacher`s accurate assessment of the volume of the recommended literature, according to the opportunities and budget, the students' time; creation of habits for rational use of the available educational and scientific base – departmental, faculty, university: libraries, study and scientific laboratories, internet halls, etc. Thus, the activities of Type A and C ensure the completed cycle of teaching activity in Chemistry of the motivated medical student.

When building the model of Type C activities – scientific work on Chemistry, we can take into account that the scientific adviser (usually one) shall involve scientific activity in Chemistry in two interrelated strands – theoretical training on the topic and practical (laboratory) work. The scientific adviser supervises and assists the implementation of the scientific work by controlling the scientific realization of the student through the obtained scientific results. The self-control, the student must be able to implement, is particularly important for this activity. The interaction, now takes place between the subject – the scientific adviser and the student. The accumulation and mastering of the new knowledge and the formation of specific laboratory skills are carried out through direct scientific work, including literature review and analysis, searching for appropriate methodology for work, drawing up of

an experimental plan, reporting and analysis of the results of a real experiment. This activity builds on the previous two and includes elements of reproduction and creativity re-creation. In recent years, scientific work is mainly work on projects, where the scientific adviser activates the scientific activity of the students in two interrelated strands-theoretical training and literature review on the topic and practical (laboratory) work. The motivation of the participants is long-term, with sufficient mechanisms and incentives to motivate students to scientific work, which forms the image of the future professional. Thus, the model of C type activities reflects the object-subjective relationships in carrying out the scientific, creative activities of the students.

In conclusion, it can be said that the models considered can be used both as schemes performing illustrative functions and as didactic models, that offer lecturers the thinking structure that arranges the complex factors in training and helps the practice, offering clarity of the circumstances and forms of manifestation of the training, which shall lead to increasing the quality and effectiveness of the learning process in the medical higher schools.

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