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COMPETENCY APPROACH TO STRUCTURING THE CURRICULUM ON BIOLOGICAL AND BIOORGANIC CHEMISTRY

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It has been a significant task to deepen, develop and improve the design of academic process according to the standards of higher education towards quality management system extrapolating to the level of departments and each individual teacher. Determining the structure of training programmes on specific subjects of the curriculum for masters of medicine has become a part of the activity which simultaneously connects the work of quality management system and a demand to apply competency approach. The article substantiates the importance of structuring the curriculum in biological and bioorganic chemistry in the framework of the academic plan of undergraduate training of future physicians as an important element of the department stage of designing educational activities. The investigation elucidated the experience of the Department of Bioorganic and Biological Chemistry of the Bogomolets National Medical University as the basic department in development of the curriculum structure in the discipline on the base of competency approach, which is an important element of the department stage of study design for future physicians. Thorough development of elements of the curriculum taking into consideration anticipated results of learning according to the standard of higher education is the pledge of improvement of the quality of professional competencies development of students. Selection and optimization of the content of didactic material, coordination and synchronization of teaching its components with the study of other medical and biological disciplines helps unload students and facilitates mastery of the content of the curriculum, is the key to consistent and systematic process of forming integral, general and special competencies. Defining clear educational objectives for students according to the competency approach and selection of appropriate learning materials for each topic on biological and bioorganic chemistry will reduce the time to master the material and further increase the quality of training of future physicians at the undergraduate level.

Key words: *curriculum, biological and bioorganic chemistry, design of educational process, educational program, higher medical education, improving the pre-diploma training of physicians, modernization of the educational environment, quality of training, quality management system, structuring of discipline.*

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КОМПЕТЕНТНІСНИЙ ПІДХІД ДО СТРУКТУРУВАННЯ НАВЧАЛЬНОЇ ПРОГРАМИ З БІОЛОГІЧНОЇ ТА БІООРГАНІЧНОЇ ХІМІЇ

О. В. Стеченко

Важливим завданням було поглибити, розвинути та удосконалити проектування за стандартами якості ISO в напрямі екстраполяції системи управління якістю (СУЯ) Університету на рівень кафедр та кожного окремого викладача. Визначення структури навчальних програм з окремих дисциплін навчального плану підготовки магістрів медицини стало частиною такої діяльності, яка одночасно пов'язала роботу СУЯ та необхідність застосування компетентнісного підходу. В статті обґрунтовано значення структурування навчальної програми з біологічної та біоорганічної хімії в рамках навчального плану додипломної підготовки майбутніх лікарів як важливого елемента кафедрального етапу проектування освітньої діяльності. Дослідження розкриває досвід кафедри біоорганічної та біологічної хімії Національного медичного університету імені О. О. Богомольця як опорної в розробці структури навчальної програми з дисципліни на засадах компетентнісного підходу, що є важливим елементом кафедрального етапу проектування навчання майбутніх медиків. Ретельна розробка елементів цієї навчальної програми з урахуванням очікуваних результатів навчання відповідно до стандарту вищої освіти є запорукою підвищення якості формування професійних компетентностей здобувачів освіти. Відбір та оптимізація змісту дидактичного матеріалу, узгодження й синхронізація викладання його компонентів з вивченням інших медико-біологічних дисциплін розвантажить студентів і сприятиме фасилітації опанування ними змісту навчальної програми, що є запорукою послідовного та системного процесу формування інтегральної, загальних та спеціальних компетентностей. Формулювання чітких освітніх цілей для студентів та підбір адекватних навчально-методичних матеріалів до кожної теми з біологічної та біоорганічної хімії зменшуватимуть час на опанування матеріалом та допоможуть подальшому підвищенню якості підготовки майбутніх лікарів на додипломному рівні.

Ключові слова: *навчальна програма, біологічна та біоорганічна хімія, компетентнісний підхід, додипломна підготовка лікарів, модернізація освітнього середовища, підвищення якості навчання, проектування освітнього процесу, система управління якістю, структурування дисципліни.*

Introduction of the issue. In response to the challenges of the transformation of higher medical education in Ukraine in line with the European integration vector, the Ministry of Health of Ukraine has initiated the transition to training of specialists in the field 22 "Health" of the second (Master's) level of higher education since 2016. Following this, the inter-University coordination group was created, that developed a draft standard of higher education for masters in the specialty 222 "Medicine" taken by institutions of higher medical education as a basis for the development of licensing cases. An important aspect of this transition was the direct application of competency approach to the formulation of learning outcomes according to the mentioned curriculum. However, this was only the first – institutional – level of implementation of a competency approach to designing educational activities, which was supported at the second – administrative – level of each institution of higher medical education when approving educational programmes and curricula. Since the design of the educational process is one of the most powerful means of influencing the quality of educational services, this process has been carried out at the NMU in the context of the QMS. An important task was to deepen,

develop and improve designing in accordance with ISO standards in the direction of extrapolation of this system to the level of departments and each individual teacher. Determining the structure of training programmes on specific subjects of the curriculum for masters of medicine training has become a part of the activity, which simultaneously linked the work of the QMS and the need for a competency approach.

Current state of the issue. Shifting attention to the consideration of the content of higher education in the context of educational outcomes has marked an important step towards its transformation in order to improve its quality, as it involves the formation of specialists, not only equipped with a certain set of knowledge and skills, but quite ready to use them in of their daily activities. It has been the concept of competency that was the key concept to assessing educational outcomes through the combination of intellectual and applied aspects, which in the most optimal way increases the level of satisfaction of education applicants. Therefore, the notion of competency implies an interpretation of the content of education formulated from the result expected by the main stakeholders of the educational process. But also competency is a complex and dynamic phenomenon, which integrates not only knowledge and practical skills, but also values, communicative and other abilities of students, which are formed and developed within the educational process, provided that there is qualitative development of the educational environment in a particular higher educational institution.

The structure and components of successful educational programs are described by Doris Layton MacKenzie in a relevant monograph [8: 9]. She emphasized that it is vital skills that are key to the interest of the students when choosing an educational programme, and this fact needs to be taken into account when designing and developing curricula.

Dolnikova and O. L. Tsubova [3: 381] by analyzing didactic approaches to structuring the content of educational material have demonstrated in their research an example of separation of the main elements of the structure and provided justification for the nature and usefulness of the system approach.

N. G. Denysenko [2: 299] has elaborated the content of professional and general values and vital competencies in the process of development and implementation of an educational professional programme for the training of teachers of physical education. V. Lutfullin showed that the structuring of learning material in school education could be the main factor in the elimination of learning overload [5: 26], which is advisable to use as a positive experience for designing educational programmes in the disciplines of curriculum for future physicians.

Higher medical education (as one of the examples of professional training) is determined by Ya. M. Nahaieva as a symbiosis of "the methods, means and processes necessary to create an organized, purposeful professional influence on the formation of personality with given properties" [6: 113]. On the example of the educational disciplines "Life Safety" and "Fundamentals of Labor Protection", the problem of structuring has been studied by S. P. Hvozdii [1: 63] who showed that the selection and division of content of educational disciplines into elements should provide horizontal interdisciplinary connections and take into account the principle of conformity with the needs of the present. Investigation of principle approaches to teaching biochemistry at the I. Horbachevsky Ternopil National Medical University, presented by M. M. Korda with co-authors,

demonstrated that the implementation of a competency approach is a key factor in the professional development of future physicians, including at the stage of learning basic theoretical disciplines. It is important to introduce a matrix of competencies into methodical guidelines for students when setting up the mastering of the subject [4: 58].

The outline of unresolved issues brought up in the article. At the same time, the issue of reflecting approaches to development of the specific competencies of future physicians within learning of biological and bioorganic chemistry is still out of the researchers consideration.

Aim of research is to reveal the experience of the Department of Bioorganic and Biological Chemistry of the Bogomolets National Medical University as the basic department in development of the curriculum structure in the discipline on the base of competency approach, which is an important element of the department stage of study design for future physicians

Results and discussion. The entry of Ukraine into the Bologna process began in May 2005 since its accession to the European Community of Education and Science in Bergen. In Ukraine, the requirements of "Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG)", developed by the European Association for Quality Assurance in Higher Education, has being just introduced since 2014 after the Law of Ukraine "On Higher Education" has been approved determining levels and elements of the system of quality assurance in higher education in the article V. But even today, in 2019, not all of the provisions of the mentioned Law on the territory of our state have been fully implemented. However, the requirement for the establishment and operation of the internal quality assurance system is the easiest to implement. At the Bogomolets National Medical University (NMU) the quality management system (QMS) was introduced and licensed in accordance with the international quality assurance standards ISO 9000:2008 in 2015. Thus, the University has significant experience in its influence on various aspects of functioning [7: 269]. Through the prism of process management, the principles and approaches to the work of all units of the NMU were reviewed and transformed, and the principle of continuous improvement was declared as the main methodology for solving any issues of daily work. The design of the educational process, as has already been mentioned, is an integral part of the university QMS, thus, it fully corresponds to the classical Deming-Shewhart cycle (plan–do–check–adjust). In the context of quality management, a scheme for the formation of competencies of future physicians when they study certain disciplines, including biological and bioorganic chemistry, can be presented (Tab. 1).

As it is seen from the Table, multi-level cyclic cooperation of various parties of the educational process – University administration, department, each teacher and students – is laid as the basis of students' teaching of the discipline "Biological and Bioorganic Chemistry". Designing of the curriculum structure on discipline is considered as derived from higher levels – administrative and state (sector). And in case of observation the department level, determined on the base of the experience of the Bogomolets National Medical University (*see* Tab. 1), the importance of this work in the overall picture of the complex process of developing the integrative, general and special (professional) competencies of future physicians, which are laid at the level of sectoral requirements for

specialists and approved by the Ministry of Health and Ministry of Education and Science of Ukraine, becomes clear.

Table 1

Scheme of the process of competencies formation of future physicians in the context of process management

<table>
<tr><th colspan="2">A. PLAN</th><th colspan="2">B. DO</th></tr>
<tr><td rowspan="2">Level of administration</td><td>1. Sectoral requirements analysis (Higher Education Standard)</td><td>1. Approval of an educational programme</td><td rowspan="2">Level of administration</td></tr>
<tr><td>2. Development of curriculum and list of staff members</td><td>2. Approval of curriculum and list of staff members</td></tr>
<tr><td rowspan="4">Level of department</td><td>3. Development of the curriculum structure on discipline in order to create the best opportunities for the development of competencies</td><td>3. Teaching of the discipline and implementation of the curriculum in the aspect of the development of competencies</td><td>Level of department</td></tr>
<tr><td>4. Structuring of the content of each lesson.</td><td>4. Implementation of the curriculum structure on each lesson.</td><td>Level of teacher</td></tr>
<tr><td>5. Selection of methods and means of teaching and control</td><td rowspan="2">5. Students' work according to the curriculum, the plan of lectures and practical (seminar) classes, the individual students' work according to materials developed by the department</td><td rowspan="2">Level of student</td></tr>
<tr><td>6. Preparation of educational and methodological materials</td></tr>
<tr><th colspan="2">D. ADJUST</th><th colspan="2">C. CHECK</th></tr>
<tr><td rowspan="3">Level of department
Level of teacher</td><td>1. Making amendments to the thematic plans of lectures, practical (seminar) classes, proposals for changes to the administration of the University regarding the amendments to the curricula.</td><td>1. Conducting the current, intermediate and final control of the level of knowledge acquisition, skills and competence development</td><td rowspan="3">Level of department

Level of teacher</td></tr>
<tr><td>2. Improvement of methods of control, means and methods of developing competencies, teaching and methodological support</td><td>2. Analysis of the control results</td></tr>
<tr><td>3. Conduct additional counseling before completing LIE "Krok"</td><td>3. Analysis of the results of LIE "Krok"</td></tr>
</table>

In accordance with the standard of higher education of the Master of Medicine, during the training at the undergraduate level, the following special competencies that are implemented during the training of biological and bioorganic chemistry should be developed:

1) the ability to determine the required list of laboratory and instrumental examinations and evaluate their results;

2) the ability to establish a preliminary and clinical diagnosis of the disease;

3) the ability to determine the nature of nutrition in the treatment of diseases.

These competencies are developed not only within studying biological and bioorganic chemistry as an isolated discipline, but partly and indirectly – through the interaction of the acquired knowledge and skills of the disciplines of natural sciences and professional training.

Consideration of the composition of the human body and the combination of biochemical transformation helps to formulate the idea of it as an integral system of interrelated components that have peculiarities of metabolism depending on conditions, age and health status. Through the acquisition of knowledge about the structure of the main types of biomolecules, their reactivity and the main types of transformations in cells under normal conditions, one can understand the biochemical and molecular bases of physiological functions of cells, organs and integral human organism. And this, in turn, underlies the understanding of changes in biochemical parameters in case of the occurrence of certain pathological processes, which are a prerequisite for the emergence of human diseases.

Deep knowledge and appropriately developed by the department means and methods of training help students gain the ability to: analyze the relevance of the structure of bioorganic compounds to the functions they perform in the body; to interpret the peculiarities of the physiological state of the organism and the development of pathological processes on the basis of laboratory investigations data; to analyze the peculiarities of the structure of molecules and transformations in the organism of bioorganic compounds, which are a prerequisite for their pharmacological effect as medicinal preparations; to explain the biochemical and molecular bases of physiological functions of cells, organs and systems of the human body; to interpret the biochemical mechanisms of occurrence of pathological processes and the principles of their correction, including – through the direct use of pharmacological agents.

Taking into account the considerable experience of teaching medical students, the Department of Bioorganic and Biological Chemistry distributed the learning material into three main content modules, which are learned during the 1st and 2nd courses: 1) biologically important classes of bioorganic compounds. Biopolymers and their structural components; 2) general patterns of metabolism; 3) molecular biology. Biochemistry of intercellular communications and functional biochemistry of organs and tissues.

During the study of the first content module, students acquire knowledge about the structure of the basic classes of bioorganic compounds that are part of the human body and / or used as drugs; learn to establish a connection between the structure of compounds and their chemical properties and biochemical role in the body. The second content module (the study of which falls on the third semester of the second year) forms the knowledge about the laws of the enzymatic

processes of metabolism, involving the transformation of carbohydrates, lipids, amino acids and proteins, as well as the basics of the regulation of metabolism. The study of the third module covers the material of molecular biology and functional biochemistry of tissues and organs, combining knowledge of the two previous content modules at the new integrative level. Thus, the learning, skills and mastery of competences go from simple to complex and the theoretical material precedes the consideration of practically oriented information, which ends with the coverage of new trends in medicine, especially at the interface of its merging with molecular biology, and modern methods of diagnosing diseases based on the results of laboratory studies.

Therefore, the indicated structuring of the curriculum on biological and bioorganic chemistry will contribute to the formation of a number of general competences for specialists of the second (master's) higher education level of specialty 222 "Medicine": the ability to abstract thinking, analysis and synthesis, the ability to learn and master modern knowledge; knowledge of the subject area and understanding of professional activity; communicative competency. Using carefully selected tests in the A format, situational tasks close to the realities of the medical practitioner work allow us to develop the ability to apply the acquired knowledge in practical situations, as well as to adapt to acting in new situations. Work on laboratory and practical research helps develop the ability to make grounded solutions, work in a team, and develops interpersonal skills. The multi-level system for controlling knowledge and practical skills allows developing perseverance and certainty about the tasks and responsibilities that are being undertaken.

At the level of the curriculum implementation, it is important to work out the materials of each class in the context of a competent approach and to enrich the teaching tools and teaching techniques with new examples from colleagues' best practices. Since the amount of study hours allocated to each content module provides about 37 % of the time for independent work of students, it becomes extremely important to determine precisely the level of autonomy and responsibility of students for "finding various sources, processing and analyzing information on specific topics of the subject , the ability to express new ideas, assumptions, motivation, deliberately make grounded solutions and bear responsibility for them" [4: 57]. Moving from the determined role of the teacher as the key and main participant of the educational process to increase of the role of the student in mastering biological and bioorganic chemistry can be effective only if the department develops teaching materials of the new generation: taking into account the matrix of competencies, combining approaches of full-time and distance learning with the use of interactive platforms, especially when preparing for licensed integrated examinations (LIE) "Krok 1. General Medical Training".

Using the results of passing by medical students of LIE "Krok 1" (as a form of independent external evaluation) by medical students is important in terms of strengthening teaching of the learning material and deepening development of the skills of using knowledge from those topics which students of the NMU have learned worse than the average medical student in Ukraine. The practice of additional counseling, conducting problem-solving lectures at the stage of the pre-exam training has already proven its effectiveness, which is demonstrated by an increase in the percentage of correct answers for

students of the NMU during LIE "Krok 1": from 73.4 % in 2017 to 75.0 % in 2018 (the national index is 71.3 % and 71.1 % respectively).

Consequently, the curriculum structuring in accordance with the educational objectives reflected in the higher education standard (and educational program) for specialists training in the Master's degree level in specialty 222 "Medicine" is the key to a consistent and systematic process of forming integral, general and special competencies. In addition, developing the curriculum structure is an important element of the educational process design, since at the department level it provides a prerequisite for improving the quality of training future physicians. Selection and optimization of the content of didactic material, coordination and synchronization of teaching its components with the study of other medical and biological disciplines helps to unload students and facilitates mastering of the content of the curriculum. Establishing the effectiveness of structuring the curriculum on biological and bioorganic chemistry can be carried out at the level of the department and higher educational institution during the final control at the end of the second year, and according to the results of the students' passing of the LIE "Krok 1. General medical training". Although the number of test questions in biological chemistry in each booklet is from 5 to 12 %, and not all themes are represented by such tests, it is important that the analysis of the results of students' passing of LIE "Krok 1" after the third year reflects the "survival" of biochemical knowledge and skills to apply it in solving professionally oriented situational tasks.

Conclusions and research perspectives. 1. The training of specialists in the second (Master's) level of higher education in specialty 222 "Medicine" requires thorough structuring of curricula, in particular on biological and bioorganic chemistry, according to the list of competencies outlined in the higher education standard. 2. The curriculum structuring is an inalienable department stage of the educational process design within the framework of functioning of the internal university quality management system, the effectiveness of which is established on the basis of data analysis of the final control on discipline and passing of the LIE "Krok 1. General medical training". 3. Selection and optimization of the content of didactic material, coordination and synchronization of teaching its components with the study of other medical and biological disciplines helps to unload students and facilitates the mastery of the content of the curriculum, is the key to the consistent and systematic process of forming integral, general and special competencies. 4. The formulation of clear educational goals for students in a competency approach and the selection of adequate teaching materials for each topic on biological and bioorganic chemistry will reduce the time to learn the material and further improve the quality of training future physicians at the undergraduate level. Prospective for further research are: formulation of scientific approaches to the implementation of a competency approach in the training of biological and bioorganic chemistry of future physicians; study of the competency approach as a means of modernizing the educational environment of a modern higher medical education institution.

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