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## METHODOLOGICAL ASPECTS OF TEACHING BIOTECHNOLOGY IN THE PHARMACEUTICAL FACULTY

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The professional community feels the need to advance and expand the role of pharmaceutical personnel to meet healthcare needs. In the last decades in the pharmaceutical practice there has been a steady tendency of patient-oriented services and services. Within this concept, the principles of service delivery and training have shifted from patient to patient focus. The impact of personalized medicine on the profession is becoming increasingly important. These changes entail the need to transform the basic knowledge and approaches taught by pharmaceutical workers.

**The purpose** of studying biotechnology by future provisors is the formation of system knowledge, skills and practical skills.

**Methods.** The article has been studied and researched a study of literary sources, metadata, method of data analysis, statistical method. Check existing data sources as well as the conditions under which they can be obtained, including any restrictions on use. Evaluation of alternatives, research of possibilities of application of potential sources of administrative data for statistical purposes. Generalization of the assessment of the legal framework in which

data will be collected and used. Statistical methods are four inter-related sections: preliminary analysis of the nature of statistical data – is to test the hypotheses of stationarity, independence, normality, homogeneity, as well as assess the type of distribution function, its parameters, etc.; identification of connections and regularities – correlation analysis, linear and nonlinear regression analysis, etc.; multidimensional statistical analysis – cluster analysis, component analysis, linear and nonlinear discriminant analysis, etc.; dynamic models and forecast based on time series. Survey, prognostic methods, student survey method and data representativeness. In teaching we try to move away from the accepted matrix reproduction of specialists, from the traditional approach to teaching “method of teaching and transfer”. We believe that only a symbiosis of knowledge will allow to carry out quality vocational training. The theoretical and methodological basis of the study was formed in the context of a new non-systemic pedagogical paradigm, for which general scientific methods were used, in particular analysis and synthesis. Specific methods of technology were used to conduct empirical research, including factor analysis based on the main components and logic.

**Results:** the biotechnology study program provides appropriate training for young people's professional careers as pharmacists, but also enables them to work in pharmaceutical enterprises, research institutes.

**Keywords:** teaching, methodological approaches, Faculty of Pharmacy, biotechnology, business game, knowledge.

## Introduction

The modern concept of higher pharmaceutical education requires the formation of students' knowledge and practical skills in the field of biotechnology. The general orientation and knowledge of students in the field of biotechnology use in pharmaceutical production is extremely important, because according to expert estimates, the share of biotechnological medicinal products in the near

future will be 50% of all used medicines. In this regard, biotechnology is becoming one of the priority disciplines of modern pharmaceutical education, combining fundamental and applied science, as well as production. Among the approaches to the scientific interpretation of the essence of vocational training pharmaceutical industry workers have a significant place in the views of academic educators, who in their research emphasize the need and importance of studying the process of professional development of a specialist in this sector of medicine. Vocational training is interpreted as a set of specialized knowledge, skills and skills, personality traits, work experience, and behavioral norms that enable successful work in the chosen profession; the process of communicating to the learner the relevant knowledge and skills. Some scholars consider it appropriate to consider it as a system of organizational and pedagogical measures, which ensure the formation in the personality of professional orientation of knowledge, skills, skills and professional readiness for certain activities. The concept of “training” is considered as a process of professional development of a specialist, providing the acquisition of basic knowledge, skills, skills and qualities, hands-on experience and codes of conduct that enable successful work in a particular profession, as well as the process of communicating relevant knowledge. Another definition of vocational training regards it as the process of forming a specialist in one of the fields of employment related to mastering a certain kind of occupation, a profession.

*Main purpose* of the study of biotechnology by future provisors is the formation of systemic knowledge, skills and practical skills for the development of methods of biosynthesis, biological transformation and a combination of methods of biological and chemical transformation of substances of drugs, prophylactic and diagnostic agents; as well as the formation of systematic knowledge of behavior, including storage and transportation, use of information and transmission of information on biotechnological products to the consumer.

*Methods.* The article has been studied and researched a study of literary sources, metadata, method of data analysis, statistical method.

## **Biotechnology as a science**

Biotechnology in pharmaceutical education is a fairly new subject, so there are some difficulties in teaching. The problems faced in organizing the educational process in biotechnology are quite wide, as is the scope of biotechnological

industries. The level of innovation and dynamism in biotechnology is very high. The growing amount of information requires the development of students' creative abilities and critical thinking skills that allow them to make their own decisions based on their basic knowledge of biotechnology (Aryistanova, Aryistanov 2012: 175).

In teaching we try to move away from the accepted matrix reproduction of specialists, from the traditional approach to teaching “method of teaching and transfer”. We believe that only a symbiosis of knowledge will allow to carry out quality vocational training. This is a fundamental difference between the conceptual approach in teaching. Obviously, the second approach is more rational. It saves time, allows the student to master the principles of science with the subsequent specialization and detailing of knowledge, without wasting time on mechanical memorization of the material.

In this regard, the succession of disciplines plays a special role in education. The biotechnology program clearly goes beyond the curriculum of her previous disciplines. Biotechnology is an integrated, multidisciplinary field of knowledge that has deep links with other sciences. Therefore, without proper in-depth development of the complex of chemical and medical sciences, understanding the essentials for pharmacy specialists in the subject of biotechnology is reduced to learning the facts (Aryistanova, Aryistanov 2012: 175).

Vocational training is considered as the process of forming a set of professional knowledge, skills, attributes, work experience and standards of behavior that provide an opportunity for successful professional activity. In addition, representatives of pedagogical science see the essence of such preparation in acquisition a person of professional education, which is the result of assimilation of intellectual knowledge, skills and formation of the necessary personal professional qualities. Vocational education is seen as a significant component of continuing education. Continuing education is defined as the collection of knowledge, skills and competences, mastery which enables them to work as specialists of secondary or higher qualification, and the psychological problems of continuing education are largely related to the professional formation and development of the individual in the system of vocational education, the introduction of new pedagogical technologies in vocational schools of various levels.

It should be noted that the pharmaceutical industry is an integral part of the healthcare system, which holds a special place in the field of intellectual and industrial of humanity. The peculiar privilege of this industry among other

industries economy is explained by the object of its achievements aimed at internal regulation and support of people's lives. It is the specificity of the object of research and practical use of achievements that combines the features of material and spiritual (ideal), due to the wide range of problems faced by the pharmaceutical industry, realizing its main task – production and timely provision of consumers with effective, safe, high quality and affordable drugs. The pharmaceutical industry specialist is the person who obtained the pharmaceutical education and qualification (rank) in specialized educational institutions or prepared directly in health care institutions and admitted to the law, according to the law, to pharmaceutical activity. A specialist in the pharmaceutical industry has the right to perform professional duties in pharmacies, pharmaceuticals factories and factories, laboratories for standardization and certification of pharmaceutical products, wholesale pharmaceutical companies, pharmacies (pharmacy, kiosk, warehouse).

Creating new, high-quality and affordable medicines, food, environmental protection is one of the most pressing issues on a global scale, which cannot be solved without using biotechnology. That is why biotechnology is one of the most promising specialties of the 21st century, not only in Ukraine but in the whole world. Biotechnology is a field of knowledge that studies and develops methods of producing useful products for humanity through biological objects: microorganisms, animal cells and plants. The first beginnings of biotechnology emerged when one began to use the fermentation process to make wine and bake baked goods. As a separate branch of science, biotechnology was recognized in the twentieth century.

Biotechnology provides the production of medicines, food, the creation of transgenic microorganisms, plants and animals, etc. Advances in biotechnology are used in almost every field of science and technology, because it helps create quality and low cost products. At present, a significant contribution of biotechnology is being made in the field of health. The possibility of unlimited production of natural protein bioregulators and biologically active substances, including rare and expensive, it opens new perspectives in the treatment of various diseases. Biotechnology is developing vaccines, in particular to combat such diseases as AIDS, hepatitis, malaria, and some cancers. Today, pharmaceutical companies spend about 20% of their budget on biotechnology research, and biotechnologists are among the top 10 specialties that are most sought after and promising.

Biotechnology – the direction of modern science and technology, whose main task is the application of biological processes for industrial purposes. Biotechnology emerged and developed at the interface of biological sciences and technology. Biotechnological processes since ancient times been used in practice, for example in the baking of bread, manufacture of milk products and beer brewing. Predecessors of biotechnology was biofactories that in the USSR were established in 30-ies of XX century for the production of vaccines and serum. The next stage of development of biotechnology industrial production of penicillin and other antibiotics in the 40-50-ies of XX century, it was later created a new independent industry – microbial, which now produces vitamins, bacterial fertilizers (azobacterin), biologics (entobacterin, dendrobacillin) and the like. Nowadays, the most intensively developed in the field of biotechnology related to the use of biosynthesis, primarily microbiological, such as animal protein. This is due to the achievements of biochemistry and cytology (e.g., obtaining in crystalline form and the use of stable and immobilized enzymes, native or partially destroyed immobilized cells of micro- and macro-organisms), technology of fermentation (eg. manufacturing products using fermentation, waste treatment of different industries by biodegradation), bioelectrochem. Crucial to the development of modern biotechnology has received genetic and cellular engineering. Methods of genetic engineering created by microorganisms that rapidly accumulate biomass and various biological substances. On the basis of microbiological synthesis using genetic engineering technology developed and implemented the production of insulin and human growth hormone, interferons and of other biologically active proteins. Developed genetic engineering technology for anti-viral vaccines. Most important to the medical biotechnology industry was cell engineering, in particular, the technology for producing monoclonal antibodies. On their basis developed and used a new system of immunological analysis radocanachi. Great opportunities of biotechnology in the production of enzymes, amino acids, polysaccharides, vitamins, etc. an important branch of biotechnology is the development of efficient industrial technologies for obtaining large quantities of useful organisms, such as entomophages; use them for biological pest control. Further development of biotechnology is connected with the use authorized control and control of biotechnological processes. Biotechnology methods are also used for the protection of materials and structures from biological damage, bacterial extraction of copper, in the processing of industrial and domestic waste and the like. The student should know: basic terms and concepts

of biotechnology; history, essence, significance, problems and prospects of biotechnology development; a typical scheme of biotechnological production, methods of cultivation of producers; principles of operation and design of bioreactors; industrial use of microorganisms (use of microorganisms-producers for production of protein preparations, food acids, amino acids, vitamins, enzyme preparations, etc.).

### **Basic methods of studying the discipline**

Taking into consideration this rapid development, FIP Special Interest Group of Pharmaceutical Biotechnology decided to develop a questionnaire concerning pharmaceutical biotechnology education in order to determine its present status and future needs. The objectives of this worldwide questionnaire study were to review all of the undergraduate courses and textbook references/scientific sources which are presently available in the area of pharmaceutical biotechnology. One of the major aim was to determine the borders and milestones of pharmaceutical biotechnology in pharmacy education from both a qualitative and quantitative aspect (Byikov, Manakov, Panfilov, Svittsov, Tarasova 1987: 142).

A student who has taken a course in biotechnology must have a certain basic level of knowledge and skills that he/she has acquired in the previous 4 years of study. In the preparation of a specialist in pharmacy, the study of disciplines is consistent. For example, at the Department of Pharmaceutical Technology and Biotechnology students from 3 to 5 course in the degree of complication of the course are studying: technology of extemporal drugs, industrial technology of drugs (finished drugs), as the final stage of preparation for technology of drugs is biotechnology (Byikov, Kryilov, Manakov, Markvichev, Orlova, Tarasova 2001: 143).

Thus, by the fifth year students are prepared for basic technological processes and apparatus, standardization, transportation, storage and dispensing of medicines, including animal and vegetable origin, GMP and production organization (Bozhkov 2008: 363).

However, if the disciplines of the pharmaceutical profile clearly trace the continuity of knowledge, then, as our work has shown, students of the Faculty of Pharmacy have large gaps in general biological training. After studying first year biology, despite repeating and deepening some topics in the following

subjects, 5 year students have little understanding of many things, such as cell energy stages, biological membrane structure, cell classification according to specialization, principles and transfer steps hereditary information, protein biosynthesis, regulation of cell activity, essence of reproduction, patterns of interrelationship between the organism and the environment, the basics of genetics, the basics of human hereditary diseases (Glik, Pasternak 2012: 589).

The total number of hours (according to the educational standard for the specialty “pharmacy”), which is devoted to the study of biology, is 84, of which 18 – lectures, 38 – practical classes and 28 independent work. This number of hours is not sufficient for basic biology training to further study biotechnology (Lazoryshynets 2011: 34-39).

Within the regional component it was proposed to increase the number of hours in biology (for a deeper study of the molecular-cellular organization of the organism, the basics of genetics). By the decision of the Cycle Methodological Commission on Pharmacy, some aspects of microbiology (virology, immunology, basics of genetics), pharmacology (drugs that affect immunity) were strengthened in the work programs in subjects (Manchenko, Holovchenko 2014: 109-117).

Additional educational services may be provided. Work has been carried out to create and implement an elective course in biochemistry, “the basics of molecular biology”. The element is intended for students of 4th year (8 semester). The course provides a deeper study of the intermolecular interaction and function of the main biomacromolecules of the cell; processes of transfer and realization of genetic information; molecular mechanisms of development of hereditary and several other diseases. The program, forms of current and frontier control of students’ knowledge have been developed.

Information on the general level of knowledge of students entering biotechnology is essential as it allows you to define a creative strategy for drawing up a quality work program for teaching the discipline of “biotechnology of medicinal products”, as well as to set guidelines for the construction of this course (Martyntenko 2010: 232).

The costs of teaching biotechnology include the lack of financial support for the educational process. Many of these problems can be eliminated in the process of integrating a higher education institution with research and development organizations working in the field of biotechnology (Melnichuk, Novak, Kunakh 2012: 520).



Working closely with businesses allows students to gain hands-on experience, get acquainted with the latest scientific advances, industrial equipment and processes that they do not encounter in a university laboratory. It is invaluable that our students have the opportunity to participate in the implementation of real scientific and technical developments, to prepare coursework and diploma papers with real topics. Without the help of research institutes and industrial enterprises, it would not be possible to provide students with modern equipment for the completion of diploma work in the field of pharmacy and biotechnology. In addition, they have the opportunity to become acquainted with the many research and manufacturing challenges to use biotechnology tools in the creation of new drugs, since the continued growth and prosperity of the biotechnology industry requires people who know and are able to solve these problems. Our task is to prepare pharmacists with an understanding of the nature of problems associated with the biotechnology industry. In this respect, we focus not on the simple transfer of knowledge, but also on the orientation and skills, the ability to use and process knowledge for practical use, to develop the ability to solve professional problems independently (Sidorov 1990: 280).

Situational problem solving, familiarity with the modern concept of quality assurance of medicines and the regulatory framework regulating biotechnological production in the form of business games that simulate different situations in real life, gives an opportunity to firmly consolidate the obtained theoretical knowledge.

In the course of teaching business “organization of pharmaceutical production” is conducted. The purpose of the business game is to broaden and deepen the knowledge of the organization of production of medicines according to GMP, the development of professional thinking (Uotson 1996: 288).

Business games have been actively used around the world for decades. This method has significant advantages over many other teaching methods. Participation in business games gives not only knowledge but also experience. With the help of business games, you can learn and learn not only how and why you need to work, but it is possible to train such essentials for successful work as communication, leadership skills, ability to navigate a difficult, fast-changing situation (Fedorenko, Ostash, Honchar, Rebets 2007: 279).

In the course of a business game, educational, upbringing and developing tasks of the pedagogical process are realized. In addition, it should be noted that the business game allows you to achieve a high level of assimilation of the material. That is, the student will not only have an idea, know and be able to organize

production according to GMP, but will also reach the level of creative thinking (Chernykh 2017).

The process of a business game consists of 4 stages: pre-briefing, preparatory stage, the actual game and analysis of the game results. Actually, the game involves the disclosure of pharmaceutical (biotechnological) production on the example of some drug (product). At this stage, information is provided on the organization of production and quality assurance of the medicinal product at the stage of its production, the necessary calculations are made, the documents are issued. The characteristics of the initial components, intermediate, finished drugs are given, their quality is controlled. As the production situation plays out the situation of marriage, establishing its causes, elimination.

The teacher, as an external auditor, analyzes the entire process of organizing the production and receipt of the drug presented by the students. Together with the participants of the game its results are discussed, the reasons for successful decisions and possible reasons for lack of products are revealed. After completing the game to evaluate educational services, students fill out a questionnaire with mandatory suggestions for improving the business game process (Hıncal, Çalış, Öner, Kaş 2017).

## Conclusions

Thus, in the process of teaching biotechnology students of the Faculty of Pharmacy have made methodological approaches that help the process of formation of biotechnological knowledge and thinking in the specialists of the pharmaceutical profile. The biotechnology study program provides appropriate training for young people's professional careers as pharmacists, but also enables them to work at pharmaceutical companies and research institutes. The standards are high, but the career prospects are great.

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