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## PRACTICALLY ORIENTED

DIRECTION OF THE BIOTECHNOLOGY COURSE IN THE PREPARATION OF FUTURE BIOLOGY TEACHERS: REGIONAL CONTEXT

### **DIRECCIÓN PRÁCTICAMENTE ORIENTADA DEL CURSO DE BIOTECNOLOGÍA EN LA PREPARACIÓN DE FUTUROS PROFESORES DE BIOLOGÍA: CONTEXTO REGIONAL**

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**ABSTRACT:** The article summarizes the practical experience of training future teachers of biology in the process of studying the fundamental discipline “Biotechnology” taking into account regional needs in the professionally-oriented environment of Izmail State Humanitarian University. A number of theoretical research methods were used: the study, analysis, systematization of psychological, pedagogical and methodical sources on the problem of practice-oriented training of future teachers of natural sciences. The practical significance of the described experience is to bring positive ideas into the practice of pedagogical institutions of higher education on the professionally-oriented training of future Biology teachers based on regional identity, the formation of students’ practice-oriented experience in the context of mastering research competence in modern biotechnology, and their professional readiness introducing the theoretical foundations and practical use of biotechnological knowledge in the content of school Biology education. Besides, the theoretical positions can be used in the pedagogical activities of teachers of school Biology courses, as well as in the system of postgraduate education of teachers of natural sciences.

**Keywords:** Pedagogical activity, regional identity, professional competency, modern biotechnology.

**RESUMEN:** El artículo resume la experiencia práctica de la formación de futuros profesores de biología en el proceso de estudio de la disciplina fundamental “Biotecnología” teniendo en cuenta las necesidades regionales en el entorno de orientación profesional de la Universidad Estatal Humanitaria de Izmail. Se utilizaron una serie de métodos de investigación teórica: el estudio, análisis, sistematización de fuentes psicológicas, pedagógicas y metódicas sobre el problema de la formación orientada a la práctica de los futuros profesores de ciencias naturales. El significado práctico de la experiencia descrita es traer ideas positivas a la práctica de las instituciones pedagógicas de educación superior sobre la formación profesionalmente orientada de futuros profesores de Biología basada en la identidad regional, la formación de la experiencia orientada a la práctica de los estudiantes en el contexto de la maestría competencia investigadora en biotecnología moderna, y su preparación profesional introduciendo los fundamentos teóricos y el uso práctico del conocimiento biotecnológico en el contenido de la educación en biología escolar. Además, las posiciones teóricas pueden ser utilizadas en las actividades pedagógicas de los profesores de los cursos de Biología escolares, así como en el sistema de formación de posgrado de profesores de ciencias naturales.

**Palabras clave:** Actividad pedagógica, identidad regional, competencia profesional, biotecnología moderna.

## INTRODUCTION

Modern humanity has entered the third millennium, and it makes people pay more and more attention to their future and comprehensive understanding of the past. Analysis of the problems that worry humanity shows that one of the most important is the global problem of interaction between nature and society. Biological knowledge has always been a means of studying wildlife and the impact on it, solving the problems of humankind, in particular agriculture, industry, medicine, ecology. Now one of the most promising areas of modern natural science is the achievement of traditional and modern biotechnology, which permeates all spheres of human life.

Innovation of biotechnology as a component of the scientific industry, first of all, is aimed at solving the key problems of our time, while ensuring the preservation of the natural balance in the system of relations "man-nature-society". The expansion of the practical sphere of biotechnology is also due to the socio-economic needs of society and is one of the priorities of the national economy of all developed countries. The production volumes of the products of the biotechnology sector, which are constantly increasing, evidence the importance of biotechnology in the world. In addition, regulatory and legislative acts on the development of new directions of scientific research and scientific and technical developments act as a stimulating factor for biotechnological production (Ukraine. Verkhovna Rada, 2011, 2013).

Through the prism of the educational realities of knowledge about the multidimensionality of biotechnology have significant potential in the professional development of future teachers of Biology, as well as a powerful factor in the integration of higher education in the European educational space. Transformation of the national system of higher education in the context of modern challenges provides for strengthening the organization of training of a modern specialist that meets all the requirements of the international community.

In this context, practice-oriented training of a future teacher of Biology capable of effective pedagogical activity in the context of the rapid development of the bio-industry is of particular importance. As Vashchuk (2011) notes: *"The demand for time is to train specialists of a new quality – able to think creatively, quickly navigate in the modern rich informational space, make non-standard decisions, learn and develop throughout life, and most importantly, be patriots of their native land"*. It follows that at the present time the educational-practical spectrum of the teacher of Biology is not limited only to the knowledge-translational function, but is expanding in the direction of

personal development (Kerimov, et al., 2018a; Kerimov, et al., 2018b).

In the context of the formation of Ukrainian statehood, the revival of national identity, the social role of the teacher in society is growing. Given the present teacher – this person is directed to the future. The updated educational content of the New Ukrainian School provides for fundamental changes in the teacher's social vocation. According to its main provisions, it is the teacher who is the key figure in the implementation of state policy on the development of personality, in the dominance of personal and professional influence on the development of students' value orientations, in introducing democratic principles into educational practice. Therefore, at the present stage of the formation of the national system of pedagogical education, the requirements for the preparation of a future teacher of Biology are greatly enhanced in the direction of the ability to use both domestic and international scientific experience, attracting regional opportunities for the implementation of science education, taking into account modern advances in biological science, the practical significance of scientific research in areas of biotechnology. In this regard, the competence paradigm of practice-oriented training of the future teacher of Biology, as a subject of personal and professional growth, which is able to constantly expand and update the subject area of its professional activity, is of particular importance (Kerimov, et al., 2018c).

Now it should be noted that the components of the professionalism of the future teacher of Biology are subject competence, which presupposes the presence of deep fundamental knowledge in the educational field of teaching, a willingness to realize scientific achievements in the process of creatively solving professional tasks. Considering that the educational sphere needs competent specialists with a high level of knowledge, focused on modern scientific achievements, it is obvious that the problem of practice-oriented teacher training for the new Ukrainian school in the parameters of European higher education standards is of particular relevance. Taking this into account, it is advisable to consider the Biotechnology course as a strategic link in the formation of practice-oriented knowledge and skills of future Biology teachers (Kerimov, et al., 2016).

After analyzing the views of foreign scientists on the problem of professional development of future teachers, it can be confirmed that the most common are the ideas of practical orientation of students' training, corresponds to the European educational requirements. In particular, representatives of the German scientific school E. Glamper, E. Terhart focus on the unity of the theoretical and practical

components of the content of professionally-oriented disciplines in contextual learning (Moon, Vlasceany & Barrows, 2003). Among the most common approaches to the training of future teachers in Switzerland, substantive competence is emphasized (Messen & Posch, 2010). Against the background of the intensive development of the biological industry, the problem of preparing future teachers of Biology in specialized classes, in particular the biotechnological direction, is being actively investigated.

However, the contextual analysis of the problem of the practice-oriented teaching of the "Biotechnology" course, taking into account regional identity, indicates its insufficient development. Since scientific research on biotechnology is primarily aimed at solving global problems of mankind, this component of the professional training of the future biology teacher involves a combination of fundamental knowledge and practical application. It is obvious that the successful solution of this problem depends on the effectiveness of the practical orientation of the course "Biotechnology", is able, on the one hand, to attract a student to the knowledge of natural-scientific picture of the world, is studied and, on the other hand, to take into account regional specificity with the aim of enhancing the subject competency of the teacher. The purpose of the article is to highlight the practice-oriented resource of the content of the course "Biotechnology" in the process of professional training of future teachers of Biology, taking into account the regional aspect.

## DEVELOPMENT

An analysis of the educational and qualification characteristics of future Biology teachers made it possible to identify the following basic requirements: an understanding of the nature and social significance of their future profession, the main problems of the discipline that determine the specific sphere of their activities; scientific and methodical awareness in the natural field of knowledge; psychological readiness to change the type and nature of their professional activities. According to Biletska (2014), a specialist of a new generation should be initiative and independent, be able to navigate in information flows, have creative thinking, be able to solve tasks that are integrative, complex character. Of particular importance is the fundamentalization of education of the future teacher of Biology, which involves the mastery of natural science and professionally oriented disciplines, which provide basic knowledge, constitute the core of the modern scientific picture of the world and are crucial for the formation of a common purview, culture of thinking and scientific outlook of students.

Biotechnologies organically fit into the structure of the new model of practice-oriented training of future teachers of Biology; it provides for ensuring an appropriate level of natural training in the context of the intensification of modern education. The basis for the implementation of measures to address this important and complex state problem is the basic provisions of the Constitution of Ukraine (Ukraine. Verkhovna Rada, 1996) and the laws of Ukraine "On Education" (Ukraine. Ukraine. Verkhovna Rada, 2017), "On Higher Education" (Ukraine. Ukraine. Verkhovna Rada, 2014), the State National Program "Education" (Ukraine. Verkhovna Rada, 1993). Updating approaches to the professional training of future Biology teachers is a requirement of time and should be directed towards creating a new educational space that provides not only practice-oriented knowledge, the formation of skills and abilities, the development of natural personality traits, but also will facilitate the application of acquired competencies in practice, self-determination and self-improvement of a person (Lapidus, et al., 2018a).

According to the basic theoretical and methodological provisions of the framework for the international comparative study of the PISA (Program for International Student Assessment) framework, natural science literacy is important both at the national and international level, as humanity faces many significant problems related to ensuring sufficient water and food, fighting disease, getting enough energy and adapting to climate change (Vakulenko, et al., 2018). Of particular importance in the proposed framework document attention is paid to the ability to solve these problems with the help of modern biotechnology at the local level. Considering this, the substantive content of the practice-oriented training of future Biology teachers must respond to the rapid changes in the scientific field and establish direct two-way communication with the pedagogical practice (Lapidus, et al., 2018b; Lapidus, et al., 2018c).

Awareness of students on biotechnology and areas of their practical application at the regional level will help future Biology teachers to become aware of the place of natural sciences in the New Ukrainian School, because the natural science of the individual as one of the key life competencies measured by PISA is an integrating factor of the national model of training future teachers to the common educational standards. We are convinced that biotechnological awareness is an important component of the future professional competence of a Biology teacher, and will develop a natural science outlook of the students. Consequently, the natural preparation of students should not be strictly professional, since within the framework of

this position a Biology teacher should be ready to solve various social and pedagogical educational problems.

The national strategy for the preparation of future Biology teachers on an integration basis focuses primarily on the position of Ukrainian regulatory documents (Ukraine. Verkhovna Rada, 2013) and the advanced experience of pedagogical training in European countries. In particular, integration into the pan-European intellectual-educational environment requires a reorientation of the content of education towards the formation of the teacher's personality, capable of acting in very rapidly changing conditions based on the needs of the region.

The fact is obvious that a qualified Biology teacher is the key to effective natural-science training of students in terms of international standards. Thus, there is a need to find out the practical-oriented potential of the Biotechnology training course in the system of professional training of future Biology teachers. In the delineated plane, it seems logical to take into account the regional aspect in the process of studying professional discipline; it determines the effectiveness of the educational needs of future specialists who are able to competently realize the pedagogical potential of the region's natural environment. We accept the scientific position of Gorbenko (2015), that it is practice-oriented learning that is the basis on which you can successfully build a new learning technology that will undoubtedly contribute to improving student motivation before entering professional competence, and also significantly shorten the adaptation period of university graduates during the transition to practical activities.

Thus, the regionalization of practice-oriented vocational training takes a significant activity position. In addition, the involvement of the regional vector as a cell of transnational scientific relations – to promote the modeling of the content of the fundamental discipline “Biotechnology”, to provide conditions for the transformation of the student's research work in the future teacher's professional activities, to update the local history approach to the natural preparation of future Biology teachers. According to the views of Heidegger (1993), the basis of the practice-oriented model of training future teachers is entrusted with the individual involvement of students in activities that acquire their social and subject identity. In the context of our study of the use of regional peculiarities in the process of teaching the Biotechnology course, teachers need to create a practice-oriented environment in which future Biology teachers have the opportunity to manifest and realize their scientific and professional interest in the knowledge of modern biotechnologies, to establish a reasonable balance between academic and practical components of vocational training.

Based on the above, we will consider some aspects of the practice-oriented teaching of the course “Biotechnology” in the process of training bachelors in the specialty 014 “Natural Sciences” of the Izmail State Humanitarian University, taking into account regional traditions of the Ukrainian Danube. Ukrainian Bessarabia or the Ukrainian Danube region is a separate segment of the country's scientific and cultural studies. The main areas of industrial specialization in the region are plant growing – grain and industrial crops, vegetables and grapes, and livestock breeding – raising cattle, pigs, sheep and poultry, and producing milk, meat, eggs, and wool. In addition, the active development of navigation on the Danube closely linked the region with Europe, and its geographical position gave it the status of cross-border. In certain conditions, Izmail State Humanitarian University as an educational center of the Ukrainian Danube region, serves as a consolidating place for academic education and practical training of future Biology teachers.

The priority direction of the University's activities is the preparation of a competitive specialist in an educational environment with a practice-oriented education, which allows overcoming the alienation of science from everyday life. A prominent place in the process of preparing future Biology teachers is occupied by the training course “Biotechnology”, which combines the most important general theoretical questions and the formation of practical experience of their use in solving vital problems and problems. In this regard, the organization of the study of professional discipline, taking into account the specificity of the contextual environment of a higher educational institution, involves the formation of a system of scientific knowledge about the possibilities of using living organisms, their systems or their metabolic products to solve technological problems.

Consequently, to implement a practice-oriented approach to the study of the academic discipline “Biotechnology”, the substantive modules were enriched with knowledge of the widespread use of microorganisms in the development of the agro-industrial complex as the leading industry of the Ukrainian Danube region. On the other hand, the use of the local lore principle as a purely scientific and educational imperative for future Biology teachers' professional training provides for systematic connections between the complex knowledge of biotechnology, school program material on Biology and the disclosure of the economic and social aspects of biotechnological processes.

The core of the integrative approach was chosen the lectures of informative module “The use of biotechnology in agricultural production”, which stimulated the development of cognitive interests of future teachers to the leading

methods of genetic engineering, molecular biology, cell biology, and the like. Along with a consistent and logical presentation of the biotechnological foundations, each topic of the lecture lesson contained practice-oriented biological knowledge that reflects their regional identity. For example, when studying the properties of microorganisms, future teachers of Biology investigated ways of developing useful for society target products using biological agents on the example of the industrial complexes of the Danube, determined the place of hybridization in the development of cross-border cooperation in the agricultural sector of the region.

Under such conditions of study, students will learn about the existing demand for biotechnological services in the field of crop production, modern advances in genetic engineering, technology of agro-bacterial infiltration. The regional content of the study of the informative module of the course "Biotechnology" consisted in a practical study of the biodiversity of plant products of local farms, identifying and determining the phenotypic characteristics of transgenic plants using the example of transformed tomatoes – the leading crop of southern Ukraine, studying methods of controlling the spread of pests and plant pathogens by means of biotechnological products.

The study of the biological mechanisms of heterosis, changes in the properties of plant organisms through the use of scientific advances in genetic engineering was carried out on the example of an agro-ecological assessment of the quality of the soils of the Ukrainian Danube region. According to its results, the region's problem is the spatial heterogeneity of the distribution of humus, as well as the presence of radionuclides in the soil. In this regard, the attention of future teachers was focused on the need to grow genetically modified varieties of maize and rice, which do not absorb heavy metals from the soil, will ensure the relative economic and environmental sustainability of the region.

Since traditionally Ukrainian Danube region belongs to the zone of risky farming, it is one of the factors of instability in the production of main types of agricultural products, the request for increasing the genetic potential of plant hybrids, livestock and poultry, the introduction of modern biotechnology technologies in the agro-industrial complex of the region is being updated. The study of the scientific foundations of biotechnology from the standpoint of regional identity directs the process of training future Biology teachers to practice-oriented activities. At the same time, we note that the content of the school Biology course involves the use of knowledge from biotechnology in combination with the local history material in the process of studying "Wildlife and methods of studying it", "Bacteria

are the smallest single-cell organisms", "Microorganisms, their role in nature and human life", "Ecosystems", which reflect the diversity, distribution, importance in nature and human economic activities of representatives of different systematic groups of living organisms (bacteria, fungi, plants, animals) and the biotechnological direction of their research.

It should be noted that the formation of fundamental knowledge on the basics of genetics, breeding and biotechnology in high school students is possible only on the basis of careful and systematic use of theoretical knowledge about the structure, functioning, distribution of living organisms in the process of direct observation of them in the natural environment. Therefore, the technological component of the study of future Biology teachers of the course "Biotechnology" acquires great importance. So, in the context of practice-oriented learning, there is a change of priorities for mastering the ready-made knowledge for independent cognitive activity of each student taking into consideration his features and capabilities. In order to strengthen the scientific component of the individual research activities of future Biology teachers in the course "Biotechnology", considerable attention is paid to the results of research by the regional center for scientific support of agro-industrial production in the Odessa region, which includes such recognized academic institutions as the breeding institute, the National Center of Seed and Cultivar Investigation, National Research Center "Institute of Viticulture and Winemaking named after V.E. Tairov", Odessa Institute of Agriculture Black Sea, Engineering and Technology Institute "Biotechnology", whose practical experience is actively used in the creative search for students.

Self-reflection of the teaching course "Biotechnology" asserts that extracurricular activity is an important factor in the professional and personal development of future Biology teachers. Therefore, an effective component of the integrated process of professional training was the annual participation of students in the international scientific and practical conference "Danube – the core of European identity", in which future Biology teachers present their scientific papers devoted to the actual problems solved by modern biotechnology, namely, new sources of raw materials of the leading agro-industrial branches of the region, alternative energy sources on the basis of bio crop production, changes in the genome of the organism, improvement of the environment, disease prevention and more. In particular, the research work of students is mostly devoted to the topical issues of regional biotechnology, such as the use of "Green Biotechnology in the Provided Ecological Sustainability

of the Ukrainian Danube region”, “Biotechnological Cultivation of Rapeseed as a Fast-Growing Bio-fuel in the Black Sea Region”, “Biotechnological traditions and innovations in the process of making cheese as polycultural product of the southern part of Bessarabia”, “The formation of a regional economic system based on modern biotechnology” and others. Academic preparedness on the fundamental provisions of modern biotechnology can be shown by the most talented student youth by participating in subject olympiads.

Involvement of students in research activities in the course “Biotechnology” also involves the use of a wide range of different forms, methods and means of conducting lectures and practical classes, in particular – work with various sources of information with the subsequent discussion, cooperation with leading research institutions of the region, the implementation of laboratory work directly in the natural environment, the successful combination of traditional and modern educational technologies (contextual and interactive learning, the involvement of Internet technologies, elements of modeling software), which promotes closer interaction between all participants in the educational process. Thus, the basis of the practice-oriented study by future teachers of the course “Biotechnology” is the possibility of identifying and realizing the cognitive interest of students.

Pedagogical practice in the system of professionally-oriented training of future teachers of Biology is an important component of ensuring its integrity. Given the present, a Biology teacher is not enough to be only an expert in his subject. Its main purpose is the design of scientific knowledge in the teaching and educational environment of the school, taking into account modern scientific trends. Under the conditions of natural professional activity, future teachers of Biology carry out methodical reflection, develop the ability of non-standard interpretation of biotechnology knowledge considering regional identity by translating the theoretical component of vocational training into a practical plane.

It should be noted that the effectiveness of teaching is determined by the personality of the teacher, his professional orientation. Therefore, the introduction of a regional aspect to the content of biotechnological training of future Biology teachers allows the formation of a personality with a scientific and pedagogical style of thinking in the fullness of intellectual, cultural, psychological and social development, observing the provisions of the new paradigm of higher education. In turn, the use of a local history approach in the practice of teaching Biology, future teachers contribute to the professional self-determination of schoolchildren related to any area of the natural industry

(biotechnology, microbiology, ecology, biochemistry, genetics, etc.). In the context of profiling school education as a basis for understanding biochemical aspects, the career guidance activity of a teacher in Biology lessons is of particular importance.

The fulfillment of the tasks of the program of pedagogical practice completely depends on the conscious and creative fulfillment of future teachers. So, in order to strengthen the practical orientation of the content of the course “Biotechnology”, one of the tasks is to involve students in project activities. It should be emphasized that on the territory of the Ukrainian Danube region unique natural complexes and ecosystems are located, including the Danube Biosphere Reserve, which form the high biosphere potential of the region, which has national and international significance. Research activities on biotechnology in the field of water purification encourage students to a deeper study of the species diversity of microorganisms, the regional prevalence of aquatic vegetation as natural filter feeders, the basics of bioengineering pond construction with counteraction to their quick silting, and the like. A broader discussion of biotechnological achievements in the economic field is carried out in the process of holding the school conference “Amazing Biotechnology”, within the framework of which the students’ creative works are being defended.

So, the practice-oriented orientation of the course “Biotechnology” contributes to the purposeful formation of the preparedness of bachelors to the future teaching activities. Thus, the experience of the practice-oriented teaching of the “Biotechnology” course, taking into account the regional identity of the Ukrainian Danube region, promotes to the effective solution of the professional tasks of environmental education of the future teacher, which can be achieved from the standpoint of learning the biotechnological knowledge system, the diversity of living organisms in the relationship and interaction of their changes under the influence of various factors.

It should be stated, that the process of professional development the future teacher of Biology is impossible without research competence. Therefore, the practical component of the course “Biotechnology” should be reoriented as a whole, to what students are taught, to what they actually master, and the result is obtained on a bachelor’s degree of higher education. Undoubtedly, in the context of practice-oriented training of future teachers, a significant potential has contextual study of learning process. That is why, in order to maximally approximate the process of studying the academic discipline “Biotechnology” to the conditions of future professional activity, we see, first of all,

in forming the personality of the future teacher's, research experience based on the region's biotechnology sector.

Firstly, such approach to the study of the course "Biotechnology" contributes to attracting students to creative research activities, developing their culture of scientific research and critical thinking, and secondly, it focuses on the preparation of a competent mobile specialist capable of educational innovations in rapidly changing conditions of pedagogical activity. Thus, the tendency of involving students in the study of biotechnological peculiarities of the production of a regional product, such as cheese, in the framework of the course "Biotechnology" in the development of the research competency of future Biology teachers of the Izmail State Humanitarian University. Cheese (brynza) is the most popular brined sheep cheese, which is considered to be the national food product of Bulgarians, Romanians, and Moldavians, and is one of the main food for the inhabitants of the Ukrainian Danube.

As part of the study of the topic "microbial proteins in human nutrition", students explore the composition of microbial cultures of starter preparations for the manufacture of cheese, comparing bacterial preparations with the most close to the natural composition of cultures of dairy bacteria dominant in raw sheep milk. The original bacterial preparation "Gerobacterin" based on strains of lactic acid microorganisms isolated from traditional cheese, liquid enzyme "Super Maya" of Bulgarian origin, was mainly used by local residents for making cheese at home conditions, as well as actually made rennet of animal origin.

By conducting a correlation analysis by students, it was found that microbial protease as the main component of the liquid "Super Maya" enzyme is the most effective and cost-effective in the manufacture of sheep cheese. Thus, laboratory studies have shown that 15 ml of liquid enzyme is enough for 10 liters of sheep milk as opposed to rennet preparation, which 100 ml was used in the same volume of raw material. Based on the results of theoretical and experimental studies, the dependence of the output of finished products – brynza, from 10 liters on average 2.5-3 kg of sheep cheese, depending on the fat content of sheep's milk and the used leaven, was detected. The obtained data show that the highest yield of the finished product was promoted by the use of the preparations "Gerobacterin" and "Super Maya", and the enzyme of animal origin promoted the excessive formation of the secondary product of milk processing – whey. In addition, it was noted that the enzyme of animal origin significantly affects the taste indicators of the dairy product, in particular, has a bitter taste, reduces its consumer properties.

Rather interesting from the point of view of professional training of future Biology teachers, the fact discovered by students based on the study of statistical indicators characterizing the health status of the population of the Ukrainian Danube region in the diet of which there is a systematic cheese that consumption of this product contributes to a more efficient absorption of calcium – a key element of bone tissue development than from the usual varieties of cheeses. At the same time, such a deficiency was found as excessive salt intake, which is explained by the technological features of the manufacture and storage of the product, which in a certain way affects the "tendency" of the endemic population of cardiovascular diseases.

## CONCLUSIONS

So, a practice-oriented approach to the preparation of a future teacher of Biology by means of modern biotechnology contributes to the implementation of the modern educational paradigm of higher education - the development of the creative potential of a teacher-researcher, focused on the student's personality. We associate the prospects of further research search with the expansion of scientific ideas about the use of practice-oriented resource content of the course "Biotechnology" in the process of training future Biology teachers by involving the biotechnology cluster in the training process, as an association of regional industrial organizations and a platform to improve the subject competence of teachers in accordance with the parameters of the European Higher Education Area.

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