UDC 378.14.015.62

https://doi.org/10.52058/2786-6165-2024-5(23)-586-599

Dekarchuk Maryna Vadymivna Doctor of Philosophy, Candidate of Pedagogical Sciences, Associate Professor of the Department of Physics and Integrative Technologies of Teaching Natural Sciences, Pavlo Tychyna Uman State Pedagogical University, Sadova St., 2, Uman, 20300, https://orcid.org/0000-0002-0457-3792

FORMATION OF PROFESSIONAL COMPETENCE OF FUTURE TEACHERS OF NATURAL SCIENCES IN THE CONDITIONS OF DIGITALIZATION OF THE EDUCATIONAL PROCESS

Abstract. The article examines the process of forming the professional competence of future teachers of natural sciences in the conditions of digitalization, which is an important element of ensuring a high-quality educational process in institutions of higher education. The interpretation of the concept of "competence" has been improved and analyzed, and the main characteristics of the competence approach have been investigated. It has been established that the competence approach is the orientation of the educational process to achieve integral learning results, which are general (basic, key) and special (subject) competencies of those who study. General (basic, key) competencies ensure continuity and consistency of learning throughout a person's life, they are gradually deepened and enriched depending on the level of education. In higher education and professional training, in addition to general (basic, key), professional (related to specialty) and professional (related to specialization) competencies are distinguished. It is specified that digitization is the transfer of information into digital form. Globalization and digitization processes are taking place in Ukraine. This does not bypass education. The use of digital technologies allows to achieve freedom of creativity of participants in the pedagogical process.

It was determined that research competence is an integrative quality of a person, which consists of knowledge, abilities, skills, experience of the researcher, valuable attitudes and personal qualities and is manifested in the readiness and ability to carry out research activities to obtain new knowledge by applying methods of scientific knowledge, creative approach in setting goals, planning, decision-making, analysis and evaluation of the results of research activities. The basis of research competence is the ability to identify
a problem, formulate a hypothesis, select appropriate research methods and process the obtained results, analyze the obtained results, conduct scientific discussions, and implement the results of scientific research into practice.

It has been established that the improvement of the quality of training of future natural science teachers is due to the possibilities of the educational process to respond to the needs of society and the individual. It was determined that the importance of the modern field of professional activity of future science teachers, which is dynamically changing, is a leading factor in the development of modern education.

**Keywords:** professional competence, future teachers, digitalization, educational process, education.

Декарчук Марина Вадимівна доктор філософії, кандидат педагогічних наук, доцент кафедри фізики та інтегративних технологій навчання природничих дисциплін, Уманський державний педагогічний університет імені Павла Тичини, вул. Садова, 2, м. Умань, 20300, https://orcid.org/0000-0002-0457-3792

**ФОРМУВАННЯ ПРОФЕСІЙНОЇ КОМПЕТЕНТНОСТІ МАЙБУТНІХ УЧИТЕЛІВ ПРИРОДНИЧИХ НАУК В УМОВАХ ДІДЖИТАЛІЗАЦІЇ ОСВІТНЬОГО ПРОЦЕСУ**

**Анотація.** У статті розглядається процес формування професійної компетентності майбутніх учительів природничих наук в умовах диджиталізації, який є важливим елементом забезпечення якісного освітнього процесу в закладах вищої освіти. Удосконалено та проаналізовано тлумачення поняття «компетентність» та досліджено основні характеристики компетентнісного підходу. Встановлено, що компетентнісний підхід це спрямованість освітнього процесу на досягнення інтегральних результатів у навчанні, якими є загальні (базові, ключові) та спеціальні (предметні) компетентності тих, хто навчається. Загальні (базові, ключові) компетентності забезпечують наступність і послідовність навчання впродовж усього життя людини, вони поступово поглиблюються і збагачуються залежно від рівня освіти. У вищій освіті та професійній підготовці виділяються, крім загальних (базових, ключових), професійні (пов’язані із спеціальністю) та фахові (пов’язані із спеціалізацією) компетентності. Уточнено, що діджиталізація – переведення інформації у цифрову форму. В Україні відбиваються процеси глобалізації і діджиталізації. Не обходять стороною це і освіту. Використання цифрових технологій дозволяє досягти свободи творчості учасників педагогічного процесу.
Визначено, що дослідницька компетентність – це інтегративна якість особистості, яка складається в собі знання, уміння, навички, досвід діяльності дослідника, цінні ставлення та особистісні якості і виявляється в готовності і здатності здійснювати дослідницьку діяльність з отримання нових знань шляхом застосування методів наукового пізнання, творчого підходу в постановці цілей, плануванні, прийнятті рішень, аналізі та оцінці результатів дослідницької діяльності. Основу дослідницької компетентності складають уміння виявляти проблему, формулювати гіпотезу, підбирати відповідні методи проведення дослідження та проводити обробку отриманих результатів, аналізувати отримані результати, вести наукові дискусії, упроваджувати результати наукових досліджень у практику.

Встановлено, що підвищення якості підготовки майбутніх учительів природничих наук обумовлено можливостями освітнього процесу реагувати на потреби суспільства та особистості. Визначено, що важливість сучасної сфери професійної діяльності майбутніх учительів природничих наук, яка динамічно змінюється, є провідним чинником у розвитку сучасної освіти.

Ключові слова: професійна компетентність, майбутні учителі, діджиталізація, освітній процес, освіта.

**Formulation of the problem.** Today, the competence approach is being actively implemented in the field of education due to changes in socio-economic conditions and processes that appeared with the transition to a market economy. In solving the problem of creating an innovative, digital, competitive national economy in the international community, a key role is assigned to personnel, as well as to the teaching staff of the educational institutions that prepare them. The innovative development of the educational field causes the complication of the essence, content and functions of pedagogical activity, expansion of the boundaries of pedagogical reality, changes in the conditions of teachers' activities and requirements for modern teachers.

The new paradigm of education consists in the formation of competences determined by the educational field, which occurs during training in an educational institution and under the condition of continuous self-improvement of specialists. In the context of training future teachers of natural sciences, it is promising to focus on the subject area, which covers the formation of competencies necessary for implementation in professional practice. In today's conditions, digitalization is associated with the newest direction of information technologies, which, in fact, correlate with modern
areas of production. Despite the rapid application of the digital direction in view of the significant potential, it is, nevertheless, in the process of its formation and formation, thereby determining the priority socio-economic directions of development. It is obvious that digitalization to a certain extent determines the competitive position, which is characterized not only by efficiency and productivity, but also by the level of innovative development. It allows you to use the latest digital forms of communication, use opportunities through acquired competencies and adapt them to permanent changes in the environment.

Analysis of recent research and publications. The research topic of the process of formation of professional competences of future teachers of natural sciences is studied by a small number of scientists. In particular, the scientific works of V. Onipko, O. Sherstyuk, S. Khotkina, N. Chaichenko, B. Kobilov, D. Vasbieva, Hà Thị Kim Hằng, K. Khaletska, O. Kalugina are devoted to the analysis of some aspects of the formation of professional competences of future science teachers sciences in the conditions of globalization processes that affected the genesis and formation of the professional competence of an individual.

At the same time, the issue of digitalization in relation to its implementation and the setting of new guidelines is the object of transformational changes at the state level, personal development based on the symbiosis of innovations, the development strategy of industrial policy and the energy strategy of Ukraine for the period until 2030. In the same context, experts predict the consequences of such symbiosis, since it is about achieving the goals and tasks of sustainable development when using softdigital. Therefore, the identified problem is in the center of attention of political, business, scientific and practical and other spheres of activity.

Analysis of recent research and publications. In the works of both domestic and foreign scientists, special attention is paid to problems related to the change in the direction of development caused by digitalization. A significant contribution to the study of this topic was made by researchers and scientists in various fields, in particular Andersson van der Heyden, O. Hrybinenko, A. Gurenko, M. Dubina, Zh.-P. de Klerk, O. Kozlyanchenko, A. Koptelova, S. Korol, K. Kupryna, T. Lazorenko, L. Ligonenko, G. Sokolova, M. Ustenko and others.

The purpose of the article is to study the process of formation of professional competences of future teachers of natural sciences to ensure a high-quality educational process in pedagogical institutions of higher education. To achieve the goal, the following tasks have been identified: to determine the main components of the process of formation of professional
competences of future teachers of natural sciences; to analyze and reveal the competencies that future science teachers should have.

Presenting main material. The need to train highly qualified teachers poses to pedagogical education the task of creating conditions conducive to the formation of a teacher capable of solving the problems of innovative development of the country. Scientists who rely on the competence approach point out that the difference between a competent and a highly qualified specialist is that the former not only has a certain level of knowledge, abilities and skills in the profession, but is also able to use them in his professional activity [18-27].

There are many interpretations of the concept of "competence" in domestic and foreign scientific opinion. Among them, the most relevant, in our opinion, are: knowledge, abilities, skills and behavior necessary for employees to meet the requirements of the employer, which is a factor that helps a person to work more efficiently than others [1, p. 68]; compliance with the requirements, criteria and standards in the existing spheres of professional activity, the ability to obtain the expected results of professional activity and master the situation [2, p. 4]; the ability of a person to be qualified to perform a certain job [3; 4].

The competence approach in higher education is based on knowledge, as it integrates reflective assessment and awareness of the limits of professional competence and provides a connection between the educational process and its understanding; as a result, students' professional identity and a positive attitude to learning develop. The main idea of this approach is to reorient the main goals of higher education from fragmented factual knowledge and skills to the graduate's ability and readiness to work effectively in various professional situations. Currently, most universities already apply a competence-based approach, which uses active and interactive learning strategies, which include business meetings, role-playing games, case studies, psychocorrective training, etc. [5, p. 61].

Professional (specialist) competence is defined as a flexible, dynamically developing spectrum of knowledge, abilities, skills and personal qualities of a specialist, necessary for carrying out a certain type of activity. The professional competence of the teacher, first of all, ensures the readiness to effectively plan, organize and carry out pedagogical activities to achieve the expected results of student learning, the ability for professional self-improvement and scientific and pedagogical research [6, p. 231].

The acquisition of scientific and research competence is decisive in the personal professional profile of a teacher of natural sciences. The concept of professional competence of a future science teacher includes a whole range
of competences, among which, according to the European Qualifications Framework (EQF), research competence occupies an important place. According to the new requirements, research competence acquired during studies at higher education institutions is an integrative component closely related to other components of professional competence [7].

The quality of future teacher training under the competence approach is defined in modern research as the level of development of professional skills and psychological readiness for professional activity. We believe that comprehensive professional competence of the future teacher of natural sciences makes it possible to effectively solve a number of professional issues, and research competence is one of its components.

The essence of the scientific-research competence of a future teacher of natural sciences is determined based on the analysis of the National Framework of Qualifications [8], which states that future teachers of natural sciences in educational institutions should acquire competencies sufficient for the emergence of new ideas, solving complex problems in the field of secondary and higher education, research and innovation activity, methodology of scientific and correctional and pedagogical activity. Teachers acquire specialized modern knowledge with the possibility of further research activities, including innovative research at university or at work with knowledge of related subjects. Key skills of future teachers include solving problems using knowledge of related sciences (biology, chemistry, physics, geography, ecology, astronomy, etc.), even with incomplete or contradictory information. Educators develop the ability for further individual learning, research activities, team strategy development, decision-making skills in difficult circumstances thanks to new approaches, and the ability to predict future consequences.

The basis of training future teachers to conduct research are the principles of integration, which provide for a close interdisciplinary connection of the content and technology of studying individual components of natural sciences (physics, chemistry, biology, geography, etc.), and research methodology in the pedagogical process. The process of preparing future specialists for research activity should be focused on the formation of research competence, which ensures the ability to manage the methodologies of educational and naturalistic (biological, physical, chemical, etc.) research.

Scientists interpret the research competence of future science teachers as a type of professional competence that ensures effective work of professional and research activities. Research competence can be formed only in the process of conducting research by students, which should take place throughout the entire period of study at a higher education institution [9, p. 18].
Future teachers of natural sciences participate in educational, scientific and research activities, join in conducting research on the basis of academic freedom.

Such factors contribute to the formation of the research competence of future teachers of natural sciences as: the involvement of students in the research of scientific topics approved by the department; use of equipped educational laboratories, exhibits and collections for conducting research; internship of students in a research institution; participation of students in student scientific clubs, intellectual games; approbation of student scientific works at international, all-Ukrainian and regional conferences, competitions, seminars, etc. [10, p. 70–71].

The formation of research competence in a pedagogical institution of higher education is an important objective condition for the development of comprehensive professional competence of a teacher of natural sciences, since the development of an important adaptive quality of modern specialists occurs during research.

Thus, the main task of pedagogical higher education is to train specialists who would have a clear idea of the integration of natural sciences, adhere to legal and environmental standards in professional work, form the ability to think independently, be able to conduct creative research, solve tasks related to the organization of the educational environment, research activities and could be competitive specialists on the labor market [11, p. 247].

Since modern education involves regular updating of the material and technical base of an educational institution taking into account the latest trends in the development of the relevant field, it is advisable to create university educational centers, unified laboratory and research complexes using modern equipment and form a new educational environment on their basis. The solution to the problem of training graduates of pedagogical specialties, competent and adapted to the requirements of the digital economy, can be the creation of an automated education system - an integrative complex containing material and technical, electronic information, educational and didactic components, during the formation of professional competencies of future teachers based on consciously acquired knowledge of the subject, skills and experience acquired in the conditions of educational, quasi-professional and educational-professional pedagogical activity. This will contribute to the development of professional competencies of future teachers in the digital economy, which are important for gaining experience in activities that simulate future professional activities in an automated educational system [12, p. 24].
The problem of professional training of natural science teachers at the current stage occurs in general scientific, socio-philosophical, socio-cultural, moral and ethical processes. Despite a fairly wide range of research related to the problem of the development of professional competencies of future teachers, insufficient attention is paid to the consideration of the structure, content, and modeling of the process of formation of these skills. Modeling has been widely used in professional pedagogy, thanks to which scientists study pedagogical objects and phenomena and which is used for the analysis and research of pedagogical processes [13, p. 56].

It is worth noting that scientists A. Stepaniuk, H. Zhirska, N. Mishchuk specified the content of the groups of competencies that future teachers of natural sciences should possess, and distinguished among them the following: socio-cultural, general scientific (fundamental), professional (subject and psychological pedagogical). Thus, socio-cultural competences are an understanding of the social significance of one's profession and, accordingly, an understanding of one's place in the system of social relations, as well as the ability to critically evaluate one's own life and professional experience, consciously choosing ways and methods of improving one's personal and professional qualities.

General scientific (fundamental) competences are basic knowledge in the field of fundamental natural, humanitarian and socio-economic sciences, necessary for mastering professional and professional disciplines. Professional (subject and psychological-pedagogical) competences reflect a set of those knowledge, abilities, skills and attitudes that are, in fact, a qualification characteristic of the teaching profession of a certain profession, in particular future teachers of natural sciences [6, p. 232]. The formation of the professional competence of the future teacher of natural sciences is realized through the motivational, cognitive, activity, reflective, and evaluation components of the educational and cognitive activity of the students of higher education.

An integral part of the process of developing professional competences is an internship, which contributes to the realization of motivation and future professional activity, the application of knowledge and skills in practical situations. Thus, first- and second-year higher education students are focused on the implementation of their activities, which consists in the development of professional competences of future teachers of natural sciences in professional training. The integrity of the process and the content of the main elements are ensured, since this is the primary stage of the implementation of professional training. Students of the third and fourth years receive a basic level of professional training, first of all, developing professional
competences. Master's studies are a professional adaptation level. On the basis of scientific research by leading scientists, a structure for the development of professional competencies of future teachers of natural sciences has been identified, which includes three components:

1) subject-content: formation and development of the system of knowledge, abilities and skills of the content concept; interdisciplinary integrity; expertise; didactic knowledge;

2) practical: formation of professional competences; determination of theoretical and practical readiness; own choice of new forms and methods of work; experimental activity; introspection; organizational skills;

3) methodical and instrumental: realization of the goal and achievement of the result; knowledge of language communication; the ability to express and justify one's own opinion; acquiring skills in pedagogical technologies; search and application of modern methods; innovations, etc. [13, p. 56].

Based on the analysis of the educational and professional program "Secondary Education (Natural Sciences)" in the studied universities, five common professional competencies were identified: 1) the ability to operate with modern terminology, scientific concepts, laws, concepts, teachings and theories of natural sciences, physics, chemistry, biology; 2) the ability to reveal the general structure of natural sciences to form a scientific picture of the world; 3) the ability to characterize natural systems of different levels of organization based on the interrelationship of the fundamental laws of nature and society; 4) the ability to apply the acquired knowledge of the subject area, modern methods and educational technologies for the formation of key and subject competencies in secondary school students, in accordance with the requirements of the state standard in the field of education "Natural Sciences"; 5) the ability to integrate the content, forms and methods of teaching natural sciences, biology, chemistry, and physics in order to form a holistic natural and scientific picture of the world in students, the ability to use modern methods and educational technologies, including information and digital ones, to ensure the high quality of the educational process. They belong to fundamental and professional-pedagogical competencies and reflect the specifics of teacher training for teaching the integrated course "Natural Sciences". Therefore, it can be concluded that taking into account all factors of the formation of professional competences of future teachers of natural sciences will contribute to quality education, their adaptation to successful employment after graduation and professional compliance with the labor market.
Conclusions. On the basis of the conducted research, it can be concluded that under the conditions of intensification of integration processes, the problem of forming the professional competences of future teachers of natural sciences is becoming more and more relevant. Ensuring the appropriate functioning of the education sector is considered one of the priority state tasks, as an important structural element of providing the labor market with professional specialists. Professional competence is vital and crucial for the development of the future science teacher's personality in the 21st century. The importance of the formation of professional competences is focused on obtaining a qualitatively new result in the higher education system, which would correspond to the state and trends of the world educational space. As a result of competence-oriented training, future teachers of natural sciences acquire the ability to work with professionally significant material, organize the educational process of natural sciences based on an integrated approach, independently acquire new professional knowledge and develop personal creative potential.

References:


16. Osvіtno-profesіjna programa «Serednja osvіta (Prirodnichі nauki)» [Educational and professional program "Secondary education". volnumy.sharepoint.com Retrieved from https://volnumy.sharepoint.com/personal/biological_vnu_edu_ua_/layouts/15/onedrive.aspx?id=%2Fpersonal%2Fbiological%5Fvnu%5Fedu%5Fu%2FDocuments%2FKRED%2FPNN%2FOPPP%20%20%20NP%2FOPPP%2D2018%5Fred%2Epdfs&parent=%2Fpersonal%2Fbiological%5Fvnu%5Fedu%5Fu%2FDocuments%2FAKR_ED%2FPNN%2FOPPP%20%20NP%&originalPath=/aHR0cHM6Ly92b2xudS1teS5zaGFyZXBvam50LmNvbS86YjovZy9wZXJzb25hc2hiaW9sb2dpY2FsX3ZudV9lZHlvd WEvVldP MinJy2hoVFFD fBoN mNfQjBQ UFCSU1TNFF5NVRseXZ6Uk1qUXpjbDQ9ydGltZT1OZhGdDVktMTJZVw [in Ukrainian].


Література:
8. Про затвердження Національної рамки кваліфікацій : Постанова Кабінету Міністрів України від 23 листопада 2011 р. № 1341. Відомості Верховної Ради України. URL: https://zakon.rada.gov.ua/laws/show/1341-2011-%D0%BF#Text
11. Оніпко В.В. Організація пошуково-дослідницької діяльності майбутніх учителів природничих дисциплін у підготовці до роботи в профільній школі. Витоки педагогічної майстерності. 2013. Вип. 11. С. 246–250.
16. Освітньо-професійна програма «Середня освіта (Природничі науки)» / Волинський національний університет ім. Л. Українки, 2021. URL: https://volnumy.sharepoint.com/personal/biological_vnu_edu ua//_layouts/15/onedrive.aspx?id=%2Fperson al%2Fbiological%5Fvnu%5Fedu%5Fu%2FDdocuments%2FAKRED%2FPNP%2FOPP%20%20NP%2FOPP%2D2018%5Fred%2Epdf&parent=%2Fpersonal%2Fbiological%5Fvnu%5Fedu%5Fua%2Fdocuments%2FAKRED%2FPNP%2FOPP%20%20NP&originalPath=aHR0cHM6Ly92b2xudS1teS5zaGFyZXNvbW9yW3NhNvbS86YyovZy9wZXJzb25hbC9iW 9sb2dpY2FsX3ZudV9lZHVfdWEvRVdpMnJ4Y2hoVFZFdjBoNmNfQjBQTUFCSUI1TNFF5NVReXZ6UK1qUXpxbjdBQT9ydGlzZT10ZjGaDVKMTJVZw


