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PREPARATION OF FUTURE TEACHERS OF NATURAL SCIENCES FOR RESEARCH ACTIVITIES

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У статті охарактеризовано наукові основи формування дослідницької компетентності майбутніх учителів природничих наук, обґрунтовано необхідність дослідної діяльності для розуміння ними суті соціальних, економічних та екологічних явищ, інноваційного розв'язання професійних завдань. Обґрунтовано, що дослідна діяльність у вищому педагогічному закладі освіти є важливою об'єктивною умовою формування цілісної професійної компетентності вчителя природничих наук, яка забезпечує розвиток важливої якості сучасного фахівця – його науково-дослідницької компетентності.

Проаналізовано дослідження українських науковців стосовно формування дослідницької компетентності майбутніх учителів та виражено вимоги Національної рамки кваліфікацій, на основі яких визначено поняття «дослідницька компетентність майбутніх учителів природничих наук» як інтегративну якість особистості, що характеризує їхню готовність до вирішення дослідних (пошукових, проектних, консультативних, організаційно-керівних) завдань шляхом застосування методів наукового пізнання, застосування діагностичного підходу в освітній, науковій, природничій і управлінській діяльності і яка виражається в єдності ціннісно-мотиваційного, когнітивного й операційного компонентів.

Запропоновано під формуванням дослідницької компетентності майбутніх учителів природничих наук розуміти процес систематизованого накопичення в позитивних кількісних і якісних змін, що дозволяють здобувачам вищої освіти ефективно здійснювати освітнє, природничо-наукове дослідження. Розглянуто особливості підготовки майбутніх учителів до науково-дослідницької діяльності, що враховують принципи: науковості, системності, зв'язку теорії з практикою, безперервності освітнього процесу, гуманізму та передбачають два основних взаємопов'язаних напрями: навчання елементів дослідницької праці, формування дослідницького досвіду; власне наукові дослідження, які проводяться під керівництвом викладачів. Схарактеризовано систему підготовки до дослідницької діяльності майбутніх учителів природничих наук, яка характеризується відкритістю, динамічністю, керованістю, гнучкістю та передбачає три основних компоненти: теоретичний, організаційно-методичний, практичний.

Ключові слова: професійна освіта, Середня освіта (Природничі науки), майбутній учитель природничих наук, дослідницька компетентність, система підготовки до науково-дослідницької діяльності.

Problem statement. The social and economic changes and the activation of Ukraine's integration into the international educational environment determine the main directions for the improvement of higher pedagogical education. In order to realize the national educational initiative "The New Ukrainian School", professionally competent teachers are necessary, and they have to

be able to think creatively, find original solutions, be initiative and ready to teach school students to search for information on their own, to do projects and conduct research. One of the current problems of the higher professional school is the education of future natural sciences teachers on the methods of searching for and processing scientific information within their individual research practice based on the competence-based approach. This problem requires a dedicated formation of students' research competence that contributes to the development of motivation to action, and to the strengthening of a pedagogue's need of knowledge.

The transition to the single European education system raises the problem of theory in the process of building and developing the personality of a competent pedagogue-researcher who has mastered the technique of organizing scientific and pedagogical experiments in the process of teaching. Ultimate requirements for the training of a future natural sciences teacher are the equipment of the person with the subject knowledge and its integration, the formation of research skills, the development of professionally important qualities, as well as the ability to find and realize new approaches to the formation of key and subject competences of students.

At the same time, such educational practice does not fully advance the development of the research competence of a future teacher. Experience shows that graduates of pedagogical higher education institutions are not ready to perform research in natural sciences and pedagogy on their own, and cannot act as its organizers. That is why it is necessary to theoretically conceptualize the research competence of a future teacher.

Research and publication analysis. The issue of future teachers' professional training was explored in the scientific works of the leading scientists and pedagogues (N. Bibik, S. Honcharenko, I. Ziazun, O. Kozlova, N. Nychkalo, O. Ovcharuk, O. Pometun, O. Savchenko, A. Sbruieva and others). The analysis of the problem of competence-based approach realization in the system of future teachers training in higher education institutions is provided in the works of L. Bondarenko, N. Priadko, S. Stryzhak, N. Chaichenko, N. Shyian, O. Yaroshenko and others. We would like to separately mention the researchers of professional training of future natural sciences teachers; in particular, the scholars examining the role of competence-based approach in the process of studying natural sciences (T. Bondarenko, N. Hrytsai, Y. Lohvinova, I. Moroz, N. Novikova, V. Onipko, Y. Shapran and others); the scholars interested in the application of innovative methods, forms and means (L. Poshtaruk and others); the researchers of the organization of individual work (B. Andriievskiy, M. Hryniova, O. Lazariyeva, V. Sotnyk and others) and of teaching practice (O. Darbysheva, T. Lohvyna-Byk, I. Truskavetska and others). The studies of various aspects of the problems of research skills and competences formation, in particular that of students of secondary education institutions in the process of learning biology, are also worth mentioning (A. Bondarenko, O. Komarova, T. Korshevniuk, O. Moshura, H. Yahenska and others); of future teachers in various specializations (Y. Volynets, H. Kit, O. Martynenko, N. Myronchuk, N. Petrova, I. Raievska and others); of future natural sciences teachers (N. Bazurin, M. Bilianska, L. Burchak, L. Horshkova, V. Hrubinko, L. Koval, O. Myrhorodska, N. Moskaliuk, M. Sydorovych and others). However, the problem of the formation of future natural sciences teachers' research competence during professional training is little-studied in the Ukrainian scientists' works.

Keen understanding of the core of social, economic and ecologic phenomena, innovative solutions of professional tasks are impossible without learning the methods of scientific cognition, the logic of the research process, its analysis and prediction of its further development. The student who conducts research is not only an analytic, he or she also acquires the professional values for their future occupation. That is why the future natural sciences teachers should know the peculiarities of teachers' professional activities, the theoretic bases of natural sciences, as well as have the practical skills of applying the occupational knowledge in research, be able to use modern equipment and broadly introduce novel research methods.

Therefore, **the purpose of the article** is to define the idea of research competence, to determine the role of the competence in the professional training of students of Secondary Education (Natural Sciences), and to provide the ways of its formation in the educational process

and in the subjects of the professional training cycle and the practical training cycle. The following tasks were determined in accordance with the purpose: - to analyze the most recent studies and publications that present solutions of this problem; - to analyze the forms and methods of students' research activity.

The results of the research.

The modern pedagogic studies cover separate aspects of the issue of future teachers' training, such as the contents of the research competence of a teacher (B. Durette, M. Fournier, M. Lafon, M. Holovan, V. Zahviazynskyi, S. Kravchenko, G. Nuthall, I. Popovych, V. Sakharova, S. Sysoieva, J. Hattie, A. Khutorskyi, O. Shkvyr and others); the general requirements to the preparation for the educational and research activities of future teachers (O. Leontovych, L. Naboka, O. Obukhov, O. Poddiakov, P. Seredenko and others). The preparation for conducting research is of great importance in the training of future teachers. Scientists attempt to systematize its separate parts, to build theory which would correspond to the increasing complication of future teachers' functionality; the necessity of developing a complex understanding of research activity with interdisciplinary connections is gradually recognized in their studies.

Research in a pedagogic higher education institution is an important objective condition for the development of the comprehensive professional competence of a natural sciences teacher, since the shaping of an important quality of modern specialists, their scientific and research competence, happens while they conduct research. Thus, the main task of pedagogical higher education is to train specialists in the Secondary Education (Natural Sciences) specialization who would have a clear idea of the integration of natural sciences and the knowledge of them, adhere to legal and ecological standards in professional work, think independently, be able to conduct creative research, to solve tasks on the organization of the educational environment, the use and protection of nature, the exploratory activities, and are competitive in the job market (Onipko, 2013). Professional competence is defined as a flexible, dynamically developing range of knowledge, skills and personality traits of a specialists, necessary for conducting a certain type of activity. The above-mentioned acquired qualities are determinative in the personal professional profile of a future natural sciences teacher. The concept of professional competence of a future natural sciences teacher is characterized with broadness and includes a range of competences, among which one of the most important roles is taken by the research competence, according to the European Qualifications Framework (EQF). In accordance with the new requirements, the research competence acquired while studying at higher education institutions is an integrative component, closely interlinked to the other components of professional competence (*The European Qualifications Framework for Lifelong Learning*, 2008).

As of today, there are different interpretations of the idea of research competence. Thus, A. Khutorskyi defines research competence as a person's proficiency in the appropriate research field. 'Competence' should mean knowledge as a result of a person's study of a certain scientific field and the research methods learned in the process of conducting research, as well as the motivation and the position of the researcher, his or her value system (Khutorskoy, 2003). I. Zimniaia believes that research and scientific competence is a combination of systematic integrated interdisciplinary knowledge, multi-functional learning skills that are constantly developed during learning, in scientific, research and project-related activities, and a great motivation and positive attitude towards scientific search and educational values (the love of truth, the aspiration to creative activities and self-improvement) (Zimniaia, 2005). According to O. Ushakov, research competence is an integral personality trait expressed through the readiness and the ability to individually search for solutions for new problems and creative changes of reality on the grounds of a set of personally acquired knowledge, skills, work methods and value systems (Ushakova, 2008). O. Norkina understands research competence to be a complex, integrative personality trait combining knowledge, skills, teaching experience, the value system and personality traits, and is expressed as the readiness and the ability to conduct research with the aim of acquiring new knowledge by applying scientific and pedagogic methods and creative

approaches in planning and making decisions, analyzing and evaluating the research results (Norkina, 2017).

According to M. Holovan, “research competence is a complex integrative personality trait combining knowledge, skills, teaching experience, the value system and personality traits, and is expressed as the readiness and the ability to conduct research with the aim of acquiring new knowledge by applying scientific and pedagogic methods and creative approaches in choosing goals, planning, making decisions, analyzing and evaluating the research results” (Holovan, 2012). The quality of a future teacher’s training, in terms of the competence-based approach, is defined in modern studies as the level of the professional skills development and the psychological readiness for professional activity. Thereupon, we believe that the comprehensive professional competence of a future natural sciences teacher gives him or her the possibility to effectively solve a range of professional issues, and research competence is one of its components.

In order to determine the essence of the research competence of a future natural sciences teacher, we have analyzed the National Qualifications Framework (*On the Adoption of the National Qualifications Framework*, 2020), which states that students of the Secondary Education (Natural Sciences) specialization have to acquire the competences that are enough to produce new ideas, solve complex problems in the field of secondary and higher education, research and innovative activities, and the methodology of scientific and correctional-pedagogic activity. Students receive specialized up-to-date knowledge with the possibility of further research activity, including innovative research at university or at work with the knowledge of related subjects. The key skills of future teachers include task solving using the knowledge of related sciences (biology, chemistry, physics, geography, ecology, astronomy) even having incomplete or contradictory information. The ability to further individual learning, research activity, team strategy building, the skills of making decisions in complicated circumstances with new approaches and the prediction ability are shaped.

Within the context of the studied issue, we have determined that the Secondary Education (Natural Sciences) study program is intended for training a pedagogue who thinks creatively, is a professionally competent specialist, knows how to use modern educational technologies and effective methodologies of research and production activities, is able to solve complex educational and applied problems connected with related knowledge fields. The contents of the specialist’s research depend on many factors, including, in particular, his or her profile, field of work; research experience, the range of working means and methods, that is the quality of training; the terms of the research tasks etc. The basics of preparing for conducting research is the principles of integration, which imply a close interdisciplinary connection of contents and technology of learning separate components of the natural sciences (physics, chemistry, biology, geography etc) and the methodology of research in the pedagogic process. For example, such disciplines as general biology and the methodology of teaching biology in an integrated course, biosphere studies, introduction to nature management and ecological education, allow to shape professional competences connected with the peculiarities of the activity of organisms, integral understanding of the biological systems organization, the ability to comprehend and apply the principles of bioethics, the modern ecological technology; to acquire the knowledge about the methodologies of teaching and conducting research in natural sciences. The preparation process for research activities of future specialists has to be focused on forming the research competence that ensures the ability to operate the methodologies of educational and naturalistic (biological, physical, chemical) research. We interpret the research competence of future natural sciences teachers as the type of professional competence that ensures effective performance of professional and research activities. Research competence can only be formed in the process of conducting research by students, which has to happen throughout the whole period of studying at the higher education institution. Future natural sciences teachers participate in the educational, scientific and research activities, join conducting research on the bases of academic freedom. The following factors contribute to the formation of the research competence: the involvement of students in

the realization of departments' scientific themes; the use of equipped educational laboratories, exhibits and collections of museums, the educational laboratory of the Science Faculty "Botanical Garden", the scientific laboratory of bryology; internships for students at scientific and research establishments; students' participation at student scientific clubs, the intellectual game "What? Where? When?"; the approbation of their research papers at international, all-Ukrainian and regional conferences, competitions, seminars etc.

Conclusions. The collected experience of research on the formation of future teachers' research competence and the requirements of the National Qualifications Framework allow us to define the research competence of future natural sciences teachers as the integrative personality trait that characterizes their readiness to solve research-related (project-related, consultative, organizational and managerial) tasks by applying the methods of scientific cognition, the diagnostic approach in educational, scientific, nature-studying, and managerial activity, and which is expressed in the unity of value systems, motivational, cognitive and operational components.

We understand the formation of the research competence of future natural sciences teachers as the process of systematic accumulation of positive quantitative and qualitative changes in its contents that will allow students to effectively conduct educational and scientific research. The preparation of students for conducting research is accomplished considering the following principles of preparation: it should be scientific, systemic, theory has to be connected with practice, the educational process has to be continuous, the principles of humanism have to be followed. Two interrelated directions are defined: teaching students the elements of research activity, forming their research experience; the research itself performed by students with teachers' guidance. The system of preparation for conducting research is characterized as open, dynamic, manageable, and flexible. Such preparation of future natural sciences teachers for conducting research has to include at least three following components: the theoretical, the organizational and methodical, and the practical component. The main purpose of theoretical preparation is to ensure that students acquire an integral knowledge system in the field of educational, naturalistic, scientific research, learn the methods of conducting it, the regularities, principles and rules of research. Organizational and methodological training includes acquiring the organizational knowledge and skills to conduct individual and joined educational, scientific (natural) research, the skills of applying the learned methodologies, as well as learning, analyzing and applying effective experience on improving naturalistic objects, the knowledge about the rules of creating regulative documentation in accordance with the results of the research. The purpose of practical training is to shape the skills necessary to conduct individual research, and to learn the technique of conducting research in the education and natural science fields. Within the practical training, students receive practical experience of solving research problems, improve their general skills, shape their skills of working with technology, develop their comprehension of science and its real possibilities through conducting their own research.

This study does not cover all the aspects of the problems of forming the research competence of future natural sciences teachers. Prospective directions for further scientific exploration include the development of the technology for shaping the research competence and the appropriate educational materials and facilities for the higher education receivers in the Secondary Education (Natural Sciences) specialization.

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PREPARATION OF FUTURE TEACHERS OF NATURAL SCIENCES FOR RESEARCH ACTIVITIES

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The article describes the scientific basis for the formation of research competence of future teachers of natural sciences, substantiates the need for research to understand the essence of social, economic, and environmental phenomena, innovative solutions to professional problems. It is substantiated that research activity in a higher pedagogical educational institution is an essential objective condition for the holistic professional competence formation of a science teacher, which ensures the development of the research competence as an important quality of a modern specialist.

The research of Ukrainian scientists on the formation of research competence of future teachers is analyzed, and the requirements of the National Qualifications Framework are highlighted, on the basis of which the category 'research competence of future teachers of natural sciences' is defined as an integrative quality of personality that characterizes their readiness to solve research (search, design, consulting, organizational and managerial) tasks by applying methods of scientific knowledge, application of the diagnostic approach in educational, scientific, natural and managerial activities and which is expressed in the unity of value-motivational, cognitive and operational components.

It is proposed to understand the process of systematic accumulation of positive quantitative and qualitative changes under the formation of research competence of future teachers of natural sciences, which allow applicants for higher education to effectively carry out educational, natural science research. The peculiarities of preparation of future teachers for research activities are considered, taking into account the following principles: scientific, systematic, a connection of theory with practice, continuity of the educational process, humanism and provide two main interrelated areas: teaching elements of research work, formation of research experience; actual research, which is conducted under the guidance of teachers. The system of preparation for research activities of future teachers of natural sciences is characterized, which is characterized by openness, dynamism, manageability, flexibility and provides three main components: theoretical, organizational, and methodological, and practical.

Keywords: professional education, Secondary Education (Natural Sciences), future teacher of natural sciences, research competence, system of preparation for research activities.

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