PROGRAMMING OF PEDAGOGICAL TECHNOLOGY FOR FORMATION OF PROFESSIONAL COMPETENCE STUDYING SPECIAL DISCIPLINES IN AGRICULTURAL ENGINEERING SCIENCES

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Abstract. The article deals with the problem of the formation of professional competence of the future engineers in the integration process of special disciplines into the agro-engineering sciences. There has been scientifically substantiated and experimentally verified the efficiency of methodology for the formation of professional competence of the future agro-engineers by integrating special disciplines, based on personal activity, competence, problem-integrative, contextual and system approaches. The psychological and pedagogical conditions for the implementation of the methodology in the process of studying agricultural mechanics, the theory of agricultural machines, machine use in the crop production and animal husbandry, etc. are determined and theoretically substantiated. The purpose of this article is the problem of the formation of sustainable professional competence of the future agricultural engineers in the integration process of natural and general technical disciplines into the special disciplines from the basic training profile. Based on the results of the research, a methodology was built, in which the effectiveness of the formation of professional competence of future agricultural engineers was scientifically substantiated and experimentally verified by integrating fundamental disciplines into special ones. There are determined and theoretically substantiated psychological and pedagogical conditions for the implementation of the developed models in the process of studying these disciplines. There is proved the efficiency of the developed logical models and their impact upon the components of professional competence, which is carried out by applying approaches to the assimilation of the scientific knowledge, the use of integrative learning technologies, as well as increasing the cognitive activity, motivating students to study special disciplines. The developed technologies for the formation of professional competence in the study of special disciplines in agro-engineering sciences can significantly increase the level of professional knowledge of the future engineer of agro-industrial production.

Keywords: competence, professional orientation, agro-engineer, agricultural mechanic.

Introduction

Humanity has entered the 21st century of a new era. It entered at the turning point of the socio-economic and political formation with a desire for the good and useful, and human but, at the same time, with misunderstanding of many concepts that are not characteristic of our mentality. We recognized, promoted and supported the laws of Darwin in nature but did not want to transfer them to society as the highest form of development of nature, the economy as a concentrated form of social environment. We faced realities, characterized by fantastic, in our opinion, information content and ways of access to all its types, regardless of regional and national aspects, mobility, often forced, in the choice of housing, work, education, a sharp change in the priorities of social protection, the ideology of cultural, ordinary, religious values. One of the most efficient means of adapting a person to the modern life is education as an organized pedagogical process of cognition, development, communication and creativity. There are two education systems in the world: supportive and innovative. Supportive – aimed at training a person to solve everyday problems, maintain a lifestyle and activities. Innovative education is focused onto the future and is associated with training the students to use the methods of forecasting, modelling, designing in life and professional activities, an independent approach to any scientific, social, and technical or life problem, developing the ability to deeply understand these problems, think, analyse.

The condition and rate of agricultural production, the specifics of the professional activity of the agricultural engineer now require that education in higher school not only deeply revealed the essence and content of the established principles of modern science but also formed active acquisition of these principles. Therefore, for higher education the primary task is to maximize the development of the students' skills to independently apply the basic principles and laws of agricultural engineering in practical activities, and to form in the students foundations of modern scientific knowledge, focused on the needs of life and production, which would provide an opportunity for active and creative participation of the young person in the public and manufacturing areas in the future.

At present Ukraine continues to reform the educational system at all levels, and this process is aimed at bringing domestic criteria for diagnosing education and its standards in line with the European requirements, i.e. the requirements of a competency-based approach and the Bologna process. The European vector of development of the domestic educational sphere, the increase in the level of competition among specialists in the labour market determine a transition from the education of knowledge to the formation of competence as an efficient mechanism of improving the quality of higher education, ensuring its compliance with the requirements of modern life. Based on knowledge, skills and abilities as components of the content of education, the competence-based approach puts forward not the student's awareness but his ability to solve the problems that arise at every step of life and activity.

The problem of professional competence was studied by many philosophers, teachers, and psychologists. The issues of formation and development of professional competence are considered in the works of V.A. Adolf, T.G. Brazhe, E.F. Zeera, I.A. Zimney, N.V. Kuzmina, M.I. Lukyanova, A.K. Markova, A.M. Novikova, G.S. Trofimova, G. Bernhard, V. Bloom, H. Markus, R. Sterner and others.

The problem of modernization of education and professional training of specialists within the context of innovative trends in the development of society is analysed in the works by V. Kremen. The author notes that modern education and professional training of the specialists must respond to new challenges of our time; the formation of a knowledge society becomes the most important priority for the life activities of any society [1]. Significant disclosures of certain areas of the problem have found their place in the scientific research of such well-known scientists: I.A. Zyazyuna, N.G. Nichkalo, S.A. Sysoeva, S.U. Goncharenko, V.P. Andrushchenko, P.M. Volovik, M.I. Mikhalchenko, A.M. Infantry, O.Ya. Savchenko, G.G. Filipchuk, A.I. Kulchitskaya, L.P. Pukhovskoy, N.A. Pobirchenko, V.V. Rybaki, O.P. Rudnitskaya, T.S. Yatsenko [1; 2].

Nichkalo N.G. believes that the replacement of the basic classical educational philosophy requires the development of new education systems, new standards, technologies, programs, plans. In her opinion, highlighting a number of functions, performed by continuous, professional education, the latter should solve the economic problem, that is, it should be aimed at meeting the needs of the state, region, various industries by specialists, prepared to introduce the latest technologies, equipment, etc. There is an urgent need to act, to act creatively, boldly, to move away from the system of "university authoritarianism", the alpha and omega of the now non-existing state USSR to design and implement new educational technologies, techniques and teaching methods [2].

Zyazyun I.A. believes that an era has come when "A person is included in the educational process at all stages of its development, taking into account heredity in the transition from one degree to another." Therefore, it is necessary to change the formula "education for life" to "education through life" [3]. Foreign researchers put into the content of the concept, first of all, practical sense, abilities that are necessary to efficiently perform a specific action in a specific subject area (Y. Adrian, J. Raven, J. Britell, F. Nugroho, D. Harding, A. Kadiyono, R. Talitha and others) [4-7].

So, according to J. Raven, competence is a phenomenon that "consists of a large number of components, many of which are relatively independent of each other, ... some components are more related to the cognitive sphere, while others are more related to the emotional, ... these components can replace each other as components of effective behaviour" [4].

This opinion is quite weighty expressed in the definition of J. Britel: "Competence is the ability to perform tasks. It can contain knowledge, skill, understanding and freedom" [5].

The importance of teachers as the basic element of improving the overall quality of education cannot be overestimated for the adoption of the future educational paradigm [7-11]. To become an efficient "agent of change", the teacher must develop into a professional figure who constantly accepts and is critical towards the diverse progress and dynamics of civilization that continue to take place in the surrounding environment [7; 12; 13].

The teachers, in collaboration with the employers, should strive to turn the educational institutions into a "magnet" that can attract the students' attention and encourage them to communicate, discuss and exchange ideas in an interesting and exciting learning environment [14]. But today educational institutions are beginning to ignore the employers due to the inability to implement an innovative

educational system that would be focused on the implementation of the tasks of training and educating such a specialist who is able to work efficiently in a dynamically changing environment [15; 16]. Despite the rather wide representation of the phenomenon to be studied, in the scientific literature there is still no unambiguity, both in its operationalization and in determination of its composition, and therefore in identification of the ways of its development. So, the relevance of the topic is determined by insufficient substantiation of methods for the development of the teachers' professional competence and the ever-increasing requirements of social practice in competent employees.

The purpose of this article is formation of sustainable professional competence of the future agricultural engineers in the integration process of natural and general technical disciplines into special disciplines of the basic training profile.

"Competence" determines the level of professionalism of an individual, and its achievements occur through the acquisition of necessary competencies, which is the goal of professional training of specialists. By competence we understand a set of interdependent qualities of a person (knowledge, abilities, skills, methods of activity) necessary for high-quality productive activity. Competence is a system of scientific knowledge, intellectual and practical abilities and skills, personal qualities and formations, which, with sufficient motivation and a high level of professionalism, ensures self-realization, self-preservation and self-improvement of the individual in the process of professional activity.

Materials and methods

The proposed methodology for the formation of professional competence of the future agricultural engineers in the process of studying special disciplines is based on the methodological foundations of competence-based and personal-activity approaches and is understood as the scientific basis for the result and process of professional training of the future specialists. It is expressed by systemic quality – competence, which ensures the ability of agricultural engineers to perform efficient professional activities. The methodology allows to define, specify and correlate the requirements of standards and elements of professional competence: professional skills, a set of acquired professional knowledge, motives and reflection of professional activity that is necessary for successful mastery of a specialty.

The methodology, proposed in the research, is a complex system, containing the training blocks:

1. the target block, including the tasks: the formation in the students and the future agricultural engineers the elements of professional competence in the process of studying special disciplines: professional skills, a set of acquired professional knowledge, development of professional qualities of a person, motives and reflection of professional activity;
2. the methodological block, containing: a competency-based approach, which is a practice-oriented tactic and the result of the formation of professional competence of the future agricultural engineers;
3. the personal-activity approach that allows developing the content of formation of professional competence of the future agricultural engineers, focused on the students' personality, and assuming a link of this content with their future activities;
4. the content-procedural block, represented by the components of professional competence of the future agricultural engineers (operational activity, cognitive, motivational and personal-reflexive), formed due to the developed content of the academic disciplines;
5. the diagnostic block, containing criteria and indicators for the assessment of professional competence of the future agricultural engineers.

Professional competence cannot be learned through traditional learning patterns. A competent student can only become independent, having determined for himself and tested on himself different models of behaviour in a particular subject area, selecting from them those that are most appropriate to his individual style, aesthetic aspirations and moral attitudes. This can be achieved by involving the student in the performance of professional, production activities in the subject area through academic subjects, practices, projects, increasing, complicating, expanding the range of his knowledge, skills, capabilities, attitudes in the system of end-to-end basic research. Thus, in the mind of the student there is a merging of knowledge about the essence of the subject content and personal readiness for the implementation of professional activities.

Practice testifies to the problems in modernizing the content of the educational programs, improving the forms and methods of teaching, as well as intensifying the students' independent work under the current norms of time for studying the disciplines. Such problems can be solved through introduction of new pedagogical technologies, purposeful formation of the students' productive activity in the process of professional training. Pedagogical technologies should take into account the constantly changing conditions of agricultural production, and the future specialist should easily adapt to new production conditions.

The formation of professional technical skills and knowledge takes place in the process of studying such special disciplines: "Technical Mechanics", "Introduction to the specialty", "Material science and TCM", "Interchangeability, standardization and technical measurements", "Agricultural machines", "Mechanical and technological properties of agricultural materials", "Machinery and equipment of the agro-industrial complex".

Exploration of the principles of selection of the content of the educational material of special disciplines, we took into account that:

- technical training should be based on the characteristics of the student's development;
- the topics of academic disciplines should be interconnected;
- the skills and knowledge, acquired during the study of theoretical courses, should be improved in the course of practice;
- the content of education must correspond to the level of development of modern science and technology.

The academic discipline "Technical Mechanics" in the system of professional training of agricultural engineers plays an important role as the basic one in further mastery of the skills and knowledge in the cycle of professionally oriented disciplines.

The main form of conducting classes in a higher educational institution is a lecture, intended for the students to master the theoretical material. Lectures on special disciplines provide an opportunity for the students to master the basics of technical sciences; new achievements in technology; awareness of the prospects for the further development of scientific research in the area under consideration; as well as the disclosure of the possibilities of using specific knowledge in professional activities. In the process of teaching special disciplines, along with the traditional lectures, we use problem lectures, which are aimed at solving technical problems, ensuring high mental development, stimulating the students' independent thinking, development of their cognitive professional interests and needs.

At problematic lectures we use such presentation of the new material when the teacher asks problematic questions and the students answer them. For example, we formulate several problematic questions that we use when teaching the discipline "Technical Mechanics": Why does the speed of the body change? Why in some cases the body moves along a rectilinear trajectory, and in others – a curvilinear one?

Solution by the students of learning problems has a significant advantage over the presentation of ready-made information, which lies in the fact that, when solving a problem, the student actively thinks, and this contributes to the formation of the ability to navigate in any situation and independently find ways to solve the problem.

A promising tool in the teaching of special disciplines are professionally oriented multimedia, which visually teach the material and prove the ability to integrate almost everything, related to the process of cognition (Fig. 1).

At laboratory and practical lessons in the special disciplines, the students, under the control of the teacher, conduct full-scale or simulation experiments in order to practically confirm individual theoretical assumptions, acquire practical skills in working with the laboratory equipment, the measuring equipment, the experimental research methods.

So, in the laboratory and practical classes in the discipline "Technical Mechanics" the students solve the following problem situations:

There is given a scheme of a mechanism. Determine what is shown in the diagram and explain the principle of operation of the mechanism (Fig. 2).

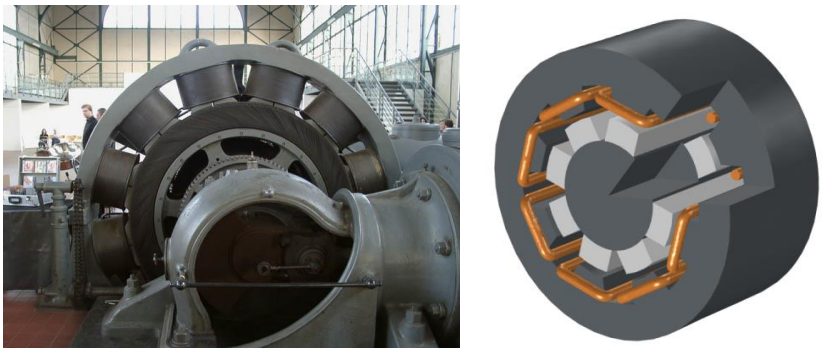

Fig. 1. **Professionally oriented multimedia**

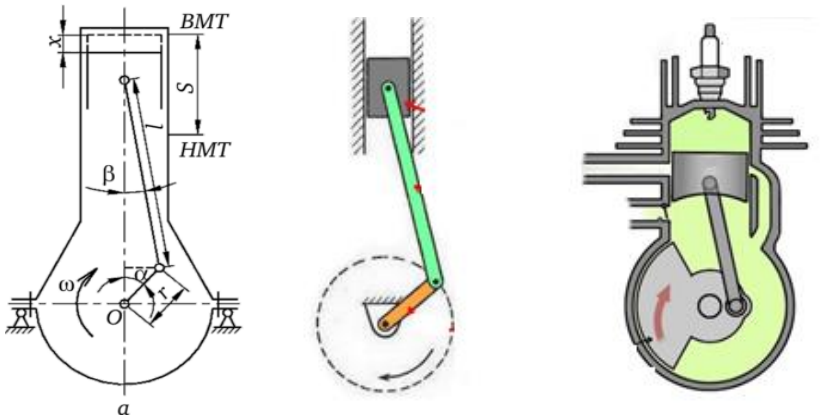

Fig. 2. **Scheme of the mechanism**

As practice shows, the graduates of agricultural technical universities are poorly trained in special disciplines. This is due to a number of reasons, including insufficiency of an illustrative professionally directed material, lack of the necessary technical support for educational laboratories, insufficient provision of the teaching disciplines with technical teaching aids, and so on. We believe that one of the ways to solve this problem is the use of professionally oriented examples in the teaching of special disciplines.

Results and discussion

Verification of the efficiency of the model for the formation of professional competence of the future agricultural engineers in the process of studying special disciplines was carried out in the course of a pedagogical experiment, the conditions for which were natural for all participants in the process. In total, 456 students of the specialty 208 "Agroengineering" participated in the experiment. To study the real state of the students' readiness for professional activities, questionnaires were developed, aimed at identification of: the students' interest in the professional competence of the future agricultural engineers; the level of awareness of the importance of the special disciplines for its formation; the level of mastery of the methods of forming such competence in the process of studying special disciplines. The study defines three levels of formation of professional competence of future engineers: low, average, high. The methods that we used, adapted in accordance with the objectives of the study, for diagnosing the model for the formation of professional competence of the future agricultural engineers in the process of studying special disciplines, in particular: a survey after Y. Feshchuk [17] (identifying the levels of the students' interest in professional competence), questioning the students in order to identify the levels of awareness about the essence of professional competence of the future agricultural engineers); ranking method (identification by the students of the importance of special disciplines for the formation of professional competence); a questionnaire survey (a study of the students' mastery of the ways of formation of professional competence in the process of studying special disciplines).

Regarding the interest of the students in professional competence of the future agro-engineers, we have found that this integrated personality quality occupies only the 7th place both among the 1st (9.0%) and the 2nd year (9.3%) students, and among the 3rd and 4th (14.9%).

In the course of the pedagogical experiment a comparative characteristic of the formation of the components of professional competence was carried out, based on the results: of the students fulfilling technical tasks; preparing computational and graphic tasks and completing tasks; using a comprehensive test; a survey of the students to determine the change in their professional qualities and abilities; resolution of situations of technical problem. As the results of the pedagogical experiment showed, implementation of the developed methodology for the formation of professional competence of the future agricultural engineers in the process of studying special disciplines had a positive impact upon the level of formation of this competence. So, in the experimental group (EG), 44% of the students reached a high level (it was 35%), 41.5% – an average level (it was 35.25%). In the reference group (RG), 29% of the students (it was 28.5%) reached a high level, 31.48% – high (it was 29.48%), average – 41.75% (it was 41.25%) (Table 1). So, the efficiency and potency of the developed methodology for the formation of professional competence of the future agricultural engineers in the process of studying special disciplines was proved, the introduction of which has significantly increased the level of formation of this competence.

Table 1

Dynamics of formation of professional competence of the future agricultural engineers (%)

Level of professional competence	At the beginning of the experiment		At the end of the experiment	
	EG	RG	EG	RG
High level	35	28.5	44	29
Average level	35.25	41.25	41.50	41.75
Low level	29.75	30.25	14.50	29.25

Conclusions

Theoretically substantiated and developed methodology for the formation of professional competence, based on the methodological foundations of competence-based and personal activity approaches. The implemented methodology allows determination, specification and correlation of the requirements of the higher education standards for training the future agricultural engineers and the components of their professional competence, necessary for successful mastery of the specialty.

The efficiency of the methodology for the formation of professional competence of the future agricultural engineers in the process of studying special disciplines was experimentally tested, showing significant differences in the quantitative and qualitative indicators of the levels of formation of professional competence of the future agricultural engineers. So, in the experimental group the dominant levels were high (44%) and medium (41.5%), while in the reference group – medium (41.75%) and low (29.25%). The indicator of a low level of professional competence formation in the experimental group decreased by 15%, while in the reference group it remained practically unchanged. This showed the efficiency of the developed methodology for the formation of professional competence of the future agricultural engineers in the process of studying special disciplines and the efficiency of the experimental work.

We see the prospects for further developments in determining the ways how to improve the efficiency of professional training of the future agricultural engineers, in particular, in the development of an integrated content of general scientific disciplines and special disciplines.

Author contributions

All authors have contributed equally to creation of this article. All authors have read and agreed to the published version of the manuscript.

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