THEORY OF PROJECT PREPARATION OF AGROENGINEERS ON THE BASIS OF SCIENTIFIC WORK ON THE DEVELOPMENT OF AGRICULTURAL MACHINERY

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Summary. *The conducted scientific researches on the theory of project preparation of agroengineers are based on scientific research on agricultural engineering which were based on regulatory documents, including the Law of Ukraine "On Higher Education", which states that the educational process is an intellectual, educational and scientific activity, which is being carried out in institutions of higher education through a system of scientific and methodological and pedagogical activities. The study of the influence of cross-cutting, scientifically substantiated sequencing and step-by-step pedagogical technology of training on the formation of readiness for future activities of future specialists in agroengineering was conducted. In a scientifically substantiated system of cross-cutting design of technical means of mechanization, the key stage is the implementation of a professionally relevant for agroengineer coursework on agricultural machines, which students perform at the 3rd year of study at the university. In these scientific studies, the readiness of a future specialist in agroengineering to design and research activities was assessed by motivational-value, cognitive-educational and activity-practical criteria.*

KEYWORDS: *PROJECT TRAINING, PROJECT ACTIVITY, TOTAL AMOUNT OF KNOWLEDGE, FUTURE AGRICULTURAL ENGINEER, THEORY, AGRICULTURAL MACHINERY.*

Introduction.

The Law of Ukraine "On Higher Education" (Article 47) states that the educational process is an intellectual, creative activity in the field of higher education and science, which is being implemented in institutions of higher education (IHE) through a system of scientific and methodological and pedagogical activities [1] . The training of future agroengineers in IHE is based on the formation of professional competences in a harmoniously developed personality capable of solving the tasks of production activity. The educational process in IHE is carried out in the following forms (Article 50 [1]): training sessions, independent work, practical training, control activities. The main types of training in agricultural institutions of higher education (AIHE), as well as in others, are: lectures, laboratory and practical classes, consultations. The main participants of the educational process are the scientific and pedagogical workers and the applicants of higher education. According to the Law of Ukraine "On Higher Education", scientific and pedagogical workers are those who, in their main place of work, conduct educational, methodological, scientific, technical and organizational activities. In their professional activity, the scientific-pedagogical staff of the AIHE chooses methods and means of training aimed at ensuring the high quality of training of agroengineering specialists. Scientific and pedagogical workers are obliged to provide teaching of disciplines at a high scientific and theoretical level, to conduct scientific activities in the IHE. Students who study in IHE have the right to participate in research, development and scientific works, scientific conferences, symposiums, exhibitions, competitions, publish their works in Ukraine and abroad [1]. Scientific, scientific and technical and innovative activities are a necessary and integral part of educational activity. The subjects of scientific and technological innovation activity are scientific-pedagogical workers of IHE, employees of enterprises that cooperate with educational institutions and, of course, students. The main purpose of scientific and technical activity is to obtain competitive innovative results of theoretical and experimental research and development aimed at the creation and introduction into the educational process and production of new technologies, machines and equipment for agricultural production, training of specialists in accordance with socio-economic needs.

***Prerequisites and means for solving the problem*.**

New standards for higher education include significant changes in the objectives and tasks of training agroengineering specialists. In this context, the design training of future specialists in agroengineering has a dominant role. In [2] presents basic components forming readiness for project activities by an agroengineer as a specialist who has combined skills in physics and mathematics, general and special units and general and professional competence who should have bachelor specialty 208 "Agroengineering." For example: to design equipment and equipment for production areas, agricultural machines, their knots, mechanisms, various connections; carry out standard design calculations of knots and machine parts and non-standard equipment; rational assembly of machine aggregates in existing production lines of plant production and livestock production; to determine the technical condition of tractors, cars and aggregates of complex equipment [2], to optimize transport processes, etc. There are also [2] presented the results of studies on the role of physical and mathematical education to the general and professional competencies of future agroengineers and impact of educational activities of teachers preparing students for the project.

General questions of the theory of design training were studied by: Bryukhanova N.O. [3], Kolesnikova I.A [4], Gorchakova-Sibirskaya M.P. [4], Nychkalo N.G. [5], Skyba M.E. [5], Anishchenko O.V. [5] and others. The theory, methodology and practice of design training for agroengineering, including in view of the design of agricultural machinery, were studied and investigated by: Bendera I.M. [6, 7, 8], Duganets V.I. [9], Pryshliak V.M. [2, 10] and others. Also, to the questions of improving the methodology of preparing future engineers are devoted the works of A. Asherova, O. Kovalenko, M. Lazareva, D. Chernilevskogo, P. Yakovyshina, and the methodological aspects of the future of agroengineering have been reflected in the scientific researches of I. Buzika, A. Demina, S. Daukilasa, A. Esaulova, P. Luzana, V. Manka, I. Palamara, S. Pastushenko, V. Yaroshenko, transformation of independent educational activity into readiness for professional self-development by means of technologies of personally oriented education - is reflected in the monograph Bondar M.N, Zhuravsky L.M. Ostapenko E.O., Pryshliak V.M, Kutsenko A.G. [11].

Solution of the examined problem.

The theory of project preparation for agroengineering is based on scientific research on agricultural engineering and it involves cross-cutting of knowledge, scientifically based sequencing and step-by-step achievement of the goal. At the final stage of training in the Agricultural Institution of Higher Education for agroengineers, it is very important the implementation and successful defense of the diploma project. It is important that the graduation project is related to real agricultural production. This would ensure the introduction of the latest developments in technological processes, and it would promote the development of the agro-industrial complex and increase the welfare of people.

Growth of the gross collection of grain, root crops, vegetables, fruits, berries and other types of agricultural products is possible only on the basis of intensification of agro-industrial production, what is meant by the growth of volumes of harvest as a result of more productive use of cultivated land due to the application of new high-tech equipment and competitive technologies, that is, obtaining from the same areas more products, of better quality and with less costs production resources. Intensive crop growing technologies are based on the industrialization of production, a solid technical basis. Industrialization involves

masses, specialization, cooperation, rhythm, standardization, complex mechanization, electrification and automation of production.

The level of mechanization of production processes in agriculture in Ukraine is on average 80 ... 85%. It is especially low in horticulture, vegetable growing, household management. In addition to the insufficient level of mechanization in crop production, it is necessary to indicate low performance indicators of technical means. Thus, the coefficient of readiness of the means of mechanization of domestic production is on average 0,87 ... 0,92, and the coefficient of their use varies from 0,4 to 0,6. In fact, the period of operation of individual machines in crop production before carrying out repair works is 1.4 ... 1.5 times lower than normative. The low level of reliability of equipment for the mechanization of plant growing is due not only to its structural imperfection, but also to the technology of manufacturing machines, the correctness of their operation. Therefore, the development and production of competitive technical equipment for agricultural enterprises, especially the level of mechanization is low, the scientific training of agro-engineering specialists is still an unresolved problem and requires profound fundamental research.

In a scientifically based system of cross-cutting design of technical means of mechanization, the key stage is the implementation of a professionally meaningful agroengineer course project on agricultural machines, which students perform at the 3rd year of studies at the university. In these research studies, the readiness of a future specialist in agroengineering to design and research should be evaluated by motivational, cognitive, cognitive, and operational-practical criteria, although some scholars use other.

By studying the main tasks of the future specialists in agroengineering, one can conclude that the highly professional and competent performance of their production functions requires a creative, creative approach, and professional activity can bring significant results only if it closely cooperates with science and widespread use of its results.

It is known that designing is one of the leading forms of human creative activity. As a rule agroengineering designing involves the creation of a new agricultural object with predefined parameters. It is based on forecasting, planning, research, scientific and technical developments, decision-making, which are reflected in the design documentation, models, laboratory facilities, designs of agricultural machines. Agrotechnical designing is a special type of project activity, as it touches on very changeable soil-climatic and weather conditions, not always sufficiently developed infrastructure and service and storage of agricultural machinery. Today, agrotechnical design is defined as a creative, labor-intensive and science-intensive process, the result of which is an individual or team project that is created by a person or a creative team for themselves or custom and implemented in real agricultural production.

Some scientists define agrotechnical design at the same time and as a goal and as a means that performs certain functions and roles in the professional activity of a specialist in agroengineering. Designing activates development of creative abilities of agroengineering, promotes realization of individual personal approach to project activity, allows to take into account the actual needs of agricultural production and the ability and competence of a trained specialist. Designing at the stage of preparation of agroengineering activates the formation of his/her agrotechnical thinking, promotes the practical development of design and research skills, ensuring the improvement of intellectual culture and professional competence of a specialist.

In defining the essence of the design and research activities in general and the development of a specific project of agrotechnical innovation in the context of this scientific work, they adhered to the fact that scientific activity is a creative process of joint operation of two or more subjects aimed at finding a solution to the actual problem or problem, in the course of which a new technology or agricultural machine is being developed on the basis of cost-economic values and conclusions of agrotechnical practice. As a subject of design and research, a specialist in agroengineering must be able to: analyze the initial data and identify the need for carrying out design and research activities for the implementation of agrotechnical innovations, to be able to formulate design and research tasks, plan research, carry out design and research, evaluate the results of the researches.

Readiness for design and development is considered a complex of qualities of a person, necessary for him to perform the functions of the subject of this activity. An analysis of literary sources has shown that the approaches to the choice of criteria for evaluation by researchers are different. For example, some distinguish four groups of important professional qualities of a specialist or components of his readiness for productive activities, namely: motivational, cognitive, indicative and operational. We chose three, which combine many related criteria. We will partially analyze some of them.

Participation of a student in research activity, along with other factors, contributes to the development of the motivational component of forming the readiness of a future specialist to perform production design functions. If, as a result of the respondents 'survey, it turns out that scientific activity on the development of agricultural machinery does not make sense, that is, participation in it is not perceived significantly, weighty, attractive to the individual, it means that so far it has not been possible to interest the admiration of students' science and need to look at the pedagogical techniques and methods that would eliminate such a disadvantage.

Indicators of the level of motivational-value criterion of readiness are: interest in learning methods and activity of participation in design and research activities, independence in choice and persistence in overcoming difficulties in solving design and research problems, activity in self-development, aspiration to learn, mastering more than predicted by the training programs.

The cognitive-educational component of the readiness of an agroengineering specialist to perform design functions is a set of knowledge, concepts, skills and competences that are necessary for a specialist to set and solve design and research tasks in their professional activities. Indicators of the level of cognitive-educational readiness for design and research activities are: understanding of the role and importance of resolving design and research tasks in the professional activities of a specialist in agro-engineering; knowledge of the types of design and research tasks of the agro-industrial complex, which are solved by experts in AI in their professional activities and methods and methods for their solution; knowledge of requirements for research projects and programs; knowledge of methods for solving design and research problems and the conditions of their application.

The operational and practical criterion of mastering the design-oriented technology of agroengineering training, forming its readiness for the project activity is characterized by the presence of students with the general special training in the design of agricultural machinery and other professional competencies for the implementation of general engineering and special functions of technical activities in the agro-industrial complex. The operational and practical criterion of the professional design competences of the future agroengineer reflects, first of all, the ability to perform calculations based on the methodologies of higher mathematics, general engineering disciplines such as theoretical mechanics, mechanics of materials and constructions, the basics of engineering methods of calculations for durability and stiffness, theory and calculation of agricultural machines. That is, the level of development of activity-practical criterion evaluates the readiness of the future specialist to conduct analytical, general engineering and special (professional) calculations and, in general, to perform the functions of the project activity.

Important in the formation of readiness for project activities of the agroengineer are learning the basics of calculating design and construction mechanization for crop improvement and modernization of both the business and the factory facilities. Therefore, the typical curriculum for the training of agroengineers is provided for the completion of course work on discipline "Agricultural Machines" [12]. In general, coursework consists of a settlement and explanatory note and a graphic part. It is believed

that course work is executed at a high level if it uses the basic provisions of the methodology of scientific research in the field of mechanization of agricultural production. The results of the conducted research showed that the implementation of this work contributed to consolidating, deepening and generalizing the knowledge of students from agricultural machines and general technical disciplines. The feature of this course work is that the student independently on the basis of the identified drawbacks of the implementation of technological processes of plant growing improves existing or developing of a new machine or technical device. To do this, he studies the accumulated historical experience of designing technical means of mechanization on the theme of course work. During the work the design of the working bodies, systems, mechanisms of the drive and control is developed, the main dimensions of the details under which the drawing is executed are calculated.

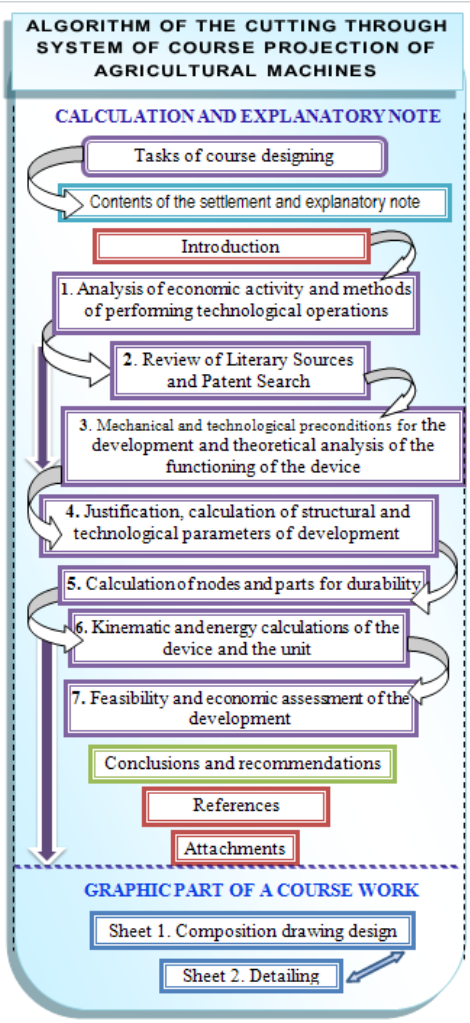

Fig. 1. *Algorithm of through system of course designing of agricultural machines*

As we see from Fig. 1 settlement and explanatory note of the course work on agricultural machines contains: title page, content, introduction, the main part (5 - 7 chapters), conclusions and recommendations, list of sources used, annexes [12]. The bulk of the course work consists of sections, divisions, items, and, possibly, sub-items. The sections of the main part include: analysis of economic activity, review of literature on the topic and the choice of development directions, theoretical analysis and presentation of research results, justification of the structural and technological parameters of the proposed design, calculation of nodes and parts for durability, peculiarities of machine operation under extreme conditions, possibility for a further development of a laboratory test bench or device, a feasibility study. At the end of each section are formulated concise conclusions.

The introduction substantiates the relevance of the topic, the purpose and objectives of a course work.

The first chapter reveals the technology of growing agricultural products, the state and efficiency of the use of technical means of mechanization for the type of a farm chosen by the student.

The second section presents the results of the patent search and review of literary sources, which describe the design schemes of machines, implements or devices, and proposes a schematic diagram of the machine being developed, its structure, principle of operation, adjustment, etc. [12].

For example, we present the elements of the developed basic scheme of a 4-row potato harvesting combine (Fig. 2), which consists of a platform 1, a disk 2, a main elevator 3, a conveying screw 4, an elevator 5, a removable conveyor 6, an intermediate conveyor 7, potato separator 9, canvas 10, bucket conveyor 11, bunker 12.

The work of the potato harvester is carried out as follows. During the movement of the aggregate in the field on which the potato pods were previously cut and, in the presence of weeds, the lumber-tree 1 cuts the layer of soil of the four adjacent rows, and the trench disks 2 cut off the bubbling zone on both sides. The cut and buried layer rises, and enters the main elevator 3, which is distributed along its canvas.

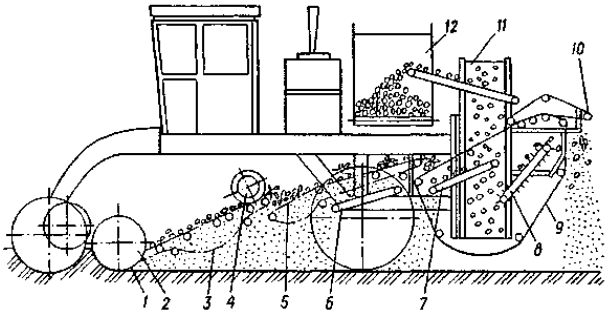

Fig. 2.*Functional scheme of the combine: 1 – laity; 2 – disk; 3 – main elevator; 4 – narrowing auger; 5 – the second elevator; 6 – a transport carrier; 7 – an intermediate conveyor; 8 – bitter; 9 – separator of potatoes (a rare-rod conveyor); 10 – canvas; 11 – bucket conveyor; 12 – bunker*

A part of the soil is sifted in the intervals between the conveyor belts, and the remaining non-silt soil, and the potatoes are directed to the screws 4 (right and left), which shift the mass to the central part of the combine to transfer it to the second elevator 5. On the latter, there is further separation of soil. Then the potatoes, potato admixture and soil are fed by the elevator 5 to the flat-bottom conveyor, where the mass is stratified into two streams: one stream is just potatoes, and the second one is potatoes with potato admixture.

The remaining potatoes and soil pass through the bars of the belt conveyor 9 to the intermediate conveyor 7, and the potatoes admixture with unbroken potatoes hang on the bars. Then they admire the top with a clamping cloth 10 and the potatoes admixture, when in contact with the bobbin bars, is torn off. The potatoes are deposited by the separator 9 on the harvested field behind the combine, and the separated potato admixture falls on the finger gauge 8, rolls over to the horizontal part of the bulk conveyor 11 and enters the hopper 12.

The presence of a bunker 12 with a capacity of up to 2 tons allows it to be used in conjunction with all modes of transport. This combine is unified on the main elements of the power equipment and chassis with the Don-1500 combine harvester.

The second section (subsection 2.2.) also provides an analysis of literary sources on general engineering disciplines, the theory, calculation and design of agricultural machines, etc., that is, those literary sources that make it possible to establish the kinematic and dynamic characteristics of the performance of the technological process and the functioning of the machine, to justify structural and technological parameters of the technical means being developed, perform engineering calculations of parts, assemblies, units and mechanisms of development. In addition, there are noted prominent scientists who have made a significant contribution to the

fundamental and applied sciences, the important literary sources developed by the student are presented for this work. Also analyzed algorithms of calculation, classical and applied methods for determining the parameters of machine working machines, mathematical models and analytical dependencies, published results of theoretical and experimental studies of scientists. Many of the students identified and analyzed material can use in their course work.

First of all, students are studying the fundamental work on which the modern dynamics of machine-tractor aggregates is based. These works are by Goryachkin V.P., Vasilenko P.M. [13], Artobolevskii I.I., Zhyligovsky V.A., Matsepuro M.E., Sablikova M.V., Lurie A.B., Litoshneva N.M., Turbina B.I., Pogoreliya L.B., Listopada G.E., and many other scientists. Then you can study applied research, similar to the theme of course work, for example [14].

As a result of theoretical research in the scientific direction in accordance with the theme of the course work, analytical dependencies and other results are established that will enable to perform a kinematic and dynamic analysis of the technological process and the functioning of the machine, to determine the design and technological parameters of the development.

In order to develop the motivational-value, cognitive-educational and activity-practical components of readiness for the project activity and the successful completion of the course work, students use the positive potential of interdisciplinary connections, which ensures the comprehensiveness, integrity and continuity of the student's project activity with minimal time and significance of the result. Students are encouraged to work on both domestic and international scientific literary sources, for example [15, 16], where they can familiarize themselves with the peculiarities of the use of equipment, stands, devices, equipment which is used for experimental research.

In the third section are presented the mechanic-technological preconditions for the development of the design, which reflect the physical and mechanical conditions of the object, with which the working bodies of the machine interact, as well as the agrotechnical requirements for them. Here also theoretical studies are carried out on the basis of analytical dependencies, formulas, systems of equations, as a result of which numerical values or the nature of changes in velocities, accelerations, forces, capacities, etc. may be determined, which may be necessary for determining the design and technological parameters of the development, the calculation of nodes and details on strength, analysis of the work of a technical tool in difficult conditions, etc. [12].

In the fourth section of the course work, constructive parameters are calculated and substantiated, that is, those which are laid down in the design of the machine and are unchanged during the execution of its technological processes, as well as technological parameters, which vary according to the conditions and modes of operation of the machine. On the basis of the constructive and technological parameters which are obtained, assembly drawings of assemblies, machines and, accordingly, work drawings of parts (detailing) are carried out. Some technological design parameters can be presented on the assembly drawing in the technical specification.

In the fifth section of the course work students use the knowledge acquired by them in the mechanics of materials and structures, parts of machines, hoists and vehicles, and count several parts, mechanisms or systems. For example, they can calculate the bolt, pin, welded joints, determine the diameter of the shaft, build a diagram of forces, twists or bending moments, choose a bearing, calculate the pass, chain transmission or hydrostatic system, etc. The resulting numerical data will also be used by students under the time of execution of the graphic part of the course work [17, 18].

In the sixth section the scheme of the drive of the working bodies is chosen, the kinematic and energy calculations of the device and the unit are carried out. It should be guided by the scheme of a prototype of a known design, which is produced by industry and the machine itself is presented on the farm. For the energy calculation of the initial data is given the data of technological and kinematic calculations, on the basis of which is being determined the load factor of the engine, the required capacity for the implementation of the technological process and the operation of the machine.

In the seventh section students give a technical and economic assessment of the work, as well as may present other specific features of the design of the development and implementation of the technological process.

The settlement and explanatory note is concluded with conclusions and recommendations, which give answers to the tasks set forth in the introduction. It is advisable to reflect on the scientific novelty and the practical significance of the results obtained, to summarize and to indicate at what level it is performed and the results of scientific research are executed. Also, recommendations are made for their use or introduction into production or information on the practical application of the results obtained, if any.

The graphic part of the course work on agricultural machines consists of 2 sheets of A1 format. As a rule, on page 1 the prefabricated drawing of a machine or a node is developed, which is developed in this course work. On sheet 2 is presented the drawing of details. A specification, which is an appendix to course work, is being developed in the assembly drawing. The specification must contain the name and designation of all component parts that are part of the product (machine, knot), which is shown in the drawing [12].

If a student is engaged in research work in a group of scientific and technical creativity or in a student design bureau, he produces an advanced metal construction or has a printed paper or a patent, then in this case machine-building shafts can be replaced with graphs, nomograms, design diagrams of the machine, schemes of calculation models, results of calculations of constructive and kinematic parameters of working bodies, as well as technological and other parameters of the investigated process.

Consequently, a pedagogical system, based on the fundamental theoretical principles of design training of agroengineers in higher education institutions, is being developed, which form the readiness of a future specialist for a project activity in production. The success of preparation depends to a large extent on the student's academic activity during the course of study, which is expedient to perform on a cross-cutting basis, that is, in stages, starting from the first year. Course work on the discipline "Agricultural Machines" is the first large, creative work that reveals the motivational-value, cognitive-educational and activity-practical components of forming the readiness for the project activity of a future specialist. In case of the successful completion of the course work, the student will easily complete the diploma project and will be able to successfully study in the magistracy, and then, if desired, in the postgraduate study course.

Results and discussion.

Innovative system of scientific and methodological developments in the form of textbooks, manuals, monographs, programs and other didactic materials, and improved pedagogical technology of training, based on the progressive, phased development of readiness of the future specialist to the project activity, provide a comprehensive, complex formation of professional competencies of agroengineering in accordance with the normative and legal provision of educational process. The scientific work of students is very important here based on the development and modernization of agricultural machinery. The first voluminous creative work of a student at AIHE is the course work on the discipline "Agricultural Machines". Its successful implementation is a solid ground for effective and effective graduate design.

Conclusion.

The obtained results of the conducted research give grounds to conclude that an effective process of preparing readiness for the future activities of future specialists in agroengineering is possible on the basis of cross-cutting innovation training technologies in accordance with the training program. The developed theoretical principles of project preparation of agroengineers on the basis of scientific research on the development of agricultural machinery

reflect the priority and strategic directions of the development of the didactics of the educational process. Selected criteria for assessing the efficiency and quality of the developed innovative teaching technology - such as motivational-value, cognitive-educational and activity-practical systematically and comprehensively diagnose the process of project preparation of agroengineering. Coursework on agricultural machines largely reflects the student's academic work at AIHE. It also has a practical orientation, since during its implementation students are encouraged to conduct an analysis of economic activity, identify the disadvantages of performing technological processes and calculate and design a machine that would eliminate them.

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