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MODELING THE PROCESS OF TEACHING HYDRAULICS TO ENGINEERING STUDENTS

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Abstract: It is important to correctly determine the goals of education in the training of specialists. In this regard, the practice of setting goals that existed until recently is critically assessed. The definitions were given in a very general form, not very specific and were mainly in the form of recommendations. These are: to give students solid knowledge, to teach them to creatively apply it in practice. Although in recent years, qualification characteristics have been developed in higher educational institutions, there have been no significant changes for the better. The structure of the characteristics has remained unchanged: the first part indicates what a specialist should know, and the second - what he should do.

Keywords. model, method, component, skill, form, simulation, pump characteristics, pedagogy.

In the qualification characteristics, the goals are described in the language of knowledge and skills. However, each skill includes a specific task (or class of tasks) that is solved by this skill. In addition, real-life tasks that a specialist will have to solve in the future and that determine a certain skill system should be included in the content of education. This means that it is impossible to develop well-founded educational goals without first identifying a set of basic tasks that a future specialist will encounter in the process of professional activity. It follows that both the language of skills and the language of typical tasks can be used to describe the goals. Obviously, in this case, these languages have equal value. In this regard, knowledge does not exist by itself, it is always an element of some activity (some skills). Correct identification and analysis of skills determined by life tasks that a specialist may encounter in the future makes it possible to accurately determine the volume and content of knowledge included in these skills. Therefore, knowledge cannot constitute an independent element of educational goals. Their programs, as well as the criteria for their mastery, are determined by the skills included in the educational goals. Thus, the description of educational goals (specialist model) implies the presentation of a typical system of tasks or a system of skills corresponding to it.

As a second problem, it is possible to consider the structure of the specialist model, in which three components should be distinguished in the model. These are: a) tasks or types of activities that are determined by their specific features in the current era; b) tasks or types of activities that are determined by the specific features of the education system of our country; c) tasks or types of activities that are determined by professional and specialty requirements.

In the first part, it is proposed to include in the educational goals a number of types of activities that students are not sufficiently trained in. For example, such skills include: the ability to learn, the ability to work in a team and readiness for it, the ability to manage a team, production. Although each profession has its own set of skills, it is possible to combine all skills into three groups in accordance with the types of tasks solved by specialists with higher education. The first of them is the skills that allow conducting research work, the second is the skills necessary for a specialist to solve practical tasks, and the third is the skills that ensure the preparation of students for pedagogical and educational work. At the same time, the ratio of these three groups of skills in different higher educational institutions is not the same: in higher educational institutions, the

main emphasis is on research and educational activities, while in technical specialties, the preparation of students to solve practical problems is of great importance.

The system of theoretical and practical training of students in the pedagogical process consists of three interacting components:

- formation of orientation in the use of theoretical and practical knowledge in the practical training of a future engineer;

- formation of special knowledge and skills in the discipline of hydraulics;

- formation of methodological knowledge and skills;

These data constitute the target block of our model, on the basis of which we selected the content of training future engineers to develop their theoretical and practical knowledge as a universal modern didactic tool to support the educational process of students.

Based on the above, we proposed a didactic model for the development of theoretical and practical knowledge of future engineers based on teaching hydraulics (Figure 2.1).

This model consisted of four interconnected components: target, substantive, technological-process and diagnostic-resultative (Figure 5).

Objective component: includes social order, state educational standards, qualification requirements, educational goals, preparation for professional activity, formation of theoretical and practical knowledge, formation of technical thinking. The model provides for the development of theoretical and practical knowledge of students in the field of hydraulics.

Content component: Knowledge includes the integrative disciplines of hydraulics and fluid and gas mechanics, principles, functions, forms, methods and tools. This component theoretically justifies the development of students' theoretical and practical knowledge in the process of teaching hydraulics.

Technological and process component: the content of the hydraulics discipline consists of practical knowledge and academic forms. In this case, the teaching of hydraulics is carried out in the processes of practice. This component fully embodies the educational process in hydraulics.

Diagnostic and result component: covers pedagogical experimental and test stages, assessment criteria, levels of preparation and results. This component confirms the correct implementation of the three components listed above.

It should be noted that the developed didactic model was developed as a result of maintaining a coherent algorithmic sequence, taking into account methodological approaches, principles and functions, and predicts the possibility of achieving high efficiency not only in teaching hydraulics to students of technical specialties, but also in other areas.

If the didactic model is considered as a continuous system directed from goal to result, then it requires the consistent implementation of the algorithmic sequence implemented in the training of future engineers. The effectiveness of the model developed by us is confirmed by the results of pedagogical experimental work. Pedagogical experimental work is presented in the third chapter of the dissertation.

The third important problem associated with determining educational goals concerns the transition from final complex goals to the goals of studying individual academic subjects.

While some subjects have the ability to directly achieve these goals, others are connected with them indirectly, that is, through one or more academic disciplines. Educational goals are presented in the form of a hierarchical system - from the final goals to the study of individual academic disciplines and their sections and topics. When developing goals for specific academic disciplines, it is necessary to take into account the three components of the specialist model, as well as interdisciplinary connections. They should be taken into account not only when planning general skills, that is, logical methods of thinking, the ability to solve worldview tasks, but also when planning skills for developing programs or projects of special, that is, interdisciplinary content related to a number of block disciplines [96].

Methods and tools. As a result of mastering the subject, the student: The lack of qualified personnel can lead to completely unusual problem solutions.

The requirements for specialists in the use and maintenance of equipment are not limited to those listed above.

One of the specific tasks of organizing the maintenance and repair of equipment is the organization of fleet networks, for which it is necessary to perform appropriate calculations of simple and complex pipelines, select suitable pumps and geared motors for them.

Thus, the purpose of teaching the subject "Hydraulics" should be to provide students with knowledge about the basic laws of hydraulics, the theoretical foundations of the structure and operation of hydraulic machines and devices used in multi-purpose hydraulic machines, systems, and nodes of technical maintenance tools.

As a result of studying the subject, students should have an idea of:

the principles of operation, technical capabilities, advantages and disadvantages of hydraulic systems and devices used in technical facilities.

Must know the following: the basic laws of hydraulics, methods of their application for calculating hydraulic devices; theoretical foundations of the structure and action of hydraulic machines and devices installed on the equipment under study.

Must be able to: read hydraulic diagrams, calculate the pipelines of hydraulic systems, select pumps according to the given characteristics (Fig. 1).

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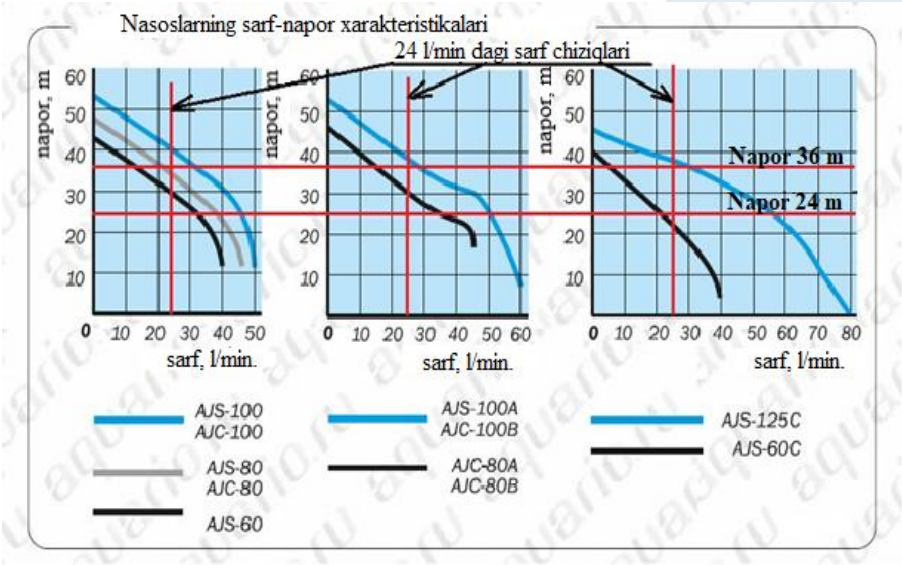

Figure 1. Consumption characteristics of pumps.

The choice of the field of competence of future specialists requires the inclusion of the following theoretical issues in the program:

A general idea of the characteristics and properties of devices and systems that use a liquid or gas as a working medium; the main properties of liquids and gases; the laws of hydrostatics, hydrostatic pressure, Pascal's law, closed vessels; the statics of a solid body immersed in a liquid, Archimedes' law, buoyancy and stability; the basics of hydrodynamics, the main concepts and parameters describing the movement of fluids, the continuity of flow, Bernoulli's equation; types of resistance in the movement of fluids through pipes, laminar and turbulent flow regimes, Reynolds number, local resistances; fluid output through slots and triples; the exchange of mechanical and hydraulic energy, hydraulic pumps and hydraulic engines.

When determining the mathematical apparatus for describing and studying selected hydraulic phenomena, the general curriculum, the content of mathematics and physics programs, as well as the experience of selecting mathematical apparatus in hydraulics curricula for other technical specialties can be used.

An analysis of the content of hydraulics curricula for specialties whose main professional activity is not related to hydraulic machines and devices showed that the description of theoretical issues of hydraulics and the description of the processes occurring can be successfully carried out on the basis of traditional higher mathematics courses, including differential and integral calculus of technical specialties, the theory of ordinary differential equations.

The experience of performing engineering calculations in the field of traditional hydraulic devices shows that instead of involving complex mathematical apparatus such as the theory of differential equations and tensor calculus in separate derivatives, one can easily limit oneself to empirical formulas that describe complex hydraulic processes approximately, but with sufficient accuracy for practice.

In modern didactics of hydraulics, based on the analysis of innovative processes occurring in pedagogical science as a scientific discipline, the following trends can be distinguished, some of which have already become laws and regulatory principles:

1. Methodology and theorization.

2. Socialization and humanization.

3. Technologization of the educational process based on computerization of the educational process.

4. Generalization of general educational tasks, educational materials, student knowledge, teaching methods based on the separation and formation of system-forming concepts, general principles of science, leading theories, basic principles and laws.

5. Formation of an invariant core and variable shells of technical knowledge, taking into account the latest achievements of science.

6. Materialistic dialectics, combining methodological principles of basic science with didactic principles of pedagogy.

7. Conceptualization of teaching the basics of science.

8. A systematic approach to education and science didactics.

9. Integration of hydraulics, pedagogy, psychological didactics and advanced pedagogical experience into a system where the general, i.e., the theory of teaching hydraulics - subjects and objects of study of special hydraulics didactics, methodological guidelines - individual, i.e., the practical activities of the hydraulics teacher as a subject of special engineering education are interconnected.

10. Formation of comparative didactics based on globalization processes and the unification of scientific knowledge and educational tasks in new socio-economic conditions.

In this article, we paid special attention to the selection and justification of teaching principles, methods and tools used in organizing the educational process to improve the quality of knowledge, skills and qualifications acquired by students in the study of hydraulics.

We paid special attention to technical educational tools that significantly increase the clarity of hydraulic processes in the study of issues that are difficult for students to perceive and, in turn, help them better and more firmly master the material being studied. We developed and used special computer programs with moving elements to demonstrate the operation of some simple hydraulic devices in the educational process. In addition, to increase the demonstration in the study of complex hydraulic devices and systems, we developed and used more advanced technical tools based on software tools - electronic slides.

A comprehensive pedagogical experiment was created to test the developed hypotheses and proposals.

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