

A Problem-Oriented Approach to Machine Science for Future Technology Teachers

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Abstract. *The essence of the contradiction between the requirements for machine science literacy of future technology teachers and its actual content is described. A way to resolve it is proposed based on the use of a problem-based approach to the formation of machine science literacy of future technology teachers based on the concept of a machine user. The author's methodology for forming a hierarchical system of qualitative and quantitative educational tasks in machine science is described. It is argued that the new machine science literacy of future technology teachers will be relevant to the content of their professional activities in secondary education institutions.*

Keywords: *technology teacher, machine science literacy, concept of a technology user, qualitative educational tasks, quantitative educational tasks, system of educational tasks, methodology for developing a system of educational tasks.*

For over 60 years, mechanical engineering has been and is an integral component of professional training, first of future teachers of labor training, and later of future teachers of technology [4]. In fact, several generations of people have changed during this time, but the concept and content of mechanical engineering has not changed. However, this fact does not apply at all to assessing the quality of mechanical engineering training of future teachers of technology. The main and permanent drawback of the formed mechanical engineering competence of a future teacher of technology is the lack of a direct connection with the content of activities in a general secondary education institution. By default, the connection is indirect and concerns the motivational and value component of the professional competence of a future teacher of technology. Only its interpretation in the past and in the present differs. In particular, in the era of polytechnics, mechanical engineering knowledge was considered in the context of general technical training of a future teacher of labor training and his orientation in industrial production technologies. Currently, the basics of mechanical science for a future technology teacher are associated with the competency-based approach and the requirements of the New Ukrainian School regarding the use of mechanical science knowledge in practice. However, there is a contradiction here between the traditional concept of mechanical science in technological education in Ukraine, formed according to the standard of training a design engineer, and the requirements of the New Ukrainian School. This contradiction lies at the heart of the

irrelevance of the mechanical science knowledge of a future technology teacher to the content of his professional activity in practice. In fact, the concept of a design-technological approach in the technological education of schoolchildren is used to mask it. The fact is that the design and construction activities of a design engineer are a full-fledged technology with which schoolchildren should be acquainted, primarily for the purpose of their professional self-determination, but it is currently unrealistic to use the design and construction competence of a future technology teacher for students' work on educational projects. In a general secondary education institution, the educational process is implemented, not the production process, with which the design and construction activities of a design engineer are genetically related. Therefore, it is necessary to change the concept of mechanical science for future technology teachers to the concept of a technology user, since the teacher is a user of technology, not its manufacturer. The concept of a technology user, in our opinion, should use as a standard the content of the training of a mechanical engineer in higher technical education institutions of Ukraine. In this way, it is possible to overcome the contradiction between the content of the mechanical science training of a future technology teacher and the content of his professional activities in a general secondary education institution.

When using the concept of the user of technology, the object of study will change from the process of manufacturing machines to a generalized structural and functional diagram of the machine [1; 2; 3]. Generalized knowledge about the machine will have worldview properties and, accordingly, will form the worldview of the future teacher of technology.

The generalized structural and logical diagram of the machine includes its drive and working body [1; 2; 3]. The machine drive includes an engine and transmission (mechanical transmissions), if it is of a mechanical type. During the operation of the machine drive, three basic technical phenomena occur, which are also characteristic of other types of drives (hydraulic, pneumatic, electric, combined). We are talking about the phenomena of energy transfer in space, changes in the kinematic parameters of energy carriers and changes in the power parameters of energy carriers.

The most accessible educational material for future technology teachers, in our opinion, will be about the mechanical drive of a machine. The mechanical drive of a machine will be presented using a kinematic schematic diagram. A characteristic feature of the kinematic diagram of a machine drive is the fractality of technical phenomena in a separate mechanical transmission of the machine drive and in the drive of machines as a whole. The fractality of technical phenomena makes it possible to develop educational tasks for individual mechanical transmissions, while their essence will not change, because only the scale of the manifestation of these phenomena will change. This feature was used by us to develop a system of qualitative and quantitative

educational tasks [5; 6] in mechanical science for future technology teachers. In the process of solving qualitative educational tasks, students will master the essence of three basic technical phenomena of the machine drive. The results of solving quantitative educational tasks by students will be the ability to use the acquired knowledge in mechanical science in practice.

The structure of the system of educational tasks in machine science includes four modules, each of which we consider as its subsystem. The tasks of each subsystem are arranged by complexity levels, and between the modules there are horizontal functional connections of the dependence of solving the tasks of the next subsystem on the solved tasks of the previous subsystem. The system of educational tasks in machine science has vertical functional connections from each module to the top, where the educational project on the topic "Bicycle Transmission" is located and constitutes the content of its tasks for students.

It is known that the requirements in the condition of educational tasks are formed on the basis of specific educational goals, therefore, we began the construction of a system of high-quality educational tasks in machine science by setting a system of educational goals, a fragment of which is given in Table 1.

Table 1. Objectives of the system of educational tasks in machine science (fragment for familiarization)

Module name	Learning objectives
Component analysis of machine drive	1. Where is the source of mechanical energy in the machine diagram? 2. How is mechanical energy transmitted over a distance? ... 8. How to choose the type of mechanical transmission in the machine drive?
Analysis of technical phenomena in the machine drive	1. What is the pitch of a cylindrical gear? 2. What does the pitch length of a cylindrical gear depend on? ... 11. What are the torques applied to the teeth of two wheels of a mechanical gear transmission if the driving wheel has a diameter twice that of the driven wheel?
Kinematic analysis of machine drive	11. How does the frequency of rotation of the machine drive shafts change in the direction from the engine to the working body? 2. What is the nature of the change in the values of the frequencies of rotation of the component elements of the machine drive in the direction from the engine to the working body of the machine drive? ... 11. How are the geometric dimensions of the elements of the mechanical transmissions of the machine drive selected along its kinematic chain, if there are four of these gears, and the angular velocity on the working body of the machine is the greatest?
Force analysis of machine drive	1. How will the magnitude of the torque change if the diameter of the driving element in a mechanical transmission is half the diameter of the driven element? 2. How will the magnitude of the torque change if the diameter of the driving element in a mechanical transmission is twice the diameter of the driven element? ... 11. How are the geometric dimensions of the mechanical transmission elements of the machine drive selected along its kinematic chain, if there are four of these gears, and the magnitude of the torque on the working body of the machine is the smallest?

Source: developed by the author.

In order to take into account the requirements of the New Ukrainian School regarding the formation of students' skills to use the acquired knowledge in practice, we have also developed a system of quantitative educational tasks in mechanical science with a similar structure to that described above.

To use the systems of qualitative and quantitative educational tasks in mechanical science that we have developed, we propose to radically change the organization of the educational process for future technology teachers when conducting practical classes in the academic discipline "Working Machines", which is in the curriculum of the Mykhailo Kotsiubynskyi Vinnytsia State Pedagogical University, or similar in content academic disciplines in other institutions of higher pedagogical education in Ukraine. In particular, all practical classes will be associated with the students' solving of qualitative and quantitative educational tasks in mechanical science in order to implement an educational project on the topic "Bicycle Transmission". It is characteristic that each student can check the results of the educational project during practical cycling, changing the vehicle's driving mode and the muscular effort applied accordingly.

The machine learning literacy for all formed in future technology teachers according to the methodology we have developed will be fully relevant to the content of their professional activities in secondary education institutions. On its basis, it is possible to organize educational project activities in the process of specialized education of high school students, thus forming in them the foundations of machine learning literacy for all, as well as readiness for conscious professional self-determination. We see further continuation of the research in the development of a program and methodology of a pedagogical experiment to assess the effectiveness of using the developed system of educational tasks for the formation of machine learning literacy for all in future technology teachers.

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Experience of Using Local History Studies in Forming Patriotic Qualities of Future Primary School Teachers

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Abstract. The paper examines the specifics of forming patriotic qualities of future primary school teachers through the use of local history studies. Theoretical and practical aspects of local history activities in higher education are highlighted. The experience of integrating local history content into university training is analyzed, proving its effectiveness in fostering national consciousness, civic values, and patriotic attitudes of future primary school teachers.

Keywords: patriotic qualities, future primary school teachers, local history studies, national-patriotic education.

Досвід застосування краєзнавства у формуванні патріотичних якостей майбутніх вчителів початкових класів

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Анотація. Розглянуто специфіку формування патріотичних якостей майбутніх вчителів початкових класів засобами краєзнавства. Висвітлено теоретичні та практичні аспекти краєзнавчої роботи здобувачів вищої освіти. Проаналізовано досвід формування патріотичних якостей майбутніх вчителів початкових класів засобами краєзнавства діяльності в умовах університетської освіти. Установлено, що формування патріотичних якостей майбутніх вчителів початкових класів початкової школи передбачає використання засобів краєзнавчої діяльності. Проаналізовано педагогічний досвід використання засобів краєзнавства в умовах університетської освіти.

Ключові слова: патріотичні якості, майбутні вчителі початкових класів, краєзнавчий матеріал, національно-патріотичне виховання.