IMPROVEMENT OF MATHEMATICAL EDUCATION OF BACHELORS-CONSTRUCTORS

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Abstract: The leading goal of education is the training of competent professionals who practice their job, ready for effective work in the specialty at the level of world professional standards, are competitive in the labor market, ready for professional growth and professional mobility, having responsibility for the results of their own professional activities. To achieve this goal, the government of the Russian Federation approved the state program "Development of education" .The article provides an overview of the requirements for the implementation of practice-oriented tasks, and their use in conducting classes in the subject "Mathematics", in order to generate students ' professional competence through the implementation of real practical tasks.

Key words: competence approach, educational concept, practice-oriented assignments and tasks, engineering training.

1 Introduction

The main element of basic education of students of construction specialties is higher mathematics. The content of the subject is determined largely by the programs of applied sciences (physics, chemistry, mechanics, etc.). These sciences use the methods of higher mathematics in solving certain and specific problems, as well as they use it in their analytical studies. According to the "Concept of development of mathematical education in the Russian Federation" this topic is specifically outlined: "the development of common mathematical culture for the use of knowledge and skills in further work on the chosen profession (this goal is characteristic of universities of natural science, technical, economic and other profiles)" (Eder, 2010; Emma & Patrick, 2015).

Modern trends in higher education are determined by the problems related to the technology of education, the formation of competencies, creating conditions for the activity of students in the educational process and the formation of interest in the study of the subject, training qualified specialists for the society (Hutmacher, 1997; . Johnson, 2002).

The existing system of mathematical education is based on two components: the first – to teach and train students to solve elementary analytical tasks (integral calculus, differential equations) and the second – to teach students the methods of solving tasks with the introduction of computer technology. As a result, the course of mathematics is overloaded and complicated with non-working material and does not take into account modern trends. The student, moving from the course of mathematics to the study of subjects of professional orientation, needs to adjust his vision to the emerging materials (McKeachie, 1994; Koryakina, 2015).

The main problem of this type of system is that it is not aimed at the development of professional competence of students and as a result is a problem of graduates in their job arrangement and as a consequence of their non-competitive ability. In the existing system of mathematical education there is no solution of tasks with the use of real industrial tasks, which leads to a huge gap between the needs of the construction industry and the capabilities of educational institutions (Bochkareva, 2016; Buyatova, 2019).

2 Methods

For the full competent training of future builders it is necessary to provide competence-based and practice-oriented approaches in the process of education. The implementation of these approaches should be taken into account with a combination of fundamental education and vocational training.

Competence-based approach provides for the acquisition of knowledge by students of the construction direction as a set of knowledge, skills and a set of professional competencies.

Practice-oriented approach in education involves the study of traditional fundamental subjects in combination with applied subjects of technological orientation. Modernization of education should contribute both to the preservation of fundamental sciences and to the comprehensive development of applied sciences.

According to the national project "Education" 2018-2024 one of the tasks is the modernization of vocational education, including the introduction of adaptive, practice-oriented and flexible educational programs.

Practice-oriented training in the system of higher professional education is the process of mastering the educational program by students in order to generate professional competence of students through the implementation of real practical tasks.

The study of any material will be more interesting if the student sees the practical application of the studied topics directly in their professional field. The teacher faces the problem of organizing the educational process so that the educational activities of students become cognitive, creative, exciting, and knowledge in demanded. This can be facilitated by the introduction of practice-oriented tasks and tasks in the subjects of the professional cycle.

When a student enters the senior course and he begins to study the subjects of the professorial cycle such as "Construction mechanics", "Construction physics", "Calculation of structures" he solves the tasks issued according to the knowledge of the already studied subject "Higher mathematics", and in such subjects as "Technology of construction production", "Building materials", "Organization of construction production" task solving should be more creative and closer to the practical activities of future specialists.

Practice-oriented tasks are used for different didactic purpose: they can arouse interest, develop mental activity, form practical skills, explain the relationship between mathematics and other subjects. It is also necessary to distinguish between practical tasks from textbooks of mathematics and tasks that appear in front of a particular employee in the course of his work. In the text of tasks in mathematics in order to establish the desired value (for example, volume or area) all the necessary for this purpose data are usually provided, in a practice-oriented task, these data still need to be found, the parameters and characteristics should be selected, the values of which are required to calculate the desired value. When solving tasks on the job profile, the problem is simplified if the student will represent the real situation. Practice shows that students solve and perceive problems of practical content with interest. Thus, practice-oriented task is a task, the condition and requirement of which determine the model of a certain situation arising in the professional activity of the future bachelor-builder, and the study of this situation by means of mathematics contributes to the professional development of the student's personality (. Krutova & Balicheva, 2011; Kryimskaya, 2014).

Requirements for practice-oriented tasks used in the framework of mathematical training of the future builder:

The first requirement - the task should describe the situation arising in the professional activity of the bachelor builder.

Task. Applicable to the discipline "Construction technology".

Determine the volume of the soil masses moved. This task is faced mainly in the planning of the construction site.

Decision. Most of the sites allocated for construction have uneven terrain. You must plan (align) the site. Calculate the number of "embankments" and "recesses", simulate the range of movement of the soil taking into account the "zero balance". When calculating, it is necessary to use the principle of dividing a complex geometric figure into several simple ones. To do this, it is enough to calculate the volume of a simple geometric figure,

and then add or subtract from it the volume of another figure that distorted the standard shapes when mating.

A second requirement is that in the task some professional characteristics of the object or phenomena must be unknown, that it is necessary to investigate the subject according to the available known characteristics using the tools of mathematics.

Task. Applicable to the discipline "Organization of construction production»

Determine the amount of crushed stone (rubble) unloaded on the construction site.

Figure 1. Schematic representation of a pile of rubble in the form of a cone

3 Decision

To determine the volume we assume that the pile of rubble has the shape of a cone. It is necessary to determine: the radius of the base *r*, the length of the generatrix – *l*, and the height of the cone *h*. The height and the base radius is impossible to find by the direct measuring. How to determine the radius of the base in this case?

We have a soft meter tape. Lets measure with it the length of the circle of the base of the pile of rubble - *P*, thus determine the radius of the circle

$$r = \frac{P}{2\pi}$$

Then it is necessary to determine the length of the generator. Having thrown a meter tape over the top of the pile, we determine the length of the two generators. To determine the length of the generator, divide the resulting length by 2.

It remains to determine the height of the pile of rubble. Knowing the radius and length of the generator, we calculate the height of the pile of rubble by Pythagorean theorem. Now we can calculate the surface area and the volume of the rubble pile.

$$V = \frac{\pi r^2 h}{3}$$

The third requirement - the solution of tasks should contribute to the strong assimilation of mathematical knowledge, techniques and methods that are the basis of professional activity of the builder;

Task. Applicable to the discipline of "Wood Construction»

One of faces of a wooden rectangular bar (Fig. 2) is maintained at a predetermined temperature for the required degree of drying, on the remaining faces T=0. It is necessary to determine at any arbitrary point of the timber established degree of drying.

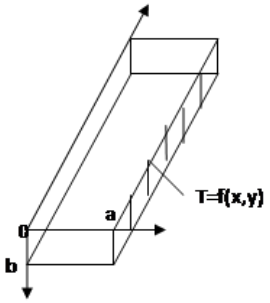

Figure 2. Wooden bar

To solve this task, a mathematical model , based on the analysis, in the form of the heat equation:

$$\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0,$$

satisfying two pairs of boundary conditions:

$$T/_{x-0} = 0, \quad T/_{x-a} = f(y),$$

$$T/_{y-0} = 0, \; T/_{y-b} = 0,$$

The Fourier method is applied to the solution of this type of equation and the function is determined

$$T(x,y) = \sum_{n=1}^{\infty} f_n \frac{sh\frac{n\pi x}{b}}{sh\frac{n\pi a}{b}} \sin\frac{n\pi y}{b}$$

where, $$f_n = \frac{2}{b}\int_0^b f(y)\sin\frac{n\pi y}{b}\,dy$$

which defines the established degree of drying of a bar in its any point.

The fourth requirement - the problem should ensure the assimilation of the relationship of mathematics with general technical and special disciplines.

Task. Applicable to the discipline "Organization of construction production»

The dump truck transports the gravel from the quarry to the place of unloading at a speed *v = a*t*. Knowing that the path *S'(t) = v(t)*, determine for how long the machine will reach the place of unloading, if the distance between the points is S.

The fifth requirement - the content of the problem and its solution require knowledge of special subjects.

Task. Applicable to the subject "Building materials»

Investigation of the effect of density r,kg/m3 of lime composite in the dry state of the introduction of expanded perlite sand in an amount of 0 to 10% of the weight of gypsum in the formation of products from the technological mixture of normal density. Under the hypothesis of linear reduction of *r* depending on the normalized factor *a*, it is necessary to find two estimates by the least square method in the model *r=b0 + B1a* based on the results of five experiments presented in the table.

a	-1	-0,5	0	0,5	1
p	1228	1136	1120	1044	942

The sixth requirement - the content of a professionally oriented mathematical task determines the propaedeutic stage of studying the concepts of special disciplines.

Task. Applicable to the discipline "Dynamics and stability of structures»

You must determine the deflection of the end of the console.

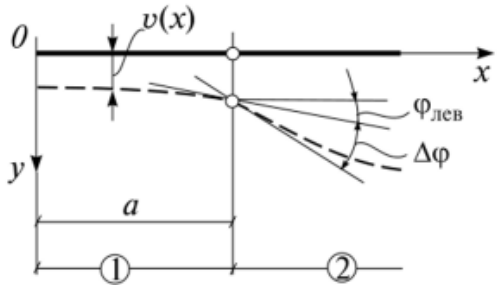

Figure 3. Deflection of a beam

Denote in the initial section x = O the following four values:

$$v(0) = v0\ ;\ \varphi(0) = \varphi 0\ ;\ M(0) = M0\ ;\ Q(0) = Q0$$

These values are deflection, angle of rotation, bending moment and transverse force in the initial beam section. They are defined as *initial parameters*.

We express the deflection of the beam in an arbitrary section through the initial parameters and the intensity of the distributed load. Write an expression for the bending moment:

$$\mathrm{M}(x) = M_0 + Q_0 x - \frac{qx^2}{2}$$

the deflection of the beam is determined by the expression:

$$v(x) = v_0 + \varphi_0 x - \frac{M_0\ x^2}{2!EJ} - \frac{Q_0\ x^3}{3!EJ} + \Delta\varphi(x-a)$$

The seventh requirement - the solution of problems should provide mathematical and professional development of the personality of the builder.

Task. Applicable to the discipline "Economics of construction".

Two options for the construction of the Department are considered: the 1st option involves the use of traditional technology, the 2nd option – the installation of an automatic line.

P1 , P2 – full investment, option 1 and 2, respectively

E1 , E2 - annual operating costs, option 1 and 2, respectively

The volume of production for the options is the same.

Determine the best option (at given *E*n and *T*n) and the value of the economic effect of its implementation.

Decision

The coefficient of the relative efficiency of the 2-th variant (the variant with the large capital investment)

$$\mathrm{E}_\phi = \frac{З_1 - З_2}{П_2 - П_1}$$

Payback period for the 2nd option

$$\mathrm{T}_\phi = \frac{1}{\mathrm{E}_\phi}$$

The given costs for the options are:

$$З_1 = П_1 + 0{,}15\,Э_1$$

$$З_2 = П_2 + 0{,}15\,Э_2$$

Annual economic benefit

$$Г = З_1 - З_2$$

Comparing the results, the conclusion is made.

4 The Results And Discussion

According to FSES 3++ of Bachelor Degree undergraduate, directing the Construction, the universal competences are installed– Systemic and critical thinking – the ability to search, critical analysis and synthesis of information, to apply a systematic approach to solve the tasks set up.

General competencies – ability to solve problems of professionally activities based on the use of theoretical and practical foundations of natural and technical sciences and the mathematical apparatus.

The ability to solve problems is determined by the level of formation of professional qualities of the bachelor-builder: personal motivation, the relationship of mathematics with the disciplines of the professional cycle, the ability to operate with mathematical methods.

The practice of teaching at the University of construction shows that the process of education organized from the perspective of a systematic representation of the professional orientation of mathematical training of students forms the professional qualities of the individual: understanding the relationship of the content of mathematical education with the content of the disciplines of specialization, professional thinking, understanding of the role of mathematical knowledge and skills for professional development of the individual.

Professionally oriented tasks can be used in the practice of teaching mathematics for different areas of students' training. The difference lies in the system of tasks of professional content, since the division of tasks into groups and the allocation of key tasks in each of them is due to the specifics of the professional direction.

5 Summary

The most important trend in the development of the discipline "Mathematics" for students of technical and construction education, which reflects the main characteristic of the modern concept of "builder- engineer" is the introduction of practice-oriented tasks and assignments in education.

You must add into the content of the learning of mathematics application tasks and problem solving tasks, the study of which promotes awareness of students of the relations of mathematics with future practical activities. The teacher must introduce at mathematics classes the tasks due to the future professional activity of students, with the analysis of their teaching methods for the formation of student ' readiness to use the mathematical apparatus in the study of related subjects and in various types of future practice.

6 Conclusion

The content and structure of the mathematics course should be effective for solving the problems of the professional cycle. To do this, it is necessary to revise the program and its constituent themes and bring them in line with the current developing trends.

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