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PROBLEMS AS METHODOF THE PROFESSIONAL ORIENTATION OF TEACHING MATHEMATICS AT TECHNICAL SPECIALTIES OF HIGHER EDUCTIONAL INSTITUTION

Abstract. The article deals with the problem of the professional orientation of teaching mathematics at technical specialties of a higher educational institution andthe analysis of the resourcesconcerning the solution of problems with professional content, their selection and ranking has been made as well. The article focuses on the didactic conditions that professionally oriented problems must coincide with in training future engineers for their successful application, the classification of problems with professional content, as well as ways to solve such problems. The main requirements for problems with professional content are shown and the problem on the theme "Application of a certain integral to pressure calculation" is considered.

Keywords:problem, complexity level, professional orientation, classification of problems.

The modern development of the economy in our country needs specialists who can construct mathematical models of various processes and phenomena at various levels. The students' mastering of theoretical knowledge in the field of mathematics is not enough to implement the learning objectives. The students need to be able to use their knowledge in various situations. One of the ways to implement this approach is the multidimensional application of the interdisciplinary relations of mathematics with general scientific and major disciplines, that is, the application of applied and professionally oriented problems atmathematics classes. Most researchers studying the problems of the applied orientation of teaching mathematics at the technical specialties of the universitybelieve thatthe most effective method of improving the quality of mathematical education and the process of teaching mathematics is teaching the problems with professional content.

The mathematical model of the applied problem reflects the real situation that arises in reality through mathematical symbols, signs and relations between them. In the process of constructing a mathematical model, the concrete objects of reality are replaced by their mathematical equivalents.

VilenkinN.Ya. [1, p.29] distinguishes the following stages in modeling:

- identifying significant factors and discarding inessential onesin a situation or phenomenon;
- constructing the relationshipscheme of the essential factors of the situation (phenomenon);
- obtaining the required conclusions from the constructed scheme.

Further, VilenkinN.Ya.continues that in orderto implement the described content of the modeling process,one must:

- know some objects, relationships and facts of a certain field of activity;
- be able to discard the inessential factorsand distinguish the main onesin the situation under consideration;

- create a scheme of the situation (phenomenon)on a received basis;
- select the "language" in which the received scheme will be considered;
- get the required conclusions from the scheme, i.e. solve the problem in the selected "language".

Solving problems in teaching is an important stage in the formation of the cognitive activity of a student. In the process of solving problems, abstraction and formalization take place, synthesis, analysis, generalization, etc. are performed, allmental processes are aggravated.

D. Poya [2, p. 56] identifies the following steps in solving problems:

1) tounderstand the condition of the problem assigned;
2) to analyze the problem;
3) to create a mathematical model of the problem;
4) tocarry out the synthesis, i.e. implement the solutionfound;
5) tocheck and assess the result.

A.M. Matyushkin [3, p.36] proposes the structure for solving problems as follows:

1) the “closed” solution, i.e. application of standard solution methods;
2) the “open” solution, i.e. finding non-standard methods;
3) the implementation of the found method of solution;
4) thecheck of the solutionresult.

In our research, we use the term “problem with professional content”.

The problems with professional content must be composed as follows:

1. Formulation of the problemconditions;
2. Initial data for solving the problem;
3. Additionalquestions;
4. Referencedata (appendix).

Theoretical knowledge, skills and abilities acquired for a certain period of time in various disciplines are accumulatedin problems with professional content. The condition for such problem should contain professional elements. Information from courses of physics, chemistry, theoretical mechanics, electrical engineering, etc. can be usedin such a problem. Therefore, the problem with professional contentis integral in its nature, i.e. it combines mathematical theories and knowledge of major disciplines. The integrity of the problem with professional content is one of the pedagogical functions assigned to it.

One of the didactic issues relating to problems with professional content is the *selection of problems* included in the educational and methodical complex.

B.S. Kaplan, N.K. Ruzin, A.A.Stolyar believe that “in particular,learning through problems definesthe thorough selection of problems, their grouping in specific sequences that allow constructing of a solution process like a research process. At the same time, one can reveal the possibilities of generalizing problems, formulating and solving new ones, and achieving a new, sometimes unexpected theoretical result, deepening the meanings of the objects studiedby solving a sequence of problems”.

The selection and making up mathematical problems with professional content havea few stages.

*Stage 1.*The analysis of normative documentation (standards, standard plans, etc.) andthe requirements for a future engineer in a given area of specialization in future professional activity. The main component here is the professional qualification of the future specialist. At the first stage, the following should be identified:

1. knowledge required to study general scientific, major, technical disciplines;
2. skillsand abilities acquired in solving problems with professional content;
3. quality (moral, professional).

Let us consider the second stage in the formation of a set of problems with professional content.

*Stage 2.*The determination and systematization of the content of higher mathematicscourse aimed at achieving the goals. The determinationof the goals for studying specific themes, sections required in teaching a series of general scientific and major disciplines.

*Stage*3.The direct formation of a series of applied and professionally oriented problems, taking into account the identified peculiarities, the thematic division of problems and ranking them based on level of complexity. One can divide the content of problems into modules of themes studied.

Based on the analysis of the above mentioned research, we distinguish the key points that determine the quality of the formation of mathematical thinking in solving problems with professional content:

- ability to transform practical problems into a mathematical language (the ability to mathematical modeling);
- logical construction in reasoning;
- ability of spatial mathematical thinking;
- accuracy of symbols when replacing a real research object with its analogue;
- accurateanalysis of the problem;
- search for the best method to solve the problem;
- prediction of a possible result;
- interpretation of the result obtained, i.e. "transformation" into the original "language".
- quality assessment of the result.

The selection of problems with professional content should be aimed at achieving the following goals:
- help the student to master the general principles of the mathematical apparatus as a means of solving the theoretical and practical problems of engineering;
- facilitate the study of a number of important disciplines that form the basis of specialist's education;

As a conclusion, we will define the requirements for problems with professional content for engineering and technical specialties:
- the problem should contain a real situation arising in the professional activities of engineers;
- the numerical data used in the problem must be real;
- the problem must include the interdisciplinary relationship;
- theproblemmust have practical value, the significance of mathematical knowledge should be revealed in it;
- depending on the complexity the problemsmust have different levels, i.e. they must be formed on the principle "from simple to complex".

The ranking of problems is carried out by the lecturer, and students can choose the level corresponding to them at the moment. The first level is aimed at developing skills and abilities in the process of solving problems, the solution algorithm of which is known (algorithmic, training). The second level of the problemcomplexity is the formation of skills and abilities of solving problems when the algorithm is not completely known (reduction to known algorithms or a superposition of a number of known algorithms). The third level of the problemcomplexity is the formation of skills and abilities of solving problems when the algorithm is unknown (research or heuristic). If the student has mastered a lower level of complexity, he can move on to the next. Such differentiated education is the most transparent and objective for students.

The successful application of professionally oriented problems in training of future engineers must meet the following didactic requirements:
- providing an organic connection between the material studied in the program of the mathematical course and professional problems arising in the activities of an engineer;
- practical significance of the selected professionally oriented problem;
- continuity, consistency and systematic application of such problems in teaching mathematics.

In the methodological literature there is no common classification of professionally oriented problems. However, the analysis of studying this issue allows us to classify problems with professional content according to the nature of the knowledge used, didactic principles, the ways of setting the problem conditions, the level of complexity and the methods of solution. Professionally oriented problems can be considered to explain a phenomenon or process; the meansof problems are divided into text, graphic, tabular.

There are two main ways to solve such problems: algorithmic and heuristic. By means of the algorithmic method of solution, the way of solving the problem is known in advance, i.e. there is a ready solution algorithm. On the contrary,the heuristic method of solution requires selection and search of many solutions and is based mainly on mathematical intuition, the experience of previously solved problems, and consideration of previous mistakes.

Let us consider one of the problems on the theme"Application of a certain integral to pressurecalculation".

Problem. Gas under atmospheric pressure is in a cylindrical container withforcer, the height *H = 2m* and the radius *r = 0.5m*. Find the work that needs to be spent on gas compression with forcer of 1.5m. The gas temperature remains constant.

Solution.

According to the Boyle-Mariotte law, under isothermal compression, the relationship between pressure and volume will be:

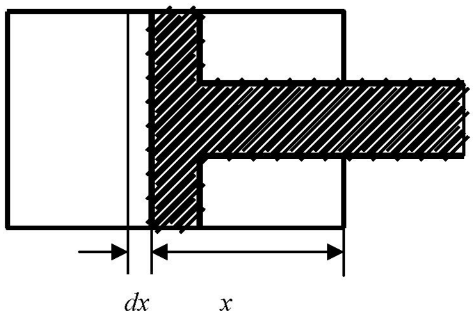
$$Pv = c. \qquad c - const.$$

When the forcer moves at *x m*. (Fig. 4), the gas pressure per unit area is:

$$P(x) = \frac{c}{v(x)} = \frac{c}{S(H-x)},$$

where S - the area of forcer. Then

$$P(x) = \frac{c}{H-x} = SP(x)$$



Figure

Let the function *a (x)* be the work to be spent on the movement of the forcer on*x* meters. Suppose that when the forcer moves on *dx*, the pressure on it *P(x)* is constant. Find the approximate differential value of the function *a(x)*

$$\Delta a \approx P(x)dx = \frac{c}{H-x}dx = da$$

Next, we calculate the work when *x* changes from *0* to *h:*

$$A = c\int_0^h \frac{dx}{H-x} = -cln(H-x)\Big|_0^h = cln\frac{H}{H-h}$$

Wecalculateat$H=2м., h=1,5м., r=0,5м., P_o=10330kg/m^2$ *(atmospheric pressure)*

$$v_0 = \pi r^2 H = 0,5\pi$$

$$c = P_0 v_0 = 5165\pi.$$

We find the work to be spent on gas compression:

$$A \approx 5165\pi \cdot ln\frac{2}{2-1,5} \approx 22494,4\text{êÃì} \approx 220175,64 \qquad (\text{Äæ})$$

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ЖОО-НЫҢ ТЕХНИКАЛЫҚ МАМАНДЫҚТАРЫНДА МАТЕМАТИКАНЫ ОҚЫТУДЫҢ КӘСІБИ БАҒЫТТЫЛЫҒЫНЫҢ ҚҰРАЛЫ РЕТІНДЕГІ МІНДЕТТЕР

Аннотация: Мақалада ЖОО-ның техникалық мамандықтарында математиканы оқытудың кәсіби бағыттылығы мәселесі қарастырылды, кәсіби мазмұнмен есептер мәселесі, оларды таңдау және саралау бойынша әдебиетке талдау жүргізілді. Болашақ инженерлерді табысты қолдану үшін оқытудағы кәсіби - бағытталған міндеттерге сәйкес келетін дидактикалық жағдайлар, кәсіби мазмұны бар есептерді жіктеу, сондай-ақ осындай міндеттерді шешу тәсілдері көрсетілген. Кәсіби мазмұны бар есептерге қойылатын негізгі талаптар көрсетілген, "қысымды есептеуге белгілі интегралды қолдану" тақырыбы бойынша есеп қарастырылды»

Түйінсөздер: міндеттері, күрделілік деңгейі, кәсіби бағыттылығы

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ЗАДАЧИ КАК СРЕДСТВО ПРОФЕССИОНАЛЬНОЙ НАПРАВЛЕННОСТИ ОБУЧЕНИЯ МАТЕМАТИКЕ НА ТЕХНИЧЕСКИХ СПЕЦИАЛЬНОСТЯХ ВУЗА

Аннотация: В статье рассмотрена проблема профессиональной направленности обучения математики на технических специальностях вуза, проведен анализ литературы по проблеме задач с профессиональным содержанием, их подбору и ранжированию. Показаны дидактические условия, которым должны соответствовать профессионально- ориентированные задач в обучении будущих инженеров для их успешного применения, классификация задач с профессиональным содержанием, а также способы решения таких задач.Перечислены основные требования к задачам с профессиональным содержанием, рассмотрена задача по теме «Применение определенного интеграла к вычислению давления»

Ключевые слова: задача, уровень сложности, профессиональная направленность, классификация задач.

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