One of the Ways to Organize Mathematical Training of Railway University Students in the Target Programs

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Abstract: The article discusses the organization of the educational process of railway university students in the target programs. A successful educational process will be effective if the training provided to students of the transport university is of an acceptable quality, which will lead to a high demand for a specialist. When participating in targeted training programs, the learning process can be optimized and structured within the educational framework, thereby placing emphasis on acquiring the necessary knowledge for future professional endeavors. The objective of the article was to examine how the minor program in the Mathematics discipline for students in targeted programs enhances their professional motivation. We propose to consider the characteristics of training in targeted programs by examining the training of students in the specialty 23.05.04 "Electric power supply of railways" at the Samara State University of Railway Transport. We believe that one way to organize the mathematical training of students in targeted programs is to use professionally oriented tasks. As the objective of the study pertains to the issues of specialized university education in the field of mathematics, the paper presents a task that is geared towards professionals for students enrolled in the targeted programs of this particular field. Furthermore, this approach to the study of mathematics yields a comprehensive understanding of one's professional pursuits, implying that the integration of the educational process is essential in the preparation of a railway transport specialist. The evaluation of the proposed methodology for the instruction of students in the targeted programs has demonstrated its efficacy.

INTRODUCTION

Students entering the transport university in target programs have interests that can be considered to be clearly formed, since they have not only decided on their future profession, which they receive, but also decided on their future place of work, which they must work for at least three years. Generally, many students believe that they are not interested in general education subjects because they do not relate to the chosen type of activity. But it shouldn't be this way. When studying a course in higher mathematics, it is important to avoid the formal approach. To increase

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motivation for training a future specialist, we propose to include professional-oriented tasks in the learning process.

The distinctiveness of targeted training stems from the fact that this particular form of education is a prevalent phenomenon in Russia, Uzbekistan, Kazakhstan, Tajikistan.

Various aspects of the application of targeted university education were described by such researchers as V.M. Anikin, B. N. Poizner and E. A. Sosnin (2019) and others (Verhaest & Baert, 2018; Klimova et al, 2021), who consider the presented training as a purposeful system of activity.

V.M. Anikin, B. N. Poizner, and E. A. Sosnin (2019) think that the main goal of studying at the university is to make today's schoolchildren become experts in their field, as agreed upon in the contract.

According to the research conducted by S.S. Bakulina, E.A. Muzychenko, and V.E. Chernoskutov (2011), the targeted recruitment ought to be regarded as an educational program wherein the student undertakes an apprenticeship at the expense of the prospective employer, who is directly interested in a specific area of specialist training.

The history of targeted training dates back to the 1960s, when the Soviet Union established the principle of admitting applicants first to postgraduate school, and then targeted training programs were introduced into higher and secondary professional educational institutions. At the same time, the need for professional personnel in industry, agriculture, household sphere and other areas of the economy in the conditions of planned economy was taken into account (Bakulina, Muzychenko & Chernoskutov, 2011).

Thus, the order of the Ministry of Higher and Secondary Special Education of the USSR dated July 31, 1962 No. 284 "On approval of the regulations on postgraduate studies" contained a special section "Targeted Postgraduate Studies". Targeted postgraduate study was understood as a certain format of personnel training, which would later be used as employees of enterprises and higher educational institutions that do not have the opportunity to train personnel on the spot. There was a strict admissions policy for the targeted postgraduate study. As a rule, all places in full-time target postgraduate studies were occupied by secondees from the Union republics, in the programs of higher educational institutions and industrial enterprises. As per the provisions enshrined in the order at that time, the expenses associated with training were borne by educational institutions, whereas specialists who had completed postgraduate studies were to be returned to the organizations that had been designated for their services.

In 1980, on the basis of the order of the Ministry of Higher and Secondary Special Education of the USSR No. 700 dated June 19, 1980 "On approval of the regulations on postgraduate studies at higher educational institutions and research institutions", a number of postulates were changed. Now the responsibility for specialists sent for targeted postgraduate training was assigned to the

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ministries and departments in charge of which there were organizations giving directions for training.

By the decree of the Council of Ministers of the RSFSR dated June 10, 1987 No. 241 "On measures to radically improve the quality of training of specialists with higher education in the national economy" before the executive authorities of the RSFSR, the trajectory of the planned transition by 1993 to a new level of interaction between higher education and production was built. This decree approved the targeted training of specialists on the basis of contracts concluded between the enterprise and the higher educational institution. It was believed that the sectoral ministries would develop plans for the training of students in a number of specialties, based on the number of target contracts concluded.

A similar level of regulation of relations between students in targeted programs and organizations continued until 2002 on the basis of the Decree of the Government of the Russian Federation dated September 19, 1995 No. 942 "On targeted contract training of specialists with higher and secondary professional education".

In 2002, in p. 11 of art. 41 of the Law of the Russian Federation No. 3266-1 "On Education" dated July 10, 1992, a norm appeared, according to which state and municipal institutions of secondary and higher professional education were granted the right to carry out targeted admission of students within state tasks (control figures) in accordance with contracts concluded with state authorities, by local governments. This reception was intended to provide assistance to these institutions in the training of specialists.

Today, each enterprise is afforded the opportunity to educate and train specialists in accordance with its individual requirements. This is applicable to various universities, including but not limited to transport, medical, communications, polytechnic, and others.

With the help of targeted training, the motivation of students for learning in general is increased. The study of the motives of students' learning activities is a very important element of the teacher's activity. The students' attitude towards studying, academic performance, interest in the result, and future professionalism depend on their motives.

The activity of students at the university is of an educational and professional nature. K. Zamfir, L.B. Itelson, E.P. Ilyin, L.P. Urvantsev, O.K. Markova, O.N. Arestova, N.A. Bakshaeva, A.A. Rean and other psychologists devoted their works to the study of the motivation of educational and professional activities of students (Deleu, 1990; Urvantsev & Maleeva, 1984)

Nowadays, the Federal Law No. 273-FZ of December 29, 2012 "On Education in the Russian Federation" establishes measures to ensure targeted training of persons with higher education.

In this regard, the increase in interest and motivation in obtaining highly professional skills that should be used in the future at a particular enterprise comes to the fore.

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It should be noted that the research in this area is not fully reflecting the systematic vision of the problems of implementing targeted distance learning, and further study is required.

MATERIALS AND METHODS

The objective of the article was to examine how the minor program in the discipline of Mathematics for students in targeted programs enhances their professional motivation.

This task involves drawing up a work program for mathematics students in targeted programs, the choice of a method that allows determining the importance of academic disciplines for professional training, and the development of professional motivation.

One of the methods for obtaining a high-quality mathematical education for railway transport engineers is the method of introducing tasks of a professionally oriented nature.

The object of the study was the process of organizing training in targeted programs at the Samara State University of Railway Transport in the specialty "Electric power supply of railways".

The research focuses on the organization of targeted teaching of mathematics at the Samara State University of Railway Transport in the specialty "Electric power supply of railways."

Employees of JSC "Russian Railways" have developed a target program: "Youth of JSC "Russian Railways". The proposed program promotes the professional growth of young employees of JSC "Russian Railways", and also contributes to the formation and development of professional leadership qualities and an active life position, and the production initiative of young people.

The Samara State University of Railway Transport annually allocates a certain number of places for the training of highly qualified personnel to meet the needs of the Kuibyshev, Volga, Gorky, South-Eastern, South Ural, Northern, North Caucasian railways.

All applicants who are interested in receiving a targeted referral for training have the opportunity to contact the personnel management service of the enterprise that is the customer of targeted training. If the applicant has not yet made a decision on admission to the university within the framework of the targeted admission, then he can enroll on other conditions and think about the possibility of targeted training later. Students are given the opportunity to conclude a contract for targeted training in any course.

In addition to the classes provided for by the budgetary basis in accordance with the state educational standards, students are offered additional classes, namely lectures and practical classes in disciplines that are not provided for by the federal state educational standards of higher education, but they are necessary for the graduate in the future in the performance of official duties. The universities costs for implementing additional educational services for students in targeted programs are reimbursed by the enterprises that sent them (Maleina, 2015).

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It is highly valuable that during this challenging period, the customer enterprise provides the graduate with a job upon completion of their university education. With successful studies, students are awarded monthly additional scholarships. In addition, the student is not seeking an internship, but rather looking for a paid position.

After completing their university education, students are granted the status of a young specialist, which entitles them to receive relocation allowances when they are assigned to work in a different area. This allowance is intended to cover the expenses of renting a dwelling and to obtain a preferential mortgage loan to acquire a dwelling within the property.

The table shows by year the number of admission places in the specialty 23.05.04 "Electric power supply of railways" and the number of places of target destination at the full-time department of the Samara State University of Railway Transport.

	2016		2017		2018		20019		2020	
	Number of admission places	Number of places of target destination	Number of admission places	Number of places of target destination	Number of admission places	Number of places of target destination	Number of admission places	Number of places of target destination	Number of admission places	Number of places of target destination
Full-time education	122	70	100	68	100	70	100	78	90	71
Extra-mural education	60	37	75	52	60	43	27	19	27	19

Table 1. The number of admission places for applicants 2016-2020 (Compiled by the authors)

Based on the analysis of the figures presented in Table 1, it is evident that there is a consistent downward trend in the number of admission places, both for full-time and extramural education. So, since 2016, the number of admission places in the specialty "Electric power supply of railways" has decreased from 122 in 2016 to 90 in 2020 in the full-time department and from 60 in 2016 to 27 in 2020 in the extramural department. Moreover, the number of places for targeted admission in the full-time department remained at the same level.

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For clarity, we present the table data for full-time education in the form of a diagram:

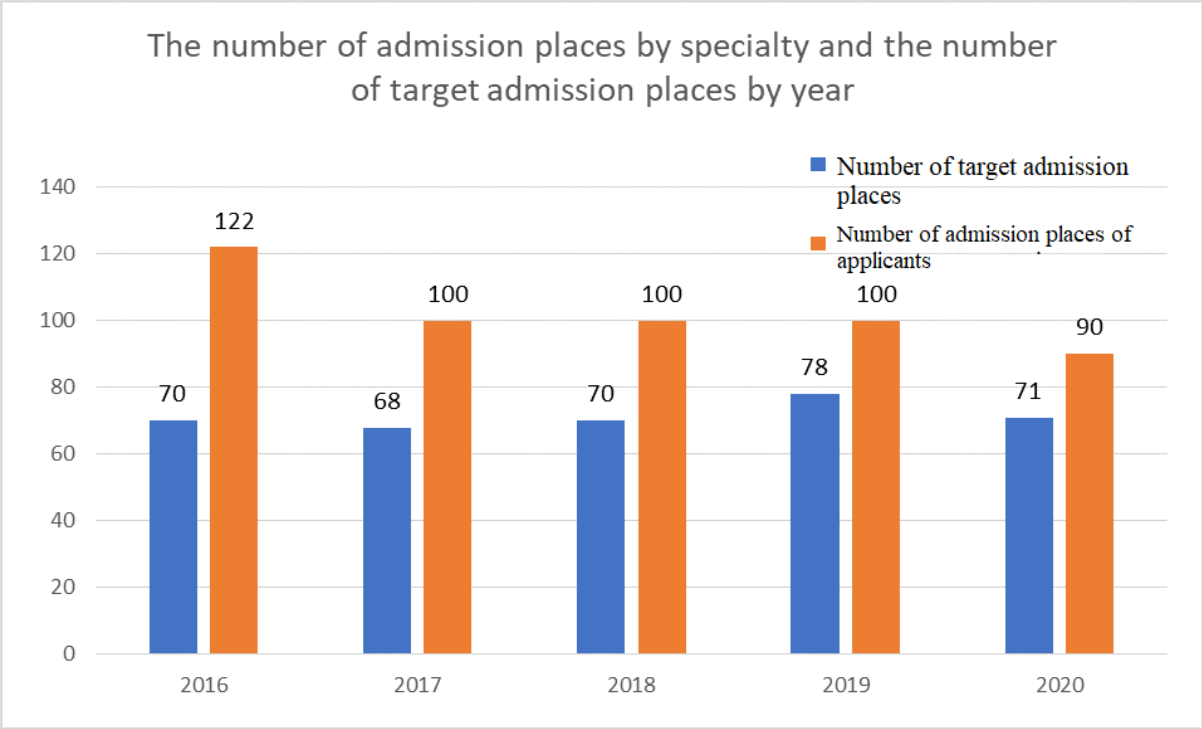

Figure 1. Diagram "Number of admission places of applicants in 2016-2020" (Compiled by the authors)

As per the current legislation, it is noteworthy that for individuals enrolled in targeted contracts, all prerequisites for free higher education have been preserved.

Candidates entering the target programs have varying levels of awareness of their future professional activities. They are both graduates of secondary schools and professional colleges. At the same time, the latter are familiar with the profession, many of them have practical experience. School graduates most often enter universities either as successors to a professional dynasty, or in company with friends, or at the insistence of their parents.

The targeted program includes both the professional cycle and the necessary disciplines for their development. Mathematics is one of those disciplines. During the creation of a mathematics course designed for targeted training programs, a variety of contemporary pedagogical technologies were used. In this study, we examine the use of professionally directed tasks in the study of mathematics. These tasks are necessary when solving problems of mathematical modeling, they are actively used

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in solving problems of a professional orientation using the project method (Han, Capraro, & Capraro, 2015; Hanushek et al, 2017; Verhaest & Baert, 2018).

In addition to the standard tasks that are covered in the discipline "Mathematics" for students in target programs, it is recommended to include professionally-directed tasks and use new pedagogical technologies (Klimova & Klose, 2020; Pardała, Uteeva & Ashirbayev, 2015). This approach helps to improve the assimilation of the basic special terms, and the ability to use mathematical apparatus in solving professionally-oriented problems is also developed.

The teachers' role is to help students understand mathematical concepts and understand how mathematical laws work in the professional field. We believe that the most effective way to develop students' mathematical activity is through the use of special professional tasks. Furthermore, the proposed methodology for teaching permits the exposition of the practical significance of the analyzed mathematical theory and serves as a stimulant for enhancing the cognitive abilities of students, thereby augmenting their mathematical knowledge. The use of professional tasks in mathematics helps students develop the ability to apply basic knowledge in the professional field, which in turn increases interest in studying the discipline, develops non-standard thinking, and the desire to work independently.

For example, here is an example of a professionally-oriented task for trainees in the specialty 23.05.04 "Electric power supply of railways" of the Samara State University of Railway Transport. (Arkhipova, Evdokimova & Rudina, 2019; 2020).

Find a rational option for the development of the single-track railway polygon ABCD (Fig. 2)

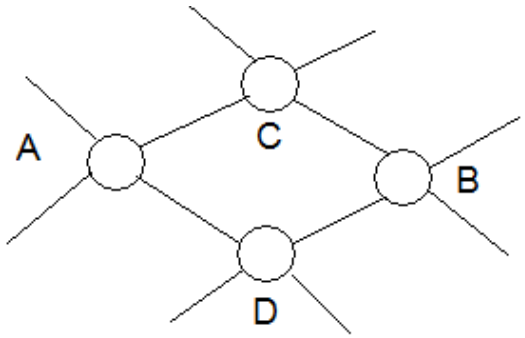

Figure 2. Scheme of single-track railways (Kaplan, Maidanov & Tsarev, 1978)

The existing capacity on all lines is 20 million tons in freight directions (from A and B to C and D). The traction on all lines is provided by diesel. Traffic-dependent costs with existing equipment everywhere are 14,000 rubles / 10 tkm.

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Table 2 shows data on the polygon lines.

Line	AC	BC	AD	BD
The prospective non-distributed flow of other cargo, with the exception of the primary planned cargo (in million tons per year), back and forth	10/12	11/14	11/10	9/11
Miles of maintained track, km.	500	450	700	600

Table 2. Data on the polygon lines. *Source: Kaplan, Maidanov & Tsarev, 1978.*

Data on the stages of traffic-capacity (the possible stages are the same for all lines):

No. of the stage	1	2	3
Performing action	Lengthening of receiving and departure tracks and increase in the weight norm	Electrification	Construction of the second track
Traffic-capacity (in million tons/year) in the cargo direction	28	40	90
Capital investments (in thousands of rubles per kilometer of operational length)	20	60	120
Annual additional independent operating costs in comparison with the previous stage (in thousand rubles / km)	2	4	12
Traffic-dependent costs per 10 t km net (in thousand rubles)	1,3	1,1	1,0

Table 3. Data on the stages of increasing the traffic-capacity of lines. *Source: Kaplan, Maidanov & Tsarev, 1978.*

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Normative coefficient of efficiency of capital investments $E_н$=0,12.

Data on the departure and arrival of the planned cargo (in million tons / year): departure A - 38; B - 48; arrival C - 43; D - 43.

Instructions: 1. In each variant of the polygon development, the attachment of consumers to suppliers is done according to the minimum total mileage (a criterion equivalent to the minimum total freight charges, and therefore corresponding to the self-support). It is possible to simplify the solution of this problem by applying this criterion (and not the minimum of dependent costs).

2. First, it is necessary to consider the option of strengthening the polygon, which makes it possible to implement transport links that are optimal in terms of mileage for the main cargo. For this purpose, the optimal attachment of the points of departure and arrival of this cargo is carried out without taking into account the network capacity. The resulting total cargo flows are determined, and for each line a set of reconstructive measures is established to make it possible to master these flows. For the polygon development and flow development option obtained in this way, the annual costs are calculated, including the adjusted capital investment, contingent and independent operating costs.

3. Further, the calculation is carried out on the principle of excluding individual initially established reconstructive measures with a check whether this leads to a reduction in the above costs (the principle of control reverse viewing in the ICTP method (Belov & Kaplan, 1972)). Initially, it should be noted that the activities of the final stage are excluded, specifically the construction of second tracks in distinct directions. If, for example, the original version provided for the construction of second tracks on two lines, then two new options are formed, in each of which the second tracks on one of the lines are excluded. The attachment is being made again for the main cargo - this time taking into account the capacity restrictions on the line on which the construction of the second track has been "canceled". The aforementioned expenses have been calculated for each of the options, and the option with the lowest expenses is selected, either one of the two new or original option.

Moreover, as per the ICTP methodology, in the event of selecting one of the "new" alternatives, it would be imperative to maintain the exclusion of reconstructive measures enacted by the chosen alternatives, such as evaluating the feasibility and economic efficacy of the second tracks on two lines or rescinding the electrification of any line. However, in order to reduce the amount of work in solving this problem, we will limit ourselves to only the first step - checking the effectiveness of abandoning the second tracks on one of the polygon lines.

4. Independent expenses and capital investments when choosing the i-th stage of reinforcement for this line are estimated as the sum of the expenditure standards specified in the task from the first to the i-th stage. For example, the capital investment per kilometer of operational length during the

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implementation of the third stage of reinforcement is equal to 20+60+120 =200 thousand rubles. (Kaplan, Maidanov & Tsarev, 1978).

In order to assess the significance of the studied disciplines for professional training and the development of professional motivation, the authors applied the methodology of T.D. Dubovitskaya (Dubovitskaya, 2003). T.D. Dubovitskaya developed a test-questionnaire, which consists of 18 judgments and contains two scales: (1) the importance of the subject for the professional training of a future specialist and (2) the importance of the subject for the development of professional motivation. The students are presented with a total of 18 judgments, and for each one, they are required to provide an answer that aligns with the notation enclosed in brackets: true - (++); probably true - (+); probably not true - (-); incorrect - (--).

The judgments are as follows:

1. Studying this subject gives me the opportunity to learn a lot of important, valuable things for my future profession.

2. During the lessons on this topic, I am beginning to feel regret for my decision to attend this institution for study and pursue this profession.

3. Through this subject, I gained a better understanding of the complexities of my future profession.

4. What they teach me in the classroom is irrelevant to my future profession.

5. The tasks I perform develop my skills necessary for the future profession.

6. The examples provided by the instructor during class have piqued my interest in my prospective profession.

7. A significant portion of the coursework required of me in the classroom in the subject will not be applicable to my future profession.

8. During the lessons on this subject, I begin to understand the significance of my profession in the life of society and for me personally.

9. If this subject were to be excluded from the curriculum, my professional training would not suffer from its absence.

10. Subject assignments do not enhance the attractiveness of my future profession to me.

11. This subject is considered to be a crucial component of a successful preparation for a prospective profession.

12. I can hardly imagine the use of the knowledge, skills and abilities gained in the classroom in the profession.

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13. During the lessons on this subject, I have thoughts that the chosen specialty is not for me and it is better for me not to work in this specialty.

14. During the lessons on this subject, I have the opportunity to present and prove myself in the role of a future specialist.

15. During the lessons on this subject, I am convinced of the correctness of the choice of my future profession.

16. The tasks performed in this subject do not give me an idea about my future specialty.

17. I do not see any connection of this subject with the future specialty.

18. Studying this subject will give me the opportunity to achieve success in the future profession.

Processing of results. The questionnaire indicators are calculated in accordance with the key, where "yes" means positive answers ("true", "probably true"), and "no" means negative ("probably not true", "wrong").

Key.

The significance of the subject for the professional training of a future specialist: Answers "yes" for the No. 1,3,5,11,14. Answers "no" for the No. 4,7,9,16,17.

The significance of the subject for the development of professional motivation: Answers "yes" for the No. 6,8,15,18. Answers "no" for the No. 2.10.12.13.

One point is awarded for each match with the key. The higher the total score, the higher the studied indicator.

RESULTS

This study was conducted at the Samara State University of Railway Transport. The tasks of professionally-oriented training were introduced into the learning process for first-year students of two groups, called experimental, in the amount of 28 and 32 people majoring in 23.05.03 "Electric power supply of railways." In the two control groups, the number of students in which was 27 and 30 people, the tasks of professionally-oriented content were not introduced into the learning process. The experimental groups consisted of students in the target programs. Mathematics is additionally allocated 18 hours for lectures, 18 hours for practical classes, and 36 hours for consultations within the framework of targeted training in the first year. The hours allocated to mathematics decreased in the second year, namely 9 hours for lectures, 18 hours for practical classes, and 36 hours for consultations. In these supplementary classes, professional tasks were taken into account. There were no additional classes in the control groups.

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In all groups, there is the same work program for the basic course of mathematics. At the same time, for experimental groups consisting of students in target programs, additional hours are allocated for the discipline "Mathematics". The work program for these groups entails the investigation of mathematical subjects that are not covered in the primary curriculum. In these supplementary classes, professional tasks were taken into account.

Upon completion of both the main and additional courses in the discipline "Mathematics", a survey was conducted in the selected groups according to the methodology of T.D. Dubovitskaya. The results of this survey are presented in Table 4.

Scale	Group			
	Experimental		Control	
	No. 1 (28 students)	No. 2 (32 students)	No. 1 (27 students)	No. 2 (30 students)
The importance of the subject for the professional training of a future specialist	7,8	6,9	5,7	5,4
The importance of the subject for the development of professional motivation	5,7	5,3	4,8	4,1

Table 4. Survey results (the table shows the average score for the group).

According to Table 4, the importance of mathematics for the professional training of a future specialist in the experimental groups is higher than in the control groups. The importance of mathematics for the development of professional motivation in the experimental groups also increased compared to the control groups.

The outcomes of the experiment have demonstrated that the inclusion of tasks that are geared towards professional development in the course "Mathematics" has a positive impact on the growth of students' professional interests. The professional orientation of the fundamental sciences enables the utilization of tasks that are specifically geared towards professionals, necessitating the selection of scientific methods that have been extensively studied in any fundamental discipline, as well as methods from related disciplines, to resolve them. Such tasks should be included in the activities

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of establishing interdisciplinary links. Professional content tasks not only increase interest in the study of new mathematical material, but also serve to consolidate it and use it in further professional activities. The method of applying such tasks contributes to the successful formation of research competence. Therefore, it is necessary to create personal directed didactic teaching tools that allow systematically organizing the mathematics training of a future specialist. It should be noted that such tasks are effectively used not only in the study of mathematics, but also in the study of physics, chemistry and other disciplines.

For students in target programs, research according to the method of T.D. Dubovitskaya has not been previously conducted.

DISCUSSION

The researchers previously addressed the issues of implementing professionally-oriented tasks, and the results were presented in the authors articles (Arkhipova, Evdokimova & Rudina, 2019; 2020).

V.A. Shershneva (2003), N.Yu. Gorbunova (2017) and others also considered the problems of introducing professionally-oriented tasks when studying mathematics courses in various higher educational establishments, in various fields of study. The results they obtained are similar. It should be noted that such studies have not previously been conducted in the context of targeted training. Nonetheless, at present, this investigation holds significance for the education of contract students at railway universities.

The methodology employed for the introduction of tasks that are geared towards professional development in the study of mathematics for the analyzed specialty has demonstrated the efficacy of a professional orientation in education.

Furthermore, this study demonstrated that the use of professionally-oriented tasks in teaching mathematics is an effective means of implementing the professional orientation of targeted education in general.

CONCLUSION

To conclude, it is noteworthy that the incorporation of mathematical problems with a professional orientation in the training process of railway universities has a favorable impact on the standard of education. Particularly, the enhancement of mathematical reasoning is ensured, the horizons are broadened, and the proficiency in identifying the primary and discarding the secondary is honed. Students also acquire mathematical knowledge that will be useful in their future professional activities.

Hence, utilizing the instance of one of the specialties, namely 23.05.04 "Electric power supply of railways" at the Samara State University of Railway Transport, we have examined a method of

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instructing in targeted programs by utilizing professionally-oriented mathematics tasks. It should be noted that the described method is applicable for any other direction of training a specialist in the transport industry. We reserve the right to use the tasks of professionally-oriented content in obtaining additional specialties and training programs while conducting further research.

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