

Improving the Quality of Training of Engineering Personnel for the Agro-Industrial Complex

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Abstract. The article notes the need to improve the quality of engineering personnel training for the agricultural economy. This is due to the fact that the development of modern agricultural production and the sharply accelerated processes of developing and implementing innovative technologies in production against the background of increasing attention to digital technologies in agriculture require a radical modernization of the technical base of the agricultural sector of the economy. The article presents the concept of agricultural classes for young people in rural areas. This concept represents a positive experience of early involvement of young people in agricultural specialties and especially engineering personnel. A special feature of this approach is the involvement of specific agricultural producers, who are anchor employers in these territories, in the early career guidance of young people. The importance of agricultural classes is that already at school, the student can form his attitude to agriculture and by the time of graduation decided what profession and specialty he wants to master. The connection between school and university formed with the help of agricultural classes helps today's students to make a choice that will determine their future life. And its correctness depends not only on the future of one person, but also on the agriculture of the country as a whole. The article presents the experience of creating and operating agricultural classes created in the Republic of Tatarstan (Russia) by Kazan State Agrarian University, which can be replicated for other countries and will help reduce the negative trends of the shortage of qualified engineering personnel for agricultural production.

1 Introduction

The Republic of Tatarstan is an economically successful region of Russia. A significant area of the national economy of the republic is the agro-industrial complex, which provides the population with primary food products of its own production. The Republic of Tatarstan took the first place in the official rating of the subjects of the Russian Federation for the implementation of the State Program for the Development of Agriculture [1].

The republic is engaged in a large-scale attraction of its own strategic investors, private companies, to the agro-industrial complex, which currently handles half of the republican arable land and keeps half of the livestock. Agriculture in Russia and the Republic of Tatarstan, as well as in the whole world, is in a digital transformation [2].

At the same time, the agriculture of the Republic of Tatarstan really faces the problems of human and labor potential necessary to ensure the innovative development of the agricultural sector, improving the quality of life of citizens in rural areas. This is due, on the one hand, to the modernization of agriculture and forestry, the need for eco-friendly and rational use of natural resources, the development of market relations, and improving the standard of living of the rural population. On the other

hand, there is the provision of sustainable development of rural areas, with the preservation and education in young people of love for the motherland, work on the land, family and national values, which are a constant source of culture, patriotism and morality.

In this regard, the training of specialists who are able to study, predict and develop tools that should contribute to sustainable development, ensure the safety and quality of life of the population, protect the environment and improve the rational use of natural resources, and preserve cultural and national identity is of particular relevance.

It is obvious that the processes of the digital economy and Industry 4.0 will affect the problems of training engineers for agriculture and the agricultural economy [3, 4].

Even today, we can talk about the need to develop master's programs in such areas as: smart agriculture; robotization of production in the agro-industrial complex; urban agriculture and "vertical cultivation"; intelligent technologies for processing food waste and resource conservation; genetic engineering and cultivation of high-yield crops; IoT in agriculture; bioeconomics and biotechnology; geo- and bioinformatics, etc. [5–7].

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agricultural production, new professional standards are also needed in: agroinformatics, agrokibernetics, for GMO agronomists, city farmers, agricultural ecologists, system biotechnologists, energy auditors, engineers of robotic systems in agriculture. This is also important for architects of living systems, architects of virtual agricultural environment, meteorological power engineer, designers of agricultural robots, park ecologists, agronomist-economist, foodnet specialists, operators of automated agricultural machinery, specialists in precision agriculture, etc. [8, 9].

2 Materials and methods

The methodological foundations of the proposed concept of the organization of specialized training and this study are:

1. A systematic approach to the organization of training, which is implemented on the basis of the restructuring of the content and optimization of teaching methods, taking into account the processes of continuity and integration in education in order to create a holistic, optimally functioning and dynamically developing system. An organically integrated system is understood as an organizational and orderly system with developed internal and purposefully established external links, new integral qualities that were not present in the interconnected subsystems. The dynamic development of such a system is understood as a pedagogically organized purposeful movement of the system from the summative level to an organically integral state, characterized by the integration relationships of their main components and the main parameters of the educational process.

2. The integrity of general and professional training is achieved through the continuous strengthening of the interrelationships of its main components on the basis of the principle of integration and its interaction with other principles of training: continuity, unity of training and education, motivation of learning and work, problem-solving. The organic integrity of professional training can be achieved if all its components are focused on the ultimate goal-improving the quality of training of qualified specialists.

3. The priority of the individual is in choosing and building their educational trajectory in accordance with their capabilities and abilities, the needs of the labor market, both at the state level and at the level of the region or municipality.

4. The priority of the specialty in the organization of educational structures through a single target focus on the final results in the planning and management of vocational training. Experience and research show that

the implementation of this provision is possible only if, in the process of designing and implementing training, the goals and objectives of the gradual complication of the theoretical and practical foundations of training are brought closer to the profile of the future specialist and laid down in the educational programs of general and professional educational institutions that provide multi-level and multi-stage training.

Based on this, the leading concepts and technologies of the study are: professional competence of a specialist, multilevel and continuous educational programs, differentiated and individualized approaches to training, the principle of early career guidance of students, and the strategy of involvement of all stakeholders in specialized training, comparative analysis and predictive scenario.

3 Results and discussion

As part of the modeling and forecasting of personnel needs, the authors conducted research on the increase in the need for engineering personnel in the economy of the Republic of Tatarstan, including in agriculture, on the one hand, and the presence of an imbalance on the other hand.

These data generally coincide with the forecasts of the Center for Strategic Assessments and Forecasts and the Center for Advanced Economic Research "Assessment and prospects for the development of the regional market of educational services in interaction with the needs of the labor market in the Volga Federal District (on the example of the Republic of Tatarstan)" [10]. It revealed characteristic trends in the development of the expected imbalance and the projected overall demand of the economy of the Republic of Tatarstan, taking into account the number of able-bodied population in the context of enlarged groups of specialties, provided that the existing approaches to the formation of development processes in the labor market, as well as in the field of educational services in the Republic of Tatarstan are preserved (Table. 1 and 2). It should be noted that these forecasts were made before the period of the COVID-19 pandemic, which certainly made adjustments, but this will require additional research.

Meanwhile, today we are faced with the fact that the number of school graduates, including rural ones, who plan to work in agriculture is decreasing [11]. How can school graduates, primarily from rural areas, make life in rural areas attractive and make a professional choice of a future career in the agro-industrial complex? What life strategies do they choose and why? What factors influence this choice? These are the questions that need to be answered first.

Table 1. Results of forecast calculations

Indicator	2012	2015	2020	2030
Total employment in the Republic of Tatarstan	1861349	1910803	2172950	2431623
Additional staffing requirements	40949	42037	47804	53495
The general need of the economy of the Republic of Tatarstan for personnel	1902299	1952841	2220755	2485119
The number of working-age population	2366678	2346947	2623996	2865573
The expected imbalance predicted by the total demand of the economy with the number of working-age population in the context of enlarged groups of specialties	464379	394106	403241	380453
Labor resources, people.	2484462	2527548	2715922	2923827
Distribution of the number of labor resources, including:				
Agriculture, hunting and forestry	183385	184978	190255	187144
Fishing, fish farming	587	592	609	599
Manufacturing industries	329153	332013	341484	335899
Construction	173981	175492	180498	177547
Wholesale and retail trade; repair of motor vehicles, motorcycles, household goods and personal items	282131	284582	292700	287914
Transport and communications	117554	118576	121958	119964
Financial activities	21159	21343	21952	21593

Table 2. Forecast of training of specialists in the areas of people

		2020	2025	2030
Economics and Management	080000	2499	2619	2690
Agromony	110200	160	167	172
Electrical Engineering	140601	128	134	137
Mechanical engineering technologies and equipment	150200	251	263	270
Technological machines and equipment	150400	150	158	162
Mechanical engineering technology	151001	1084	1136	1167
Automobile and tractor construction	190201	134	140	144
Automobiles and automotive industry	190601	81	85	87
Organization of transportation and transport management	190700	105	110	113
Computer Science and Engineering	230100	158	166	170
Chemical technology of organic substances and fuels	240400	382	400	411
Chemical technology of high-molecular compounds	240501	137	143	147
Machines and apparatuses of chemical production	240801	184	193	198
Construction	270100	989	1036	1064
Other areas of training (more than 80 areas of training)		5779	6058	6213

The problems of education of rural youth or those focused on agricultural specialties are the least popular and studied in the scientific literature. Such a picture is observed mainly in the industrialized countries of the world, among which Russia can be attributed with some degree of conditionality. According to published materials, for example, in the United States, despite the fact that almost a whole professional body is engaged in the development of relevant issues, during the reform period of the 1950s and 1980s, the gap in the quality of urban and rural education became essentially insurmountable. This is probably due to the excessive concentration of specialists working on the development

of higher education, concentrated mainly in cities [11, 12], despite the fact that today in the United States, more than a third of the total number of schools belong to rural areas. No more than 6 % of the content of the leading scientific publications on education is devoted to their problems [11, 12]. The ratio of schools in Russia, with a rough calculation, is actually the opposite – three rural schools fall to two urban ones. The analysis of the problems of education in rural areas is given incomparably little attention. It is possible to list only some of the most interesting works related to the topic of our project, which determine the main trends in this field of research and reveal the factors that influence the life strategies of rural schoolchildren. For example, in one of

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the works of S. Bian and colleagues [11, 12], which analyzed the chances of urban and rural students to successfully obtain higher education, it was found that the traditionally higher level of social capital of rural communities has a positive impact on the life chances of people from rural families. A number of researchers believe that it is impossible to cope with the problem of "brain drain" from villages to cities. They believe that any investment in the development of rural education eventually leads to the fact that the beneficiaries are those cities where the most motivated, educated and trained young people from these villages strive [11, 12].

The conclusions obtained by the researcher G.G. Sillaste are of interest. According to this author, the excessive focus of social policy in the field of education on urban youth, together with the high level of poverty in rural areas and the very low prestige of rural labor, becomes one of the strongest factors that determine the departure of young people from villages to cities after graduating from high school [13].

There is an opinion that the future of the Russian countryside directly depends on the goals and values that guide young people today, especially rural ones [14]. At the same time, scientists recognize that there is a vicious circle: the development of agriculture will be only when normal social conditions of life are created. At the same time, only progress in agricultural production can ensure the growth of the social sphere of the village [15, 16].

4 Conclusions

The problem of combining the rapidly growing differences between the needs of modern agriculture and those who live in rural areas is one of the most important tasks, both for Russia and for many countries of the world [17, 18]. One of the ways to solve this problem can be the creation of agricultural classes on the basis of schools in rural areas. Kazan State Agrarian University has come up with this initiative, especially since it is a part and continuation of the career guidance "Program of socialization and career guidance of the personality of students of educational organizations in the regions of the Republic of Tatarstan. Agricultural schools of the agrarian direction located on the territory of the Russian Federation were studied [19].

Kazan State Agrarian University developed the concept of agricultural specialized classes for schools in rural areas in the Republic of Tatarstan. This concept of "Agrotechnological direction: classes focused on agriculture and entrepreneurship" is implemented in the course of training in additional educational programs, extracurricular activities, in the conditions of interaction of the school with other social structures: family, universities, schools or engineering lyceum, resource centers, enterprises and organizations of engineering and agricultural orientation. Here, the agricultural enterprise performs the function of the main partner, which is interested in targeted training of personnel for itself and for this rural area.

The first classes in the Republic of Tatarstan appeared in the Baltasinsky Municipal district, where

basic schools were selected in the following areas. An agreement was drawn up on cooperation in the implementation of the project together with the Kazan State Agrarian University. The next stage was the training of teachers of basic schools-part-time teachers of the MBOU "Center for Extracurricular Work" (hereinafter referred to as TSVR) according to individual training programs on the basis of Kazan State University. Technical circles of the Central Research and Development Center were identified on the basis of schools.

To determine the interest, inclinations to professions in the areas of Psychological and Pedagogical Service of schools through the effect on studio program we tested students in grades 7–11 (with the consent of parents). A willing and motivated contingent was identified to implement the project. The enterprises of the district are also actively involved in this process. The days of visiting, working on agricultural machinery, and professional tests were determined. A number of seminars with the heads of educational institutions of the Baltasinsky Municipal district were held on the basis of the Kazan State Agrarian University, seminars with teachers on the development of work programs led to the opening of classes with agrotechnological directions in 2019. On this day, each school was awarded a certificate of specialized direction. Today, this project operates in 10 secondary schools of the district, where the school, together with the Department of Education, the Department of Agriculture and the Kazan State Agrarian University, has identified agrotechnological directions for itself, based on the needs of the Baltasinsky municipal district, a specific rural settlement, and the training and interest of students.

The goal of the project involves not only the choice and preparation of students for a particular profession, but also the formation of a positive attitude and willingness to work in agriculture, love and respect for agricultural workers, as well as high moral and labor qualities necessary for any employee of our society.

This project gives students the opportunity:

- to gain skills in agricultural professions through agricultural labor;
- to strengthen the material and technical base of labor education of rural schoolchildren;
- to help students' professional self-determination;
- to develop entrepreneurial skills among students;
- to provide an opportunity to enter a specialized institution for obtaining a profession.

For the fifth year in the Baltasinsky Municipal district, the Championship of working professions "Worldskilz Baltasi Junior" is held. This Championship allows you to conduct professional tests in a competitive form. In 2020, this Championship was held on the basis of Kazan State Agrarian University in the following competencies: operation of agricultural machines, agronomy, landscape design.

Currently, Kazan State Agrarian University and Baltasinsky Municipal District are working together on the implementation of the project "Agricultural classes in the Republic of Tatarstan". To date, in the Baltasinsky

district, 10 schools have created agricultural classes in agrotechnological, forestry, engineering, and economic areas. Anchor companies are assigned to each school.

One of the important tasks of creating agricultural classes is to introduce students to the professions and specialties that are in demand in the agro-industrial complex of the republic, with the content, nature and working conditions, and to give students an idea of the current state of agriculture. The program of classes in agricultural classes includes practical exercises: conducting field trips to enterprises, visiting which, students gain experience and an idea of working in the agro-industrial complex. Also, classes are held in the form of laboratory classes and excursions, including on the basis of Kazan State University, where students learn the basics of research work. Together with the University teachers, they conduct laboratory experiments. According to the research results, students of agricultural classes prepare materials for participation in various conferences and competitions held by the University.

According to the project program, an annual competition is held in the Junior Skills format for the competencies "Operation of agricultural machines"; "Agronomy"; "Landscape design".

Currently, this project continues to expand and other schools in rural areas of the Republic of Tatarstan are joining it. This approach has shown its relevance and there is a serious hope that the imbalance of personnel for agriculture will change for the better.

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