



PERSONNEL TRAINING FOR THE AGRICULTURAL SECTOR IN TERMS OF DIGITAL TRANSFORMATION OF THE ECONOMY: TRENDS, PROSPECTS AND LIMITATIONS

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ABSTRACT

The paper presents the results of theoretical understanding of trends, prospects and limitations that exist in the training of personnel for agriculture in the context of digital transformation of the economy. The transition to the target settings of the new technological order, which is associated with the spread of digital technologies, requires the solution of a whole range of problems in the field of training. The widespread introduction of digital technologies sets the task for universities to train personnel with competencies that are not currently reflected in the current Federal Educational Standards for such directions of training as: "Agriculture, Forestry and Fish Industry", "Industrial Ecology and Biotechnology, Earth Sciences", "Electric

Power and Heat Power Engineering”, “Veterinary Science and Zootechnics”. The article presents the results of a survey conducted among students, which characterize the attitude of future graduates to the prospects of digitalization of agriculture. The study showed on the one hand the disunity of respondents' opinions on certain aspects of the use of digital technologies, on the other hand a great interest in the issue under study. It should be noted that the digital transformation of the economy has exacerbated the problem of staffing agriculture and other sectors of the economy.

Keywords: digital transformation of the economy; agriculture; training; competence of specialists.

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1. INTRODUCTION

Currently, the development of the digital economy is becoming one of the most important strategic priorities of the State. In the terms of the large-scale spread of digital technologies, the development of information infrastructure, increasing the requirements for a minimum set of digital competencies for workers in most areas of economic activity and sectors of the economy, an increasingly clear and important task is the training of personnel for the digital economy.

The transition to the target settings of the new technological order, which is associated with the spread of digital technologies, requires the solution of a whole range of problems in the field of personnel training:

digital technology is a dynamic and fast-growing field in which the emergence, obsolescence and change of technology is extremely fast. In turn, the process of formation of educational standards is not so dynamic and often lags behind the ever-changing requirements of the economy;

elimination of digital inequality of the population in the regions (especially in rural areas) and increasing the availability of digital technologies;

the emergence of new professions with multidisciplinary competencies and the need for continuous adaptation of educational programs to the requirements of the real sector of the economy;

low adaptive potential of educational programs to specific requirements and features of formation of professional competences in agrotechnological, agricultural, biotechnological and other spheres in view of branch specifics;

the lack of a link between the education system and the sphere of implementation and use of digital technologies, which leads to the fact that the function of permanent and multilateral monitoring of labor market demands and the subsequent development of relevant competencies among students of educational institutions is not developing;

even traditional professions in the terms of digital transformation of the economy require the formation of additional competencies, the development of cross-functional qualities of a specialist, which requires a change in approaches to additional education and professional retraining, the transition to lifelong learning and effective combination of training with professional activities.

It should be noted that according to the index of development of digital technologies (IDI), the Russian Federation ranks only 45th in the world, while the sub-index of practical skills in the use of IDI Russia is on the 13th place, while the level of access to IDI and the use of IDI is 45 and 50 respectively, which indicates a low level of development of digital infrastructure, but a sufficiently high potential of specialists using these technologies. At the same time, according to the global cyber security index, Russia is on the 10th place (1st is Singapore, 2nd is the USA, 3rd is Malaysia). According to the international index of digital economy and society in 2016, the Russian Federation was on the 12th place [11].

The aim of the study: to identify trends, prospects and limitations in personnel training for agriculture in the conditions of digital transformation of the Russian economy.

2. LITERATURE REVIEW

The introduction of digital technologies is a current global trend, as evidenced by the results of a review of publications conducted on the Scopus database. In total, 176.8 thousand documents are determined for the search query “Digital Technologies” for December 2018, which are presented in such areas as “Engineering” (89.8 thousand documents), “Informatics” (68.4 thousand documents), “Social Sciences” (25.4 thousand documents).

It should be noted that the top 10 most widely represented areas of scientific knowledge does not include the area of “Agriculture”. At the request of “Digital technologies in agricultural production” in the information system only 250 publications were presented, which are classified as the following areas of scientific knowledge: “Agricultural and Biological Sciences” - 121 publications, “Engineering Sciences” - 114 publications, “Informatics” - 44 publications, “Environmental Sciences” - 33 publications, “Social Sciences” - 23 publications. It should be mentioned also, that 1 publication may refer to 2 or more branches of scientific knowledge. Thus, we can say that large-scale digitalization of technological processes in agriculture is yet to be achieved. And today it is important to take a leading position in this industry, taking into account the increasing role of food security of countries and regions, as well as global trends in the digital economy.

The review of publications on request “Digital technologies in agricultural production” presents research works covering different levels of the economy: from the introduction of digitalization of production processes in small and medium-sized enterprises to the regional level or level of the whole country.

In the article “Creation of an Information System is A Necessary Condition of Rational Organization of Agricultural Production”, the authors Altukhov, A. I., Bogoviz, A. V., Kuznetsov, I. M. analyze the problem field of insufficient activity of the introduction of digital technologies in Russian agriculture. Among the key factors the following are mentioned: the lack of systematization in the Informatization of agricultural processes, low level of automation of operational management, the unavailability of managers and specialists to implement and work in the conditions of Informatization of technological processes. The authors propose a single three-level automated information management system in agricultural production as a possible option for the promotion of digital technologies in the management of production processes [2]. The ideas of information support for process control in the industry are also presented in the publications of many other authors [6, 7, 12, 21, 22].

The issues of introduction of digital technologies in agricultural production are relevant not only for Russia, which is confirmed by the results of studies in other countries. In their publication “IoT Architecture Based on Wireless Sensor Network Applied to Agricultural Monitoring: A Case of Study of Cacao Crops in Ecuador” Guillermo J.C., García-Cedeño A., Rivas-Lalaleo D., Huerta M., Clotet R. introduce the system of automated monitoring of crops on the example of

cocoa. The monitoring architecture proposed by the authors allows small and medium-sized agricultural producers to track and store information on various climatic and soil factors that affect the optimal growth and production of cocoa using a multiplatform application. Data visualization is carried out with the help of interactive maps, tables and statistical graphs, with notification of specific events important for timely decision-making. Thus, sustainable development of agricultural crops is achieved through proper management of resources, promotion of product quality control and development of preventive plans for the timely protection of plants from pests and diseases [9]. Development of digitalization of technological processes in crop production is presented in a large part of publications devoted to informatization of cultivation of various crops and soil conditions of growth [3, 14, 15, 16].

Monitoring systems based on the latest conceptual model of the Internet of Things and fuzzy control theory are also presented in the works “Field microclimate monitoring system based on wireless sensor network” [26], “Improvement of Defects in Soil Moisture Monitoring of Wireless Sensor Network by Mobile Sensor Platform” [4], and others [5, 13, 17, 20]

The introduction of new information technologies is important not only to ensure more efficient operation of agricultural producers, but also for the state administration of the agricultural sector. This is evidenced, for example, by the results of studies of land resources of Egypt, presented in the work GadA. “A Synopsis on Egypt’s Digital Land Resources Database Serving Agricultural Development Plans”. The paper describes a digital information platform, which digitally reflects land resources in the basin of the Egyptian Nile, the Northern coast and desert oases. The use of digital technologies has allowed to establish a number of facts important for planning the future sustainable development of territories:

- 45% of the Nile delta and 15.5% of the valley are characterized by high productivity;
- the development of urban areas is often due to fertile soils;
- the imbalance between the lengths of irrigation and drainage networks in some areas relates to its impact on accelerating land degradation, waterlogging and salinization [8].

The creation of an accurate database with extensive integration capabilities makes the developed information platform an important tool for decision-making support and management of sustainable development plans [7, 18, 21, 22].

Among the publications covering the process of digitalization of agriculture, the works related to interactive monitoring of soils and plants, diagnostics of machines and mechanisms are presented [2, 19, 23, 26].

In general, it can be concluded that the publications are devoted to information and analytical support of the administrative decision-making process regarding certain technological processes in agriculture, which indicates the need to prepare managers and specialists to work in a digital agriculture and confirms the relevance of the study.

3. METHODOLOGY

In October 2018, Stavropol State Agrarian University conducted an expert survey of top management of 54 agricultural universities in the country to determine the prospects for the development of digital agriculture and personnel training for the agricultural sector of the regions.

4. RESULTS

The survey participants expressed their opinion on the training of personnel in the Russian Federation on advanced digital, intelligent manufacturing technologies. Half of the expert survey participants believe that the system of training for digital agriculture requires significant changes (53.8% of the survey participants). About a third of respondents believe that the existing system is quite capable of training personnel for agriculture in the digital economy (28.8% of respondents). According to 3.8% of respondents today it is impossible to accurately assess how the standards of the digital economy will affect the training of personnel for agriculture and 9.6% of respondents found it difficult to give a definite answer.

Currently, agricultural universities have the opportunity to use modern technical systems that support the introduction of digital technologies: broadband Internet (78.4% of survey participants noted); cloud services (56.9% of survey participants noted); RFID technologies (27.5% of survey participants noted); ERP systems (21.6% of survey participants noted). В рамках исследования респонденты из числа топ-менеджмента аграрных вузов высказали свое мнение относительно основных трудностей в подготовке кадров для цифрового сельского хозяйства.

A 10-point scale was used to assess the significance of the problem. The data is shown in the figure.

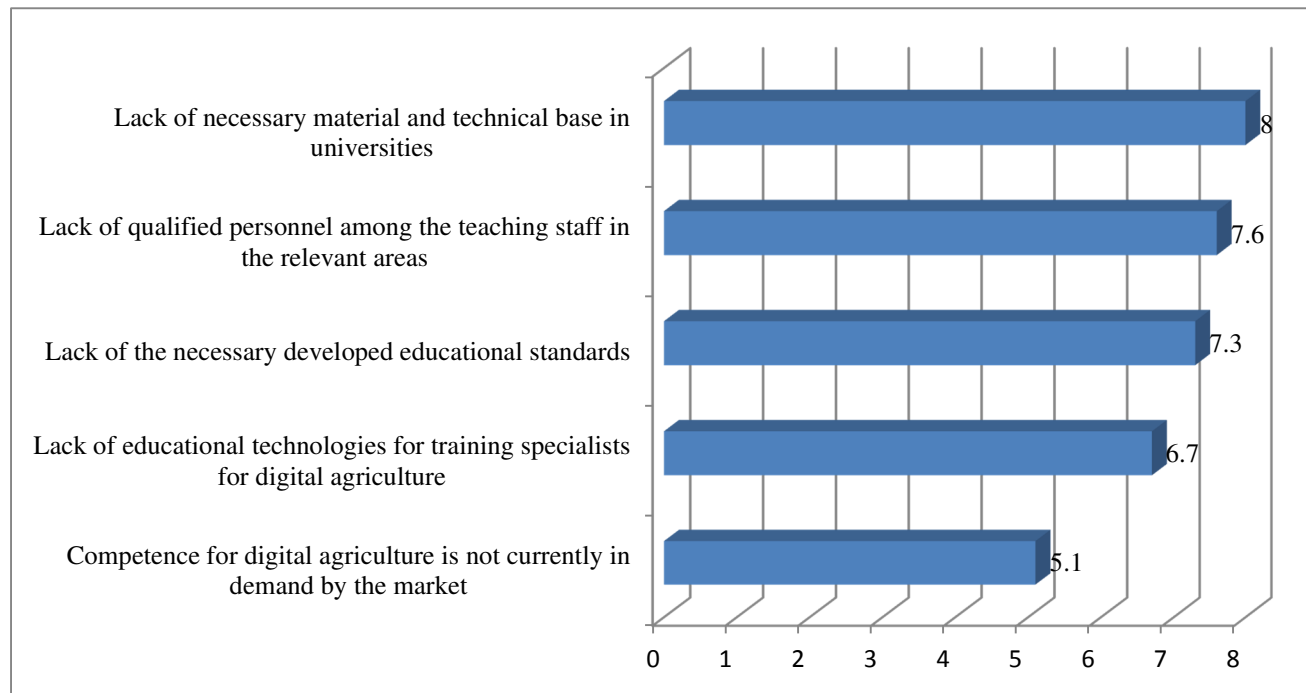


Figure 1. Importance of problems in training for digital agriculture (average score on a ten-point scale)

Ranking of answers on the degree of importance of the problems showed that the first place expert community puts the lack of the necessary material and technical base in universities (8.0 points on a ten-point scale); in second place—the lack of qualified personnel among the teaching staff in the relevant areas (7.6 points on a ten-point scale); the third place – the lack of the necessary developed educational standards (7.3 points on a ten-point scale). In fourth place in importance, the survey participants put the problem of the lack of educational technologies for training specialists for digital agriculture (6.7 points on a ten-point scale). And the last place in the degree of importance of the survey participants was put the following problem—competence for digital agriculture is not currently in demand by the market, which indicates the

unavailability of the labor market to create a request that is relevant in 5-10 years based on the vectors of scientific and technological progress.

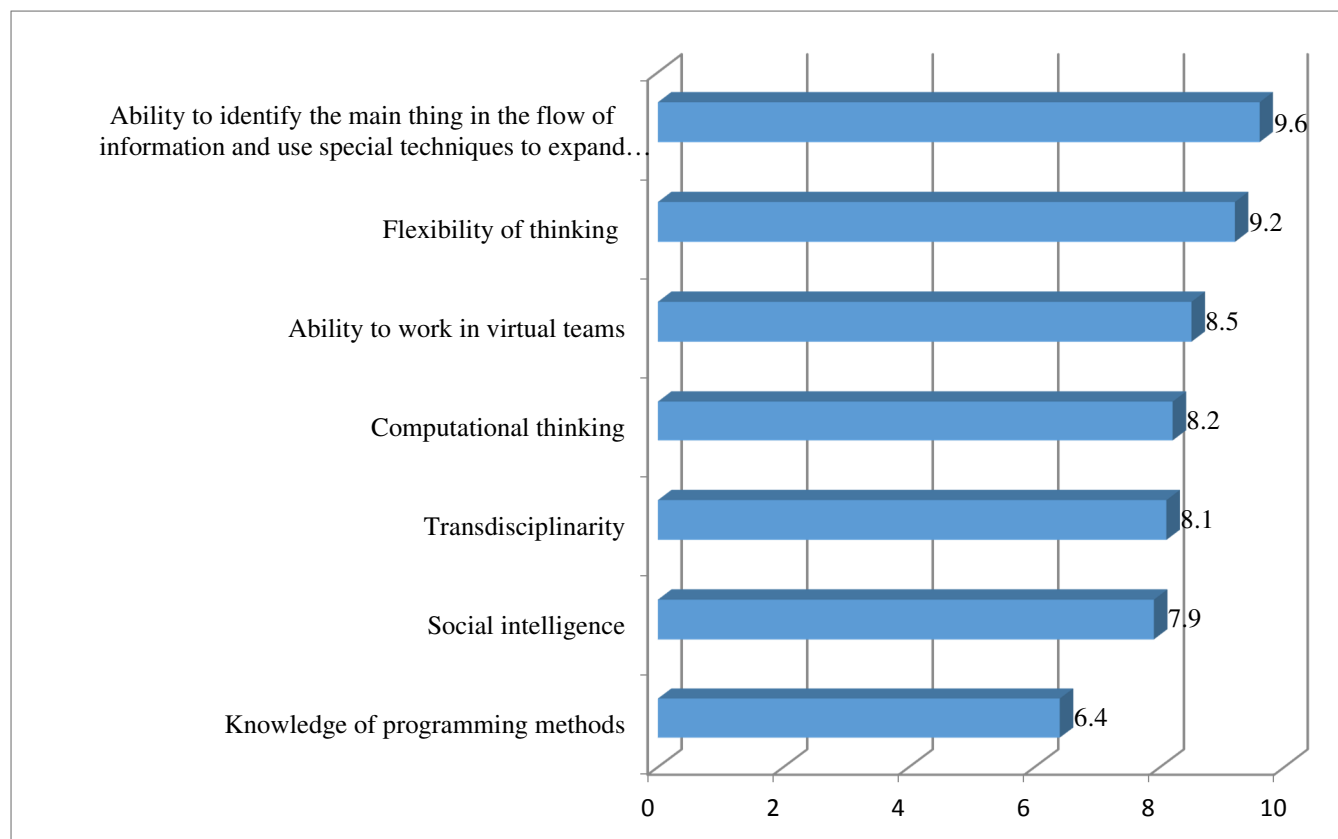


Figure 2. Ranking of competencies required by specialists of the agricultural sector in the terms of digital transformation of the economy (average score on a ten-point scale)

The ranking of competencies necessary for successful work in the terms of digital transformation of the economy showed that in the first place the survey participants put such competencies as the ability to identify the main thing in the flow of information and use special techniques to expand their mental capabilities, flexibility of thinking and the ability to work in virtual teams.

According to experts from among the top management of agricultural universities in Russia, not all sectors of agriculture have the same opportunities for digital transformation, i.e. there are objective features of digitalization of production processes due to the complexity of their formalization, multifactorial conditionality of the result, a high level of uncertainty and dependence on uncontrollable or poorly controlled factors – climatic, biological, socio-psychological, etc.

The most extensive possibilities of digitalization of production processes in the field of Economics and Accounting (9.6 points on a ten-point scale); Electrification of agriculture (8.8 points on a ten-point scale); Mechanization of agriculture (8.7 points on a ten-point scale). According to the survey participants, the possibility of introducing digital technologies is less in Agronomy (8.2 points on a ten-point scale) and in the Processing of Agricultural Products (7.8 points on a ten-point scale). And the lowest opportunities – in Veterinary Science (6.6 points on a ten-point scale).

Ranking the importance of the digital economy, which is most in demand for the training of specialists for agriculture, shows that the first place is “Automation and control systems”

(8.8 points on a ten-point scale) –the activities of these employees is a key and system-forming in the digitization of production processes and gives focus to all actions of departments and employees. In the second place – “Information resources” (8.1 points on a ten-point scale) – the prevailing need for personnel training in this particular area of training is also determined by the output of the functional of employees to ensure the processes for the entire enterprise-information systems and knowledge bases.

Further, the ranking of the importance of the digital economy, in which the training of specialists for agriculture is most in demand, affects the detailed specifications of operational processes: remote sensing (8.0 points on a ten-point scale); robotics (7.9 points on a ten-point scale); software development (7.6 points on a ten-point scale); telecommunications (6.8 points on a ten-point scale); computer equipment and architecture (6.3 points on a ten-point scale).

To provide training for digital agriculture, it is necessary to overcome the lack of competence of scientific and pedagogical staff of the University in the field of application of advanced digital technologies and, first of all, we are talking about the analysis of big data, the development of mobile applications, the analysis of spatial data, the design of mechanisms and objects of agricultural purposes.

Among the professional digital competencies (Hard skills) in the field of information technology, according to the expert community, the following competencies will be most in demand among specialists in the agricultural sector in the next 3-5 years:

- in planning process -analysis and evaluation of new technologies, products and their properties (70,6% of respondents noted);
- in implementation process – information systems integration (60.8% of respondents noted);
- in operation process - support of information systems users (52.9% of respondents noted);
- in providing process– training and education of users (62.7% of respondents noted);
- in management – optimization of processes (70,6% of respondents noted).

5. DISCUSSION AND CONCLUSIONS

The opinion of the expert community from among the top management of 54 agrarian universities of Russia on the current state of personnel training for digital agriculture has no pronounced main trend: half of the participants of the expert survey believe that the system of training for digital agriculture requires significant changes (53.8% of the survey participants); about a third of respondents believe that the existing system is quite capable of training personnel for agriculture in the terms of digital economy (28.8% of respondents); the remaining 17.4% of respondents found it difficult to give a certain assessment.

The widespread introduction of digital technologies sets the task for universities to train personnel with competencies that are not currently reflected in the current Federal Educational Standards for such directions of training as: “Agriculture, Forestry and Fish Industry”, “Industrial Ecology and Biotechnology, Earth Sciences”, “Electric Power and Heat Power Engineering”, “Veterinary Science and Zootechnics”.

The ranking of competencies necessary for successful work in terms of digital transformation of the economy showed that the experts put such competencies as the ability to identify the main thing in the flow of information and use special techniques to expand their mental capabilities, flexibility of thinking and the ability to work in virtual teams in the first place.

Among the professional digital competencies (Hard skills) in the field of information technology, according to the expert community, the following competencies will be most in demand among specialists in the agricultural sector in the next 3-5 years: analysis and evaluation of new technologies, products and their properties (noted by 70.6% of respondents); information systems integration (noted by 60.8% of respondents); support for users of information systems (noted by 52.9% of respondents); users' training (noted by 62.7% of respondents); optimization of processes (noted by 70.6% of respondents).

Based on the possibilities of introducing digital technologies in the production process of agriculture, the survey participants believe that the greatest opportunities for digitalization are presented in such areas as Economics and Accounting, Electrification of agriculture, Mechanization of agriculture.

The most significant problems in the training of personnel for the digital economy are the lack of educational technologies for training specialists for digital agriculture; the lack of the necessary material and technical base in universities.

The study showed on the one hand the disunity of respondents' opinions on certain aspects of the use of digital technologies, on the other hand a great interest in the issue under study. It should be noted that the digital transformation of the economy has exacerbated the problem of staffing agriculture and other sectors of the economy. The results of the survey allow us to formulate a number of important determinants, regularities and problems, the leveling of which should be a priority of state policy in the training of personnel for the digital economy:

1. It should be taken into account that already at the stage of training, in practice students will face a large amount of all kinds of data, so "the ability to identify the main thing in the flow of information and use special techniques to expand their mental capabilities" respondents consider one of the most important competencies. Thus, educational standards should ensure the acquisition of skills in working with big data and knowledge of management decision-making technologies in an excessive amount of information;

2. To improve the efficiency of personnel training in the conditions of digital transformation of the economy it is necessary to improve the material and technical base of universities, the creation of basic departments in the production, the inclusion of representatives of IT companies and the largest agricultural holdings in the region in the Boards of Trustees of Universities. In addition, according to the respondents, the question of availability of qualified personnel among the teaching staff of Universities in the relevant areas, capable of developing educational technologies for training specialists for digital agriculture on the principles of interdisciplinary training is also important;

3. As industries that are more amenable to digital transformation, respondents identify industries that use the most routine operations and processes. This suggests a lack of in-depth understanding of the processes of digital transformation of the economy, in which the introduction of digital technologies takes place in more technological areas related to the production of products and require the use of robotic systems.

4. In order to develop an interdisciplinary and practice-oriented approach to training, it is also advisable to include in the Boards of Trustees of Universities and technical schools specializing in training for the digital economy, senior management of large IT companies, as well as leading industrial and agricultural enterprises in the region.

5. The development of new, previously not in demand competencies is a difficult process to identify, in this regard, it is necessary to form the methodological councils of Universities together with the management of industry enterprises list of relevant competencies to make changes in the training program of students in accordance with the modern needs of

enterprises. In addition, it is necessary to conduct an annual monitoring of the needs of the regional economy in industry professionals with digital technologies and skills.

6. In order to attract high-class specialists to agriculture, it is necessary to improve the image of work in rural areas and format the attitude to agriculture on the part of the population as a non-technological sector of the economy.

7. In the region it is necessary to develop digital infrastructure, increase the availability of digital technologies for the population, to level the digital inequality between urban and rural settlements, to develop information and telecommunications infrastructure for high-speed transmission of large amounts of data, to take measures to improve the protection of the individual, society and the state from internal and external information threats, to significantly increase the budget places for higher education programs related to ICT. To do this, it is necessary to increase domestic spending on the development of the digital economy at the expense of all sources.

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