

About training of personnel for digital agriculture

Vladimir Trukhachev
 Department of Animal Feeding
 and General Biology
 Stavropol State Agrarian University
 Stavropol, Russia
rector@stgau.ru

Aslan Apazhev
 Department of Technical
 Mechanics and Physics
 Kabardino-Balkarian State Agricultural
 University named after V.M. Kokov
 Nalchik, Russia
apazhev.aslan@mail.ru

Abstract — The article reveals essential issues of personnel training for digital agriculture. The results of the expert survey of 54 agricultural universities top management of the country, devoted to issues of personnel training for digital economy, have been described. As a result of the study, the ranking of competencies required by the specialists of the agricultural sector in the digital transformation of the economy has been made; the project of competencies for the formation of pass-through digital literacy has been developed; the systemic contradictions and problems of personnel training in the conditions of digital transformation of the economy in general and agriculture in particular have been identified, grading of which will allow to increase digital literacy in the agricultural sector. The main obstacles for the development of personnel training system for digital agriculture have been highlighted: digital inequality between rural and urban population; insufficient development of the agrarian universities facilities; fragmentary formation of digital competencies; requiring a transition to the comprehensive education of these skills through the improvement of educational programs at the level of secondary vocational education, undergraduate, graduate and postgraduate studies; different speed of requirements change for the competencies of modern specialists and for educational programs updating; lack of effective technologies to form interdisciplinary competencies and skills in the educational system; insufficient flexibility of the existing system of personnel training in the agricultural sector of the economy due to the lack of practice in the formation of short “digital” competencies in the online education system.

Keywords—*digital economy, agriculture, personnel training, digital literacy, digital inequality*

I. INTRODUCTION

Information technologies and the digitization of economic processes have significantly changed the approaches to transformations in traditional sectors of the economy, and have affected the consumption structure. There are new methods in analytics, forecasting and making management decisions. Obviously, the proliferation of digital technologies in one degree or another will affect the functioning of all subjects of market relations. In addition, as a result of the digital transformation of the economy, new markets will appear, most of which will have a networked nature, with an enhanced focus on the individual as an end user.

In the conditions of large-scale distribution of digital technologies, development of information infrastructure, increasing requirements for a minimum set of digital competencies for workers in most sectors of the economic

activity and sectors of the economy, personnel training is becoming an increasingly important task. [1]

II. RESEARCH METHODOLOGY

In order to identify major trends, prospects and limitations of HR training system for digital agriculture, in September 2018 Stavropol State Agrarian University scientists and specialists have conducted an expert survey of top management of 54 agricultural universities of Russia. As a result it was found that half of the respondents noted the necessity of a significant change in the system of HR training for digital agriculture (53.8%), one third believed that the existing system is fully capable of training personnel in the digital economy (28.8%), in the opinion of 3.8% of experts, it is currently impossible to correctly assess the way digital economy standards will affect HR training and 9.6% found it difficult to give a definite answer.

III. RESEARCH RESULTS

The Decree of the President of the Russian Federation (No. 204 of 07/05/2018) singled out a separate field “Digital Economy” which specifies [2] creation of pass-through digital technologies mainly based on domestic developments, ensuring the training of highly qualified personnel for the digital economy, transformation of priority sectors of economy, including education and agriculture through the introduction of digital technologies and platform solutions.

Digital technology is a dynamic and rapidly growing field in which the emergence, obsolescence and change of technology occur extremely quickly. But the process of formation of educational standards is not so dynamic and often lags behind the constantly changing demands of the economy.

Transition to the objectives of the new technological structure, which is associated with the spread of digital technologies, requires the solution of a whole range of problems in training specialists: eliminating the digital inequality of the population in the regions (especially in rural areas) and increasing the availability of digital technologies; emergence of new professions implies constant adaptation of training programs to specific requirements and peculiarities of vocational education in agrotechnological, agricultural, biotechnological and other areas of industry specificity; the link between the education system and the use of digital technology is required – permanent and multilateral monitoring of labor market requirements and the subsequent development of relevant competences of students in

educational institutions; the system of education needs more flexibility and adaptability – introduction of online learning.

According to the index of digital technology development (ICT), the Russian Federation occupies only 45th place in the world, agriculture accounts for no more than 0.5%, while in terms of the subindex of practical skills in the use of ICT Russia ranks 13th, in terms of accessibility to ICT and its use – 45 and 50, respectively, with a high potential of specialists using these technologies (Table 1).

According to the Global Cybersecurity Index, Russia is in 10th place (1 - Singapore, 2 - United States, 3 - Malaysia). In the ranking of the International Digital Economy and Society Index the Russian Federation ranked 12th in 2016. [1] The International Digital Economy and Society Index (I-DESI) is calculated by the European Commission Directorate General for Communications Networks, Content and Technology for non-EU countries, in accordance with the Digital Economy and Society Index (DESI) methodology.

By 2024 it is planned that 20% of workplaces in agriculture will be directly related to digital technologies, the share of coverage by various communication technologies for agricultural lands will be 70%, 10% of workplaces will be equipped with information technologies [3].

Nowadays, agricultural universities are capable of using modern technical systems that support the implementation of

digital technologies: broadband Internet (noted by 78.4% of survey participants); Cloud services (56.9%); RFID technology (27.5%); ERP systems (21.6%).

As part of the survey, respondents from the top management of agricultural universities expressed their opinion about the main difficulties in HR training for digital agriculture. The degree of significance of the problem was assessed on a 10-point scale. The ranking of answers showed that the top three places are taken by: lack of material and technical base in universities (8.0 points); lack of qualified personnel among the teaching staff in the relevant areas (7.6); the need for educational standards (7.3).

The key competencies necessary for successful work in the economy's digital transformation include: the ability to highlight the most important things in the information flow and use of special techniques for mental ability expansion, flexible thinking and ability to work in virtual teams..

According to experts, not all agricultural production related business processes are in the same digital transformation conditions. There are objective features of digitalization of production processes existing due to complexity of their formalization, multifactor result conditioning, high level of uncertainty and dependency on uncontrollable or lightly controllable factors - climatic, biological, socio-psychological, etc.

TABLE I. RANKING OF COUNTRIES BY THE INDEX OF DEVELOPMENT OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN 2017

	ICT Development Index		Including subindexes					
			Access sub-index		Use sub-index		Skills sub-index	
	Rank (change from 2016)	Value						
Iceland	1(+)	898	2 (0)	9.38	5 (0)	8.70	9 (+11)	8.75
The Republic of Korea	2(-)	885	7 (0)	8.85	4 (0)	8.71	2 (+1)	9.15
Switzerland	3(+)	874	8 (0)	8.85	2 (+1)	8.88	31 (0)	8.21
Denmark	4(-)	871	14 (0)	8.39	1 (0)	8.94	6 (0)	8.87
Great Britain	5(0)	865	4 (0)	9.15	7 (+1)	8.38	33 (-4)	8.17
Hong Kong (China)	6(0)	861	3 (0)	9.22	10 (+4)	8.21	32 (+1)	8.19
The Netherlands	7(+3)	849	10 (0)	8.65	9 (0)	8.28	14 (-2)	8.59
Norway	8(-)	847	27 (-1)	8.00	3 (-1)	8.82	11 (-2)	8.71
Luxemburg	9(0)	847	1 (0)	9.54	8 (-1)	8.30	74 (-3)	6.65
Japan	10(+)	843	9 (0)	8.80	11 (-1)	8.15	30 (+5)	8.22
Czech Republic	43(-)	7.16	55 (0)	7.14	39 (-4)	6.62	28 (-1)	8.27
Portugal	44(0)	7.13	31 (+3)	7.91	50 (+4)	6.15	53 (-6)	7.50
Russia	45(-2)	7.07	50 (+4)	7.23	51 (-4)	6.13	13 (+1)	8.62
Slovakia	46(+)	7.06	51 (-1)	7.22	36 (+4)	6.67	50 (-5)	7.54
Italy	47(-)	7.04	47 (+1)	7.33	42 (+1)	6.35	43 (-2)	7.86

The respondents evaluated the possibilities of digitization of production processes in the areas of: Economics and Accounting - 9.6 points; Farm Electrification - 8.8; Farm Mechanization - 8.7, Agronomy - 8.2; processing of Agricultural Products - 7.8; Veterinary Medicine - 6.6 points.

The importance ranking of the Digital Economy areas demanding agriculture HR training the most shows that the top two places are taken by “Automation and Control Systems” (8.8 points), and "Information Resources" (8.1).

The importance ranking of the Digital Economy areas demanding agriculture HR training the most affects the detailed specifications of operational processes: remote sensing (8.0 points); robotics (7.9); software development (7.6); telecommunications (6.8); computer equipment and architecture (6.3 points).

To provide training for digital agriculture, it is necessary to overcome the lack of competence of scientific and pedagogical staff of universities, 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 agricultural objects. [1]

According to the expert community, the number of professional digital competencies (Hard skills) will be most in demand among specialists of the agricultural sector in the next 3-5 years: planning and analysis of new technologies, products and their properties (70.6% of respondents); in implementation – integration of information systems (60.8%); in operation – support for users of information systems (52.9%); in providing – training and education of users (62.7%); in management, optimization process (noted by 70.6% of respondents).

Analysis of existing educational standards for the four integrated groups of specialties and areas of training that define the agricultural profile of agricultural universities (19.00.00 Industrial Ecology and Biotechnology, 21.00.00 Applied Geology, Mining, Oil and Gas and Geodesy, 35.00.00 Agriculture, Forestry and Fisheries, 36.00.00 Veterinary and Zootechnics) revealed that out of 53 educational standards in force at educational levels (secondary vocational education, bachelor, master and postgraduate studies), 10 of the universities had lack of competences in developing digital literacy among students. The remaining 43 contain competencies aimed only at the formation of basic computer programs (the initial stage of digital literacy). We propose a project of competencies aimed at obtaining the most demanded competencies in the modern economy (tab. 2).

TABLE II. DRAFT OF COMPETENCIES FOR BUILDING THROUGH DIGITAL LITERACY

<i>Educational level, program</i>	<i>Digital literacy competencies</i>
The specialists middle managers	<ol style="list-style-type: none"> 1. The use of modern computer equipment and communications. 2. Application of standard and / or specialized information databases
Undergraduate Programs	<ol style="list-style-type: none"> 1. The ability to use the tools of information resources, platforms and technologies that increase production efficiency, contribute to improved control and supervision, ensuring effective management 2. Ability to use the “Internet of things” platforms (cyber-physical systems) 3. Ability to solve typical professional tasks on the basis of standard and / or specialized information databases. 4. Knowledge of technology and technical means for automation, robotization and intelligent agricultural production 5. Ability to execute documentation using specialized databases in professional activities
Pedagogical personnel, postgraduate study	<ol style="list-style-type: none"> 1. Able to conduct information retrieval and apply digital analysis technologies based on information resources tools, platforms and technologies that increase production efficiency, improve control and supervision, ensure management efficiency 2. Based on the analysis of the advantages and disadvantages of the Internet of Things platforms (cyber-physical systems), it is able to choose / form an optimal strategy of functioning within the framework of professional activity
Magistracy	<ol style="list-style-type: none"> 1. Able to carry out operational regulation on the basis of information resources tools, platforms and technologies that increase production efficiency, contribute to improved control and supervision, ensure effective management

<ol style="list-style-type: none"> 2. Able to analyse the advantages and disadvantages based on data from the Internet of Things platforms (cyber-physical systems) 3. Able to perform critical analysis based on standard and / or specialized information databases. 4. Able to develop a system of measures for the development and implementation of technology and technical means for automation, robotization and intellectual support of agricultural production

The positive effect of the presented model is provided by the system of formation of interconnected interrelated skills of possession of digital technologies at all levels of education:

1. A mid-level specialist, first of all, requires possession of basic computer equipment, including standard and / or specialized information databases;
2. Bachelor requires knowledge to use digital technology work functions;
3. Master must manage processes using digital technology;
4. Graduate students need to own information retrieval and apply digital analysis technology in research activities.

A special role in training for digital agriculture should be assigned to the core departments. According to the survey, only 15% of agrarian universities have such departments, and 60% have declared their education is ready. The massive opening of basic departments, which would facilitate the transfer of advanced digital technologies from the corporate sector to the educational environment, is difficult due to objective legislative restrictions. Thus, the presence of requirements for entering into the license addresses of the basic departments, as places of educational activity – a significant barrier to practical training in real production. [4] In 2016, a draft law was introduced on amending Federal Law No. 273 “On Education in the Russian Federation” dated December 29, 2012, which allows for educational activities in structural units, including basic departments, without entering addresses into the license. The adoption of this change will contribute to a significant expansion of cooperation with enterprises of the agro-industrial complex and reduce the gap between theoretical and practical training.

IV. CONCLUSIONS AND RESULTS

The study showed, on the one hand, the disunity of the respondents' opinions regarding certain aspects of the application of digital technologies, and on the other, great interest in the issue under study. The survey results provide an opportunity to formulate a number of important determinants, patterns and problems of the development of agrarian education in modern conditions, the leveling of which should be a priority of the state policy in matters of training personnel for the digital economy [5], [6], [7].

1. Educational standards should ensure the acquisition of skills for working with big data and knowledge of management decision-making technologies in the conditions of excessive information.

2. It is necessary to improve the material and technical base of universities, the creation of basic departments in production. The question of the availability of qualified

personnel among the faculty of higher educational institutions in relevant areas capable of developing educational technologies for training specialists for digital agriculture on the principles of interdisciplinary training is relevant.

3. An important contradiction has been revealed, according to which industries have been noted that are more amenable to digital transformation and use the most routine operations and processes. However, most experts point out that the introduction of digital technologies occurs primarily in more technological areas related to the production of products and require the use of robotic systems.

4. In order to develop interdisciplinary and practice-oriented approaches in training, it is also advisable to include in the boards of trustees of universities and colleges specializing in training personnel for the digital economy senior management personnel of large IT companies, as well as leading industrial and agricultural enterprises in the region.

5. It is necessary to form the methodological councils of universities, together with the leadership of industry enterprises, a list of relevant competences to make changes in the curriculum for students in accordance with the modern needs of enterprises. In addition, annual monitoring of the needs of the regional economy in industry professionals with digital technologies and skills should be conducted.

V. THE DISCUSSION OF THE RESULTS

The study identified the main problems of the training system, the leveling of which will improve digital literacy in the agricultural sector.

The most promising areas of the personnel system improving are the following:

improving the image of labor activity in rural areas, positioning this sector of the economy as a high-tech and knowledge-intensive, which it will become in the coming years, which will attract professionals to the industry;

development of digital infrastructure to reduce digital inequality between urban and rural population, systematic

measures to improve the protection of the individual, society and the state from internal and external information threats;

increase in budget places for higher education programs related to information and communication technologies;

development of additional education (costs in economically developed countries are comparable to the costs of higher education) by creating a Federal center for advanced training of scientific and pedagogical workers of agricultural universities in the field of digital technologies in agriculture;

development of the system of students and teaching staff self-education on open Internet platforms. Orientation of educational technology for a "short" competencies in terms of when digital technology is evolving at a more rapid rate than they come to the universities.

REFERENCES

- [1] Indicators of the digital economy: 2018: collected statistics / G.I. Abdrakhmanova, K.O. Vishnevsky, G.L. Volkova, L.M. Hochberg et al.; National research university "Higher School of Economics", Moscow: HSE, 2018.
- [2] G.G. Kozlova, "The role of higher education in the development of the digital economy", *International Journal of Humanities and Natural Sciences*, № 2, p. 63-65, 2018.
- [3] N.A. Kulagina, E.M. Kozlova, "The basis for assessing the innovative potential of an economic entity in the context of modern realities", *Transport of Russia*, № 6, p. 19-20, 2013.
- [4] I.B. Manzhosova, *Modernization of agriculture in the digital economy: problem analysis and search for solutions*, Stavropol: Sequoia, 2018.
- [5] The program "Digital Economy of the Russian Federation" approved by decree of the Government of the Russian Federation No. 1632-p dated July 28, 2017. Access from the Consultant Plus reference and legal system (accessed: 12.12.2018).
- [6] Russian Federation. Laws. On education in the Russian Federation: Federal Law of December 29, 2012 No. 273-FZ (as amended on August 3, 2018). Access from the Consultant Plus reference and legal system (accessed: 12.12.2018).
- [7] Presidential Decree of 07.05.2018 No. 204 (as amended 07.19.2018) "On the national goals and strategic objectives of the development of the Russian Federation for the period up to 2024". Access from the Consultant Plus legal reference system (accessed: 12.12.2018).