ANALYSIS OF MODERN TRENDS IN AGRICULTURAL EDUCATION

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Abstract

The paper addresses the issue of transformation of agricultural education under the impact of the main trends caused by digitalization, such as Lifelong Learning, lifelong education based on a practice-oriented approach, organically related to online education. Rapid modernization of agro-industrial technologies requires flexibility, multifunctionality and continuity, freedom of choice of "learning path", a combination of formal and non-formal education. The authors conducted a comparative analysis of the experience of various agricultural universities in Russia in terms of these trends and explored the prospects for implementation of foreign experience. It was reported that the experience of foreign countries helps Russian universities implement the main approaches. Based on the analysis of the results of monitoring indicators and sociological surveys conducted by different universities and organizations, the authors considered the problems of training digital personnel at agricultural universities. Development of new digital areas of training at agricultural universities is underway, which will require further transformation of formal education in different areas. Online education in various forms plays a crucial role in this process, one of which is online courses. The paper presents the results of the analysis of online courses, which revealed their deficiency in agriculture related disciplines. This is not only a challenge, but also an opportunity for regional experts, teachers and practitioners, to create their own courses. The competent integration of online courses into the educational process at different levels of training will allow, together with the development of professional competencies, mastering of digital competencies.

1. Introduction

Digitalization determines trends in the labor market, sets new trends, and triggers the emergence of creative professions. (Skosyreva et al., 2020) The transition to mass transformation is hindered not only by the digital gap, but to a greater extent by the lack of qualified personnel capable of forming the architecture of the digital ecosystem of the agro-industrial complex. (Shumakova et al., 2021)

Rapid development and renewal of technologies, digital transformation, transition to APK 4.0, uncontrolled flows of new information impose flexibility and continuity of the education system and require lifelong professional development and retraining of the graduate, as well as extended education and interdisciplinary knowledge throughout his life.

According to the Moscow School of Management Skolkovo and the Agency for Strategic Initiatives, six new professions related to agricultural production are expected to appear by 2030: agronomist-economist; agricultural ecologist; operator of automated agricultural systems, machines, mechanisms and devices; city farmer; GMO agronomist; agriculture computer specialist/cybernetic specialist (Atlas of new professions. Agriculture, 2021).

However, according to the Institute of Agrarian Research of the Higher School of Economics (Orlova et al., 2021), agricultural universities are less prepared for new realities of the modern economy due to the most conservative and inflexible educational systems. Graduates from Russian agricultural universities are multi-skilled, while those from the world agricultural universities are narrowly focused specialties. The results of this study indicate the lack of qualified narrow specialists in the Russian agro-industrial complex, a low prestige of agricultural education, the lack of applicants, and a low level of graduates working in this industry.

2. Problem Statement

Digitalization in such a traditional industry as the agro-industrial complex primarily depends on workers who apply new technologies. Thus, it is human capital that is the main factor affecting digitalization. At present, this is the key and most basic factor inhibiting innovation in agriculture in our country (Levina, 2019). Moreover, the lack of qualified personnel is observed not in new specialties, for which not all employers are ready, but in quite traditional ones. In addition, large companies need highly qualified specialists with a wider range of competencies, including digital ones. To date, the lack of personnel is evident in the agro-industrial complex, especially of those with digital competencies. Thus, training of specialists requires new approaches in education, with regard to modern trends and requirements imposed by employers (Kosenchuk et al., 2021).

3. Research Questions

The object of the study is the impact of the main trends on agricultural education in general, their manifestations in the practice of universities, both Russian and foreign, as well as in expanding opportunities for young people in the agricultural sector.

4.   Purpose of the Study

The purpose of the study is to analyze the impact of the main trends caused by digitalization on the structure, technologies, and formats of agricultural education, which in turn contribute to self-determination of young people and increase their motivation to work in the agricultural sector.

5.   Research Methods

A systematic and interdisciplinary approach was employed in the study. The empirical study was carried out through the content analysis, analysis of monitoring indicators, as well as the results of questionnaires conducted by different universities and organizations.

6.   Findings

6.1. Main modern trends in agricultural education

Among the current trends in education, Lifelong Learning is the main one, which is due to the need to follow rapid changes in the economy of the whole world and in the agricultural sector.

Lifelong Learning is primarily associated with digitalization of the economy, formation of a new stage of agricultural technologies called AgroTech 4.0, which dictates the need to acquire and constantly update digital competencies as the main factor in the competitiveness of a young specialist in the future labor market. Agriculture should become more attractive for highly qualified specialists with digital skills that occupy new professions and gain new knowledge in the field of robotics, bioinformatics, bio- and nanotechnology, "smart" solutions. A new flexible model of agricultural education should ensure the continuous formation of digital competencies and provide an opportunity for not only acquiring new professions, but also professional retraining and additional education throughout life.

Young people, as the most mobile part of the population, accept everything new. According to the survey conducted by the Department of Political Science and Mass Communications at the Financial University under the Government of the Russian Federation (Professionalization of Youth in the Digital Environment, 2018), the majority of respondents, 87% out of 1,500 respondents (aged 15 to 24), agree that a person should have many professions; 89% of those surveyed report the ability and desire to learn throughout life as necessary in modern conditions; 68% of respondents believe that a profession should be chosen once and for all.

Lifelong Learning is identified by many authors with lifelong or additional education, including that obtained as a result of retraining. At present, the understanding of lifelong education is expanded due to the increased value of equal opportunities for adaptation to modern challenges, rapid changes in the economy, agro-industrial complex technologies, the surrounding reality of both future applicants and students of higher and secondary vocational educational institutions, as well as those who have already received a profession and have work experience.

Modern lifelong learning implies a broader, customer and digitalization oriented spectrum of opportunities and time boundaries. A free "learning path" allows combination of self-development and self-study in independently chosen areas (non-formal education) with training according to the developed

standards under the guidance of teachers (formal education), which sets a multifunctional vector for development of the lifelong education model. In addition, the time frame for lifelong learning encompasses a wider period from the first understanding of the profession in elementary secondary school and professional self-determination to the completion of labor self-realization.

In America, the concept of agricultural lifelong education is referred to as "educational conveyor" and includes a whole range of programs. SPECA (for high schools and colleges) and HEC (for universities), which cover all levels of education from elementary school to master's degree. In addition, there are programs aimed at the development of agricultural education in secondary schools to identify and support gifted and talented youth, and create conditions for cooperation between private business and educational organizations.

Russian agricultural education is actively adopting foreign experience. In works published in the first decade of the 2000s, successful introduction of multilevel integrated education have been discussed. For example, since 2002 at Belgorod State Agrarian University (Dorofeev, 2007), since 2010 at Orenburg State Agrarian University, later at Omsk State Agrarian University, at Izhevsk State Agrarian University and other agricultural universities, a unique project aimed at developing agricultural classes is being implemented on the basis of universities and their experimental farms. The Ministry of agriculture and the most important agro-industrial enterprises of the region support the project. Classes are conducted for students of grades 10 and 11 from different parts of the region by university teachers and provide in-depth training in subjects significant for the future profession, namely, the basics of robotics, business planning, Internet entrepreneurship (Shumakova & Mozzherina, 2018). Under the scientific guidance of teachers, students take part in conferences, competitions, projects, career guidance tests, attend master classes, get acquainted with agricultural enterprises, laboratories and basic farms of the university, where practical classes are conducted in agricultural classes and even free internships are possible. In some regions of Russia, for example, in Nizhny Novgorod and Omsk regions, the cooperation between agricultural colleges and rural schools and agricultural universities is being implemented. In this case, students have the opportunity to acquire working professions at school, which implies acquisition of in-depth theoretical knowledge and practical skills, and then they can continue training at the agricultural college and university.

A practice-oriented approach is an integral part of the system of lifelong agricultural education (Ob'edkova & Opeykina, 2018). Unfortunately, in agricultural education, the material and technical base does not always respond to the demands of the market and employers, thus not allowing sufficient preparation of students for practical activities. The need to modernize the material and technical base and replace obsolete technologies is indicated in the Strategy for Development of Agrarian Education until 2030, the main role is assigned to the creation of technopolises and innovation centers that expand the infrastructure of universities (Strategies for the development of agricultural education until 2030, 2020). Underdeveloped and systematic contractual relations of universities with enterprises and organizations, in which students can have industrial and pre-diploma practice, gain invaluable practical experience. The system of grants to bring virtual projects to life is not debugged.

In this case, foreign experience cannot be neglected. In the United States, private universities have no government support and receive funding from specific enterprises. Such universities fully adjust to the needs of enterprises and implement their practice-oriented programs on the basis of these enterprises. State

universities in America have a useful and long-term experience of the most active interaction of theoretical, research activities, experimental and design developments of students and teachers with the real sector of the economy through grant implementation. The experience of leading universities in France, England and the United States proves the importance of project-based learning. To create and implement projects, there are special organizations that train how to start business, take the first steps, and test projects created during studies at universities.

In Russian universities, the emphasis is on the formation of predominantly applied educational programs, project training, project competitions, and cooperation between enterprises in the agricultural sector of the region. Omsk GAU has 54 farms, laboratories and departments in the production sector. Since 2021, a unique all-Russian project "Carbon polygon of Omsk State Agrarian University" has been implemented, which includes a system of agroecological monitoring that implement measures to develop and test methods for controlling the ratio of climatically active gases released during agro-industrial production. As part of the project, partnership is being established between Omsk State Agrarian University and two large agricultural enterprises, which aims to create carbon farms on their balance sheet to implement the methods developed at the test site.

The experience of creating an educational cluster or an agrarian-university complex and a system of additional education for agricultural enterprises in Vologda region is valuable. This is the integration of educational institutions of different levels headed by the university with the business structures of the industry according to the "science–technology–business" scheme (Ob'edkova & Opeikina, 2018).

Experience of Belgorod State Agrarian University in successful cooperation between agricultural enterprises and educational institutions is of interest. The number of basic farms is 68 and it is increasing annually. The electronic atlas of dual (practice-oriented) education developed by the university (Yakhtanigova, 2019) includes basic agricultural enterprises ready to cooperate with the university on the basis of an agreement, located both in Belgorod region and throughout Russia. In addition, the atlas comprises information on the resources of the Agrotekhnopark innovation center, which is part of the university and allows implementation of scientific and practical activities on the basis of its material and technical base. The interactive map of the atlas provides students with the opportunity to independently analyze and choose the place of practice, the topic of the thesis or course project, and receive information about the thesis and course projects defended on the basis of this enterprise.

Thus, modern trends are perceived by the university community and implemented by different universities to a greater or lesser extent despite a large number of constraining factors.

Training of the staff for digital agriculture

Modern trends in agricultural education require specialists with sufficiently developed digital competencies. In turn, these competencies can be developed in young specialists by means of appropriate departments of agricultural universities, educational technologies and qualified teachers, cooperation with developers of information systems and professional suppliers, such as Analytical Technologies LLC, Loginom Company, 1C, and SAS. Digital areas and training profiles appear in many agricultural universities, and digital competencies and new disciplines appear in educational programs. At the initial stage of the formation of digital competencies in the conditions of the electronic information educational environment of the university, services provided by cloud technologies were widely used. Cloud services

allow formation of ICT competency, which is the basis for formation of digital competencies (Stepanova & Vasyukova, 2019).

According to the results of the survey at agricultural enterprises and the expert analysis conducted by Kuban State Agrarian University, 95% of respondents believe that digitalization of agriculture is appropriate for the attraction of new qualified specialists into the industry. At the same time, more than 70% of respondents note the absence of educational technologies and highly qualified teachers in agricultural universities for training these specialist (Digital Transformation of Agriculture in Russia, 2019). According to the results of the survey at Omsk State Agrarian University, many students realize that their competencies are insufficient to work in high-tech companies and are inclined to continue their education. They do not yet have a sufficient understanding of professions associated with digitalization of the agro-industrial complex (Avlasovich & Vasyukova, 2021)

Non-agricultural technical universities are training IT and other in-demand specialists with digital competencies, such as Moscow Institute of Physics and Technology, Moscow State Technical University named after N. Bauman, Moscow State University named after M.V. Lomonosov, National Research University of Information Technologies, Mechanics and Optics, Novosibirsk State University, Research University 'Higher School of Economics', Kazan Federal University, Mytishchi Branch of Moscow State Technical University named after N.E. Bauman, Omsk State Technical University, SibADI, Omsk State University, and many others.

The list of agricultural universities that offer training programs for digital agriculture is much shorter. The leader is Russian State Agrarian University of Moscow Agricultural Academy named after K.A. Timiryazev, who has several graduate and bachelor's degree programs, which provide training for specialists in the field of information and digital technologies of the agricultural sector, data analysis, applied mathematics, computer systems and networks, education informatization, business analytics, logistics, etc. Perm State Agrarian and Technological University offers programs in the field of software and information systems, applied mathematics in economics, information systems and technologies. Digital profiles have appeared in Omsk State Agrarian University, a new program "Information systems and technologies" is offered for the bachelor's and master's degrees. In addition, formation of digital competencies is introduced into various agricultural programs.

Analysis of the employment of graduates revealed a high demand on the labor market for agricultural specialists with digital skills and high-level competencies. With regard to the above difficulties faced by agricultural universities in the formation of digital competencies in graduates from 2020, the federal project "Personnel for Digital Economy" is being implemented within the framework of the national program "Digital Economy of the Russian Federation", which provides an opportunity for educational organizations to provide training of highly qualified specialists capable of working in the conditions of production digitalization.

Graduates in agricultural specialties/areas can be involved in the following projects: Digital Professions, Ready for Digital, CDO. The "Digital Professions" project implies professional retraining using 24 educational programs. Students can get additional IT education for half the cost. Training is implemented by educational organizations and IT companies. The "Ready for Digital" project is an aggregator of services for testing the level of digital literacy and training safe and effective work with digital

technologies. The project aims to assess the level of digital literacy, learn about the possibilities of the online environment, and form the necessary IT skills. The "CDO" project is an educational program that allows acquiring new digital competencies.

The leader of the project is the Innopolis University, which is a support platform for several large-scale federal projects and trains specialists for the digital economy. The most popular programs are those for training management personnel for digital transformation of the economy, date analysts and architects of digital solutions. For the program implementation, the Institute of Lifelong Education of the Innopolis University established the Supporting Educational Center. Training is carried out in different forms: review sessions (2–3 days), adaptation of courses to company requests, online and mixed format. The programs are divided into three blocks: Management, Technology, Development. The main goal of the federal project is to provide training of highly qualified specialists for the digital economy. The target audience is not only graduates, but also representatives of federal and regional authorities responsible for the implementation of the national program "Digital Economy", heads and managers of Russian companies, industry and scientific organizations interested in digital development, as well as representatives of higher educational institutions. More than 50% of teachers from Omsk GAU have already completed training at the Innopolis University under the program "Digital technologies in teaching specialized disciplines". In order to preserve and increase the gained experience, the results of the individual and collective work of students of advanced training courses in digital technologies conducted by the Supporting Educational Center of the Innopolis University were combined into the book "Digital technologies in teaching specialized disciplines". The authors of the book are teachers from universities and organizations of secondary vocational education. Cases and assignments with practical recommendations for the development of digital competencies, assessment tools and examples of students' works provide an opportunity for teachers of specialized disciplines of secondary vocational and higher education organizations to develop digital skills and competencies in students.

Formation of digital competencies in future agricultural specialists requires careful consideration of the specifics of agricultural production. In the context of the development of digital agriculture, special requirements are imposed on workers in the agricultural sector. When training personnel for the agro-industrial complex, it is necessary to use the scientific potential of educational organizations, to introduce courses and programs into the educational process in order to study innovative technologies of digital agricultural production. As a result of implementation of the above measures, the modern industry of the agro-industrial complex will have specialists for successful implementation of the digital transformation of agriculture.

6.2. Development of agricultural online education

A large-scale systemic transformation of traditional educational systems is impossible without an online format, which is widely used in professional activities. Some professions have fully or partially moved online. Thus, regular management practice will include: remote work, on-line recruitment and on-line training (Podcerob, 2020). Over the years of the COVID-19 pandemic, most people have discovered the possibilities of online education as an effective alternative to offline education (Govorova et al., 2021) In this regard, the demand for online education through online courses has increased sharply. According to

the Passport of the priority project "Modern digital educational environment in the Russian Federation", online courses created in the formal education system should be used to implement basic professional educational programs and additional professional education. Online courses created in the non-formal system provide an opportunity for lifelong learning, self-determination and vocational guidance, and identifying talented children. (Passport of the priority project "Modern digital educational environment in the Russian Federation", 2017)

The integration of web-based online courses into the educational process is expanding. The beginning of integration of online courses into the educational process is associated with the launch of the national platform "Open Education" created by the joint efforts of eight leading Russian universities in 2015. The platform currently hosts 762 online courses. The courses are developed by the largest universities, comply with the Federal State Educational Standard of Higher Education, are certified, and therefore, by the decision of the university, can be used as full-time courses.

Agricultural universities, Omsk State Agrarian University in particular, have started using this platform since 2017. Of the three main teaching models that employ network open online courses, agricultural universities prefer using online courses as additional teaching materials to study individual disciplines, which is due to their specificity. This model uses the online course mostly for additional study and consolidation of the material. Independent study of courses requires a high level of self-organization, motivation and a sufficient level of digital literacy, therefore, it can be more effectively implemented at the level of additional professional training. However, despite the large number of courses on the platform, all of them cover basic disciplines, but there are practically no agricultural courses.

In this regard, a digital educational platform "Open agricultural education" was developed on the basis of public-private cooperation. Its main principle is lifelong learning. The platform is a roadmap for digital transformation of the Russian agro-industrial complex in terms of improving additional professional education for the agrarian business.

A systematic study of the needs for additional vocational education services conducted by the All-Russian Institute of Agrarian Problems and Informatics named after V.I. A.A. Nikonov revealed directions for the development of online courses for more frequent business requests and certain issues requiring professional advice from experts (as cited in Ganieva et al., 2020)

Thus, the content of the leading teachers of regional agricultural universities who implement additional vocational education programs and experts – practitioners working in the field of agro-industrial complex – has been developed. The platform will provide a wide range of distance educational services in the agricultural sector for specialists from Russia and Russian-speaking countries.

Online agricultural courses can be found on other non-formal education platforms, for example, "Agricultural Academy. Online education" created on the basis of a social and public project aimed at improving the training of young professionals. It contains 172 free courses in four agricultural areas: rabbit farming, poultry farming, plant growing, beekeeping. They can be used for training in agricultural classes and for secondary vocational education. In addition, for secondary vocational education, a number of courses in agricultural disciplines are offered by the online platform "Yurayt".

The integration of online courses into the educational process enables mastering digital competencies while studying different disciplines. The level of mastering digital competencies can be

gradually increased via the competent integration of online courses through the entire chain of lifelong learning.

Online learning is designed not only to complement learning, but also for students to learn how to use and integrate them. (Kydyrbaeva & Rakhimzhanova, 2021)

7. Conclusion

Analysis of modern trends in agricultural education revealed the most significant trends for digital transformation of the agro-industrial complex, one of which is the formation of a new model of agricultural education. Lifelong multilevel education integrated with the real sector of the economy should be focused on practice and requests of the employer, who is the customer of personnel for the agricultural sector of the economy. It should correspond to the realities of the modern economy and the concept of digitalization and sustainable development of the agro-industrial complex. Thus, the active phase of digitalization of the agricultural sector set new trends in the system of agricultural education. On the one hand, digitalization exacerbates the problems associated with its low rate, on the other hand, it opens up new great opportunities for a single digital contour for universities, employers and students, for cooperation within a single digital educational environment, and for professional self-identification of students. A number of problems can be solved by the competent use of online courses in the educational process at different levels in order to overcome the limitations existing in the traditional education system, to increase the level of formation of the competencies necessary in the digital economy and to promote motivation for further education among students. The increased level of digital literacy of graduates is an urgent task of any educational institution, one of the main requirements of employers, and an important condition for successful digital transformation of agriculture.

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