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ANALYSIS OF THE IMPACT OF DIGITAL TECHNOLOGIES ON THE LEVEL OF DIGITAL SKILLS DEVELOPMENT IN RURAL AREAS OF AZERBAIJAN

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Abstract

Digital technologies have encompassed all spheres of our lives. The application of digital technologies in rural areas is expanding. Mastering these technologies has become more of a requirement than an option. The goal of this work is not only to highlight several activities related to implementing the country's strategy for developing information and communication technologies, increasing the use of digital skills among rural populations, and raising awareness among small and medium-sized agricultural businesses about new technologies. It also aims to investigate gaps between digital skills meeting employer needs and the skills workers actually possess. To achieve this goal, international experiences from various thematic areas related to digital skills were examined. The study employed a general methodology for measuring the effectiveness of digital skills, utilizing statistical analysis tools to assess the digital competency of rural populations and entrepreneurs in comparison to urban areas. This is crucial for Azerbaijan, as the country's small and medium-sized agricultural businesses constitute a significant portion of the national economy. The study conducted variance analysis, allowing the identification of the digital divide and the measurement of digital skills. Recommendations are provided for fostering continuous development of digital skills.

Key words**:** *digital technologies, digital skills, digital divide*

INTRODUCTION

Digitization brings a positive contribution to the country's comprehensive development and integration with other nations. Through international integration, we can come closer to global trends, adapt to them, and implement them with greater flexibility [2]. The main goals of digitizing society primarily involve upgraded skills shaped by the digital transformation process, used in the professional activities of those directly engaged in, or not engaged in, developments in the field of information and communication technologies. The widespread adoption of digital skills across society has influenced the development of research seeking qualitative and quantitative measures to gauge the digital economy and society. Enhancements in information and communication technologies have led to a rapid surge in Internet usage, altering consumer behavior. Internet users acquire specific digital skills while adapting to the innovations in information and communication technologies. The effectiveness of adopting and mastering these skills depends on the level of a country's socioeconomic development. The impact of digital technologies is evident in shaping a country's development strategy and its economic sectors. The degree of information and communication technology development in rural areas varies among developed countries, developing nations, and those with transitioning economies. The scope of discussions concerning the development of digital technologies in relation to rural progress is continuously expanding [9]. The impact of digital technologies on enhancing the productivity of the food system, spanning a wide array of activities, goods, and services linked to agriculture, is evident. Digital technologies provide access to information about markets, finances, employment, and have the potential to ensure efficiency and transparency within production and distribution chains. Based on a literature review, it has been determined that researchers from various disciplines have

shown interest in the causes and consequences of the digital divide between urban and rural areas, employing a binary opposition principle to compare territories in different countries around the world. In this study not only academic scientific research but also governmental documents have been examined in order to obtain current information about the impact of digital technologies on digital skills, digital challenges, and opportunities in rural territories. In the work of Koen Salemink, Dirk Strijker, and Gary Bosworth, the issue of digital inequality between developed countries' urban and rural areas is explored. This is because telecommunication companies are unable to meet the individual needs of rural residents [18].

The focus of this article's research is on the digital opportunities present in rural territories. Pattanapong Tiwasing, Beth Clark, and Menelaos Gkartzios chose the research topic of addressing key issues in rural areas of the United Kingdom concerning the application of digital technologies, the provision of digital services, the hiring and retention of young professionals with digital skills [21]. The author of the present article was intrigued by a similar question about the ability of rural businesses to equally thrive in the digital era in Azerbaijan. Overall, literature in this field suggests that active participation in digitizing rural areas requires affordable mobile broadband connectivity [5], government initiatives to stimulate rural business growth [17;21], creating favorable conditions for entrepreneurs engaged in innovative developments [15], acquiring digital skills [1;10] through enhancing the level of digital education [4] for rural residents. Azerbaijan possesses resources and opportunities for the development of a digital economy. The country's geographical location, its active utilization of digital information and communication technologies, and international collaboration in shaping the information space are among the factors accelerating this process. Given the significant role of digitization in the country's development, this field is considered a priority in all future strategies [22].

The President of the Republic of Azerbaijan has approved "Azerbaijan 2030: National Priorities for Socio-Economic Development" [13], setting the goal of digitizing the economy and society [6] in the country's strategic plan for 2022-2026 [19]. Azerbaijan is currently focused on modernizing digital transformation management [7], leading to the establishment of the Azerbaijani Electronic Agricultural Information System [14] The agricultural sector, a traditional economic domain in Azerbaijan's regions, has entered a qualitatively new stage of development. A significant accomplishment is that our republic has managed to satisfy domestic demand for food products in various important categories solely through local production. Ongoing agricultural reforms envision further rural development, for which the state has implemented extensive support measures. Some of the agricultural reforms implemented in recent years aim at realizing state support for farmers through more transparent mechanisms, minimizing interactions between officials and farmers, thus eliminating negative situations. The Electronic Agricultural Information System (EAIS) has introduced numerous new opportunities for farmers. To leverage these capabilities, farmers must register in the system and create their personal accounts. Notably, farmers have shown significant interest in this new system. Consequently, the registration process of farmers in the new system is almost complete due to this high interest. At present, approximately 410,000 farmers have registered in the Electronic Agricultural Information System and created their personal accounts. Farmers registered in the system can declare the crops they plan to sow for the upcoming year at the end of each year.

Against the backdrop of Azerbaijan's achievements in the digitalization of the country, the goal of this article is to investigate and analyze the acquisition, implementation, and development of digital skills in rural areas based on the utilization of digital technologies.

MATERIALS AND METHODS

To assess the impact and effectiveness of digitalization policy measures, the availability of statistical data holds significant importance in terms of developing medium-term strategies within the framework of the Azerbaijan 2030 development concept. The State Statistical Committee of the Republic of Azerbaijan is currently engaged in digitizing the private sector, including rural territories. The committee collects a very limited set of related indicators, primarily focused on companies' and households' access to the internet. Presently, a range of indicators crucial for successful digital development of the country is being utilized. The Information and Communication Technology (ICT) Development Index is considered a key indicator that characterizes the dynamics of ICT development in countries worldwide. The methodology for calculating this index was proposed by the International Telecommunication Union (ITU). According to the calculation methodology, the IDI index is characterized by a combined representation and synthesis of basic ICT indicators and their comparison over corresponding periods. The advantage of this indicator lies in its ability to compare the level of information and communication technology (ICT) development among countries globally not based on individual indicators, but on the basis of aggregated average indicators. In the first subgroup of the "*access sub-index*", the fundamental indicators include the number of fixed-line telephones per 100 population, the number of mobile cellular subscribers per 100 population, the volume of international communication channels per user, the percentage of households with a computer having internet access. The second indexed group's *"use sub-index"* comprises fundamental coefficients: the number of internet users per 100 individuals in the population, the quantity of fixed broadband internet subscribers per 100 individuals, and the count of mobile broadband internet subscribers per 100 individuals in the population. In the third subgroup of the "*skills sub-index*", fundamental indicators include the adult literacy rate, with the overall ratio of higher and secondary education serving as the basis. Comparing the values of two indicators: computer users and internet users in Azerbaijan, it's possible to determine the trends in their development. As evident from Figure 1, over the past 5 years, the number of computer and internet users has proportionally increased. While taking into account the results of comparing these trends, further investigation can be conducted to determine whether a digital divide exists among social groups or between population categories in the country. For instance, this can be explored when considering the indicator of rural residents' access to active participation in the digital society.

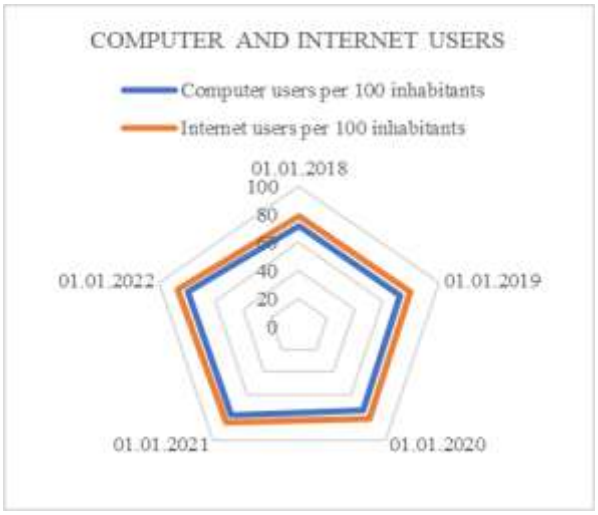


Fig. 1. Computer and internet users per 100 inhabitants
Source: official data of the State Statistics Committee of the Republic of Azerbaijan [20].

The methodological framework for calculating indicators of the digital economy, as mentioned earlier, is based on the synthesis of indexed variables and is in the process of formation. Thanks to the research efforts of scholars worldwide, the calculation methodology is continuously being improved [8].

Researchers contribute to expanding the methodological base by adding both basic and additional indicators that form the aggregated IDI index. Currently, the practical application of skills and the availability of educational programs for developing digital competencies are ahead of the formulation of theoretical methodologies for analyzing the impact of

digital technologies on the daily life of institutional entities. While everyone is being taught how to use skills, there isn't a specific methodology for assessing digital skills and the criteria for such assessment. The necessity of analysis arises from the fact that after 2020, when the embryonic period of the Fourth Industrial Revolution concluded, the information environment changed. Following climate and global changes, humanity entered a new era known as BANI – a world characterized by brittleness, anxiety, nonlinearity, and incomprehensibility [3]. The fragility of the world lies in the global threats to further human development, which significantly influences society's concern over the potential loss of familiar systems that become invisible, lack obvious parameters, and fail to form a logical chain with a defined algorithm. Simultaneously, decisions must be made and a new world built, overcoming challenges in situations of uncertainty and enhancing skills: hard skills, soft skills, self-skills, and digital skills. Currently, the demands on employees in the 'information flow' have become extensive and diverse. The nature of attitudes towards work, employers, and money has changed, both in urban and rural settings, in developed as well as developing countries.

Therefore, there is a need to understand how the presence and development of digital technologies influence the acquisition and utilization of digital skills. This can be achieved by employing statistical data analysis techniques from the State Statistical Committee, employing empirical data processing, statistical methods of comparison, grouping, aggregation, and analysis of variance (ANOVA). The ultimate goal is to determine the level of differences and the digital divide between urban and rural areas in Azerbaijan.

RESULTS AND DISCUSSIONS

When systematizing indicators related to information and communication technologies in Azerbaijan, the author conducted a comparative analysis of the main data from 2005 to 2021 and visually presented it in Table 1.

Table 1. Key parameters of information and communication technologies (ICTs)

Indicators	2005	2006	2007	2010	2015	2019	2020	2021
Number of Internet users per 100 people, persons	8	10	11	46	77	81	85	87
Number of broadband Internet access users per 100 people, persons	2	2	4	15	72	77	83	85
Volume of international Internet channels per capita, kbps	0.04	0.09	0.73	4.6	54.0	111.1	181.5	198.6
Share of the population living in the territory covered by mobile communications in the total population of the country	99.0	99.0	99.0	99.8	99.9	100.0	100.0	100.0
Average rate for 20 hours of Internet usage per month, manat	5.0	4.8	4.0	1.9	1.3	0.9	0.9	0.9
Ratio of Internet tariff to average monthly gross national income per capita, in percent	4.5	2.9	1.7	0.6	0.3	0.1	0.1	0.1
Average tariff for 100 minutes of mobile communication during a month, manat	18.0	16.0	12.0	7.7	6.9	6.4	6.4	6.4
Ratio of cell phone call tariff to average monthly gross national income per capita, in percents	16.1	9.7	5.0	2.0	1.5	1.0	1.1	0.8
ICT Development Index	2.58	2.7	2.77	3.78	6.23	6.49	6.64	6.67

Source: official data of the State Statistical Committee of the Republic of Azerbaijan [20].

Despite nearly the entire population residing in the covered area having mobile communication, the number of Internet users per 100 people was relatively low in 2005 and increased almost 11-fold by 2021. Broadband Internet access users accounted for a higher percentage in 2021, at 85%, compared to only 2% in 2005. The more than fivefold increase in Internet usage rates allows for an improvement in digital skills. As a point of comparison, according to the statistical analysis conducted by the International Telecommunication Union (ITU) and the Alliance for Affordable Internet, [12] the cost of internet connectivity as a percentage of

gross national income per capita rose to 2.0% in 2021 compared to 1.9% in 2020 worldwide. The passage describes how the availability and the development of digital technologies in Azerbaijan have contributed to the acquisition and usage of digital skills. Despite global trends of rising prices and increased use of fixed and mobile broadband connections, relative costs for internet access have remained unchanged in Azerbaijan. Unlike many other countries, where a decreasing number of people have access to affordable internet, Azerbaijan has ensured affordable internet access with consistent quality for its population. The government has launched initiatives such as the "Digital Girls" national education program and the project "Development of Multimedia Online Courses and Web Portals in the Field of Information Technology for Women," [16] both aimed at promoting digital skills, especially among women. However, the global trend of low internet usage in rural areas and among women is also observed in Azerbaijan [11]. For example, in sectors like agriculture, forestry, and fishing, only 27.5% of internet users are women.

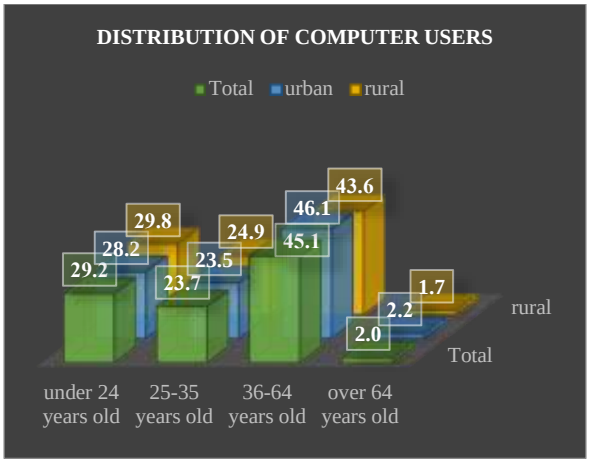
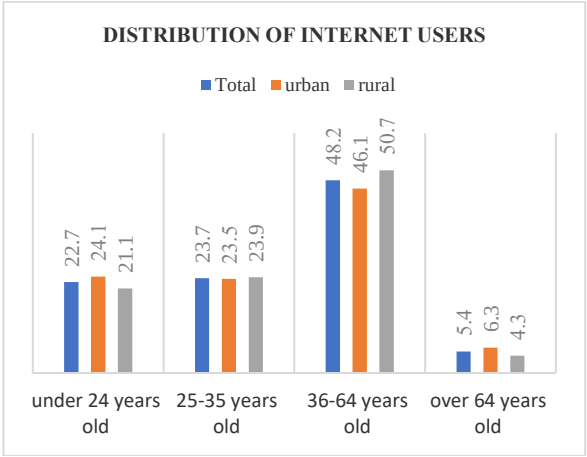


Fig. 2. Distribution of computer users by age groups as % to total, 2021
Source: official data of the State Statistics Committee of the Republic of Azerbaijan [20].

The author of the article conducted research using data collected by the State Statistical Committee of Azerbaijan. The research included over 28.2 thousand household members aged 7 and older, sampled using a sampling method. Given that 47.1% of Azerbaijan's population lives in rural areas, access to telecommunication services in these areas is crucial for the well-being of this demographic.

Figure 2 illustrates the combination of indicators depicting the number of computer users across age groups and territorial structure. This gap has increased for age groups under 24 and 25 to 35 by +5.7% and +6.0%, respectively, while decreasing for age groups 36 to 64 and older than 64 by 94.6% and 77.3%, respectively.

The research on the number of internet users across different age groups and places of residence is depicted in Figure 3.



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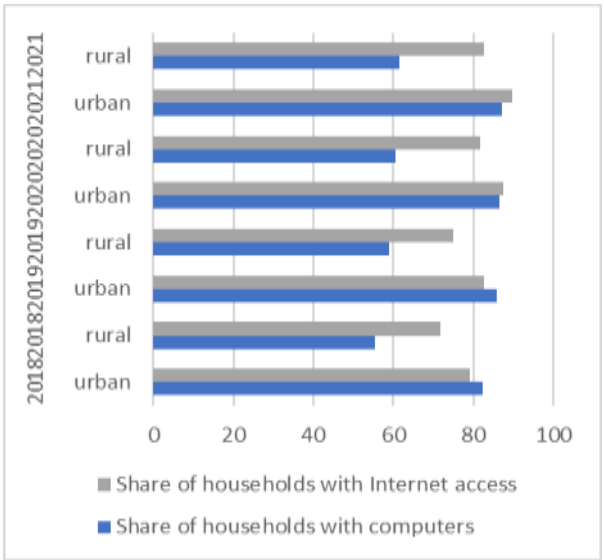

Fig. 4. Ratio of shares of households with computers and Internet access in urban and rural areas of Azerbaijan (%)
Source: official data of the State Statistics Committee of the Republic of Azerbaijan [20].

The study of the number of internet users across age groups and residential areas is reflected in Figure 3. As seen in the figure, the number of rural residents in two age groups, aged 25 to 64, using the internet is higher than that of urban residents. Undoubtedly, this is primarily associated with the demographic rejuvenation trends in rural areas.

Table 2. Distribution of equipment by type of wireless connection to the Internet, as a percentage of the total, 2021

Area	of which:					
	Via LTE	Via satellite	using a data card or USB modem	Via CDMA	via mobile internet	including using a 3G or 4G network
Total	1.6	1.7	2.1	1.7	92.9	71.3
urban	2.8	3.4	1.7	0.3	91.8	73.6
rural	1.0	0.9	2.3	0.8	87.5	67.4

Source: official data of the State Statistical Committee of the Republic of Azerbaijan [20].

The study of the urban-rural ratio in terms of household computer ownership and their Internet access yielded the following results, as presented in Figure 4. As evident from the diagram, the extent of coverage of rural areas in terms of telecommunication services significantly lags behind urban areas. A significant limitation to Internet access is the existing infrastructure, which relies on low-speed modem connections through the telephone network. Technologies such as digital subscriber lines, which transmit information at much higher speeds over existing infrastructure, are not always available in the country's cities, let alone its rural areas. An analysis of the proportion of rural households with computers showed that only about 60% of rural residents have computers on an approximate yearly basis. Consequently, rural residents rely more on accessing the World Wide Web (which is over 80% of them) not through computers, but through other digital communication means, primarily smartphones and tablets. Rural residents mostly connect to the Internet through data cards or USB modems, utilizing CDMA (Code Division Multiple Access) technology and mobile Internet. Subsequently, Table 2 examines the types of wireless Internet connections based on 2021 data.

During the investigation into Internet unavailability in households, the following reasons were identified: [20]

-"Internet is not needed" - expressed by 40.8% of urban residents and 46.5% of rural residents.

-"Access to the Internet is available elsewhere" stated by 13% of urban residents and 3.9% of rural residents.

-"Expensive equipment required for Internet connection" characterized by 12.4% of urban residents and 7.2% of rural residents.

- "High fees for usage" mentioned by 10.5% of urban residents and 11.3% of rural residents.

-"Feeling not confident about personal information security online" voiced by 2.2% of urban residents and 0.4% of rural residents.

-Expressed their opinion about lack of technical possibilities in this area - reported by 6.2% of urban population and 6.8% of rural population.

-Not satisfied with Internet speed and quality - mentioned by 1.4% of urban residents and 4.2% of rural residents.

-Consider the Internet harmful - expressed by 5.7% of urban residents and 7.5% of rural residents.

-Other reasons - identified by 7.8% of urban residents and 12.2% of rural residents.

Table 3. Distribution of computer, of internet users by educational attainments, as % to total, 2021

Population categories by residence	Primary education or lower	Lower secondary education	Upper secondary or postsecondary non-tertiary	Tertiary education
urban computer users	15.1	11.4	52.4	21.1
urban internet users	15.1	11.5	51.1	22.3
rural computer users	19.2	7.2	54.2	19.4
rural internet users	12.5	9.5	57.2	20.8

Source: official data of the State Statistical Committee of the Republic of Azerbaijan [20].

The category of "other reasons" for Internet unavailability in households includes digital illiteracy or lack of digital skills among the population. The modernization of digital technologies requires a progressive movement towards increasing the level of education. The users of computers and the Internet in 2021 were subjected to analysis based on their educational levels in Table 3.

In order to determine whether a significant difference exists between the education levels of urban and rural populations in terms of digital skills, a two-way analysis of variance (ANOVA) was conducted, and three hypotheses were formulated (accepted):

H1: Categories of population based on place of residence do not affect digital skills.

H2: Education levels do not affect digital skills.

H3: The combined interaction of population category and education levels does not affect digital skills.

Table 4. Two-factor analysis of variance with repetitions

Anova: Two-Factor With Replication						
SUMMARY		Primary education or lower	Lower secondary education	Upper secondary or postsecondary non-tertiary	Tertiary education	TOTAL
Urban computer internet users						
Count		2	2	2	2	8
Sum		30.2	22.9	103.5	43.4	200
Average		15.1	11.45	51.75	21.7	25
Variance		0	0.005	0.845	0.72	288.2429
Rural computer internet users						
Count		2	2	2	2	8
Sum		31.7	16.7	111.4	40.2	200
Average		15.85	8.35	55.7	20.1	25
Variance		22.445	2.645	4.5	0.98	383.6371
Total						
Count		4	4	4	4	
Sum		61.9	39.6	214.9	83.6	
Average		15.475	9.9	53.725	20.9	
Variance		7.669167	4.086667	6.9825	1.42	
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Sample (urban, rural population)	9.0913	1	9.0913	2.2613	1	5.317655
Columns (levels of education)	4642.685	3	1547.562	385.2051	5.4809	4.066181
Interaction	28.335	3	9.445	2.350965	0.148451	4.066181
Within	32.14	8	4.0175			
Total	4703.16	15				

Source: systematized by the author on the basis of the data of the State Statistics Committee of the Republic of Azerbaijan [20].

While analyzing the collected data, it becomes evident that the value of the F-criterion for the population category factor based on place of residence (urban and rural) is F-observed = 2.26, while the critical F-value is F-critical = 5.32. If F-observed < F-critical, there is no basis to reject the null hypothesis: population categories based on place of residence do not have an impact on digital skills. This conclusion is further supported by the sample coefficient of determination for the population category factor: R^2=0.002, signifying that 0.2% of the total sample variance in the number of computer and internet users is attributed to the population category (urban or rural). Therefore, the acquisition, possession, and enhancement of digital skills are not dependent on the population category based on place of residence, provided that access to information and communication technologies is equal for both urban and rural residents. Azerbaijan has established nearly identical

conditions for digital development across the country's territories based on the indicators of the first two sub-index groups of the IDI, as revealed in previous calculations. When analyzing the value of the F-criterion for the education level factor, it was found that F-observed > F-critical. Therefore, the null hypothesis should be rejected in favor of the alternative hypothesis. The sample coefficient of determination for the education level factor is R^2 =0.987, indicating that 98.7% of the total sample variance in the number of computer and internet users is attributed to the education level. Hence, education level influences the acquisition and utilization of digital skills. Additionally, in the analysis of the interaction between the two factors, population category and education level, the obtained values are as follows: F-observed = 2.35 and F-critical = 4.07. This implies that the combined interaction of population category and education level factors does not affect the number of users of both computers and the Internet. Consequently, digital skills are not influenced by this interaction. The indicator reflecting the number of purchased computers, smartphones, and other digital devices cannot accurately characterize the extent of digital skills possessed by urban or rural populations. It is also not reliably possible to determine the level of digital skills among individuals with degrees in relevant fields. In such cases, certification comes to the aid. Skills are acquired, and a certificate is obtained. However, there is a lack of statistical data on the number of certified professionals (or simply workers). In my opinion, companies that require certifications should maintain their own proprietary observation of the range of acquired and applied digital skills in their work. In other words, they should standardize skills, just as working hours were standardized in the recent past.

Here, readers might have objections, such as:

-When hiring for vacant positions, applicants are required to have not only educational credentials but also specific skills that match their future roles. In my view, company requirements can sometimes be narrowly focused. In many companies, employees often possess a limited set of skills. With the ever-growing volume of information that needs to be processed in real-time, employees might not meet the requirements that have evolved due to the changing nature of the digital era.

-There are situations where skills obtained through education are not fully utilized. These skills can become atrophied, like lifeless organs. In this case, there is a significant loss of an employee's qualitative abilities. To address this, it would be advisable to use qualitative indicators such as timely and high-quality document submission, teamwork, and the level of employee compliance with instructions from supervisors. Typically, qualitative indicators are assessed using a scoring system. However, an ill-considered approach to evaluating an employee's digital skills won't allow the identification of the degree of difference between alternative actions the employee could take. In most cases, deviations from established norms (scores) can only be indirectly assessed using an ordinal or rank scale. For instance, when evaluating digital skills based on the indicator of compliance with instructions while working on a computer, employees can be assigned scores ranging from 2 (low) to 5 (high), or more categorically, 0 points (not done) and 1 point (done) for the assigned task. If anything is not completed, it can be considered that the entire task has failed. It's similar to a mathematical problem: either the correct answer is obtained or it's incorrect.

Many experts, including marketers, share the view that it's not about creating but acquiring. Gaining a larger audience comes first, and then understanding the effectiveness of digital skills can come later. This approach makes sense from an economic standpoint: if there's an entry-interest, there will be an exit-skills. However, even this doesn't define the quality of the acquired skills and their effectiveness. To achieve the necessary scale of effectiveness, it requires self-acquisition of new skills and their implementation through specific methods suitable for different population groups. The advantage of this approach lies in the fact that such structured learning conditions will enhance the acquisition of all types of digital skills. Expert

knowledge in a specific field is unquestionably important. It not only serves as the backbone or foundation of awareness about the availability of resources for skill acquisition, but it is also a resource itself. However, continuous self-refreshment of skills enhances employees' qualifications and simplifies life. Digital skills are defined by digital competencies. The digital transformation has the potential to enhance the economic efficiency of small and medium-sized enterprises, including those in the agricultural sector. Entrepreneurial digitalization enables companies to make decisions to improve agricultural business efficiency, modulate business processes, explore new markets, optimize and refine their operations, and adapt their approach to employees. Digitization helps companies integrate more easily into global value chains and expand their innovative activities. It can increase company efficiency: companies decide to invest in digital tools and practices for various reasons, and as a result, the technology implementation process should bring tangible benefits to companies undergoing digital transformation. Digitization also helps increase productivity, which, in turn, leads to higher wages due to improved digital skills and an improved standard of living in rural areas.

CONCLUSIONS

Summing up the study's findings, it can be concluded that digitization is multifaceted and typically involves the utilization of digital tools and technologies to address specific problems and enhance operations carried out by businesses. The application of digital technologies can improve the performance of small and medium-sized agribusinesses, increase company efficiency, and enhance the quality of life for rural residents. Individuals need to be prepared for the demands of the new digital era, which are related to processing large volumes of information and solving problems that machines cannot handle. This is achievable only by employees possessing digital skills. The level of employees with digital competencies holds significance in rural areas. Farming enterprises will only attain a competitive advantage through a high level of employees with digital skills. Further acceleration of the process of forming an information society in rural areas is possible by overcoming several objective challenges, such as: the shortage of computer science literature in Azerbaijani is due to rural Azerbaijan residents primarily speaking only their national language; the translation of educational programs in computer science, from basic levels providing only minimal proficiency in information and communication technologies, lacks progression toward deeper, diverse, and technical knowledge, to more profound, diverse, and technical knowledge. Ensuring information security, safeguarding personal and private information. Establishing and developing regional and local information and educational centers to expand the opportunities for all layers of the rural population to access information resources, creating conditions for providing free information services to underprivileged segments of the rural population. Educating rural populations about modern information and communication technology tools and their utilization.

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