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The Impact of Digital Literacy on Labor Productivity in the Context of the Educational Environment Transformation

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ABSTRACT

Purpose: The low level of digital literacy and the insufficient capabilities of the existing personnel training system to improve it, have restrained the labor productivity growth at most enterprises in the non-resource sector in the Russian Federation. The purpose of the study was to assess the impact of the working-age population's digital literacy on labor productivity in Russian regions and to analyze the impact of the educational environment's digital transformation on the digital literacy of the population. **Method:** The study includes data on 87 constituent entities of the Russian Federation for 2015-2019 years retrieved from the website of the Federal State Statistics Service of the Russian Federation. Panel regressions with random effects were employed to estimate the impact of digital literacy on labor productivity in Russian regions and the impact of educational environment transformation on digital literacy.

Findings: Modeling results showed that digital literacy has a positive impact on labor productivity. The use of ICT by the population has the greatest positive impact on labor productivity among other studied factors. The educational environment's digital transformation has a positive effect on digital literacy. The use of ICT in the educational process and management of educational institutions is the most important factor in the formation of digital literacy over time.

Implications for Research and Practice: New activities in the regional subprojects of the national projects of the Russian Federation "Labor Productivity" and "Demography" can be proposed based on the study results.

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Introduction

Most countries of the world, including the Russian Federation, in their program and strategic documents, declare socio-economic development as the main evolutionary idea of the long-term and sustainable existence of society. This complex concept combines on an equal basis the social, organizational, and economic aspect of countries and regions' development. An established interaction of state, regional and municipal structures, and regulators, as well as socio-political institutions and the private sector, which together ensure the functioning of the economy, is necessary for the socio-economic development of territories. Each country chooses its own mechanism for organizing such interaction, but social and economic guidelines are almost everywhere the most important in making decisions on the allocation and distribution of resources. Finding ways to accelerate the economic growth of national and regional economies is the most important task for any political leadership.

The most common instruments of state influence on socio-economic development are budget investments and other forms of "infusion" of financial resources into the economy. Economic theory does not give an unambiguous answer to the question of how effectively additional budget expenditures affect economic growth, although there is no doubt that there is a positive impact (the growth of government spending itself increases GDP because these costs are part of it). Empirical studies show that the impact of government spending on increasing economic growth depends on the costs themselves. The multiplicative effect of productive expenditures (on infrastructure, healthcare, education, etc.) is significantly greater than that of unproductive ones (on national defense, security, social sphere, etc.). In the process of spending additional funds on infrastructure, education or healthcare, capital, physical or human (including intellectual), is formed and accumulated, which positively affects the development of the economy in future periods.

In modern Russia, starting from 2019, a state model of additional budgetary financing of the economy has been chosen through a system of national projects, the goals of which are divided into three large blocks:

1) human capital.
2) comfortable living environment.
3) economic growth.

One of the most important indicators characterizing the efficiency of any socio-economic system is labor productivity, which became the basis for the formation of a national project related to the third block, with the same name "Labor productivity". Until recently, this national project was called "Labor productivity and employment support", but since the promotion of employment relates more to the formation and use of human capital than to economic growth, employment support measures since 2021 have become fully related to the national project "Demography".

Despite the presence of the labor productivity indicator, which is most important for economic growth, in the very name of the national project, most of the approved and implemented national projects of the first and third blocks are directed to the growth of labor productivity to one degree or another. Let us list only some of the targets of national projects that characterize their impact on labor productivity (table 1).

Table 1

Impact of national projects implemented in the Russian Federation on labor productivity

National project	Impact on labor productivity
Science and universities	Contributes to improving the quality of higher education and, accordingly, the demand for university graduates from employers. Additional competencies and skills of specialists with higher education are reflected in the growth of the volume of products and services provided. Creates conditions for the generation of new scientific and technical results, the commercialization of which generates new added value and increases the competitiveness of enterprises producing innovative products.
Small and medium business	Contributes to the growth of the number of self-employed in the Russian economy and increases the effectiveness of their entrepreneurial activities. Provides for improving the conditions (including tax) of doing business for small enterprises, thereby stimulating their economic development. Offers a set of measures to accelerate small businesses, including the possibility of obtaining preferential loans.
Digital economy	Creates and promotes a digital ecosystem focused on the needs of entrepreneurs. Creates favorable conditions for the development and implementation of digital technologies based on domestic developments through a comprehensive system of measures of state support for IT start-ups and software developers, as well as stimulating the demand of companies in various sectors of the economy for ICT solutions. Promotes an increase in the digital literacy of the population and the training of qualified personnel for the digital economy, characterized by a high share of added value. Stimulates the growth of the number of domestic developments in the field of artificial intelligence, which will subsequently reduce the volume of living and significantly increase the amount of materialized labor.
Labor productivity	Promotes the implementation of best practices to improve labor productivity. Introduces digital services to improve labor productivity. Provides comprehensive support to enterprises, including by training managers in the skills of organizing lean production and increasing labor productivity.
International cooperation and export	Helps industrial enterprises to supply their goods to new sales markets, to increase the competitiveness of Russian products. Promotes the development of the reclamation complex, supports the creation and modernization of agricultural facilities to increase their international competitiveness.

National project	Impact on labor productivity
Comprehensive plan for the modernization and expansion of the backbone infrastructure	Provides communication between centers of economic growth. Promotes the development of cooperative economic ties and the reduction of logistics costs.
Demography	Provides an opportunity for retraining in a new specialty, including for older people. Provides an opportunity to find a new job, including using a unified information platform that is being created for all employment centers in Russia.
Health care	Supports the training and retraining of qualified personnel in the field of healthcare. Promotes the services of domestic clinics abroad. Creates conditions for increasing the working age of the population. Creates a unified state digital circuit in healthcare. Provides automation of workplaces of medical workers, which allows them to serve patients more efficiently.
Tourism and hospitality industry	Stimulates demand in the field of tourism and hospitality, especially during the spread of coronavirus infection. Supports infrastructure and investment projects in the field of tourism and hospitality. Promotes the acquisition of the most up-to-date digital knowledge and skills by tourism management specialists.
Education	Contributes to the development of the secondary vocational education system and the satisfaction of vacancies in the labor market in working specialties. Ensures the introduction of digital technologies into the educational process. Forms the basic intellectual potential of new generations of able-bodied citizens of Russia.
Culture	Supports creative initiatives of citizens. Provides opportunities for cultural workers to undergo retraining in the best creative universities in Russia. Contributes to the formation of a digital culture of the population.

Three more national projects "Safe high-quality roads", "Housing and urban environment" and "Ecology", which are not presented in the table, belong to the second block of national goals "Comfortable living environment" and are not directly related to economic growth indicators. However, they also play a significant role in the use of new technologies, which will undoubtedly have a positive effect on labor productivity.

As can be seen from the analysis, there are many overlaps between national projects in the format of solutions aimed at increasing labor productivity. Most national projects include training and retraining activities, which is a key opportunity to increase the return on labor force utilization. Also, there are solutions for the digitalization of a particular field of activity in almost every national project. It is obvious that digitalization of any processes reduces the time and other resources spent on performing productive operations and, as a result, affects labor productivity.

Proceeding from the above, relying on the imperatives of national projects, it can be noted that the most important reasons for the relatively low labor productivity in the Russian Federation, unrelated to the level of capital-labor ratio of production, are: 1). Structural imbalances in the labor market, expressed in the discrepancy between the competencies of graduates of the education system and the real needs of industries and sectors of the economy. 2). Low level of digital literacy of the working-age population, which does not allow using all the new opportunities of the digital economy. The current state of digital competencies of Russians, despite significant progress in this area, does not correspond to the level of most developed countries.

Hence, we can formulate the research problem – the low level of digital literacy and the insufficient capabilities of the existing personnel training system to improve it restrain the growth of labor productivity at most enterprises in the non-resource sector in the Russian Federation. The hypothesis of the study is that to increase labor productivity at enterprises of the non-resource sector in the Russian Federation, it is necessary to increase the digital literacy of the working-age population based on the digital transformation of the educational environment. Thus, the purpose of the study was to assess the impact of digital literacy of the working-age population of the regions of the Russian Federation on labor productivity and to analyze the impact of digital transformation of the educational environment on the digital literacy of the population.

Literature Review

Automation and digitalization, as long-term evolutionary processes, cause significant effects, such as the transformation of professions and job profiles, changes in forms of employment and a more significant role of the platform economy, creating problems for social policy (Husár et al., 2020; Justice et al., 2020; Sima et al., 2020). The actively occurring changes in the economy and society, the digitalization processes caused by the development of technologies and the growing complexity of global markets and management systems necessitate the development of a new type of human capital with skills that will make it competitive in the future socio-economic and technological reality.

In recent years, both the global academic community and Russian scholars have been studying issues related to the ongoing changes in production methods, the formation of new, digital competencies in the workforce (ANATOLEVICH et al., 2017; Gacs et al., 2020; Hernandez-de-Menendez et al., 2020; Le et al., 2019). What should be the professionals of the future? And how to "grow" them efficiently? The educational environment of the future should provide an opportunity for a person to acquire new knowledge and skills throughout his life. It includes mobile applications, online platforms and other services built around humans (artificial intelligence and machine learning). Digital technologies are the drivers of changes in education (Bilyalova et al., 2019; Krylov et al., 2019; Oliveira & de SOUZA, 2021; Popova et al., 2020; Rodríguez-Abitia & Bribiesca-Correa, 2021; Zain, 2021).

It is necessary to define the concept of digital literacy in economics for our research. Some authors use the term ICT or digital literacy in their research (Bolek et al., 2018; Nevado-Peña et al., 2019; Scherer & Siddiq, 2019). Other researchers call it digital competence (Cabero-Almenara et al., 2020; Guillén-Gámez et al., 2021; Henry, 2020). International ICT Literacy Panel defines ICT literacy in the following way: ICT literacy is using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society (Panel, 2002).

However, this definition does not adequately reflect the role of digital literacy in economic processes, such as value creation. Therefore, we propose to define digital literacy in economics as an evaluation characteristic of a person's knowledge, skills and abilities to use digital technology, communications tools, and/or networks in all spheres of life to participate more effectively in social and economic processes (Zhuckovskaya et al., 2020).

A considerable effort has been devoted, in recent years, to the analysis of the interrelation between digital literacy and labor efficiency and economic growth including in Russia (Bogoviz et al., 2018; Metcalfe et al., 2020; Ojeomogha, 2019; Vishnyakova et al., 2021; Yashalova et al., 2019). The issue of the digital literacy impact on labor productivity in Russian regions in the context of the educational environment's digital transformation remains unexplored.

Method

Research model/Design

The Ministry of Digital Development, Communications and Mass Media of the Russian Federation has developed a consolidated list of indicators used to assess the level of development of the information society in the regions of the Russian Federation. It served as the basis for selecting the indicators that we included in the study.

The set of indicators for assessing the level of digital literacy of the population in Russian regions is shown in table 2.

Table 2

Digital Literacy Characteristics

Variable	Description of the indicator
DL1	Availability of ICT among the population
DL11	Number of households with a personal computer (percentage of the total number of households)
DL12	Number of households with Internet access (percentage of the total number of households)
DL13	Number of households with access to the Internet from a personal computer (percentage of the total number of households)
DL14	Number of households with broadband Internet access (percentage of the total number of households)
DL2	ICT use by the population
DL21	Share of the population using the Internet, %
DL22	Share of the population using information security tools, %
DL23	Share of the population using the Internet to order goods and services, %
DL24	Share of the population using electronic methods of payment for goods and services, %
DL25	The share of the population that interacted with government and local authorities via the Internet (using official websites and portals of state and municipal services, mobile devices (mobile phone, tablet, etc.), e-mail, self-service terminals), %
DL26	Share of the population using mobile devices (mobile phones or smartphones, e-book readers, etc.) to access the Internet, %
DL3	Personal computer skills of the population
DL31	Share of population with word processing skills, %
DL32	Share of population with skills to transfer files between computer and peripheral devices, %
DL33	Share of population with spreadsheet skills, %
DL34	Share of population with the skills to use photo, video and audio editing software, %

The first block of indicators for assessing the digital literacy of the population reflects the presence of various ICTs at home. It indirectly testifies to digital literacy, since it suggests that people understand that these technologies have long been not a luxury, but an objective necessity, and therefore they must be at home.

The second block of indicators characterizes the use of ICT by people in various spheres of life. It reflects the use of the achievements of the digital society for convenience.

The third block of indicators characterizes the skills of working on a personal computer.

Indicators characterizing the level of digital transformation of the educational environment are presented in Table 3.

Table 3

Digital transformation of the educational environment (e-education)

Variable	Description of the indicator
EET1	Readiness of educational institutions for ICT-based development
EET11	Number of personal computers used for educational purposes per 100 students of state and municipal educational institutions, number per 100 students
EET12	Number of personal computers used for educational purposes, located in local computer networks (LAN), per 100 students by educational institutions (secondary vocational education), number per 100 students
EET13	Number of personal computers used for educational purposes, located in the LAN, per 100 students in educational institutions (higher professional education), number per 100 students
EET14	Share of educational institutions of higher professional education connected to the Internet with a speed of 256 Kbps and above in the total number of surveyed institutions of higher professional education, %
EET15	Share of educational institutions of higher professional education connected to the Internet at a speed of 2 Mbps and above in the total number of surveyed institutions of higher professional education, %
EET16	Number of personal computers used for educational purposes with access to the Internet, per 100 students by educational institutions (secondary vocational education), number per 100 students
EET17	Number of personal computers used for educational purposes with access to the Internet, per 100 students by educational institutions (higher professional education), number per 100 students
EET2	Use of ICT in the educational process and management of an educational institution
EET21	Share of educational institutions with a website on the Internet in the total number of independent educational institutions (secondary vocational education), %
EET22	Share of educational institutions with a website on the Internet in the total number of independent educational institutions (higher professional education), %
EET23	Share of educational institutions implementing educational programs using distance learning technologies for the implementation of basic educational programs, in the total number of independent educational institutions (secondary vocational education), %
EET24	Share of educational institutions implementing educational programs using distance learning technologies for the implementation of basic educational programs, in the total number of independent educational institutions (higher professional education), %

We normalized the above indicators to calculate the indices of digital literacy and digital transformation of education. Normalized indicators are calculated as follows:

$$y_i(x_i) = \frac{x_i - x_{min}}{x_{max} - x_{min}} \quad (1)$$

where:
y_i – normalized indicator,
x_i – indicator,

x_{min} – minimum value of indicator among Russian Regions,
x_{max} – maximum value of indicator among Russian Regions.

Formula (1) converts the indicator x_i to an index with a range of values from 0 to 1.

The integration of indicators is carried out to give a generalized description of various aspects of digital literacy and transformation of the educational environment.

Formula (2) brings the indicators of the third level (DL11, DL12, etc.) to the indicators of the second level (DL1, DL2, etc.):

$$Z_k = \frac{\sum_{i=1}^{n} y_{ki}}{n}. \quad (2)$$

Formula (3) brings the indicators of the second level (DL1, DL2, etc.) to the indicators of the first level (DL, EET):

$$I = \frac{\sum_{i=1}^{k} z_k}{k}. \quad (3)$$

We calculated the labor productivity at the regional level as the ratio of the gross regional product (GRP) to the average annual number of employees.

Research Sample

The study includes data on 87 constituent entities of the Russian Federation for 2015–2019. The choice of this time interval for the analysis was because some of the indicators included in the study have been collected by the Federal Statistics Service of the Russian Federation since 2015. The sources were the official statistics data presented on the websites of the Federal State Statistics Service (https://rosstat.gov.ru/) and EMISS (https://www.fedstat.ru/).

Descriptive statistics are presented in Table 4.

Table 4

Descriptive statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
DL	0.484761	0.473771	0.927325	0.143071	0.121919	435
DL1	0.510568	0.511782	1	0.058796	0.174684	435
DL11, %	70.20092	69.9	96.5	0	9.601306	435
DL12, %	74.60092	74	98.1	59.7	6.897438	435
DL13, %	66.10299	66.3	95.9	14.3	9.301673	435
DL14, %	68.92897	69.4	96.3	0	10.35064	435
DL2	0.465875	0.455613	0.981193	0.074433	0.134828	435
DL21, %	81.96759	82.1	98.6	61.2	6.627487	435
DL22, %	82.94304	84.6	97.7	23.8	9.192898	435
DL23, %	32.23149	30.9	81.4	0	12.50413	435
DL24, %	25.97563	24	73.2	2.7	12.39393	435
DL25, %	35.13404	33.8	93.6	0.9	20.22713	435
DL26, %	53.39609	53.8	88.4	19.9	13.82952	435
DL3	0.477841	0.478766	0.928568	0.026779	0.14541	435
DL31, %	54.68506	54.8	85.4	22.5	9.406257	435

	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
DL32, %	38.53126	38.4	81.3	7.5	10.7868	435
DL33, %	27.88897	27.9	51	8.2	7.057393	435
DL34, %	28.04874	27.8	53.9	6.9	8.233047	435
EET	0.469265	0.477912	0.74862	0	0.111157	435
EET1	0.38381	0.38775	0.75611	0	0.104692	435
EET11, number per 100 students	13.78123	12.22512	79.0923	3.361538	7.503934	435
EET12, number per 100 students	12.57712	12.19895	37.4979	1.590697	5.217157	435
EET13, number per 100 students	23.43153	21.69791	154	6.585037	13.33056	430
EET14, %	92.79002	95.45455	100	8	10.20927	430
EET15, %	80.44924	82.35294	100	20	14.88808	427
EET16, number per 100 students	13.41472	12.78355	37.32975	2.934562	5.058998	435
EET17, number per 100 students	23.84247	22.0601	166	5.47807	13.72984	430
EET2	0.55472	0.561417	1	0	0.184994	435
EET21, %	95.96514	100	100	33.33333	8.975668	435
EET22, %	99.92563	100	100	75	1.241269	420
EET23, %	25.27447	23.43137	86.66667	0	15.17009	396
EET24, %	61.58357	57.14286	100	0	27.24868	377
LP, million rubles per person	1.139706	0.8299	10.57437	0.289826	1.175942	435

Research Instrument and Procedure

The following hypotheses were to be tested:

H1: The higher the digital literacy of the population, the higher labor productivity in the regions of the Russian Federation.

H2: The faster the digital transformation of the educational environment takes place, the higher the digital literacy of the population in the regions of the Russian Federation.

Since the raw data for analysis has a panel data structure, panel regression models with fixed or random effects apply to them. All variables were tested using the Levin, Lin, and Chu unit root test for panel data. The studied variables are stationary at a statistical significance level of 5%. The resulting models are panel regression models with random effects. The random-effects models are appropriate according to the Hausman test.

Data Analysis

Estimated econometric models are presented in Tables 5-8.

Table 5

Econometric models 1-4

Variable / Model	Model1	Model2	Model3	Model4
Dependent variable	LP	LP	LP	LP
DL	0.249707 (0.200489)			
DL(-1)		**0.354507*** (0.202805)		
DL(-2)			**0.688515***** (0.195248)	
DL(-3)				**0.428807***** (0.078807)
Constant	**1.018658***** (0.146638)	**1.016584***** (0.003596)	**0.904557***** (0.157161)	**1.104673***** (0.142525)
R-squared	0.003402	0.008320	0.043468	0.138469
Adjusted R-squared	0.001100	0.005454	0.039775	0.133460
F-statistic	1.477883	2.902936	11.76977	27.64449
Observations	435	348	261	174

Note: Standard Errors are in parentheses. *** stat. significance on 1%, ** stat. significance on 5%, * stat. significance on 10%.

Models 1-4 reflect the impact of digital literacy on labor productivity in the regions of the Russian Federation. Modeling results show that digital literacy has an impact on labor productivity with lags of 1, 2 and 3 years. Thus, hypothesis H1 was confirmed.

Table 6

Econometric models 5-8

Variable / Model	Model5	Model6	Model7	Model8
Dependent variable	DL	DL	DL	DL
EET	-0.042487 (0.049245)			
EET(-1)		**0.177038***** (0.051492)		
EET(-2)			**0.093388*** (0.051103)	
EET(-3)				**0.099258*** (0.058443)
Constant	**0.504699***** (0.025496)	**0.413912***** (0.026238)	**0.435289***** (0.026297)	**0.424082***** (0.030346)
R-squared	0.001698	0.033128	0.012769	0.016576
Adjusted R-squared	-0.000607	0.030334	0.008957	0.010858
F-statistic	0.736660	11.85511	3.349816	2.899095
Observations	435	348	261	174

Note: Standard Errors are in parentheses. *** stat. significance on 1%, ** stat. significance on 5%, * stat. significance on 10%.

Models 5-8 are built to test hypothesis H2. They confirm it with a lag of 1, 2, 3 years. The digital transformation of the educational environment has a positive effect on the digital literacy of the population in the Russian regions.

Subsequent models are built to detail the results.

Table 7

Econometric models 9-12

Variable / Model	Model9	Model10	Model11	Model12
Dependent variable	LP	LP		
DL1	**-0.827507***** (0.115034)			
DL2	**1.364877***** (0.185693)			
DL3	0.142938 (0.153479)			
DL1(-1)		**-0.607962***** (0.130278)		
DL2(-1)		**1.012855***** (0.206023)		
DL3(-1)		0.265335 (0.170760)		
DL1(-2)			-0.030713 (0.194596)	
DL2(-2)			**0.547542**** (0.272367)	
DL3(-2)			0.268014 (0.208399)	
DL1(-3)				0.071825 (0.208399)
DL2(-3)				**0.222332*** (0.126588)
DL3(-3)				0.157293 (0.096308)
Constant	**0.858042***** (0.142463)	**0.919753***** (0.150993)	**0.889802***** (0.159535)	**1.102337***** (0.143552)
R-squared	0.164491	0.107334	0.050562	0.140330
Adjusted R-squared	0.158676	0.099549	0.039480	0.125159
F-statistic	28.28445	13.78750	4.562196	9.250084
Observations	435	348	261	174

Note: Standard Errors are in parentheses. *** stat. significance on 1%, ** stat. significance on 5%, * stat. significance on 10%.

Models 9-12 allow us to analyze the impact of various constituents of digital literacy on labor productivity. They suggest that the use of ICT by the population has the greatest positive impact on labor productivity. This influence is present in all the 9-12 models – in the current year and with a lag of 1-3 years. The availability of ICT in the first year after

acquisition may even have a negative effect on labor productivity. This can be explained by the fact, firstly, that the acquisition of ICT is associated with costs, and the costs do not increase productivity. Secondly, acquiring ICT does not mean knowing how to use it. Thirdly, it can be difficult to use new technologies for the first time after their acquisition, and only after a while, their availability begins to bring an effect.

The models 9-12 indicate that the skills of working on a personal computer do not have a statistically significant impact on labor productivity. Indeed, these skills are not necessary for all professions. In addition, mobile devices are becoming increasingly popular. Thus, only the use of ICT leads to an increase in labor productivity. And the controlling influences from the state and regional authorities should be aimed at stimulating the use of ICT by the population. However, models 13-16 detail the impact of the digital transformation of the educational environment on the digital literacy of the population of the regions of the Russian Federation.

Table 8

Econometric models 13-16

Variable / Model	Model13	Model14	Model15	Model16
Dependent variable	DL	DL	DL	DL
EET1	**0.288481***** (0.048590)			
EET2	**-0.090481***** (0.025331)			
EET1(-1)		**0.193948***** (0.052796)		
EET2(-1)		**0.060696**** (0.028208)		
EET1(-2)			0.033952 (0.067331)	
EET2(-2)			**0.048757*** (0.026384)	
EET2(-3)				0.108363 (0.069660)
EET2(-3)				0.045057 (0.029589)
Constant	**0.424231***** (0.026345)	**0.387481***** (0.028127)	**0.439375***** (0.033286)	**0.402675***** (0.037797)
R-squared	0.107680	0.046891	0.012984	0.021294
Adjusted R-squared	0.103548	0.041366	0.005332	0.009847
F-statistic	26.06552	8.486646	1.696914	1.860215
Observations	435	348	261	174

Note: Standard Errors are in parentheses. *** stat. significance on 1%, ** stat. significance on 5%, * stat. significance on 10%.

The readiness of educational institutions to develop based on ICT in the current year leads to an increase in digital competence, however, with the increase in the use of ICT in the educational process and management of an educational institution, digital literacy

decreases (model 13). This can be explained by the fact that the introduction of new technologies is usually associated with difficulties in their use and takes time to adapt to them. This is confirmed by model 14, where, with a lag of 1 year, the positive impact of both the readiness of educational institutions for development based on ICT and the use of ICT in the educational process and management of an educational institution on digital literacy is confirmed. Model 15 with a lag of 2 years indicates that over time, the use of ICT in the educational process and management of an educational institution becomes the most important among the other factors of transformation of the educational environment. Model 16 with a lag of 3 years has no statistically significant factors.

Discussion, Conclusion and Recommendations

The study was devoted to assessing the impact of digital literacy of the population on labor productivity in the context of the educational environment transformation in Russian regions. The problem in the field is that the low level of digital literacy and the insufficient capabilities of the existing system of personnel training to improve it, restrain the growth of labor productivity at most enterprises in the non-resource sector in the Russian Federation. Hence the hypothesis of the study was: to increase labor productivity at enterprises of the non-resource sector in the Russian Federation, it is necessary to increase the digital literacy of the working-age population based on the digital transformation of the educational environment.

The study includes data on 87 constituent entities of the Russian Federation for 2015–2019. We used regression analysis to check the research hypothesis. The set of indicators covers the indicators of digital literacy level, the level of digital transformation of the educational environment and the labor productivity in Russian regions. Modeling results indicate that digital literacy has a positive impact on labor productivity with lags of 1, 2 and 3 years. This is consistent with the logic of work activity since the growth of competence does not always lead to an instant result. It takes time to introduce new knowledge and skills into practice. The use of ICT by the population has the greatest positive impact on labor productivity among other factors of digital literacy.

The digital transformation of the educational environment has a positive effect on the digital literacy of the population in the Russian regions with a lag of 1, 2, 3 years. The readiness of educational institutions for ICT-based development in the current year leads to an increase in digital literacy. With a lag of 1 year, the positive impact of both the readiness of educational institutions for development based on ICT and the use of ICT in the educational process and management of an educational institution on digital literacy is confirmed. Overtime (with a lag of 2 years), the use of ICT in the educational process and management of an educational institution becomes more important.

The research results are consistent with Bloom et al. (2012), Dahl et al. (2011), Engelbrecht and Xayavong (2006), Hofman et al. (2016), Jorgenson (2001) who argue that ICT enhances productivity and GDP growth. Van Ark (2016) found the productivity paradox: intensive digital-using industries are contributing most to productivity slowdown. Our results show that ICT implementation may indeed be ineffective in the first year. Any innovations take time to adapt personnel to them. According to our research, productivity will increase if digital skills are developed in the working population. Bughin

et al. (2018) analyzed the causes of the productivity-growth slowdown and concluded that we have an opportunity to boost productivity growth through a focus on education and skills. Our research results are consistent with this conclusion.

The national projects being implemented in the Russian Federation basically contain measures aimed at increasing labor productivity, including those based on improving educational technologies, developing a system for advanced training, and retraining of personnel and introducing modern digital technologies. It is advisable to concentrate efforts on improving the educational environment and developing the digital skills of the working population to increase labor productivity with the allocation of centralized budgetary resources, including within the framework of national projects. These areas can give the greatest multiplier effect for the socio-economic development of national and regional systems.

The study results can find practical implications in suggestions development for adjusting Regional Development Strategies. Based on the study results new activities in the regional subprojects of the National projects of the Russian Federation "Labor Productivity" and "Demography" can be proposed. It should be noted that our findings cannot be applied to each Russian region. They describe the average situation in the country. Further research can be aimed at developing a methodology for distributing funds to support initiatives in the field of transforming the educational environment, as well as stimulating an increase in digital literacy of the population.

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