Digital Technologies in Education in Russia: Problems and Prospects in the Context of Unequal Digitalization

Revinova S.[1], Valko E.[2]
RUDN University, Moscow, Russia
revinova-syu@rudn.ru, 1032216727@pfur.ru

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Abstract: This article is devoted to e-education in the Russian Federation, problems and prospects of its development. The study evaluates the contemporary landscape pertaining to the digitalization of education across Russia. Based on the model built using correlation and regression analysis, further growth of this sphere is predicted. Among the problems for the digital education market in Russia, significant concern is the disparity in digital access across various regions. The digitalization of Russia's federal districts was analyzed using the sum of places method. The application of this method allowed us to identify regions that need to implement government programs to overcome the digital divide at different levels to further improve the level of regional development. The leading regions in terms of digital endowment and competencies were the Southern and Urals Federal Districts, while the North Caucasus Federal District was the region in need of increasing the level of digitalization, both in terms of infrastructure and increasing the digital literacy of the population.

1 INTRODUCTION

Intensification of the use of information and communication technologies has led to major changes in all spheres of human life. A large number of services, both public and private, are transferred to the online environment. The positive aspects of digitalization have been noted in many scientific works. For example, Batsoev K.T. talks about the transition of business to the Internet and the emergence of opportunities to work remotely (Batsoev, 2022), and Orlova A.A. notes "the cheapening of many processes and increasing the availability of goods and services for the general public" (Orlova, 2022).

This trend has not bypassed the field of education, which led to the emergence of a new form of knowledge transfer - e-learning. Nazarov I.U. and Alibekov S.A. note that "e-learning tools are becoming the basis of modern education, guaranteeing the necessary level of quality, variability, differentiation and individualization of training and education" (Alibekov, 2021). Digitalization of learning is the main way to improve educational processes, the opportunity to create a high-quality product that meets the current trends and demands of the population. March 2020 caused fundamental changes in the education system, allowing us to rethink educational processes (Liguori et al., 2020). It was COVID-19 that made adjustments in the education system - it set a new vector of development and improvement of the educational process, demonstrating the importance of ICT application (Almaiah et al., 2020; Radha ey al., 2020).

Today it can be noted that digital technologies of knowledge transfer have penetrated all types of education: higher education, preschool, additional education, etc. This opens up new opportunities for learners: receiving quality education from anywhere in the world. This opens up new opportunities for learners: receiving quality education from anywhere in the world. However, it is worth noting that issues related to digital inequality or digital divide have recently become more acute. This is due to the fact that only those who have these technologies and know how to use them competently can benefit from the use of ICT in various spheres. The Organization

[1] https://orcid.org/0000-0002-2442-2393
[2]

for Economic Cooperation and Development defines the digital divide as “unequal access to digital technologies, especially in terms of internet connectivity and device availability, as well as inequalities in infrastructure, skills and accessibility” (Digital divide in education, n.d.). The Oxford Dictionary defines digital divide (digital divide, barrier, etc.) as unequal access to computers, information, internet and telecommunications at any of the levels: global, regional, local. If technologies are expensive and can only be learned in rich countries, the gap between rich and poor will widen further (Clinch, 2017).

The widening digital divide can have unpleasant consequences, especially for large countries such as the Russian Federation, which occupies a large geographical area, with diverse terrain and includes remote and inaccessible territories. People living below the poverty line cannot receive the same services as the well-off. They are deprived or limited in their access to vital services such as education, health care, trade, etc. This situation leads to even greater stratification of the population.

Coleman noted that equality of educational opportunity is equality of results with equal inputs (Coleman, 1968). E-education allows people from both developed regions and less developed subjects to acquire the same knowledge. This knowledge is important for both further education and employment. Thus, e-learning reduces educational inequality by providing equal opportunities to learners. However, online learning is impossible without information technologies, the availability of which also varies across regions.

Many countries, including the Russian Federation, are making efforts to overcome the digital divide - some measures are aimed at expanding access to technology, others at improving digital literacy of the population. These programs have certain results, but this is not enough to equalize the digitalization of the regions. Mohammed Miah notes that the digital divide remains a pressing issue with serious implications for learning outcomes (Miah, 2023). The question that arises here is: does e-learning, through its vast possibilities, reduce the digital divide or does it deepen it? There is debate among experts on this topic, but there is no denying that inequalities in access to education exist.

The purpose of this study is to assess the current state and prospects for the development of e-education in the Russian Federation, as well as to identify problems related to digital inequality in the federal districts of the Russian Federation.

2 METHODOLOGY

The empirical data sourced from publicly available repositories, including Statista, the Federal State Statistics Service, and the Ministry of Education of the Russian Federation, in conjunction with scholarly articles, constituted the foundation for the analytical assessment. A combination of correlation and regression analyses was employed to evaluate the potential trajectories of the Russian e-education sector and to construct a predictive model. The methodologies of correlation and regression analyses are utilized concurrently, enabling the examination of the interrelationships among the observed variables. The primary objective of correlation analysis is to evaluate the degree of association between the variables, whereas regression analysis aims to elucidate the nature of this relationship. In the construction of the regression model, the authors designated the quantity of e-learning participants in Russia as the dependent variable, while the average per capita income of the populace was identified as the independent variable for the model's development.

To assess the problems associated with numerical inequality, the authors consider the indicators for the Federal Districts of the Russian Federation for 2023. The method of research was used as the method of sum of places. The sum method implies ranking of indicators in ascending order. The use of this method made it possible to determine the ranking of regions by the level of digital security and literacy.

The study also used the methods of logical and comparative analysis.

3 RESULTS AND DISCUSSION

3.1 Prospects for the development of the e-education market in the Russian Federation

The global e-learning market is developing: competition is growing, non-standard business solutions are being generated, and the appreciation of this type of education among trainees is growing. All over the world there is a growth of investments in this sphere, which provokes further growth of the sector. Similar processes are taking place in the Russian market.

The volume of the Russian online education market in 2023 will reach 118 billion rubles - this, according to Smart Ranking agency, is 32% more than a year earlier (Edtech-market, 2024). The highest user growth was seen in 2020-2021, driven by pandemic restrictions. There was then a slight decline, but growth continued in 2022. Figure 1. shows data that confirms the stated trend: the number of eLearning users is growing again from 2022 and already in 2023 exceeds the pandemic figures.

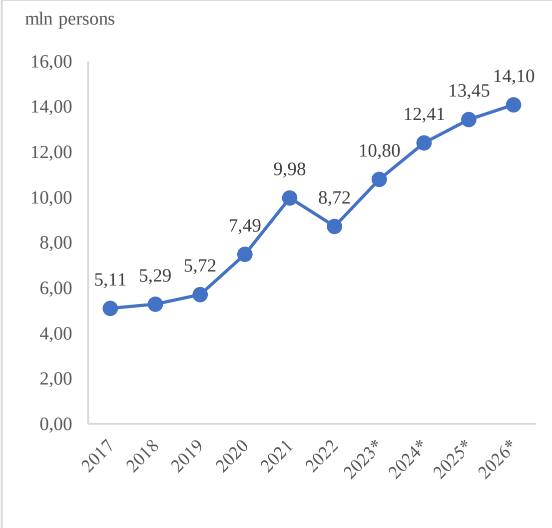

Figure 1: Number of e-learning users in Russia, mln, 2017-2026, mln people. * - forecast values. Source: compiled by the authors according to (Online education in Russia, 2021).

To assess the prospects for the development of the e-education market in the Russian Federation, we considered such factors affecting this market as the number of Internet users, the volume of investments, the real income of the population, and the number of courses. The correlation analysis showed that the most significant factor is the real income of the population. In the construction of a model aimed at evaluating the potential of the electronic marketplace, this element was designated as the independent variable, whereas the dependent variable was identified as the quantity of e-learning participants (Revinova, 2024). The subsequent equation was derived:

$$USERi = \beta 1 + \beta 2*INCOME + \delta*Dummy + \varepsilon i \qquad (1)$$

The estimated equation is presented in Fig. 2. Figure 2 shows the graphical results of the e-Learning market modeling and compares it with Statista data. The obtained model is of high enough quality and coincides with the forecast data of other studies, for example, Statista. This indicates the reliability of the model and allows us to use it to forecast the spread of e-learning in Russia for the nearest period. The graph shows that in the forecast period the number of e-learning users in Russia is expected to increase, which is explained by the growth of real incomes.

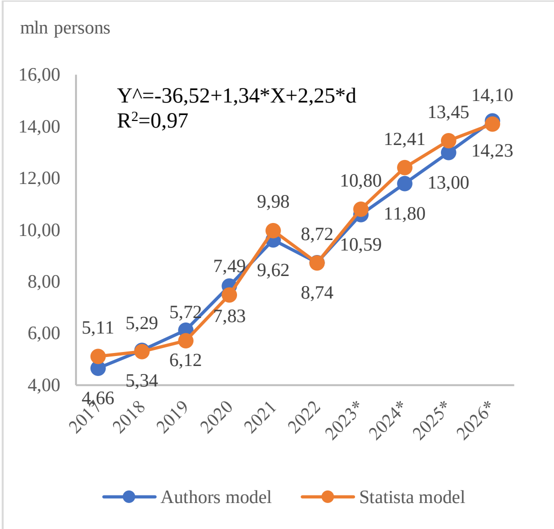

Figure 2: Comparison of the authors' and Statista's models for forecasting the number of e-learning users in Russia, 2017-2026, in million people. * - forecast values. Source: compiled by the authors, (Online education in Russia, 2021).

Indeed, the increase in the real income of the population contributes to the fact that users have more opportunities to choose additional learning. Thus, e-learning is a global force of the 21st century, which has favorable prospects for development, but there are inherent risks and challenges to any market, what are the problems faced by e-learning users?

3.2 Problems of the electronic market in the context of the digital divide in the Russian Federation

The topic of implementation of e-learning methods is inextricably linked to digital inequality. Initially it was considered as a problem of spatial unevenness in the distribution of digital technologies (Basova, 2021), now it is considered in terms of the relationship between accessibility and ICT use. This topic can be analyzed most fully and comprehensively using the model of three levels of digital inequality (Gladkova et al., 2019).

The following indicators were identified to assess digital inequality in access to education at three levels (1 - ICT accessibility; 2 - ICT skills; 3 - ICT benefits) (Table 1).

Table 1: Indicators of the level of digital divide in education.

Levels of digital inequality Indicators	Levels of digital inequality Indicators
ICT accessibility	- number of households with access to the Internet - number of Internet users - proportion of active Internet users
Skills to use ICTs	digital literacy of the population: - digital competencies - digital security -digital consumption
Benefits of using ICTs	- opportunities for professional and personal fulfillment

Source: compiled by authors.

This model was used to assess the digital inequality of Russian regions in access to education, on the basis of which the authors identified the regions that have the greatest chances to gain privileges from the use of ICT in the educational process, and the regions lagging behind for various reasons. Table 2 presents the ranks of federal districts (FD) by two levels of digital inequality, based on which the average score was identified.

According to the first level of the digital divide, the following was revealed: the population of the Southern and Urals Federal Districts has the greatest access to the Internet, followed by the Central and Far Eastern Federal Districts and the North Caucasus Federal District. Despite the fact that the Central FD is one of the most developed, it lags behind other regions in the rating of the population's access to ICT. The lagging region is the Siberian FD.

The assessment of the second level of digital inequality showed the following results. The Southern FD is the leader in digital consumption and competencies, but digital security in this region is low (5th place), which together puts this region in second place in digital literacy. The first place in the final ranking is occupied by the North-Western FD, which has high indicators of digital consumption, competencies and security. The Ural FD closes the top three, with indicators at the same level. The Central Federal District took only 4th place in this rating. The North Caucasus FD is the outsider of this rating.

Table 2: Matrix of FIs ranking by levels of numerical inequality.

FD	First level					Second level				
	Number of Internet users per 100 people	Share of the population that are active Internet users, %	Share of households with broadband Internet access, %	Share of households with access to the Internet, %	Final rank	Digital consumption	Digital competencies	Digital security	Final rank	
Central	1	1	1	2	2	4	4	2	4	**3,0**
North-Western	2	3	3	3	5	2	2	1	1	**3,0**
Southern	1	1	1	1	1	1	1	5	2	**1,5**
North Caucasus	2	2	1	1	3	8	8	8	8	**5,5**
Volga	2	1	2	2	4	5	5	4	5	**4,5**
Urals	1	1	1	1	1	3	3	3	3	**2,0**
Siberian	3	3	3	3	6	6	6	6	6	**6,0**
Far Eastern	1	1	1	2	2	7	7	7	7	**4,5**
Central	1	1	1	2	2	4	4	2	4	**3,0**

Source: compiled by the authors from (Official Statistical Indicators, 2024), (Digital Dictation Outcomes 2023, 2023).

Thus, at the first level of the digital divide, the North-Western Federal District was lagging behind, but the indicators of the second level of the digital divide show the leadership of this district. This suggests that the digital divide may be narrowing as we move from one level to another, which is explained by the high awareness of the population about Internet safety measures and the competent use of ICTs to develop competencies with relatively low access to them. However, the opposite can also be observed - some regions have high access to ICTs, but do not use all the opportunities of information technologies, e.g. Far Eastern and North Caucasus Federal Districts.

The average score allows us to form the following rating of regions. The leader is the Southern FD, followed by the Urals, Central and Northwestern Federal Districts. The North Caucasus FD is also an outsider in this rating. It is the regions with a high average score that should be paid attention to when conducting programs to bridge the digital divide, and the indicators of Levels 1 and 2 will help to understand what is lacking in the region: ICT or the knowledge of the population in this area.

At the third level of digital inequality in education, we consider opportunities for professional and personal realization. As noted earlier, digital technologies play a major role in additional education, professional development and retraining of employees.

The analysis has shown that the districts with the highest population density are leading in the development of digital infrastructure. The largest number of professional educational institutions is located in the Volga Federal District, with the 4th place in terms of population density. This indicates a highly developed higher education system. Also, the regions of the Volga FD over the last 5 years have seen high rates of development of institutions of additional education, including vocational education. At the same time, the North Caucasus Federal District is noticeably behind in terms of the number of educational institutions, including the number of institutions of additional education. The way out of this situation may be the use of online education, but the same region ranks last in terms of the availability of digital skills among the population. To improve the situation in the region it is necessary to take comprehensive measures, as it is educational institutions that serve as a channel for obtaining ICT skills, without which it is impossible to effectively use the Internet to obtain knowledge. Thus, in order to improve the level of education and utilize the full benefits of online education, it is necessary to work systematically to increase the digital literacy of the population.

If we consider the total number of organizations of additional education in Russia, they are much smaller in comparison with other educational organizations. However, at present it is precisely additional education that is widespread, the shortage of full-time educational institutions for which makes users resort to e-education. This fact once again confirms the importance of digital literacy of the population for the effective use of the Internet in educational activities. E-learning is an important tool that can bridge the digital divide (Singh, 2022).

Thus, the analysis of the digital divide at different levels has shown that there are regions that need to implement government programs aimed at developing digital competencies. This will allow the population to effectively use the Internet in educational activities, so that people living in regions that do not have a developed network of educational institutions will be able to obtain knowledge on an equal footing with other highly developed regions. These measures will help to reduce the educational and digital gap between the regions, as well as increase and equalize the overall level of development of the federal districts of the Russian Federation.

Digital inequality remains a global problem that leads to inequality of educational opportunities and deepens the gap in the socio-economic development of regions in different countries, including Russia. Analyzing the federal districts of the Russian Federation according to the three levels of the digital divide allowed us to identify regions that are inferior to the rest in terms of ICT endowment or skills in their use. However, it is important not only to identify the ranking of regions, but also to develop measures that will smooth the existing digital divide.

In 2014, the Ministry of Digital Development, Communications and Mass Media of the Russian Federation and Rostelecom developed the federal project “Elimination of Digital Inequality”, which provides for the organization of Internet access in settlements with a population of 100-500 people. This project is of great importance, as it makes it possible to provide access to ICT to residents of settlements that meet the project criteria. Under the program, the Internet was provided not only to private homes but also to socially important facilities. Such facilities include educational institutions, which opened up new opportunities for students and teachers. The implementation of this program makes it possible to overcome the first level of the digital divide, which is important for regions with low access to ICT.

The second level of digital inequality is also overcome at the state level: educational institutions implement courses aimed at improving digital literacy. The annual digital dictation allows us to assess the effectiveness of these activities. For example, as part of the national program “Digital Economy”, the Russian Ministry of Digital Literacy launched the service “Ready for Digital”. The portal allows testing the level of digital literacy, teaches safe and effective work with digital technologies.

It is to be noted that it is important to place efforts to overcome the digital divide not only on the state, but also on the entrepreneurial community. Such organizations have the necessary funds to implement the programs, and also have a certain influence on the population, which will make it possible to implement these programs with maximum efficiency. For example, as part of the “Ready for Digital” program mentioned above, 18 companies have joined together to form a consortium to develop digital literacy and digital economy competencies. Such an event will make it possible to spread the importance of improving digital literacy, as well as the way to improve it among more people.

An important aspect is also the involvement of opinion leaders in various federal events. In today's world, the young generation is guided by such people and listens to their recommendations, so this move will popularize digital competencies and skills, which will further improve the safety of Internet use.

4 CONCLUSIONS

As a result of the study, it was found out that e-education is a trend that spread during COVID-19 and after the removal of pandemic restrictions has not lost its relevance, but on the contrary continues to capture more and more territories and penetrate various segments. In the course of the work, a forecast has been built that confirms the stated trend: in the coming years, the e-learning market will grow and the number of users will increase.

However, as digitalization spreads, various problems arise in the educational process, one of them being digital inequality, which calls into question the beneficial impact of e-education on the level of development of regions. As a result of the study, it was found out that some subjects of the Russian Federation, which lag behind in access to ICT, may have a high level of digital literacy or other competencies. Thus, not having wide access to digital resources, it is possible to develop and utilize the available opportunities for quality education. Thus, e-education can be a factor that reinforces digital inequality, or it can be a means to overcome various barriers.

The study assessed the digital development of the regions. The leaders were the Southern, Urals, Central and North-Western Federal Districts, while the lagging region was the North Caucasus Federal District. Public and private educational organizations should pay attention to the federal districts that have relatively low digital competencies; these are the regions that need to implement programs to bridge the digital divide. It is necessary to help the population learn how to use ICTs effectively in different areas, which will reduce the digital divide of the regions. Access to electronic educational resources can become one of the drivers of regional development.

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