

# *Digitalization of the Educational Space of the Industrial Macro-Region*

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**Abstract** – The article is devoted to assessing the trends of digital development of the educational space of the industrial macro-region. As indicators of the digital development of the educational space, the state of informational openness, the use of special software tools, the implementation of educational programs using distance learning technologies and e-learning were considered, their dynamics was studied. The paper presents the results of the influence of digitalization processes on the spatial organization of the regional vocational education system, and based on the selected indicators, the digitalization index is calculated. The analysis of the indicators and the results of the research made it possible to assess the trends in the digital development of the regional educational space in the context of an information society.

**Keywords** – regional system of professional education, digital economy, indicators of digitalization.

## I. INTRODUCTION

In the study of the spatial characteristics of the regional vocational education system (RSPE) of the subjects of the Ural industrial macro-region, the author's methodology includes the stage of assessing the trends of its digital development. Pursuant to the Federal Law of the Russian Federation dated 29.12.2012 No. 273-ФЗ “On Education in the Russian Federation”, we consider educational organizations of secondary vocational education (VSE) and higher education (HE), divided into levels.

For the analysis and evaluation of RSPE digitalization processes, we selected the following four indicators of educational organizations of VSE (vocational secondary education) and HE (higher education):

- 1) informational openness;
- 2) use of special software in the educational process;
- 3) indicators of the implementation of educational programs using distance learning technologies (DLT);
- 4) indicators of the implementation of professional educational programs using e-learning (EL).

Under the terms and conditions of the formation of a new information society for the development and functioning of the RSPE as an educational space in the region, one of the most important conditions is to ensure the openness of the

activities of educational organizations. For example, at present, the practice of preparing public reports by educational organizations is actively developing, various ratings are being compiled, monitoring their activities in order to monitor and evaluate the quality of students' training and other indicators characterizing the results of the educational process. T.A. Mertsalova considers information openness of educational organizations as a world trend, state priority, and regional resource [6]. We share the opinion of researchers that informational openness results in increase in the quality of education, is subject to regulatory regulation, i.e. is stimulating, controlled, regulated and controlled.

In recent years, special software, distance education technologies (DET) e-learning (EL), etc. have been actively used in the field of VSE and HE. The statistical data of these indicators have been appearing since 2013. Since 2015, a statistical accounting of special software for solving organizational, managerial and economic tasks (excluding automated document management systems) of educational organizations has appeared. Special software tools have a subdivision depending on the purpose of use: for the educational process and for organizational and managerial work.

New technologies in the educational process (DET, ELO) have both positive and negative sides, and, like everything new, they are improved in the process of their application, which takes time. Legislatively, according to the Federal Law of December 29, 2012 “On Education in the Russian Federation”, as amended on August 3, 2018, Article 16 clarifies the essence of e-learning – this is “... the organization of educational activities with the use contained in the databases and information used in the implementation of educational programs and information technologies providing it, processing, technical means, as well as information and telecommunication networks providing the transfer of the specified information via communication lines, interaction of students and the teachers” [14]. The main difference between the electronic form of education and the distance learning is the process of its implementation – mainly with “the use of information and telecommunication networks with indirect (at a distance) interaction of students and teachers” [14]. The use of new forms of education requires appropriate hardware and software. The study analyzed the statistical data of their use in the educational process of organizations of the VSE and HE.

## II. METHODS

An index method was used to analyze and evaluate the trends of digital development of the RSPE. This method of research, in our opinion, allows us to obtain an index of digitalization of the RSPE, identifying the trend of the process of digitization of the educational space of the region, the transformation of its content in the new environment. All selected statistics for digitization of the educational space were converted to dimensionless values using the following formula:

$$R_i = (X_i - X_{\min}) / (X_{\max} - X_{\min}), \quad (1)$$

wherein  $X_i$  – value of the selected indicator for the  $i$ -th region;  $X_{\max}$  and  $X_{\min}$  – its maximum and minimum values, respectively.

Then, each indicator is converted into an index with values ranging from 0 (minimum value of the analyzed indicator) to 1 (maximum value of the analyzed indicator). As a result, we obtained a composite index of digital rendering of the RSPE as an arithmetic average of the obtained partial indices.

## III. LITERATURE REVIEW

The analysis of the scientific literature has shown that in the new economic conditions the RSPE is an integral part of the socio-economic system of the region (M.A. Shabanova (2006) [16], A. Etzioni (2002) [18] and others). The study and identification of factors affecting the development of the RSPE in a new economy (information era, digitalization) are engaged in many researchers, for example, E.G. Animitsa, Ya.P. Silin (2017) [10], E.B. Dvoryadkina, E.G. Efimova (2018) [1], A.A. Tonzherakova (2014) [13], Mertsalova T.A. (2015) [6] and others.

The study examined various author's methods of assessing the state and development of the RSPE, including those proposed by G.A. Agarkov. (2012) [2], Solovey O.V. (2014) [11], Shvakova O.N. (2011) [17], Ye.P. Maskaykin and Artser T.V. (2009) [5], G.N. Fomitskaya (2012) [15], a team of researchers of the HSE (2017) [7], I.V. Zakharova (2011) [4], A.V. Suvorova (2014) [12] and other authors.

Statistical data on the selected indicators were taken from the website of the Ministry of Education and Science of the Russian Federation and from the collections "Regions of Russia: socio-economic indicators" for the years 2003-2017.

## IV. RESEARCH RESULTS

At present, the process of national educational reform continues. It should be noted that the ongoing reform has led to a reduction in the total number of elements of the RSPE. At the same time, there is an intensive reduction in the number of HE organizations and an increase in the number of VSE organizations mainly due to the introduction from 2013 (according to legislative changes) to this level of primary vocational education organizations (PEOs). The revealed dynamics of the change in the total number of elements of the armature is presented in figure one.

The indicator of the information openness of educational organizations of SPO and HE are their official websites available on the Internet. The data presented in Table 1 shows that the overwhelming majority of educational organizations of the Ural Region (99.8% m — obtained in the

study) [9] are characterized by informational openness and indicate that educational organizations follow the state of informational openness.

The next indicator of digitalization is the number of personal computers (PCs). This indicator has a close relationship with three other indicators: with informational openness, the use of special software, the use of EA and DET. In general, the use of the PC is now a means to implement the process of the digitalization of society.

Table 2 presents statistical data on the use of PC by the organizations of secondary professional education and higher education in the studied subjects, who find that the number of their use is growing. Only in the Orenburg region, the number of PCs decreased slightly (Table 2), due to the fact that in the course of educational reform in this subject, more than in other subjects of the Ural Region, the number of HE organizations decreased.

The process of digitization of the educational space is characterized by the indicator of the use of DET in the implementation of basic and additional educational programs by SPE and HE organizations. Table 3 presents statistical data on their use.

The data in Table 3 demonstrate the positive dynamics of the use of DET in organizations of SPO and HE in most subjects, except for the Kurgan and Chelyabinsk regions. In these subjects, most educational organizations are located in rural areas, where necessary conditions are not always available for using DET: for example, dedicated communication lines, uninterrupted quality communication, and hence the corresponding quality of equipment, specialists in its maintenance, and the similar.

Table 4 provides the indicators of the use of special software in the educational process of secondary vocational education and higher education. The data in Table 4 demonstrate the dynamics of the intensive growth of their use, which is explained by the increase in the number of OSS and the number of software used in all educational institutions of VSE and HE.

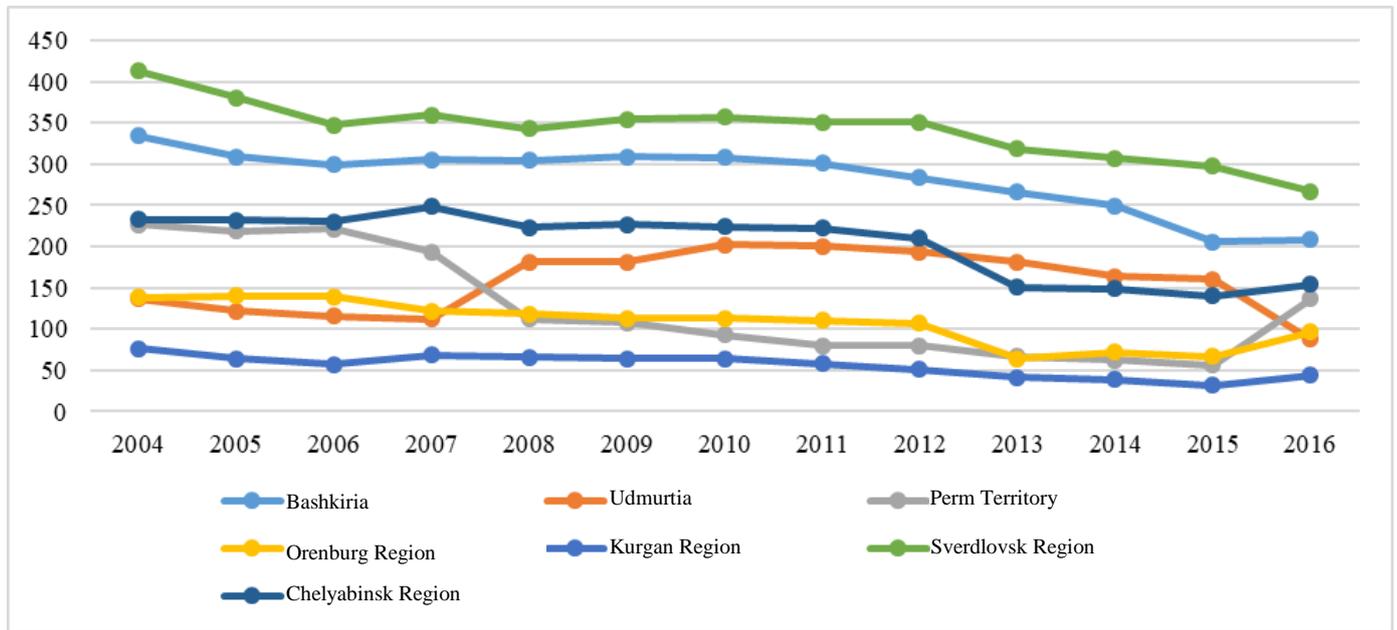


Fig. 1 – Dynamics of changes in the number of elements of the RSPE in the subjects of the Ural Region from 2004 to 2016 [8].

TABLE I. NUMBER OF EDUCATIONAL INSTITUTIONS OF VSE (VOCATIONAL SECONDARY EDUCATION) AND HE (HIGHER EDUCATION), HAVING AN E-MAIL ADDRESS AND A WEBSITE IN THE INTERNET, (UNITS)\*

Subject	2013		2014		2015		2016	
	Email	Website	Email	Website	Email	Website	Email	Website
Republic of Bashkortostan	138	135	127	125	160	152	164	159
Udmurtia	64	60	65	63	73	71	81	79
Perm region	121	115	115	113	82	82	124	124
Orenburg region	98	91	97	92	85	84	84	82
Kurgan region	37	37	36	33	42	41	44	41
Sverdlovsk region	221	211	215	209	225	219	213	210
Chelyabinsk region	54	52	49	49	43	43	39	38

\*Made under the data [9]

TABLE II. NUMBER OF PERSONAL COMPUTERS IN VSE AND HE INSTITUTIONS OF URAL REGION\*

Subject	Number of personal computers in educational institutions used::											
	for educational purposes	having access to the Internet	as part of local computer networks	for educational purposes	having access to the Internet	as part of local computer networks	for educational purposes	having access to the Internet	as part of local computer networks	for educational purposes	having access to the Internet	as part of local computer networks
	2013			2014			2015			2016		
Republic of Bashkortostan	24514	19739	20152	24956	21044	21293	25054	20899	20442	27785	25668	24400
Udmurtia	8163	6927	7030	8739	7579	7566	9108	7876	8023	8225	8522	8322
Perm region	18 274	14439	14176	18092	14587	14143	15078	12161	10029	18707	18001	14974
Orenburg region	11858	9142	9669	12232	9360	9707	12120	61730	9133	11684	11114	10669
Kurgan region	6163	4967	5255	6466	5408	5581	6993	6009	5903	6491	6928	6610
Sverdlovsk region	37202	33426	33338	36685	33544	33418	37051	34494	33282	37325	38718	36443
Chelyabinsk region	27239	23089	24562	27010	24197	24395	26992	24698	25406	27286	27734	26679

\* Made under the data [9]

**TABLE III. USE OF DET FOR THE IMPLEMENTATION OF EDUCATIONAL PROGRAMS BY SPO AND HE ORGANIZATIONS OF SUBJECTS OF THE URAL REGION \***

Subjects	Implementation of educational program, including:							
	2013		2014		2015		2016	
	main	additional	main	additional	main	additional	main	additional
Republic of Bashkortostan	44	34	39	33	54	35	65	37
Udmurtia	22	18	18	18	27	17	29	16
Perm region	25	24	30	27	21	11	52	11
Orenburg region	15	18	11	18	27	13	52	17
Kurgan region	16	10	11	8	8	3	11	5
Sverdlovsk region	71	47	73	46	92	34	75	34
Chelyabinsk region	52	31	82	34	54	18	40	11

\* Made under the data [9]

**TABLE IV. INDICATORS OF THE USE OF SPECIAL SOFTWARE (EXCEPT FOR GENERAL PURPOSE SOFTWARE) BY EDUCATIONAL ORGANIZATIONS OF VSE AND HE IN THE SUBJECTS OF THE URAL REGION \***

Subjects	Availability of special software (except for general purpose software), total			
	2013	2014	2015*	2016
Republic of Bashkortostan	933	871	1291	1407
Udmurtia	442	442	561	628
Perm region	800	780	619	966
Orenburg region	637	616	740	791
Kurgan region	247	235	313	335
Sverdlovsk region	1445	1429	1790	1714
Chelyabinsk region	932	836	1116	1070

\* Made under the data [9]

**TABLE V. INDICATORS OF THE IMPLEMENTATION OF EDUCATIONAL PROGRAMS WITH THE USE OF EE BY HE AND SPO ORGANIZATIONS IN THE SUB-SUBJECTS OF THE URAL REGION \***

Subjects	HE Educational organizations		VSE Educational organizations	
	2015	2016	2015	2016
Republic of Bashkortostan	25	24	112	134
Udmurtia	15	22	46	60
Perm region	27	25	42	74
Orenburg region	9	9	76	95
Kurgan region	14	14	14	10
Sverdlovsk region	60	49	145	152
Chelyabinsk region	51	38	112	82

\* Made under the data [9]

**TABLE VI. RSPE DIGITALIZATION INDEX**

Subjects	2013	2014	2015	2016
Republic of Bashkortostan	0,9	1,0	1,3	1,4
Udmurtia	0,2	0,2	0,3	0,3
Perm region	0,7	0,8	0,5	1,0
Orenburg region	0,3	0,3	1,0	0,6
Kurgan region	0,0	0,0	0,0	0,0
Sverdlovsk region	1,7	1,8	2,2	2,2
Chelyabinsk region	1,3	1,2	1,4	1,4

Relatively recently, a new form of education has emerged – e-learning (EL). Since this form is the newest, statistical data on its use in the federal statistical database are available only for 2015 and 2016, given in Table 5.

It is incorrect to analyze the dynamics of changes in EL application indicators for two years, but nevertheless, according to Table 5, we see that in most of the subjects of the Ural Region their dynamics is positive, although in general, the current national educational reform has a great influence on this process. It should be noted that the dynamics of the implementation of educational programs with the use of EL is similar to the dynamics of the use of DET – increasing. It is obvious that the indicator of the implementation of educational programs with the use of EE (and DET) in the process of computerization of the life sphere of society, including education, is the future vector of its development.

All the above statistics describing the process of digitization of educational activities were converted into dimensionless ones. On the basis of the obtained dimensionless values of the selected indicators, it can be stated that in the studied subjects there is an increase in the digital development of RSPE. On the basis of dimensionless indicators, the author has calculated the composite index of digitalization of RSPE as the arithmetic average of the individual indices included in it. The RSPE digitalization index, presented in Table 6, gives a general idea of the digital development trend of the RSPE elements of the studied subjects of the Ural Region.

According to Table 6, the following ranking of subjects was obtained: the Sverdlovsk Region became the absolute leader, followed by the Chelyabinsk Region and the Republic of Bashkortostan. The Perm region has the rating of the digitalization index above average. The average place in the ranking is occupied by the Orenburg region, slightly lower than the average rating of the Udmurt Republic. The Kurgan Region has become an absolute outsider – all indicators are zero.

In most of the studied subjects, the dynamics of values are positive in comparison with 2013. It should be a belt that the zero value of the digitalization index for the Kurgan Region does not mean at all that in this subject there is no digital development of the educational space (all values of the subject indicators in tables are not null). In the Kurgan Region, the smallest number of elements of RSPE among the seven subjects of the Ural Region, which in the reform process has decreased even more by 2015, and in 2016 the total number of RSPE elements does not exceed any indicator for the entire submitted period. Kurgan Region is a subsidized business entity, which determines the process of its social and economic development, including the state of the vocational education system.

In general, the digitalization index obtained in the study demonstrates the dynamics of growth, which indicates the state of its growth in the educational space of the studied subjects. The growing digitalization index is evidenced by the fact that in the process of the education system reform, against the background of a decrease in the total number of professional educational organizations (see Figure 1), there is an increase in the indicators of the digital development of AFSP considered in this article.

## V. CONCLUSION

The study reveals that the process of digitization of RSPE started relatively recently, including demonstration of a positive trend in the context of the ongoing national educational reform. The selected four indicators (informational openness, use of special software, new forms of education: DET and EL) characterize the ongoing process of digitization of the educational space of the regions. Information openness is the basis for creating two-way communication of educational institutions with consumers of their services. In the sphere of functioning of the educational market, an important goal is to satisfy the information needs of its participants on the status and results of activities of educational institutions in the region.

The modern tools and equipment, new technologies and new forms of education (DET, EL), the Internet and other innovative technologies are an essential attribute of digitalization of the educational space in the new information age. In general, the use of DET and EE has many positive aspects: for example, it can reduce (reduce) the length of the educational space, make it more accessible in terms of overcoming distances, convenient to use for consumers, more affordable in terms of tuition fees, and others. With regard to the quality of the provision of educational services through DET (and EL), we can say that this is a matter of another research direction (this study does not set such an objective).

It should be noted that currently DET in higher education institutions are used to a greater extent than in SPO organizations and this is explained by the fact that VSE educational organizations implement educational programs directly in the area where customers live, so there is no urgent need for DET.

Educational programs in the form of EL are essentially the implementation of a software product using the Internet or local area networks. Such a software product can be called an educational-methodical complex of the discipline in which the teacher (developer) places all educational and control and measuring materials, tasks for practical and laboratory work, and other materials for studying it. With the development of modern technologies, the Internet and other innovative means, it is obvious that DET and EL will increasingly penetrate into the life of the emerging information society [3]. As a result, we can conclude that the trend of the growth of the studied process of digitization of the RSPE is detected.

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