

Education and Skills as a Component of Ensuring Russian Competitiveness in the Global Digital Space: Statistical Aspect

Bychkova S.G.¹ Parshintseva L.S.^{2,*} Silina S.A.¹

¹ *Department of Service Marketing and Brand Management, State University of Management, Moscow 109542, Russian Federation*

² *Department of statistics, State University of Management, Moscow 109542, Russian Federation*

**Corresponding author. Email: lsparshintseva@yandex.ru*

ABSTRACT

The article is devoted to the actual topic of analyzing the formation of the information society from the point of view of assessing the level of knowledge and digital skills among the population. The aim of the study is a comparative analysis of indicators of education and the availability of necessary digital skills among the population included in various generalizing international indices and on their basis conducting cross-country comparisons and to assessing Russia's place in the world community. An analysis of the indicators used revealed two main problems. First, data for most statistical indicators are presented for earlier periods of time, while there is a lack of data for an extensive list of countries, and secondly, many generalizing indexes use expert assessments, which, on the one hand, expand the analytical capabilities of the studied indices, on the other hand, are subjective estimates and can distort the final results. A comparative analysis of countries and an assessment of Russia's positions were carried out on the basis of the proposed system of indicators using multidimensional clustering methods. As a result of the statistical study, the place of Russia in terms of education and digital skills among the population as the most important components of the formation and development of the information society was determined. The lag of the country from developed countries in terms of the use of Internet services and the population enrollment in higher education is revealed, as a result of overcoming of which the tasks set in the Information Society Development Strategy will be solved.

Keywords: *digital economy, statistical study of ICT development, knowledge and skills component, multidimensional classification of countries*

1. INTRODUCTION

In the modern world, important trends in the development of the economy and the social sphere are the development of information and communication technologies and the formation of the information society, a significant component of which is the presence of knowledge and digital skills among the population.

The growth of scientific interest in the knowledge economy and the digital economy can be traced in 1994-1996 as a result of the rapid increase in productivity in the USA and developed countries as a result of the introduction and use of ICT.

For example, Donald Tapscott in 1994 for the first time introduced the concept of "digital economy" into scientific circulation, while he defined knowledge as one of its most important characteristics [1]. In 1995, by Jace Katz and Philip Aspeden based on random national a telephone survey of the population on barriers to using the Internet has been shown to

the main obstacles to informatization of society are material difficulties and the lack of necessary knowledge and skills among the population [2]. Eric Brynjolfson and Brian Kahin [3] argued that the term "information economy" is based on information and knowledge as the basis for the long-term trend of asset expansion.

Over the next two decades, as a result of the development of the concept of the digital economy, this concept has been significantly expanded, while the intellectual component of the population is given increasing importance in the formation of the information society.

Of significant interest in this regard is the definition [4], which notes that the digital economy represents "a wide range of types of economic activity, which include the use of digitized information and knowledge as a key factor in production ...".

It is knowledge and digital skills of the population that are one of the most important components that form the basis of the ecosystem of the modern economy. A qualitatively new level of development of human capital allows us to create conditions for a new configuration of interaction

between various communities, business and the state in the country, which will ensure the country's competitiveness in the face of ever-accelerating globalization processes. A significant problem in the formation of a single digital space in the country is insufficient coordination of accounting at the national level, lack of transparency in the process of collecting and processing data. As well as their insufficient quality and level of detail, a large number of few interconnected software and technological solutions, as well as methodological approaches. Such problems indicate the need not only to change the educational level of the population and increase its digital literacy. But also the formation of skills in communities, allowing the use of fundamentally new digital services, as well as being participants in creating the technological infrastructure of the digital economy ecosystem. Accordingly, the development of knowledge and digital skills of the country's population will ensure its development in the context of world spaces.

The efforts undertaken by the world community to assess the development of the digital economy and society have led to the creation of a whole analytical direction, which involves, on the one hand, the formation of detailed multi-level indicator systems, and on the other, the allocation of indicators and generalized assessments of the development of the digital economy and society. The indicators currently used in global intercountry comparisons have a rather complicated structure, however, almost all of them contain components that characterize the development of human capital, including education and population skills.

The use by Russia of international experience in the formation of the "human" component of the ecosystem of the digital economy, as well as the development of its own data management systems taking into account the challenges facing the country, will solve fundamentally new challenges for the development of the country and ensuring its place in the global digital ecosystem.

To date, a large number of global indices have been developed aimed at measuring cross-country differences in the digitalization level of the economy and society, containing the intellectual component of the population.

In this regard, the aim of the study is a comparative analysis of the intellectual component of generalizing international indicators and, based on them, conducting cross-country comparisons and assessing Russia's place in the world community.

2. MATERIALS AND METHODS

The information base of the study was the official statistics of leading international organizations.

As statistical tools, methods of average values and multidimensional classification were used, as well as tabular and graphical methods of visual presentation of the research results. The primary data processing was carried out using statistical analysis application packages: Microsoft Excel and STATISTICA 10.0.

3. RESULTS

The importance in the formation of the information society is given to the knowledge and skills of the population. In most global indexes developed by leading international organizations, such as the World Economic Forum, the International Telecommunication Union, UNCTAD, the UN, the European Commission, the Economist Intelligence Unit and others, to assess the level of development of various aspects of informatization of the economy and society and cross-country comparison, a separate block is allocated component related to the assessment of education and the availability of digital skills among the population (Table 1) [5].

It should be noted that most indicators evaluating knowledge and skills among the population are obtained on the basis of expert assessments and specially organized surveys, which, on the one hand, deepen the possibilities for a qualitative assessment of the analyzed aspect of the development of the information society, on the other hand, are subjective and may not be correctly reflected on the total values of indices and ratings of countries of the world.

In addition, another problem in assessing the Knowledge and Skills component is the lack of data for most of the indicators cited for a complete list of countries.

and skills" (Figure 1).

Table 1 Indexes that include indicators of the "Knowledge and skills" component»

| Index | Component / Sub-index / group | Indicators |
|--|--------------------------------------|---|
| Global Competitiveness Index [6] | 6. Skills | 6.01. Mean years of schooling, years 6.02. Extent of staff training, 1-7 (best) 6.03. Quality of vocational training, 1-7 (best) 6.04. Skillset of graduates, 1-7 (best) 6.04a Skillset of secondary-education graduates, 1-7 (best) 6.04b Skillset of university graduates, 1-7 (best) 6.05. Digital skills among active population, 1-7 (best) 6.06. Ease of finding skilled employees, 1-7 (best) 6.07. School life expectancy, years 6.08. Critical thinking in teaching, 1-7 (best) 6.09. Pupil-to-teacher ratio in primary education, ratio |
| Global Social Mobility Index [7] | 2. Education Access | 2.01. Pre-primary enrolment, % of children 2.02. Quality of vocation training, 1-7 (best) 2.03. NEET ratio, % of 15-24 year olds 2.04. Out-of-school children, % of school age children 2.05. Inequality-adjusted education access, 0-100 (best) |
| | 3. Education Quality and Equity | 3.01. Children below minimum proficiency by age 10, % of children in school 3.02. Pupil-to-teacher ratio in pre-primary education, ratio 3.03. Pupil-to-teacher ratio in primary education, ratio 3.04. Pupil-to-teacher ratio in secondary education, ratio 3.05. Harmonized learning outcomes, score 3.06. Social diversity in schools, score 3.07. Lack of education materials among disadvantaged students, % of disadvantaged students in schools which report a lack of education material |
| | 4. Lifelong Learning | 4.01. Extent of staff training, 1-7 (best) 4.02. Active labour market policies, 1-7 (best) 4.03. Impact of ICTs on access to basic services, 1-7 (best) 4.04. Firms offering formal training, % of firms 4.05. Digital skills among active population, 1-7 (best) |
| ICT Development Index [8] | Skills | Mean years of schooling, years Secondary gross enrolment ratio, ratio Tertiary gross enrolment ratio, ratio |
| E-government development index [9] | Human capital Index | Adult literacy, per cent Gross enrolment ratio, per cent Expected years of schooling, years Mean years of schooling, years |
| Web-Index [10] | Education and awareness | Secondary school enrolment rates Literacy rates Ratio of female: male tertiary enrolment School life expectancy (years) male/female Government implementation of gender equity of web access for women and girls |
| E-commerce index [11] | - | Share of individuals using the Internet Share of individuals with an account |
| The Digital Economy and Society Index [12] | Human capital | 2a Internet user skills: 2a1 At least basic digital skills, % individuals 2a2 Above basic digital skills, % individuals 2a3 At least basic software skills, % individuals 2b Advanced skills and development 2b1 ICT specialists, % total employment |

| | | |
|-----------------------------------|---|--|
| | | 2b2 Female ICT specialists, % female employment 2b3 ICT graduates, % graduates |
| | Use of internet services | 3b Activities online 3b1 News 3b2 Music, videos and games 3b3 Video on demand 3b4 Video calls 3b5 Social networks 3b6 Professional social networks 3b7 Doing an online course 3b8 Online consultations and voting 3c Transactions 3c1 Banking 3c2 Shopping 3c3 Selling online |
| The Inclusive Internet Index [13] | 3. Relevance | 3.2. Relevant content 3.2.2. Value of e-finance 3.2.4. Value of e-health 3.2.5. E-Entertainment usage 3.2.7. Value of e-Commerce |
| | 4. Readiness | 4.1. Literacy 4.1.1. Level of literacy 4.1.2. Educational attainment 4.1.3. Support for digital literacy |
| The digital literacy index [14] | 1. The sub-index of digital consumption | Level of social consumption media; The level of consumption of digital public service; The level of consumption of news information on the Internet. |
| | 2. The sub-index of digital competence | Competence in the field of search information on the Internet; Competence in the use of mobile devices communication tools; Competence in the use of social networks; Competence in conducting financial transactions through Internet; Competence in the field of consumption of goods and services through Internet; Competence in the field of critical perception of information and validation checks; Competence in the field of multimedia content production for the Internet. |
| | 3. The sub-index of digital security | Have the skills to deal with threats to the integrity of information and computer viruses |

Since the purpose of the study is a comparative analysis of the component relating to the assessment of knowledge and skills among the population, international indices, as well as an assessment of the positions of the Russian Federation in terms of the studied characteristics in comparison with developed countries (with OECD countries), and with countries making up, along with Russia, organizations such as BRICS, CIS, EAEU, Shanghai Cooperation Organization, taking into account minimization of the risks described above, a subsystem of statistical indicators was created that characterizes the Knowledge component

To identify the place of Russia among the OECD, BRICS, CIS, EurAsEC and SCO countries, 6 indicators were selected according to the level of "knowledge and digital skills among the population: 3 indicators of the Education group and 3 indicators of the Skills group.

Table 2 shows the results of a multidimensional grouping of countries for 2018 and 2019. Based on the results of the countries clustering, 3 groups were identified, the first of which is characterized by a low level of knowledge and digital skills among the population, and the third group consisted of the countries with the highest values of the considered indicators.

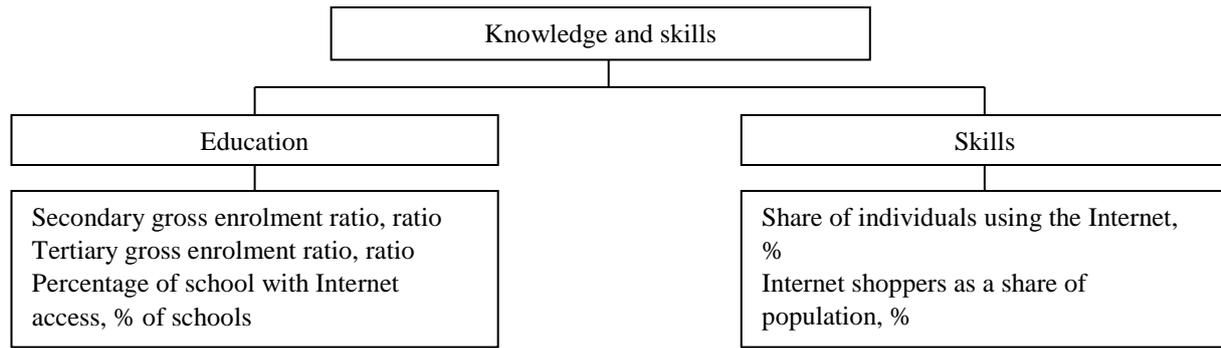


Figure 1 Statistical indicators of the "Knowledge and skills" component"

Since the purpose of the study is a comparative analysis of the component relating to the assessment of knowledge and skills among the population, international indices, as well as an assessment of the positions of the Russian Federation in terms of the studied characteristics in comparison with developed countries (with OECD countries), and with countries making up, along with Russia, organizations such as BRICS, CIS, EAEU, Shanghai Cooperation Organization, taking into account minimization of the risks described above, a subsystem of statistical indicators was created that characterizes the Knowledge component

To identify the place of Russia among the OECD, BRICS, CIS, EurAsEC and SCO countries, 6 indicators were selected according to the level of "knowledge and digital skills among the population: 3 indicators of the Education group and 3 indicators of the Skills group.

Table 2 shows the results of a multidimensional grouping of countries for 2018 and 2019. Based on the results of the countries clustering, 3 groups were identified, the first of which is characterized by a low level of knowledge and digital skills among the population, and the third group consisted of the countries with the highest values of the considered indicators.

Table 2 Average values of indicators for selected groups of countries

| Indicators | Year | The cluster number | | |
|--|------|--------------------|--------|--------|
| | | 1 | 2 | 3 |
| Share of individuals using the Internet, % | 2019 | 45,20 | 75,72 | 90,38 |
| | 2018 | 43,65 | 74,89 | 90,25 |
| Internet shoppers as a share of population, % | 2019 | 4,80 | 31,39 | 68,13 |
| | 2018 | 4,65 | 30,12 | 67,18 |
| E-Entertainment usage, % | 2019 | 85,70 | 91,98 | 86,01 |
| | 2018 | 84,69 | 91,10 | 85,60 |
| Percentage of schools with Internet access; % of schools | 2019 | 48,73 | 90,32 | 98,98 |
| | 2018 | 47,14 | 89,70 | 97,30 |
| Gross enrolment ratio, tertiary, both sexes (%) | 2019 | 21,96 | 66,39 | 77,96 |
| | 2018 | 20,70 | 65,80 | 76,20 |
| Gross enrolment ratio, secondary, both sexes (%) | 2019 | 83,74 | 102,52 | 124,55 |
| | 2018 | 82,85 | 101,80 | 123,70 |

The clustering of countries did not include Iceland, Kyrgyzstan, Luxembourg, Moldova, Norway, New Zealand, Slovakia, Slovenia, Tajikistan, Japan due to the lack of data on most of the indicators analyzed. Table 3 presents the composition of the selected groups of countries for 2018 and 2019. Based on the results of the multivariate classification, it was concluded that the composition of the groups is quite stable during the analyzed period, with the exception of Armenia and Azerbaijan, which in 2019 improved their positions and moved from the first group to the second.

The best group in terms of the Knowledge and Skills component is the third group, which included exclusively the most developed countries.

During the analyzed period, the Russian Federation fell into the second group along with most of the CIS countries, EurAsEC and SCO. The second group is characterized by lower values for all the studied indicators compared to the third group of countries, with the exception of the E-Entertainment usage indicator, where the highest values were recorded.

The analysis showed that the Russian Federation is characterized, first of all, by the lag in popularity of the use of Internet services by the population.

Table 3 Composition of country groups by statistical indicators of the Knowledge and Skills component

| Year | The cluster number | | |
|------|--|--|--|
| | 1 | 2 | 3 |
| 2019 | India, Mexico, Pakistan, South Africa, Uzbekistan | Armenia, Azerbaijan, Belarus, Brazil, Chile, China, Czech Republic, Greece, Hungary, Israel, Italy, Korea, Kazakhstan, Poland, Portugal, Russia, Turkey, Ukraine | Australia, Austria, Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Ireland, Netherlands, Spain, Sweden, Switzerland, United Kingdom, United States |
| 2018 | India, Mexico, Pakistan, South Africa, Uzbekistan, Armenia, Azerbaijan | Belarus, Brazil, Chile, China, Czech Republic, Greece, Hungary, Israel, Italy, Korea, Kazakhstan, Poland, Portugal, Russia, Turkey, Ukraine | Australia, Austria, Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Ireland, Netherlands, Spain, Sweden, Switzerland, United Kingdom, United States |

Table 4 Distribution of countries by regions of the world for 2019

| Group of countries | World region | The cluster number | | |
|----------------------------|-----------------------------|--------------------|-----------|-----------|
| | | 1 | 2 | 3 |
| OECD | Eastern Europe | - | 3 | - |
| | Western Europe | - | - | 6 |
| | Southern Europe | - | 3 | 1 |
| | Northern Europe | - | - | 6 |
| | Australia and Oceania | - | - | 1 |
| | Middle East | - | 2 | - |
| | East Asia | - | 1 | - |
| | Northern America | - | - | 2 |
| CIS, EurAsEC | Latin America | 1 | 1 | - |
| | Eastern Europe | - | 2 | - |
| | Central Asia | 1 | 1 | - |
| SCO | Middle East | - | 2 | - |
| | South Asia (Pakistan) | 1 | - | - |
| BRICs | Latin America (Brazil) | - | 1 | - |
| | Eastern Europe (Russia) | - | 1 | - |
| | South Asia (India) | 1 | - | - |
| | East Asia (China) | - | 1 | - |
| | South Africa (South Africa) | 1 | - | - |
| Number of countries | | 5 | 18 | 16 |

Table 4 shows the distribution of countries by region of the world for 2019.

The first group of countries includes countries with a low level of "knowledge and digital skills" among the population. This group was made up of the BRICS, SCO and CIS countries. The second group of countries (the largest) is represented by 10 OECD countries, 5 CIS and EurAsEC countries and 3 BRICS countries. The highest level of knowledge and digital skills of the population occurs among the countries of the third group, which is represented by the countries of Northern and Western Europe. It also includes Australia, Spain, Canada and the United States.

4. DISCUSSION AND CONCLUSION

The study made it possible to identify the composition of indicators related to knowledge and digital skills among the population, as well as the possibility of their use for cross-country comparisons. It was found that for most indicators there is no data for a wide range of countries, while statistics are provided for earlier years and do not take into account recent trends. Also, when calculating a number of generalizing characteristics, expert estimates and specially organized surveys are used, which, on the one hand, significantly expand the capabilities of the analysis of the intellectual component, on the other hand, are subjective.

As a result of multidimensional classification, it was concluded that the population of the most developed countries have a higher level of education and possess the necessary digital skills.

The Russian Federation is characterized by a lag behind developed countries in terms of the use of Internet services by the population, such as, for example, electronic commerce, as well as in the coverage of the population with higher education. Despite the fact that the country is at the junction between the second and third clusters in most of the analyzed indicators without overcoming this gap, it will be problematic to reduce the differences between Russia and developed countries.

REFERENCES

- [1] Tapscott, D, *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*, New York, N.Y.: McGraw-Hill, 1994, pp. 368
- [2] Katz, J., & Aspden, Ph, *Motivations for and Barriers To Internet Usage: Results of a National Public Opinion Survey*. *Internet Research—Electronic Networking Applications and Policy*, 1997, 7(3), 170-188
- [3] Brynjolfsson E., Kahin B, *Introduction*, in *Understanding the Digital Economy* / E. Brynjolfsson, B. Kahin (eds). Cambridge: MIT Press, 2000, pp. 1–10.
- [4] G20 DETF (2016) *G20 Digital Economy Development and Cooperation Initiative*. Access: <http://www.g20.utoronto.ca/2016/g20-digital-economy-development-and-cooperation.pdf> (date: 05.02. 2020).
- [5] Svetlana G. Bychkova, Lidiya S. Parshintseva, *Information and communication technologies as a basis for the development of the information society: Russia in the system of international statistical indicators*, *Statistica I Ekonomika*, 2019, T. 16, 1, pp. 32-40.
- [6] *The Global Competitiveness Report 2019*. Geneva: World Economic Forum; 2019
- [7] *Global Social Mobility Index 2020*. Geneva: World Economic Forum; 2020
- [8] Itu.int [Internet] Available from: <https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017/methodology.aspx>
- [9] *E-government 2018. The use of e-government to create a sustainable and flexible society*. New York: United Nations; 2018.
- [10] Thewebindex.org [Internet] Available from: https://thewebindex.org/data/?indicator=ITU_G
- [11] UNCTAD *B2C E-COMMERCE INDEX 2019*. United Nation: United Nations Conference on Trade and Development, 2019
- [12] Ec.europa.eu [Internet] Available from: <https://ec.europa.eu/digital-single-market/en/desi>
- [13] *The Inclusive Internet Index 2019*. Sweden: Economist Intelligence Unit, 2019
- [14] *Information Society Indicators in the Russian Federation*. Moscow: HSE University, 2019