

EDN: RRNXHD
УДК 331.108

Assessment of the level of Human Capital Development in the Central Black Earth Macroregion and Formation of a Strategy for Interregional Cooperation in Order to Develop Human Capital in the Context of Digital Transformation

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Received 25.12.2022, received in revised form 25.12.2023, accepted 17.01.2024

Abstract. The article provides an analytical basis for assessing the level of human capital development in the regions of the Central Black Earth macroregion. The authors want to determine the priorities of the strategic directions for the development of human capital, taking into account the problem areas of the human capital development of the region in the context of digital transformation in order to form a strategy for interregional interaction for the development of human capital of the macroregion in the context of digital transformation. The selected system of aggregated indicators of human capital forms from the standpoint of digitalization made it possible to assess the regions of the Central Black Earth macroregion and identify the regions that are the leaders and outsiders in terms of the level of human capital development. The results show that the development of human capital in the regions included in the region, taking into account the problem areas for the development of all forms of human capital, is only possible in a comprehensive and systematic way. This can be achieved within the framework of the integrated implementation of the interregional cooperation strategy for the development of the intellectual form of human capital. The novelty of scientific research lies in solving the practical problem of developing instrumental support for the system of developing the human capital of the region in the context of digital transformation.

Keywords: assessment of human capital development, macroregion, strategic priorities, algorithm, strategy for interregional interaction.

Research area: social structure, social institutions and processes (sociological sciences); economics.

Citation: Fedorova A. Yu., Weiss E. V., Cherkashnev R. Yu., Ilyukhina M. V. Assessment of the level of Human Capital Development in the Central Black Earth Macroregion and Formation of a Strategy for Interregional Cooperation in Order to Develop Human Capital in the Context of Digital Transformation. In: *J. Sib. Fed. Univ. Humanit. soc. sci.*, 2024, 17(3), 430–444. EDN: RRNXHD



Оценка уровня развития человеческого капитала Центрально-Черноземного макрорегиона и формирование стратегии межрегионального взаимодействия с целью развития человеческого капитала Центрально-Черноземного макрорегиона в условиях цифровой трансформации

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Аннотация. В статье излагается аналитическая основа для оценки уровня развития человеческого капитала регионов Центрально-Черноземного макрорегиона. Авторы хотят определить приоритеты стратегических направлений развития человеческого капитала с учетом проблемных зон развития человеческого капитала региона в условиях цифровой трансформации с целью формирования стратегии межрегионального взаимодействия по развитию человеческого капитала Центрально-Черноземного макрорегиона в условиях цифровой трансформации. Подобранный система агрегированных индикаторов форм человеческого капитала с позиции цифровизации позволила провести оценку регионов Центрально-Черноземного макрорегиона и выявить регионы, являющиеся лидерами и аутсайдерами по уровню развития человеческого капитала. Результаты показывают, что развитие человеческого капитала регионов, входящих в Центрально-Черноземный регион, с учетом проблемных зон развития всех форм человеческого капитала возможно только комплексно и системно. Этого можно достичь в рамках комплексного внедрения стратегии межрегионального взаимодействия по развитию интеллектуальной формы человеческого капитала. Новизна научного исследования состоит в решении практической задачи разработки инструментального обеспечения системы развития человеческого капитала региона в условиях цифровой трансформации.

Ключевые слова: оценка развития человеческого капитала, макрорегион, стратегические приоритеты, алгоритм, стратегия межрегионального взаимодействия.

Научная специальность: 5.4.4. Социальная структура, социальные институты и процессы (социологические науки); 5.2. Экономические науки.

Цитирование: Федорова А. Ю., Вейс Е. В., Черкашнев Р. Ю., Илюхина М. В. Оценка уровня развития человеческого капитала Центрально-Черноземного макрорегиона и формирование стратегии межрегионального взаимодействия с целью развития человеческого капитала Центрально-

Черноземного макрорегиона в условиях цифровой трансформации. *Журн. Сиб. федер. ун-та. Гуманитарные науки*, 2024, 17(3), 430–444. EDN: RRNXHD

Introduction

The present time dictates new rules for the development of the economy not only of the regions, but of the entire country. Its main direction is the spatial development of the Russian Federation, which is indicated in the Strategy for the spatial development of the Russian Federation for the period up to 2025, approved by the Government on February 13, 2019. It is worth noting that the most important issue in the geopolitical economy is «the spatial development of most countries, aimed at increasing the number of economic growth centers with a competitive economy, as well as ensuring the high connectivity of such centers with each other, with adjacent territories and entry points to international markets».

At the moment, a group of large centers is integrated in the Russian Federation, which are centers of economic growth, namely the macroregions of the country.

«Macroregions activate interregional economic interaction, enhance cooperative synergy, form spatial “growth poles” that make it possible to increase the efficiency of using the existing resource base of the regions» (Weiss, 2021).

Summarizing all of the above, it is obvious that the development of human capital in the context of a digital transformational economy formation is a fundamental provision for economic growth not only in the region, but also in the macroregion (Filippova, 2007; Kastrulina, 2012). In this regard, the assessment of human capital will be carried out using the general integral coefficient of human capital development, namely in the regions included in the Central Black Earth macroregion.

This is due to the fact that the Central Black Earth region is of fundamental strategic importance for the development of the Russian Federation, because it occupies an advantageous geo-economic position, acting as a trigger for progressive regional development.

The conducted assessment and analysis will make it possible to determine the regions –

leaders and the regions – outsiders in terms of the level and quality of human capital development using the integral coefficient of human capital development in the regions included in the Central Black Earth region. Also, based on the results obtained, we will propose an effective scenario for the formation of a strategy for interregional interaction in order to develop the human capital of the Central Black Earth macroregion in the context of digital transformation.

Data

The Central Black Earth macroregion is an integration of a group of regions, namely Belgorod, Voronezh, Kursk, Lipetsk and Tambov regions. Graphically, the Central Black Earth region can be represented as follows (Fig. 1):

The area of the Central Black Earth macroregion is 167.7 thousand km². The population of this macroregion is 7,141,554 people, the population density per km² is 42.90. The level of urbanization: 68 % of the population lives in cities, 32 % – in rural areas.

One of the largest iron ore deposits in the world, the Kursk Magnetic Anomaly, is located in the Central Black Earth macroregion. Also, the macroregion is distinguished by its soil richness, more than 80 % of the land here is fertile black soil. The main industries are ferrous metallurgy, mechanical engineering and chemical industry. The population is distributed relatively evenly throughout the region, there is no obvious bias towards urbanization, but a shortage of labor resources is gradually beginning to be felt.

Next, we assessed the human capital of the regions included in the Central Black Earth macroregion for the period from 2016 to 2020, using the methodology for assessing the development of the human capital in the region through the integral coefficient for assessing the development of the human capital in the region (Kurgansky, 2011).

A graphical diagram of the system and parameters for the formation of the integral co-

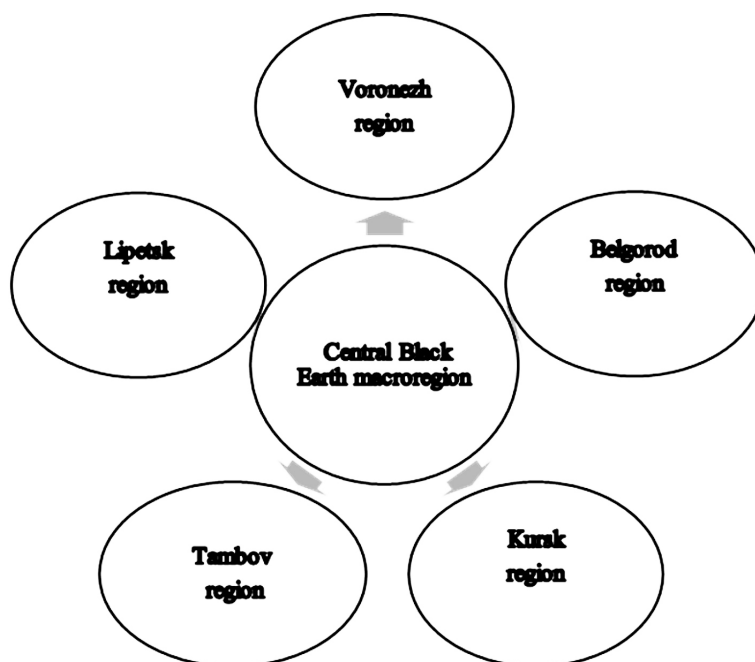


Fig. 1. The graphic image of the Central Black Earth macroregion

efficient of human capital development in the region is shown in Fig. 2.

Discussion

Based on this methodology, we obtained the following values of the integral coefficient of human capital development in the regions of the Central Black Earth economic region, shown in Fig. 3 and Table 1.

After analyzing the obtained value of this integral coefficient for the study period, it is obvious that there is a decrease in all regions, with the exception of the Belgorod region.

In order to determine the reason for such negative dynamics, let us consider in detail the dynamics of generalizing coefficients in all regions included in the Central Black Earth macroregion, such as:

- generalizing development coefficient of the physical form of human capital;
- generalizing development coefficient of the network form of human capital;
- generalizing development coefficient of the intellectual form of human capital;
- generalizing development coefficient of the social form of human capital;

- generalizing development coefficient of the organizational form of human capital (Weiss, 2020).

Dynamics of the generalizing coefficient of the physical form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020 (Table 2 and Fig. 4).

Let us consider in more detail the dynamics of generalizing coefficients in the presented areas of the macroregion.

The dynamics and value of the generalizing coefficient characterizing the development of the social form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020 in the context of digital transformation are presented in Table 3 and Fig. 5.

The following is the value of the generalizing development coefficient of the organizational form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020 (Table 4).

Dynamics of the generalizing coefficient of the organizational form of human capital in the regions included in the Central Black Earth

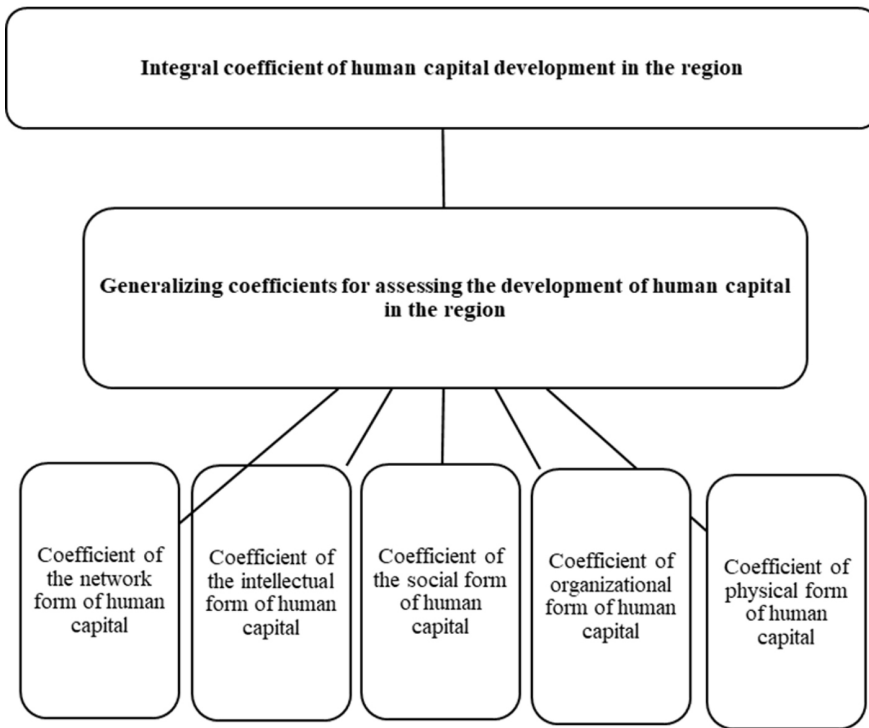


Fig. 2. Scheme of the system and parameters for the formation of the integral coefficient of human capital development in the region

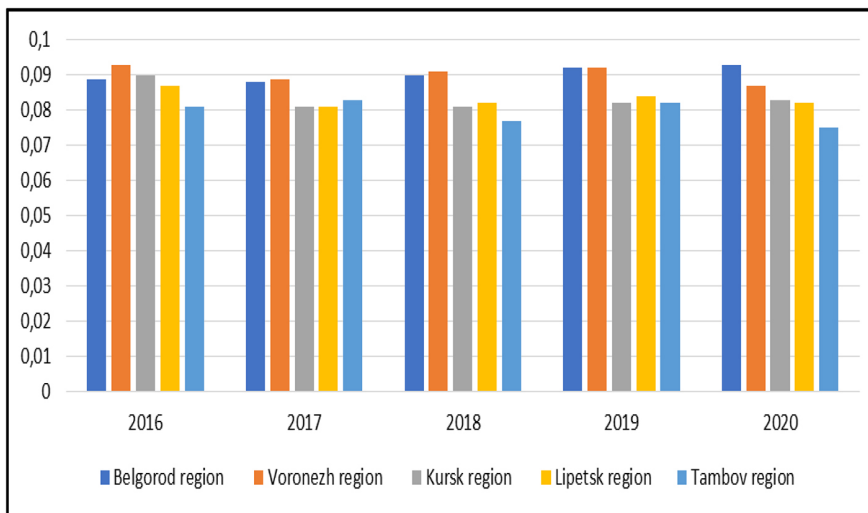


Fig. 3. Dynamics and value of the integral coefficient of human capital development in the regions of the Central Black Earth macroregion for the period from 2016–2020

Table 1. The value of the integral coefficient of human capital development for the period from 2016–2020

Integral coefficient of human capital development					
Region	2016	2017	2018	2019	2020
Belgorod region	0,089	0,088	0,090	0,092	0,093
Voronezh region	0,093	0,089	0,091	0,092	0,087
Kursk region	0,090	0,081	0,081	0,082	0,083
Lipetsk region	0,087	0,081	0,082	0,084	0,082
Tambov Region	0,081	0,083	0,077	0,082	0,075

Table 2. The value of the generalizing coefficient of development of the physical form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Generalizing integral coefficient of physical form (Kifk)					
Region	2016	2017	2018	2019	2020
Belgorod region	0,068	0,056	0,058	0,072	0,079
Voronezh region	0,099	0,084	0,077	0,08	0,059
Kursk legion	0,112	0,069	0,074	0,082	0,093
Lipetsk region	0,078	0,054	0,05	0,06	0,045
Tambov Region	0,07	0,071	0,028	0,054	0,026

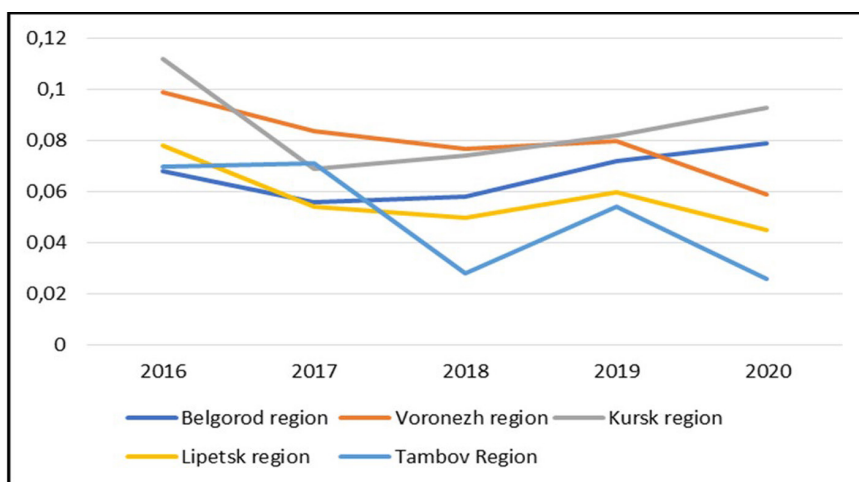


Fig. 4. Dynamics of the generalizing coefficient of the physical form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Table 3. The value of the generalizing coefficient of development of the social form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

The generalizing integral coefficient of the social form (Kisok)					
Region	2016	2017	2018	2019	2020
Belgorod region	0,098	0,094	0,092	0,088	0,091
Voronezh region	0,096	0,09	0,088	0,085	0,086
Kursk region	0,082	0,077	0,076	0,074	0,074
Lipetsk region	0,092	0,089	0,085	0,086	0,088
Tambov Region	0,082	0,08	0,08	0,072	0,075

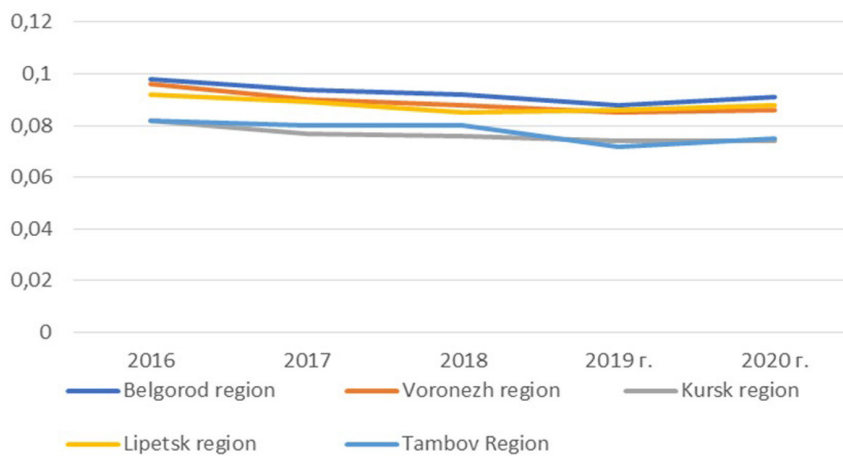


Fig. 5. Dynamics of the generalizing coefficient of the social form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Table 4. The value of the generalizing development coefficient of the organizational form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Generalizing integral coefficient of organizational form (Kiok)					
Region	2016	2017	2018	2019	2020
Belgorod region	0,099	0,09	0,097	0,103	0,107
Voronezh region	0,094	0,089	0,098	0,104	0,103
Kursk region	0,078	0,076	0,078	0,08	0,082
Lipetsk region	0,106	0,096	0,099	0,096	0,096
Tambov Region	0,089	0,083	0,087	0,096	0,095

macroregion for the period from 2016–2020 shown in Fig. 6.

The next stage is the value of the generalizing development coefficient of the intellectual form of human capital in the regions included

in the Central Black Earth macroregion for the period from 2016–2020 (Table 5).

Fig. 7 shows the dynamics of the generalizing coefficient of the intellectual form of human capital in the regions included in the

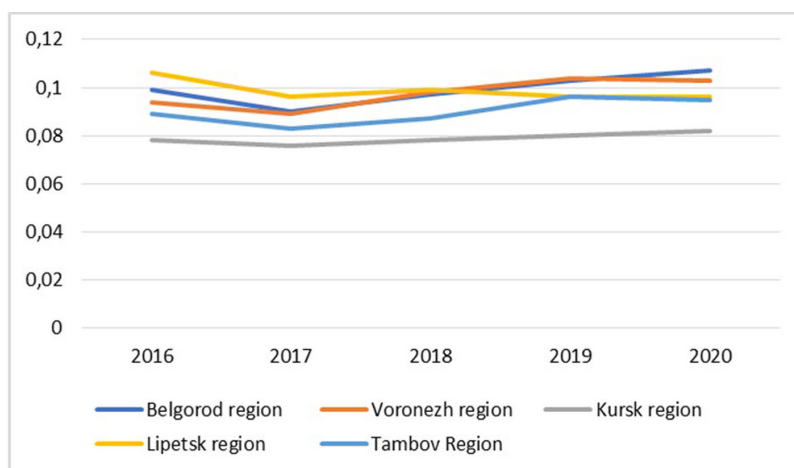


Fig. 6. Dynamics of the generalizing coefficient of the organizational form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Table 5. The value of the generalizing development coefficient of the intellectual form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Generalizing integral coefficient of intellectual form (Kiik)					
Region	2016	2017	2018	2019	2020
Belgorod region	0,005	0,006	0,006	0,006	0,005
Voronezh region	0,009	0,01	0,011	0,013	0,01
Kursk region	0,005	0,004	0,004	0,005	0,004
Lipetsk region	0,003	0,004	0,004	0,004	0,003
Tambov Region	0,004	0,003	0,004	0,004	0,004

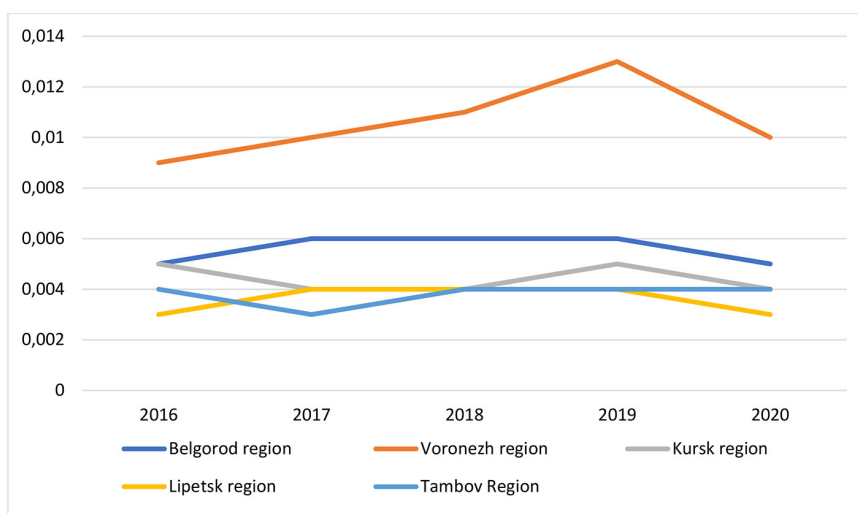


Fig. 7. Dynamics of the generalizing coefficient of the intellectual form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Central Black Earth macroregion for the period from 2016–2020.

The final stage in the analysis and evaluation of the generalizing coefficients of the integral coefficient of human capital development in the regions of the Central Black Earth macroregion for the period from 2016–2020 is the assessment of the network form of human capital.

The value of the generalizing coefficient characterizing the development of the network form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020 in the context of digital transformation is presented in Table 6.

Dynamics of the generalizing coefficient of the network form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020 is shown in Fig. 8.

For a more visual representation and convenience of assessment, we integrated in Table 7 the values of the generalizing coefficients of human capital in the regions included in the Central Black Earth macroregion in 2020 by forms of human capital.

Next, we graphically presented a general characteristic of the generalizing coefficients of human capital in the regions included in the Central Black Earth macroregion in 2020 by the forms of human capital (Fig. 9).

Table 6. The value of the generalizing development coefficient of the network form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Generalizing integral coefficient of the network form (Kisk)					
Region	2016	2017	2018	2019	2020
Belgorod region	0,175	0,192	0,195	0,19	0,183
Voronezh region	0,167	0,174	0,181	0,178	0,179
Kursk region	0,172	0,177	0,171	0,171	0,16
Lipetsk region	0,158	0,164	0,172	0,175	0,178
Tambov Region	0,158	0,18	0,186	0,184	0,174

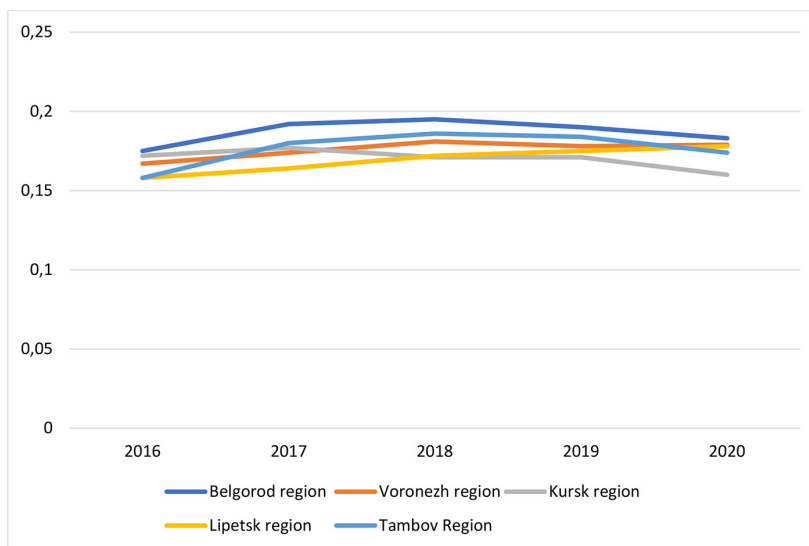


Fig. 8. Dynamics of the generalizing coefficient of the network form of human capital in the regions included in the Central Black Earth macroregion for the period from 2016–2020

Table 7. The value of the generalizing coefficients of human capital in the regions included in the Central Black Earth macroregion in 2020 by forms of human capital

Generalizing coefficients of human capital					
Region	Physical form	Organization the form	Social form	Network form	Intellectual form
Belgorod region	0,079	0,107	0,091	0,183	0,005
Voronezh region	0,059	0,103	0,086	0,179	0,01
Kursk region	0,093	0,082	0,074	0,16	0,004
Lipetsk region	0,045	0,096	0,088	0,178	0,003
Tambov Region	0,026	0,095	0,075	0,174	0,004

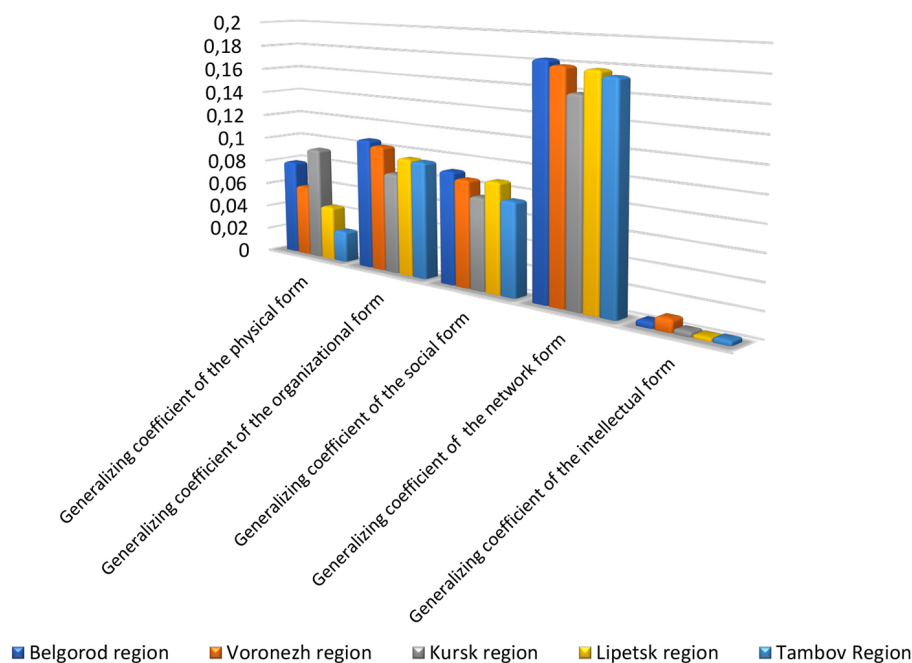


Fig. 9. Characteristics of the generalizing coefficients of human capital in the regions included in the Central Black Earth macro-region in 2020 by forms of human capital

Analyzing the obtained values of the generalizing coefficients of human capital, it is obvious that they show an ambiguous picture.

The leading position in terms of the level of development and quality of human capital was occupied by the Belgorod region.

The Belgorod region is a leader in terms of human capital in terms of organizational, social and network forms.

The Voronezh region has the highest value in terms of the intellectual form of human capital.

The Kursk region has become a leader in the development of the physical form of human capital.

The Lipetsk region has a very worthy position in terms of the development of human capital in the context of digital transformation.

The Tambov region has an unsatisfactory low level of development of the physical form of human capital.

Summarizing all of the above, it is obvious that for the studied regions that are part of the Central Black Earth macroregion, an integral

and comprehensive development of all forms of human capital is necessary, and this necessitates the development of a number of strategic measures that provide an opportunity to eliminate vulnerabilities in the human capital development system, both of an individual form, and of the whole group of human capital forms (Polyakov, 2010).

In our opinion, the formation of a strategy for the development of the human capital in the regions should affect all available partial indicators of the integral coefficient. At the same time, one should focus on strategic priorities chosen in accordance with a certain form of human capital. Such priorities, in turn, are aimed at strengthening the development of a particular form and imply the implementation of certain actions, taking into account strategic factors.

It should be noted that in the context of progressive and rapid absorption by digitalization of all spheres of a person's life, the human development is a priority in forming the socio-economic policy of the region. Therefore, the level and quality of human capital is a fundamental factor for high efficiency and progress in the development of the regions of the Russian Federation.

For this purpose, we propose the development of an interregional cooperation strategy for the development of human capital in the regions included in the Central Black Earth macroregion, which will take into account all forms of human capital, determine priority strategic directions and act as a single integrated multi-component system.

"The strategy of interregional interaction for the development of the human capital of the region is a vector of interregional interaction aimed at eliminating problem areas in the development of the human capital of the regions under study" (Kappusheva, 2017).

Formation of a strategy for interregional cooperation

The developed algorithm for the formation of an interregional interaction strategy for the development of the human capital in the region is shown in Fig. 10.

This algorithm consists of five interrelated stages:

The first stage is the assessment of the integral coefficient of human capital development in the regions included in the Central Black Earth macroregion and the determination of the main strategic directions of interregional cooperation using the priority selection matrix.

The second stage is the development of an interregional interaction scenario for the development of the human capital in the region, which includes key positions for the development of all forms of human capital, based on a previously developed list of strategic scenarios for interregional interaction and then, based on the chosen target scenario for the construction of a digital integrated platform for interregional interaction.

The fourth stage is the formation of a target program containing priority areas related to interregional cooperation.

The fifth stage is the coordination of the strategy at the regional level and approval by the legislative authority of the macroregion.

According to Fig. 11, it is obvious that the formation of an interregional interaction strategy for the development of human capital in the Central Black Earth macroregion is necessary from the point of view of the development of an intellectual form of human capital in the region, since in all regions included in the macroregion, the given form of human capital lags far behind other forms that make up a single system for the development of human capital.

Based on the list of strategic scenarios for interregional cooperation in order to develop the human capital of the region in the context of digital transformations (Demidova ad al, 2015; Jorgenson, Fraumeni, 1989), we need to take the scenario or the development of the intellectual form of human capital as the basis for building a strategy for interregional interaction.

Fig. 11 shows that the interregional interaction will be formed in two parallels: the development of an innovative educational ecosystem and the creation of a scientific and educational digital platform.

The main goal for forming this strategy will be the modernization and improvement of communication skills in the digital educational environment, the training of personnel for

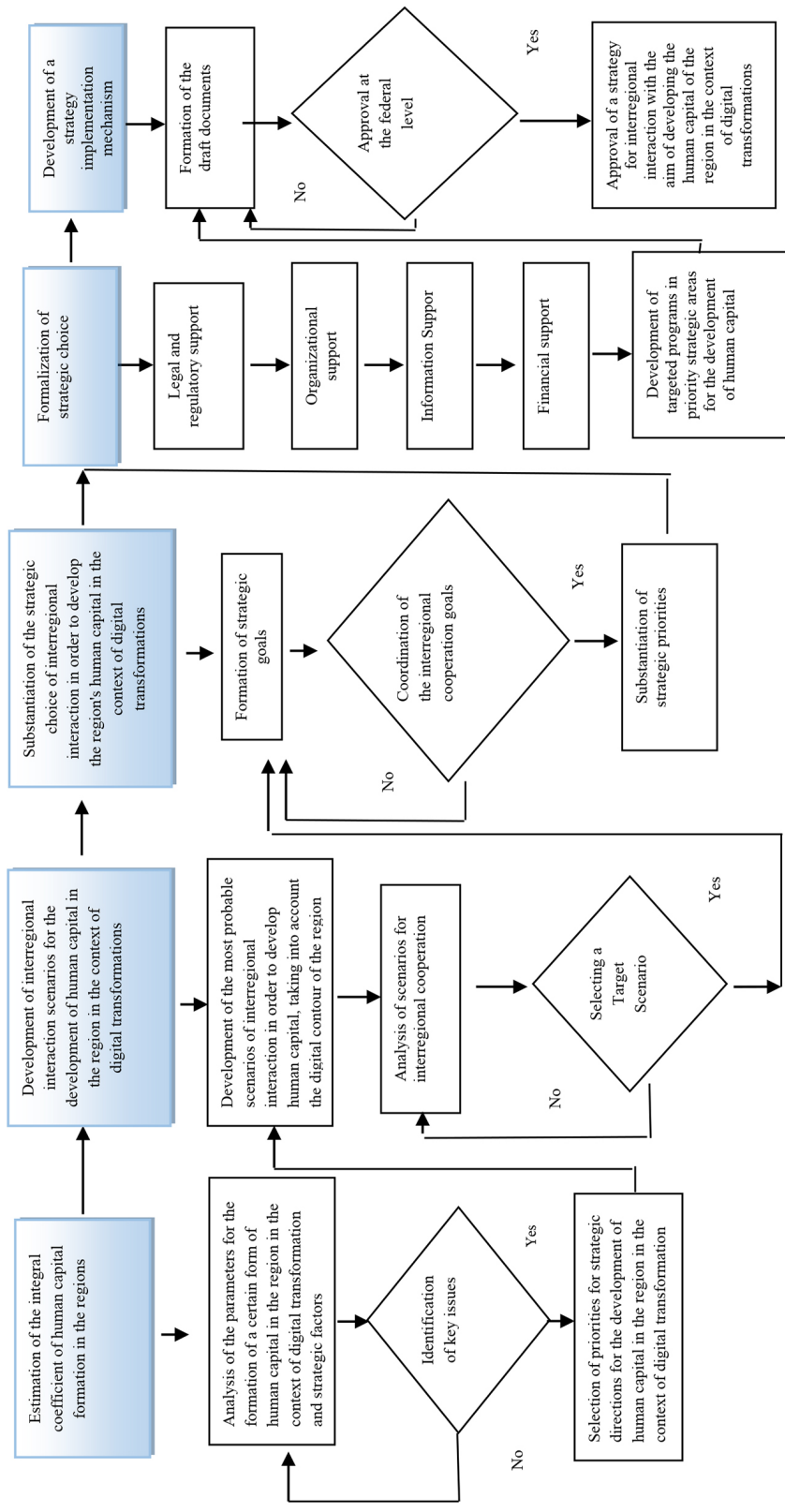


Fig. 10. Algorithm for the formation of an interregional cooperation strategy for the development of human capital in the regions included in the Central Black Earth macroregion, taking into account digital transformations

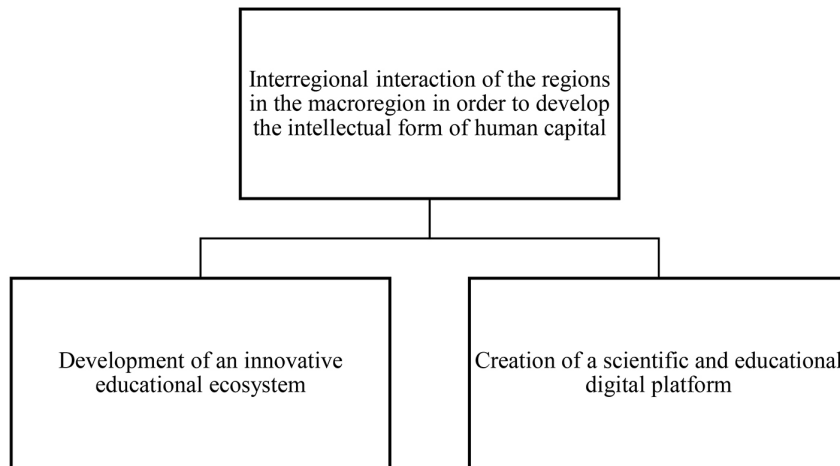


Fig. 11. Graphic image of interregional interaction between the regions of the Central Black Earth macroregion on the development of an intellectual form of human capital

high-tech industries, the creation of technology parks and co-working centers, the experience integration of leading scientific and educational organizations with the aim of spatial development of macroregions.

As a result of the implementation and successful operation of the proposed interregional strategy in the Central Black Earth macroregion:

1. There will be an increase in the attractiveness of work in the Central Black Earth macroregion as a result of the effective use of innovative products and information and computer technologies at all enterprises of the macroregion, and as a result, a decrease in unemployment and the outflow of young people;

2. The number of scientific researchers will increase, therefore, there will be an increase in publications in journals indexed in the WOS and Scopus databases;

3. Patent activity will increase, resulting in new digital, scientific and educational projects;

4. The number of companies involved in the implementation of scientific and educational digital projects will increase;

5. The number of participants in educational, scientific and scientific-technical programs will increase.

In order to determine how effective the implementation of the interregional strategy for the development of the intellectual form of

human capital in the Central Black Earth macroregion is, a systematic and comprehensive analysis of the results obtained is necessary.

The evaluation of the results obtained must be carried out in two groups, namely:

1. Evaluating the level of fulfillment of the goal set to form interregional cooperation for the development of the intellectual form of human capital in the Central Black Earth macroregion.

2. Evaluating the level of implementation of strategic measures to eliminate disadvantaged areas for the development of the intellectual form of human capital (Grechko, 2016) in the Central Black Earth macroregion, taking into account the challenges of the digital economy.

The effectiveness of the strategy implementation can be assessed using the moving periods average method (Fig. 12).

This method makes it possible to conduct an assessment immediately after each event for the implementation of the interregional strategy. Being at the upper boundary of the corridor indicates the effectiveness of the implemented strategic measures, and approaching the lower threshold value, on the contrary, indicates a decrease in the level of development of the intellectual form of human capital in the regions of the Central Black Earth macroregion (Fig. 12).

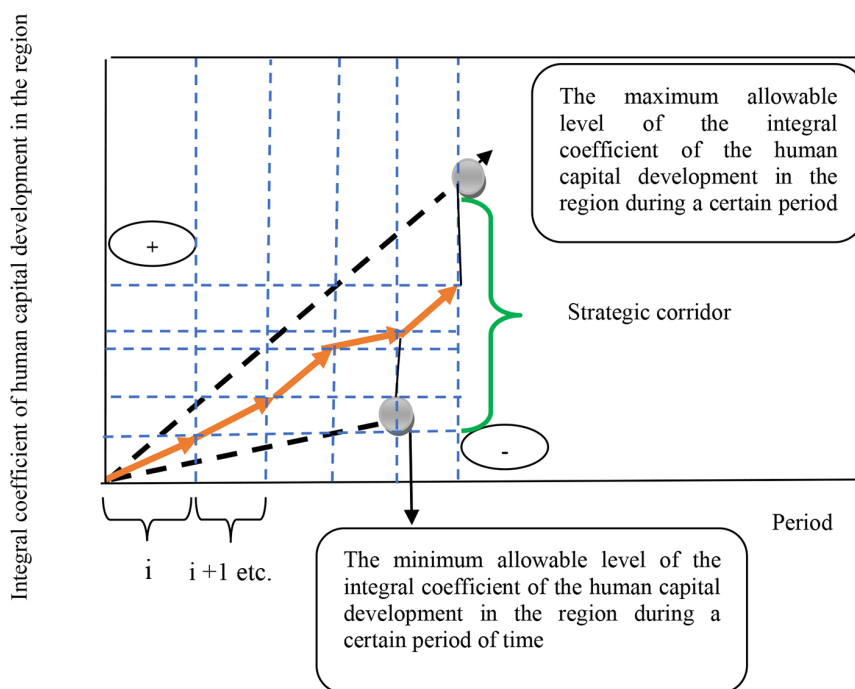


Fig. 12. Evaluating the effectiveness of the implementation of the interregional cooperation strategy for the development of the intellectual form of human capital in the Central Black Earth macroregion by the moving periods average method

Conclusion

Summarizing all of the above, it is obvious that the development of human capital in the regions included in the Central Black Earth region, taking into account the problem areas for the development of all forms of human capital, is only possible in a comprehensive and systematic way. At the same time, it should be taken into account that this requires the modernization and digitalization of professional knowledge, the motivation of employees, as a result of improv-

ing the technical and technological sphere of activity, as well as investing in the intellectual sphere of human capital (Stryabkova, 2019).

All this is possible only within the framework of the integrated implementation of the strategy of interregional cooperation for the development of an intellectual form of human capital. This will become the main direction for the development of the Central Black Earth macroregion, taking into account the challenges of digital transformation.

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