



## ARTICLE



## DEVELOPMENT OF THE INNOVATIVE POTENTIAL OF HUMAN CAPITAL AS A FACTOR IN INCREASING THE COMPETITIVENESS OF THE MACROREGION ECONOMY

## DESENVOLVIMENTO DO POTENCIAL INOVADOR DO CAPITAL HUMANO COMO FATOR DE AUMENTO DA COMPETITIVIDADE DA ECONOMIA DA MACROREGIÃO

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Alumni.In Editors**How to cite this article:**

Batov, G., Mambetova, F., Sulumov, S., & Dadaev, Y. (2025). Desenvolvimento do Potencial Inovador do Capital Humano como Fator de Aumento da Competitividade da Economia da Macroregião. *Journal of Sustainable Competitive Intelligence*, 15(00), e0531. <https://doi.org/10.37497/eagleSustainable.v15i.531>

**ABSTRACT**

**Objective:** The study aims to substantiate the priority development of the innovative potential of human capital as a key factor in enhancing the competitiveness of macroregions, particularly in territories lagging behind in socio-economic growth.

**Methodology/Approach:** The research applies methodological developments for assessing human potential, adapting and refining existing approaches with new indicators. Using statistical analysis, integral indices of human capital and competitiveness were calculated for the Southern and North Caucasus Federal Districts of Russia. The correlation between these indices and the innovation potential of human capital was examined using Spearman's rank correlation method.

**Originality/Relevance:** The novelty of the study lies in demonstrating that the innovative potential of human capital has a stronger impact on competitiveness in less developed regions compared to leading socio-economic regions. This highlights the decisive role of human-centered factors in regional growth under conditions of digital transformation.

**Main Conclusion:** Findings show that while the Southern Federal District outperforms the North Caucasus Federal District in socio-economic development, the correlation between innovation potential and competitiveness is stronger in the North Caucasus. This suggests that traditional factors dominate in the Southern regions, whereas human capital's innovative capacity plays an increasingly critical role in the North Caucasus.

**Theoretical/Methodological Contribution:** The study advances the methodology of assessing human capital by introducing refined indicators and applying Spearman's correlation to analyze interrelations between competitiveness and innovation. It contributes to the theoretical understanding of human capital as a driver of regional competitiveness and offers practical insights for managing innovation-oriented development strategies.

**Keywords:** Region. Integral index. Competitive advantage. Spearman's method

DOI: <https://doi.org/10.37497/eagleSustainable.v15i.531>



## RESUMO

**Objetivo:** O estudo visa fundamentar a prioridade de desenvolvimento do potencial inovador do capital humano como fator-chave para o aumento da competitividade das macrorregiões, particularmente em territórios com crescimento socioeconômico mais lento.

**Metodologia/Abordagem:** A pesquisa aplica desenvolvimentos metodológicos para avaliar o potencial humano, adaptando e refinando abordagens existentes com novos indicadores. Utilizando análise estatística, foram calculados índices integrais de capital humano e competitividade para os Distritos Federais do Sul e do Norte do Cáucaso, na Rússia. A correlação entre esses índices e o potencial de inovação do capital humano foi examinada utilizando o método de correlação de postos de Spearman.

**Originalidade/Relevância:** A novidade do estudo reside em demonstrar que o potencial inovador do capital humano tem um impacto mais forte na competitividade em regiões menos desenvolvidas, em comparação com as regiões socioeconômicas líderes. Isso destaca o papel decisivo dos fatores centrados no ser humano no crescimento regional em condições de transformação digital.

**Conclusão Principal:** Os resultados mostram que, embora o Distrito Federal do Sul supere o Distrito Federal do Cáucaso do Norte em desenvolvimento socioeconômico, a correlação entre potencial de inovação e competitividade é mais forte no Cáucaso do Norte. Isso sugere que fatores tradicionais predominam nas regiões do Sul, enquanto a capacidade inovadora do capital humano desempenha um papel cada vez mais crítico no Cáucaso do Norte.

**Contribuição Teórica/Metodológica:** O estudo avança a metodologia de avaliação do capital humano, introduzindo indicadores refinados e aplicando a correlação de Spearman para analisar as inter-relações entre competitividade e inovação. Contribui para a compreensão teórica do capital humano como impulsionador da competitividade regional e oferece insights práticos para a gestão de estratégias de desenvolvimento orientadas à inovação.

**Palavras-chave:** Região. Índice integral. Vantagem competitiva. Método de Spearman



## 1. INTRODUCTION

A retrospective comprehensive analysis of the development of the global community shows that the leaders in socio-economic and technological development were countries that had a high level of science, education, healthcare and culture. The same analysis shows that the formation and enhancement of human potential requires high costs and is extremely expensive, but countries are doing this because they understand that without developed human capital there can be no progress in the development of the economy and society, including the creation of a digital economy and an innovative information society.

The importance of human capital is particularly increasing in the context of digitalization and digital transformations in the economy. Digital transformation is accompanied by the introduction of artificial intelligence and robotics, active automation of business processes, and the emergence of new professions that require specialized knowledge and skills. The process of permanently increasing the use of digital technologies in various areas of life requires constant updating of knowledge and skills. In the new conditions, the development of human capital is becoming particularly important, since the requirements for the level of qualifications of employees, their ability to adapt and master new technologies are significantly increasing, and they also require a revision of traditional approaches to the formation and development of human capital.

We can agree with the opinion of Chernukhina and Ermolovskaya (2020) that "the digitalization of the economy has been declared a priority area, where people with relevant competencies will play a key role. In the next 10 years, entrepreneurial structures will survive in which the majority of employees will have digital skills. In other words, organizations should take care of creating an environment where competent employees can work who are able to create and use digital technologies for the benefit of their company" (p. 49).

One of the first to introduce the term "human capital" was Mincer (1958). American researchers Schultz (1971) and Becker (1954) developed the main provisions of the theory of human capital, which formed the methodological basis of the study. It can be noted that human capital as an economic category has acquired its place in economic literature and does not cause much discussion on its content, although each author interprets the concept of "human capital" in the context of his research. At the same time, it should be noted that in all scientific publications related to the subject of human capital, the authors give their own definition. If we summarize them, it can be noted that both domestic and foreign researchers, to one degree or another, focus on and highlight such components as education, health and culture and come to the conclusion that human capital is one of the most important factors in the socio-economic development of an enterprise (company). the region and the country, and "also the main factor of innovative development, especially in the modern conditions of the formation of the digital economy" (Apokina & Baykova, 2023, p. 157).

In her monograph, Zotkina and her co-authors (2021) propose "to identify the following main approaches to its interpretation (of human capital) as economic categories of modern labor science: human capital as a stock; human capital as an investment: human capital as assets; human capital as a factor of production" (p. 16). Human capital can be added to this list as a factor that contains innovative potential.

Our approach to the concept of "human capital" is that we consider it to be an aggregated concept, which includes such elements as: intellectual; social; cultural and moral; organizational; managerial; consumer; creative and labor; entrepreneurial; innovative; structural and logical.

The listed elements of human capital are important and necessary, but in the modern realities of the development of the economy, which (economy) has a digital-innovative orientation, the innovative component of human capital becomes particularly relevant. As noted



in the source (Ivanova, 2024), "innovative human capital is an integral unity of innovative human potential and intellectual and professional capital of specialists of a socio-economic entity" (Ivanova, 2024, p. 3).

According to Rudchenko (2015), "by innovative human capital we mean the ability of an employee to improve existing knowledge and introduce new ideas, solutions and innovations for their transformation. At the same time, an important role in the formation of innovative human capital is played by the thinking of the employee himself, who is open to the perception of new, previously unknown knowledge" (p. 61).

Our approach and understanding of the concept of "innovative potential of human capital (IPCHK)" is that (IPCHK) is an intangible asset, acts as an integral component of a person, is an important factor in creating new value, additional income, innovative products and services, contributes to adaptation to digital transformation, contributes to improving the efficiency and productivity of an economic entity, region and country.

The development of human capital is the most important factor determining the sustainability of the regional economy. In an unstable global environment, rising geopolitical tensions, sanctions, international market volatility, and changing technological trends, the effectiveness and adaptability of the regional economy largely depend on the quality of human capital. Regions with a high level of human capital have a competitive advantage because they can adapt faster to new economic conditions and increase their attractiveness to investors.

It should be noted that the regions approach this problem with understanding. Terentyeva and Arnaut (2023), based on an analysis of the regulatory framework for the strategic development of the subjects of the Russian Federation, revealed that "most of the regions of the Russian Federation directly point to the high role of human capital in their development strategies, define it as the main factor influencing the socio-economic development of the territory and as the main guideline for the formation of necessary conditions for a person; Other regions do not emphasize human capital in their regulatory documents, but at the same time indirectly determine the priority of its development by improving socio-economic conditions for the population. Based on the data of the analysis, it is possible to conclude that the issues of ensuring the formation and development of human capital and its role in the development of the region have a valid regulatory framework and definitely high chances for implementation" (p. 4007).

The purpose of the article is to substantiate the priority development of the innovative potential of human potential to increase the competitiveness of the macroregion.

The research objects are the regions of the Southern Federal District (SFD) and the North Caucasus Federal District (NCFD).

The main objectives are:

- conducting a comparative analysis of the state of human capital in the regions of Southern Russia;
- calculation of the integral indicator of human capital in the regions of the Southern Federal District and the North Caucasus Federal District;
- establishment of the human capital innovation potential index in the Southern Federal District and North Caucasus Federal District regions;
- calculation of the level of interrelation and mutual influence of the integral human capital index, the human capital innovation potential index and the competitiveness index of the Southern Federal District and North Caucasus Federal District regions using Spearman's methodology;

The relevance of the research topic is justified by the fact that the research facilities (Southern Federal District and North Caucasus Federal District) show low rates of development and lag behind other federal districts, especially the North Caucasus Federal District. In these conditions, increasing the innovativeness of human capital will allow the subjects of these



districts to improve their socio-economic situation and embark on the path of sustainable development.

In recent years, the role of human capital as a driver of regional competitiveness has gained renewed empirical support in global settings. For instance, a multi-country European study on regional human capital allocation across five states (2022–2024) demonstrates that disparities in human capital distribution significantly predict divergence in regional growth trajectories (Emmanouil et al., 2023). In recent years, empirical studies across diverse regions have reinforced the central role of innovative human capital in driving regional competitiveness, especially in territories lagging behind core economic centers. For example, a cross-regional analysis in the European Union shows that the heterogeneous impact of innovation on growth is strongly mediated by local human capital endowments, with regions having stronger human capital benefiting disproportionately from innovation investments (Pinar, Karahasan, 2025).

## 2. LITERATURE REVIEW

A lot of attention is paid to the development of human capital. In the economic literature, many articles are devoted to various aspects of the development of human capital, its role in production, management, culture and social life. As for the problems of formation, accumulation and use of the innovative potential of human capital and its role in increasing the competitiveness of the macroregion, there are such works, but they remain in small numbers.

Zharova (2023) draws attention to the fact that "in the regions of Russia, the field of research related to the development of human capital, especially its innovative capital, is particularly relevant due to the significant differentiation of socio-economic development of regions and the need to smooth out regional imbalances through the implementation of effective management decisions" (p. 732).

In their work, Rudychev and Levchenko (2020) approach human capital as a strategic resource for ensuring the competitiveness of an enterprise and note that "the classical typology of factors for ensuring the competitiveness of an enterprise, represented by the quality and cost of products/services, flexibility of management, speed of response to market changes and the level of customer service, generally remains, but in On its basis, the key role of the human factor is becoming more and more pronounced. Consequently, the creation and preservation of a long-term competitive advantage in modern conditions is possible only with the maximum realization of the creative, innovative, intellectual energy of talented employees of the organization" (p. 113).

A slightly different approach to this topic is noted by Stukalenko and Mosina (2020), who consider human capital at the country level and, in their opinion, "the quality of accumulated national human capital is of high importance as the main growth factors. Therefore, one of the primary conditions for the transition of developing countries' economies to the developed group, which can subsequently ensure the international competitiveness of national products, is the ability not only to effectively use, but also to create innovative products through the development of human capital, science and information technology" (p. 303).

In their article, Maslov and Sherstobitova analyzed the risks of economic security in the regions. Based on the analysis of the literature, the authors outline methods and methods of ensuring economic security and substantiate that the development of human capital may be the most effective way. For this, they propose to pay special attention to the problems that "are associated with the education system, which makes it necessary to maintain forms of continuing education, regular professional development in an accessible form, which requires large resources, and it is still insufficiently developed in Russia" (Maslov & Sherstobitova, 2024, p. 27).



According to Khmeleva (2022), under the conditions of sanctions, it is necessary to pay more attention to the development of the innovative potential of human capital, since the low pace of economic development based on innovation is associated precisely with an insufficient level of competencies and skills, and that the problem of labor shortage is overlaid by the problem of the quality of human capital.

In their work, Mubarik and co-authors substantiate the need to ensure the interaction of human capital with the business strategy, organizational and technological resources of the organization. They reveal the multifaceted role of human capital, analyze the role of human capital in Industry 4.0, the internationalization of firms, and describe strategies for firms to increase the readiness of their human capital, considering modern business dynamics. The central focus of the study is on how human capital interacts with and complements other organizational resources and technological developments (Mubarik et al., 2023).

Chinese researcher Chen (2022) notes that China is the country with the largest population in the world. It has abundant human resources, but very little human capital. The shortage of human capital has a negative impact on the growth of enterprises. The article substantiates the need to transform human resources into human capital through its integration into a dynamic multi-contour relationship of social capital, learning and knowledge management.

In the source (Tóth et al., 2020), the authors managed to find a significant correlation between competitiveness, GDP per capita, higher education and innovation. They note that the link between higher education and GDP is significant in Poland, the Czech Republic, Russia, and Hungary, while the correlation between innovation and GDP is significant in Serbia, Poland, and Hungary. They (the authors) managed to demonstrate a significant correlation between higher education and innovation only in Russia. It is clear that significant investments in higher education enhance competitiveness. Continuous development of knowledge and skills is necessary for effective work in the workplace. Given the disadvantages of higher education, which are already obvious today, employee training has become an interest in companies, namely, they usually even take on the costs of their education (Tóth et al., 2020).

Mohamed and co-authors point out that human development plays a crucial role in achieving sustainable development by harnessing the power of well-educated workers and employees, scientists, politicians, and people from all walks of life and the economy. However, there is no single path for human development. The planning, development, and implementation of human development policies require country-specific approaches based on unique characteristics such as historical development trajectories, future goals, leadership commitment, culture, geography, and climate, to name but a few (Mohamed et al., 2021).

As noted by Gishkaeva (2022), "the competitiveness of modern national economies mainly depends on their ability to create innovations and use progressive technological achievements, which in turn are determined by the level of human capital development. The human factor in post-industrial society is represented as the main factor in the economic development of the entire world community, therefore, the influence of other traditional factors of production such as capital accumulation, population growth, labor productivity, technological progress, etc. It must be considered in relation to the most important human factor" (p. 217).

Litvinova (2024) pays special attention to the role of universities in implementing innovation policy in the digital economy and states that "currently, human capital is becoming the basis of innovative economic development, and the struggle for high-level professionals at the corporate and national levels is becoming more acute, which is only exacerbated by the rapid development of technology. In the context of digitalization and digital transformation, the struggle for human capital is reaching a new level, companies are actively competing for specialists in the field of IT, artificial intelligence and other advanced areas" (pp. 7927-7928).



A recent study examining peripheral and core regions in Northwest Bohemia demonstrates that human and demographic capital varies not only in volume but also in structure, with some peripheral municipalities outperforming more central ones due to historical, geographical, and cross-border dynamics (Veselý & Kubeš, 2025). This suggests that peripherality does not necessarily equate to weakness in human capital, and that regional planning must recognize such internal differentiation.

Similarly, Misra and Pugh (2023) show that establishing universities in non-core regions can catalyze regional transformation, particularly when these institutions are embedded in local innovation systems. Their research on the UK context illustrates how higher education institutions serve as developmental anchors, attracting talent, fostering entrepreneurship, and reinforcing local identity in underserved regions.

Expanding the geographical scope, Zhou et al. (2025) provide evidence from China that innovative human capital, supported by targeted government science funding, significantly enhances regional resilience. Their findings underline the importance of aligning human capital development with innovation ecosystems, especially in the face of external economic shocks.

In the African context, Awode et al. (2025) explore how the interaction between technological innovation and human capital development drives industrial competitiveness. They emphasize that innovation alone is insufficient without skilled human capital capable of absorbing and applying new technologies, reinforcing the notion that capacity building must accompany technological investment in emerging economies.

From the analysis of the literature, it can be concluded that human capital is viewed from different angles, the factors that influence it and how it (human capital) affects the development of the company, market, region, economic growth, labor productivity, etc. are revealed. At the same time, the essence, content and use of the innovative potential of human capital is considered in a small number of studies, especially issues related to its assessment at the regional level.

### **3. MATERIALS AND METHODS**

#### **3.1. Theoretical and Methodological Basis**

The theoretical and methodological basis of the research was the theory of human capital. The research is based on the works of domestic and foreign researchers, developments of theorists and practitioners. The work is based on materials from the Southern Federal District and North Caucasus Federal District regions.

The methodological developments described in various sources were used in the work (Parakhina & Ustaev, 2018; Shulgin & Zinkina, 2021; Shcherbakov, 2023). The methods proposed by different authors have been adapted to the subject of the study, improved and refined using new indicators.

#### **3.2. Data Sources**

The research used statistical data from official publications, including Regions of Russia. Socio-economic indicators. Statistical collection (Rosstat, Moscow, 2022, 2023, 2024) and open databases (<https://av-group.ru/post/296>) for the period 2021–2023. Data were collected for all regions of the Southern Federal District (SFD) and the North Caucasus Federal District (NCFD). Data were selected according to the representativeness and availability of indicators related to labor, education, science, and professional qualification. This ensured consistency in comparing regions with different socio-economic structures.



### 3.3. Indicators and Variables

To assess human capital and competitiveness following indicators (Table 1).

Indicator	Definition	Data Source	Unit / Period
Labor Activity Index (LAI)	Employment activity level	Rosstat	ratio, 2021–2023
Educational Level Index (ELI)	Share of population with higher or vocational education	Rosstat	ratio, 2021–2023
Scientific Index (SI)	Number of researchers per 10,000 employed persons	Rosstat	absolute value, 2021–2023
Professional Qualification Index (PQI)	Share of employees with advanced training	Rosstat	ratio, 2021–2023
Index of People Engaged in R&D (RDI)	Share of population working in R&D sectors	Rosstat	ratio, 2021–2023

**Table 1.** Indicators and data sources

From these indicators, three composite indices were calculated:

- Integral Human Capital Index (IHCI) – reflects the aggregated level of regional human potential;
- Index of the Effectiveness of Using the Innovative Potential of Human Capital (IRIHC) – characterizes the innovation activity of human resources;
- Index of Regional Competitiveness (IRC) – measures the overall economic competitiveness of regions.

The combination of these indicators allows the identification of regional differences in the structure and efficiency of human capital.

### 3.4. Integral Index Calculation Procedures

Normalization was used to make filter variables comparable despite differences in scale and socio-economy between the regions by aggregating values using the arithmetic mean. Integral indices for each region and the two federal districts as a whole (SFD and NCFD) were calculated separately.

Thus, it became possible to track the relationship between the level of human capital development and its innovative component and the level of competitiveness. Once adjusted, the comparisons between education and innovation show a clear difference between the Southern and Caucasus regions in the structural development of human capital.

### 3.1. Statistical Analyses and Correlations

Statistical analysis methods were used, including the calculation of correlation coefficients using Spearman's method. The use of Spearman's correlation is justified by the non-parametric nature of the regional data and the need to identify monotonic relationships between the indices of socio-economic development, competitiveness, and the innovative potential of human capital.



#### 4. RESULTS

The regions of Southern Russia are represented by two federal districts, the Southern Federal District and the North Caucasus Federal District. The Southern Federal District includes 8 regions, the area of the Southern Federal District is 447 thousand km<sup>2</sup>, the population as of January 1, 2024 was 16,642,1 thousand people, urban population 63.2%, rural population 36.8%. The Southern Federal District includes: the Republic of Adygea (RA), the Republic of Kalmykia (RK), the Republic of Crimea (R. Crimea), Krasnodar Territory (KK), Astrakhan region (AO), Volgograd region (VO), Rostov region (RO), Sevastopol (Sevast.)

The North Caucasus Federal District includes 7 regions, the area of the territory is 170.4 thousand km<sup>2</sup>, the population as of January 1, 2024 was 10,251.1 thousand people, the urban population is 50.6, the rural population is 49.6. The North Caucasus Federal District includes: the Republic of Dagestan (RD), the Republic of Ingushetia (RI), the Kabardino-Balkarian Republic (KBR), the Karachay-Cherkess Republic (KCR), the Republic of North Ossetia–Alania (RSO-Alania), the Chechen Republic (CR), the Stavropol Territory (SK).

For the regions of the Southern Federal District and the North Caucasus Federal District, issues of human capital development, especially its innovative component, are of particular interest. This is especially relevant due to the need to increase the socio-economic level of their development, smooth regional imbalances, gain competitive advantages and increase their competitiveness. In a review of the literature, some authors noted (Khmeleva, 2022; Mubarik et al., 2023; Rudychev & Levchenko, 2020) that in the market space, the basic conditions for ensuring the competitiveness of subjects at different levels are shifting from material and technical prerequisites to intellectual and creative factors that are embodied in the human factor of this subject. The situation and the situation in which the economy of the regions of the studied districts is located is characterized by the fact that in market conditions an entity can be competitive if the object or subject of the market surpasses its competitors not only or not so much with production facilities and technologies, but with human capital, who has a higher innovative potential of human capital, to emerge victorious in this rivalry. In the current conditions, the competitiveness of the region (economic entities, the country as a whole) is reduced to the competitiveness of human capital, which is expressed in the realization of the existing total human capital of the territory, the specifics of the development of the regional economic system, cultural characteristics, historical conditions.

It is possible to form the competitive advantages of the region due to the growth of the innovative potential of a person, an employee, who can be achieved by increasing the level of education and cultivating an innovative culture. The peculiarity and value of human capital lies in the extent to which it allows you to achieve and maintain leadership in the segment where this subject is located, and if it concerns the region, then how this state of human capital allows you to outperform other regions.

To analyze and assess the state of human capital, as well as the competitiveness of the regions of the studied districts, 15 additional tables were compiled and calculated, which cover 11 indicators. At the same time, data for three years (2021-2023) were used. The integral human potential index on average for the Russian Federation, the Southern Federal District and the North Caucasus Federal District and other indicators were also calculated.

The index of the effectiveness of using the innovative potential of human capital (IRIIPCHK) and the competitiveness index of each region of the districts separately and as a whole for the Southern Federal District and the North Caucasus Federal District were determined separately:

- the index of the effectiveness of using the innovative potential of human capital (IRIIPCHK);
- the index of regional competitiveness (IQR).

Let's consider and evaluate how the presented indicators are formed in the regions of the Southern Federal District (Table 2) and the North Caucasus Federal District (Table 2). Let's start with the regions of the Southern Federal District.

Regions	Labor Activity Index (LAI)	Educational Level Index (ELI)	Scientific Index (SI)	Professional Qualification Index (PQI)	Index of People Engaged in R&D (RDI)	Integral Human Capital Index (IHCI)	Rank/Place	Index of the Effectiveness of Using the Innovative Potential of Human Capital (IRIHC)	Rank/Place	Index of Regional Competitiveness (IRC)	Rank/Place
<b>Russian Federation</b>	<b>0,949</b>	<b>0,092</b>	<b>0,0014</b>	<b>0,803</b>	<b>0,026</b>	<b>1,8714</b>		<b>0,033</b>			
<b>Southern Federal District</b>	<b>0,936</b>	<b>0,089</b>	<b>0,0008</b>	<b>0,775</b>	<b>0,010</b>	<b>1,8108</b>		<b>0,062</b>		<b>1,666</b>	
Republic of Adygea	0,753	0,108	0,0008	0,778	0,004	1,6438	6	0,035	8	0,746	7
Republic of Kalmykia	0,813	0,115	0,0009	0,793	0,003	1,7249	8	0,056	4	0,511	8
Republic of Crimea	0,924	0,068	0,0005	0,752	0,007	1,7515	7	0,047	5	1,421	5
Krasnodar Territory	0,978	0,079	0,0006	0,731	0,008	1,7966	5	0,074	3	3,337	1
Astrakhan Region	0,927	0,107	0,0009	0,828	0,004	1,8669	2	0,112	1	1,549	4
Volgograd Region	0,902	0,089	0,0007	0,819	0,009	1,8197	4	0,097	2	2,095	3
Rostov Region	0,938	0,102	0,0013	0,796	0,016	1,8533	3	0,036	7	2,835	2
Sevastopol	0,879	0,084	0,0008	0,895	0,010	1,8688	1	0,044	6	0,868	6

**Table 2.** Dynamics of the integral human capital index and the competitiveness index of the Southern Federal District regions

**Sources:** the authors' calculations based on the Regions of Russia. Socio-economic indicators. Statistical collection / Rosstat. Moscow, 2022, 2023, 2024. <https://av-group.ru/post/296> , 2021,2022,2023

As the data in Table 2 show, the integral human capital index of the Southern Federal District regions remains below the national average. At the same time, there is a spread of indicators within the region. The highest rates are recorded in the cities of Sevastopol, Astrakhan and Rostov regions. If we look at individual indicators, the Krasnodar Territory is the leader in the labor activity index, the Republic of Kalmykia is the educational index, the Rostov Region is the scientific index, and the Sevastopol city is the professional qualification index.

The most important indicator is the human capital Innovation Potential index, which shows what scientific baggage a given region has. According to this indicator, the Astrakhan Region ranks first, the Volgograd Region ranks second, and the Krasnodar Territory ranks third.

According to the competitiveness index, the Krasnodar Territory is the undisputed leader, which acquires its leadership due to natural factors and investment policy.

Of the indices considered, the scientific index has the lowest value; in general, it is lower than the national average for the district. One of the reasons is the small number of graduate students, and the number of doctoral students is even smaller. Such regions as the Republic of Adygea, the Republic of Kalmykia, and Sevastopol did not have doctoral students during the study period, while others were limited to three or four units. This issue is most successful in the Rostov region, where more attention is paid to the training of doctoral students.

A characteristic feature that deserves special attention is the ratio between the number of people employed in the economy of regions with higher education and the number of specialists with secondary vocational education. In regions such as the Republic of Adygea, the Republic of Kalmykia and, in some periods, Sevastopol, the number of people employed in the economy with higher education is higher than with secondary vocational education, but this factor does not become a driving force for the development of the economy of these regions. If we look at the district as a whole, the number of young people entering universities for higher education is higher than those who enter secondary vocational schools and technical schools, but it turns out that the number of people employed in the economy with secondary specialized education is higher than with higher education. This situation suggests that many of those who graduated from a university do not work in their specialty (perhaps due to an oversupply in certain specialties) and that the higher education system and economics "do not understand" each other.

During the study, Spearman's rank correlation coefficient was established between the integral human capital index and the competitiveness index in the regions of the Southern Federal District, which was  $r_s = 0.697$ , which emphasizes that the relationship between the indicators is statistically significant. The relationship between the competitiveness index and the human innovation potential index was  $r_s = 0.661$ , which is also significant. The correlation between the integral human potential index and the human capital innovation potential index was  $r_s = 0.636$ . The results show that the correlation between the studied indicators in the regions of the Southern Federal District is significant and noticeable.

Let's consider the state of these same indicators in another macroregion, the North Caucasus Federal District (Table 3) and let's conduct a comparative analysis with the indicators of the Southern Federal District, determine what they have in common and how they differ from each other.

Regions	Labor Activity Index (LAI)	Educational Level Index (ELI)	Scientific Index (SI)	Professional Qualification Index (PQI)	Index of People Engaged in R&D (RDI)	Integral Human Capital Index (IHCI)	Rank / Place	Index of the Effectiveness of Using the Innovative Potential of Human Capital (IRIHC)	Rank / Place	Index of Regional Competitiveness (IRC)	Rank / Place
Russian Federation	0,949	0,092	0,0014	0,803	0,026	1,8714		0,033			
Southern Federal District	0,936	0,089	0,0008	0,775	0,010	1,8108		0,062		1,666	
North Caucasus Federal District	0,850	0,088	0,0006	0,694	0,004	1,6366		0,059		1,083	
Republic of Dagestan	0,811	0,087	0,0004	0,589	0,003	1,4874	7	0,054	5	1,550	2
Republic of Ingushetia	0,707	0,073	0,0001	0,887	0,002	1,6691	4	0,030	6	0,599	7

Kabardino-Balkarian Republic	0,838	0,067	0,0010	0,665	0,009	1,5800	6	0,055	4	0,861	4
Karachay-Cherkess Republic	0,815	0,092	0,0007	0,706	0,008	1,6217	5	0,016	7	0,649	6
Republic of North Ossetia–Alania	0,824	0,108	0,0015	0,759	0,004	1,6965	2	0,130	1	0,818	5
Chechen Republic	0,856	0,098	0,0003	0,731	0,001	1,6863	3	0,067	2	0,979	3
Stavropol Territory	0,934	0,092	0,0007	0,734	0,005	1,7657	1	0,061	3	2,126	1

**Table 3.** Dynamics of the integral human capital index and the competitiveness index of the NCFD regions

**Source:** the authors' calculations based on the Regions of Russia data. Socio-economic indicators. Statistical collection / Rosstat. Moscow, 2022, 2023, 2024. <https://av-group.ru/post/296>, 2021,2022,2023

According to Table 3, the Stavropol Territory and the Chechen Republic have the highest labor activity index, while the Republics of Dagestan and Ingushetia lag behind. The scientific index remains low, it is lower not only than the average Russian indicator, but also the indicator of the Southern Federal District. According to the index of professional qualifications, the Republic of Ingushetia stands out, followed by the Republic of North Ossetia-Alania and the Stavropol Territory. The North Caucasus Federal District lags behind the Southern Federal District in all indicators, including the index of the number of people engaged in research and development.

If we compare the competitiveness indices, the Southern Federal District regions outperform the North Caucasus Federal District both quantitatively and qualitatively.

In the course of the study, the same Spearman rank correlation coefficients were determined as for the Southern Federal District. Calculations have shown that the ratio between the integral human capital index and the competitiveness index in the regions of the North Caucasus Federal District is  $r_s = 0.709$ , which indicates that the relationship between the indicators is statistically significant, the relationship between the competitiveness index and the human innovation potential index was  $r_s = 0.806$ , and the correlation between the integral human capital index and the innovation potential index is The value of human potential was:  $r_s = 0.867$ . All the results obtained are significant and high.

Summing up the results for the regions of Southern Russia, it can be noted that the Southern Federal District surpasses the North Caucasus Federal District in all analyzed indicators. The innovative potential of the Southern Federal District's human capital remains higher than in the North Caucasus Federal District due to the fact that the scientific index, the index of educational level and the index of professional qualifications remain higher than the same indicators of the North Caucasus Federal District. The main content of these indicators is knowledge, and they are also formed through knowledge. At the same time, it should be noted that all the indicators that were obtained as a result of the study turned out to be less than the national average.

At the same time, the internal reserves of the regional population, that is, the educational level, the ability to learn new skills, adapt to changing conditions, think critically and solve the problems that arise, play an important role. These are the general principles of the region's adaptive capacity, according to which the region's capacity to respond to external shocks and redirect its development path depends on the quality of its human resources and institutional capacity.

At the same time, all Spearman's rank correlation coefficients in the North Caucasus Federal District are characterized by higher values than those of the Southern Federal District regions and show a high score on the Chaddock scale. This is despite the fact that the Southern



Federal District is ahead of the North Caucasus Federal District in terms of socio-economic development. These indicators give grounds to assert that the level of human capital development and its innovative potential determine the state of regional economic competitiveness. The same dependence and statement is noted in the source (Akramova, 2018), which means that there is a closer correlation between the indicators of the regions of the North Caucasus Federal District than in the regions of the Southern Federal District.

This gap between the two districts indicates a need for better integrated education, workforce and regional innovation planning. Furthermore, the low scientific index score and the low share of people working in R&D in the region show a mismatch between the human capital and regional systems of innovation of the region. Innovation not only requires new knowledge but also competently trained human capital for its application. Improving vocational training systems, modernizing research infrastructure and providing competitive career opportunities and secure jobs for skilled manpower could help to fill the gap between education and its economic returns in the region and globally. Otherwise, the innovation potential of human capital will not be used and there will be difficulties in building a sustainable model of development and long-term competitiveness of macroregions.

It can be concluded that for the regions of the Southern Federal District, traditional factors play a greater role than human factors, and in the North Caucasus Federal District, the innovative potential of human capital is becoming an important factor in the development of the regions' economies.

The results show a need for public policies that grow the value of human capital in developing macroregions. The regional governments could in this sense invest in modern educational institutions focusing on technical and technological courses. These offerings could be aligned with local industrial demands. This includes increasing accessibility to research facilities plus supporting postgraduate education in priority sectors. It also involves easing public-private partnerships promoting applied regional research. Additionally, efforts should be made in order to improve early-stage education, with an increased focus on digital skills and an entrepreneurial mindset, to create a tomorrow-proof workforce to drive local innovation ecosystems.

Apart from policy considerations, the regional training programs should be in line with local labor market structures, and should aim to provide the people with not only technical skills, but also flexibility, critical thinking and team working. SMEs offer internships. They offer apprenticeships. They offer training programs, which improve the transition from education into productive employment outcomes. Regional policies toward promoting knowledge exchanges among universities, businesses, and municipalities help to create open innovation environments where skilled workers are willing to stay and where their skills are not lost. This process changes human capital from a passive good to a driver that constantly improves regional competition.

## 5. CONCLUSION

The results of the study allow us to conclude that the regions of the Southern Federal District and the North Caucasus Federal District are characterized by the fact that the use of the innovative potential of human capital does not correspond to the available potential, which leads to negative consequences in the form of low economic productivity. Based on this, for the regions of Southern Russia, the most important task is to increase the effectiveness of human potential management, using appropriate methods and tools aimed at developing innovative components.

Creating conditions for the development of the innovative potential of the human capital of the regions is one of the directions for the formation of their competitive advantages. Along



with this, it is also necessary to increase the efficiency of using the potential of the human capital of the regions by managing its qualitative and quantitative characteristics. The formation and use of personnel with innovative potential will allow the regions of Southern Russia to adapt to the conditions of the digital economy, create new competitive advantages, and improve the quality and standard of living of the population.

## ACKNOWLEDGMENTS

The article was prepared within the framework of the Russian Science Foundation project No. 24-28-01644 "Methods and models for increasing the innovative potential of human capital in the contours of a new stage of civilizational development: a macro-regional aspect".

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