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Human capital as a key element supporting innovation in regions

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Abstract

Aim: The aim of the article was to theoretically analyse the importance of human capital and innovation in the process of regional development within the framework of a knowledge-based economy.

Methodology: The article employs a literature review and a descriptive method to explore the relationship between human capital and the ability of regions to introduce innovations.

Results: Human capital – defined as the knowledge, skills, experience, and creativity of a region's inhabitants – plays a key role in innovation processes. Regions with well-developed human capital demonstrate greater potential for implementing innovations, which strengthens their competitiveness and fosters economic growth.

Implications and recommendations: Strengthening human capital should be a priority in regional policy. Investment in education, skills development, and fostering creativity enhances a region's ability to generate and apply innovations effectively.

Originality/value: The article provides added value by highlighting the fundamental role of human capital as a driver of innovation and regional competitiveness in the modern knowledge-based economy.

Keywords: human capital, innovation, regions

1. Introduction

Contemporary economic and social processes pose a number of new challenges to regions, related to the need to adapt to rapidly changing technological and organizational conditions. The key element that determines the success of these transformations is human capital which is the foundation for the development of knowledge and competences, and also shapes the ability of regions to generate innovations. Innovation, understood as the ability to introduce new products, processes and organizational solutions, is becoming the basis for the competitiveness of regions in the global economy. The literature on the subject increasingly emphasises the fact that human capital plays a fundamental role in the process of creating innovation, and its quality and structure have a direct impact on regional development. Regions in which residents can boast a high level of education, extensive professional experience and creativity tend to introduce innovations faster, thus favouring the emergence of new sectors of the economy, which then contributes to the increase in their competitiveness.

2. Innovation / research / competition of regions

The competitiveness of regions results from strong arguments, or the most important strengths of the region, the essence of which lies in the educational system, infrastructure and economic structure. "A competitive region is also defined as one in which the level of human knowledge, understood as the ability to anticipate needs and discover new combinations and applications of existing or new material resources, allows for the creation of a structural advantage and commercialization of the region's products" (Kot, 2007, pp. 10-11). The issue of regional competitiveness is entirely related to the innovativeness of the region. Łaźniewska and Gorynia stated that "regional competitiveness can be defined as the lasting ability of a region to compete with other regions, to ensure lasting economic growth and development, including the ability to attract and retain productive capital, creative talents, as well as to be innovative in the broad sense of the word (…)". Hence, "regional competitiveness is the innovative and entrepreneurial transformation of these resources into intellectual capital, added value, economic growth and development. (…) The competitiveness of regions is therefore a combination of: resources (natural or man-made), processes (processing resources into effects) and the internationalisation of economic activity" (Łaźniewska & Gorynia, 2012, p. 42).

Nowadays it is thought that a competitive region is an innovative region and vice versa. "The problem of measuring innovation, including regional innovation, is very difficult, and experiences in the field of methodology and empirical research are in the discussion phase" (Strahl, 2006, p. 37). Whatever its course and advancement, there is no doubt that innovation is the result of many factors occurring in the region. This also results from the multitude of features that characterise contemporary innovation. "Factors influencing innovation include not only economic conditions, but also the social and political dimensions of learning and creating innovations" (Nowakowska, 2013, p. 449). It is very important to refer to space in the sense of not only the administratively defined region, but it is also important to consider it in the sense of the broad concept of territory. "Regional innovation can be defined as the ability and motivation of the economy (enterprises) to constantly search for and use in practice scientific research, new concepts, ideas and inventions" (Kot, 2007, pp. 10-11). The current perception of innovation is moving away from a single event to a set of processes, events and phenomena creating new patterns, technologies and goods in the sphere of production and services. Innovations arise both in a specific space, but also in the system of connections, defined as an innovation system, which includes production and scientific-technical subsystems, dependencies and connections between them and institutional solutions. "They characterise the level of innovation of a given region" (Markowski, 2004, p. 152). Among the factors favouring the innovation of the economy, both on a micro and macro scale, the following are mentioned:

- "market and institutional conditions
- motivational patent and legal system

- high level of education of society
- economic diversity
- high level of capital accumulation
- high level of investment in R&D by the economic and public sectors
- presence of universities and research institutes
- level and quality of cooperation between the economy and science
- willingness to take economic risks, entrepreneurial climate
- good system of institutions supporting and transmitting innovations
- availability of capital and credit
- international and interregional cooperation" (Kot, 2007, pp. 10-11).

The multitude of factors and aspects influencing the innovativeness of the economy in the regional scope justifies the concept of the innovation environment. An acceptable approach is to define it as a territorially oriented set in which interactions between economic entities occurring as a result of multi-form transactions, are conducive to the processes of learning and introducing innovations. "As a consequence, they influence the creation of external effects, specific to innovation processes, enabling the emergence of increasingly perfect forms of collective learning and resource management" (Nowakowska, 2013, p. 49). Their quality is important for the processes of economic and regional development in the market economy, and they are a common phenomenon occuring in every member state of the European Union. Their limitation can be contributed to by improving the quality of the natural environment through the actions of entities in a similar way from the economic and public sphere. It is worth remembering that innovation and innovative environment are meant to play a supporting role in the creation of economic growth and development processes, which are the source of all social welfare, both in regional and national systems. Due to the multitude of factors that make up the innovation environment, the following five categories were distinguished in the study: innovation activity, research and development activities of enterprises innovative enterprises, human capital, public sector support, and intellectual property protection. The diagnostic variables presented below (see Table 1) were assigned to them. The author is aware that the selection of categories and diagnostic variables is not fully elaborated for a thorough description of the issues undertaken in the article, however it allows for an effective analysis of the statistical data for the purposes of the article. Regional innovation must be reflected in the entrepreneurship index and the size of GDP per capita, indicators which show the appropriate relationship between the innovation environment and economic processes in the regional system, illustrating the strong correlation of these indicators in the development of regions.

Table 1. Variables describing the innovation environment in the regions

Main category	Importance	Diagnostic variable	Importance
Innovative enterprises	20.00%	Research-active units in the corporate sector	25.00%
		Average share of innovative enterprises in the total number of enterprises	25.00%
		Percentage of industrial and service sector enterprises that incurred expenditure on innovation activities	25.00%
		Percentage of industrial and service sector companies that have introduced innovations	25.00%
		Total:	100.00%
Innovation and R&D activity of enterprises	20.00%	Share of expenditure on innovation activities in enterprises in national expenditure	25.00%
		Share of expenditure on innovation activities of enterprises from the service sector from own funds in total expenditure	25.00%
		Share of expenditure on innovation activities of industrial enterprises from own funds in total expenditure	25.00%

Main category	Importance	Diagnostic variable	Importance
		Share of expenditures incurred by the enterprise sector in total expenditures on R&D activities	25.00%
		Total:	100.00%
Public sector support	20.00%	Research-active units in the public sector per 100 thousand entities of the national economy	50.00%
		Percentage of industrial enterprises in the public sector that incurred expenditure on innovation activities	50.00%
		Total:	100.00%
Human capital	20.00%	Percentage of people employed in R&D activities in total employment	33.33%
		Percentage of academic teachers at technical universities	33.33%
		Percentage of graduates from technical universities	33.33%
		Total:	100.00%
Intellectual property protection	20.00%	Patents and utility models filed per 1 million inhabitants	50.00%
		Patent rights granted and protection per 1 million inhabitants	50.00%
		Total:	100.00%
Total			100.00%

Source: own study.

This framework provides a comprehensive and balanced approach to assessing the key factors that contribute to a nation's or region's innovation ecosystem. By allocating equal importance to five critical categories – Innovative Enterprises, Innovation and R&D Activity of Enterprises, Public Sector Support, Human Capital, and Intellectual Property Protection – the framework underlines the interconnected nature of these elements in fostering innovation. Similarly, the Innovation and R&D Activity of Enterprises category underlines the importance of financial commitment from the private sector. By analysing the share of national expenditure on innovation and the breakdown of how service and industrial sectors allocate funds, it offers insight into the extent of investment in research and development. This category highlights the private sector's responsibility in advancing technological progress and ensuring sustainable innovation efforts. In conclusion, the framework as a whole reflects a holistic view of innovation. It acknowledges that innovation is not a single-dimensional process but rather an integrated effort that involves the private sector, public sector, human capital, and a strong legal infrastructure for intellectual property protection. The equal emphasis on each of these areas signifies that for innovation to thrive, there must be a coordinated and supportive ecosystem that fosters research, development, and commercialisation of new ideas. This balanced approach ensures that a nation or region is equipped to face the challenges of an increasingly competitive and technology-driven global economy.

3. The pro-development impact of human capital in the regional context

Human capital resources have an increasingly greater impact on the level and pace of development, as well as the competitiveness of the region, and it is also an important element of the economy based mainly on knowledge. "Its value and level directly affect innovation processes and the processes of creating and transferring knowledge and technology" (Golejewska, 2012, pp. 86-124). In the process of building and developing human capital, socio-cultural conditions are important, therefore the connections with social capital are in the form of norms and institutions, hence human capital is presented in a narrow and broad conceptual perspective. In the narrow approach, this is understood as "knowledge, skills, abilities and other items that individuals have and which are appropriate for a given economic activity" (OECD, 1998). In the broad approach, human capital can be defined as

“a resource of knowledge and skills, together with health and vital energy, embedded in society. (…) This resource is given by the genetic characteristics of a given population once and for all, but it can be increased through investment i.e. investment in human factors: in people, in human capital, in human life” (Domański, 1993, p. 19). “Human capital, which characterizes the knowledge and individual competences of the inhabitants of a given territory, is – in addition to social, structural and relational capital – a component of the intellectual capital of the region” (Wosiek, 2012, pp. 40-54).

“In theories of regional development, human capital is perceived as an important factor conditioning development” (Bartnik, 2016, pp. 13-17). “An example is one of the most important concepts of polarization – the core and periphery theory” (Friedmann, 1969), which specifies the importance of human and social factors in the development of a region. The improvement of regions is interdependent on non-economic factors – psychological, sociological, political – which are identified with humans. The processes taking place in this space are conditioned by human actions and social interactions. The growth of the core regions is based mainly on innovation related to concentration in those areas where the quality of human capital and social capital is excessive for the appropriate conditions favourable to the production of innovations.

Research shows that the impulse for regional development is the ability to learn, improve one's skills and create innovation. “The importance of innovation, knowledge and human capital have been appreciated in the theory of regional innovation systems. (…) Innovation systems, both in the regional and national dimension, support the development of innovation and modern technologies in the economy” (Cooke, 1992, pp. 365-382). They are created by various public and private institutions, among which the most important are: public authorities, enterprises, scientific and research and development institutions, business environment institutions, social associations. The main element of innovation systems is the comprehensive nature of institutional, network connections, i.e. mutual cooperation and coordination of the activities of all entities creating the system. The effectiveness of this system depends on a large number of factors going beyond the sphere of the institutions creating them, in which of key importance are, apart from production systems, also the social and cultural systems of a given society. “The forms and scope of social cooperation, human and social capital resources and the degree of development of the innovation culture promoting values related to entrepreneurship, cooperation, trust, reciprocity, etc. are also important” (Grosse, 2007, pp. 333-362).

“The growing importance of knowledge and innovation, and consequently of human and intellectual capital, in economic processes has found expression, among others, in the concept of a learning region developed in scientific literature since the 1990s” (Storper, 1995, pp. 433-455).

A learning region is interpreted as a pro-development coalition of various regional actors operating in network (also global) cooperation systems based on knowledge and mutual learning. According to the concept of cooperation focusing on knowledge and this learning, factors based on culture, resources of the regional community in terms of knowledge, openness, creativity, and learning ability are of fundamental importance for the development and competitiveness of the region, as they facilitate the creation of innovations. A theory that undoubtedly refers to this idea of a learning region and pro-development, and the influence of human and social capital is the concept of the triple helix. “It outlines a broad perspective of research on the relations between entities in three spheres: science, business, administration” (Etzkowitz, 2002, pp. 115-128). These three institutional spheres enter into increasingly stronger relations and mutual dependencies. “The situation within each of them and the relations between them create a system of interactions that exerts a significant influence on the functioning of the socio-economic system of the region, bringing positive results, among others in the form of the creation of many institutions and organizations of intermediate activities providing in the functional space between science, business and administration” (Olechnicka, 2012, p. 248). These are the centres of regional accumulation of knowledge, sharing the results of scientific research of enterprises, and improving the workforce of the regional economy. Spin-off companies, technology parks, business incubators, institutions dealing with technology transfer, commercialisation of

knowledge, and protection of patent rights, etc. are opening in the region. “Thanks to this, regional development receives comprehensive support, becoming strengthened and accelerated” (Tuziak, 2013, pp. 540-560).

“In recent years, the issue of the role played in the processes of economic growth of cities and regions by creative individuals with a high level of human capital and specialist competences, defining new directions and areas of application of knowledge, has been increasingly taken up” (Florida, 2004, pp. 68-69). In this stream of interest, attention should be paid to, among others, the concept of the creative class elaborated by R. Florida: “The creative class consists of two categories of people” (Florida, 2004, pp. 68-69). The first is the super creative core – a group consisting of employees from a wide range of disciplines, starting with science through engineering, people related to art, design and media, as well as computer programming education. The primary professional goal of employees creating the super active core is to search for creative and innovative solutions, their work focuses not only on solving problems, but also on finding them. The second category is creative professionals – people with thorough professional and specialist training performing their work in the areas of: law, finance, health care, business management, and finance. They solve tangible problems using high competences and skills acquired throughout the entire process of higher education. For representatives of the creative class, the key is the ‘quality of place’ determined by specific features of the urban community. The creative class focuses on the so-called creative centres – open, multi-ethnic, and culturally diverse cities. “To attract representatives of this class, the city (region) must offer the 3T – Talent, Tolerance, Technology” (Florida, 2004, pp. 249-266). Talent means educated, brilliant residents with a high level of human capital. Tolerance is a diverse, open to strangers, tolerant community. Ultimately, technology is technical infrastructure, advanced technology, innovative industries, etc. The creative class values meritocracy, diversity, and individualism, guided in particular by these values when choosing a place to live and work. The economic benefits resulting from the activity of the creative class are associated with the creation of new products, ideas, theories and strategies, advanced technologies and innovations, which has its impact on the development of cities and regions. Florida turned upside down the traditional view, according to which an environment conducive to economic growth must be characterised by a good business climate, claiming that a good people climate is more important. Members of the creative class do not choose specific places of residence only because high rates of growth and economic development are the result of the concentration of people classified as creative in given places. It is worth adding that interesting studies and analyses of factors determining the ‘happiness of cities’ show that the factor that plays the main role in increasing the level of well-being and the sense of happiness of metropolitan residents is human capital. It has become clear that it is more important than income and many other variables influencing the sense of happiness and life satisfaction.

The research and analyses of the impact of human capital on regional growth and development conducted in Poland showed that there was a detailed interdependence between the resources and growth of human capital and the level of income and the rate of economic growth of subregions in the period 1999-2003. Regions that in the mid-nineties were distinguished by a high potential of human capital achieved relatively rapid growth in subsequent years, however regions where the level of human capital was relatively lower developed more slowly. It is necessary to point out that human capital correlates with social capital. Moreover, cultural conditions are also important for the effectiveness of the pro-development impact of social capital, among which social norms that reward cooperation, innovation and openness as well as the ability to compromise in the name of the common good are of particular importance. Nevertheless, the sense of the common good is rejected by competition in defence of one's own interests, and compromise in social dialogue is considered a manifestation of weakness, then in principle there is no possibility of combining particular interests with the general interest. Hence, the culturally determined way of understanding individual interest and general interest is also of great importance for the development of the region.

4. Innovation measurement

The model of the innovative environment stresses the importance of interactions between economic entities, based on mutual learning and joint effort in solving various problems. This cooperation takes place in a specific geographical space and takes the form of a network. However, cooperation between enterprises alone may not be sufficient for the region to effectively generate and absorb knowledge and innovation. Therefore the literature has traditionally emphasised the essence of the public factor, research and development activities and institutions intermediating the transfer of innovations, called the 'golden triangle'.

The key force of development is the knowledge of people, which can be divided into two categories: codified knowledge and tacit knowledge. Codified knowledge is that which is recorded and stored in various forms, such as books, Internet resources or reports. Tacit knowledge, on the other hand, is inextricably linked to people – their talents, experience and skills; its transfer is possible only through direct contacts. Knowledge is the greatest strategic resource, and the learning process plays a key role in the development of innovation.

Specific resources of the region, such as knowledge resources, learning capacity, organizational culture and infrastructure, have a significant impact on the competitiveness of local enterprises and their innovative activity. "These competitive advantages are local in nature, they result from the concentration of highly specialized knowledge, the presence of public institutions, competition, trading partners and consumers" (Florida, 2000, pp. 58-72).

In order to examine the diversity of provinces and regions in terms of the level of innovation, it is proposed to adopt eight key components, which include: human capital, financing and support, business activity, links between them, protection of intellectual property, innovators and economic effects, which can be represented by appropriate statistical features. The author believes that these components will enable an accurate diagnosis of differences in the innovation potential of individual provinces, as well as an indication of the weakest element in the innovation process, which is a barrier to building a competitive advantage. "They are an element of the author's concept of acquiring regional development factors as a modern concept of regional development" (see Makieła, 2013, pp. 40-86).

Human capital:

- people working in the research and development sector per 1,000 professionally active people,
- share (%) of people with higher education in the age group 25-35,
- share (%) of students of public schools in engineering and technical fields in the age group 18-25,
- share (%) of pupils and students in the age group 25-35,
- share (%) of students using the internet,
- graduates of science and technology per 1,000 residents in the age group 25-35,
- people with a doctorate in science per 1,000 residents in science, in the age group 25-35,
- share (%) of people with a postdoctoral degree in higher education in the group of doctors of science,
- share (%) of professors of higher technical schools in the group of research workers.

Financing the R&D sector:

- share (%) of public expenditure on R&D in GDP,
- share (%) of private investments and loans in GDP,
- expenditure on R&D in higher education (PLN million),
- expenditure on R&D per capita (PLN),
- expenditure on R&D per 1 employee in the R&D sector (PLN thousand),
- share (%) of expenditure on R&D activity to GDP.

Financing in the enterprise sector:

- share (%) of expenditure on R&D by enterprises to GDP,
- share (%) of expenditure on innovative technologies to GDP,
- share (%) of expenditure on innovation activity of industrial enterprises from own funds (PLN thousand),
- expenditure on innovation activity of industrial enterprises from budget funds (PLN thousand),
- expenditure on R&D activity in the enterprise sector (PLN million),
- share (%) of enterprises that introduced innovations in the group of enterprises.

Relational capital in the SME sector:

- share (%) of SMEs conducting R&D activities and implementing proprietary innovations in the total number of SMEs,
- share (%) of SMEs cooperating with the science sector in the total number of SMEs,
- share (%) of SMEs in technology parks in the total number of enterprises.

Intellectual property:

- number of inventions submitted for patent protection to the European Patent Office per 1 million inhabitants,
- number of trademarks submitted per 1 million inhabitants,
- number of utility models submitted per 1 million inhabitants.

Categories of innovative enterprises:

- product innovations implemented in enterprises per 100 enterprises,
- organizational innovations implemented in enterprises per 100 enterprises,
- marketing innovations implemented in enterprises per 100 enterprises,
- technological innovations implemented in enterprises per 100 enterprises,
- ecological innovations implemented in enterprises per 100 enterprises.

Economic efficiency:

- share (%) of export of innovative products to total export,
- share (%) of sales of new products or modernised products in total sales of enterprises.

Based on the above elements of innovation, one can prepare an assessment of the level of differentiation of regions, their hierarchy and innovation structure, which will then provide support in the process of searching for functional solutions aimed at rebuilding regional structures, taking action for the climate of innovation, and searching for innovative regional resources. The orientation of the development of settlement units, metropolises, cities, and local government units towards the idea of developing entrepreneurship and innovation results from their specific features. Local government units are distinguished by:

- human resources (people and their specific predispositions – the quality of human capital and social capital),
- natural resources (e.g. land, raw materials, size of the surface),
- capital resources (material and financial values created by humanity, needed for production, invested financial capital),
- organizational resources,
- entrepreneurship and innovation potential,
- smart specialisations,
- leading functions and rank in the hierarchical structure.

Human capital plays a crucial role in regional development, particularly in fostering innovation and entrepreneurship. The data provided valuable insights into various aspects of human capital, financing for research and development (R&D), intellectual property, and the innovation structure across regions, enabling a thorough analysis of how these factors contribute to regional economic growth and innovation. Another important indicator was the share of people with higher education in the age group 25-35. A higher percentage of educated individuals in this age group indicates a more skilled and capable workforce, which is essential for the growth of innovation-driven industries. Similarly, the number of graduates in science and technology fields per 1,000 residents within the same age group demonstrates how well regions are preparing their young workforce for future challenges. Areas with a high concentration of STEM graduates are well-positioned to develop cutting-edge technologies and engage in high-value industries. In terms of financing R&D, both public and private investment levels play a pivotal role. Public expenditure on R&D as a share of GDP reflects a region's governmental commitment to supporting innovation through research grants, infrastructure, and public research institutions. A high level of public investment in R&D is vital for creating a foundation for innovation, particularly in regions that may not have significant private-sector funding, whereas private investment in R&D, reflected as a percentage of GDP, demonstrates the engagement of the private sector in driving technological advancements. A region where the private sector heavily invests in R&D is likely to see a quicker commercialisation of new ideas and technologies. Economic efficiency metrics such as the share of exports of innovative products to total exports and the share of sales from new or modernised products to total sales of enterprises, highlight how successful the region is in translating its innovation into economic value. A region with a high proportion of innovative products in its exports is likely to be competitive on the global stage, while businesses that sell new or modernised products are more likely to experience higher profitability and growth. Finally, regional resources such as human, natural, capital, and organizational resources, along with smart specialisations, entrepreneurship, and innovation potential, all contribute to the development of regional economies. The quality of human capital, including education, skills, and expertise, is a fundamental driver of innovation. A region with abundant skilled professionals, access to advanced education, and strong ties between academia and industry is better equipped to leverage its resources to foster growth. The smart specialisation of a region, with a focus on developing competitive advantages in specific sectors, ensures that innovation efforts are targeted and efficient.

5. Conclusion

Based on the analysis of the subject literature, it can be seen that human capital, innovation and regional development are closely linked and play a key role in the economic success of regions in the modern world. Human capital, defined as the knowledge, skills and competencies of its residents, is the foundation for the process of generating innovation. High quality human capital, supported by an appropriate educational system and professional mobility, contributes to the creation of innovative technological, organizational and product solutions. Innovation also results from the creativity and adaptability of both individuals and organizations that use human capital resources in the process of introducing changes. Regions with strong human capital are distinguished by a higher level of innovation, which translates into their competitiveness and attractiveness to investors. Cooperation between the public and private sectors and the scientific community favours the creation of innovation ecosystems, in which the development of human capital and innovation go hand in hand. The literature also points out that regions with different levels of human capital and innovation need appropriately adapted political strategies. Supporting the development of education, investing in research and development, and creating favourable conditions for entrepreneurship and technology transfer are becoming key to stimulating innovation at regional level. To sum up, human capital and innovation are inextricably linked and constitute the basic determinants of regional development, whilst their mutual interaction has a significant impact on improving competitiveness, creating new jobs, and improving the quality of life of residents in individual areas.

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Kapitał ludzki jako kluczowy element wspierający innowacje w regionach

Streszczenie

Cel: Celem artykułu jest teoretyczna analiza znaczenia kapitału ludzkiego i innowacyjności w procesie rozwoju regionalnego w kontekście gospodarki opartej na wiedzy.

Metodyka: W artykule zastosowano analizę literatury przedmiotu oraz metodę opisową w celu ukazania relacji między kapitałem ludzkim a zdolnością regionów do wprowadzania innowacji.

Wyniki: Kapitał ludzki – rozumiany jako wiedza, umiejętności, doświadczenie i kreatywność mieszkańców – odgrywa kluczową rolę w procesach innowacyjnych. Regiony charakteryzujące się dobrze rozwiniętym kapitałem ludzkim wykazują wyższy potencjał wdrażania innowacji, co przekłada się na ich konkurencyjność i wzrost gospodarczy.

Implikacje i rekomendacje: Wzmacnianie kapitału ludzkiego powinno być priorytetem polityki regionalnej, ponieważ inwestycje w edukację, rozwój kompetencji i kreatywność mieszkańców zwiększają zdolność regionu do tworzenia i wdrażania innowacji.

Oryginalność/wartość: Artykuł wnosi wartość dodaną poprzez podkreślenie znaczenia kapitału ludzkiego jako podstawy innowacyjności i konkurencyjności regionów w warunkach współczesnej gospodarki opartej na wiedzy.

Słowa kluczowe: innowacja, badania, konkurencja regionów