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Security of human capital: negative factors, health care, problems of investment and loss in modern conditions of digitization

Seguridad del capital humano: factores negativos, atención médica, problemas de inversión y pérdidas en las condiciones modernas de digitalización

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Abstract

The main purpose of the article is to identify key factors influencing the safety and health of human capital in open socio-economic systems in the digital era. To achieve this goal, the task was determined to carry out factor modeling. The object of the study is human capital, its security system and investment in its healthcare. The research methodology involves the use of modern modeling methods to prioritize the action of certain impact factors. As a result of the study, key factors influencing the health and safety of human capital in Ukraine were identified. The innovativeness of the results obtained is revealed through the presentation of the author's approach to modeling the ordering of the action of certain factors. A model for counteracting the negative influence of these factors is proposed. The study is limited by not taking into account all possible influencing factors. Prospects for further research include covering broader aspects of the

Resumen

El objetivo principal del artículo es identificar factores clave que influyen en la seguridad y la salud del capital humano en sistemas socioeconómicos abiertos en la era digital. Para lograr este objetivo, se determinó la tarea de realizar un modelado factorial. El objeto del estudio es el capital humano, su sistema de seguridad y la inversión en su asistencia sanitaria. La metodología de investigación implica el uso de métodos de modelado modernos para priorizar la acción de ciertos factores de impacto. Como resultado del estudio, se identificaron factores clave que influyen en la salud y seguridad del capital humano en Ucrania. El carácter innovador de los resultados obtenidos se revela a través de la presentación del enfoque del autor para modelar el orden de la acción de ciertos factores. Se propone un modelo para contrarrestar la influencia negativa de estos factores. El estudio se ve limitado al no tener en cuenta todos los posibles factores que influyen. Las perspectivas de futuras

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topic and taking into account the entire EU market.

Key words: health care, health security, human, human capital, security, digitization, main factors, investments.

Introduction

Health care is a critical component in human capital development because healthy workers are more productive, which contributes to economic growth. Health influences educational opportunities and work productivity. For example, healthy children do better in school, which increases their chances of getting better jobs in the future. Adults who are physically and mentally healthy can work more efficiently and with fewer interruptions, increasing overall productivity.

Investment in health helps reduce poverty because healthy individuals can work and earn money, while illness often leads to financial hardship. Also, spending on health care is an investment in the future: it ensures a healthy society that can actively contribute to the social, economic and cultural aspects of life. In addition, treating health as a primary need for human capital investment helps create the foundation for long-term development. Ensuring access to quality health care and healthcare helps improve quality of life, which is a key element of sustainable development. Thus, investing in healthcare does not simply improve individual health, but also forms the basis for the development of an effective and productive society, increasing the overall level of human capital, which is important for overall socio-economic development.

Security of human capital means ensuring conditions that allow people to fully develop, work and live in a safe environment where their health, education and well-being are protected. Health is an important element in this context, as healthy people are the foundation of a productive workforce and an innovative society.

Investments in human capital, including health, education and professional development, are critical to ensuring its security. Increased investment in these areas improves the skills, health and overall well-being of the population, which in turn leads to increased productivity and economic sustainability.

investigaciones incluyen cubrir aspectos más amplios del tema y tener en cuenta todo el mercado de la UE.

Palabras clave: atención de salud, seguridad en salud, humano, capital humano, seguridad, digitalización, principales factores, inversiones.

Digitalization also plays an important role in shaping the security of human capital. Digital technologies can improve access to educational resources, simplify job search and professional development, and provide new opportunities for monitoring and managing population health. For example, telemedicine and mobile health monitoring applications allow people to better monitor their physical condition and receive timely medical care.

Medicine, in particular, has a direct impact on the security of human capital. Investments in medical infrastructure, research and development of new methods of treating and preventing diseases help increase life expectancy and quality of life, reducing health-related risks. So, the security of human capital is a complex concept that includes the protection and development of health, education and professional development of the individual. Investments in these areas, along with the integration of digital technologies, are key to creating a strong, healthy, educated and innovative workforce that is the foundation of a stable and efficient economy.

The main purpose of the article is to identify key factors influencing the safety and health of human capital in open socio-economic systems in the digital era. The object of the study is human capital, its security system and investment in its healthcare.

The structure of the article consists of the following elements: an introduction, including a structural overview of the selected topic, a review of scientific sources on the topic, a description of the research methodology, a presentation of the main results of the study, a discussion of the results and conclusions.

Literature review

In the realm of human capital security, particularly in the context of healthcare, investment challenges, and the evolving digital landscape, scholarly research presents a complex tapestry of interrelated issues and insights. The

essence of human capital is intricately tied to the health and well-being of individuals, as explored in various studies.

Bilan, Mishchuk, & Dzhyhar (2017) study delves into the core of human capital by examining the relationship between human capital factors and remuneration, revealing a critical link between education, skills, and financial rewards. This relationship underscores the tangible value of investing in human capital, where enhanced skills and education directly impact earnings.

The role of community health workers, as explored by Olaniran et al., (2019), shifts the focus to a grassroots level, highlighting how essential local health initiatives are in bolstering the health component of human capital, particularly in maternal and newborn care in Africa and Asia. This perspective is crucial in understanding the health care system's reach and its ability to cater to diverse populations.

In an era dominated by digital information, the study by Cannito et al., (2020) becomes particularly relevant. Their research on health anxiety and attentional bias during the COVID-19 pandemic illuminates the psychological impacts of health crises on human capital. The digital age, with its rampant spread of both information and misinformation, plays a pivotal role in shaping public health perceptions and responses.

The intricate relationship between health care expenditures and life expectancy, as analyzed by Heuvel and Olariou (2017), points to the foundational need for financial investment in healthcare systems. Their findings in the European context highlight how life expectancy, a key measure of a nation's health, is deeply influenced by healthcare spending. Ruger's (2007) exploration into global health governance, with a focus on the World Bank's role, broadens the lens to a global perspective. This study is critical in understanding the international dynamics and policies that shape national healthcare systems, influencing the health aspect of human capital on a broader scale. Furthermore, Holzer (2020) study provides an interesting intersection between public health and policing, offering a unique vantage point on the occupational safety of law enforcement as a public health issue. This perspective is vital in comprehending the broader implications of health and safety in various occupational sectors. In the context of rural health, Chuke et al., (2023) study in Southeast Nigeria emphasizes the challenges faced by rural health workers and the

implications for community and sustainable development. This research is crucial in understanding the unique health care challenges in rural settings, which often lack resources and infrastructure. Rezapour et al., (2019) analysis of the effects of health expenditure on health outcomes through a panel data approach further adds to the understanding of how investment in healthcare translates into tangible health improvements. Their findings are particularly pertinent in policy-making and strategic planning for health care systems.

Lastly, Strasser, Kam, & Regalado (2016) review on rural health care access in developing countries completes the picture by offering insights into the challenges and policies needed to improve health care in less accessible regions. Collectively, these studies paint a comprehensive picture of the multifaceted challenges and considerations in securing human capital, highlighting the critical role of healthcare, the impact of digitization, and the importance of strategic investment in fostering a healthy, productive population in the modern world. The imperative for continued research in the area of human capital security, especially considering healthcare, investment, and the impact of digitization, stems from the dynamic and evolving nature of these fields. While existing literature provides foundational insights, the landscape in which human capital exists is constantly shifting due to various factors. Firstly, global health challenges are in a state of flux. New health threats emerge, such as the COVID-19 pandemic, which not only present immediate health risks but also have long-term implications on mental health, societal dynamics, and economic stability. These evolving challenges necessitate ongoing research to understand their impacts comprehensively, develop effective healthcare strategies, and adapt policies to ensure the resilience and well-being of human capital.

Methodology

Expert analysis in our context consists of involving healthcare and human capital specialists to identify and assess negative factors affecting these areas. Experts use experience and knowledge to identify key issues and determine their impact.

Hierarchical analysis helps to organize the identified factors according to their importance or influence. This method allows you to structure problems from the most important to the least important, thus contributing to a better understanding of priorities for solution.

The graphical modeling method is used to visually represent the problems found and possible ways to solve them. This allows the relationships between different factors to be clearly depicted and effective strategies to be developed to counter the negative impacts on health and human capital development.

Results and discussion

The development of human capital is closely interconnected with the healthcare system. The health of individuals has a direct impact on their productivity and performance. When people are healthy, they are able to work more effectively, maintaining a high level of professional activity and quality of work. In contrast, illness or poor health can significantly reduce work productivity. In addition to its direct impact on the workforce, health status affects educational opportunities and the quality of learning. This is especially important in childhood and adolescence, when chronic illness or ongoing health problems can interfere with the educational process, resulting in reduced educational achievement and potential for future development.

An effective healthcare system also helps support workforce longevity, ensuring that people can remain active and productive in the labor market for longer. This not only improves the overall level of well-being in a society, but contributes to sustainable economic growth, since a healthy workforce is a key component in the development of human capital.

Productivity and healthcare are closely linked because the health of workers has a direct impact on their ability to perform their jobs effectively. Healthy workers typically have better concentration, stamina and the ability to learn quickly, which are key factors for increased productivity. In addition, illness can lead to a decrease in these abilities, an increase in the number of days lost due to illness, and, as a result, a decrease in overall work productivity. In addition, quality health care and preventative health programs can reduce the risk of chronic disease, which is important not only for keeping workers healthy, but also for stability and increased productivity in the workplace. Effective health systems that provide rapid access to treatment and preventive measures help keep workers in good health, reducing sickness absence and increasing overall productivity.

Investing in the development and security of human capital is a multifaceted process that

includes a number of measures and strategies aimed at improving the health, education and overall well-being of the population. One of the key aspects of this investment is strengthening the health care system.

Strengthening the healthcare system involves increasing the availability and quality of medical services. This means not only providing the population with the necessary medicines and medical services, but also the development of healthcare infrastructure: the construction of new hospitals, the purchase of modern medical equipment, and the training of qualified medical personnel. A focus on preventive measures and raising public awareness about a healthy lifestyle is also important.

In parallel with health initiatives, investing in human capital includes improving the education system. This means not only the creation of new educational institutions and improving the quality of education, but also the development of programs aimed at developing the skills needed in the modern world, such as digital literacy, critical thinking, and an innovative approach. In addition, investing in human capital also involves creating a safe and healthy working environment. This includes ensuring a safe working environment, reducing occupational risks, raising labor safety standards, and ensuring social protection for workers.

The benefits of such investments are multiple. First, they improve productivity because healthy and well-educated workers are able to perform their jobs more effectively. Secondly, the burden on the healthcare system is reduced due to a decrease in the level of illness and injury in the workplace. It also promotes social well-being, as people who feel healthy and happy in their jobs have higher levels of life satisfaction.

The implications of this holistic approach to investing in human capital could be significant. At the macroeconomic level, this can lead to GDP growth as the overall productivity of the economy increases. At the social level, there may be a decrease in poverty and inequality as more people have access to quality education and health care. This creates a more stable and prosperous society where every individual has the opportunity to realize their potential.

The low share of investment in healthcare in the structure of investment in human capital development in Ukraine is explained by several factors. First, economic constraints play a significant role. Ukraine has a limited budget and

faces numerous economic challenges, leading to competition for limited resources among different sectors such as education, infrastructure, defense and healthcare. This may limit investment in healthcare.

The second factor is the historical legacy and structural problems in the health care system. The Ukrainian healthcare system is inherited from the Soviet era and has shortcomings such as outdated equipment and insufficient infrastructure. This requires significant investment in upgrading and improving the system.

Political challenges also have an impact on healthcare investment. Political instability and changes in government can influence decisions about the allocation of resources to health care, as well as the adoption of reforms in this area.

Social aspects include low levels of public awareness of the importance of investing in health and insufficient demand for health services. This may be due to cultural and social factors influencing the perception of the need to improve the healthcare system (Fig.1).

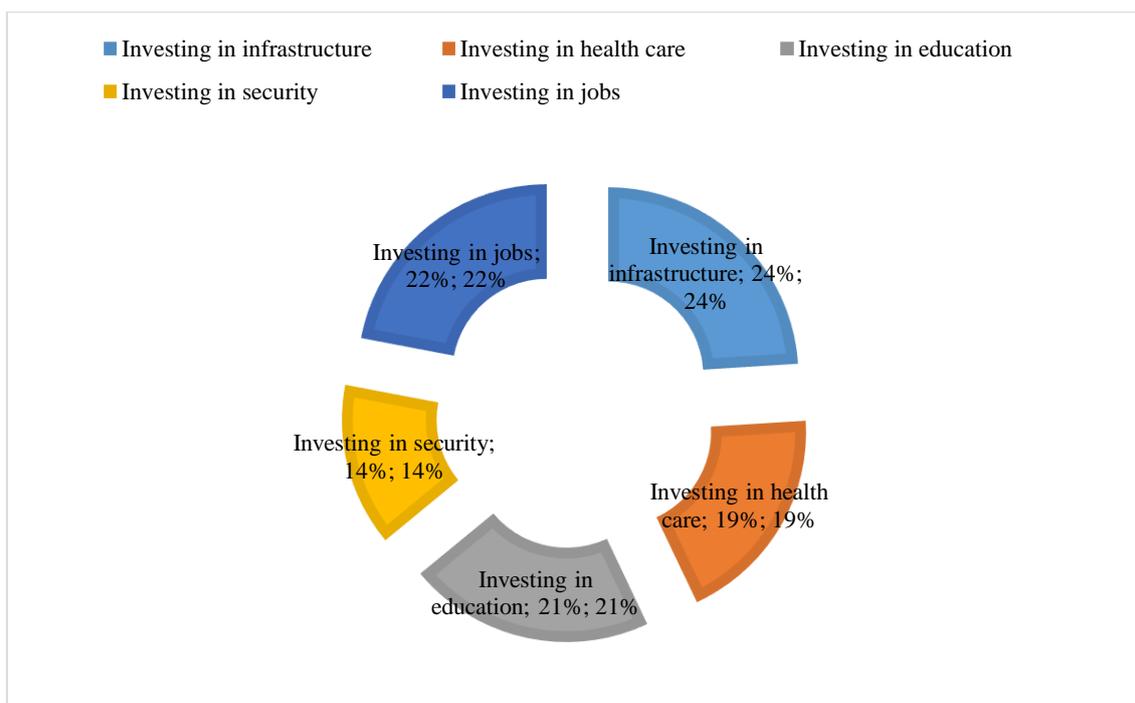


Figure 1. The structure of investment in the development of human capital in Ukraine for 2022, % (Formed by authors)

Based on the results of a survey of experts, we will highlight the most significant negative factors affecting the security and development of human capital in Ukraine:

1. Insufficient investment in healthcare. This can lead to a deterioration in the general health of the population, inaccessibility of health services to all segments of society and an increase in morbidity and mortality.
2. Digital divide. Unequal access to digital technology and the internet can create a large gap between those who have access to digital resources and those who do not. This limits educational, work and social development opportunities for a large part of the population.
3. Low quality of education. Insufficient funding, outdated educational programs and a lack of qualified teachers can lead to low quality education, limiting the development of skills and knowledge needed for the modern labor market.
4. Economic inequality. Large economic inequalities can lead to social instability, limit access to basic resources for the poor, and reduce opportunities for social and professional development.
5. Political instability and corruption: These factors can have a serious impact on human capital development as they lead to poor management of resources, lack of trust in government and limited business and investment opportunities.

Each factor is assigned a number for the convenience of subsequent calculations: 1-5. To perform a hierarchical analysis using the Saati's Analytic Hierarchy Process (AHP), we need to follow these steps:

1. Define the Criteria and Comparison: The criteria here are the five negative factors affecting human capital development: Insufficient investment in health care, Digital divide, Low quality of education, Economic inequality, Political instability and corruption.
2. Construct Pairwise Comparison Matrices: We will compare each factor against each

other in pairs, assigning a scale of importance from 1 to 9 (where 1 means equally important, and 9 means extremely more important).

3. Calculate the Priority Vector: This involves normalizing the pairwise comparison matrix and finding the average of each row, which gives us the priority of each factor.
4. Check for Consistency: We need to ensure the consistency ratio (CR) is less than 10% to ensure reasonable judgments.

First of all, let's build a matrix of even comparisons (Table 1).

Table 1.
The Pairwise Comparison Matrix

	1	2	3	4	5
1	1	3	4	2	5
2	1/3	1	2	1/2	3
3	1/4	1/2	1	1/3	2
4	1/2	2	3	1	4
5	1/5	1/3	1/2	1/4	1

(Formed by authors)

To check for consistency, we calculate the Consistency Index (WI) and the Consistency Ratio (WR). The formula for WI is (1):

$$WI = \lambda_{max} - n / (n - 1) \quad (1)$$

Where λ_{max} is the average of the sum of each column of the pairwise comparison matrix multiplied by its respective priority vector, and n is the number of criteria.

The WR is calculated as (2):

$$WR = WI / RI \quad (2)$$

Where RI (Random Index) depends on the number of criteria (for 5 criteria, RI = 1.12).

In our case, Consistency Index (WI): 0.0226; Consistency Ratio (WR): 2.02%. Since the Consistency Ratio is 2.02%, which is less than 10%, the judgments made in the pairwise comparisons can be considered consistent.

Next, we need build normalized pairwise comparison matrix. This matrix is derived from the pairwise comparison matrix by normalizing each column. The priority vector is then obtained by calculating the average of the rows in the normalized matrix (table 2).

Table 2.
Normalized Pairwise Comparison Matrix

	1	2	3	4	5
1	0.43	0.44	0.39	0.48	0.33
2	0.14	0.15	0.19	0.12	0.2
3	0.11	0.07	0.09	0.08	0.13
4	0.22	0.29	0.28	0.24	0.26
5	0.08	0.05	0.04	0.06	0.06

(Formed by authors)

Based on the conditional calculation using Saaty's Analytic Hierarchy Process (AHP), we have the following results (Priority Vector (Relative Importance of Each Factor)):

1. Insufficient Investment in Health Care: 41.62%
2. Digital Divide: 16.11%

3. Low Quality of Education: 9.86%
4. Economic Inequality: 26.18%
5. Political Instability and Corruption: 6.24%

As a result of the calculations, it was determined that the most important and negative factor is the low volume of investment in health care (Fig.2).

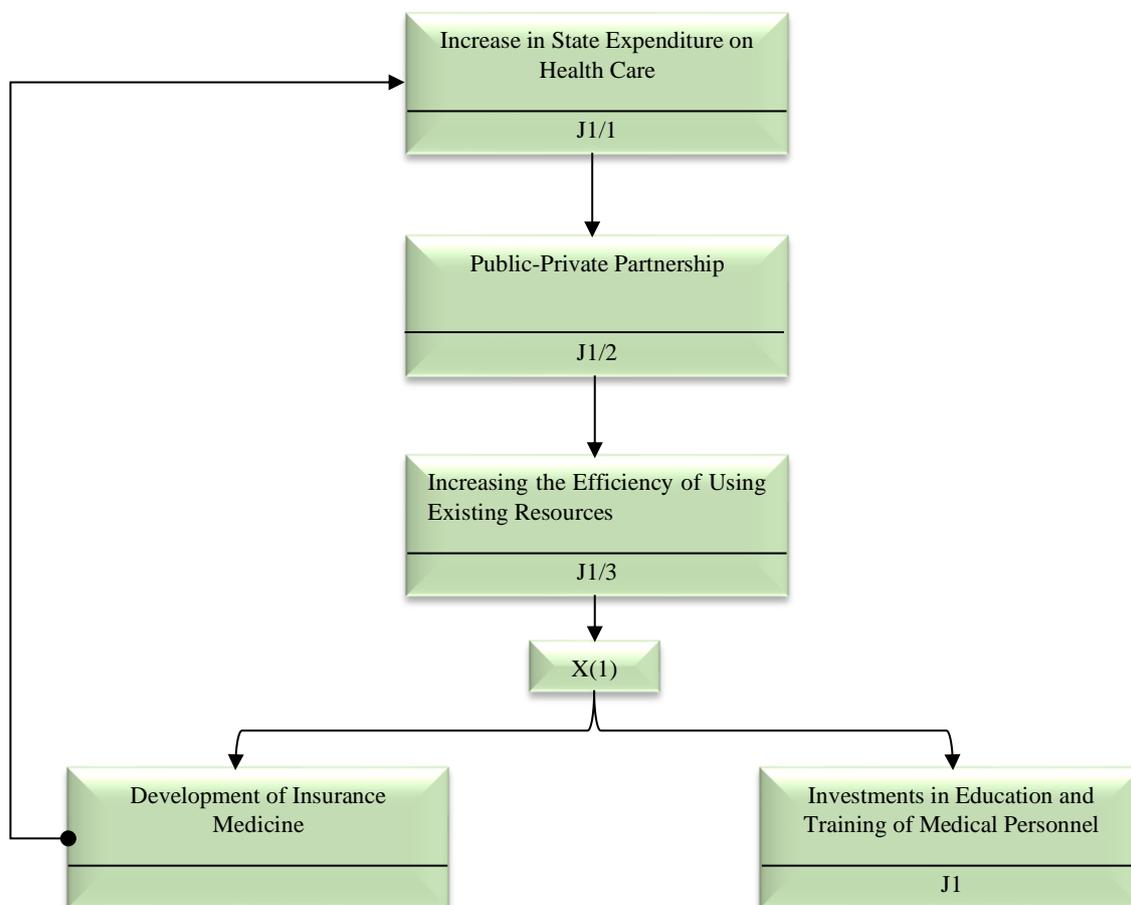


Figure 2. A model for increasing investment in the health care system in the context of strengthening the security of human capital (Formed by authors)

These measures can significantly improve the state of health investment and improve the quality of health care in the country.

In discussing the health and safety of human capital, particularly in the Ukrainian context, we juxtapose our study's findings with various international perspectives and methodologies. Our research identified key factors influencing the health and safety of human capital in Ukraine, presenting an innovative authorial approach to modeling and counteracting these influences. However, it's crucial to note the limitation in not accounting for all possible influencing factors and the need for a broader scope in future research. Morina et al., (2022) examination of the

effect of health expenditure on life expectancy resonates with our findings, underscoring the importance of financial investment in healthcare. However, our study extends this by proposing a model for counteracting negative influences, which could be further enriched by incorporating Morina et al.'s insights on sustainable development and planning. Podra et al., (2020) delve into the theoretical aspects of human capital formation, focusing on migration and investment processes. This study provides a broader context for our work, especially in understanding how human potential migration and investment contribute to the formation and safety of human capital. This perspective can be instrumental in extending our model to include

factors related to workforce mobility and its implications. The comparative study by Paluttur et al., (2015) on healthy city capacity in Indonesia and Korea offers a unique lens through which we can examine our model. Their approach to assessing health capacity at the urban level could provide a more granular perspective, which is particularly relevant given the urban-centric development of countries like Ukraine.

Gladka and Fedorova (2019) focus on defining personnel marketing strategies, a dimension not explicitly covered in our study. Integrating their insights on personnel strategies could enhance our model by considering how marketing and human resource strategies impact human capital's health and safety. Lee et al., (2020) update on health promoting schools is particularly relevant in the context of our study's focus on youth and educational settings. Their findings could inform a more nuanced approach in our model, especially in addressing the educational sector's role in safeguarding human capital. The study by Paluttur et al., (2022) on expert needs for health center development in South Sulawesi provides insights into healthcare infrastructure, which is crucial for understanding the health component of human capital. Integrating their approach could offer a more comprehensive view of healthcare system needs in our model.

Our study's focus on the health and safety of human capital in Ukraine revealed innovative approaches to modeling the influence of various factors. The comparison with the aforementioned studies highlights the necessity of incorporating broader aspects, such as health expenditure's impact, human capital formation through migration, urban health capacity, personnel strategies, and health infrastructure development. These dimensions could greatly enrich our understanding and provide a more holistic view of the factors influencing human capital's health and safety.

Conclusions

The study reveals the key factors influencing the health and safety of human capital in Ukraine. These factors, which affect the health system in different countries, highlight the complex interaction between various aspects of society and the economy. Financial constraints are often at the heart of these challenges, as insufficient funding can lead to shortages of medical resources, equipment and trained personnel. Furthermore, social inequalities and the lack of universal access to health services can leave a

significant part of the population without necessary care.

The innovation of the results obtained is revealed through the presentation of the author's approach to modeling the influence of certain factors. A model is proposed to counteract the negative influence of these factors.

The study is limited by not taking into account all possible influencing factors. Research on the security of human capital, its development and investment in health opens broad perspectives to create a sustainable, productive and innovative society. The key aspect here is to understand how to provide optimal conditions for human development at all stages of life. This involves not only ensuring physical health through medical services, but also creating an environment conducive to education, professional growth, and psychological well-being.

Investing in human capital development and health can lead to significant increases in economic productivity. Healthy, educated and motivated workers can contribute more effectively to the economy by promoting technological progress and innovation. On the other hand, improving working conditions and ensuring workplace safety can reduce the incidence of occupational illnesses and injuries, which, in turn, has a positive impact on overall work productivity.

The development of digital technologies in health and education opens new opportunities for a personalized approach in treatment, training and professional development. This allows for more efficient use of resources and ensures that services are better tailored to individual needs. Additionally, an emphasis on human capital security can help create a more equitable society. The focus on ensuring equal access to education and health services helps reduce social inequality and improve overall living standards.

In summary, the prospects for investigating the security of human capital, investing in its development and health, promise the creation of a sustainable, healthy and innovative social structure capable of adapting to changes in the global context and the challenges of the future.

As a result of the study, key factors influencing the health and safety of human capital in Ukraine were identified. Negative factors affecting the human capital health system in different countries exist due to the complex interaction

between different aspects of society and the economy. Economic constraints are often at the core of these challenges, as insufficient funding can lead to a shortage of medical resources, equipment and trained personnel. Also, social inequalities and the lack of universal access to health services can leave a significant part of the population without necessary health care.

The innovativeness of the results obtained is revealed through the presentation of the author's approach to modeling the ordering of the action of certain factors. A model for counteracting the negative influence of these factors is proposed.

The study is limited by not taking into account all possible influencing factors. Research into the security of human capital, its development and investment in health opens up broad prospects for creating a sustainable, productive and innovative society. The key aspect here is a deep understanding of how to provide optimal conditions for human development at all stages of his life. This involves not only ensuring physical health through medical services, but also creating a favorable environment for education, professional growth and psychological well-being.

Investing in human capital development and health can lead to significant increases in economic productivity. Healthy, educated and well-motivated workers are able to contribute more effectively to the economy by promoting technological progress and innovation. On the other hand, improving working conditions and ensuring workplace safety can reduce the level of occupational diseases and injuries, which, in turn, has a positive impact on overall labor productivity.

The development of digital technologies in healthcare and education opens up new opportunities for a personalized approach to treatment, training and professional development. This allows for more efficient use of resources and also ensures that services are better tailored to the needs of specific individuals. In addition, an emphasis on human capital security research can help create a more equitable society. Focusing on ensuring equal access to education and health services helps reduce social inequality, improving overall living standards.

As a result, the prospects for researching the security of human capital, investing in its development and health promise the creation of a sustainable, healthy and innovative social

structure capable of adapting to changes in the global context and the challenges of the future.

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