

Review Paper

The Application of Digitization in the Economy as a Promising Direction in the Growth of Human Capital

Iryna Shevchenko^{1*}, Hanna Zavadskykh², Olena Ptashchenko³, Viktor Zvonar⁴ and Iryna Vishka⁵

¹Department of International Economics, West Ukrainian National University, Ternopil, Ukraine

²Department of Economics and Business, Dmytro Motornyi Tavria State Agrotechnological University, Melitopol, Zaporizhzhiaobl., Ukraine

³Department of Entrepreneurship and Trade, Western Ukrainian National University, Ternopil, Ukraine

⁴Faculty of Economics and Management, Borys Grinchenko Kyiv University, Kyiv, Ukraine

⁵Department of Administrative and Financial Management Educational Work of Lviv Polytechnic National University, Lviv, Ukraine

*Corresponding author: irina_shevchenko@ukr.net (ORCID ID: 0000-0001-8188-3551)

Received: 10-11-2022

Revised: 29-01-2023

Accepted: 06-02-2023

ABSTRACT

In scientific and technical progress development conditions, human capital acts as the basis for forming economic systems and ensuring their competitiveness at the macroeconomic and microeconomic levels. The article analyzes the factors influencing the processes of human capital formation, defined as a project of the World Bank. Trends in the development of society are analyzed, in particular, the formation of innovative approaches to developing economic systems - the introduction of digital technologies and the transformational transition to a qualitatively new economic level - the digital economy. The research determines the factors influencing the formation and development of human capital. By accumulating the study of literary sources, a set of influencing factors on the formation and development of human capital was formed. Hypotheses have been put forward regarding the interrelationships of factors influencing human capital factors influencing digital technologies. The hypothesis was confirmed by a sociological survey with control charts and correlation-regression analysis of their results. Mathematical confirmation of the hypothesis made it possible to develop proposals for implementing the function of the dependence of influencing factors on the formation and development of human capital with the definition of digital technologies. Based on the conducted research, a model of the interconnected effects of digital technologies and human capital development was developed. The proposed model can be used to develop human capital to ensure the competitiveness of economic systems and ensure the sustainable development of society.

HIGHLIGHTS

- Trends in the development of society are analyzed, in particular, the formation of innovative approaches to the development of economic systems - the introduction of digital technologies and the transformational transition to a qualitatively new economic level - the digital economy. The research determines the factors influencing the formation and development of human capital.

Keywords: Digital technologies, digital economy, human capital index, human capital

Human capital is the basis of economic development at both global and national levels. The development of science and technology and the implementation of the results of technological progress determine the important role of the intellectual component

in economic systems. Human capital is the main

How to cite this article: Shevchenko, I., Zavadskykh, H., Ptashchenko, O., Zvonar, V. and Vishka, I. (2023). The Application of Digitization in the Economy as a Promising Direction in the Growth of Human Capital. *Econ. Aff.*, 68(01s): 345-352.

Source of Support: None; **Conflict of Interest:** None



carrier of the economic system's intellectual component. The formation of prerequisites for the development of a new type of society - digital, involves the formation of new conditions for the development of the economy - the formation of a digital economy. In such conditions, the relevance of analyzing the degree of influence of digital skills on the formation and development of human capital is increasing. According to statistics, as of 2022, the planet's population is 8.041 billion people. In 1960, this indicator was 3.032 billion; over the past 80 years, this indicator has increased by more than 2.5 times. Population growth occurs in a geometric progression and shows rates not characteristic of a single historical period before this period. For example, by analyzing the mortality rates of the population during the First and Second World Wars (20 million people during the First World War and 50 to 75 million people during the Second World War), it is reasonable to determine that the population recovered to the pre-war level in only 20 years. The UN predicts population growth to be 9.7 billion people by 2050, and the population figure will reach 11 billion people by the end of the century. Such a population determines additional requirements for life support processes for the population, including the formation and development of human capital. Developed by researchers of the World Bank as part of the Human Capital Project, the human capital index determines the potential of using human resources, that is, their level of knowledge, skills, qualifications, health, and other indicators that can affect work capacity and work efficiency. This indicator can be defined as an element of the ratio of the population to its efficiency.

Therefore, the issue of determining the impact of digital technologies on the global population to form human capital and its effective use to ensure the sustainable development of the planet is of great practical importance and relevance.

Therefore, the article aims to model the impact of digital technologies and the formation and development of human capital as an element of the economic system.

To achieve the goal of the study, the following tasks were performed:

- ◆ an analysis of trends in the development of digital technologies was carried out,

- ◆ factors influencing the formation of human capital are determined,
- ◆ the weighting coefficients of the influence of digital technologies on the development of human capital are mathematically substantiated,
- ◆ the function of the dependence of human capital on the factors of the development of digital technologies was developed.
- ◆ an interconnected effects model of digital technologies and the development of human capital was building.

Literature Review

The study of human capital development issues is closely related to the determination of the impact of digital technologies on the development processes of society. The development of digital technologies today is the basis of the development of society. The transition to the information society determines the priority of digital technologies. An essential element of the study of human capital development processes and digital processes is the determination of factors influencing transformations. Numerous researchers defined a set of factors that were analyzed in the construction industry. The competitiveness and efficiency of construction enterprises are determined by the degree of implementation of digital technologies. A set of influencing factors on the processes of ensuring production efficiency is proposed, the confirmation of which was determined by surveying expert opinions of industry specialists. Among the influencing factors, experts and researchers identified the following:

- ◆ level of automation of production processes,
- ◆ the level of competence of industry specialists in the field of digital technologies,
- ◆ the level of providing operational processes with digital technologies,
- ◆ the level of digitization of strategic planning and management processes,
- ◆ the level of computerization of production processes,
- ◆ the level of efficiency in the use of information and communication technologies,
- ◆ the level of access to digital technologies,
- ◆ the level of efficiency of information transmission,

- ♦ the level of communicative activity,
- ♦ the level of education of specialists,
- ♦ the level of automation of service provision processes,
- ♦ the level of presentation of services, goods, products, and image creation, brand formation on the market as a factor of competitiveness.

Analyzing the factors of influence of digital technologies on the development of production, it is advisable to group them into the following blocks: digital technologies in the system of operational processes, digital technologies in the formation of strategic management, digital processes in the formation of human capital, digital technologies of a presentation and communication nature.

As a result of the analysis, multi-criteria decision-making methods for introducing digital technologies were developed. The set of factors was confirmed through an empirical study using a t-test. Research has confirmed the role of digital methods as a critical factor in ensuring competitiveness and efficiency. For our study, a group of factors related to the formation and development of human capital was eradicated (Bajpai and Misra, 2022).

An empirical study of digital technologies' influence on economic systems' investment attractiveness is interesting. Investment activity is an element of the realization of the intellectual potential of the system and, accordingly, has a direct dependence on the implementation of digital technologies. The study was conducted based on statistical data from 70 developing countries. In the study, countries are divided into two groups according to the level of investment attractiveness, depending on the level of implementation of digital technologies. The interdependencies of the level of investment attractiveness and the level of application of digital technologies are also determined in the research of the World Bank and the International Labor Organization. Also, the developed hypotheses were confirmed by empirical research methods. The application of digitalization methods has a positive effect on the level of employment and the reduction of unemployment at the macroeconomic level, contributes to entrepreneurial activity, growth in the level of GDP, an increase in the share of products with high added value in the structure of GDP and, accordingly, an increase in the volume of investments

and an increase in investment attractiveness. So, it is determined that a high level of digitization contributes to economic growth. The low level of use of digital technologies causes the reverse factors: high level of unemployment, low level of income of the employed population, low standard of living, lack of technological development, low level of competitiveness of the country's economy, and resource orientation of the economy. Therefore, the high role of digital technologies in ensuring the economy's competitiveness, the standard of living, and economic development have been determined (Sinha, Tirtosuharto, Chaudhury *et al.* 2022).

Analysis of the digital technologies' impact on economic growth determines the eco-information system of assessment. Using empirical research methods, the integration of multiple linear regression was carried out based on the OLS model and the Dumitrescu-Hurlin method. The study results made it possible to confirm the hypothesis regarding the development of an eco-information model of digitalization based on the examples of European countries. The research identifies limitations that aim to select only relevant indicators of the impact of digital technologies on systems. As a result of the study, the factors of the interrelationship of ecological, economic, and digital factors were determined (Alina-Petronela, Mirela, Gina Ionela *et al.* 2023).

The study of digitization processes in the Industry 4.0 system is interesting. On the basis of the study of Industry 4.0 processes, influencing factors in ensuring the quality of economic systems were determined. The quality of economic systems is defined as one of the elements of competitiveness of national economies. The development of the economy involves ensuring the quality of the results of the system. Numerous authors define the role of digital technologies in the processes of ensuring economic development (Prashar, 2023).

Digitization has a profound impact on the economy. The development of economic systems determines the prerequisites for the development of social and public systems, so it is appropriate to analyze the impact of digital technologies on the development of human capital. The effects of digital processes on human capital should be determined at the macroeconomic level, in the system of social, economic, and social development, in various

sectors and spheres of life of the population (Şener, 2022).

In addition to the socio-economic and social components, it is essential to determine the role of digital technologies in the financial component. Therefore, it is advisable to determine the effects of digital processes on the following areas:

- ♦ economic development,
- ♦ financial processes,
- ♦ development of intellectual potential,
- ♦ social welfare,
- ♦ social processes,
- ♦ competitiveness and effectiveness of socio-economic systems.

The analysis of literary sources made it possible to determine the role of digital technologies and the degree of human capital development on the above-described processes (Salvi, Petruzzella, Raimo *et al.* 2022; Sabir, Niyaz and Bakhtiyar, 2022).

Human capital is defined in several research as an investment component of social development. Researches human capital development factors make it possible to determine the level of its influence on the implementation of innovations. Empirical research have determined the high impact of human capital development on implementing innovations, primarily digital technologies. Research by several authors determines the influence of such factors as the number of applications for patents and inventions, the introduction of digital technologies into operational processes, the scientific expertise of management processes, and the introduction of innovations into strategic management (Valenti and Horner, 2020).

Human capital theories and several economic theories were analyzed to determine the level of influence of digital technologies and factors of influence. The theory of human capital determines the council's role in the human capital development system. In today's society, digital skills are gaining more and more importance. The survey of employers made it possible to determine that the majority put digital skills as the TOP-5 skills of future employees. Therefore, the education system should provide for the formation of digital skills as a basis for developing human capital (Tight, 2018).

The accumulation of the results of the analysis of economic theories determines four groups of factors influencing the formation and development of human capital (Bryant-Kutcher, Jones and Widener, 2008):

- ♦ education,
- ♦ development of information technologies,
- ♦ the standard of living,
- ♦ level of economic development.

Using the concept of medical triage and business models to analyze the level of human capital development in poor countries, the following influencing factors were determined (Bonner, Neely, Stone *et al.* 2022):

- ♦ education expenses,
- ♦ health care costs,
- ♦ measures to create jobs,
- ♦ measures aimed at introducing innovations.

Numerous types of research are devoted to the analysis of the impact of the level of human capital development on the digital sectors of the economy. Human capital has a positive effect on innovation. Hypotheses are tested using a set of hierarchical linear regression, which allowed to confirm the following statements (Zane, 2022; Ghlichlee and Goodarzi, 2022):

- ♦ digital technologies are developing in societies with a high degree of human capital development,
- ♦ systems in which the introduction of digital technologies begins to develop the level of their human capital,
- ♦ digital technologies are the basis of the formation of competitiveness in the conditions of modern economic challenges and priorities,
- ♦ human capital is directly dependent on the level of education and qualifications the population forms.

So, because of the analysis of literary sources, it was determined that factors of digitization have an essential influence on the formation and development of human capital. It is advisable to continue the research and form a set of influencing factors.

Methodology

The article analyzes literary sources, because of which the main models of the formation of human capital are determined. A comparative analysis of the role and effects of digital technologies on the development of social processes and the development of human capital was carried out. By way of generalization, a set of digital technologies has been developed to potentially influence the formation and development of human capital. A sociological survey of 50 respondents working in the field of education was conducted to determine the weighting factors accumulated because of epistemological methods of cognition. A sociological survey was conducted among representatives of education and science of Ukraine who work in the field of sustainable development and human capital formation. For conducting a sociological survey, control maps with parameters proposed for analysis were developed. The results of the sociological survey using control charts were accumulated, averaged, and necessary minimum and maximum values were rejected by means of correlation analysis, which made it possible to ensure a high correlation of the research, accordingly, the high relevance of its results. By analyzing the results of a sociological survey, a function of the dependence on indicators and the development of human capital was developed., model of the interconnected effects of digital technologies and the development of human capital is proposed based on mathematical calculations.

RESULTS

The generalization of the literary analysis made it possible to determine the following factors of influence on the formation and development of human capital, which is focused on the implementation of digital technologies:

- ♦ the level of education and the acquisition of practical skills in the development of digital education,
- ♦ the level of health care as an element of ensuring human productivity and life expectancy, the use of digital technologies in the system to improve the quality of public health,
- ♦ the standard of living of the population as an element of motivation for work, development,

productivity, the use of digital technologies in the provision of social and administrative services, service spheres, etc.,

- ♦ the level of production of goods with high added value,
- ♦ the level of information provision of life processes,
- ♦ level of creativity,
- ♦ the level of application of innovative technologies.

These indicators are accumulated in the general structure of factors affecting human capital. For further analysis, we will apply a system of parameters allowing us to quantitatively describe the structured factors. The results of the development of the factor structure and their quantitative parameters are presented in Table 1.

The proposed indicators were accumulated through comparative analysis of approaches in the research works of several authors, the grouping of international experience. Indices and index parameters are developed by analyzing statistical data United National Research Institute for Social Development.

It was decided to define weighting factors for grouped indicators for further analysis. The results of the control charts and correlation analysis are presented in Table 2. The correlation analysis was carried out by using the basic functions of the program MC Excel.

Table 2 presents the weighting factors of influence factors analyzed in the study. The hypothesis developed by the study's authors, based on a comparative analysis of the approaches of scientists and an analysis of international experience by conducting a sociological survey, was confirmed by calculating the correlation dependence, which in all indicators is higher than 0.65. Therefore, the weighting coefficients can be used to develop the function of the dependence of influencing factors and human capital development processes - formula 1.

$$\begin{aligned} \phi_i^n = & \sum_i^n (0,97E_{i[0,78-1,0]}; 0,73GHS_{i[0,67-1,0]}; \\ & 0,84HD_{i[0,92-1,0]}; 0,77AV_{[0,63-1,0]}; 0,91D_{i[0,75-1,0]}; \\ & 0,82CL_{i[0,8-1,0]}; 0,85DES_{i[0,85-1,0]}) \end{aligned}$$

Table 1: The results of the development of the structure of factors and their quantitative parameters

Factor	Quantification coefficient	Parameter	Description of the impact on human capital
the level of education and the acquisition of practical skills	Education Index	0,78-1,0	reflects the level of literacy, that is, how many percent of the population can read and write, which affects the formation of the level of economic development
the level of health care	Global Health Security Index	0,67-1,0	the level of health of the population determines the effectiveness and efficiency of work of the working population and the economic potential
the standard of living of the population	Human Development Index	0,92-1,0	the standard of living of the population determines the motivation of people to productive work, raising the level of education and qualifications as the basis of the development of human capital
the level of production of goods with high-added value	The share of the total added value of all enterprises in the country to the level of GDP	0,63-1,0	The indicator determines the degree of development of the economy, and its technological support, which can be formed thanks to the rational use of human capital
the level of information provision of life processes	Index of development of information and communication technologies	0,75-1,0	characterizes the achievements of the countries of the world from the point of view of the development of information and communication technologies as the basis of the formation of human capital in the conditions of the digital society
the level of creativity	Creative layer index	0,8-1,0	creativity is the basis of the development of creative industries, which directly depend on the level of human capital, and form the prerequisites for the development of the economy and ensuring a high standard of living of the population, meeting the needs of the population at the highest level
the level of application of innovative technologies	Digital economy and society index	0,85-1,0	summarizes relevant indicators on the effectiveness of digital technologies in Europe and monitors the evolution of EU member states in the field of digital competitiveness

* **Resource:** Developed by the author based on the analysis of social development indices of the UN and the European Union [United National Research Institute for Social Development, Digital Economy, and Society Index. Thematic chapters].

Table 2: The results of the analysis of control charts and the correlation analysis of the sociological survey to determine the weighting coefficients of the influencing factors

Factor	Quantification coefficient	Weight factor	Correlational dependencies
the level of education and the acquisition of practical skills	Education Index	0,97	0,74
the level of health care	Global Health Security Index	0,73	0,69
the standard of living of the population	Human Development Index	0,84	0,72
the level of production of goods with high added value	The share of the total added value of all enterprises in the country to the level of GDP	0,77	0,65
the level of information provision of life processes	Index of development of information and communication technologies	0,91	0,79
the level of creativity	Creative layer index	0,82	0,77
the level of application of innovative technologies	Digital economy and society index	0,85	0,7

where n - the number of research objects;

i - analyzed indexes;

E_i - Education Index;

GHS_i - Global Health Security Index;

HD_i - Human Development Index;

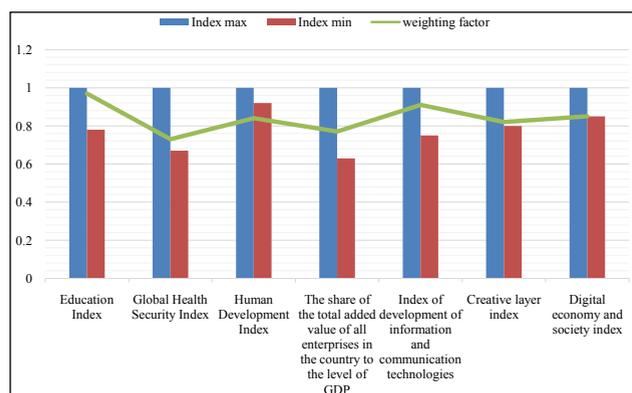
AV - The share of the total added value of all enterprises in the country to the level of GDP;

D_i - Index of development of information and communication technologies;

CL_i - Creative layer index;

DES_i - Digital economy and society index.

Based on the developed function, the proposed model of the interconnected effects of digital technologies and human capital development is presented in Fig. 1.



* Resource: Developed by the author.

Fig. 1: A model of the interconnected effects of digital technologies and human capital development

The model allows for analyzing the available statistical indicators of digital development and determining their critical parameters to ensure the effective use of digital capital. Going beyond the model's parameters indicates the low efficiency of using digital technologies in ensuring the formation and development of human capital.

DISCUSSION

As a result of the research, a set of digital technologies was identified as influencing factors on the formation and development of human capital. By conducting a sociological survey, the weighting coefficients of the factors were determined, which made it possible to develop a linear function of the factors affecting the human capital index. Based

on the conducted research and mathematical justification of the proposed set of factors and their influence, a model of the interconnected effects of digital technologies and the development of human capital was developed.

The model has a systemic and complex nature and considers innovative trends in the development of society, in particular, the influence of digital technologies. The developed model is of practical importance at the level of public management systems, economic policy formation, and ensuring the sustainable development of systems at the macro- and meso-economic levels. The practical implementation of the model allows simulation of the processes of economic development by determining the role of digital technologies. In further research, it is planned to introduce a model of influences on the analysis of basic indices of the socio-economic development of states to ensure a comprehensive analysis.

The question of the practical use of the function developed in the study is debatable because problems may arise with the calculations of the real indicator of the human capital index and its elements due to the lack of statistical data, for example, due to the lack of a system of keeping statistics according to specific parameters, its closedness or untruthfulness, which can be characteristic for a country with a low level of socio-economic development, authoritarian regimes, countries with special regulatory and legal requirements for keeping statistical data, countries where martial law has been introduced and, accordingly, part of the statistical information is hidden, which may cause particular difficulties for the practical implementation of the developed models

CONCLUSION

As a result of the conducted research, a set of influencing factors on the processes of formation and development of human capital was accumulated. Human capital is an essential element of economic development in modern conditions. With the development of innovative technologies the transition to a digital society, the important role of the intellectual component of economic systems is determined. Elements of human capital characterize the intellectual component. Analyzing the human

capital index and trends in the development of digital technologies made it possible to determine their interrelationships. As a result of the research, a model of the interrelated effects of digital technologies and the development of human capital was developed. The model aims to provide practical mechanisms for managing economic systems with the aim of their qualitative transformations, which is carried out by increasing the human capital index at the macroeconomic and mesoeconomic levels through rationalizing the processes of introduction and development of digital technologies. The practical value of the research ensures its relevance, and the directions of further research can ensure its comprehensiveness and systematicity.

REFERENCES

- Alina-Petronela, H., Mirela, Ş., Gina Ionela, B. and Rodica Cristina, B. 2023. Climate neutrality through economic growth, digitalisation, eco-innovation and renewable energy in European countries, *Kybernetes*, ahead-of-print, ahead-of-print. <https://doi.org/10.1108/K-09-2022-1254>
- Bajpai, A. and Misra, S.C. 2022, Evaluation of success factors to implement digitalization in the construction industry, *Construction Innovation*, ahead-of-print. ahead-of-print. <https://doi.org/10.1108/CI-02-2022-0042>
- Bonner, R.L., Neely, A.R., Stone, C.B., Lengnick-Hall, C.A. and Lengnick-Hall, M.L. 2022. Triaging your human capital: an integrative perspective on strategic human capital asset allocation, *Manag Res Rev*, ahead-of-print, ahead-of-print. <https://doi.org/10.1108/MRR-12-2020-0735>
- Bryant-Kutcher, L., Jones, D.A. and Widener, S.K. 2008. Market valuation of intangible resources: The use of strategic human capital, Epstein, M.J. and Lee, J.Y. (Ed.) *Adv. Manag. Account.*, 17: 1-42. Emerald Group Publishing Limited, Bingley,. [https://doi.org/10.1016/S1474-7871\(08\)17001-0](https://doi.org/10.1016/S1474-7871(08)17001-0)
- Ghlichlee, B. and Goodarzi, A. 2022. Strategic human resource practices and new product development performance: the mediating role of intellectual capital, *J. Intellectual Capital*, ahead-of-print, ahead-of-print. <https://doi.org/10.1108/JIC-11-2020-0360>
- Official website European Union. Digital Economy and Society Index. Thematic chapters. Electronic resource. <https://eufordigital.eu/wp-content/uploads/2020/06/DESI2020Thematicchapters-FullEuropeanAnalysis.pdf>
- Official website United National Research Institute for Social Development. Research Catalogue. Electronic resource. <https://www.unrisd.org/en/research/decades/2020s>
- Prashar, A. 2023. Towards digitalisation of quality management: conceptual framework and case study of auto-component manufacturer, *TQM. J.*, ahead-of-print, ahead-of-print. <https://doi.org/10.1108/TQM-09-2022-0289>
- Sabir, R.A., Niyaz, A.M. and Bakhtiyar, A.G. 2022. Social Benefits of Digitalisation. In *The New Digital Era: Digitalisation, Emerging Risks and Opportunities* (pp. 31–47). Emerald Publishing Limited. <https://doi.org/10.1108/s1569-37592022000109a003>
- Salvi, A., Petruzzella, F., Raimo, N. and Vitolla, F. 2022. Transparency in the digitalization choices and the cost of equity capital, *Qual. Res. Financ. Mark.*, ahead-of-print, ahead-of-print. <https://doi.org/10.1108/QRFM-02-2022-0015>
- Şener, I. 2022. Sectoral Digital Business Conflicts. In *Conflict Management in Digital Business* (pp. 187–203). Emerald Publishing Limited. doi:10.1108/978-1-80262-773-220221017
- Sinha, M., Tirtosuharto, D., Ray Chaudhury, A. and Basu, P. 2022. FDI, digitalization and employment: empirical evidence from developing economies, *Researches in Economics and Finance*. ahead-of-print, ahead-of-print. <https://doi.org/10.1108/SEF-10-2021-0450>
- Tight, M. 2018. Human and Social Capital and Their Application in Higher Education Research. In *Theory and Method in Higher Education Research* (pp. 209–223). Emerald Publishing Limited. doi:10.1108/s2056-375220180000004013
- Valenti, A. and Horner, S.V. 2020. Leveraging board talent for innovation strategy, *J. Bus. Strategy*, 41(1): 11-18. <https://doi.org/10.1108/JBS-12-2018-0207>
- Zane, L.J. 2022. Intellectual capital and the acquisition of human capital by technology-based new ventures, *Journal of Intellectual Capital*, ahead-of-print, ahead-of-print. <https://doi.org/10.1108/JIC-04-2021-0122>