ECONOMIC EDUCATION UNDER THE INFLUENCE OF INFORMATION TECHNOLOGY: ANALYSIS OF THE BIBLIOGRAPHIC LANDSCAPE

Olga Kudrina[1], Viacheslav Riznyk[2], Yuliia Ivchenko[3]

Abstract. *The aim* of the article is to carry out a bibliographic analysis of articles related to the use of IT in economic education, in order to characterise the future landscape of scientific and pedagogical research. The material for the analysis were publications from the scientometric database Web of Science from 2020 to 26 March 2024. Only open access publications were taken into account. The VOSviewer application was used to qualitatively characterise the publication's landscape using keyword sets. The search was conducted among publications from 2020 using the words "information technology" and "economic education" in the "Keywords" and "Abstract" fields according to the search formula "information technology AND economic education". In terms of quantitative indicators, there is reason to believe that with the development of the IT industry and, importantly, with the emergence of artificial intelligence and the development of machine learning, the number of qualitative studies in economic education is growing. *The subject* of such research is the modernisation of economic disciplines, the introduction of active learning methods, and the spread of digital platforms that improve the training of economists. A qualitative analysis of the keywords that form the three main clusters of research reveals three trends: (1) the trend of integrative influence of IT development on the development of educational institutions, introduction of innovative models in economic education and its management; (2) the trend of development of personal qualities under the influence of economic education with the use of information technologies; (3) the trend of integration of economic education into socio-economic processes and its impact on human resources and their development. These areas are interconnected and therefore considered promising for the future: research related to the various impacts of the digital economy on the development of universities and their digital administration (digital university, provision of educational services anywhere in the world; development of digital learning environments and pedagogical design, and so forth); research related to the development of learning technologies under the influence of Internet technologies (immersive, gaming technologies, simulations, use of virtual and augmented reality), development of individual qualities of specialists in the field of economics (development of relevant skills – critical and creative thinking, digital communication skills, lifelong learning); research that reveals the peculiarities of organising education in the face of constraints and characterises the causes of digital divide; study of economic processes that determine the links between economic growth, economic education, the introduction of Industry 4.0 and the spread of artificial intelligence in all areas of the national economy.

Keywords: economic education, information technology, influential IT, digital economy, economic training, bibliographic landscape.

JEL Classification: I23, I25, I26

1. Introduction

Modern society today is developing under the influence of globalisation and informatisation. Technologies are spreading rapidly, digital analysis and forecasting tools are being developed, and innovations are emerging that are embodied in various industries (Pilege et al., 2021). Therefore, it is natural to notice not only changes in the economy

[1] Sumy State Pedagogical University named after A. S. Makarenko, Ukraine *(corresponding author)*
E-mail: science@sspu.edu.ua
ORCID: https://orcid.org/0000-0002-7364-1998
[2] Hryhorii Skovoroda University in Pereiaslav, Ukraine
E-mail: riznyk84@gmail.com
ORCID: https://orcid.org/0000-0002-6083-2242
[3] Volodymyr Dahl East Ukrainian National University, Ukraine
E-mail: ivchenko_ja@snu.edu.ua
ORCID: https://orcid.org/0000-0002-4192-482X

focused on a digital society, but also a change in the priorities of economic education, which has acquired new meanings in recent years and is based on modern information technologies (Danish et al., 2023).

Analysing scientific and pedagogical research related to the use of IT in economic education, the study of economics at universities, the requirements for training economists and the results of such training, the authors noted a wide range of research topics:

– The use of digital business simulators as a type of digital educational resource used in the preparation of information technology masters is discussed in (Antoniuk et al., 2023). Such business simulators shape knowledge and skills and prepare for making informed decisions in economic and managerial activities. The authors argue that the use of simulations (Contract Design and Principal-Agent Dilemma Simulation) promotes understanding of the concepts of contract design and information asymmetry in economics and management, and increases interest in and develops the behavioural component of economic and managerial competence, which is now considered an essential soft skill of a specialist;

– The use of web-quests in management training is described in (Rudenko et al., 2022). The authors describe the game technology web-quest for solving applied problems and demonstrate its effectiveness: they find a positive effect on the intensity of learning new knowledge and a positive emotional effect on educational overload. Digital educational escape rooms are discussed in (Sánchez, 2023). The authors show that quest rooms serve as a means of motivating and facilitating the viewing of content for students, future economists, who have taken the course "Organization of Production (Market Theory)";

– The justification for the feasibility of digital visual materials in education is given in (Semenikhina et al., 2020). In particular, the authors emphasise the importance of visual representation of information content for economists, which allows to speed up the perception and processing of text, data arrays, etc., and describe the relevant specific course;

– The use of open educational platforms in modern economic (mathematical) education is presented in (Semenikhina et al., 2019). The authors summarise the experience of teaching mathematical courses on which economic education is based (analytical geometry, linear algebra, etc.) and describe their features (support for various formats of presentation of materials, access, possibility of modification, etc.). The article (Valadao et al., 2023) gives an idea of the use of the flipped classroom method for mastering linear algebra in the process of economic education based on digital information and communication technologies "Octave";

– The paper (Chen et al., 2022) emphasises the possibility of using Web3.0 technologies not only for the development of the digital economy, but also for economic preparation by providing ubiquitous access to Internet technologies, driven by the development of artificial intelligence in the fields of machine learning, finance and data management;

– The IT-based case study method for teaching economics and business students is presented in (Hoang et al., 2022). The authors demonstrate the effectiveness of financial education in colleges and universities in developing countries.

The analysis shows the prevalence of different approaches to teaching economics using information technology. At the same time, such studies confirm the diverse landscape of economic education under the influence of IT. Therefore, the analysis and generalisation of modern pedagogical practices in economic education are relevant and provide an opportunity to see the existing trends in the use of IT for economic education in general.

The purpose of the article is to conduct a bibliographic analysis of articles related to the use of IT in economic education, thereby characterising the future landscape of scientific and pedagogical research.

2. Materials

The material for the analysis were publications from the scientometric database Web of Science from 2020 to 26 March 2024. Only open access publications were included.

3. Methods

The overall analysis was based on the number of publications for 5-year periods: 2005-2009, 2010-2014, 2015-2019 and 2020-20.03.2024. On its basis, the trend of relevance of research on the use of IT in economic education is expressed. Further, the VOSviewer application (https://www.cwts.nl) was used, which allows to qualitatively characterise the publication landscape using sets of keywords. The developers of VOSviewer provided the calculation of markers:

– (Cluster) – a set of network elements that are close to each other by a certain characteristic, marked with a number;

– (weight) of an element indicates the importance of the element: an element with a higher weight is considered more important than an element with a lower weight;

– (w_l) is the weight of the links: the number of links the element has with other elements;

– (wtls) is the weight of the total bond strength: the total strength of the bond of an element to other elements;

– (w_o) – when working with keywords, indicates the number of documents in which the keyword appears;

– (s_{apy}) – the average year of publication of documents in which this keyword occurs.

The search was conducted among publications from 2020 using the words "information technology" and "economic education" in the "Keywords" and "Abstract" fields according to the search formula "information technology AND economic education".

Based on the publications found, the application calculated quantitative indicators, which were collected in a table. The app's algorithms divided the publications into clusters depending on the number of references found. These clusters were analysed on a quantitative basis and the general trends that were identified were described. To make the tables clear, the depth of the tables was limited.

4. Results

The quantitative analysis of the publications in the search for "information technology AND economic education" (Table 1) shows an increase in the number of publications related to the use of IT in economic education (the last column will show to exceed the previous indicators, as today publications are analysed only until March 2024).

The set of publications for the query "information technology AND economic education" gives a set of 4709 keywords. Analysis of the most frequently used keywords (mentioned in at least 20 publications) divides this set into 3 clusters (Table 2).

Each cluster has a different number of words, but they are related and form a specific field of research. The first, the red cluster, includes the words "digital economy, digitalisation, higher education, innovation, management, model, students, sustainable development, technologies". Together they characterise the educational process in higher education. The words "innovation, management, model" have the highest number of links (36, 34, 33 respectively) and the words "higher education, innovation, management" have the highest strength of links (111, 134, 226 respectively). They are the most frequent among the keywords of the set of publications (58, 54, 54, 54). They characterise the cluster as one that emphasises the link between "higher education, innovation, management and models", which is interpreted as a trend towards the modernisation of economic higher education under the influence of IT through innovation, modern management strategies and the introduction of innovative models for the training of economists. This trend is reinforced by research on the digital economy and the sustainable development of universities. This trend is confirmed by other studies (Johnson & Meder, 2023; Liu et al., 2024; Yurchenko et al., 2023; Xu & Song, 2022).

The second, green cluster, includes the words "adoption, China, covid-19, determinants, digital divide, gender, impact, information, Internet, skills, technology", with the words "impact, information, technology" having the largest number of connections (40, 39, 38 respectively), which also have the largest strength of connections (284, 301, 275 respectively). These keywords are also the most frequent ones in the cluster. Taken together, these words characterise higher economic education from the point of view of the impact of IT on individuals, their health and the development of personal skills. Generalising the data on the green cluster, it is possible to talk about the trend associated with Internet technologies for teaching economic disciplines (especially during the pandemic), the impact of information technology not only on health, but also on the level of acquired skills, the widening of the digital divide for different groups (through access to the Internet, due to economic factors, etc.). This trend is confirmed by other studies (Pivneva et al., 2023; Nataraja et al., 2011; Yang & Hong, 2023).

The third, blue cluster, contains the words "economic growth, education, globalisation, growth, human capital, ICT, information technology, knowledge, performance, productivity". The analysis of the third cluster shows the best indicators for the words "economic growth, education, ICT" in terms of the number of links (34, 40, 39 respectively), the strength of the links (172, 364, 315 respectively) and the number of publications with these keywords (55, 180, 112 respectively). The cluster includes words that characterise economic education in the context of globalisation, growth, human capital and productivity. Therefore, there are reasons to highlight the trend of integrating economic education into socio-economic processes: publications characterise the widespread (global) impact of not only the economy, but also economic education on society, economic growth and productivity, which is due to the development of information technology and ICT. This tendency is confirmed by other studies (Medvedeva et al., 2022; Carayannis et al., 2014; Aoujil et al., 2023).

Thus, based on the bibliographic analysis of publications on the use of IT in economic education, there are three trends (Figure 1).

Table 1

Number of publications

Keywords	2005-2009	2010-2014	2015-2019	2020-20.03.2024
Information technology AND economic education	208	598	1128	1054

Table 2

Keyword clusters for "information technology AND economic education"

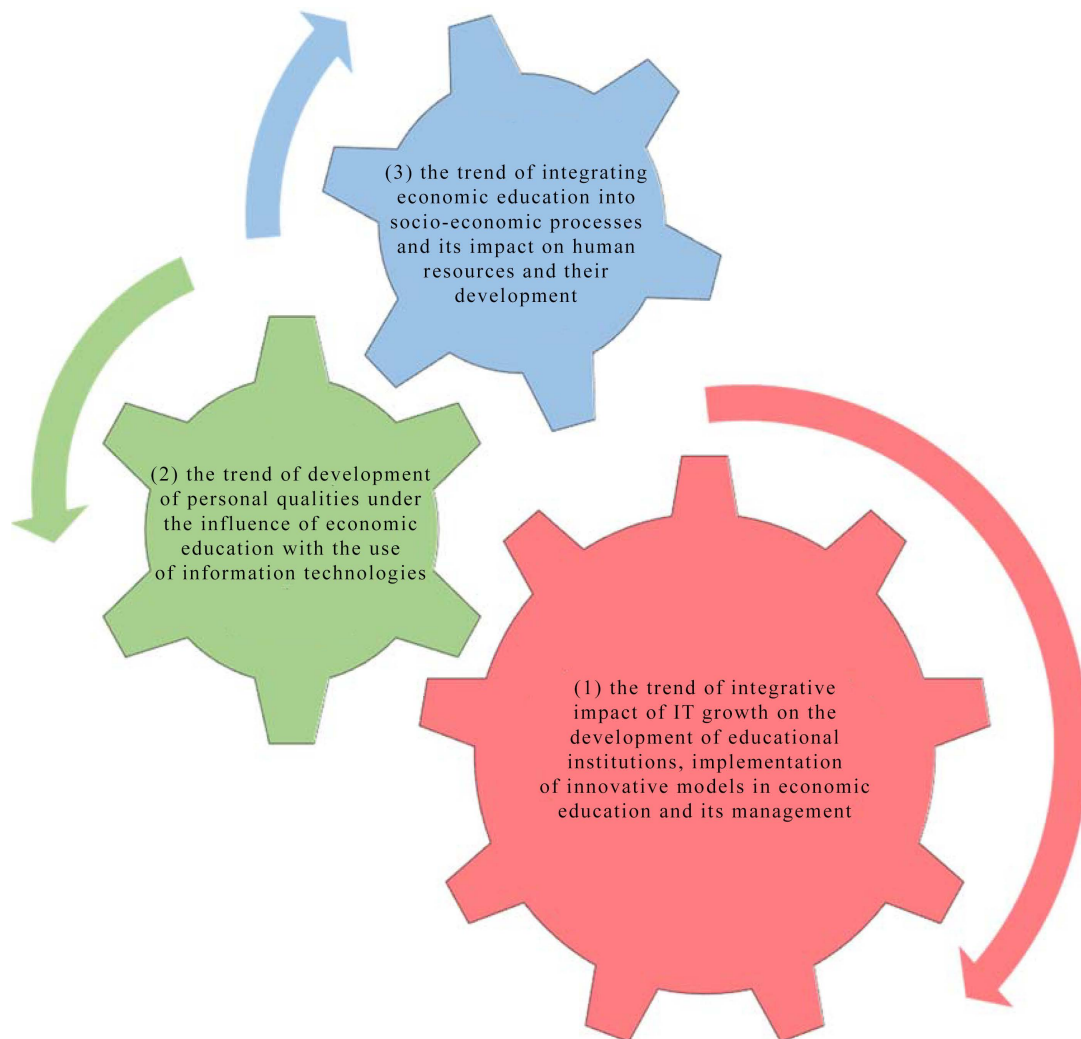| No	Keyword	cluster	wl	wtls	wo	sapy
1.	challenges	1	29	65	25	2021.8
2.	digital economy	1	20	39	21	2021.0
3.	digitalisation	1	32	99	42	2021.3
4.	higher education	1	29	**111**	**58**	2021.3
5.	higher-education	1	24	45	21	2021.7
6.	information and communication technologies	1	24	50	36	2021.3
7.	innovation	1	**36**	**134**	**54**	2021.6
8.	management	1	**34**	**126**	**54**	2021.7
9.	model	1	**33**	79	34	2021.8
10.	science	1	19	40	21	2021.4
11.	students	1	31	104	47	2021.4
12.	sustainability	1	21	48	26	2021.6
13.	sustainable development	1	26	54	22	2022.2
14.	technologies	1	29	59	27	2021.4
15.	university	1	20	52	24	2021.3
16.	access	2	21	59	20	2021.2
17.	adoption	2	29	127	55	2021.9
18.	agriculture	2	18	43	21	2021.3
19.	China	2	28	74	28	2022.0
20.	covid-19	2	28	88	58	2021.8
21.	determinants	2	27	98	35	2021.9
22.	digital divide	2	28	102	35	2021.4
23.	gender	2	25	51	22	2021.7
24.	health	2	18	33	21	2021.9
25.	impact	2	**40**	**284**	**98**	2021.9
26.	information	2	**39**	**301**	**113**	2021.8
27.	Internet	2	33	101	39	2021.7
28.	skills	2	22	60	26	2021.7
29.	technology	2	**38**	**275**	**103**	2021.8
30.	economic growth	3	24	79	28	2022.0
31.	economic-growth	3	**34**	**172**	**55**	2022.0
32.	education	3	**40**	**364**	**180**	2021.7
33.	globalisation	3	22	54	20	2021.6
34.	growth	3	29	95	32	2021.9
35.	human capital	3	23	61	23	2021.6
36.	ICT	3	**39**	**315**	**112**	2021.7
37.	information technology	3	26	60	39	2021.6
38.	information-technology	3	30	85	31	2021.8
39.	knowledge	3	26	70	31	2021.8
40.	performance	3	27	77	31	2021.871
41.	productivity	3	29	85	28	2021.75

5. Conclusions

The bibliographic analysis makes it possible to characterise the current scientific research related to the use of IT in economic education. In terms of quantitative indicators, there is reason to believe that with the development of the IT industry and, significantly, with the advent of AI and the development of machine learning, the number of qualitative studies in economic education is increasing. The subject of such research is the modernisation of economic disciplines, the introduction of active teaching methods and the spread of digital platforms, thanks to which the training of economic specialists is improved.

The qualitative analysis of the keywords that form the three main clusters of the study allows tracing:
– The trend of integrative impact of IT development on the development of educational institutions, introduction of innovative models in economic education and its management;
– the trend towards the development of personal qualities under the influence of economic education with the use of information technologies;
– the trend of integrating economic education into socio-economic processes and its impact on human resources and their development.

The trend highlighted emphasises the links between different areas of society: the development

(3) the trend of integrating economic education into socio-economic processes and its impact on human resources and their development

(2) the trend of development of personal qualities under the influence of economic education with the use of information technologies

(1) the trend of integrative impact of IT growth on the development of educational institutions, implementation of innovative models in economic education and its management

Figure 1. Trends in research areas on the use of IT in economic education

of digital technologies, the development of the economy, the development of the education sector, the modernisation of economic education and the development of digital tools for the economy.

These areas are interconnected and therefore considered promising for the future: scientific research related to the various impacts of the digital economy on the development of universities and their digital management (digital university, provision of educational services anywhere in the world; development of digital educational environments and pedagogical design, etc.); research related to the development of learning technologies under the influence of Internet technologies (immersive, game technologies, simulations, use of virtual and augmented reality), development of individual qualities of specialists in the field of economics (development

of relevant skills – critical and creative thinking, digital communication skills, ability to learn throughout life); research that reveals the peculiarities of organising education in the face of constraints and characterises the causes of digital divide; study of economic processes that determine the links between economic growth, economic education, the introduction of Industry 4.0 and the spread of artificial intelligence in all areas of the national economy.

6. Restriction

A significant part of the analysed publications was taken from the Web of Science database. The analysis does not include materials published in the database before 2020 and after 20 March, 2024.

References:

Antoniuk, D. S., Spirin, O. M., & Vakaliuk, T. A. (2023). Using digital business simulators in economic and managerial development of master's in information technologies. *Information Technologies and Learning Tools*, Vol. 94(2), p. 72–86. DOI: https://doi.org/10.33407/itlt.v94i2.5172

Aoujil, Z., Hanine, M., Flores, E.S., Samad, M.A., Ashraf, I. (2023). Artificial Intelligence and Behavioral Economics: A Bibliographic Analysis of Research Field. *IEEE Access*, Vol. 11, 139367–139394. DOI: https://doi.org/10.1109/ACCESS.2023.3339778

Carayannis, E., Sindakis, S., & Biginas, K. (2014). Entrepreneurial education, intelligence and competitiveness enabled by higher order technological learning (hotl) and strategic knowledge serendipity and arbitrage (skarse). Edulearn14: 6th International Conference On Education And New Learning Technologies, 3766–3773.

Chen, C., Zhang, L., Li, YH., Liao, TC., Zhao, SR., Zheng, ZB., Huang, HW., Wu, JJ. (2022). When Digital Economy Meets Web3.0: Applications and Challenges. *IEEE Open Journal of the Computer Society*, Vol. 3, p. 233–245. DOI: https://doi.org/10.1109/OJCS.2022.3217565

Danish, Khan, S., & Haneklaus, N. (2023). Sustainable economic development across globe: The dynamics between technology, digital trade and economic performance. *Technology in Society*, Vol. 72, 102207. DOI: https://doi.org/10.1016/j.techsoc.2023.102207

Hoang, D. C., Phuc, P. T., Tha, T. H. (2022). Further Discussion On Educational Issues And Case Teaching Method For Economic Students Via Case Studies Journal for Educators. *Teachers and Trainers*, Vol. 13(4), p. 120–130. DOI: https://doi.org/10.47750/jett.2022.13.04.018

Johnson, M., & Meder, M. (2023). Twenty-Three Years of Teaching Economics with Technology. *International Review of Economics Education*, Vol. 45, 100279. DOI: https://doi.org/10.1016/j.iree.2023.100279

Liu, YQ., Su, YL., Fu, HJ. (2024). Innovative Platform for the Comprehensive Quality Evaluation of Postgraduate Students Based on Redactable Blockchain. *Journal of circuits systems and computers,* Vol. 33(1), 2450012. DOI: https://doi.org/10.1142/S0218126624500129

Medvedeva, Y. M., Abdulov, R. E., Dzhabborov, D. B., & Komolov, O. O. (2022). Digitalization of the Economy and Advanced Planning Technologies as a Way to Overcome the Economic Recession. *Biologically inspired cognitive architectures 2021,* 1032, 275–280. DOI: https://doi.org/10.1007/978-3-030-96993-6_29

Nataraja, S., Rasheed, M., Al-Aameri, A., & Paracha, ZU. (2011). Core Competencies for Business Graduates Embark on the Economic Clusters of Saudi Arabia. Proceedings of the 7th european conference on management leadership and governance, p. 306–312.

Pilege, E., Plota, S., Pilegis, G., & Zivitere, M. (2021). ACT Digital: The Strategic Role of Analytics, Creativity and Technologies for Cultural and Creative Sector and Education. *Digital Presentation and Preservation of Cultural and Scientific Heritage,* Vol. 11, p. 135–150. DOI: https://doi.org/10.55630/dipp.2021.11.12

Pivneva, S., Chernova, O., Abalyan, Z., Shangaraeva, L., Rubannikova, I., & Litvinov, A. (2023). Raising the level of motivation of economics students for studying english using the Myenglishlab Blended Learning Platform. *Revista Conrado*, Vol. 19(90), p. 270–276.

Rudenko, Y., Naboka, O., Petrenko, S., Ostroha, M., Pronikova, M., & Semenikhina, O. (2022). Using Web Quests in Professional Training Student-Managers. 2022 45th Jubilee International Convention on Information, Communication and Electronic Technology (MIPRO), Opatija, Croatia, p. 706–710. DOI: https://doi.org/10.23919/MIPRO55190.2022.9803400

Sánchez, A. M. (2023). Using digital educational escape rooms as a motivational review tool for Economics. *International Journal of Management Education*, Vol. 21(3), 100852. DOI: https://doi.org/10.1016/j.ijme.2023.100852

Semenikhina, O., Drushlyak, M., Bondarenko, Yu., Kondratiuk, S., & Ionova, I. (2019). Open Educational Resources as a Trend of Modern Education. 2019 42nd International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, Croatia, p. 779–782. DOI: https://doi.org/10.23919/MIPRO.2019.8756837

Semenikhina, O., Kudrina, O., Koriakin, O., Ponomarenko, L., Korinna, H., & Krasilov, A. (2020). The Formation of Skills to Visualize by the Tools of Computer Visualization. *TEM Journal*, Vol. 9(4), p. 1704–1710. DOI: https://doi.org/10.18421/TEM94-51

Valadao, M.A.C., Santiago, D.F.G., & Lima, T.P. (2023). Flipped Classroom and Linear Algebra: a Suggestion of Activities Involving Octave and Markov Chains. *ABAKOS*, Vol. 11(2), p. 91–113.

Xu, CY., Song, C. (2022). Optimization of Innovation and Entrepreneurship Education and Training System in Colleges and Universities Based on OpenStack Cloud Computing. *Scientific programming*, 2868499. DOI: https://doi.org/10.1155/2022/2868499

Yang, L., & Hong, Y. (2023). Education Informationization and Education Power: The Influence of Fintech on Educational Equity. ECNU Review of Education. DOI: https://doi.org/10.1177/20965311231210312

Yurchenko, A., Rozumenko, A., Rozumenko, A., Momot, R., & Semenikhina, O. (2023). Cloud technologies in education: the bibliographic review. *Informatyka, Automatyka, Pomiary w Gospodarce i Ochronie Środowiska*, Vol. 13(4), p. 79–84. DOI: https://doi.org/10.35784/iapgos.4421