JEL Classification: A22; C13; I20; I21 **DOI**: https://doi.org/10.31521/modecon.V49(2025)-07

Gorbenko Olena, PhD (Technical Sciences), Associate Professor, Associate Professor of Department of Agroengineering, Mykolayiv National Agrarian University, Mykolayiv, Ukraine

ORCID ID: 0000-0001-6006-6931
e-mail: gorbenko_ea@mnau.edu.ua

Ivanov Gennady, PhD (Technical Sciences), Associate Professor, Associate Professor of Department of General Technical Disciplines, Mykolayiv National Agrarian University, Mykolayiv, Ukraine

ORCID ID: 0000-0002-3861-7300
e-mail: ivanovgo@mnau.edu.ua

Haleeva Antonina, PhD (Pedagogical Sciences), Associate Professor, Associate Professor of Department of Tractors and Agricultural Machinery, Operation and Technical Service, Mykolayiv National Agrarian University, Mykolayiv, Ukraine

ORCID ID: 0000-0002-8017-3133
e-mail: galeevaap@mnau.edu.ua

Khramov Mykyta, Assistant of Department of Agroengineering, Mykolayiv National Agrarian University, Mykolayiv, Ukraine

ORCID ID: 0000-0002-2537-7344
e-mail: khramov_ns@mnau.edu.ua

Problems and Prospects of Staffing of Food Industry Enterprises in the Conditions of Digital Economy

Abstract. Introduction*. The development of the digital economy gives rise to a number of challenges for staffing food industry enterprises, including the introduction of innovative technologies and automated systems, big data analysis, and artificial intelligence tools. Therefore, the processes of training qualified personnel require transformation and orientation on the use of digital technologies to meet the requirements of the modern labor market.*

Purpose. *The article outlines the problems of staffing food industry enterprises and identifies promising ways of adapting specialists to the requirements of digitalization.*

Results. *The article outlines the problems and challenges of staffing food industry enterprises in the digital economy. Based on this analysis, a survey was conducted among graduates regarding the impact of the level of digital literacy on employment. A statistical test of the reliability of the results obtained was carried out, during which the hypothesis was accepted that the level of digital literacy is directly proportional to a high level of employment. The relevance of digital economy tools in the context of food industry enterprises was also assessed. The final stage was to outline the prospects for staffing food industry enterprises in the context of the digital economy.*

Conclusions. *The article presents the problems and prospects in food industry enterprises in the digital economy. As well as there are presented the results the level of influence of digital skills of future specialists on demand in the labour market and analysis of the level of development of digital skills of graduates working in food industry enterprises. It is concluded that prospects of staffing of food industry enterprises in the conditions of digital economy are development of digital competencies, integration of artificial intelligence and Big Data, dual education and development of flexible forms of employment.*

Keywords: *human resources; food industry enterprises; digital economy; human resource training.*

УДК 502.131: 37.09-005.94

Горбенко О. А., кандидат технічних наук, доцент, доцент кафедри агроінженерії, Миколаївський національний аграрний університет, м. Миколаїв, Україна

Іванов Г. О., кандидат технічних наук, доцент, доцент кафедри загальнотехнічних дисциплін, Миколаївський національний аграрний університет, м. Миколаїв, Україна

Галєєва А.П., кандидат педагогічних наук, доцент, доцент кафедри тракторів та сільськогосподарських машин, експлуатації і технічного сервісу, Миколаївський національний аграрний університет, м. Миколаїв, Україна

Храмов М. С., асистент кафедри агроінженерії, Миколаївський національний аграрний університет, м. Миколаїв, Україна

[1]**Стаття надійшла до редакції**: 20.02.2025
Received: 20 February 2025

Проблеми та перспективи кадрового забезпечення підприємств харчової промисловості в умовах цифрової економіки

***Анотація**. Розвиток цифрової економіки спричиняє появі низки викликів для кадрового забезпечення підприємств харчової промисловості, до яких відносяться впровадження інноваційних технологій та автоматизованих систем, аналіз великих даних, засоби штучного інтелекту. Тому процеси підготовки кваліфікованих кадрів потребують трансформації та орієнтацію на застосування цифрових технологій для відповідності фахівців вимогам сучасного ринку праці.*

У статті окреслено проблеми кадрового забезпечення підприємств харчової промисловості та визначено перспективні шляхи адаптації фахівців до вимог цифровізації.

В статті окреслено проблеми та виклики кадрового забезпечення підприємств харчової промисловості в умовах цифрової економіки. На основі цього аналізу серед випускників проведено опитування стосовно впливу рівня цифрової грамотності на працевлаштування. Здійснено статистичну перевірку достовірності отриманих результатів, в ході якої прийнято гіпотезу, що рівень цифрової грамотності прямо пропорційний високому рівню працевлаштування. Також здійснено оцінку актуальності засобів цифрової економіки в умовах підприємств харчової промисловості. Заключним етапом було окреслення перспектив кадрового забезпечення підприємств харчової промисловості в умовах цифрової економіки.

У статті представлено проблеми та перспективи розвитку підприємств харчової промисловості в цифровій економіці. А також наведено результати визначення рівня впливу цифрових навичок майбутніх спеціалістів на попит на ринку праці та аналізу рівня розвитку цифрових навичок випускників, які працюють на підприємствах харчової промисловості. Зроблено висновок, що перспективами кадрового забезпечення підприємств харчової промисловості в умовах цифрової економіки є розвиток цифрових компетенцій, інтеграція штучного інтелекту та Big Data, дуальна освіта та розвиток гнучких форм зайнятості.

***Ключові слова**: кадрове забезпечення; підприємства харчової промисловості; цифрова економіка; підготовка кадрового потенціалу.*

***JEL Classification:** R11, R13, R15*

Formulation of the problem. Digital transformation affects the development of the modern food industry, so there is a need to adapt approaches to staffing. With the advent of production automation, the use of artificial intelligence systems and the use of big data, the requirements for the qualification of specialists are changing, who must have not only formed professional competencies, but also a wide range of digital skills.

In their professional activities, food industry workers encounter such digital systems as the Internet of Things, robotic production lines, blockchain for tracking logistics processes. Therefore, to increase the competitiveness of enterprises, the level of qualification of employees must meet the requirements of digitalization.

The problems of staffing food enterprises in the digital economy include the insufficient level of training of future specialists to work with automated systems and digital tools, the mismatch of educational program requirements with real staffing requirements, the difficulties of integrating training programs for working specialists, the low level of interaction between higher education institutions and enterprises. Ways to overcome these challenges include the implementation of a dual education system and advanced training programs, and cooperation between educational institutions and businesses.

Analysis of recent research and publications. In the context of the analysis of research on the implementation of digital approaches for training highly qualified specialists, the authors note an insufficient level of coordination between enterprises and educational institutions [1], [2]. The paper states that an important aspect of training competitive specialists is the development of digital competence [3]. The authors outline the need to improve the skills of employees, which leads to an increase in the level of human resources potential [4]. The integration of education and practical training allows to ensure the training of specialists who meet the requirements of the industry [5], [12].

The study aimed to analyse the adoption of electronic market technology using the digital technology perception model [13]. Identifying factors of enterprise competitiveness is an urgent task due to the significant development of the economy and the impact of digital transformation on the business processes of economic participants [6]. In the conditions of digitalization and high information activity of the market, global instability, companies must look for new ways to strengthen market positions, increase profits, and find competitive advantages [7]. The article describes a model for identifying factors of strategic competitiveness of organizations [14].

In the conditions of globalization, market consolidation, economic instability, companies must look for new ways to strengthen their market positions, reduce business risks, and increase profits [8], [9]. The formation and implementation of an enterprise's diversification strategy allows partially solving these problems [10]. A difficult task for an enterprise is to choose a diversification strategy that would provide maximum economic effect in the long term. The article describes some well-known methods of decision-making on the problem of choosing a diversification strategy [15].

The authors of [11] note the importance of using a comprehensive approach to overcome the challenges of staffing the food industry through the introduction of digital technologies; such an approach should include the modernization of educational programs and the introduction of practice-oriented approaches to training specialists.

Formulation of research goals. The aim of the research is development problems of staffing food industry enterprises and outlining promising ways of adapting specialists to the requirements of digitalization.

Outline of the main research material. Automation of production processes and digital transformation of food enterprises require the implementation of new approaches to staffing. Table 1 presents an analysis of the problems of staffing food enterprises in the digital economy.

Table 1 **Analysis of staffing problems in food industry enterprises in the digital economy**

Staffing problems	Problem description
Shortage of qualified personnel	A small number of higher education institutions offer specialized educational programs to train personnel for food industry enterprises and develop competencies in the field of food technology.
Low level of digital literacy	The complexity of mechanisms for implementing digital technologies for working with modern equipment in food enterprises.
Differences between the content of educational programs and the requirements of employers	Lack of practical experience with digital technologies and alignment of educational programs with technological changes in enterprises.
Problems of adapting professional training	The emergence of retraining personnel to work with artificial intelligence systems and taking into account the principles of the digital economy.

Source: authors' development

To determine the level of influence of digital skills of future specialists on demand in the labour market, a survey was conducted among graduates of higher and vocational pre-higher education institutions in Mykolaiv region. During the survey, it was proposed to determine the level of digital skills and whether the education seeker works in his specialty. The results obtained were subject to statistical verification using the Pearson criterion $\chi 2$.

Two hypotheses were put forward regarding the relationship between digital skills and demand in the labour market:

H_0 - (null hypothesis) - there is no statistically significant relationship between the level of digital skills and demand in the labour market;

H_1 - (alternative hypothesis) - there is a statistically significant relationship between the level of digital skills and demand in the labour market.

Table 2 presents the results the level of influence of digital skills of future specialists on demand in the labour market.

Table 2 **The results the level of influence of digital skills of future specialists on demand in the labour market.**

Level of digital skills	**Number of graduates of group A, %**	**n_i of group A**	**Number of graduates of group B, %**	**n_{i1} of group B**	(ni-ni1) ^2	(ni-ni1)^2/ ni1
High	27,78%	65	9,87%	23	1764	76,70
Average	38,03%	89	20,60%	48	1681	35,02
Low	20,94%	49	50,21%	117	4624	39,52
Insufficient	13,25%	31	19,31%	45	196	4,36
Total	100,00%	234	100,00%	233		155,59

Note: ni1, ni1 – empirical frequency; group A - graduates working in their specialty, group B - graduates not working in their specialty.

Source: authors' development

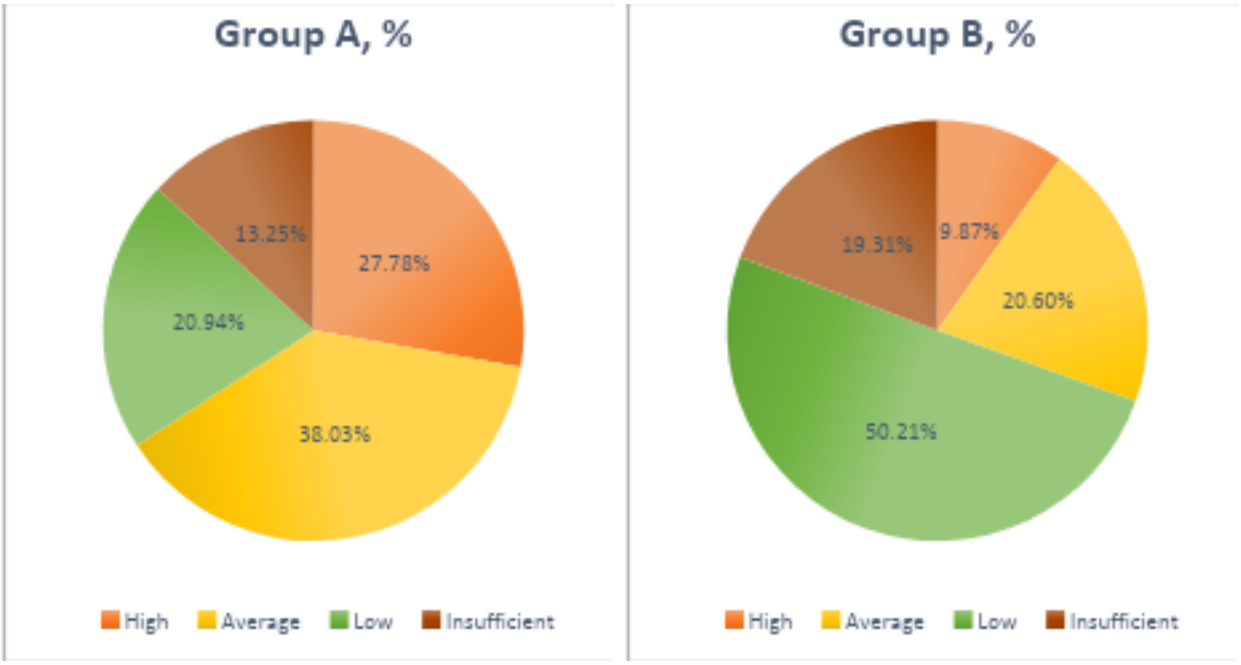

Figure 1 – **Visualization of the results the level of influence of digital skills of future specialists on demand in the labour market**

Source: authors' development

It is calculated the empirical value of Pearson's criterion χ^2 in groups A and B. The graduates of group A working in their specialty, as well as the graduates of group B not working in their specialty.

The amount of the 234 respondents of group A took part in the survey, as well as 233 respondents of group B. Critical value for χ^2 for levels of statistical significance $\rho \leq 0.05$ (6.973) and $\rho \leq 0.01$ (16.272).

As can be seen from Table 2, the value of χ^2_{emp} = 155,59 and $\chi^2_{emp} \geq \chi^2_{crit}$. It was determined that the statistical differences between the groups A and B have significant differences, based on the comparison of the hypotheses put forward, it can be concluded that the correct is H_1 - (alternative hypothesis) - there is a statistically significant relationship between the level of digital skills and demand in the labour market.

Based on a survey of graduates working in the food industry, an analysis of the level of development of digital skills and identification of skills that are relevant for the formation of a competitive specialist were carried out. Fig. 2 presents an analysis of the level of development of digital skills for staffing food industry enterprises in the digital economy.

To assess the level of development of digital skills of graduates working in food industry enterprises, a 100-percent scale was used. The average level of skills in working with automated programs in production was noted by almost 60% of respondents, a high level - by almost 30%.

Such skills allow you to speed up technological processes and reduce the labor intensity of production. IoT and Industry 4.0 are innovative production trends, they are used to track workflow parameters and track demand for goods and services, the average level of skills in these areas was noted by 50%, and high - up to 30%.

Big data analysis allows you to make more informed decisions, predict consumption and track demand, the average level of mastering these skills was noted by 50%, and low - more than 10%.

Blockchain simplifies the interaction between suppliers and enterprises and is a modern technology for logistics operations, 40% of respondents noted a medium and high level of mastery of this technology. Possession of digital marketing skills was noted at an average level by 48%, at a high level by 37%. Digital modeling is used for testing product packaging, at an average level this skill is possessed by 53%, at a high level by 34%. The use of biotechnology is an important direction for sustainable production and about 40% possess these technologies at an average and high level. Basic data protection skills are possessed by 50% of respondents at an average level. The use of digital training platforms is an important aspect for improving the skills of employees, more than 50% of respondents possess it at an average level. Digital resource management was mastered at an average level by 40% of respondents.

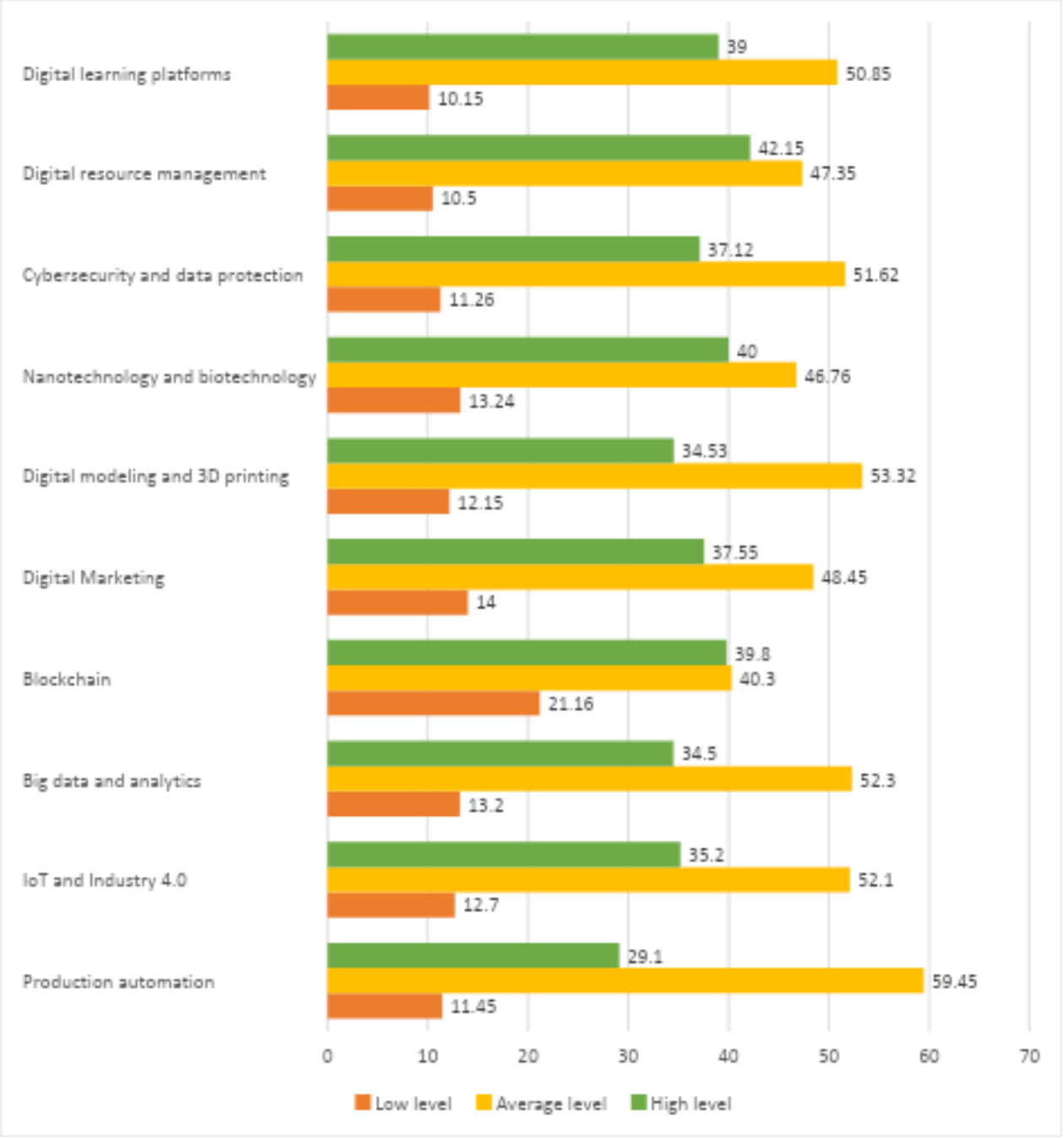

Figure 2 – **Analysis of the level of development of digital skills of graduates working in food industry enterprises**

Source: authors' development

It can be concluded that digital transformation is a key factor in the development of food industry enterprises and opens up market opportunities and improves services. The prospects for mastering digital skills to increase the human resources potential of food enterprises are outlined in the table 3.

Table 3 **Analysis of staffing prospects in food industry enterprises in the digital economy**

The prospects for mastering digital skills	Description
Development of digital competencies	Conducting trainings, corporate learning, and implementing educational partnerships between higher education institutions and food enterprises.

Integration of artificial intelligence and Big Data	Using digital platforms and adaptive learning systems to analyse the level and personalize professional development
Dual education	Integration of training in higher education institutions and the introduction of cooperation between business and academic institutions to update educational programs
Development of flexible forms of employment	Use of flexible schedules for project work and advanced training of future specialists.

Source: authors' development

For the successful integration of digital skills to form the human resource potential of food industry enterprises, it is necessary to develop the digital competencies of future specialists. Adapting educational programs and training trajectories to the requirements of the digital economy will ensure sustainable development of the industry and increase the level of competitiveness of specialists.

Conclusions. The lack of staffing in the food industry and the challenges of digitalization of the processing industry sectors necessitate the training of specialists who would meet the needs of the present. There is conducted analysis of staffing problems in food industry enterprises in the digital economy. There are presented the results the level of influence of digital skills of future specialists on demand in the labour market according to the survey that were conducted for graduates that are staffing of food industry enterprises in the conditions of digital economy. Also, there were presented the analysis of the level of development of digital skills of graduates working in food industry enterprises.

On the basis of the concluded information, in the article are presented the staffing prospects in food industry enterprises in the conditions of digital economy. The prospects for staffing food industry enterprises in the digital economy are the implementation of training programs to increase the level of digital literacy and the establishment of private partnership programs between higher education institutions and food industry enterprises.

References:

1. Abate, A., Cascone, L., Nappi, M., Narducci, F., & Passero, I. (2021). Attention monitoring for synchronous distance learning. *Future Generation Computer Systems*, 125, 774–784. https://doi.org/10.1016/j.future.2021.07.026 [in English].
2. Babenko, D. et al. (2024). Implementation of the Blended Learning Approach in the Conditions of the Learning Management System of the Higher Education Institution. *Modern Economics,* 44(2024), 6-13. https://doi.org/10.31521/modecon.V44(2024)-0 [in English].
3. Bragelien, J. J., Hasleberg, H., & Voldsund, K. H. (2020). Entrepreneurship education through sustainable value creation. 2020 IEEE Global Engineering Education Conference (EDUCON), 1409-1415. https://doi.org/10.1109/EDUCON45650.2020.9125171 [in English].
4. Dastgheib-Beheshti, B., & Nizich, M. (2023). Entrepreneurship programs to connect university classrooms to industry. 2023 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE), 1–4. https://doi.org/10.1109/TALE56641.2023.10398388. [in English].
5. Trishch, R. M., Sichinava, A., Bartoš, V., Stasiukynas, A., & Schieg, M. (2023). Comparative assessment of economic development in the countries of the European Union. *Journal of Business Economics and Management*, 24(1), 20–36. https://doi.org/10.3846/jbem.2023.18320 [in English].
6. Grosemans, I., & De Cuyper, N. (2021). Career competencies in the transition from higher education to the labor market: Examining developmental trajectories. *Journal of Vocational Behavior,* 128, 103602. https://doi.org/10.1016/j.jvb.2021.103602 [in English].
7. Lucas, M. et al. (2020). The relation between in-service teachers' digital competence and personal and contextual factors: What matters most? *Computers & Education,* 160, 104052. https://doi.org/10.1016/j.compedu.2020.104052 [in English].
8. Limon, M. R., Vallente, J. P. C., Chua, C. T., & Rustia, A. S. (2022). Situating curriculum in context: Using Glatthorn's Standards-Based Curriculum Development Model to contextualize food safety learning competencies. *Food Control*, 132, 108538. https://doi.org/10.1016/j.foodcont.2021.108538 [in English].
9. Al-Samarraie, H., & Saeed, N. (2018). A systematic review of cloud computing tools for collaborative learning: Opportunities and challenges to the blended-learning environment. *Computers & Education*, 124, 77-91. https://doi.org/10.1016/j.compedu.2018.05.016 [in English].
10. Pan, S., Hafez, B., Iskandar, A., & Zhao, M. (2024). Integrating constructivist principles in an adaptive hybrid learning system for developing social entrepreneurship education among college students. *Learning and Motivation*, 87, 102023. https://doi.org/10.1016/j.lmot.2024.102023 [in English].
11. Limano, Ferric. (2023). New digital culture metaverse preparation digital society for virtual ecosystem. *E3S Web of Conferences*, 388. https://doi.org/10.1051/e3sconf/202338804057 [in English].
12. Idrees, H., Xu, J., Haider, S. A., & Tehseen, Sh. (2021). A systematic review of knowledge management and new product development projects: Trends, issues, and challenges. *Journal of Innovation & Knowledge,* 8(1003504), 1–10. https://doi.org/10.1016/j.jik.2023.100350 [in English].
13. Andarwati, M., Assih, P., Amrullah, F., Putri, D. M., & Thamrin, E. (2020). Success of Small and Medium Enterprises (SMEs): Actual Technology Use in e-Marketplace Based on Technology Acceptance Model (TAM) Analysis. 2020 6th *International Conference on Education and Technology (ICET)*, Malang, Indonesia, 142–147. https://doi.org/10.1109/ICET51153.2020.9276594.
14. Bielienkova, O., Stetsenko, S., Oliferuk, S., Sapiga, P., Horbach, M., & Toxanov, S. (2021). Conceptual model for assessing the competitiveness of the enterprise based on fuzzy logic: social and resource factors. 2021 *IEEE International Conference on Smart Information Systems and Technologies (SIST),* Nur-Sultan, Kazakhstan, 2021, pp. 1-5. https://doi.org/10.1109/SIST50301.2021.9465923 [in English].
15. Li, Y., Biloshchytskyi, A., Bronin, S., & Liashchenko, T. (2021). A conceptual model for diversification strategies choice. In 2021 *IEEE International Conference on Smart Information Systems and Technologies (SIST),* 1-4. Nur-Sultan, Kazakhstan. https://doi.org/10.1109/SIST50301.2021.9465934 [in English].