DIGITALISATION METHODOLOGICAL FOUNDATIONS OF THE EDUCATIONAL ENVIRONMENT IN VOCATIONAL (VOCATIONAL AND TECHNICAL) EDUCATION INSTITUTIONS

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Digitalisation has become the most visible and sensitive trend in the economic and social development of society in the first half of the 21st century. The digitalisation of the global world is based on new technologies, such as the Internet, telecommunications, large databases, artificial intelligence, blockchain, cryptocurrencies, mobility and accessibility of relevant technological devices, etc. Accordingly, there is an opportunity and a strong potential for innovation and digitalisation of vocational education in Ukraine [1].

The digitalisation of education can ensure the development of distance learning with the use of information and communication technologies to improve the quality of training and professional competence of vocational education students. The digitalisation of the educational environment (EE) of vocational (vocational and technical) education institutions requires special training of developers, users (students) and teachers of distance learning courses, as well as models and methods of their teaching, including learning tools [2].

In turn, the EE digitalisation of VET institutions is carried out in an unsystematic and inconsistent manner, which negatively affects the interactivity, individualisation of learning, rapid feedback from the student to the teacher, control of the learning process and the results of the educational process [3].

There is a need to analyse the peculiarities of EE digitalisation of vocational education institutions and to substantiate the methodological foundations of this process.

Experts were invited to participate in the discussion of the methodological foundations of vocational education digitalisation – the most competent scientists, teachers, heads of educational institutions who have more than ten years of experience in vocational education and research institutions, have academic degrees and academic titles, and have publications on digitalisation of education and on the training of vocational education students in distance learning.

The qualitative membership of the expert committee is an important condition for the effectiveness of the expert method. It is quite obvious that in all cases, without exception, the expertise should be carried out by educated, highly qualified, fully competent and experienced specialists.

The analysis of pedagogical research in relation to the digitalisation of education from more than sixty different approaches allowed us to identify thirteen main ones: acmeological (n_1), axiological (n_2), differentiated (n_3), activity-based (n_4), integrative (n_5), informative (n_6), clustered (n_7), competence-based (n_8), contextual (n_9), person-centred (n_{10}), reflective (n_{11}), systemic (n_{12}) and technological (n_{13}).

Table 1

Results of the approaches ranking and checking the consistency of experts' opinions

Expert	**Indicator of expertise – approach (R_i)**												
	n_1	n_2	n_3	n_4	n_5	n_6	n_7	n_8	n_9	n_{10}	n_{11}	n_{12}	n_{13}
m_1	7	10	8	6	13	2	9	4	12	5	11	1	3
m_2	11	8	12	7	13	1	10	5	9	4	6	2	3
m_3	9	13	6	10	8	2	7	4	12	5	11	1	3
m_4	7	9	13	6	8	2	12	4	11	5	10	1	3
m_5	11	7	10	6	13	1	8	5	9	4	12	2	3
m_6	9	8	6	10	11	3	7	4	12	5	13	1	2
m_7	8	13	6	11	10	3	12	4	9	5	7	1	2
m_8	12	7	6	11	10	2	8	5	9	4	13	1	3
m_9	7	10	13	6	11	1	10	4	8	5	12	3	2
m_{10}	10	13	6	7	11	2	12	5	9	4	8	1	3
m_{11}	7	12	8	13	6	2	9	4	11	5	10	1	3
m_{12}	10	7	9	8	12	3	11	5	6	4	13	2	1
ΣR_i	**108**	**112**	**97**	**90**	**133**	**24**	**115**	**53**	**117**	**55**	**141**	**17**	**31**
$R_i - R_{cep}$	23,92	27,92	12,92	5,92	48,92	–60,08	30,92	–31,08	32,92	–29,08	56,92	–67,08	–53,08
$(R_i - R_{cep})^2$	572,31	779,70	167,01	35,08	2393,47	3609,24	956,24	965,77	1083,93	845,47	3240,24	4499,31	2817,16
Rank	**8**	**9**	**7**	**6**	**12**	**2**	**10**	**4**	**11**	**5**	**13**	**1**	**3**

The expert group was presented with these methodological approaches, on the basis of which it is advisable to digitalise the educational environment of vocational (vocational and technical) education institutions. The results of the ranking by experts (12 people) of the objects of examination (13 indicators – methodological approaches) are presented in the table 1.

According to the task, the experts had to assign ranks from 1 to 13 to the selected indicators.

In order to determine the reliability of the results obtained by the expert group, it is necessary to first check the degree of consistency of the experts' opinions. The reliability degree of the expert assessment can be checked using the concordance coefficient *W*, which shows how much the experts' opinions are consistent with each other, i.e., belong to the same general set of assessments. If $W < 0.2 – 0.4$, this indicates a weak agreement among experts, and if $W > 0.6 – 0.8$, we can conclude that there is a strong agreement among experts:

$$W = \frac{12\sum_{i=1}^{n}(R_i - R_{cep})^2}{n^2 \cdot (m^3 - m)} = \frac{12 \cdot 20592{,}92}{12^2 \cdot \left(13^3 - 13\right)} = \frac{247115{,}1}{314496} = 0{,}7857,$$

where 12 – a constant value in the formula for calculating the concordance, coefficient proposed by Kendall; m – number of indicators; n – number of experts; R_i – the points sum of the i-th indicator; R_{cep} – the scores average sum of all indicators.

Since $W = 0.79 > 0.6$, we can talk about the coherence of experts' opinions on methodological approaches to the EE digitalisation of VET institutions and start analysing the data obtained.

According to the requirement, the highest rank is denoted by the number "1", so the approach with a lower ranking of 2, 3, etc. up to 13, i.e., the one that least meets the conditions of the digital vision. The Pareto diagram (Fig. 1) shows the distribution of data in descending order of frequency (sum of rating values). The line of cumulative values of the additional axis shows the percentage of the total. It was found that the approaches numbered n_{12}, n_6, n_{13}, n_8 and n_{10} correspond to more than 90 % of the total rating sum. We define these approaches as the main ones.

Thus, the digitalisation of the educational environment of vocational education and training institutions should be based on the following methodological approaches: systemic (n_{12}); informative (n_6); technological (n_{13}); competence-based (n_8); person-centred (n_{10}).

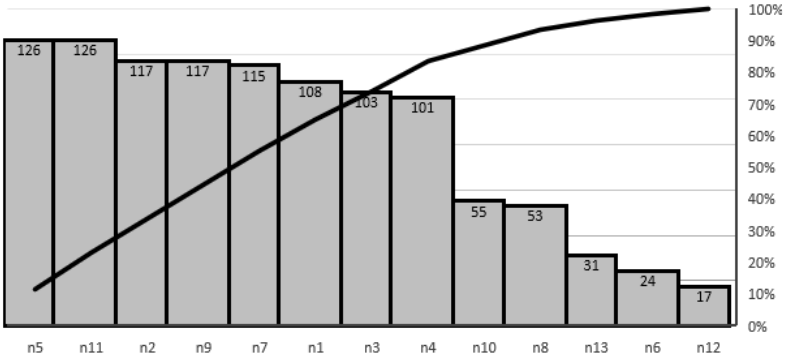

Fig. 1. Distribution of expert assessments of methodological approaches to the EE digitalisation of VET institutions (Pareto diagram)

It is necessary to take into account the basic principles of the functioning of the modern EE of vocational (vocational and technical) education institutions for the transition to the full implementation of digital technologies. For this purpose, new provisions, principles and ideas should be used to build the theory and improve the practice of using the educational institution's EE.

The principles of digitalisation should become the regulators of modernisation that set the direction of the process of digitalisation of the educational environment of vocational (vocational-technical) education institutions in the context of the modern education paradigm.

The principle of proactive information services, according to which information services should provide students, teachers and administration with information that was not ordered by them, but can be used to solve problems that arise in the organisation and implementation of the educational process.

The implementation of this principle is ensured by the creation of a specialised digital complex. Researchers of the Laboratory of Electronic Learning Resources of the Institute of Vocational Education NAES of Ukraine have developed a conceptual model of the SMART complex as an information and dynamic system of the EE of vocational (vocational-technical) education institutions of educational and methodological orientation [4].

Working with information on the basis of "memorisation" is gradually losing its meaning due to the development of the Internet as a global source of information, and therefore, not only knowledge but also skills of the XXI century, including media literacy and the ability to work with information, are becoming important [5].

Taking into account the model of knowledge self-organisation, developed on the basis of solving the problem with boundary conditions for the Kolmogorov equation and taking into account differences in individual abilities, we note that each student will receive a different amount of educational information during a certain period of study time. On the other hand, depending on the individual specifics of memory, each student tends to forget a certain amount of the received learning information. The amount of forgotten learning information is an individual parameter of a vocational education student.

The forgetting of educational information by a student, depending on the step (time interval) of learning, is determined empirically, taking into account the Ebbinghaus forgetting curve, which is described by the following mathematical formula:

$$Z = 0.35 + 0.65e^{\frac{-\tau}{0,45}},$$

where Z – percentage of retained learning information; τ – the period of time when the learning information is forgotten.

The formula is valid for one-time acquisition and perception of learning information. If we take a week (168 hours per week) as a time period, then, taking into account the exponential nature of the Ebbinghaus curve, it is established that the process of forgetting actively occurs in the first 2–4 hours, when the student forgets more than 60 % of the received learning information. Then the forgetting process slows down and 20–30 % of the learning information is retained in the memory for a long time. Therefore, the function of repeating the learning of educational material should be taken into account when designing and using EE of vocational (vocational-technical) education institutions.

The principle of accessibility of up-to-date information, according to which a vocational education student should immediately move to the level of the most up-to-date, reliable knowledge in the vocational (vocational-technical) education institutions, while avoiding outdated or fake information.

The main goal of EE digitalisation of vocational (vocational-technical) education institutions is economic in nature and is aimed at increasing efficiency and increasing the amount of learning information acquired through the use of digital technologies.

Digitalisation should be led by state authorities and follow uniform rules and programmes for educational institutions. That is, ideas, actions, initiatives and programmes on digitalisation should be fully integrated into national and regional strategies and development of vocational education. Only in this situation will a full and effective digital transformation of education take place [6].

Sporadic use of digital technologies should be avoided. Such an approach leads to a one-sided improvement of the existing educational process, i.e., a separate element of the system is improved, but the system itself is not updated. Only if the problem is solved comprehensively, a new EE essence of vocational (vocational-technical) education institutions can be formed.

The principle of all-encompassing digitalisation implies that instead of selective fragmentary digitalisation, which only improves certain qualities of the education system, there should be a complete transformation of the existing EE of vocational (vocational-technical) education institutions into a new quality.

The EE digitalisation of vocational (vocational-technical) education institutions should be carried out systematically, taking into account methodological approaches (systemic; information; technological; competence-based; person-centred) and the conceptual foundations of digital technologies (proactive provision of reliable, relevant, educational information, and the comprehensive nature of digitalisation). This will make it possible to organise a high-quality innovative educational process in vocational (vocational-technical) education institutions, ensuring individualisation, interactivity, inclusiveness, flexible control and accounting of learning outcomes.

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ВИКЛИКИ ОСВІТНІХ РОЗРИВІВ У ЦИФРОВОМУ СУСПІЛЬСТВІ

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Технологічний вибух, який триває протягом останніх двадцяти років і постійно змінює промисловість, економіку, підприємництво, освіту та інші галузі. Дослідники називають це хвилею цифрового підприємництва, вони стверджують, що «зараз, в епоху цифрових технологій, підприємництво затребуване як ніколи. Однак цифрове підприємництво не обмежується онлайн-зустрічами, безпаперовим офісом чи спілкуванням у соціальних мережах. Це слід розглядати як цілісний підхід до мислення, який охоплює всі організаційні процеси, включаючи комунікацію та надання послуг. Якщо вдасться «мислити в цифровому режимі», наприклад, інтегрувати підтримку цифрових процесів на всіх рівнях, ми зможемо досягти довгострокового успіху» [3, с. 7].

Відповідно, світ перейшов у цифровий простір миттєвого спілкування та зворотного зв'язку, де ланцюг зв'язків змінився назавжди, і час відповіді має бути таким же швидким, інакше очікуваних результатів не буде досягнуто. Дослідники бізнес-школи IMD (Швейцарія) використовують термін «цифровий вихор» (Digital Vortex, DV), щоб продемонструвати, як, здавалося б, дрібні та інколи малозрозумілі зміни, набираючи «вихрову» швидкість, перетворюються на величезні глобальні цифрові трансформації [1; 2]. DV активно трансформує соціальне життя: дедалі частіше з'являються нові можливості, яких раніше не було, поряд із новими неймовірними моделями діяльності генеруються нові знання та інформація. Цифрова технологія змінює суспільство, що суттєво впливає на те, як кожен із нас працює та