

The social responsibility of distance higher education in the COVID-19 pandemic



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ABSTRACT

The purpose of this paper is to determine the actual and ultimate necessary level of social responsibility of distance higher education in the context of the COVID-19 pandemic. The article presents a model for assessing the effectiveness of teaching and social responsibility of distance higher education in the context of the COVID-19 pandemic. This model, unlike the existing ones, takes into account organizational and technological, economic, and socio-pedagogical factors. The degree of influence of the presented factors was revealed using factor analysis. Based on the taxonomic method and cluster analysis, clusters of universities were obtained by the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic. The initial data included online reporting of 50 higher education institutions from the Top 200 Ukraine rating for 2020; the results of a survey of teachers and students on the Google Forms platform. The proposed model, unlike the existing ones, makes it possible to adjust the components of distance learning at universities, to develop a system of measures to increase the level of social responsibility of distance learning in the context of the COVID-19 pandemic.

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1. Introduction

The pandemic caused by the spread of a new coronavirus infection COVID-19 has drastically changed the operating conditions of all sectors and areas of the economy (Karabag, 2019). At present time it seems to be impossible to identify positively when exactly the pandemic will be over (Li et al., 2020). Experts conduct arguments (Ahmed et al., 2020): Whether immunity develops in those who have been infected, whether reinfection is possible when the "second wave" of infections will come, whether coronavirus infection will be seasonal when an effective vaccine against the virus will be developed when effective means and protocols for treating those already affected will be found (Ibn-Mohammed et al., 2021). All this information proves

that mankind is facing a serious global challenge. A professional, systematic analysis of the new situation by the expert community is necessary in order to develop an adequate strategy to mitigate possible risks and find the best way forward (Anser et al., 2021).

An education sector has proven to be one of the few most important areas of human activity that can continue to function effectively under special (extreme) conditions (Dhawan, 2020). The pandemic brought educational institutions into a critical situation: Maintaining the traditional form of giving classes created unacceptably high risks of spreading the said infection (Jiang et al., 2021). The forced transition to distance learning and the results of this operation arouse a lot of discussions, including discussions of a negative nature. The transition of educational institutions to a new (remote) organization of their activities, has the form of providing a high-quality educational process based on distance learning technologies; organization of remote functioning of the educational organization itself as an object of management (Adnan and Anwar, 2020). The new situation significantly changes the legal, economic and organizational, and managerial

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mode of operation of higher education institutions (HEI), creating additional challenges (Abou El-Seoud et al., 2014). The mission of universities under the new conditions is to train highly qualified specialists by implementing educational programs that meet international standards (Ali, 2020). In order to perform this mission, on the one hand, we need to make considerable investments into new distance learning technologies, which ensure the transfer of the educational process into the format of mediated (remote) interaction between teachers and students, the organization of remote functioning of educational organizations, the formation of fundamentally new content, and advanced training of teaching staff and administrative-and-managerial personnel. (Coman et al., 2020). On the other hand, the financial base (income) of higher educational institutions is objectively narrowing: The effective demand of the population is falling down. For the educational organization, this factor significantly increases the following risks: The number of requests for deferral (or reduction) of tuition fees increases significantly; new admission of students is in question; there is a need to revise the pricing policy of universities to reduce; the inflow of foreign students decreases (Popa et al., 2020).

The conducted analysis concerning the relevance of the chosen research problem allows us to certify that the use of distance learning technologies in higher education is a requirement of the modern state of the world. In the light of the COVID-19 pandemic, higher education institutions face a dual challenge: to ensure the economic performance and social responsibility of distance higher education. The purpose of this study was to determine the actual and ultimate necessary level of teaching and social responsibility of distance higher education in the context of the COVID-19 pandemic. The initial data for the research included information on the state of distance learning in 50 higher educational institutions of the "Top 200 Ukraine" rating for the year 2020.

2. Materials and methods

The effectiveness of teaching and social responsibility of distance higher education in the light of the COVID-19 pandemic can be characterized by organizational-technological, economic, and social-pedagogical aspects. The data for evaluating organizational-technological and teaching efficiency were obtained from the published online results of the studied higher education institutions for the year 2020. Socio-pedagogical responsibility of distance higher education in the light of the COVID-19 pandemic was studied by interviewing teachers and students from 50 higher educational institutions of the "Top-200 Ukraine" 2020 rating using the Google forms platform by means of a survey using a standardized questionnaire form.

The indicators that can measure the organizational and technological performance (efficiency of using organizational and technological

support and management system of distance learning) are:

The level of loading of educational services and systems:

$$L_{es} = \frac{L_{ess/act}}{L_{ess/max}}, \quad (1)$$

where, L_{es} is the level of loading of educational services and systems; $L_{ess/act}$ is the actual loading of educational services and systems; $L_{ess/max}$ is the maximum possible loading of educational services and systems.

The availability level of material and technical resources for students, teachers, and higher education institutions:

$$L_{mtr} = \frac{N_{mtr}}{N_{us}}, \quad (2)$$

where, L_{mtr} is a level of provision with material and technical means of students, teachers, and higher education institutions; N_{mtr} is the number of material and technical means of distance learning; N_{us} is the number of users.

The level of provision with standards and norms on online platforms:

$$L_{st} = \frac{N_{st/act}}{N_{st/nor}}, \quad (3)$$

where, L_{st} is a level of provision with standards and norms on online platforms; $N_{st/act}$ is standards and norms actually introduced into online learning; $N_{st/nor}$ is the normative number of standards and norms in online learning.

The efficiency of content introduction and use of new computer equipment for distance learning:

$$E_{F1} = \frac{\ln F_1}{C_1}, \quad (4)$$

where, E_{F1} is the efficiency of content introduction and use of new computer equipment for distance learning; $\ln F_1$ is the income of higher educational institutions as a result of the introduction of the technical maintenance system for distance learning; C_1 is aggregate costs taking into account the development of content and purchase of computer equipment.

Indicators that can measure the efficiency (comparison of costs and revenues from distance education) are:

$$E_{F2} = \frac{\ln F_2}{C_2}, \quad (5)$$

where, E_{F2} is efficiency of classroom maintenance optimization and educational support staff; $\ln F_1$ is income of the higher educational institution as a result of savings in the support of the auditory fund and educational support staff; C_2 is full costs taking into account savings in the support of the auditory fund and educational support staff.

$$E = \frac{\ln}{c}, \quad (6)$$

where, E is the total efficiency of distance learning; In is the aggregate income of a higher educational institution due to the application of distance learning; C is the total costs of distance learning.

Indicators that can measure the socio-pedagogical effectiveness and responsibility (satisfaction with the results and conditions of distance education) are:

$$E_{pt} = \frac{A_{pat} - A_{pbt}}{C_{tp}}, \quad (7)$$

where, E_{pt} is the learning efficiency of distance technologies for teaching staff; A_{pat} is the appraisal of personnel performance after training; A_{pbt} is the appraisal of personnel performance before training; C_{tp} is the cost for the training process.

The motivation level of students and teachers for the need to obtain additional knowledge of online technologies:

$$L_{mot} = \frac{N_{ad.kn.}}{N_{stu}}, \quad (8)$$

where, L_{mot} is the motivation level of students and teachers for the need to obtain additional knowledge of online technologies; $N_{ad.kn.}$ is the number of students who consciously acquire additional knowledge in online technologies; N_{stu} is the number of students who study online.

The level of independence, self-organization, and responsibility of students for acquiring knowledge:

$$L_{self-org} = \frac{N_{self-org}}{N_{stu}}, \quad (9)$$

where, $L_{self-org}$ is the level of students' independence, self-organization, and responsibility for acquiring knowledge; $N_{self-org.}$ is the number of students who study consciously and with high responsibility.

Time-saving for travel, waiting for classes, and other activities not related to the acquisition of knowledge:

$$S_{t/trav.wait.} = \frac{N_{aver}}{N_{stu}}, \quad (10)$$

where, $S_{t/trav.wait.}$ is time-saving for travel, and waiting for classes; T_{aver} is the total time for travel, waiting for classes, and other activities not related to acquiring knowledge before the transition to distance learning.

The level of comfort during online learning (the opportunity to study at all reasonable times, regardless of the school scheduling):

$$L_{comf} = \frac{N_{comf}}{N_{stu}}, \quad (11)$$

where, L_{comf} is the level of comfort during online learning; $N_{comf.}$ is the number of students who feel comfortable in view of distance learning.

Indicators in Eqs. 8, 9, and 11 were evaluated by students during the questionnaire on a five-point scale: 1 point-no, 2 points-rather no; 3 points-sometimes no, sometimes yes; 4 points-rather yes; 5 points-yes. The rest of the indicators were calculated based on the data obtained from the statistical reporting of higher education institutions, and the data of the open questionnaire. All the evaluated indicators and their conventional symbols are shown in Table 1 for illustration purposes.

Table 1: System of indicators of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic

Indicators	Symbol
The loading level of educational services and systems, L_{es}	Var1
The level of providing students, teachers, and higher education institutions with material and technical resources, L_{mtr}	Var2
The level of provision with standards and norms at online platforms, L_{st}	Var3
The efficiency of content introduction and use of new computer equipment for distance learning, E_{F1}	Var4
The efficiency of classroom maintenance optimization and educational support staff, E_{F2}	Var5
The overall efficiency of distance learning, E	Var6
The efficiency of staff training in distance learning, E_{pt}	Var7
The motivation level of students and teachers for the need to obtain additional knowledge of online technologies, L_{mot}	Var8
The level of students' independence, self-organization, responsibility for acquiring knowledge, $L_{self-org}$	Var9
Time-saving for travel, waiting for classes, $S_{t/trav.wait}$	Var10
The level of comfort during online learning (the opportunity to study at all reasonable times, regardless of the school scheduling), L_{comf}	Var11

Further methodology of calculations is as follows. In the first stage, we have determined the number of factors influencing the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic by means of a factor analysis of the STATISTICA application software package. A factor, in this case, is an aggregate set of indicators reflecting a certain aspect of the efficiency/responsibility of distance higher education in the COVID-19 pandemic. Indicators that have an impact on the process are highlighted in red by the program, and those that have no impact are highlighted in black. The actual level of teaching effectiveness and social responsibility of distance higher education in the

context of the COVID-19 pandemic is determined by the equation:

$$Imp_i = \sum_{j=1}^N F_j, \quad (12)$$

where, Imp_j is the actual level of teaching effectiveness and social responsibility of distance higher education in the context of COVID-19 pandemic i -HIE; F_{j-j-th} factor; N -number of identified factors. The value of each factor is determined by:

$$F_j = \frac{1}{ExpL.F_j} \times \sum (a_{ij} \times Var_{ij}), \quad (13)$$

where, $Expl.F_j$ is a factor loading of the j -th aspect of teaching effectiveness and social responsibility of distance higher education in the context of COVID-19 pandemic; a_{ij} – Var_{ij} indicator value; Var_{ij} – ij -th indicator.

In the second stage, we have used a K-means cluster analysis to divide on a reasonable basis higher education institutions into groups according to the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic. The analysis was carried out by means of using the STATISTICA application software package.

In the third stage, using the taxonomy method, we have determined the boundary value of the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic for each of the clusters in the form of an integral taxonomy indicator. The order of determining the integral indicator of taxonomy is as follows.

Formation of the initial matrix of significant indicators:

$$Var = \begin{pmatrix} Var_{11} \dots Var_{1n} \\ \dots \dots \dots \\ Var_{m1} \dots Var_{mn} \end{pmatrix}, \quad (14)$$

Initial matrix reduction 14 to a nondimensional form, making a vector-standard, where 0 is the best value by columns:

$$Var^0 = [Var_1^0, \dots, Var_n^0], \quad (15)$$

Determination of the multidimensional Euclidean distance from the etalon vector:

$$L_i = [\sum_{i=1}^n (Var_i - Var_i^0)^2]^{1/2} \quad (16)$$

Determination of the value of the average Euclidean distance:

$$\overline{L} = \frac{1}{N} \times \sum_{i=1}^N L_i, \quad (17)$$

Determination of the standard deviation:

$$\sigma = \frac{1}{N} \left[\sum_{i=1}^N (L_i - \overline{L})^2 \right]^{1/2}, \quad (18)$$

Calculation of the integral index of taxonomy:

$$\eta_i = 1 - \frac{L_i}{\overline{L} + 2\sigma} \quad (19)$$

The received value of the integral indicator of taxonomy is interpreted in the following way: the higher the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic, the closer its value to 20. The actual level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic was visualized in the form of a dendrogram by means of the STATISTICA program.

During the fourth stage, a discriminant analysis was used to monitor the need to correct the components of distance education. Linear functions of affiliation recognition of a higher educational institution make it possible to establish the fact that a higher educational institution is affiliated to a certain cluster and the probability of its transition to another cluster in view of the change in evaluation indicators.

3. Results and discussion

A factor analysis was conducted during the first stage to determine the indicators having an impact on the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic (Fig. 1). The first factor included 5 indicators: The level of providing students, teachers, higher education institution with material and technical resources; level of provision with standards and norms at online platforms; efficiency of content introduction and use of new computer equipment for distance learning; efficiency of classroom maintenance optimization and educational support staff; overall efficiency of distance learning. The second factor included 5 indicators: Efficiency of staff training in distance learning, the motivation level of students and teachers for the need to obtain additional knowledge of online technologies, the level of independence, self-organization, the responsibility of students for obtaining knowledge, time-saving time for travel, waiting for classes, the level of comfort during online learning (the opportunity to study at all reasonable time, regardless of the school scheduling institution).

Variable	Factor Loadings (Unrotated) (Data) Extraction: Principal components (Marked loadings are > ,700000)	
Var1	-0.395359	-0.520738
Var2	0.897195	-0.39211
Var3	0.898816	-0.376124
Var4	0.791579	0.373512
Var5	0.857288	0.34934
Var6	0.830543	0.32161
Var7	0.436431	0.902169
Var8	-0.139211	0.764063
Var9	-0.152074	0.793303
Var10	0.216105	0.856597
Var11	0.161049	0.800512
Expl.Var	6.222085	3.349715
Prp.Totl	0.556553	0.322701

Fig. 1: Results of factor analysis regarding the determination of indicators affecting the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic (listing)

The results of the factor analysis showed that the teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic are completely characterized by the obtained two factors. Only one of 11 evaluation indicators, as the results of the factor analysis, showed, does not affect the process-the loading level of educational services and systems. This means that all 50 higher education institutions have a sufficiently developed technical base. The first factor can be characterized as organizational-technological and teaching effectiveness of distance higher education in the context of the COVID-19 pandemic. It describes 55.65% of the variance and has the greatest impact on the process. The second factor describes 32.27% of the variance. It characterizes the socio-pedagogical efficiency and responsibility of distance higher education in the light of the COVID-

19 pandemic. According to Fig. 1, the magnitude of the impact of the first factor is equal to:

$$F_1 = 1/6.222085 \cdot (0.897195 Var_2 + 0.898816 Var_3 + 0.791579 Var_4 + 0.857288 Var_5 + 0.830543 Var_6) \quad (20)$$

The magnitude of the impact of the second factor is equal to:

$$F_2 = 1/3.349715 (0.902169 Var_7 + 0.764063 Var_8 + 0.793303 Var_9 + 0.856597 Var_{10} + 0.800512 Var_{11}) \quad (21)$$

A cluster analysis was conducted during the second stage to classify on a reasonable basis the studied higher education institutions into groups according to the level of teaching effectiveness and social responsibility of distance higher education in the context of the COVID-19 pandemic. The K-means graph is shown in Fig. 2.

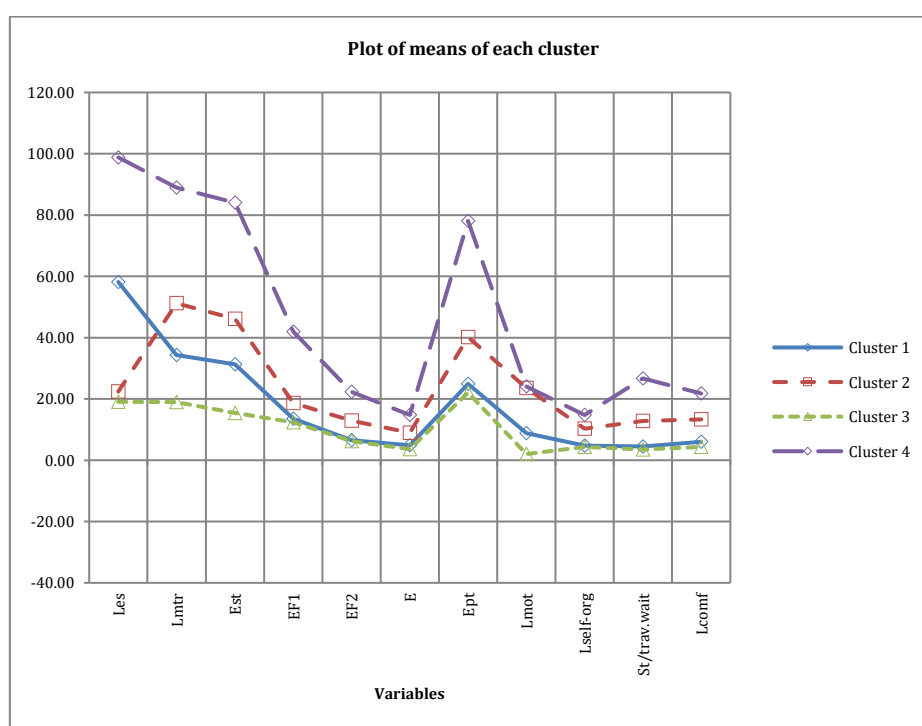


Fig. 2: Graph of the average values of indicators of the level of teaching effectiveness and social responsibility of distance higher education under the COVID-19 pandemic

Fig. 2 shows that according to the level of teaching effectiveness and social responsibility of distance higher education in the COVID-19 pandemic the studied higher education institutions are classified into 4 clusters. The number and structure of the resulting clusters are presented in Table 2.

According to the data given in Table 2 regarding the identification attributes: "Organizational-technological and economic performance/socio-pedagogical efficiency and responsibility of distance higher education in the context of COVID-19 pandemic": The first cluster included HEIs with low socio-pedagogical efficiency and responsibility, while the organizational-technological and economic performance is average. According to the survey of students and teachers, low socio-pedagogical responsibility is the result of the low motivation of teaching staff due to the low level of payment with

the increased workload in view of the transition to online learning, reduction of the number of teachers. The HEIs in the second cluster are characterized by an average level of organizational-technological, economic, and socio-pedagogical efficiency and responsibility. Most of the universities under study (27 out of 50) fell into the third cluster, where all the indicators are low. These are mainly regional HEIs, where the infrastructure is not developed, the motivation for transition to distance learning is practically absent, and the low level of income of the population reduces the possibility of families paying for education to the full extent during the pandemic (mass close of business). The fourth cluster includes only one higher education institution-Kyiv National Taras Shevchenko University, the largest university in Ukraine (the only one from Ukraine that made it to the international QS rating) with well-developed

infrastructure, and a high level of payment for teachers. Therefore, all the evaluation indicators are at a high level.

Table 2: Results of cluster analysis: cluster element definition of higher education institutions on the level of teaching effectiveness and social responsibility of distance higher education in the COVID-19 pandemic

Higher education institutions	Level Identification
<p>Cluster 1 (12 universities): Donetsk National Medical University; Danylo Halytsky Lviv National Medical University; Vasyl Stefanik Precarpathian National University; Dnipropetrovsk Medical Academy; Ukrainian State Chemical Engineering University; Cherkasy National University named after Bogdan Khmelnytsky; National Medical University named after Bohomolets; National University of Kyiv-Mohyla Academy; National Aerospace University. Bogomolets National University; Donetsk National University named after Vasyl Stus; National University "Kyiv-Mohyla Academy"; National Aerospace University named after N. E. Zhukovsky "Kharkov Aviation Institute" Kharkov National University of Radio Electronics; East European National University named after Lesya Ukrainka</p> <p>Higher education institutions</p> <p>Cluster 2 (10 universities): V. N. Karazin Kharkiv National University; Yuriy Fedkovych Chernivtsi National University; Ivan Franko Lviv National University; I. I. Mechnikov Odessa National University; Igor Sikorsky Kyiv Polytechnic Institute NTUU; Oles Gonchar Dnipro National University; Kharkiv Polytechnic Institute National Technical University Lviv Polytechnic National University; Sumy State University; Uzhgorod National University</p> <p>Cluster 3 (27 universities): Kharkiv National Medical University; National University of Bioresources and Environmental Management of Ukraine; Open International University of Human Development "Ukraine"; Donetsk National Technical University; National Aviation University; Odessa National Academy of Food Technologies; Academician Yuri Bugay International University of Science and Technology; National University of Food Technologies; Kyiv National University of Technology and Design; National University of Pharmacy; Odessa Gzhytskyi; Donbas State Machine Building Academy; National Forestry University of Ukraine; Bukovina State Medical University; Nikolaev National University named after V. A. Sukhomlinskiy; Vinnitsa National Technical University; Khmelnytsky National University; Ivan Franko Drohobych State Pedagogical University; Chernihiv National Technological University; National Metallurgical Academy of Ukraine; Ivano-Frankivsk National Medical University; Krivoy Rog National University; Lugansk National Agrarian University; Vinnitsa National Pirogov Medical University; Ternopil National Economic University; Kremenchug National University named after Mikhail Ostrogradsky</p> <p>Cluster 4 (1 university): Kyiv National Taras Shevchenko University</p>	<p>Medium level of the organizational and technological and economic performance of distance higher education in the context of the COVID-19 pandemic</p> <p>Low level of socio-pedagogical efficiency and responsibility of distance higher education in the context of the COVID-19 pandemic</p> <p>Level Identification</p> <p>The average level of the organizational and technological and economic performance of distance higher education in the context of the COVID-19 pandemic</p> <p>The average level of socio-pedagogical efficiency and responsibility of distance higher education in the context of COVID-19 pandemic</p> <p>Low level of the organizational, technological, and economic performance of distance higher education in the context of the COVID-19 pandemic</p> <p>Low level of socio-pedagogical efficiency and responsibility of distance higher education in the context of the COVID-19 pandemic</p> <p>High level of the organizational and technological and economic performance of distance higher education in the context of the COVID-19 pandemic</p> <p>High level of socio-pedagogical efficiency and responsibility of distance higher education in the context of COVID-19 pandemic conditions</p>

The integral taxonomy indicators for each of the clusters were calculated using equations 14–19 during the third stage. The value of the integral taxonomy indicator shows the boundary below which it is economically unsound or socially undesirable to continue providing distance higher education services. The obtained value of the integral taxonomy indicator of the studied higher

educational institutions of the third cluster was visualized in the form of a dendrogram (Fig. 3) by means of the STATISTICA program. The data in Fig. 3 show that the ultimate level of organizational-technological and economic performance/socio-pedagogical efficiency and responsibility of distance higher education in the context of the COVID-19 pandemic is 5%.

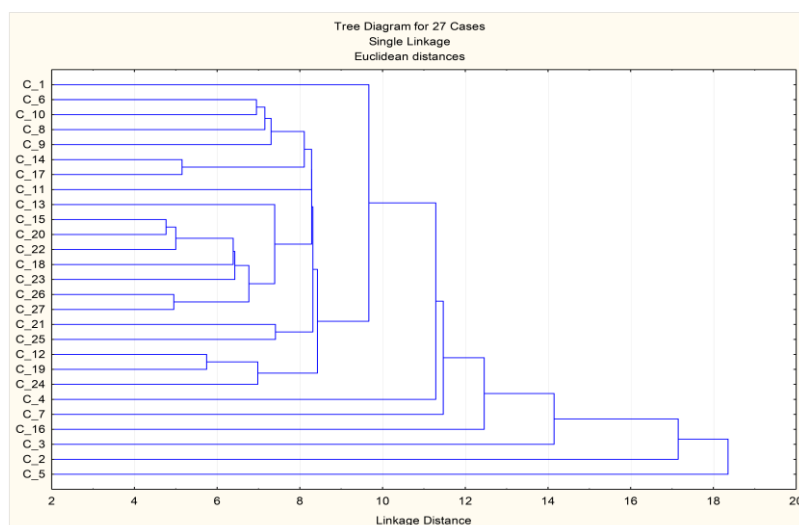


Fig. 3: Dendrogram of integral taxonomy indicators regarding the level of organizational-technological efficiency and socio-pedagogical responsibility of distance higher education in the context of the COVID-19 pandemic

The discriminant analysis makes it possible to monitor the necessity to correct the components of distance education in higher education institutions.

In case of degradation of the situation, it is necessary to take appropriate measures. The results of the discriminant analysis are shown in Table 3.

Table 3: Results of discriminant analysis: Monitoring changes in the level of organizational-technological efficiency and socio-pedagogical responsibility of distance higher education in the context of the COVID-19 pandemic

The discriminant function of the change in the level of performance / responsibility of the <i>i</i> -th cluster	Condition of affiliation of the university to the <i>i</i> -th cluster	Suggested methods to correct organizational-technological and economic performance / socio-pedagogical efficiency and responsibility of distance higher education in the light of the COVID-19 pandemic
$Int_1 = 0.161 + 0.64x_2 - 0.65x_3 + 0.98x_4 - 0.16x_5 - 0.51x_6 - 0.11x_7 - 0.06x_8 - 0.86x_9 + 0.65x_{10} + 0.86x_{11}$	$Int_1 = \max$	To maintain the achieved level of organizational, technological, and economic performance; to use active measures to increase the level of social responsibility and motivation of teachers
$Int_2 = 0.311 + 0.83x_2 - 0.61x_3 + 0.99x_4 - 0.19x_5 - 0.41x_6 - 0.19x_7 - 0.06x_8 - 0.66x_9 + 0.81x_{10} + 0.83x_{11}$	$Int_2 = \max$	To maintain and increase the achieved level of organizational and technological, economic performance; social responsibility, and motivation of teachers
$Int_3 = 0.418 - 0.69x_2 + 0.86x_3 - 0.59x_4 + 1.01x_5 - 0.16x_6 - 0.40x_7 - 0.16x_8 - 0.05x_9 + 0.88x_{10} + 0.88x_{11}$	$Int_3 = \max$	To develop the program of improvement of organizational-technological, economic performance, social and pedagogical efficiency, and responsibility
$Int_4 = 0.555 - 0.59x_2 + 0.49x_3 + 1.03x_4 - 0.13x_5 - 0.36x_6 - 0.13x_7 - 0.03x_8 - 0.66x_9 + 0.98x_{10} + 0.98x_{11}$	$Int_4 = \max$	To maintain the achieved level of organizational and technological, economic performance; social responsibility, and motivation of teachers

The use of the suggested discriminant method for monitoring the situation concerning the provision of distance higher education services in the light of the COVID-19 pandemic makes it possible: To identify possible degradation (improvement) of the level of organizational and technological, economic performance, socio-pedagogical efficiency, and responsibility, on a timely basis suggest changes in methods of motivating teachers, technological and organizational support of the process.

The analysis of the achieved level of organizational-technological and socio-pedagogical indicators confirms the view (Ganushchak-Efimenko et al., 2018) that only consideration of all factors will allow the development and implementation of active measures to increase the level of social responsibility and motivation of teachers. Consideration of lessons learned (Beaudoin, 2016; Clark, 1993) will allow the development of an effective system of distance higher education in light of the COVID-19 pandemic. At the same time, (Shcherbak et al., 2021) believe that only the use of reasonable social distance will ensure quality education for students and safety for all participants in the educational process. However, one cannot agree with (Inciso, 2021; Lebrón, 2020) that there is no difference between distance education and online learning in a pandemic context. Only an integrated combination of online and offline learning will create an effective higher education system in the context of the COVID-19 pandemic.

4. Conclusion

The COVID-19 pandemic has turned to be a global crisis for the field of education, causing the largest disturbance of the education system in history. The mass transition to online distance education has reduced the risks of disturbance to higher education and training. The conducted analysis of the evolution of distance learning, models, methods, tools, and platforms used at present time certify that higher education is one of the industry sectors that was almost ready for a complete transition to distance working in the light of the COVID-19 pandemic. The

conducted study of public information concerning the results of 50 higher education institutions in Ukraine, an online questionnaire survey of students and teachers identified 3 aspects affecting the level of socio-economic performance and responsibility of distance higher education. This model, unlike the existing ones (Adnan and Anwar, 2020), takes into account organizational and technological, economic, and socio-pedagogical factors. The obtained data were processed by means of the STATISTICA application software package. The following methods were used for the analysis: Factor, cluster, discriminant analysis, taxonomy method, and dendrogram. The calculations showed the following. The cluster analysis identified 4 clusters of HEIs, which differ in the actual level of performance and responsibility of distance learning, reflect the level of manifestation of problems of readiness and results of the transition to complete distance work. The first group of problems is related to an insufficient level of organizational and technological support for distance learning (3 clusters, 27 of 50 HEIs). The second group of problems is related to an average or below average level of organizational and methodological equipment and economic efficiency of distance learning (2nd cluster, 10 out of 50 HEIs). The third group of problems is related to a low level of socio-pedagogical responsibility and efficiency of distance learning (1 cluster, 12 out of 50 HEIs). Cluster 4 includes only one HEI-Kyiv National Taras Shevchenko University, the largest university in Ukraine, where the level of efficiency and social responsibility of distance education is at a high level. Dendrogram makes it possible to visualize the actual and ultimate-low levels of efficiency and responsibility of distance learning in HEI. Discriminant analysis was applied to create a system for monitoring the actual level of efficiency and responsibility of higher distance education and the changes taking place. Using this method, in contrast to the existing ones (Popa et al., 2020), allows reacting in a timely manner to changes for the worse: to determine the transition from a cluster with high (medium) indicators to a cluster with low

indicators and to take the necessary measures in a timely manner.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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