

UDC 378.1(330.3)

JEL Classification: I23, M21, O31, O38

DOI: [https://doi.org/10.32515/2663-1636.2018.1\(34\).64-74](https://doi.org/10.32515/2663-1636.2018.1(34).64-74)

Iлона Tsarenko, Postgraduate

Central Ukrainian National Technical University, Kropyvnytskyi, Ukraine

Educational Component of the Forming of Innovative-Integrated Structures in Ukraine

The role of the educational component in the forming of innovative-integrated structures in Ukraine is researched in the article. It is established that there is a strong relationship between the level of development of higher education institutions and the level of clustering of a certain territory. Some indicators of activity of higher educational institutions of Ukraine are considered. It was emphasized that in Ukraine there is a process of optimizing the network of universities, academies and institutes. A comparative description of the expenditures on the sphere of higher education, the position of the Global Innovation Index and the level of clusterization in the context of the countries of the world and Ukraine is given. The attention is focused on the fact that the level of development of the network of higher education institutions in the regions of Ukraine is related to the level of their innovation activity. The key peculiarities of the transformation of approaches to the educational component in terms of its importance in the forming of innovative-integrated structures are substantiated.

educational component, innovative-integrated structure, higher education, higher educational institutions, HEIs, innovations

И.А. Царенко, асп.

Центральноукраїнський національний технічний університет, г. Кропивницький, Україна

Образовательная компонента формирования инновационно-интегрированных структур в Украине

В статье исследована роль образовательной компоненты в формировании инновационно-интегрированных структур в Украине. Установлено наличие четкой взаимосвязи между уровнем развития учреждений высшего образования и уровнем кластеризации определенной территории. Рассмотрены некоторые показатели деятельности высших учебных заведений Украины. Подчеркнуто, что в Украине происходит процесс оптимизации сети университетов, академий и институтов. Приведена сравнительная характеристика расходов на высшее образование, позиций Глобального индекса инноваций и уровня кластеризации в разрезе стран мира и Украины. Акцентируется внимание на том, что уровень развития сети образовательных учреждений регионов Украины имеют связь с уровнем их инновационной активности. Обоснованно ключевые особенности трансформации подходов к образовательной составляющей с точки зрения ее значимости в формировании инновационно-интегрированных структур.

образовательная компонента, инновационно-интегрированная структура, высшее образование, учреждение высшего образования, УВО, инновации

Statement of the problem. The forming of innovative-integrated structures at the present stage is an effective instrument for enhancing the competitiveness of the regions and the national economy in general. After all, it serves as a mechanism for optimizing the relationship between government, business and educational institutions. As the foreign experience shows, the introduction of such progressive forms of cooperation as innovative-integrated structures is becoming prevalent in the world, as it enables to develop exports, attract investments, generate research, technology transfer, develop small and medium-sized businesses, start-ups, technology parks, educational institutions and labor force [6]. It is the strategy of the forming of innovative-integrated structures, which allows all participants (business, state, educational institutions) gain the additional competitive advantages under the influence of the aggregate synergistic effect.

Analysis of recent researches and publications. The various aspects of the forming of innovative-integrated structures are the subject of scientific research of many domestic scientists. For example, Boyko L. and Kudrya S. study the clusters as a grouping of the interconnected companies and institutions that compete and cooperate with each other, and which are linked by a system of market and other connections, which, in turn, constitute one of the most effective forms of cooperation [1].

Vyshnyakova I. characterizes the aspect of the forming of innovative-integrated structures, including the positive experience of the forming and development of clusters in certain countries of northern, eastern and central Europe [2]. The research of Yermakova O. about the using of the cluster model in the increasing of the competitiveness of Ukrainian regions is argumentable [4].

The role of clusters in ensuring the sustainable development of the territory and reveals the forming of the territorial clusters as an instrument of regional development by Mamonova V., Kuts Yu. and Makarenko O. [10].

Sokolenko S. in her research points to the existing problems and perspectives of the strengthening of the competitiveness of the Ukrainian economy on the basis of a cluster approach [13].

However, in spite of the exclusive attention of the scientists to the research of the positive effect of the forming of innovative-integrated structures on the level of competitiveness of the regions or the country as a whole, the recent importance of the educational component of the forming of innovative-integrated structures in Ukraine and within individual regions has become a relevant aspect, which enables the full potential of the territories to be discovered.

Statement of the objective. The purpose of this research is to study the educational component of the forming of innovative-integrated structures at the present stage and the positive effect of its development in Ukraine.

The main material. In general, the innovative-integrated structure is a set of business entities, which are connected with each other by the network system of the financial and economic relations, which are aimed to the increasing the efficiency of innovation activities of participants through the optimization of resource provision. Such structures should include the scientific and technical alliances, technopolises, technology parks, clusters and others [8].

However, despite on a fairly wide range of the existing types of innovative-integrated structures, the formative components are common, in particular: the basic production; suppliers of special equipment, raw materials, services, technologies; universities, standardization centers, trade associations which are providing the specialized training, research, technical support; local authorities and representatives of the state authorities in the region.

One of the components is the educational component. In order to establish the degree of significance of education in the forming of innovative-integrated structures, we carried out a correlation-regression analysis [18].

As a result, an existing interdependence between the development of education and the level of clusterization of a certain territory was established. In particular, the relationship between cluster development and university ranking depicted in Figure 1 has a notable correlation of 0.68. Besides, we can see, that mean value of cluster development is 51.63.

The lowest value of cluster development among the countries is 22.13 score (minimum), the highest is 78.78 score (maximum). The highest value is on 56.65 score higher than the lowest value (dimension). The standard deviation is 12.58. Consequently, the variance, the square of the standard deviation, is $(12.58) * 2 = 25.16$.

The asymmetry and the coefficient of variation are given with the corresponding standard errors. The mean value of university ranking is 42.77. The lowest value of university ranking among the countries is 7.06 score (minimum), the highest is 100.00 score (maximum). The highest value is on 92.94 score higher than the lowest value (dimension). The standard deviation is 24.75 [18].

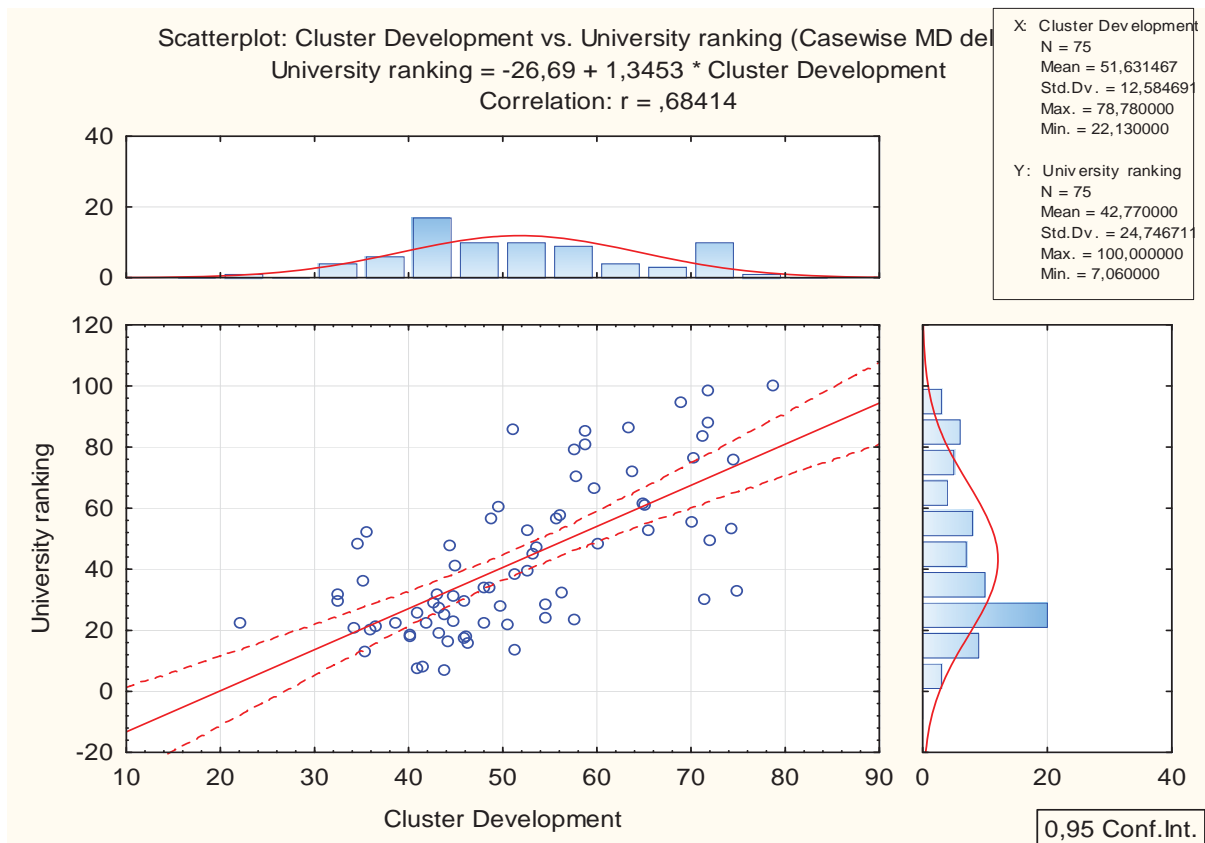


Figure 1 – The ratio of correlation between Cluster Development and University Ranking

Source: developed by the author using data from [18]

Thus, the obtained calculated results of our research indicate about influence the educational component on the state of innovative-integrated structures and could be used by stakeholders as an instrument for developing the innovative-integrated structures.

Taking into account the results of the correlation analysis, there is no doubt that the successful formation of any form of innovative integrated structures requires the qualified specialists, that is, the conditions must be created in the region/country for the training of the specialized labor force through an education system, which is oriented to the relevant labor market. Therefore, we consider it necessary to consider the main indicators of the activities of higher educational institutions of Ukraine.

First of all, it is worth exploring in detail the dynamics of the number of higher educational institutions in the period 1990-2017 (Table 1). As can be seen from the table 1, the number of higher educational institutions of III-IV accreditation levels grew until 2008, a gradual reduction in their number has been observed since 2009, given the policy of optimizing the network of universities, academies and institutes, in particular: the change in the number of higher educational institutions of III-IV accreditation levels in 2017 relative to 2010 - 64 units, 2000 - 30 units, and a positive increase of 140 units relative to 1990. The opposite tendency is characteristic for the higher educational institutions of I-II accreditation levels - a gradual reduction in the number, including: by 137 units in 2017 in comparison with 2010, by 296 units in comparison with 2000, and by 374 units in comparison with 1990. A positive tendency during the period under review was observed from 1999 to 2003 years.

In general, we see that the largest proportion of colleges, technical schools, colleges have such regions as: Vinnytsa (4.6%), Dnipropetrovsk (7.8%), Lviv (5.7%), Odesa (5.1%), Kharkiv (8.4%) and city of Kyiv with 8.1% share in 2017 (7%), while the proportion in 2010 was as follows: the Autonomous Republic of Crimea (3.4%), Dnipropetrovsk (6.1%), Donetsk (10.9%), Luhansk (5.5%), Lviv (4.6%), Odesa (4.0%), Kharkiv (6.5%) and city of Kyiv (9.3%).

Table 1 – The dynamics of the number of higher educational institutions in the period 1990-2017, units

Academic year	Number of higher educational institutions, units	
	I-II accreditation levels	III-IV accreditation levels
1990/91	742	149
1991/92	754	156
1992/93	753	158
1993/94	754	159
1994/95	778	232
1995/96	782	255
1996/97	790	274
1997/98	660	280
1998/99	653	298
1999/00	658	313
2000/01	664	315
2001/02	665	318
2002/03	667	330
2003/04	670	339
2004/05	619	347
2005/06	606	345
2006/07	570	350
2007/08	553	351
2008/09	528	353
2009/10	511	350
2010/11	505	349
2011/12	501	345
2012/13	489	334
2013/14	478	325
2014/15	387	277
2015/16	371	288
2016/17	370	287
2017/18	372	289

Source: developed by the author using data from [11]

The largest share of universities, academies, institutes in 2017 have such regions as: Vinnytsa (2.1%), Dnipropetrovsk (8.4%), Lviv (7.3%), Odesa (7.3%), Kharkiv (13.2%) and city of Kyiv (23.3%), while the largest weight in 2010 was given to the following: the Autonomous Republic of Crimea (4.3%), Dnipropetrovsk (7.2%), Donetsk (7, 7%), Luhansk (2.9%), Lviv (6.6%), Odesa (6.3%), Kharkiv (10.6%) and city of Kyiv (19.8%).

Comparing the specific weight in 2010 and 2017 years, we consider it appropriate to analyze the change of the specific weight: in particular, the positive dynamics are typical for colleges, technical schools of Vinnytsya (1.2%), Dnipropetrovsk (1.7%), Lviv (1.1%), Odesa (1.2%) and Kharkiv (1.8%) regions and for universities, academies, institutes of Vinnytsa (0.7%), Dnipropetrovsk (1.2%), Lviv (0.7%), Odesa (1.0%), Kharkiv (2.6%) regions and city of Kyiv (3.6%).

In return the negative dynamics are inherent to the Autonomous Republic of Crimea (-3.4%), Donetsk (-6.6%), Ivano-Frankivsk (-0.8%), Luhansk (-3.4%), Chernihiv (-0.1%) regions, city of Kyiv (-1.2%) and Sevastopol (-1.0%) for colleges, technical schools and for universities, academies, institutes of the Autonomous Republic of Crimea (-4.3%), Donetsk (-4.6%), Ivano-Frankivsk (-0.8%), Kirovohrad (-1.0%), Luhansk (-1.5%), Chernivtsi (-0.1%) regions and Sevastopol (-1.1%).

Thus, in view of the analysis of the above-mentioned tendencies, it should be noted that Ukraine has a policy of optimizing the network of higher educational institutions.

From here, we consider it necessary to compare the number of population per 1 higher educational institution in Europe, the CIS and Ukraine, in particular by comparing the number of

higher educational institutions of university level in one of the European countries or the CIS countries with higher educational institutions of all levels of accreditation in Ukraine (Table 2), due to the inequivalence of interpretations of the higher educational institutions in national educational standards.

Table 2 – The comparison of the countries of Europe and the CIS in terms of the number of population per 1 HEI

Country	the number of HEI (Webometrics)	Population, thousand persons	the number of population per 1 HEI
Liechtenstein	3	37 007	12 336
Greenland	2	57 714	28 857
Monaco	1	30 500	30 500
San Marino	1	32 448	32 448
Estonia	34	1 266 375	37 246
Latvia	56	2 178 443	38 901
Iceland	8	315 281	39 410
Bosnia and Herzegovina	76	3 875 723	50 996
Slovenia	39	1 992 690	51 095
Denmark	84	5 556 452	66 148
Cyprus	17	1 155 403	67 965
Georgia	66	4 555 911	69 029
Norway	63	4 722 701	74 964
Croatia	59	4 475 611	75 858
Switzerland	104	7 996 026	76 885
Poland	440	38 383 809	87 236
Finland	48	5 266 114	109 711
France	597	65 951 611	110 472
Belgium	89	10 444 268	117 351
Czech Republic	82	10 162 921	123 938
Ukraine	306	44 573 205	145 664
Slovakia	33	5 488 339	166 313
Sweden	49	9 119 423	186 111
Germany	406	81 147 265	199 870
the UK	308	63 395 574	205 830
Turkey	164	80 694 485	492 040
Europe and the CIS	6041	905 260 983	149 853
CIS	1857	272 740 459	146 872
EU-28	3555	509 365 627	143 281

Source: developed by the author using data from [11]

Analyzing table 2, we do not observe a strong dependence. Moreover, in order to the evaluation the correlation between the number of higher educational institutions and the number of population per 1 HEI, the correlation coefficient was calculated, which is 0.17, and indicates a weak direct dependence.

Further, we consider it necessary to analyze the number of higher educational institutions in the regions of Ukraine and the number of persons in HEIs, including the graduated in the 2017/2018 academic year (table 3).

Table 3 – The number of higher educational institutions and the persons in HEIs by regions of Ukraine in the 2017/2018 academic year

Region	Number of HEIs, units	Number of persons in HEIs		
		accepted	students	graduated
Ukraine	661	323577	1538565	421131
Vinnitsya rigeon	23	9366	44955	9495
Volyn rigeon	14	6018	25288	7480
Dnipropetrovsk rigeon	55	25061	113079	31208
Donetsk rigeon	29	7513	32186	8747
Zhytomyr rigeon	20	6911	29942	8097
Transcarpathian rigeon	14	5163	23695	5480
Zaporozhzhya rigeon	24	13191	67444	19548
Ivano-Frankivsk rigeon	16	8446	37088	10960
Kyiv rigeon	21	5708	27545	8404
Kirovohrad rigeon	16	3353	14433	4442
Luhansk rigeon	13	4738	19120	5333
Lviv rigeon	43	26687	123148	32222
Mykolaiv rigeon	17	6806	31640	8484
Odesa rigeon	40	21408	107517	31914
Poltava rigeon	18	9875	46224	12383
Rivne rigeon	14	7198	32473	10782
Sumy rigeon	14	7110	34604	9582
Ternopil rigeon	18	9701	40992	10792
Kharkiv rigeon	65	33294	171298	42672
Kherson rigeon	21	6027	26635	7735
Khmelnyskyi rigeon	18	6687	30983	8289
Cherkassy rigeon	16	6995	37035	12537
Chernivtsi rigeon	16	6835	29873	8178
Chernihiv rigeon	16	4281	20113	6137
Kyiv	100	75205	371255	100230

Source: developed by the author using data from [11]

Analyzing Table 3, we observe that during the analyzed period the highest number of HEIs is characteristic for Kyiv and such regions as Kharkiv, Dnipropetrovsk, Lviv and Odesa. According to Figure 2, the ratio of the number of graduates per 1 HEI in these regions is the highest. That is, despite on the extensive network of HEIs in these regions and the capital, the contingent of students and the number of graduates is quite high, which indicates the high level of labor potential of these regions. Moreover, according to the preliminary studies (CEFE 2018), the availability of such network of HEIs forms a significant potential in the direction of innovation activity, including forming innovative-integrated structures.

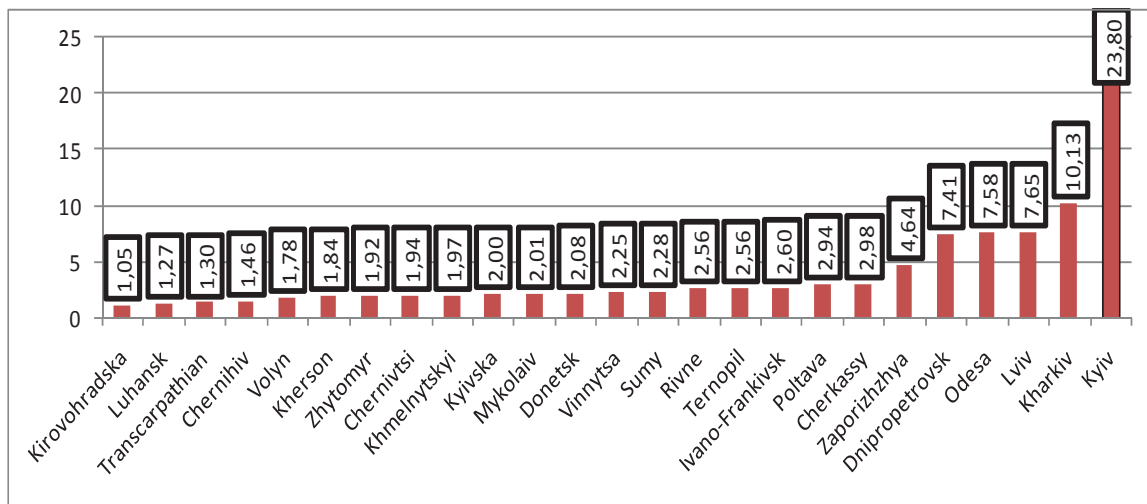


Figure 2 – The ratio of the number of graduates per 1 HEI

Source: developed by the author using data from [10]

Instead, the catastrophic situation is typical of such regions as Kirovohrad, Luhansk and Transcarpathian, for which the ratio of the number of graduates per 1 HEI is 1.05, 1.27 and 1.30 respectively, which is 20 times lower than the value for Kyiv and 7 times for Dnipropetrovsk, Odesa and Lviv regions. It should be noted that if in Luhansk and Transcarpathian the number of HEIs in Ukraine is one of the lowest - 13 and 14 units respectively, then in the Kirovohrad region there are 16 HEIs, that, for example, are 2 units more than in the Sumy region (where the ratio of the number of graduates per 1 HEI is 2.28).

Given the significant role of the educational component in the forming of innovative-integrated structures, we consider it appropriate to characterize in more detail the state of innovation transformations in the field of higher education, which can only be realized through financing.

Taking into account the table 4, we observe that the expenditure on the sphere of higher education in absolute terms shows the significant disparities in the countries from 340 dollars US per 10,0 thousands population to 15,139 dollars per 10,0 thousands population.

Table 4 – The comparative description of the expenditures on the sphere of higher education, the position of the Global Index of Innovation and the level of clusterization by the countries of the world and Ukraine in 2016

Country	the expenditures on the sphere of higher education as a percentage of GDP, (%)	the expenditures on the sphere of higher education in absolute terms, mln. dollars USA	the expenditures on the sphere of higher education, for 10 thousand person of the population (thousands dollars USA)	the position of the Global Index of Innovation	the level of clusterization
the USA	2,6	482,8	15 139	61,40 (4)	5,6 (1)
Switzerland	1,2	6,4	7 712	66,28 (1)	5,1 (14)
Denmark	1,7	4,9	8 575	58,45 (8)	4,6 (22)
the UK	1,8	50,6	7 949	61,93 (3)	5,3 (6)
Sweden	1,7	8,3	8 520	63,57 (2)	5,0 (16)
Finland	1,8	4,3	7 751	59,90 (5)	4,9 (18)
Netherlands	1,7	14,8	8 739	58,29 (9)	5,3 (7)
Singapore	1.1	3,0	5 557	59,16 (6)	5,2 (12)
Canada	2,5	40,8	11 481	54,71 (15)	4,7 (20)
Australia	1,7	20,1	8 569	53,07 (19)	4,0 (43)
Czech Republic	1,3	4,8	4 579	49,40 (27)	3,8 (59)
Slovenia	1,2	0,8	3 906	45,97 (32)	3,5 (87)
Hungary	1,3	3,5	3 557	44,71 (33)	3,4 (96)
Poland	1,4	14,8	3 852	40,22 (39)	3,7 (71)
Slovakia	1,1	1,9	3 436	41,70 (37)	3,9 (51)
Ukraine	1,6	1,4	340	35,72 (56)	3,0 (125)

Source: compiled by the author using data from [7]

Thus, the support and development of the tertiary sector create the conditions for the forming of modern innovative-integrated structures, which are extremely important for the development of regions, as evidenced by the positive experience of foreign countries, which are assimilated on the principles of the triple spiral model.

So, taking into account the intensification of the innovation development of the countries of the world and the moderately slow pace of such processes in Ukraine, as evidenced by the structure of the economy and a small number of innovative-oriented enterprises, as well as the lack of widespread innovative-integrated structures, in particular the involvement of higher education institutions in their creation cells of innovation, changing the requirements for the national system of higher education, that is the educational component of their forming, is relevant in the context of

the emergence of innovative-oriented structures, in particular:

- the changes in requirements for graduates: it is not just persons who have received a certain list of knowledge within the course, but also those who have skills and ability to continue their lifelong learning (learning to learn), the ability to independently search for the necessary information from a large array and its direct analysis/syntes;
- the change of the philosophy of the education itself: the dissemination of the interactive model of the partner relationships between professors and students as a subject with the subject, in contrast to the existing "model of subject-object";
- the educational environment that provides the possibility of professors to play the role of a guide on the way of "gaining knowledge" at such universities;
- the services of higher education are gradually increasing as a result of the intensification of the internationalization of services with the growth of the number of foreign students abroad;
- the universities are becoming more global, which are requiring the application of the new criteria for the evaluation of quality in a global dimension;
- the system of the higher education system is becoming not only the producer of the educational services and a new knowledge for their stakeholders (with their own centers, powerful research centers and laboratories that can be used by students of such universities), as well as their consumer by creating the powerful research centers at such universities, which would be actively involved in the introduction of innovations in the various spheres of economy and innovation activities;
- the attractiveness of educational hubs is expanding;
- the technologies are becoming increasingly important for education all over the world;
- cooperation in the educational environment by the creation of consortia is becoming more widespread;
- the change of the principle of regulation of the sphere of higher education by the state, since competition between the HEIs is growing due to the lack of borders in the educational environment;
- the necessity of involving the HEIs in project activities, which are aimed at solving both the national and global problems of the countries of the world [3].

So, the adaptation of progressive practices of the developed countries of the world will enhance the innovation processes both in sphere of higher education and in the national economy as a whole, as a result, will create the prerequisites for the enhancing of its competitive position in the international dimension, because the cluster-building tools are an effective means of ensuring the sustainable development of territories, the more rational using of existing resources, creating a favorable business environment, improving the level and quality of population's life in whole.

Conclusions and prospects for further researchers. The conducted research allowed to state that in modern conditions the role of the educational component in ensuring the sustainable development of innovative-integrated structures is significantly increasing. The strengthening of the innovativeness of higher education institutions is an integral part of their future participation in such structures. Because, as stated by the research, the educational component is not only one of the components of the forming, but has the prevailing importance in terms of labor potential. The research was established that there are disproportions in the development of higher educational institutions of Ukraine by the regions and their contingent, that destabilizes the sustainable development of the economy as a whole, because the basis for the development of foci of innovation is radically different, as are the possibilities of the regions. In particular, the city of Kyiv is the leader among the number of graduates of the HEIs) and Kirovohrad region, on the contrary, is an outsider among all regions of Ukraine. If we analyze the level of innovative development of the regions to the current state of development of higher education, we can observe a clear correlation of indicators. This situation, on the one hand, characterizes exclusively the state of development and the effectiveness of higher education in terms of territorial aspect, but this view, we consider, is one-sided, because the situation is as an indicator of the potential of the regions in the future, in particular the innovative activity of enterprises and the possibilities of forming the innovative-

integrated structures on their territories. Because, classically, the latter are formed with the participation of HEIs, and in some forms on the basis of HEIs, hence the power of development of the educational network of the region is a key to the forming in the current or subsequent periods an innovative-integrated structures.

The prospects for further scientific research in this direction are to find the ways to the further enhance cooperation of higher education institutions with all subjects of innovation and investment activities in the process of ensuring the sustainable socio-economic development of territories and the creating conditions for the high-tech production and providing highly intelligent types of services in the modern economic development countries of the world, which are require the direct participation of scientists in these processes and commercialization of their scientific ideas.

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І.О. Царенко, асп.

Центральноукраїнський національний технічний університет, м. Кропивницький, Україна

Освітня компонента формування інноваційно-інтегрованих структур в Україні

У статті досліджено роль освітньої компоненти у формуванні інноваційно-інтегрованих структур в Україні. На підставі результатів кореляційно-регресійного аналізу встановлено наявність чіткої взаємозалежності між рівнем розвитку закладів вищої освіти та рівнем кластеризації певної території. Розглянуто деякі показники діяльності закладів вищої освіти України, зокрема: динаміку кількості закладів вищої освіти у 1990-2017 роках, кількість закладів вищої освіти та осіб у них за регіонами України у 2017/2018 навчальному році, в тому числі, прийнятих, студентів та випущених, витрати на вищу освіту в абсолютному виразі та інші.

Підкреслено, що в Україні відбувається процес оптимізації мережі університетів, академій та інститутів. Динаміка контингенту в абсолютному виразі віддзеркалює демографічну тенденцію в країні та демонструє наявну територіальну диспропорцію, яка відображена не лише у чисельності студентів, а у кількості випущених по відношенню до одного закладу вищої освіти. Наведено порівняльну характеристику витрат на вищу освіту, позицій Глобального індексу інновацій та рівня кластеризації в розрізі країн світу та України. Крім того, проаналізовано чисельність населення, яке припадає на один заклад вищої освіти в деяких країнах Європи, СНД та в Україні.

Обґрунтовано ключові особливості трансформації підходів до освітньої складової з точки зору її значимості у формуванні інноваційно-інтегрованих структур, зокрема: зміни в вимогах до випускників, філософії самої освіти, розширюється привабливість освітніх хабів, технології стають дедалі важливішими для освіти, поглиблюється кооперація в освітньому середовищі, зміна принципу регулювання сфери вищої освіти державою, необхідність залучення університетів до проектної діяльності, система вищої освіти стає не тільки виробником освітніх послуг та нових знань для їх стейкхолдерів, університети стають все більш глобальними, професорсько-викладацький склад відіграє роль ґіда на шляху «добування знань» тощо.

освітня компонента, інноваційно-інтегрована структура, вища освіта, заклад вищої освіти, ЗВО, інновації

Одержано (Received) 02.11.2018

Прорецензовано (Reviewed) 20.11.2018

Прийнято до друку (Approved) 20.12.2018