Identification of the Educational Clusters in the Regional Economy: Theory, Methodology and Research Results (in Example of Perm Krai)

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Abstract Article provides an algorithm and defined criteria for the identification of educational clusters in the regional economy, adapted to the Russian reality. Identification of the leading industries as promising regional educational clusters in the economy of Perm Krai conducted on the basis of quantitative Shift-Share analysis and the calculation of the localization coefficient. Statistical base of the research were materials of the central statistical database of the Federal State Statistics Service of the Russian Federation for 2007-2012 years by employment indicators. Qualitative diagnosis of educational clusters allowed to establish the shape and direction of development of strategic partnership in the educational system in the region, to identify the factors of competition. As a result, by applying a set of quantitative and qualitative methods of analysis of cluster, authors found that in the economy of Perm Krai has four potential educational clusters to be formed, the development of which should be a priority of educational policy in the region.

Keywords: educational cluster, Shift-Share analysis, localization, expert interviews, regional economy, cluster policy

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1. Introduction

In modern conditions, socio-economic space in many Russian regions increasingly acquires the cluster features. In most regions, the cluster approach is declared as one of the basic conditions for effective public policies, and clusters play the role of tools for increasing the competitiveness of regional economies, ensuring the formation of centers of attraction of investment and innovative activity.

Effective cluster structures can be a tool to address urgent social and economic problems [10,15]. For example, today is particularly acute decline in the quality of educational services; there is a reduction in the proportion of people with higher and specialized secondary education, particularly in rural areas, compounded by disparities in the structure of demand for education. The pre-school education in many Russian regions in a deep crisis. In this regard, the important issue is the formation of educational clusters, the operation of which will be aimed at the intensive solution of these problems in order to ensure sustainable socio-economic development of the territories.

2. Theoretical Background

The founder of the cluster theory is fairly considered Michael Porter, a professor at Harvard Business School. M. Porter defines a cluster as 'a geographically concentrated groups of interconnected companies, specialized suppliers, service providers, firms in related industries, as well as associated with their activities organizations (e.g., universities, agencies, standardization, trade associations) in certain areas, competing but at the same time working together' [13].

Cluster boundaries may vary. This is due to the fact that there are new businesses and industries emerge, the existing industries are narrowing as well as there are various kinds of new organizations. Clusters operate without creating any new actors. Under these conditions, a huge role in the successful operation of the cluster becomes arranges relationship between the parties and informal communication, trust between the cluster members. Due to the lack of red tape in a cluster this form of organization is more flexible and agile than other forms of business [5]. The flexibility and mobility of this structure can be regarded as a significant advantage in terms of the modern economy.

According to S. Rosenfeld, a cluster is a concentration of firms able to achieve synergies in view of their close geographic location and interdependence, even though the scale of presence in the area is not enough [14]. T. Roelandt and P. den Hertag write that 'clusters can be described as a network of actively interacting companies (including specialized suppliers), interconnected by relationships within the value chain' [7]. According to the approach of B. Elsner, a cluster is a group of firms that are functionally related to the market both vertically and horizontally [4]. These definitions indicate the features of clusters: geographic location, industry specialization, a combination of institutions of competition and cooperation of organizations in the cluster.

The basic typology of clusters in the economy can be regarded as: production (industrial) clusters and clusters of services. Cluster of service sector is 'a group of independent companies that are in geographical proximity within the region who compete, cooperate and interact with each other, providing both local consumers and consumers from other regions, a range of services to meet their needs in a particular area' [[11], p. 36]. The main feature of the cluster in service sector compared to industrial cluster is that its member companies, within a single value chain, at the same time realize the ultimate service completely independently. This feature determines the specificity of the services value chain in this type of cluster, where each link of the chain is a separate service, but may be supplemented by another service, resulting in the consumer receiving more than one service, and a range of services in one area.

Recently, the educational clusters became especially highlighted among the clusters of service sector, the development of which is capable of providing innovative reproduction of human capital of the country and regions, the relationship of the educational system and the modern labor market, the creation of preconditions for structural modernization of the educational sector.

The foreign and domestic economic literature show no consensus on the interpretation of the educational cluster. According to the representation R. Culatta, educational cluster should be innovative and represent a group of related educational, research and business organizations, aimed at the production and implementation of innovations, and their promotion on the local and global markets [3]. The model of educational innovation cluster of R. Culatta includes three key players: educational institutions, scientific research organizations and businesses. Educational institutions provide the formation of intellectual retrieval environment in which the favorable conditions for the development of new ideas, technology and products by teachers and students, as well as innovation in the learning process are created. It is separately emphasized that educational partners have a real opportunity to test the promising developments in pilot innovative projects. Research organizations, in cooperation with business partners and educational institutions carry out basic and applied research, conduct an examination of the scientific and technical projects developed in the cluster, and develop effective learning technologies to improve the effectiveness of research activities in the educational system. Commercial partners are there to commercialize innovations, conduct applied research for educational institutions. They can also fund a research project to invest in innovative enterprises established in the cluster.

R. Tieman believes that the educational cluster is a system of inter-related universities, specialized schools and research organizations, which allows cluster members to combine their efforts and resources to promote educational services in the global market [16].

In contrast to the approach of foreign researchers, Russian authors consider educational clusters as structures oriented at improving the effectiveness of training and development of human capital, on the convergence of the educational process with innovative and entrepreneurial activities. For example, N.A. Korchagina understands educational cluster as only 'a group of educational institutions, which are localized in the same area, forming the final product as an educational service, competing and cooperating with each other and with suppliers around the necessary factors of production, equipment, specialized services, infrastructure, research institutes, with this reinforcing the competitive advantages of each other' [8]. M.V. Zhuravleva defines educational cluster as a set of interrelated institutions of professional education, combined according to different sectors and related partnerships with companies in the sector [18]. According to V.M. Yuryev and M.S. Chvanova, innovative educational cluster is an association of institutions of higher education and enterprises a particular industry for training and conducting a practice oriented research for the industry [17].

These interpretations indicate the formation of clusters in modern economics of an integrated approach to the study of clusters as tools for territorial development, which are not only universal, but holding the integrating nature, is to solve the complex problems of improving the competitiveness of the economy, modernizing the educational system, the transition to an innovative model of development.

3. Methodology

In modern scientific literature, special attention is paid to the study of natural clusters as particular forms of inter-organizational interaction of economic agents, penetrating the various levels of the economic hierarchy. However, the problem of identifying promising cluster formations remains open to discussions of academic economists. In this regard, the urgency and relevance of forming a complex algorithm of cluster analysis is defined by the increasing role of clusters in promoting regional economic space.

Since the formation of the cluster mechanisms of economic development is related to a number of factors, which are often quite difficult to formalize, a priority in most countries are in qualitative methods of evaluation of clusters that are supported by quantitative analysis. However, the current statistical base, both Russian and foreign, allows to create and implement a system of quantitative methods of cluster analysis, providing identification of important empirical regularities of formation and functioning of clusters in the economy, which cannot be diagnosed using qualitative approaches, as widespread [9].

The experience of studying clusters shows that the original cluster analysis algorithm is based on a synthesis of the two most frequently used techniques of evaluations with quantitative basis: identification of clusters by estimating the degree of localization (i.e. localization coefficient) and evaluation of the regional contribution of the sector to the economy (i.e. Shift-Share Analysis).

The estimate of the localization coefficient, allowing to compare regional and national economic characteristics (variables), such as employment, gross value added, investment, etc., and to identify the specialization area, is done according to the formula:

$$LQ_i = \frac{l_i/l}{L_i/L} \qquad (1)$$

with l_i – employment in the i sector in the region; L_i – employment in the i sector in the country; l and L – total employment in the region and country respectively.

Interpretation of the calculated values is given in the article for the employment figures.

If the value of LQ greater than 1, then the concentration of the industry in the region is higher than in the country as a whole, hence the industry might have cluster features. According to the approach of M. Porter, which is shared by the authors of this article, LQ, exceeding 0.8 also demonstrates the high potential of the industry cluster.

Method of assessing structural shifts (Shift-Share Analysis) enables to identify the leading industry, the causes and trends of the cluster structure of the spatial economy. This is done by evaluation of the contribution of the national, sectoral and regional factors in the change in the value of the analyzed variable (e.g. employment, labor productivity, gross value added, etc.) [1].

Assessing the impact of the national factor (NS), for example, the growth of national employment, on the key indicators of regional economic development is done according to the formula:

$$NS = l_{t-1}^i * (\frac{L_t}{L_{t-1}} - 1) \qquad (2)$$

with l_{t-1}^i – employment in the i sector in the region in the period $(t-1)$; L_{t-1} and L_t – total employment in the country during the periods $(t-1)$ and t respectively.

Industry factor (IM) is estimated by determining the contribution of national growth rates of the analyzed variable in industry to change industry benchmarks in the region:

$$IM = l_{t-1}^i * (\frac{L_t^i}{L_{t-1}^i} - \frac{L_t}{L_{t-1}}) \qquad (3)$$

with L_{t-1}^i and L_t^i – number of people employed in the i sector in the country during the period $(t-1)$ and t.

Industry factor that secures national industry trends impact on the dynamics of the industry in the region reflects the quality of the industry structure of the regional economy in the analyzed variable, as IM can take both positive and negative values.

Regional factor (RS), as a key indicator of the quantitative identification of clusters, allows setting the leading and lagging sectors in the economy of the region by the criteria of the relative competitiveness: a comparison of growth rates of variable to be analyzed for the industry in the country and the region. It is calculated by the formula:

$$RS = l_{t-1}^i * (\frac{l_t^i}{l_{t-1}^i} - \frac{L_t^i}{L_{t-1}^i}) \qquad (4)$$

The industry characterized by high values of the index RS has considerable cluster potential. Industries with consistently negative values of the regional factor are outsiders of the economy.

Finding the general growth of the variable with the influence of national, sectoral and regional factors is performed as follows:

$$SS = NS + IM + RS. \qquad (5)$$

In order to isolate the leading economic activities that are able to create the core of the cluster, it is advisable to use the approach to classification of regional industry leaders on the ratio of the RS and IM (Table 1).

Table 1. Typology of industries by the ratio of the RS and IM

Industry type	Index ratio	interpretation of indicators
1	RS>0, IM>0	There are favorable conditions for regional and sectoral development
2	RS>0, IM<0, /RS/> /IM/	Favorable conditions for regional development prevail over less favorable industry conditions of growth
3	RS<0, IM>0, /RS/< /IM/	Favorable conditions for the development of industry is dominated by a less favorable regional conditions of growth
4	RS>0, IM<0, /RS/< /IM/	Favorable conditions for regional development is not able to exceed unfavorable industry conditions of growth
5	RS<0, IM>0, /RS/> /IM/	Favorable conditions for the development of industry is not able to exceed the unfavorable regional conditions of growth
6	RS<0, IM<0	There are unfavorable regional and sectoral development conditions

Source: [6]

The first and second types of industries are among the regional leaders. It is obvious that the sector of the first type has the greatest potential for clusters' formation; industries of the second type are also able to form the core of the cluster. Industries of the third type, to a lesser extent have the ability to form the nucleus of the cluster, as

regional conditions of growth do not contribute as much as hinder their development. However, it is possible that the implementation of an enabling economic policies will ensure their transformation into the first or second type of industry leaders.

It should be emphasized that Russia's statistical base, formed according to the industries or by types of economic activity, allows to fully use the identification of clusters by the methods of evaluating LQ and Shift-Share analysis, widely used abroad. Application of such quantitative methods as 'input-output' tables is impossible in Russia to date because national and regional statistical offices for a long time do not constitute cross-sectoral balances.

For the analysis of quantitative research results, it is advisable to take the following criteria for classifying industries (i.e. forms of economic activities) to the number of the key components of the clusters shown in Table 2.

Table 2. Criteria for classifying types of activities among the key components of clusters

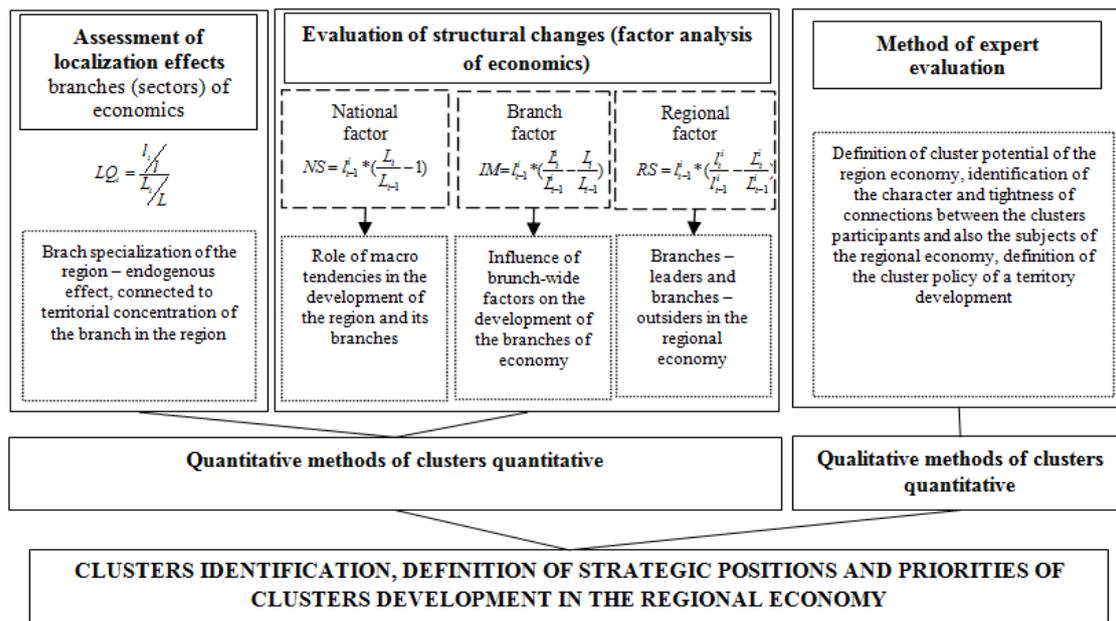| Indicator	Criteria
Localization coefficient (*LQ*)	*LQ≥0,8* at least twice during the analyzed period
Regional component (*RS*)	*RS>0* at least twice during the analyzed period
The ratio of regional and sectoral components (ratio of *RS* and *IM*)	Relation allows to classify the type of activity to 1, 2 or 3 types of industries

Figure 1. Algorithm of identification and analysis of the regional educational clusters

The results of quantitative methods to identify clusters should be supplemented by qualitative assessments, particularly among which are expert surveys. The method of expert estimates is universal, applicable for various purposes, and can be used to identify regional economic clusters. In this case, the conclusions obtained on the basis of intuitive features are based on knowledge and experience of experts. Figure 1 summarizes the algorithm for identifying regional clusters, which has been developed and tested to identify educational clusters in the economy of the Perm Krai.

4. Research Results

Table 3. The localization coefficient in terms of average number of employees for the 'Education' type of economic activity in the Perm Krai

Type of economic activity	2007	2008	2009	2010	2011	2012
Education, total	1,03	1,01	0,99	0,97	0,89	0,89
Pre-school education (prior to the primary education)	1,30	1,26	1,21	1,16	1,04	1,02
Primary, basic and secondary (complete) general education	0,96	0,95	0,95	0,94	0,87	0,90
Additional education for children	1,07	1,05	1,00	0,98	0,89	0,88
Primary and secondary professional education	1,23	1,22	1,12	0,98	0,85	0,80
A higher professional education	0,68	0,69	0,70	0,74	0,70	0,72
Education for adults and other kinds of education	0,98	0,92	0,92	0,97	0,90	0,87

Calculated by the authors according to the Federal State Statistics Service of the Russian Federation.

According to the presented algorithm in Figure 1, the identification of educational clusters starts with quantitative methods. To estimate the LQ and structural changes the statistical data on the employment of the Federal State Statistics Service of the Russian Federation in 2007-2012 was used. Table 3 shows the results of calculations of the localization coefficient for the type of economic activity 'Education' and its subtypes (subclasses) in terms of average number of employees (excluding external and part-time employment).

Value of LQ indicates the high potential of the cluster of education in Perm Krai. Leaders in this indicator are pre-school, primary and secondary professional education. The average value of LQ greater than 0.9 have schools, additional education for children and education for adults. Only the sphere of higher education is characterized by the LQ less than 0.8.

Using the method of structural changes, we estimate the impact of national, sectoral and regional contribution to the change in the average number of employees for each

subtype of 'Education' activities in the Perm Krai (see Table 4).

According to Table 4, it can be concluded that negative structural trends during the period have amplified in the field of education in the region, which has reduced the cluster potential of the industry. In particular, in 2012, employment in the areas of pre-school and school education, additional education for children, primary and secondary professional education and adult education has decreased mainly due to the impact of the regional component (RS). Minimal negative impact of structural changes seen in the field of higher education of the Perm Krai: the regional factor takes positive values in 2008-2010. However, in 2011 and 2012 RS is negative, which can be associated with both the effects of the economic crisis and with the ongoing reforms in the Russian sphere of education.

Table 5 provides a typology of subtypes of 'Education' activities by the ratio of regional and industrial components for the economy of the Perm Krai.

As evident from the matrix of RS and IM, no sphere of education of the Perm Krai can be regarded as a regional leader. In particular, for the 2007-2012 period the matrix of 'industry type' identified negative trends in the sectors of higher and professional education, pre-school education and adult education. The results indicate the need to improve regional conditions for the development of education in the Perm Krai, and provides a reasonable basis for the development and implementation of the state cluster policy.

It should be emphasized that the cluster projects initiated by the regional authorities should be considered as indicators of cluster development in the respective territory. The practical value of such initiatives is that regional authorities, interested in the development of clusters, provide a framework for cooperation and long-term cooperation of economic actors – educational institutions, businesses, research organizations, financial institutions and others.

Table 4. The influence of the national contribution (NS), the contribution of the industry (IM) and the regional input (RS) on the change in the average number of employees (excluding external and part-time employment) in 'Education' in the Perm Krai

2008/2007	2009/2008	2010/2009	2011/2010	2012/2011	2008/2007	2009/2008	2010/2009	2011/2010	2012/2011
Education, total									
pers.					%				
990	-4 401	-1 637	-1 843	53	-30%	166%	21%	24%	-1%
-2 057	3 286	-965	-1 086	-1 743	62%	-124%	12%	14%	33%
-2 273	-1 535	-5 304	-4 667	-3 660	68%	58%	67%	61%	68%
-3 340	-2 650	-7 906	-7 596	-5 349	100%	100%	100%	100%	100%
Pre-school education (prior to the primary education)									
pers.					%				
287,8831	-1313,13	-495,031	-568,309	16,62577	-244%	371%	28%	28%	-1%
671,256	2322,502	1018,379	437,1878	408,0628	-569%	-656%	-57%	-22%	-27%
-1077,14	-1363,37	-2300,35	-1889,88	-1955,69	913%	385%	129%	94%	128%
-118	-354	-1777	-2021	-1531	100%	100%	100%	100%	100%
Primary, basic and secondary (complete) general education									
pers.					%				
407,3533	-1753,31	-653,559	-726,981	20,89838	-14%	181%	18%	22%	-1%
-2897,61	914,478	-1515,54	-992,898	-1234,54	102%	-94%	42%	31%	77%
-348,741	-130,166	-1463,9	-1517,12	-382,357	12%	13%	40%	47%	24%
-2839	-969	-3633	-3237	-1596	100%	100%	100%	100%	100%

Factors of structural changes by activity type	2008/2007	2009/2008	2010/2009	2011/2010	2012/2011	2008/2007	2009/2008	2010/2009	2011/2010	2012/2011
	Additional education for children									
	pers.					%				
NS	59,88071	-272,883	-104,719	-121,686	3,585251	-193%	-546%	35%	31%	-1%
IM	86,3038	654,3735	125,4168	68,32939	26,10134	-278%	1309%	-43%	-18%	-7%
RS	-177,185	-331,491	-315,698	-334,643	-411,687	572%	-663%	107%	86%	108%
SS	-31	50	-295	-388	-382	100%	100%	100%	100%	100%
	Primary and secondary professional education									
	pers.					%				
NS	122,7251	-539,728	-181,577	-179,584	4,810935	-22%	34%	8%	13%	0%
IM	-587,521	-34,8003	-296,148	-330,177	-431,367	105%	2%	13%	23%	35%
RS	-97,2036	-1036,47	-1767,27	-910,239	-800,444	17%	64%	79%	64%	65%
SS	-562	-1611	-2245	-1420	-1227	100%	100%	100%	100%	100%
	A higher professional education									
	pers.					%				
NS	103,136	-482,289	-187,493	-228,603	6,86904	40%	-193%	-293%	46%	-1%
IM	-17,0528	491,8749	-30,6016	-132,166	-294,58	-7%	197%	-48%	27%	54%
RS	173,9169	240,4142	282,0945	-132,231	-258,289	67%	96%	441%	27%	47%
SS	260	250	64	-493	-546	100%	100%	100%	100%	100%
	Education for adults and other kinds of education									
	pers.					%				
NS	9,130717	-39,7954	-14,9534	-17,741	0,533793	-18%	284%	68%	48%	-1%
IM	3,456144	31,33484	-30,4286	6,03991	7,360561	-7%	-224%	138%	-16%	-11%
RS	-63,5869	-5,53942	23,38201	-25,299	-72,8944	125%	40%	-106%	68%	112%
SS	-51	-14	-22	-37	-65	100%	100%	100%	100%	100%

Calculated by the authors according to the Federal State Statistics Service of the Russian Federation.

Table 5. Changes in the type of industries to the ratio of the RS, and IM for subtypes of 'Education' activities in the economy of the Perm Krai in 2007-2012

Type of economic activity	Industry type				
	2008/2007	2009/2008	2010/2009	2011/2010	2012/2011
Pre-school education (prior to the primary education)	5	3	5	5	5
Primary, basic and secondary (complete) general education	6	3	6	6	6
Additional education for children	5	3	5	5	5
Primary and secondary professional education	6	6	6	6	6
A higher professional education	2	1	2	6	6
Education for adults and other kinds of education	5	3	4	5	5

Note: the type of industry sector specified in Table 1

As for the Perm Krai, today the region has received considerable attention in the formation of the cluster projects. For example, regional authorities, together with the Perm Chamber of Commerce (hereinafter - PCC) use cluster tools to support the development of secondary and higher professional education: in the Perm Krai since May 2013 is accepted a Regulation on professional education cluster [12]. Currently, in the Perm Krai, with the support of regional authorities and PCC created an agro-educational cluster, the work is ongoing to form a professional education cluster in the engineering industry. The authors also see the prospect of creating a regional construction and petrochemical professional education clusters. Generalization of the research results of quantitative methods to identify educational clusters is shown in Table 6, which is based on the criteria presented in Table 2.

Table 6. Summary results of a quantitative identification of clusters in terms of employment in the Perm Krai for the period 2007-2012

Types of economic activity	Methods for the identification of clusters		
	Localization coefficient (*LQ*)	Regional factor (*RS*)	The ratio of *RS* and *IM*
Pre-school education (prior to the primary education)	+	-	-
Primary, basic and secondary (complete) general education	+	-	-
Additional education for children	+	-	-
Primary and secondary professional education	+	-	-
A higher professional education	-	+	+
Education for adults and other kinds of education	+	-	-

Note: + cluster symptoms are present; - The absence of the cluster features.

It should be noted that none of the subtypes of 'Education' activity meets all three criteria simultaneously. However, given the fact that the educational clusters of Perm Krai is in its infancy and the regional authorities are interested in their development, a number of key components of the cluster include activities that meet the requirements of at least one of the criteria. Thus, the generalization of the findings based on the application of quantitative methods in combination, suggests the formation of four educational clusters in the Perm Krai: 1) a cluster of pre-school education; 2) a cluster of schools; 3) a cluster of additional education of children; 4) a cluster of professional education and training.

To determine the cluster potential of the regional economy and to identify the nature and closeness of interaction between participants in the cluster, we performed a survey of experts, which was attended by over 30 experts. Figure 2 shows the distribution of experts by occupational activities.
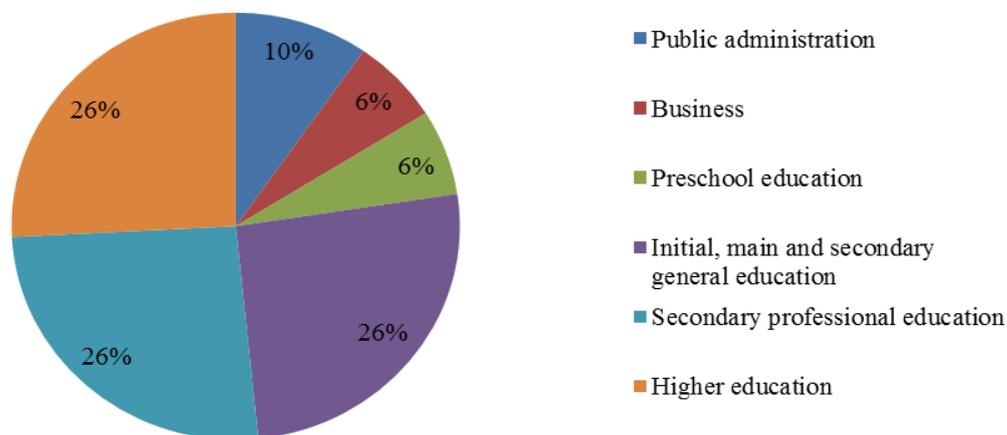

Figure 2. Distribution of experts by occupational sector

The experts were asked to assess the key factors in the development of education in the Perm Krai on a scale of 0 to 4, where 0 - insignificant factor, and 4 - a highly significant factor. The results of expert evaluations are presented in Figure 3.
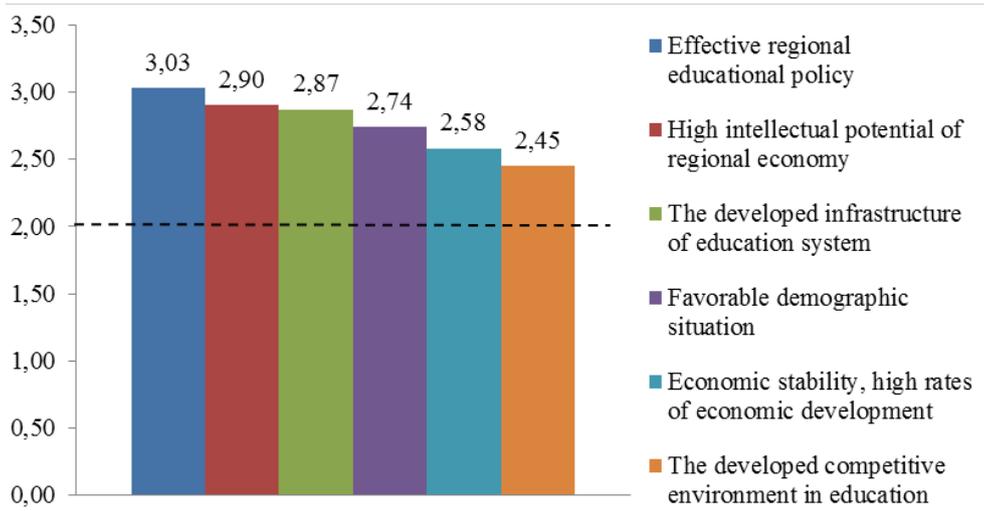
Figure 3. Key factors in the development of education in the Perm region

As seen in Figure 3, all factors are important above average. However, the factor of the 'development of a competitive environment in the field of education' has the lowest weight, according to experts.

Figure 4 shows the expert evaluation of the level of development of the main areas of education in Perm Krai. According to the survey, the highest averages have school and higher professional education.
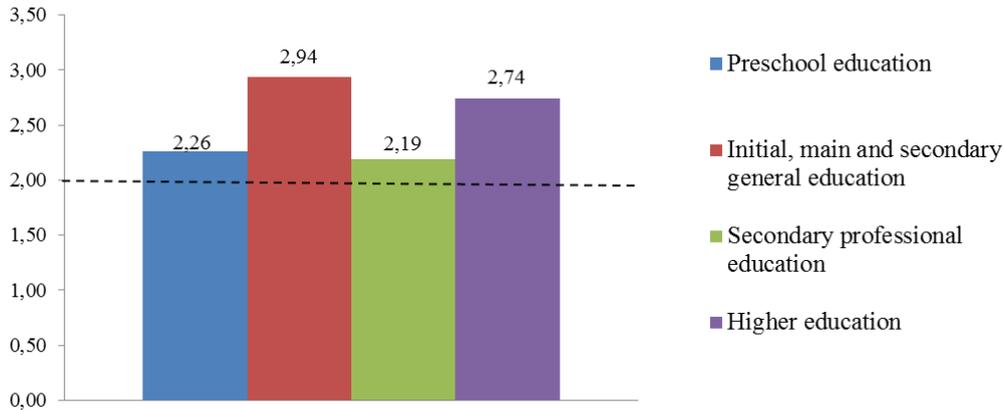

Figure 4. Expert assessment of the level of development of education of Perm Krai

The following two questions were directed to the study of competition in the field of education in the region as one of the key factors in the development of cluster structures.

First, the experts were asked to assess the intensity of competition in the field of education (a score of 0 was put in case of no competition, while a score of 4 indicates intense competition). Then, the experts were asked to rate the factors that make up the competitiveness of educational services (0 - lack of contribution to competitiveness, 4 - high contribution to competitiveness). Processed results of expert opinion demonstrated in Figure 5 and Figure 6.
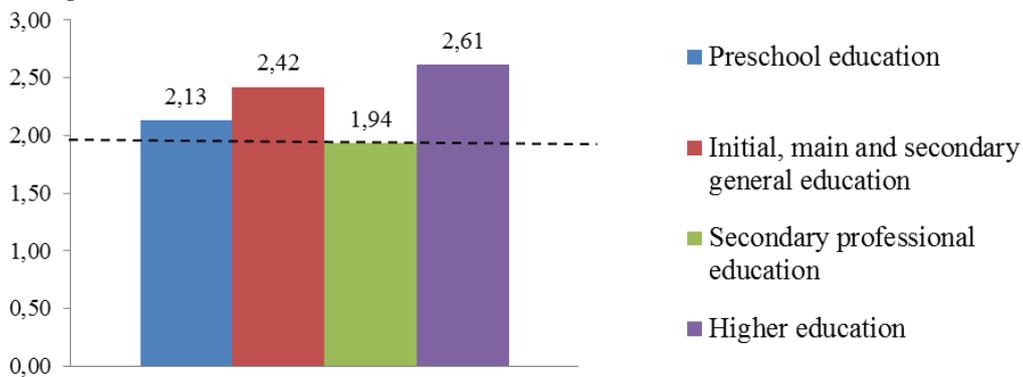

Figure 5. The intensity of competition in the field of education in the Perm region: expert evaluation

As can be seen from Figure 5, the highest intensity of competition develops in the field of higher education (the deviation from the mean value of 30.5%). The lowest intensity of competition, according to experts, has developed in the field of professional education (deviation from the average - 3%).
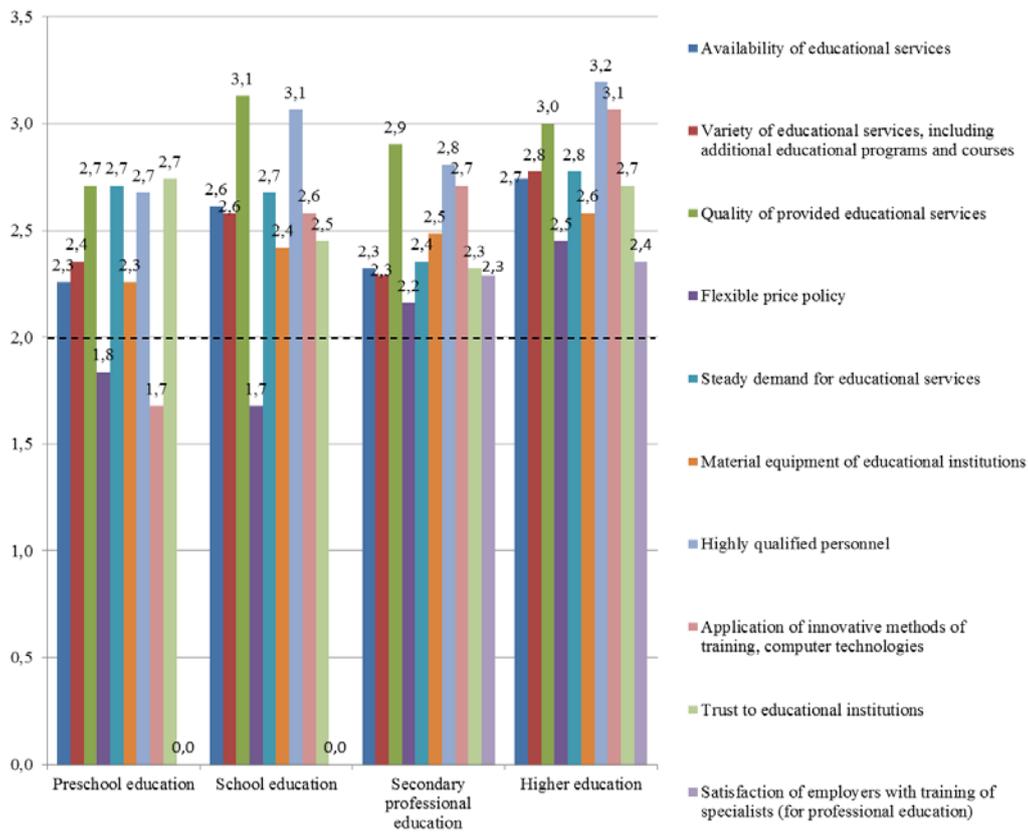
Figure 6. Factors that make up the competitiveness of the educational services of the Perm Krai: expert evaluation

Figure 6 illustrates the experts' opinion that the competitiveness of the educational services of all four levels of education have the greatest impact by two factors: the quality of services and highly qualified personnel (these factors have the highest average value).

Evaluation of the relevance and completeness of cooperation between educational institutions, the horizontal and vertical forms of cooperation between the subjects of clusters are shown in Figure 7. Evaluation scale remains the same: 0 - lack of relevance and cooperation, 4 - very high level of importance and cooperation.

Figure 7 shows that the assessment of the importance of all levels of interaction is significantly higher than the estimate of completeness, highlighting the need for the development and implementation of cluster policy in the region, aimed at the development of forms and mechanisms of cooperation, without which the successful functioning of educational clusters is impossible.
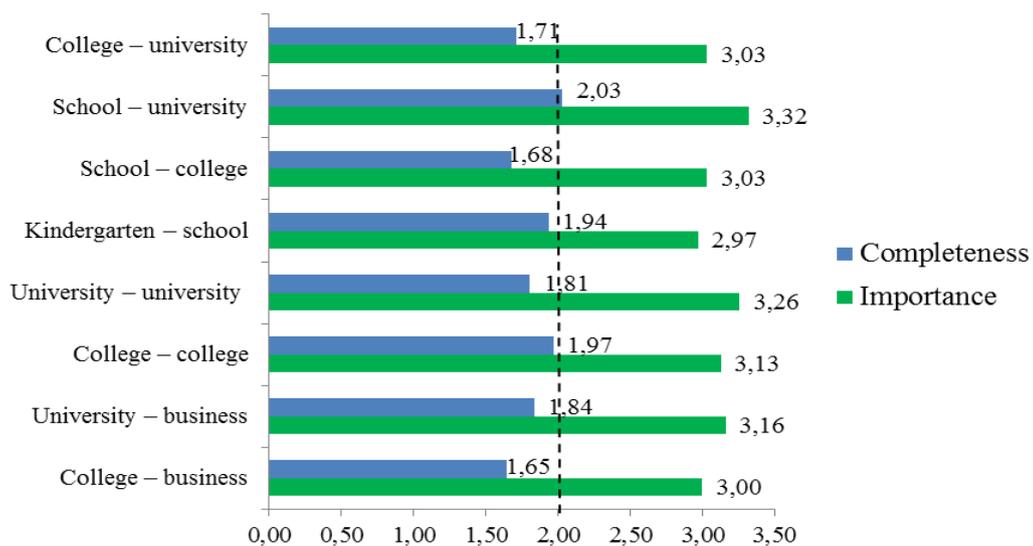

Figure 7. Expert assessment of the level of interaction and cooperation between educational institutions with each other and the business

Further analyzed the forms of cooperation among the potential participants of educational clusters. Figure 8 shows the expert evaluation of the relevance and completeness of cooperation in the context of its basic forms between professional educational institutions of the same level.

Figure 8 shows that all forms of interactions between single-level educational institutions are weak. With the

high importance of such forms as co-financing educational projects and activities, joint lobbying in government, the organization of joint training courses for teachers, they are currently the least developed.

Figure 9 shows the expert evaluation of the relevance and completeness of cooperation in the context of the main forms of cooperation between educational institutions of different levels, present in Perm Krai.

The Figure 9 suggests that, according to experts, regarding the cluster development a considerable attention should be given to joint research projects, especially between 'school-college' and 'university-colleges', and professional development of teachers and teachers of educational institutions. Based on the results of qualitative research in the future it is advisable to determine the strategic imperatives of regional policy on the formation of educational clusters in the Perm Krai.
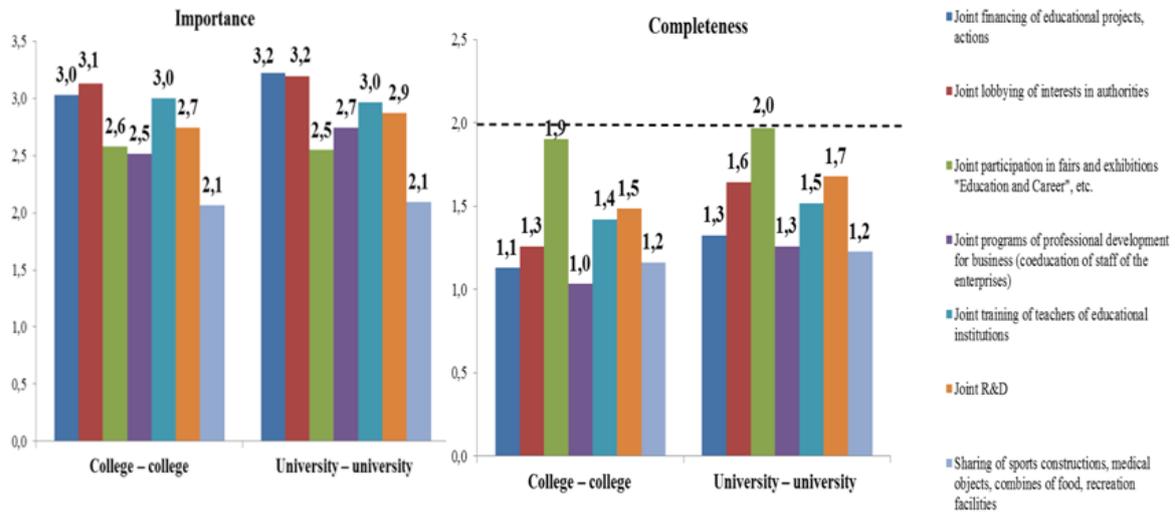

Figure 8. Level of development of horizontal linkages between educational institutions of Perm Krai: expert evaluation
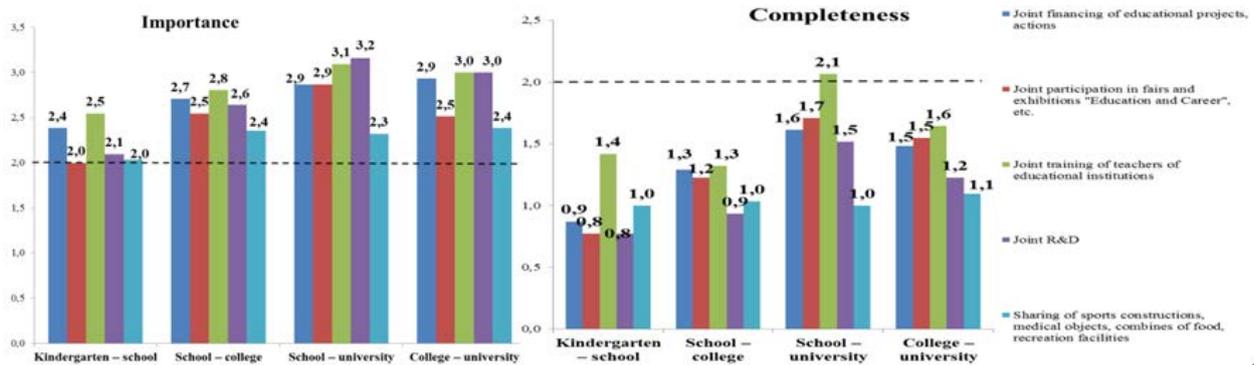

Figure 9. Level of development of vertical linkages between educational institutions of Perm Krai: expert evaluation

5. Conclusion

The application of quantitative methods of identification revealed four potential educational clusters in the economy of Perm Krai: educational cluster of pre-school education, educational cluster of schools, educational cluster of supplementary education for children and educational cluster of professional education and training.

Using the method of expert estimations (i.e. the Delphi method), has allowed to establish forms of interaction between the participants of educational clusters, as well as identify areas of cooperation between them. Assessment of the importance of all levels of interaction between educational institutions, according to experts, is significantly higher than the fullness of interaction. It is worth noting a rather high general level of development of the educational system in the Perm Krai.

Synthesis of the results of quantitative and qualitative methods of detection and diagnosis of educational clusters suggests the need for a comprehensive policy for cluster

development in Perm Krai. Today, the regional authorities of the Perm Krai have initiated a project to create a cluster of agro-educational and professional education cluster in the engineering industry, which indicates the importance of the cluster structures in the development of the educational system in the region. Given the industrial structure of the economy of the Perm Krai, the positive effect can bring the formation of the construction and petrochemical educational clusters.

Establishment and operation of educational clusters enhances the competitiveness of the educational system in the region by strengthening the integration between education, research, innovation organizations, enterprises, institutions of public education governance, financial, consulting, and other structures.

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