

**REGIONAL DIMENSION OF SCHOOL DROPOUT IN THE EUROPEAN UNION
- A CLUSTER ANALYSIS**

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Abstract

Dropouts are not only a weakness and a threat level of any human community. Due to the importance of reducing or even eliminating it, the main objectives of the European Commission's education policies include prevention of early school leaving. A comparative analysis of school drop-out in European Union countries highlights the fact that it is not uniform but shows wide variations from country to country and even from region to region. The aim of the paper is to identify different macro-regions developed within the EU28 according to the level and dynamics of school abandonment in the year 2016. The research method used was the cluster analysis with the help of which seven clusters were identified in terms of dropout .

Keywords: *education, school dropout, cluster analysis, development regions.*

Classification JEL: *C18, I24, I25*

1. Introduction and methodology

At European Union level, there is a common framework for cooperation in education and training known as ET 2020 which was adopted by the Council in May 2009, but the organization and content of education and training systems is the responsibility of each member country. One of the objectives set out in ET 2020 is to reduce the dropout rate and the maximum level should be no more than 10%.

The comparative analysis of the EU27 regions in terms of school drop-out is of particular importance for narrowing the gap between regions and the harmonious development of a solid education and training system within the European Union.

Taking into account the dimensions of the data series on most of the development regions of the European Union, for grouping them according to school abandon rates, a cluster analysis was chosen and the effectiveness and relevance of the results of its use is highlighted in various papers [1].

The paper includes 89 macro-regions within the EU28. The main source of data was the Eurostat database [2-5].

Since the main objective of the research, identify different between regions in the EU-28 included in the analysis, according to the dropout of their generation clusters have used the method Hierarchical cluster from a matrix organization type $Y = \left\| y_{ij} \right\|_{i=1, n, j=1, m}$ where n represents the number of development regions under analysis (n = 89 regions), and m is the number of indicators considered (m = 3, drop out rate for Males, Females and Total). On the matrix X elements, the transformation was applied [9]:

$$z_{ij} = \frac{y_{ij} - \bar{y}_j}{\sigma_j}, \quad \text{where} \quad \bar{y}_j = \frac{\sum_{i=1}^n y_{ij}}{n}, \quad \sigma_j = \sqrt{\frac{\sum_{i=1}^n (y_{ij} - \bar{y}_j)^2}{n-1}} \quad (1)$$

Using (1) and Euclidian distance [8] was obtained Proximity Matrix:

$$W = \|w_{ij}\|_{i=1, n, j=1, m}, \quad w_{ij} = \sqrt{\sum_{k=1}^n (z_{ik} - z_{jk})^2}, \quad j = \overline{1, m}, \quad k = \overline{1, m} \quad j \neq i, \quad k \neq i, \quad w_{ii} = 0 \quad (2)$$

Cluster generation was performed from the Proximity Matrix using the "between-group average linkage" method, where the distance between two elements (clusters) A and B is:

$$D(A, B) = \frac{1}{N_A \cdot N_B} \cdot \sum_{x \in A} \sum_{y \in B} d(x, y) \quad (3)$$

To test the significance of belonging to the three cluster variables, we started from the results of Levene's Test, whose null hypothesis is:

$$H_{0_1} : \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = K = \sigma_r^2 \quad (4)$$

The condition of accepting the null hypothesis H_{0_1} is:

$$Sig.F > \alpha \quad \text{equivalent to} \quad F_{stat} < F_{\alpha, df_1, df_2} \quad (5)$$

In case of accepting the null hypothesis for testing the statistical significance of the cluster average, was used the ANOVA methodology with the null hypothesis H_{0_2} :

$$H_{0_2} : m_1 = m_2 = m_3 = K = m_r \quad (6)$$

In the case of rejection of the null hypothesis (H_{0_1}), the Welch and Brown-Forsythe tests were used. For data processing SPSS [6,7] and Excel have been used

2. School dropout, a real problem

At the level of the Member States of the European Union, disparities in school drop-out are significant. Thus, in the year 2016 (Table no. 1) the dropout rate within the EU-28 was between the minimum values included in the range 0% - 4.9% (Croatia, Lithuania, Slovenia) and high and very high values between 15% and 19.9% (Romania, Spain, Malta).

In terms of the total population aged 18-24, the top seven (most unfavorable) are Malta (19.6%), Spain (19.0%), Romania (18.5%), Portugal (14.0%), Italy (13.8%), Bulgaria (13.8%) and Hungary (12.4). In contrast, the lowest rates of school dropout were in Croatia (2.8%), Lithuania (4.8%), Slovenia (4.9%), Poland (5.2%) and Luxembourg (5.5%).

However, this hierarchy is only partially maintained if the school dropout rate is analyzed. For male population, the dropout rate for the 18-24 year old population in 2016 ranged between 3.5% in Croatia and 23.1% (6.6 times) in Malta. In the first place, with high school dropout rates, alongside Malta, were Spain (22.7%), Romania (18.4%), Portugal (17.4%), Italy (16.1%), Estonia (14.3%) and Bulgaria (13.7%). The lowest values, besides Croatia, were recorded in Lithuania (6.0%), Poland (6.4%), Czech Republic (6.6%) Slovenia (6.7%) and Luxembourg (6.8%).

As regards the 18-24-year-old female population, the dropout rate in 2016 ranged between 2.0% in Croatia and 18.7% (9.35 times) in Romania. The highest drop-out rates for female population, along with Romania, were registered in Malta (15.8%) and Spain (15.1%), while the lowest values, except Croatia, were registered in Slovenia (3.1%), Lithuania (3.6%), Poland (3.9%), Luxembourg (4.2%), Cyprus (4.3%) and Ireland (4.6%).

Table no. 1 The classification of European Union member states by the school dropout recorded in 2016 for the total population aged 18 to 24

Percentage	Countries
0% – 4.9%	Croatia, Lithuania, Slovenia
5% – 9.9%	Poland, Luxemburg, Greece, Ireland, Czech Republic, Austria, Denmark, Slovakia, Sweden, Cyprus, Finland, Netherlands, France, Belgium
10% – 14.9%	Latvia, Germany, Estonia, United Kingdom, Hungary, Bulgaria, Italy, Portugal
15% – 19.9%	Romania, Spain, Malta

Space, a picture of the extent of dropout is shown in Figure no. 1. It is noticed that most of the European Union countries have a dropout rate of between 5% and 14.9% (26 states). In addition, it is highlighted a group of states of significant positive performances (Croatia, Lithuanian and Slovenia with school dropout rates below 5%) and a group of losers (Romania, Spain and Malta) with school dropout rates for the population aged 18-24 old, over 15%.

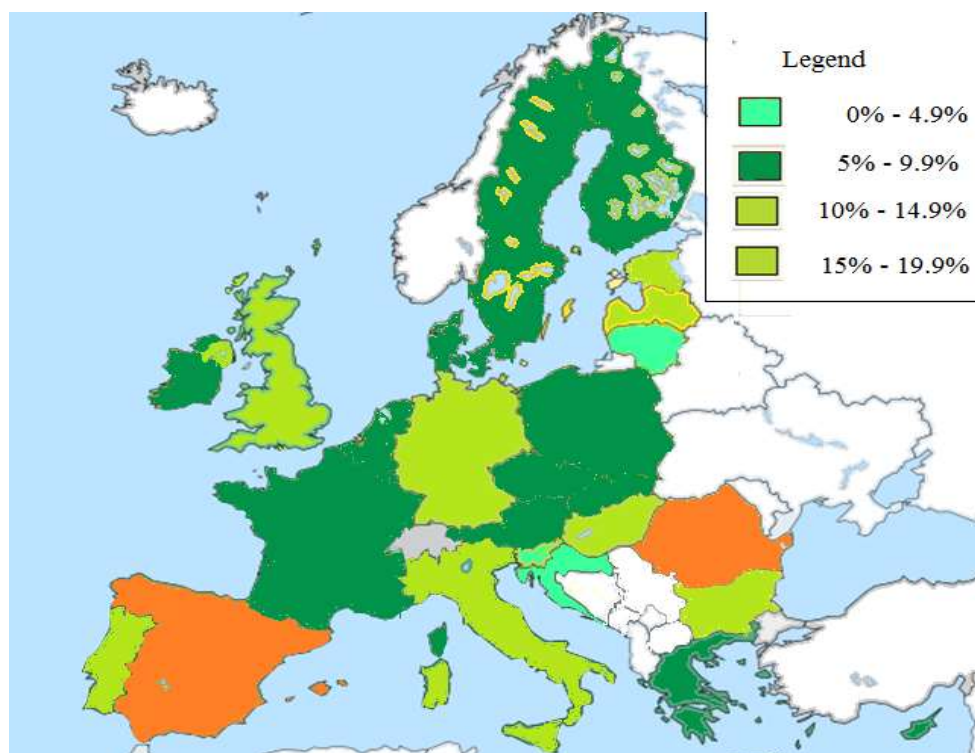


Figure no. 1 European Union countries by the level of school dropout registered in 2016, among the total population aged 18-24. Source: own elaboration based on http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=edat_lfse_16&lang=en.

The ranking of the Member States of the European Union according to the gender school dropout rate for 18 - 24 year olds (Figure no. 2) shows that the male population is more likely to

leave school. Exceptions are countries like Romania and Bulgaria where the school dropout rate among women is higher than among men.

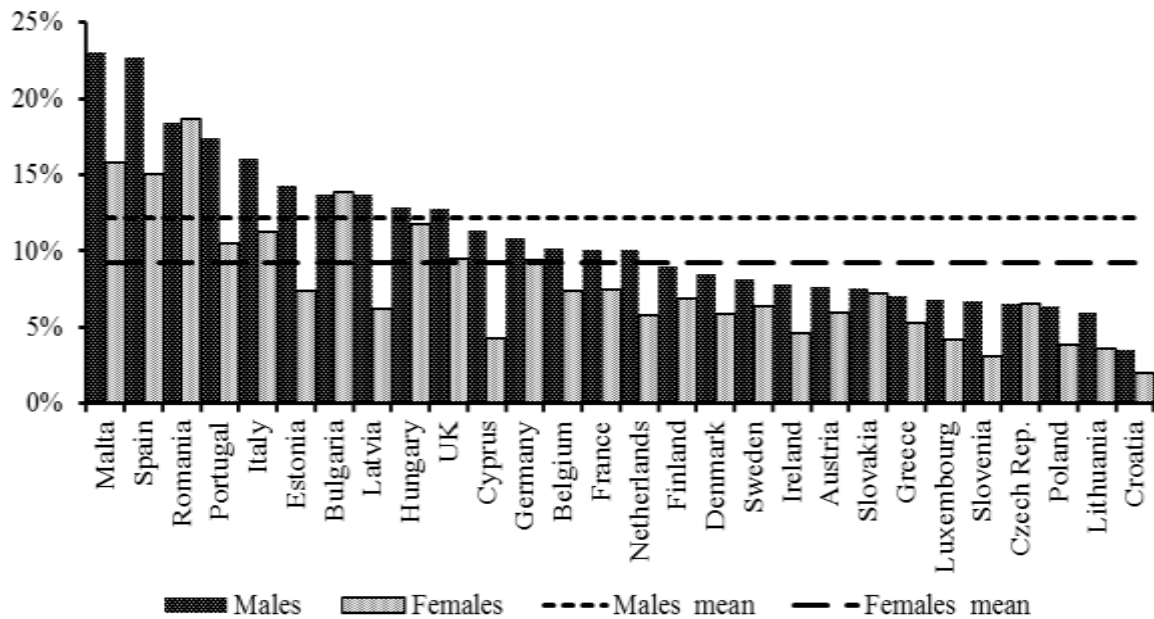


Figure no. 2 School dropout levels for male and female populations aged 18 to 24 years old from European Union countries in 2016.

As can be seen from Figure 2, the average school dropout rate at EU28 is 9.2% among the female population (minimum 2.0% in Croatia and maximum 18.7% in Romania) and 12.2% among the population male (minimum of 3.5% in Croatia and maximum 23.1% in Malta).

Disparities in school dropout rates exist not only within the European Union, at the level of member countries, but also within each country, depending on the region. To highlight this fact, the 89 development regions included in the analysis were grouped using the Hierarchical cluster methodology in 7 groups (Figure no. 3). As the dendrogram shows, the number of development regions included in clusters differs greatly. The highest number of states is included in cluster 2 (33 states) followed by cluster 3 (24 states), and the smallest number is recorded in clusters 4 and 7 (3 states).

The results of the Levene test (Test of Homogeneity of Variance), presented in Table no 2, show that all values of $\text{Sig.} > \alpha = 0$, leading to the acceptance of the null hypothesis $H_{0,2}$. As a consequence, the ANOVA methodology can be applied.

Table no 2. Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Total	0,849	6	82	0,536
Males	1,891	6	82	0,092
Females	2,010	6	82	0,074

Testing the statistical significance of the belonging of the three cluster variables, obtained in this case (Table 3), leads to the rejection of the null hypothesis $H_{0,2}$, and consequently the mean values at the cluster level are statistically significant.

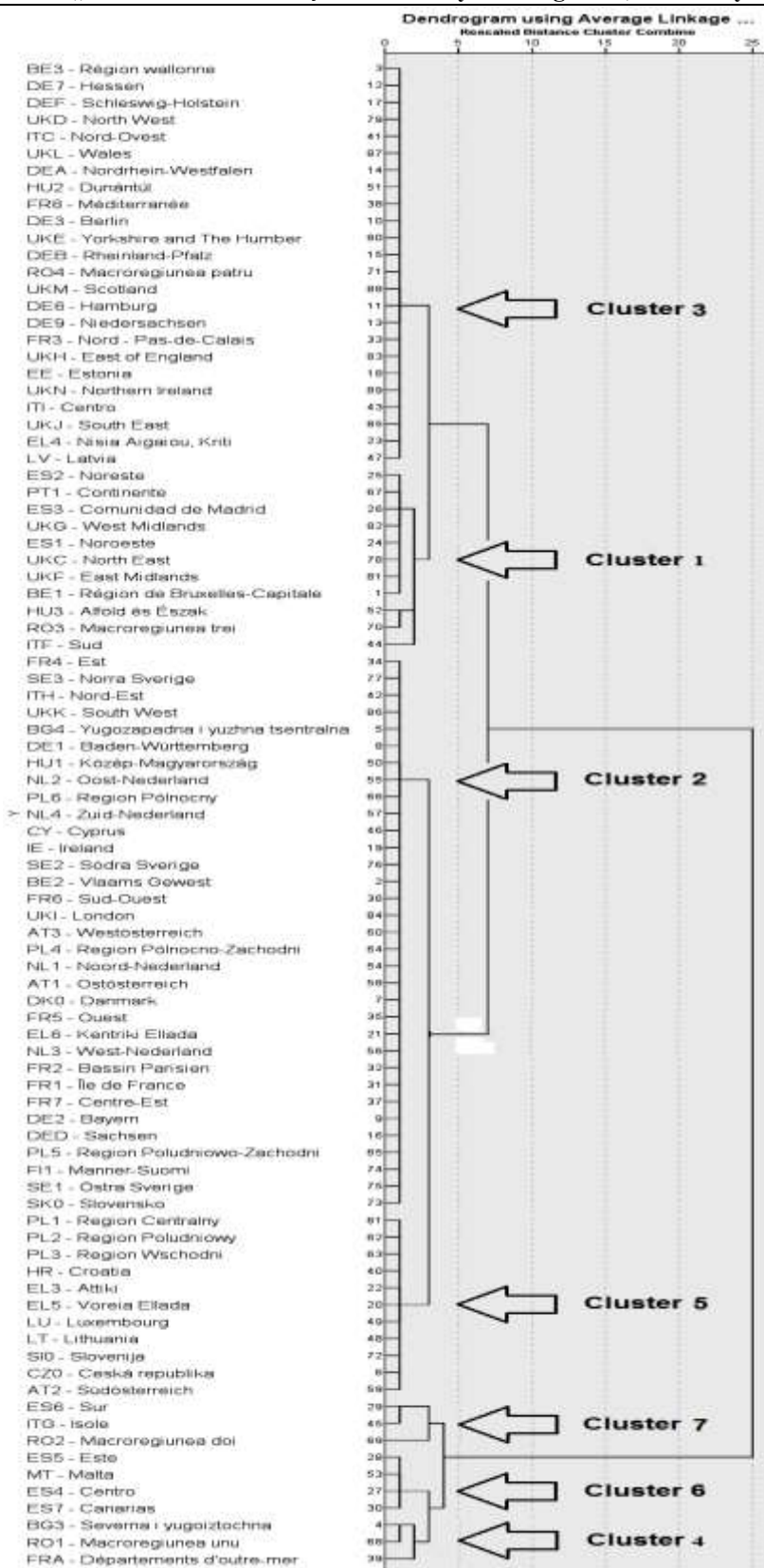


Figure no.3 The dendrogram of the grouping of the development regions within the European Union included in the analysis, at the level of 2016, in terms of the school dropout rate of both the total population aged 18-24 years and by gender.

Table no. 3 The results of testing the statistical significance of the belonging of variables to the clusters using ANOVA methodology

		Sum of Squares	df	Mean Square	F	Sig.
Total	Between Groups	1892,015	6	315,336	352,842	0,000
	Within Groups	73,284	82	0,894		
	Total	1965,299	88			
Males	Between Groups	2344,652	6	390,775	274,901	0,000
	Within Groups	116,564	82	1,422		
	Total	2461,216	88			
Females	Between Groups	1526,153	6	254,359	100,242	0,000
	Within Groups	208,072	82	2,537		
	Total	1734,224	88			

The results obtained meet the conditions of the statistical significance tests. The clusters of development macroregions included in the cluster analysis is presented in Table no 4.

Tabela no. 4 The structure of development macroregions of in the European Union states, structured according to the levels registered at school dropout among the total population aged 18-24 years and by gender.

Cluster 1	BE1 - Région de Bruxelles-Capitale, ES1 – Noroeste, ES2 – Noreste, ES3 - Comunidad de Madrid, ITF – Sud, HU3 - Alföld és Észak, PT1 – Continente, RO3 - Macroregiunea trei , UKC - North East, UKF - East Midlands, UKG - West Midlands
Cluster 2	BE2 - Vlaams Gewest, BG4 - Yugozapadna i yuzhna tsentralna, DK0 – Danmark, DE1 - Baden-Württemberg, DE2 – Bayern, DED – Sachsen, IE – Ireland, EL6 - Kentriki Ellada, FR1 - Île de France, FR2 - Bassin Parisien, FR4 – Est, FR5 – Ouest, FR6 - Sud-Ouest, FR7 - Centre-Est, ITH - Nord-Est, CY – Cyprus, HU1 - Közép-Magyarország, NL1 - Noord-Nederland, NL2 - Oost-Nederland, NL3 - West-Nederland, NL4 - Zuid-Nederland, AT1 – Ostösterreich, AT3 – Westösterreich, PL4 - Region Północno-Zachodni, PL5 - Region Południowo-Zachodni, PL6 - Region Północny, SK0 – Slovensko, FI1 - Manner-Suomi, SE1 - Östra Sverige, SE2 - Södra Sverige, SE3 - Norra Sverige, UKI – London, UKK - South West
Cluster 3	BE3 - Région wallonne, DE3 – Berlin, DE6 – Hamburg, DE7 – Hessen, DE9 – Niedersachsen, DEA - Nordrhein-Westfalen, DEB - Rheinland-Pfalz, DEF - Schleswig-Holstein, EE – Estonia, EL4 - Nisia Aigaiou-Kriti, FR3 - Nord - Pas-de-Calais, FR8 – Méditerranée, ITC - Nord-Ovest, ITI – Centro, LV – Latvia, HU2 – Dunántúl, RO4 - Macroregiunea patru , UKD - North West, UKE - Yorkshire and The Humber, UKH - East of England, UKJ - South East, UKL – Wales, UKM – Scotland, UKN - Northern Ireland
Cluster 4	BG3 - Severna i yugoiztochna, FRA - Départements d'outre-mer, RO1 - Macroregiunea unu
Cluster 5	CZ0 - Česká republika, EL5 - Voreia Ellada, EL3 – Attiki, HR – Croatia, LT – Lithuania, LU – Luxembourg, AT2 – Südösterreich, PL1 - Region Centralny, PL2 - Region Południowy, :PL3 - Region Wschodni, SI0 - Slovenija
Cluster 6	ES4 – Centro, :ES5 – Este, ES7 – Canarias, MT - Malta
Cluster 7	ES6 – Sur, ITG – Isole, RO2 - Macroregiunea doi

Levels of school drop-out amongst the total population aged 18-24, determined on clusters (Table 5), are between a minimum of 2.8% (Croatia - corresponding to cluster 5) and a maximum of 24.5% (RO2 - Macro-region 2 - corresponding to cluster 7). For the 18-24 year old male population, determined on clusters, are between a minimum of 3.5% (Croatia - corresponding to

cluster 5) and a maximum of 27.5% (ES6 - Sur - corresponding to cluster 7). For the 18-24-year-old female population, school dropout rates are between a minimum of 2.0% (Croatia - corresponding to cluster 5) and a maximum of 23.6% (RO2 - Macro-2 - cluster 7).

Table no. 5 Characteristics of development regions included in clusters in terms of school dropout rates for 18 - 24-year-olds in 2016

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum	
				Lower Bound	Upper Bound			
Total	1	11	14,4455	1,03862	13,7477	15,1432	12,90	16,60
	2	33	7,7818	,88968	7,4664	8,0973	6,30	9,80
	3	24	11,3333	,86460	10,9682	11,6984	10,00	13,10
	4	3	19,5667	1,19304	16,6030	22,5303	18,60	20,90
	5	11	4,6455	1,18014	3,8526	5,4383	2,80	6,60
	6	4	19,6000	,57155	18,6905	20,5095	18,90	20,30
	7	3	23,5000	1,05357	20,8828	26,1172	22,40	24,50
	Total	89	10,6337	4,72577	9,6382	11,6292	2,80	24,50
Males	1	11	16,4727	1,30391	15,5967	17,3487	14,30	19,10
	2	33	9,1333	1,05169	8,7604	9,5062	7,60	11,40
	3	24	12,5583	1,16243	12,0675	13,0492	10,10	14,30
	4	3	19,6667	2,53837	13,3610	25,9723	17,60	22,50
	5	11	5,4182	1,29755	4,5465	6,2899	3,50	7,10
	6	4	23,7750	,58523	22,8438	24,7062	23,10	24,50
	7	3	26,6000	1,08167	23,9130	29,2870	25,40	27,50
	Total	89	12,1067	5,28851	10,9927	13,2208	3,50	27,50
Females	1	11	12,3727	2,08235	10,9738	13,7717	9,30	15,90
	2	33	6,3970	1,26922	5,9469	6,8470	4,30	9,10
	3	24	10,0458	1,70523	9,3258	10,7659	6,20	13,50
	4	3	19,4667	,25166	18,8415	20,0918	19,20	19,70
	5	11	3,8545	1,40169	2,9129	4,7962	2,00	6,60
	6	4	15,2000	1,60208	12,6507	17,7493	13,10	16,90
	7	3	20,2333	3,06649	12,6158	27,8509	17,60	23,60
	Total	89	9,1079	4,43927	8,1727	10,0430	2,00	23,60

Cluster 1 comprises eleven development macroregions with an average school dropout rate among the total population aged 18-24 years of 14.4%, the male population by 16.5% and the female population by 12.4%.

Cluster 2 comprises thirty-three development macroregions, with an average school dropout rate amongst the total population aged 18-24 years of 7.8%, the male population by 9.1% and the female population by 6.4%.

Cluster 3 comprises twenty-four development macroregions, with an average school dropout rate among the total population aged 18-24 years of 11.3%, the male population by 12.6% and the female population by 10.0%.

Cluster 4 comprises three development macroregions, with an average school dropout rate among the 18-24 year old population by 19.6%, the male population by 19.7% and the female population by 19.5%.

Cluster 5 comprises eleven development macroregions, with an average school dropout rate among the total population aged 18-24 years of 4.6%, the male population by 5.4%, and the female population by 3.9%. Cluster 5 shows the lowest school dropout rate.

Cluster 6 comprises four development macroregions, with an average school dropout rate among the 18-24 year old population of 19.6%, the male population by 23.8%, and the female population by 15.2%.

Cluster 7 comprises three development macroregions with an average school dropout rate among the 18-24 year old population of 23.5%, the male population by 26.6%, and the female population by 20.2%.

It can be noticed that there are countries with large variations in the school dropout rate by development macroregions. For example, Greece divided by NUTS I in 4 macroregions (EL3-EL6) is found with EL5 - Voreia Ellada and EL3 - Attiki in cluster 5, with EL6 - Kentriki Ellada in cluster 2, and with EL4 - Nisia Aigaiou in cluster 3. Another example is Romania, which also has one of the highest rates of dropout, has four regions grouped in different clusters, as follows: RO1 - Macro-region 1 - cluster 4, RO2 - Macro-region 2 - cluster 7, RO3 - Macro-Region Three - Cluster 1, RO4 - Macro-Region Four - Cluster 3.

Conclusions

At European Union level, policies to develop education and training systems have been promoted and ongoing progress is monitored by each country in meeting the objectives set out in the EU 2020 Strategic Framework for Education and Training 2020. One of these objectives is to reduce the share of early leavers of education and training to less than 10%.

The school dropout is a complex phenomenon that is influenced by a multitude of factors in the social, economic, family and not only environments, which implies a considerable effort to counteract it.

The average of the 28 EU countries shows a 10.7% school dropout rate in 2016, but there are large fluctuations between countries and even between development macroregions. Thus, 7 clusters have been identified that show levels of school abandonment among the total population aged 18-24 years between a minimum of 2.8% (Croatia - corresponding to cluster 5) and a maximum of 24.5% (RO2 - Macroregion two - corresponding to cluster 7).

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