THE USV ANNALS OF ECONOMICS AND PUBLIC ADMINISTRATION | VOLUME 23, ISSUE 1(37), 2023

POPULATION INVOLVEMENT IN EDUCATION. ROMANIA'S POSITION IN EUROPEAN CONTEXT - DISPARITIES AND SIMILARITIES

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Received 28 February 2023; Accepted 25 May 2023

Abstract:
It is almost universally recognized that sustainable development is fundamental to the future of humanity. Its implementation does not depend only on the economic possibilities and availabilities, on the level of material development of each state and, above all, on the human factor, on the degree of knowledge, understanding and practical application of this desired, from the individual, community level local, regional and national. This is largely determined by the level of education of individuals and the population as a whole. From this point of view in the European Union there are gaps in some significant cases. In this context, our paper analyzes the disparities and similarities between the EU states, as well as the identification of Romania's place through the lens of the population's involvement in education.

Key words: education, school dropout, teachers, cluster analysis

JEL classification:I21, C10

INTRODUCTION

The level of education of the population is a fundamental factor in ensuring sustainable development, economic growth being closely linked to the regional and national level of education (Szeles et.al. 2019). This is basically an axiom that has imposed itself on educational management during the European integration process, a process that is still in full swing.

In developing the level of education of the young generation, it is necessary to start education from the earliest ages, by including them in different forms of education (Rabigan and Manea, 2019) in accordance with the specifics of the local communities in which they live (Silva and al., 2020).

On the other hand, the disparities between the different social environments, between urban and rural, constitute gaps that are difficult to cross both in Romania and in the other EU states (Drăgoi, 2019). Of these, special attention should be paid to disadvantaged communities, with very low living standards, for which the studies carried out (Yuvaraj & Arabi, 2021) conclude the need to establish specific and at the same time priority objectives.

In this context, education must be oriented towards identifying and understanding the type of education necessary for sustainable human development (Bunda, Baciu & Ciote, 2010). On the other hand, the significant differences must be taken into account, both between the development regions within a state (Hapenciuc & Neamțu, 2016), and between the member states of the European Union in order to reduce and eliminate the disparities between them (Angelov, 2019)

Taking into account these aspects, the main objective of the research was to highlight the similarities and disparities between the member states of the European Union regarding the involvement of the population in education and the identification of Romania's place in this context,

based on the series of official data available in the Eurostat database (Eurostat, 2022) of the European Commission.

DATA SERIES AND RESARCH METHOLOGY

Taking into account the main objective of the research carried out, in the integrated analysis of the share of the EU27 population involved in education, corroborated with the level of gross domestic product per inhabitant, five series of data were used. The meanings, identifiers and sources of the data series are shown in Table 1.

Among the 27 member states of the European Union, in the analysis of the disparities and similarities between them regarding the population involved in education in conjunction with the gross domestic product per inhabitant, 24 states were included. The other three Member States (Czech Republic, Estonia and Lithuania) could not be included in the analysis due to missing values corresponding to one or more of the five variables used as classification criteria.

Table no. 1. Variable identifiers, their meanings and data sources used in the integrated analysis of population involvement in education in the EU

Variables	Significance	Sources
PPTE	Pupils and students by education level - as % of total age population	Ednrp, 2020
PPEAP	Classroom teachers working full-time and part-time in primary, lower-secondary and upper-secondary education - as % of total active population	Edper, 2022
P0CEP	Pupils from age 0 to the starting age of compulsory education at primary level - as % of the population of the corresponding age	Edert, 2022
PPATS	Early leavers from education and training	Edabs, 2022
PGDP	Gross domestic product (euro/locuitor) at current market prices by NUTS 2 regions	Eugdp, 2022

In a first stage of the research undertaken, the main characteristics of the parameters of the data series included in the analysis were determined and analyzed. Analyzing the values of their characteristic parameters (Table 2), a first conclusion that emerges is that the average value is only conclusive for the P0CEP, PPTE and PPEAP variables, for which the data series are relatively homogeneous, the other data series being heterogeneous ($V > 0.3$).These results show that, between the EU states included in the analysis, there are significant differences regarding the rates of school dropout (PPATS) and gross domestic product per inhabitant (GDP)..

Table no. 2. The main characteristics of the analyzed variables

	Medie	Mediana	St.Dev*	Kurtosis	Skewness	W	Min	Max	V
PPTE	20.89	20.15	3.00	-0.53	0.75	9.90	16.90	26.80	0.14
PPEAP	2.62	2.50	0.56	0.33	0.84	2.20	1.80	4.00	0.21
P0CEP	57.17	55.10	11.70	-1.34	0.09	36.00	40.20	76.20	0.20
PPATS	8.66	8.25	3.69	0.05	0.65	14.30	3.00	17.30	0.43
PGDP	30846	26250	20009	5.49	1.93	92100	8800	100900	0.65

Source: calculated by authors, based on Ednrp, Edper, Edert, Edabs and Eugdp data series

A second conclusion is that of the four variables only three have a normal distribution, the data series of the PGDP variable being leptokurtic, the value of the Kurtosis characteristic $E = 5{,}49 > |1{,}96|$.

Taking into account these results, as well as the fact that the amplitude of the range of variation (W), compared to the average, is quite large for the PPATS and PGDP variables, it follows that, in order to characterize the performances of the states included in the analysis, a structuring (grouping) of them according to the five criteria corresponding to the variables. In this sense, the methodology of hierarchical clusters was used (Rotaru, 2006). Euclidian distance was used to obtain the proximity matrix, and for generating clusters, Ward's method was used (Zaharia et.al, 2022):

$$\Delta(A,B) = \sum_{i\in A\cup B}\left\|x_i - m_{A\cup B}\right\|^2 - \sum_{i\in A}\left\|x_i - m_A\right\|^2 - \sum_{i\in B}\left\|x_i - m_{\mathbf{B}}\right\|^2 - \frac{n_{A\cap B}}{n_{A\cup B}}\left\|m_A - m_B\right\|^2 \quad (1)$$

In (1), A and B are two clusters, m_i is the centroid, n_i is the number of elements from cluster i. and x_i an item.

The statistical significance of the obtained results was performed with the Levene test, to check the homogeneity of the dispersions, and the Brown-Forsythe test to check the statistical significance of the mean values obtained at the cluster level.

Their null hypotheses are:

– for Levene's test:

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

– for Brown-Forsythe test:

$$H_{0\_2}: \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \ldots = \sigma_r^2 \quad (3)$$

The condition for accepting the null hypothesis is $Sig.F > \alpha$.

If the hypothesis H_{0_1} is accepted, the ANOVA methodology can be applied to test the statistical significance of the averages obtained at the cluster level (Gogonea and Zaharia, 2008), otherwise the Brown-Forsythe test is used.

SPSS (Popa, 2008) and Excel were used for data processing, and a significance threshold $\alpha = 0.05$ corresponding to a confidence level of 95% was used to test the statistical hypotheses.

RESULTS AND DISCUSSIONS

Taking into account the preliminary results presented above, following the tests and analyzes carried out, according to the five classification criteria, a structure (Figure 1) with five clusters (Table 3) was obtained, to which one exception is added: Luxembourg.

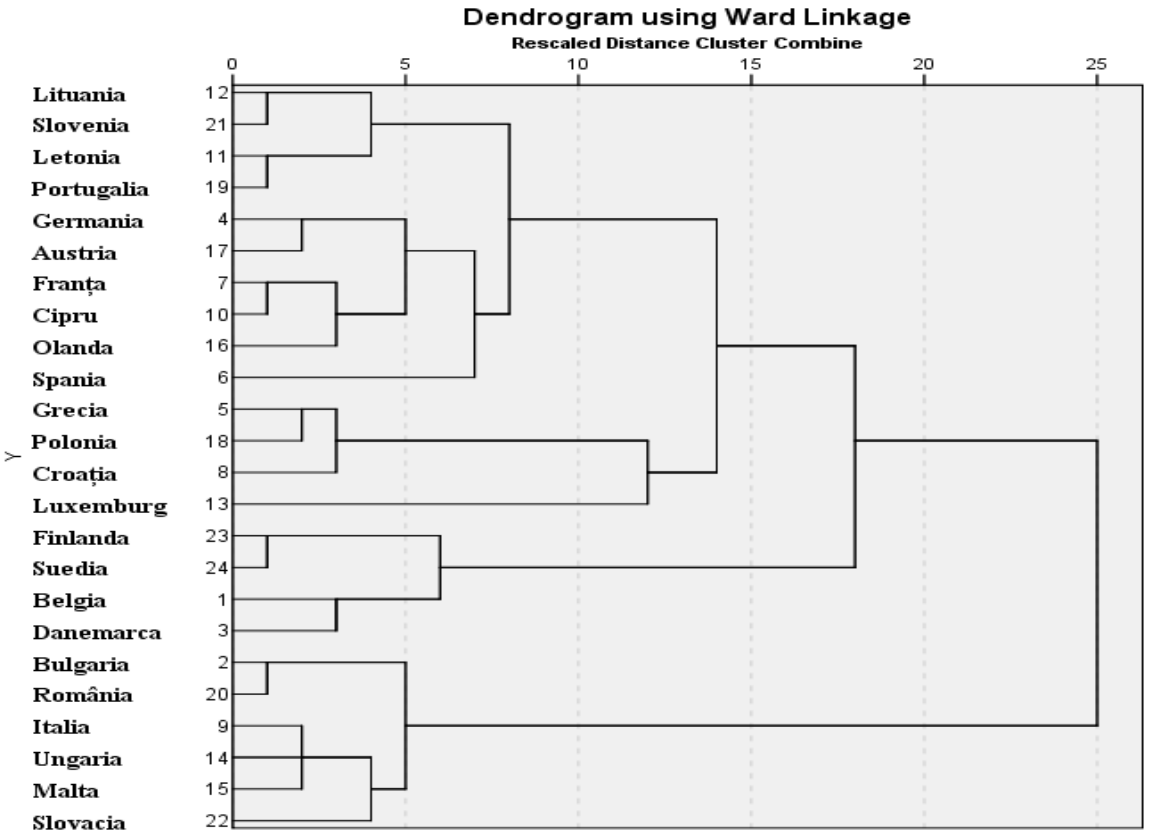

Figure no. 1. Cluster dendogram generation

Among the five clusters obtained, clusters A and E include four states each, clusters B and C include six states each, and cluster D consists of three states.

Table no. 3. Structuring the states analyzed by clusters according to the criteria used

Clusteri	Composition of clusters
A	Belgium, Denmark, Finland, Sweden
B	Bulgaria, Italy, Hungary, Malta, Romania, Slovakia
C	Germany, Austria, Spain, France, Cyprus, Netherlands
D	Greece, Croatia, Poland
E	Latvia, Lithuania, Portugal, Slovenia

Source: calculated by authors using SPSS

In order to establish the method of testing the statistical significance of the average values recorded at the cluster level, the Levene test was used. The results obtained (Table 4) highlight the fact that for the PPEAP and PGDP variables is $Sig.F < \alpha = 0.05$, which leads to the rejection of the null hypothesis H_{0_1} and, consequently, for testing the statistical significance of the cluster means, the ANOVA methodology cannot be applied.

Table no. 4. Testing homogeneity of variances of data series

Variables	Levene Statistic	df1	df2	Sig.
P0CEP	2.179	4	18	0.113
PPTE	2.332	4	18	0.095
PPATS	1.094	4	18	0.389
PPEAP	5.133	4	18	0.006
PGDP	3.074	4	18	0.043

Source: calculated by authors using SPSS

Since the H0_1 hypothesis was rejected, the Brown-Forsythe test was used to test the statistical significance of the mean values recorded at the cluster level.

Table no. 5. Results of the Brown-Forsythe test of statistical significance of the mean values obtained at the cluster level

Variables	Statistic[a]	df1	df2	Sig.
P0CEP	16.855	4	8.832	0.000
PPTE	26.392	4	9.069	0.000
PPATS	7.132	4	13.451	0.003
PPEAP	5.463	4	6.627	0.028
PGDP	20.999	4	14.571	0.000

[a] Asymptotically F distributed.

Source: calculated by authors using SPSS

Considering that all the values $Sig.F < \alpha = 0.05$ (Table 5) show that, the null hypothesis H0_2 is rejected and consequently the classification of the EU states included in the analysis, based on the five classification criteria, is conclusive (valid).

The attributes of the clusters (Table 6) highlight a series of similarities and disparities between the states analyzed from the point of view of population participation in education, correlated with PGDP values.

Cluster A, including Belgium, Denmark, Finland and Sweden, is the best performer in terms of the chosen criteria, characterized by the highest average values for the indicators Pupils from age 0 to the starting age of compulsory education at primary level - as % of the population of the

corresponding age (P0CEP=73.84%), Pupils and students by education level - as % of total age population (PPTE=26.13%) and Gross domestic product (PGDP=46200 euro/inhabitant). There are also significant values of the indicator Classroom teachers working full-time and part-time in primary, lower-secondary and upper-secondary education - as % of total active population (PPEAP=3.08%), with only 0.22 percentage points less than cluster D, which is the leader from this point of view.

Within the cluster, each country holds a dominant position or is at the best level, in relation to the values of the indicators used. Compared to the other component states of cluster A, Denmark is at the top of the ranking with 76.2% in P0CEP, with 9.9% in PPATS and with 53400 euros/inhabitant in PGDP and holds the last place in PPTE with 25.4%. Sweden and Belgium have the highest percentages of 26.8%, respectively 4% for PPTE, respectively PPEAP, while with 6.5% for PPATS, respectively with 41,600 euros/inhabitant for PGDP, these countries are at the bottom of the ranking. Finland is the only country of this cluster that registers the lowest percentages of 67.9% and 2.4% in P0CEP and PPEAP.

Table no. 6. The main characteristics of the clusters in terms of the classification criteria used

	Variabila	Medie	St.Dev	Min	Max
A	P0CEP	73.08	3.70	67.90	76.20
	PPTE	26.13	0.68	25.40	26.80
	PPATS	8.03	1.47	6.50	9.90
	PPEAP	3.08	0.73	2.40	4.00
	PGDP	46200	5192	41600	53400
B	P0CEP	45.48	4.55	40.60	51.40
	PPTE	17.85	0.73	16.90	18.70
	PPATS	12.78	2.47	8.30	15.30
	PPEAP	2.23	0.39	1.80	2.80
	PGDP	18400	8695	8800	30100
C	P0CEP	58.00	8.58	45.90	69.80
	PPTE	21.58	1.97	19.50	24.40
	PPATS	10.05	3.70	7.50	17.30
	PPEAP	2.32	0.26	1.90	2.70
	PGDP	37000	9100	26100	46900
D	P0CEP	49.20	7.98	40.20	55.40
	PPTE	20.33	1.65	18.70	22.00
	PPATS	4.10	1.10	3.00	5.20
	PPEAP	3.30	0.30	3.00	3.60
	PGDP	14900	1908	13700	17100
E	P0CEP	66.38	2.07	64.20	68.80
	PPTE	20.20	0.73	19.30	21.00
	PPATS	6.98	3.19	4.00	10.60
	PPEAP	2.48	0.05	2.40	2.50
	PGDP	19375	3244	16000	23200

Luxemburg		
P0CEP	PPTE	PPATS
45.8	18.5	7.2
PPEAP	PGDP	
3.4	100900	

Source: calculated by authors using SPSS

At the opposite pole of cluster A is cluster B, which includes the countries Bulgaria, Italy, Hungary, Malta, Romania, Slovakia and which is characterized by the lowest average values for most indicators: Pupils from age 0 to the starting age of compulsory education at primary level - as % of the population of the corresponding age (P0CEP=45.48%), Pupils and students by education level - as % of total age population (PPTE=17.85%), Classroom teachers working full-time and part-time in primary, lower-secondary and upper-secondary education - as % of total active population (PPEAP=2.23%).

Inside the cluster, the first place is occupied by Italy with 51.4% (P0CEP), 2.8% (PPEAP) and 30100 euros/inhabitant (PGDB), Hungary with 1% (PPTE). At the bottom of the ranking of cluster B is Bulgaria with 17% for PPTE, 1.8% for PPEAP and 8800 euros/inhabitant for PGDB, respectively Slovakia with 40.6% for P0CEP indicators. Unfortunately, Romania records the most unfavorable and shameful value of 15.3% at Early leavers from education and training.

In the ranking of the 5 clusters, Cluster C (Germany, Austria, Spain, France, Cyprus, Netherlands) takes the second place by the average values determined for Pupils and students by education level - as % of total age population (PPTE=21.58%), Early leavers from education and training labor (PPATS=10.05%) and Gross domestic product (PGDP=37000 euros/inhabitant). If Pupils from age 0 to the starting age of compulsory education at primary level - as % of the

population of the corresponding age, the 58%, places the cluster in 3rd place compared to the other four, by 2.32% of the indicator Classroom teachers working full- time and part-time in primary, lower-secondary and upper-secondary education - as % of total active population is on the penultimate hierarchical step.

Among the member states of cluster C, France is the only country that does not have an extreme position on any indicator. The lowest values are recorded by Austria at PPTE with 19.5%, by Germany at PPEAP with 1.9% and by Cyprus with 26100 euros/inhabitant at PPTE. The minimums of the other two indicators, P0CEP with 45.9% and PPATS with 17.3% are recorded by the Netherlands. Although for the two indicators it is on the last hierarchical step, for the other two it is sovereign with 24.4% at PPTE and with 46,900 euros/inhabitant at PGDP.

In terms of the classification criteria used, cluster D (Greece, Croatia, Poland) is in third place for Pupils and students by education level - as % of total age population (PPTE=20.33%) and fourth place for Pupils from age 0 to the starting age of compulsory education at primary level - as % of the population of the corresponding age (P0CEP=49.26%). Within the cluster, the three states have different positions from one indicator to another. Thus, if at PPTE and PGDB the minimum belongs to Croatia and the maximum to Greece, at P0CEP the order is reversed.

The fifth cluster, cluster E (Latvia, Lithuania, Portugal and Slovenia), compared to the other clusters, ranks second in Pupils from age 0 to the starting age of compulsory education at primary level - as % of the population of the corresponding age (P0CEP=66.38%), third place in Classroom teachers working full-time and part-time in primary, lower-secondary and upper-secondary education - as % of total active population (PPEAP=2.48%) and in Gross domestic product (PGDB=19375 euro/inhabitant) and fourth place for Pupils and students by education level - as % of total age population and for Early leavers from education and training .

The ranking of the countries within cluster E shows that Lithuania registers the best value for PPATS (4%). In the case of the others, Slovenia records maximums for P0CEP (68.8%), PGDB (23200) and a minimum for PPEAP (2.4%), Latvia with 21% for PPTE is in first place and Portugal is fourth for PPTE with 19.3% , but it registers a very high value at PPATS (10.6%)

Luxembourg represents the country that does not belong to any of the clusters, registering 3.4% for PPEAP, 7.2% for PPATS, 18.5% for PPTE, 45.8% for P0CEP and 100,900 euros/inhabitant for PGDP.

CONCLUSIONS

The analysis of the disparities and similarities between the 24 EU member states led to the conclusion that Pupils from age 0 to the starting age of compulsory education at primary level - as % of the population of the corresponding age (P0CEP) registers the maximum average percentage value in within cluster A by 73.08% and minimum at cluster B by 45.48%. In relation to the EU average (57.17%), clusters D and F, together with cluster B, register lower percentages, while clusters C, E and G register values above this average.

In relation to the EU average, the values of the indicator Pupils and students by education level - as % of total age population (PPTE), highlight that, above the average percentage value of 20.89%, there are clusters A, F and G, and below it clusters B, C, D and E.

The analysis of the percentage values of the indicator Early leavers from education and training by sex and labor (PPATS), highlights the fact that the lowest level of school dropout is recorded in the states included in cluster D (4.10%), while the average recorded at the state level from cluster B is 12.78%, a value negatively influenced by Romania.

Classroom teachers working full-time and part-time in primary, lower-secondary and upper-secondary education - as % of total active population (PPEAP) highlighted the fact that the lowest value 2.23% corresponds to cluster B, which together with clusters C , E F and G are below the EU average (2.62%) average surpassed only by clusters A and D.

Romania, the component of cluster B, registers weights that are, for most of the indicators, below the cluster averages (PPATS, P0CEP, PPTE, PPEAT and PGDP), only PPATS having a

weight above the average, being otherwise also the most unfavorable values among all the included states in analysis. In this context, it should be emphasized the very low level of development of Romanian education, a fact confirmed by all the results highlighted by the indicators addressed. On the other hand, it should also be emphasized that the GDP is one of the smallest among the EU member states. This highlights the mutual connection between education and sustainable development, its achievement depending on the level of development of education in each state.

BIBLIOGRAPHY

1. Angelov, Angel, (2019), Public Expenditure on Education in the EU Member States: A Cluster Analysis, *Economic Archive*, issue 1 Year 2019, p. 52-64.
2. Bunda, N. R., Baciu, L. and Ciote, C.(2010), Education for Sustainable Development: National, Regional and Global Perspectives, *Ovidius University Annals, Economic Sciences Series*, **X**, issue 1, p. 566-571.
3. Drăgoi, A-E., (2019), Education in EU and Romania - A Theoretical Approach of the Rural – Urban Education Gap, *Euroinfo*, **3**, issue 2, p. 55-66.
4. Edabs (2022) Early leavers from education and training by sex and labour status[edat_lfse_14] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=edat_lfse_14&lang=enEugdp, 2022
5. Edert (2022) Pupils from age 0 to the starting age of compulsory education at primary level - as % of the population of the corresponding age[educ_uoe_enra23] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_enra23&lang=en
6. Ednrp (2022) Pupils and students by education level - as % of total age population [educ_uoe_enra04] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_enra04&lang=en
7. Edper (2022) Classroom teachers working full-time and part-time in primary, lower-secondary and upper-secondary education - as % of total active population[educ_uoe_perp03] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_perp03&lang=en
8. Eugdp (2020) Gross domestic product (GDP) at current market prices by NUTS 2 regions[nama_10r_2gdp] https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do
9. Eurostat, 2022
10. Gogonea R.M., Zaharia M.(2008) *Econometrie cu aplicații în comerț-turism-servicii*, Editura Universitară, București
11. Hapenciuc, C. V. and Neamtu, D. M., (2016), Comparative Analysis of the Geographical Disparities Regarding the Level of Education of the Population and the Level of Economic Development in Romania and in the Regional Profile, *EcoForum*, **5**, issue 2.
12. Rabigan, T. and Manea, C., (2019), Quality Education within the Scope Sustainable Development in the Context of Globalization. A Case Study of Primary Education in Eastern Europe and Central Asia: The Case of Romania, *Logos Universalitate Mentalitate Educatie Noutate - Sectiunea Stiinte Sociale/ Logos Universality Mentality Education Novelty - Section: Social Sciences*, **8**, issue 1, p. 61-69.
13. Rotaru T. (ed.), Badescu G., Culic I., Mezei E. & Mureșan C. (2006) *Metode statistice aplicate în științele sociale*, Ed. Polirom, Iași,

14. Silva A., W., P., Araújo L., C., Ana L., Santos H., C., C., Neto, A., R., Veiga C., Ahiram B., C. and El-Aouar W., A. (2020), Education principles and practises turned to sustainability in primary school, *Environment, Development and Sustainability: A Multidisciplinary Approach to the Theory and Practice of Sustainable Development*, **22**, issue 7, p. 6645-6670
15. Szeles, M. R., Anton, C., Baba, M., Busuioceanu, S., Litră, A. and Suciu, T., (2019), Explaining The EU Regional Economic Growth upon Regional- and Country-Level Achievements in Education, *Journal for Economic Forecasting*, issue 1, p. 143-157.
16. Yuvaraj, N. and Arabi, U, (2021), Determinants of Household Expenditure on Primary Education, *Shanlax International Journal of Economics*, **9**, issue 3, p. 10-14.
17. Zaharia M., Bălăcescu, A., Păunescu, L., Halil Ibrahim Aydin (2022) Tertiary Education in Europe.What is Romania's place? *Valahian Journal of Economic Studies*. Volume 13(27) Issue 1/2022.