The Impact of the Covid-19 Crisis on Tertiary Education in Europe: Insights from Romania

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Abstract

The crisis caused by the COVID-19 pandemic has generated significant disruptions in tertiary education at the European level. The paper analyzed the impact of the COVID-19 crisis on tertiary education in Europe, with a particular focus on Romania, during the period 2015–2023. The research tracked the evolution of ten relevant indicators for education, digitalization, governance, and social vulnerability, using data provided by the World Bank. The study was structured in three phases: the pre-pandemic period (2015–2019), the pandemic period (2020–2021), and the post-pandemic period (2022–2023). Quantitative methods were applied, such as exploratory data analysis, cluster analysis, and the k-means method. The results highlighted three main groups of countries: high-performing, transitioning, and vulnerable. The originality of the paper consisted of a cluster analysis for an extended period (2015–2023). The study also offered an applied perspective on Romania, correlating its educational performance with the evolution of the institutional and social context during and after the COVID-19 crisis.

Keywords: *COVID-19, education, principal component analysis, cluster analysis, data analysis*

JEL classification: C33, C38, I21, I24

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1. Introduction

The emergence of the COVID-19 pandemic in 2019 has had a major impact on numerous sectors globally, including the education system.

A wide array of educational programs is available at these levels, encompassing general academic tracks, vocational training, and technical education. These programs are designed to meet the needs of students in their late adolescence and young adult years.

The quick adaptation to new methods of instruction, such as remote learning, hybrid models, and mixed approaches, was necessitated by the COVID-19 pandemic in educational institutions throughout Europe. The abrupt shift presented notable difficulties for teachers, children, and families alike, intensifying pre-existing inequalities in the availability of technology, resources, and support services. Moreover, disturbances in conventional educational settings influence students'

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social and emotional welfare, as well as their academic advancement and achievement.

Educational policymakers and stakeholders had the challenging endeavor of reconciling health and safety considerations with the necessity of maintaining educational continuity, as nations faced varying infection rates and evolving public health protocols. Europe used a range of strategies, including school closures, physical distancing measures, and remote learning platforms, to different extents, which were influenced by the unique circumstances and priorities of each country.

The education system in Romania encountered distinct obstacles because of the epidemic, as it encompasses a wide range of educational levels from primary to university education. Ensuring fair access to education has been recognized as a significant problem due to the implementation of lockdowns, social distancing measures, and remote learning mandates, given the presence of over 3 million students and a network of schools spanning both urban and rural locations.

The sudden shutdown of educational institutions at the beginning of 2020 compelled educators and policymakers to confront unfamiliar circumstances as they struggled with the urgent need to shift to online and distance learning methods. Nevertheless, Romania's digital infrastructure and connectivity presented difficulties, especially in rural and underserved areas, where there was limited availability of dependable internet and technology.

Romania implemented various policy actions in response to the evolving epidemic, with the objective of striking a balance between maintaining educational continuity and addressing public health imperatives. To offset the impact of the pandemic on student learning outcomes, various strategies were implemented, including delayed school reopening, hybrid learning models, and targeted support for remote learning efforts.

Notwithstanding the obstacles encountered, the epidemic has also served as a catalyst for innovation and collaboration within the education sector of Romania. To enhance remote learning experiences and promote student well-being, schools, teachers, and educational organizations have adopted technology-enabled solutions, created online resources, and established community connections.

2. Literature Review

According to the research conducted by Tadesse and Muluye, it has been demonstrated that COVID-19 is a pandemic ailment resulting from viral transmission, which has significant implications for the educational systems of both developing and wealthy nations.

Distance learning has been proposed as a solution, but it poses challenges in underdeveloped countries due to lack of parental education, inadequate ICT infrastructure, and limited access to computers, radio, and television. Rural students may face financial burdens and increased susceptibility to sexual abuse and coerced labor. The global pandemic has necessitated the widespread adoption of online teaching and learning. Governments should expand network infrastructure and

improve internet access in both urban and rural areas. Collaboration between researchers, curriculum designers, education officers, and institutions is crucial for a comprehensive transformation of the education system (Tadesse and Muluye, 2020).

Tarkar's research indicates that the closure of educational institutions has disrupted student learning and qualifications exams. Online teaching has replaced traditional methods, but it presents challenges. Institutions are seeking solutions to compensate for the decline in learning opportunities. They need resources to reopen, and strategies to engage students and effectively use resources are needed. Delaying the event and implementing policies for recent graduates are also crucial (Tarkar, 2020).

Another study indicated that the COVID-19 pandemic significantly impacted psychological well-being, educational attainment, and daily schedules, highlighting obstacles and opportunities for alternative strategies in education. Implementing new laws and standards could alleviate adverse consequences and equip teachers and students (Chaturvedi et al., 2021).

Research shows that children with Special Educational Needs and Disabilities (SENDs) and their families are more likely to experience mental health issues and stress during the COVID-19 pandemic. This study does not include a control group, so it's crucial to evaluate their unique needs and implement measures. Common recommendations include expert guidance, suitable remote learning materials, and opportunities for interaction with familiar individuals. Prioritizing these families and providing tailored help in education, health, and social care is essential (Asbury et al., 2021).

The study by Chatterjy and Li highlights the need for data collection on policies to mitigate the pandemic's impact on adolescents, focusing on school enrollment during the pandemic. Further research should explore the long-term effects on student involvement, academic achievements, college attendance, and income (Chatterji and Li, 2021).

A study in the Netherlands found a decline in employment prospects during lockdown, especially among graduates with lower education levels. However, after restrictions were lifted, employment in the Netherlands quickly recovered, indicating a constrained labour market. The immediate impacts of the COVID-19 crisis were less severe than economic crises, possibly due to stricter measures. We noted variations in the impact of lockdown measures based on education and gender. The study underscores the need for data on the pandemic's impact on adolescents (Bussink et al., 2022).

3. Methodology

The study began with the identification of research questions. These were the following:

Q_1: Can European countries be grouped based on certain indicators in the fields of education, digitalization, governance, and inequalities, and how have these clusters evolved from 2015 to 2023?

Q_2: Which are the most vulnerable countries, and from which cluster are they for the analyzed period?

The cluster analysis aimed to identify patterns of similarity and differentiation between countries based on institutional capacity, digital development, and social performance.

We used principal component analysis to extract two dimensions for each year. On these dimensions, the k-means algorithm was applied. The interpretation of the dimensions remained consistent throughout the study. Dim 1 represented governance/education/digitalization and Dim 2 showed social vulnerability/inequality. The overall percentage covered by the two dimensions is 72%. Because the indicators were linked, principal components were used to cut down on the number of dimensions and make cluster analysis run as quickly and efficiently as possible.

4. Results and discussion

Exploratory data analysis

The data used in the analysis was obtained from the World Bank Group and contained the next set of indicators with their respective measurement units: school enrollment (tertiary (% gross), educational attainment (at least bachelor's or equivalent), population (25+, total (%) (individuals using the Internet (% of the population), government expenditure on education (total (% of GDP), government effectiveness (estimate score), unemployment (youth total (% of total labor force ages 15–24) (modeled ILO estimate), poverty headcount ratio at national poverty lines (% of the population, Gini index (scale from 0 to 100), control of corruption (estimate score), and regulatory quality (estimate score).

Variable code and variable name of indicators

Table 1

Variable code	Variable name
X_1	School enrollment, tertiary
X_2	Educational attainment, at least Bachelor’s or equivalent
X_3	Individuals using the Internet
X_4	Government expenditure on education, total
X_5	Government effectiveness
X_6	Unemployment, youth total
X_7	Poverty headcount ratio at national poverty lines
X_8	Gini index
X_9	Control of corruption
X_{10}	Regulatory quality

The analysis period was between 2015 and 2023 and included 35 countries. The table in the appendix displays the complete list of these countries along with their associated codes.

The study examined how each indicator changed over time for each of the three times: before the pandemic (2015–2019), during the pandemic (2020–2021), and after the pandemic (2022–2023). The graph below illustrated all the indicators considered in the analysis for all three periods.

The pre-pandemic period was marked in blue, the pandemic period in red, and the post-pandemic period in green. We have observed that the values of enrollment in higher education have remained relatively stable over time. Over time, we observed an increasing number of students enrolling. We identified a slight increase in the highest level of education, at least a bachelor's degree or equivalent, across all periods. The findings suggested a gradual improvement in education over time. The number of people using the internet also increased. Government spending on education has decreased slightly after the pandemic, most likely due to changes in budget priorities or economic tensions. There have been no major changes related to the government's effectiveness, only minor variations. Youth unemployment has decreased over the analyzed period. We observed minimal changes in the poverty headcount ratio over the three periods. We have maintained the same observation for the Gini index. We have confirmed that the control of corruption has not undergone any significant changes. The quality of regulation has decreased a little over the three periods.

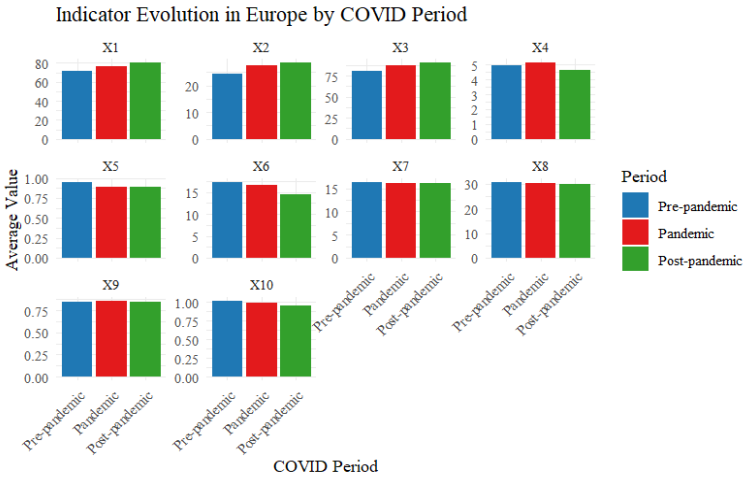

Figure 1. Indicator evolution in Europe by COVID-19 period

The graph below highlighted the evolution of indicators for Romania over the three periods. The number of students who enrolled in college has increased over the analyzed period. The education level of those holding a bachelor's degree or equivalent has shown a slight upward trend. Just like in the case of Europe, the number of people who have started using the internet has increased significantly. The pandemic recorded the highest government spending on education. The spending on education was lower during the other two periods. Government effectiveness in Romania includes negative values for all three periods. There was a

significant decline during the pandemic. The decrease reflects public dissatisfaction or the institutional tension visible during the crisis. Compared to Europe, youth unemployment in Romania is increasing, not decreasing. The poverty headcount ratio gradually declined, possibly due to social support measures or recovery effects. Income inequality has been quite stable for Romania. Negative values were also observed for corruption control in Romania. There has been a constant decline related to the quality of regulations. The decline indicated a reduced confidence in the quality of regulations or difficulties regarding adaptation challenges.

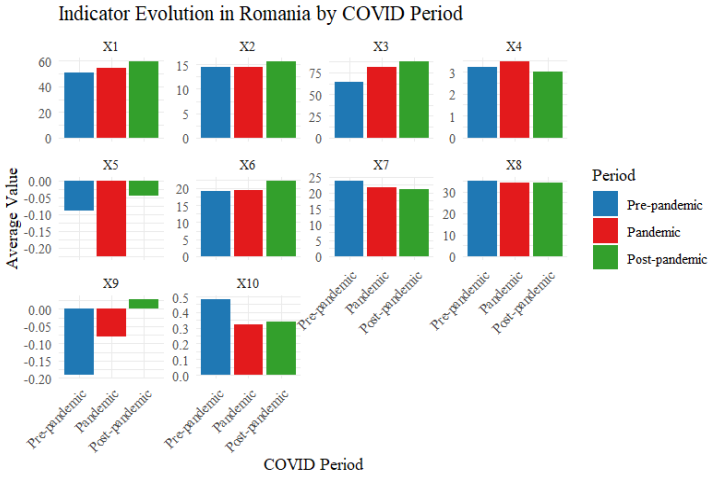

Figure 2. Indicator evolution in Romania by COVID-19 period

Cluster analysis

The graphs below illustrated the results of applying cluster analysis for each year. For all the years, Dim 1 represented governance, education, and digital capacity, and Dim 2 signified the inequality and vulnerability of work.

The first graph was for the year 2015. High values meant weak governance, low internet access, and low education. High values meant high unemployment among young people, poverty, and inequality. Cluster 1 in red included the following countries: Romania, Serbia, Albania, Italy, Bulgaria, Greece, Croatia, Spain, and Portugal. These countries have high values for Dim 1, which meant digitalization, education, and reduced governance. We also observed medium or high values for Dim 2, which reflected various issues of poverty or unemployment. The middle cluster in green included countries such as Malta, Hungary, Moldova, Belarus, Sweden, Czechia, Slovenia, Slovakia, and Poland. They presented average values for Dim 1 and low values for Dim 2, meaning fewer inequalities and better social outcomes. The third cluster in blue included countries such as Luxembourg, Lithuania, Latvia, Cyprus, France, Austria, Belgium, Iceland, Finland, Norway, Denmark, Switzerland, the Netherlands, Germany, the United Kingdom, Ireland, and Estonia. They had strong governance, education, and digital access. Some are also low in inequality.

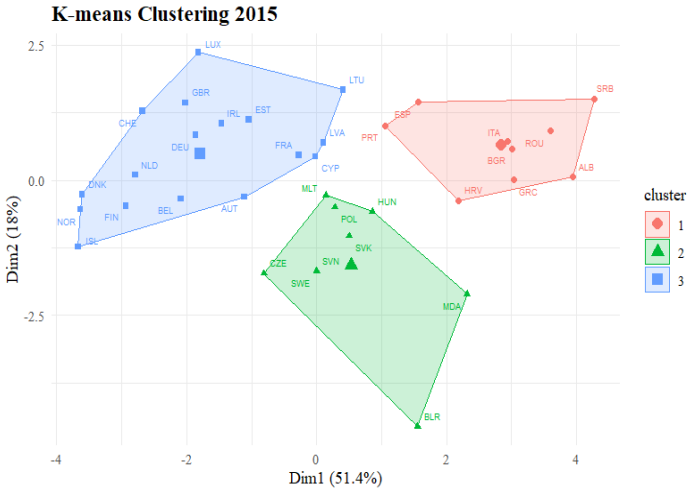

Figure 3. K-means clustering 2015

The significance of the two dimensions remained for the year 2016 as well. In the first red cluster, the following countries were identified: Lithuania, Bulgaria, Serbia, Albania, Greece, Croatia, Portugal, Latvia, Romania, Italy, and Spain. These are countries with lower performance, facing challenges in both governance and social inequalities. The second green cluster included the following countries: France, Cyprus, Hungary, Moldova, Belarus, Czech Republic, Malta, Poland, Slovakia, Slovenia, and Sweden. These countries are emerging or in transition. In the last blue cluster, countries such as Luxembourg, Ireland, Estonia, Austria, Belgium, Finland, Norway, Denmark, Switzerland, the Netherlands, the United Kingdom, and Germany could be observed. These were central, high-performing countries with strong institutions and decent social inclusion.

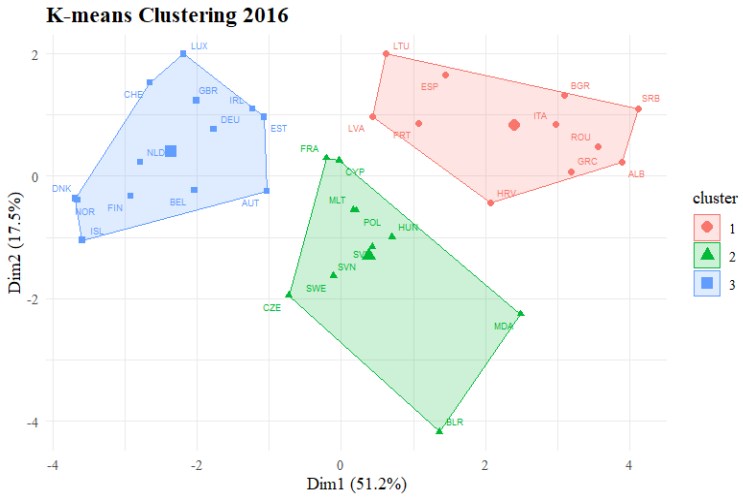

Figure 4. K-means clustering 2016

The meaning of the dimensions has remained the same for 2017. In Cluster 1, marked in red, were countries such as Lithuania, Spain, Bulgaria, Italy, Serbia, Albania, Moldova, Croatia, Romania, Greece, and Latvia. This cluster struggled with institutional and social issues. The second cluster, characterized by green, included countries like France, Portugal, Cyprus, Hungary, Belarus, Slovenia, Sweden, Czech Republic, Austria, Malta, and Poland. These were countries in transition. The last blue cluster included countries such as Luxembourg, Estonia, Ireland, Belgium, Iceland, Norway, Denmark, Switzerland, Finland, the Netherlands, Germany, and the United Kingdom. The central cluster of countries in Western/Northern Europe was characterized by strong institutions, high digital capacity, and lower inequalities.

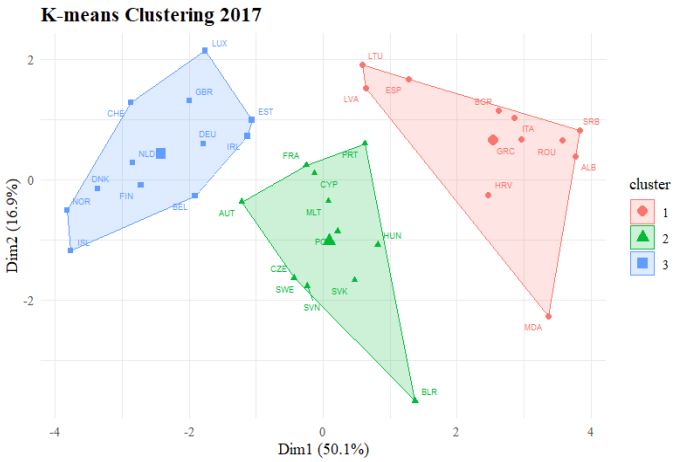

Figure 5. K-means clustering 2017

For the year 2018, high values for Dim 1 represented weaker institutional and digital development, while for Dim 2 they signified resilience at work and a better social life. In cluster 1 (red), there were countries such as Belarus, Moldova, Hungary, Poland, Malta, the Czech Republic, Sweden, Slovenia, and Slovakia. They were socially stable countries but institutionally lagging. Cluster 2 in green included countries such as Cyprus, Croatia, Albania, Romania, Serbia, Bulgaria, Spain, Latvia, Lithuania, Portugal, Italy, and Greece. They performed worse on both axes—socially and institutionally vulnerable. The last blue cluster included countries such as Iceland, Norway, Denmark, the Netherlands, Switzerland, Luxembourg, the United Kingdom, France, Austria, Belgium, Finland, Germany, Ireland, and Estonia. These were the most high-performing countries.

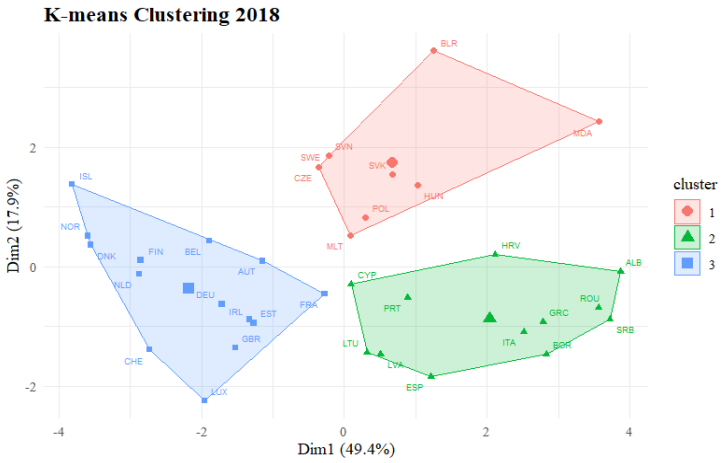

Figure 6. K-means clustering 2018

The following graph was for the year 2019. Low values on Dim1 represented better governance, higher education, and digital access, while low values on Dim2 signified better social conditions. In the first red cluster, countries such as Iceland, Norway, Denmark, the Netherlands, Switzerland, Luxembourg, Lithuania, Latvia, Cyprus, Austria, Belarus, Finland, Germany, the United Kingdom, Estonia, Ireland, and France were found. This cluster included countries with strong governance, digitalization, and education, and moderate to medium inequality. The second green cluster encompassed countries like Belarus, Hungary, Malta, Poland, Slovenia, Czechia, Sweden, and Slovakia. They recorded lower institutional power and an increase in inequality/unemployment. The last blue cluster included countries such as Moldova, Albania, Serbia, Romania, Bulgaria, Italy, Greece, Spain, Portugal, and Croatia. They have demonstrated low governance, education, and digital access, as well as vulnerability regarding inequality and unemployment.

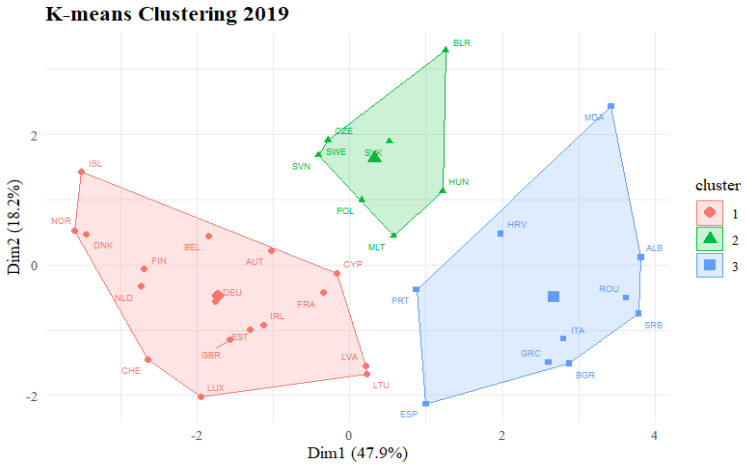

Figure 7. K-means clustering 2019

The definitions of the two dimensions remain unchanged. We identified Moldova, Croatia, Portugal, Lithuania, Latvia, Spain, Greece, Bulgaria, Serbia, Albania, Romania, and Italy in the first red cluster. High values for Dim 1 represented poor governance, education, and digital capacity. The low to medium values for Dim 2 represented labor market vulnerability and poverty. The second green cluster included the following countries: Bulgaria, Czechia, Slovenia, Sweden, Austria, Cyprus, France, Hungary, Slovakia, Poland, and Malta. These were the countries in transition. The last blue cluster included the following countries: Iceland, Norway, Finland, Switzerland, Denmark, Luxembourg, Estonia, Ireland, Germany, Belgium, the Netherlands, and the United Kingdom. These are the countries that are leaders in both institutional and digital development.

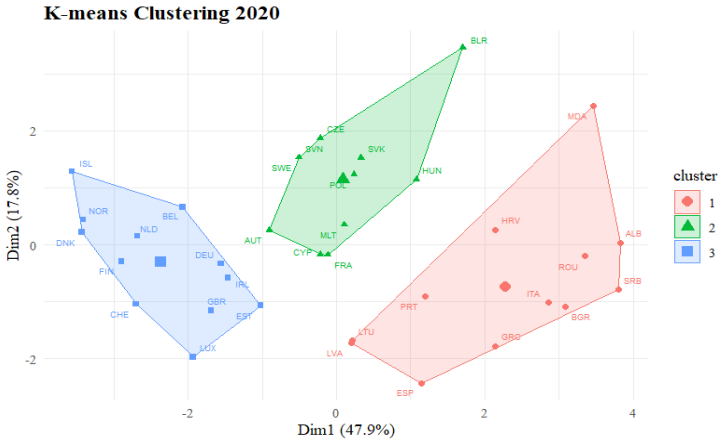

Figure 8. K-means clustering 2020

The following graph was for the year 2021. In the first red cluster, countries such as Romania, Croatia, Albania, Serbia, Italy, Bulgaria, Greece, Spain, and Portugal were evident. These countries remain in a vulnerable cluster, both institutionally and socially. The green cluster included countries such as Belarus, Moldova, Hungary, Malta, Cyprus, Sweden, Slovenia, the Czech Republic, Slovakia, and Poland. These were in the process of development. The last blue cluster included Iceland, Denmark, Switzerland, Luxembourg, Estonia, Lithuania, Latvia, France, Austria, Belgium, Norway, Finland, the Netherlands, the United Kingdom, Germany, and Ireland. They were the most stable and high-performing countries.

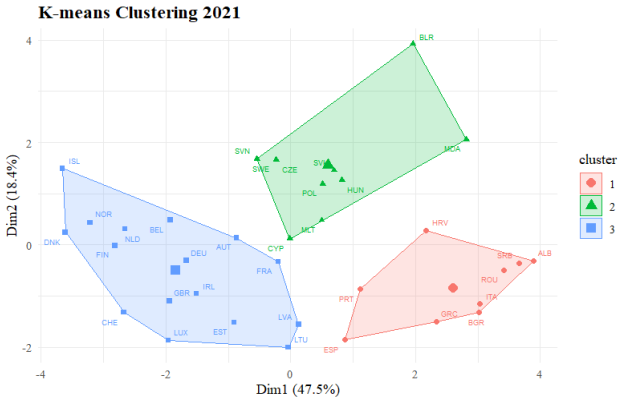

Figure 9. K-means clustering 2021

The significance of the dimensions has been maintained for the year 2022 as well. The first red cluster included the following countries: Belarus, Moldova, Cyprus, France, Czech Republic, Slovenia, Sweden, Slovakia, Hungary, Poland, and Malta. These countries had relatively decent social cohesion, despite institutional limitations—perhaps due to post-COVID support programs or recovery policies. The significance of the dimensions has been maintained for the year 2022 as well. The first red cluster included the following countries: Belarus, Moldova, Cyprus, France, Czech Republic, Slovenia, Sweden, Slovakia, Hungary, Poland, and Malta. These countries had relatively decent social cohesion, despite institutional limitations—perhaps due to post-COVID support programs or recovery policies. The last blue cluster included the following countries: Croatia, Bulgaria, Serbia, Albania, Romania, Greece, Spain, Latvia, Portugal, and Italy. This group was the most vulnerable of all.

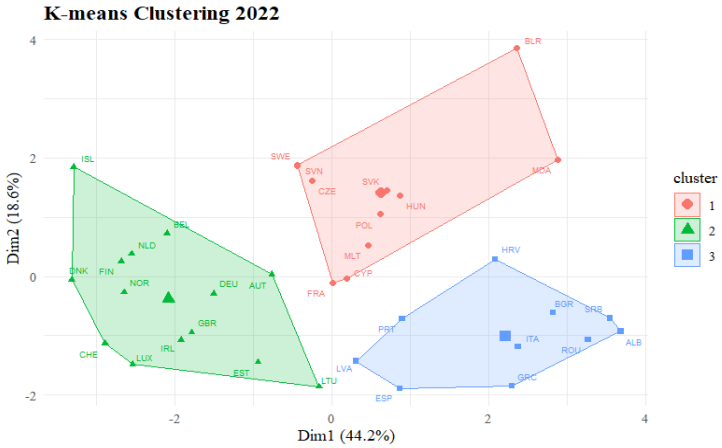

Figure 10. K-means clustering 2022

The last figure was for the year 2023. The first red cluster identified countries like Belarus, Bulgaria, Sweden, Slovenia, France, Cyprus, Malta, Slovakia, Moldova, Czechia, Poland, and Hungary. They have fragile institutions, but some improve social conditions, possibly due to targeted public spending or EU support mechanisms. The second green cluster included Croatia, Serbia, Albania, Romania, Greece, Italy, Spain, and Portugal. It is the most vulnerable grouping, bringing with it a warning related to long-term systemic weaknesses post-pandemic. The blue cluster included Iceland, Belgium, Germany, Austria, Latvia, Lithuania, Estonia, Ireland, Luxembourg, Switzerland, Denmark, the Netherlands, Finland, the United Kingdom, and Norway. These were the most efficient countries.

Figure 11. K-means clustering 2023

The table below lists the countries that have moved from one cluster to another for ease of interpretation. The notations in the table are as follows: 1 represented the high-performance cluster, 2 the transition cluster, and 3 the vulnerable cluster.

The movement of countries

Table 2

Code	2015	2016	2017	2018	2019	2020	2021	2022	2023
AUT	1	1	2	1	1	2	1	1	1
BGR	3	3	3	2	3	3	3	3	2
HRV	3	3	3	2	3	3	3	3	3
CYP	1	2	2	2	1	2	2	2	2
FRA	1	2	2	1	1	2	1	2	2
GRC	3	3	3	2	3	3	3	3	3
ITA	3	3	3	2	3	3	3	3	3
LVA	1	3	3	2	1	3	1	3	1
LTU	1	3	3	2	1	3	1	1	1

Code	2015	2016	2017	2018	2019	2020	2021	2022	2023
MLT	2	2	2	3	2	2	2	2	2
POL	2	2	2	3	2	2	2	2	2
PRT	3	3	2	2	3	3	3	3	3
ROU	3	3	3	2	3	3	3	3	3
SVK	2	2	2	3	2	2	2	2	2
SVN	2	2	2	3	2	2	2	2	2
ESP	3	3	3	2	3	3	3	3	3
SWE	2	2	2	3	2	2	2	2	2
HUN	2	2	2	3	2	2	2	2	2
ALB	3	3	3	2	3	3	3	3	3
MDA	2	2	3	3	3	3	2	2	2
SRB	3	3	3	2	3	3	3	3	3
BLR	2	2	2	3	2	2	2	2	2

5. Conclusions

This research aimed to investigate how the COVID-19 crisis has influenced educational systems, institutional capacity, and social dimensions in Europe, with a focus on the case of Romania, during the period 2015–2023.

A preliminary study conducted at the European level found that the number of people enrolling in tertiary education was steadily rising. At the same time, the number of people using the internet quickly increased, which is a sign of progress in digitalization. There was also a small drop in the number of unemployed young people, stable levels of poverty and social inequality, and a slight drop in the quality of regulations, which could mean that institutions are becoming less stable after the pandemic.

Regarding the case of Romania, there has been a positive evolution in education and digitalization, but low levels of government efficiency and corruption control, an increasing youth unemployment rate compared to the European average, and a gradual decrease in poverty, but persistent difficulties related to the quality of regulations and trust in institutions.

Based on these dimensions, the cluster analysis allowed for the grouping of countries into three constant typologies over the years: the cluster of vulnerable countries, the cluster of developing countries, and the cluster of performing countries.

Belgium, Denmark, Estonia, Finland, Germany, Ireland, Luxembourg, the Netherlands, Norway, Iceland, and the United Kingdom were the countries that remained in the efficient countries cluster throughout the entire analysis period. Countries such as Bulgaria, Croatia, Czech Republic, Greece, Italy, Portugal, Romania, Spain, Albania, and Serbia have mostly been in the cluster of vulnerable

countries and have only changed their position to another cluster once. The other countries have moved from one cluster to another several times over time.

The study's limitations include conducting the analysis at the national level. Intra-national differences (e.g., regions) were not included, even though inequalities can vary significantly within a country, the exclusion of certain indicators that could have been of great importance for the study, and the application of more methods. As future research directions, the following could be considered: regional analysis of these indicators, application of econometric models or other methods, and the inclusion of additional indicators in the analysis.

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Appendix

In this section, the list of countries considered in the analysis is presented.

List of countries

Table 3

Country	Code
Austria	AUT
Belgium	BEL
Bulgaria	BGR
Croatia	HRV
Cyprus	CYP
Czechia	CZE
Denmark	DNK
Estonia	EST
Finland	FIN
France	FRA
Germany	DEU
Greece	GRC
Ireland	IRL
Italy	ITA
Latvia	LVA
Lithuania	LTU
Luxembourg	LUX
Malta	MLT
Netherlands	NLD
Poland	POL
Portugal	PRT
Romania	ROU
Slovak Republic	SVK
Slovenia	SVN
Spain	ESP
Sweden	SWE
Hungary	HUN
Albania	ALB
Moldova	MDA
Serbia	SRB
Belarus	BLR
Switzerland	CHE
Norway	NOR
Iceland	ISL
United Kingdom	GBR