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Adult Learning: Cluster Analysis of European Union Countries

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Abstract

Lifelong learning, which the European Union especially attaches great importance to for social and economic cohesion, covers not only general and vocational education and training provided through formal and non-formal education, but also learning activities in all areas of life. As an important component of lifelong learning, adult learning includes educational activities designed to develop personal and professional skills and represents the participation of adults in lifelong learning. This study aimed to group the European Union countries in terms of adult learning within the scope of lifelong learning. Thus cluster analysis was performed using Wards and k-means clustering methods, resulting in the identification of four distinct clusters of countries. The analysis identified that Denmark, Estonia, Finland, Ireland, Luxembourg, the Netherlands, Spain, and Sweden are in Cluster 1; Belgium, the Czech Republic, Italy, Lithuania, Malta, Portugal, and Slovenia are in Cluster 2; Bulgaria, Croatia, Cyprus, Greece, Poland, and Romania are in Cluster 3; and Austria, France, Germany, Hungary, Latvia, and Slovakia are in Cluster 4. Additionally, by assessing the similarities and differences among the groups, it was determined that the countries vary in terms of variables of the participation rate in education and internet use for any learning activity.

Keywords: *Adult Learning, Lifelong Learning, Cluster Analysis, European Union Countries*

Öz

Avrupa Birliği'nin özellikle toplumsal ve ekonomik uyum için büyük önem verdiği yaşam boyu öğrenme, örgün ve yaygın eğitim yoluyla sağlanan genel ve mesleki eğitim ve öğretimin yanı sıra yaşamın her alanındaki öğrenme etkinliklerini de kapsamaktadır. Yaşam boyu öğrenmenin önemli bir bileşeni olan yetişkin öğrenimi, kişisel ve mesleki becerileri geliştirmeye yönelik eğitim etkinliklerini içerir ve yetişkinlerin yaşam boyu öğrenmeye katılımını temsil eder. Bu çalışma, yaşam boyu öğrenme kapsamında yetişkin öğrenimi açısından Avrupa Birliği ülkelerini gruplandırmayı amaçlamaktadır. Bu doğrultuda Wards ve k-ortalamalar kümeleme yöntemleri kullanılarak yapılan analiz sonucunda dört ayrı ülke kümesi belirlenmiştir. Analiz sonucunda Danimarka, Estonya, Finlandiya, İrlanda, Lüksemburg, Hollanda, İspanya ve İsveç'in Küme 1'de; Belçika, Çek Cumhuriyeti, İtalya, Litvanya, Malta, Portekiz ve Slovenya'nın Küme 2'de; Bulgaristan, Hırvatistan, Kıbrıs, Yunanistan, Polonya ve Romanya'nın Küme 3'de; Avusturya, Fransa, Almanya, Macaristan, Letonya ve Slovakya ise Küme 4'de yer aldığı tespit edilmiştir. Ayrıca gruplar arasındaki benzerlik ve farklılıklar değerlendirilerek, ülkelerin yetişkinlerin eğitime katılım oranı ve herhangi bir öğrenme etkinliği için internet kullanımı değişkenleri açısından farklılık gösterdiği belirlenmiştir.

Anahtar Kelimeler: *Yetişkin Öğrenimi, Yaşam Boyu Öğrenme, Kümeleme Analizi, Avrupa Birliği Ülkeleri*

Introduction

Since the 1990s, the European Union (EU) has focused on the concept of "Lifelong Learning," and in 1996, declared it the "European Year of Lifelong Learning (Colardyn, 2001, s. 7). Lifelong Learning (LLL), which allows participation from individuals of all segments of society, facilitates personal and professional development, thereby supporting the advancement and strengthening of the community. Among the United Nations Sustainable Development Goals (SDGs), Goal 4 aims to ensure that every individual receives a quality education and has access to lifelong learning opportunities (United Nations, 2015). Lifelong learning is a philosophy that encourages individuals to continue their learning processes throughout their lives, and is accepted in Europe as a fundamental principle that emphasizes the acquisition of knowledge and skills throughout the individual's life. The European Union (EU) regards education as a fundamental pillar in individual, social, economic, political, and cultural domains. In this context, to achieve success in becoming a knowledge society and a competitive economy in the era of globalization, the EU has framed its educational policies through the perspective of lifelong learning, establishing numerous goals and implementing various strategies accordingly (European Commission, 2001).

In its 2003 report on lifelong learning, the European Commission highlighted the importance of facilitating access to lifelong learning and removing barriers to participation. The report emphasized the promotion of adult learning as a key element in encouraging lifelong learning (Kaya, 2014, s. 104). In this regard, adult learning has been assigned a significant role, with action plans developed to update the skills and knowledge of the adult population to enhance employability.

Adult learning involves the engagement of adults in lifelong education, making it crucial as it represents one of the most comprehensive areas of lifelong learning. It includes educational activities designed to enhance both personal and professional skills. The OECD describes adult learning as encompassing various forms of learning pursued by adults, aiming to enhance their knowledge, skills, and competencies that are pertinent to their personal and professional development (OECD, 2019). Typically, this refers to learning that occurs after the completion of basic education and is a critical component of the European Union's lifelong learning policy. Furthermore, as the EU strives to become the world's most competitive and dynamic knowledge-based economy, it underscores the importance of continuing education for adults who have completed formal education and entered the workforce, in light of the rapidly evolving skill requirements of the labor market (European Commission, 2006).

The 2006 report by the European Commission reiterated the importance of lifelong learning for competitiveness and employability and introduced a specific focus on the concept of "adult learning" as a new initiative. In the plan published by European Commission in 2007, underscored the need for high-quality and accessible adult learning. The plan also addressed the necessity to increase the skill levels of the workforce, particularly in response to employment challenges posed by demographic changes, positioning adult learning as a crucial solution (Kaya, 2014).

According to the OECD, adult learning encompasses all educational and learning activities undertaken by adults to improve their knowledge, skills, and competencies within a lifelong learning framework (OECD, 2005). This definition includes not only organized educational programs but also self-directed learning, on-the-job training, and learning through daily life experiences. Adult learning aims to support individuals' social, economic, cultural, and personal development. Jarvis (2004) describes it as a process in which individuals who no longer regularly engage in full-time education participate in structured and sequential activities with the explicit goal of making changes in their knowledge, expertise, understanding, skills, appreciation, attitudes, and values. Adult learning includes a variety of learning activities undertaken after completing initial, full-time education and after entering the labor market (Rüber, Rees, & Schmidt-Hertha, 2018). Adult learning involves

various learning activities undertaken by individuals after completing their initial full-time education and often after entering the workforce. However, the scope of adult learning is broader, as it encompasses lifelong learning opportunities that address adults' needs at different life stages. It includes educational programs and activities that contribute to career advancement, personal growth, social responsibility, community service, or personal interests (Knowles, 1990; Merriam & Bierema, 2013).

The European Union characterizes education and lifelong learning as covering the comprehensive spectrum of formal, informal and non-formal learning experiences (Eurostat, 2016). Formal learning encompasses either the continuation or re-entry into structured educational systems, often resulting in a certificate that is nationally recognized. This type of learning takes place within organized and structured environments explicitly designed for educational purposes. The primary goal is the acquisition of knowledge, skills, and competencies. It includes structured programs such as university degrees, professional certifications, or diplomas. Informal learning, in contrast, typically encompasses self-directed and intentional learning that occurs outside formal courses or institutions. Informal learning arises from everyday activities related to work, family, or leisure, and it is often unplanned from the learner's perspective. Commonly known as "learning by experience" this type of learning reflects the continuous exposure to learning opportunities inherent in daily life. It includes online courses, workshops, or seminars. Non-formal learning is positioned between formal and informal learning, and adopting a framework of varying degrees of formality rather than strict definitions may prove advantageous. This approach addresses the need for a conceptual intermediary between formal and informal learning a need that users frequently encounter. Non-formal learning typically involves general or vocational courses offered in structured settings such as adult education institutions, which are common environments for non-formal learning (Eurostat, 2016). Successful participation in non-formal learning often leads to various types of certification, including participation certificates or credentials specific to accreditation systems within adult education organizations (Patrick, 2010). Additionally, methods used in adult learning include e-learning, face-to-face instruction, and blended learning approaches. These educational experiences cover a broad range from personal development to professional skills.

Literature Review

The aim of this study is to classify European Union countries in terms of adult learning within the scope of lifelong learning. In this context, recent studies on adult education in Europe have been reviewed, with a focus on those that share a similar objective with this study.

In Grześkowiak's (2014) article, the author examines how individuals in Poland utilize lifelong learning opportunities and the challenges they face, employing multivariate analytical methods. The study includes statistical analyses to understand the impact of various factors on participation and to identify key barriers to accessing education. The clustering procedure reveals that some of the obstacles to continuous education tend to co-occur. The article provides insights into the primary barriers encountered in the lifelong learning process in Poland and offers recommendations for developing policies to mitigate these barriers.

Boeren (2016), in her book, provides a comprehensive examination of adult and lifelong learning within the context of evolving policy environments. It approaches the subject through an interdisciplinary lens, drawing on theories and research from education, sociology, and policy studies. The book explores the factors influencing adults' participation in lifelong learning, such as individual motivations, institutional frameworks, and societal trends. Additionally, it discusses how national and international policies impact access to and engagement in lifelong learning opportunities. A key contribution of this work is its analysis of the interaction between individual agency and structural factors in shaping participation in lifelong learning.

Dumicic, Milun, and Antic (2019), in their study, were examined the impact of adult participation in lifelong learning on employability in selected European countries. The authors compare participation rates in adult learning programs across various European nations to analyze how increased participation influences job prospects. The study used Eurostat data, applying Ordinary Least Squares (OLS) regression analysis to identify significant impacts on adult education, and cluster analysis to categorize countries into distinct groups. The use of Gross Domestic Product per capita alongside Adult Participation in Learning demonstrated that the most developed and wealthiest European countries are grouped together, whereas the less developed countries form separate clusters.

In their article, Crick, Broadfoot, and Claxton (2004) detail the process of developing an inventory for assessing lifelong learning skills. The study utilized factor analysis to identify dimensions and conducted K-means clustering analysis on the data to further investigate potential connections between these dimensions and distinctions among individual students. To evaluate differences between groups based on various variables, ANOVA was employed, and the results were interpreted accordingly.

In their study; Costantiello, Laureti, and Leogrande (2022) examines the factors influencing lifelong learning in Europe using data from the European Innovation Scoreboard (EIS). The study applies various econometric methods, performs cluster analysis using the k-Means algorithm, and conducts Network Analysis to identify four complex and two simplified network structures. Additionally, the study compares eight machine learning algorithms for predicting lifelong learning values and finds that linear regression offers the highest prediction accuracy. The article provides insights into the impact of lifelong learning policies and practices, offering recommendations for the development of educational policies and strategies.

Hwu and Peng (2023) analyzed online learning environments by classifying students' personal traits and behaviors to identify various learner profiles. The study conducted with 2386 participants reveals a significant correlation between learning performance and permanence across three learning clusters and indicating a trend towards continuous learning. It is thought that this classification provides educators with insights into the characteristics of learning behavior, enabling more effective management and support of the learning process.

Most studies in the literature are descriptive and analyze the development of adult learning, often focusing on individual countries. However, this study emphasizes adult learning in the context of evolving education and training processes affected by technological developments and new opportunities, especially in the post-pandemic period. The study aims to classify European countries according to their approaches to adult learning. In this context, studies that are more comparative and classificatory rather than merely descriptive taken into consideration. The literature review reveals that there are no current clustering studies addressing the variables examined in the research. In this context, it is believed that the research provides current and original insights for future studies on the subject.

Method

In this study, European Union countries are examined in terms of adult learning within the scope of lifelong learning. Clustering analysis is conducted and interpreted to classify the countries based on the data obtained regarding adult learning, in order to analyze the similarities and differences between the countries.

Cluster analysis refers to a multivariate statistical technique that partitions variables or units into groups or clusters based on their shared characteristics (Hair, Black, Babin, & Anderson, 2014). Unlike other multivariate statistical techniques, cluster analysis utilizes measures of similarity and distance, placing less emphasis on assumptions such as normality, linearity, and homoscedasticity. It is generally sufficient for the sample to be representative of the population and for there to be no multicollinearity among the variables (Alpar, 2013).

In the literature, cluster analysis is classified in various ways, but it is generally categorized into two main groups: hierarchical and non-hierarchical clustering methods. Hierarchical methods involve a series of n - 1 clustering decisions, where n is the number of units, transforming these units into a hierarchy or a tree structure. Hierarchical clustering is divided into two primary classes: agglomerative and divisive methods. Agglomerative methods begin with each observation forming its own cluster. Then, at each step, the two most similar clusters are merged, continuing this process until a single cluster remains. Among agglomerative methods are single linkage, complete linkage, average linkage, Ward's method, median centering, and centroid methods. In contrast, divisive methods start with a single cluster that includes all units and iteratively split into two, three, and more clusters until each unit is in its own cluster. Divisive methods include techniques such as divisive analysis and automatic interaction detection (Çokluk, Şekercioğlu, & Büyüköztürk, 2014; Hair, Black, Babin, & Anderson, 2014). Unlike hierarchical methods, non-hierarchical methods do not involve a stepwise process. Instead, observations are assigned to clusters after the number of clusters is determined. The most commonly used non-hierarchical methods include k-means, medoid, fuzzy, and density-based clustering techniques (Özdamar, 2013).

The study conducted hierarchical clustering analysis using the Ward method with Euclidean distance to identify distinct country groups among the 27 European Union (EU) member states based on selected variables related to adult learning as of 2024. Due to the absence of a predefined number of clusters based on theoretical knowledge, it is decided to apply a hierarchical clustering approach. Ward's method is chosen from among hierarchical clustering techniques because it effectively minimizes within-cluster variability by grouping units with different variance structures. Given the possible unstability of clustering analysis outcomes, the k-means clustering method, which is a non-hierarchical approach, was utilized to verify the clusters and enable the comparison of results.

The Ward method incorporates an analysis of variance approach in hierarchical clustering. During the merging of two clusters, the increase in the sum of squared errors for possible combinations is calculated, and the linkage that minimizes this increase is selected to perform the clustering (Akpınar, 2014; Hair, Black, Babin, & Anderson, 2014). The Ward method utilizes equation (1) for clustering. In this equation, N represents the number of elements in the relevant cluster, m denotes the new cluster formed by merging two clusters, k and l are the previously formed clusters, and j is the cluster to be merged with these. d_{mj} indicates the distance between cluster m and cluster j (Özdamar, 2013).

$$d_{mj}=\frac{\left((N_j+N_k)d_{kj}+(N_j+N_l)d_{lj}-N_jd_{kl}\right)}{(N_j+N_m)} \quad (1)$$

The k-means method partitions a dataset of N units into a predetermined number of clusters in such a way as to minimize the within-cluster sum of squares. To perform this task, initial cluster center points are first selected. Subsequently, unit assignments to clusters are made iteratively based on these central points. The assignment process ends when the objective function is maximized, achieving minimal within-cluster variance and maximal between-cluster variance. This maximization is accomplished using equation (2). In equation (2), k denotes the number of clusters, xcj represents the jth unit in cluster c, mc is the centroid of cluster c, and Nc indicates the number of units in cluster c. In this context, a unit assigned to cluster a in one iteration may be assigned to a different cluster in the next iteration (Özdamar, 2013).

$$\sum_{c=1}^{k}\sum_{j=1}^{N_c}\left\|x_{cj}-m_c\right\|^2 \quad (2)$$

The study focuses on adult learning in the member countries of the European Union, and according to Eurostat, adult participation in lifelong learning is defined as the participation rate of the population aged 25-64 in education and lifelong learning. In this context, statistics pertaining to these individuals have been

evaluated. The variables considered in this study are presented in Table 1.

Table 1. Variables Included in the Analysis

Variable names	Variable
V1	Participation rate in education
V2	Internet use for any learning activity
V3	Education expenditures
V4	Adult population rate
V5	Adult employment rate

The most recent data published by Eurostat for all variables considered in the study were taken into account. The first variable, "participation rate in education," is sourced from the Eurostat Adult Education Survey, with the latest data from 2022 reflecting the percentage of individuals aged 25-64 participating in education and training. The data for the variable "internet use for any learning activity" pertains to 2023 and represents the proportion of individuals aged 25-64 using the internet for purposes such as taking an online course, accessing online learning materials, or communicating with instructors or students via educational websites/portals, in relation to all adults.

Table 2. Data Used in Analysis

Country names	V1	V2	V3	V4	V5
Austria	58,00	31,54	4,80	55,15	77,90
Belgium	41,60	34,50	6,30	51,88	75,50
Bulgaria	20,60	13,62	3,90	52,91	79,40
Croatia	27,30	22,09	4,80	52,12	73,50
Cyprus	44,90	13,35	5,10	55,51	81,00
Czechia	45,70	27,15	4,90	50,32	84,80
Denmark	53,00	48,39	5,30	51,36	81,10
Estonia	48,10	47,25	5,80	52,97	83,60
Finland	53,10	59,22	5,50	50,74	80,00
France	50,80	25,60	5,20	48,37	76,40
Germany	60,40	25,71	4,50	54,33	82,10
Greece	16,60	14,27	3,80	53,27	70,00
Hungary	62,40	28,06	5,10	53,87	83,80
Ireland	54,80	54,62	2,70	53,22	80,20
Italy	35,70	31,66	4,10	53,14	69,10
Latvia	52,20	30,83	5,30	52,18	79,10
Lithuania	31,40	32,72	4,90	55,88	80,40
Luxembourg	50,00	45,25	4,70	57,52	78,10
Malta	46,40	40,00	5,00	59,44	82,70
Netherland	65,20	58,61	5,10	51,76	83,80
Poland	24,30	17,51	4,60	53,84	80,10
Portugal	44,20	38,27	4,30	52,12	81,30
Romania	25,60	8,97	3,20	52,87	71,90
Slovakia	54,80	32,89	4,50	55,81	80,70
Slovenia	42,40	35,31	5,60	53,50	79,80
Spain	49,20	50,00	4,40	55,85	73,30
Sweden	73,90	51,08	7,10	50,81	84,70

The "education expenditures" variable refers to the percentage of government expenditures on education relative to the Gross Domestic Product (GDP) for the year 2022. Since separate data on expenditures for adult education was not available, general education spending has been considered. The "adult population rate" variable indicates the proportion of individuals aged 25-64 within the total population for the year 2023. The final variable, "adult employment rate," represents the employment rate of individuals aged 25-64 in 2023. The data used in the research are compiled from the Eurostat databases and presented in Table 2.

Findings

Analyses in the study are performed using SPSS 24. The dendrogram obtained using the Wards method of the hierarchical clustering methods, is given in Figure 1.

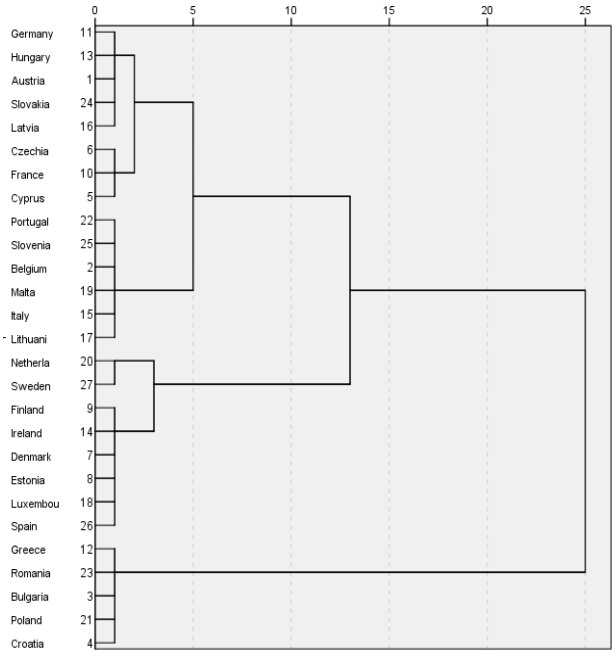

Figure 1. Dendrogram of European Union Countries According to Adult Learning

Based on the dendrogram obtained from the analysis of data on adult learning in European countries using Ward's method and the coefficients showing the distance between observations in the agglomeration schedule, it is determined that the appropriate number of

clusters is 4. The results of the k-means clustering analysis are presented in Table 3.

Table 3. K-means Cluster Analysis Results

Cluster	Countries	Number of countries
1	Denmark, Estonia, Finland, Ireland, Luxembourg, Netherland, Spain, Sweden	8
2	Belgium, Czechia, Italy, Lithuania, Malta, Portugal, Slovenia	7
3	Bulgaria, Croatia, Cyprus, Greece, Poland, Romania	6
4	Austria, France, Germany, Hungary, Latvia, Slovakia	6

When examining the countries in Cluster 1, which includes Denmark, Estonia, Finland, Ireland, Luxembourg, the Netherlands, Spain, and Sweden, it is observed that, except for Spain, most are Northern European countries. Cluster 2 consists of Belgium, Czechia, Italy, Lithuania, Malta, Portugal, and Slovenia. In Cluster 3, which includes Bulgaria, Croatia, Cyprus, Greece, Poland, and Romania, it is noted that, with the exception of Greece, these are the most recent countries to join the European Union. Cluster 4, which includes Austria, France, Germany, Hungary, Latvia, and Slovakia, is primarily made up of Central European countries with shared borders, except for Latvia.

Table 4. Cluster Centers

Variable names	Cluster 1	Cluster 2	Cluster 3	Cluster 4
V1	55,91	41,06	26,55	56,43
V2	51,80	34,23	14,97	29,11
V3	5,08	5,01	4,23	4,90
V4	53,03	53,75	53,42	53,29
V5	80,60	79,09	75,98	80,00

Table 4 shows the means of the variables within the clusters. Accordingly, the participation rates in education of adults are highest in Cluster 4 and lowest in Cluster 3. In this group, the proportion of individuals using the internet for any learning activity is highest in Cluster 1 and lowest in Cluster 3. When considering general government expenditure on education as a percentage of Gross Domestic Product (GDP), the highest value is in Cluster 1 and the lowest is in Cluster 3. The ratio of adults to the population is very similar across all clusters, so it can be considered nearly same. Lastly, the adult employment rate is highest in Cluster 1 and lowest in Cluster 3. Upon reviewing Table 4, it is noteworthy that the lowest values for all examined variables are calculated for Cluster 3, which includes the countries Bulgaria, Croatia, Cyprus, Greece, Poland and Romania.

Table 5. Distances Between Final Cluster Centers

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Cluster 1		23,072	47,340	22,714
Cluster 2	23,072		24,327	16,241
Cluster 3	47,340	24,327		33,308
Cluster 4	22,714	16,241	33,308	

Table 5 illustrates the distances between the final cluster centers. As the distance value increases, the similarity between the clusters decreases. Accordingly, the two closest clusters are Cluster 2 and Cluster 4, while the most distant clusters are Cluster 1 and Cluster 3.

In the k-means clustering analysis, an analysis of variance (ANOVA) is conducted to determine which variables are influential, and the results are presented in Table 6.

Table 6. ANOVA Table for K-means Clustering Method

Variables	Cluster Mean Square	Error Mean Square	F	Sig.
V1	1292,251	58,100	22,242	,000
V2	1617,595	19,324	83,708	,000
V3	,961	,768	1,252	,314
V4	,674	6,151	,110	,954
V5	27,024	17,902	1,510	,239

Upon examining Table 6, it is observed that there are no statistically significant differences among the cluster means based on the variables V3 (Education expenditures), V4 (Adult population rate), and V5 (Adult employment rate). On the other hand, significant differences are found among the cluster means for the variables V1 (Participation rate in education) and V2 (Internet use for any learning activity). To determine which clusters account for these differences, an ANOVA is conducted for these variables to further analyze the results.

First, the variable V1 (Participation rate in education) is examined, with Levene's statistic

(0.685) and its significance (0.570) indicating that the assumption of homogeneity of variances is met. To further investigate the differences among means, Tukey's post-hoc test is performed. The findings related to these tests are presented in Table 7.

Table 7. ANOVA Results for Participation Rate in Education

Cluster	Mean	Cluster	Mean Difference	Sig.
1	55,9125	2	14,85536*	0,005
		3	29,36250*	0,000
		4	-0,52083	0,999
2	41,0571	1	-14,85536*	0,005
		3	14,50714*	0,012
		4	-15,37619*	0,007
3	26,5500	1	-29,36250*	0,000
		2	-14,50714*	0,012
		4	-29,88333*	0,000
4	56,4333	1	0,52083	0,999
		2	15,37619*	0,007
		3	29,88333*	0,000

**The mean difference is significant at the 0,05 level.*

Upon examining Table 7, it is observed that there is no significant difference between the means of Cluster 1 and Cluster 4, while significant differences are found among all other pairwise cluster combinations. Notably, Clusters 4 and 1 are highlighted as having the highest mean values for participation rates in adult education. Similarly, for the variable V2 (Internet use for any learning activity), Levene's statistic (0.685) and its significance (0.570) are examined, indicating that the assumption of homogeneity of variances is met. Tukey's post-hoc test is again performed, and the findings are presented in Table 8.

According to Table 8, there is no significant difference between the means of Cluster 2 and Cluster 4, while significant differences are found among all other pairwise cluster combinations.

In assessing the distances between cluster centers, it was found that Cluster 2 and Cluster 4 are the closest, while Cluster 1 and Cluster 3 are the most distant, which aligns with previous observations. According to the results of analysis of variance (ANOVA) for k-means clustering, there were no statistically significant differences in the means of general government expenditure on education, the proportion of the adult population, and the rate of adult employment among the clusters. However, significant differences were found in the means of adult participation in education and the use of the internet for any learning activities.

Table 8. ANOVA Results for Internet Use for any Learning Activity

Cluster	Mean	Cluster	Mean Difference	Sig.
1	51,8025	2	17,57250*	0,000
		3	36,83417*	0,000
		4	22,69750*	0,000
2	34,2300	1	-17,57250*	0,000
		3	19,26167*	0,000
		4	5,12500	0,184
3	14,9683	1	-36,83417*	0,000
		2	-19,26167*	0,000
		4	-14,13667*	0,000
4	29,1050	1	-22,69750*	0,000
		2	-5,12500	0,184
		3	14,13667*	0,000

**The mean difference is significant at the 0,05 level.*

Specifically, there was no significant difference between the mean values of Cluster 1 and Cluster 4, which have the highest average rates of adult participation in education, while significant differences were observed between all other pairwise cluster combinations. This indicates that the rates of adult participation in education in the countries of Cluster 1 and Cluster 4 are statistically similar, whereas they differ significantly from those in the other clusters. Regarding the variable of internet usage for learning activities, no significant difference was found between the mean values of Cluster 2 and Cluster 4, whereas significant differences were present between all other pairwise cluster combinations.

Discussions and Conclusion

In today's world, where the value of knowledge is increasingly recognized, education has become a critical priority for countries aiming to evolve into knowledge societies and achieve economic competitiveness. As the European Union strives to become the world's most competitive and dynamic knowledge-based economy, it acknowledges the rapid evolution of workforce requirements and emphasizes the importance of adult learning. Adult learning plays a vital role in encouraging

individuals to engage in lifelong learning, contributing to both societal progress and economic development. By enabling individuals to enhance their skills and competencies, adult learning boosts their competitiveness in the labor market and supports economic growth. Particularly, digital skills, vocational training, and reskilling programs are essential for adapting the workforce to changing economic conditions.

The European Union promotes a culture of lifelong learning to support individuals in their personal and professional development. This approach enables individuals to adapt to evolving social and technological conditions and encourages the adoption of continuous learning as a way of life. Adult learning facilitates the enhancement of skills and competencies, thereby increasing individuals' competitiveness in the labor market and contributing to economic growth. Digital skills, vocational training, and reskilling programs are particularly crucial in ensuring that the workforce can effectively respond to changing economic circumstances.

Adult learning is a crucial tool for combating unemployment and increasing employment. Reskilling and professional development programs assist unemployed individuals in transitioning to new job sectors and enhancing their chances of finding employment. It equips adults with the necessary skills to effectively navigate the digital world. Specifically, digital literacy and technology adaptation are essential for individuals to succeed in both their professional and personal lives. Given the European Union's multicultural framework, adult learning programs help individuals communicate more effectively with people from diverse cultural backgrounds and strengthen social cohesion.

This study aims to categorize European Union countries based on adult learning within the framework of lifelong learning. Using Ward's method and k-means clustering techniques, a cluster analysis was conducted, resulting in the identification of four distinct country clusters. Additionally, by assessing the similarities and differences between these groups, it was determined that countries vary in terms of variables such as adult participation in education and the use of the internet for any learning activity. The results align with and expand upon existing literature, offering a comprehensive understanding of how different countries perform in terms of adult education and lifelong learning policies. By comparing these findings with prior research, the discussion emphasizes both similarities and novel contributions.

When considering the countries in Cluster 1, they are among those with the highest living standards globally. These countries excel in education, healthcare services, social welfare systems, and overall quality of life. They possess competitive, innovation-driven economies within the global market. Ranked among the top nations for educational attainment, Sweden, the Netherlands, Denmark, Finland, Ireland, and Luxembourg are included in this cluster. These countries are also among the wealthiest globally in terms of GDP per capita, with Luxembourg, Ireland, the Netherlands, and Denmark occupying the top four positions. These results are consistent with studies such as those by Dumicic, Milun, and Antic (2019), which demonstrated that wealthier and more developed countries tend to exhibit higher levels of adult participation in education. This cluster's strong performance in variables such as internet usage for learning and government expenditure on education reflects the advanced digital infrastructure and policy prioritization in these nations. Previous literature, such as Boeren (2016), highlights the critical role of systemic and institutional frameworks in enabling successful lifelong learning programs. Cluster 1 countries exemplify these dynamics, showcasing the benefits of consistent investments in education and digitalization. Despite their small populations, these nations exert significant economic influence. They are recognized for their high-tech industries, vibrant startup ecosystems, and robust digital infrastructure, frequently ranking at the top of innovation indices.

Belgium, Czechia, Italy, Lithuania, Malta, Portugal, and Slovenia, have been grouped into Cluster 2 due to the similarities they exhibit across the variables considered in this study. While Belgium and Italy, in particular, have well-developed industrial and service sectors, the other

countries also demonstrate significant activity across industrial, tourism, agricultural, and service sectors. Despite varying levels of development, these nations are either close to or exceed the European average in terms of GDP per capita. With the exception of Italy, they are categorized as small to medium-sized economies within the EU. This cluster, encompassing countries like Belgium and Italy, represents nations with diverse but relatively stable economies. The findings support the observations of Grześkowiak (2014), which identified middle-performing countries facing both opportunities and barriers in lifelong learning. This cluster's balanced approach to adult learning policies suggests that while progress has been made, additional efforts are needed to align these nations with the top-performing clusters. The significance of vocational education and reskilling programs, as discussed in European Commission reports (2006, 2007), is particularly evident in these countries, highlighting the role of targeted interventions in improving adult learning outcomes.

The countries in Cluster 3 generally rank among the lowest in educational attainment within the European Union. Bulgaria and Greece, in particular, were ranked the last and second-to-last, respectively, in GDP per capita in 2023, with Croatia, Romania, Poland, and Cyprus also falling below the European average. This cluster's low performance in adult participation rates and education expenditures aligns with earlier findings, such as those by Costantiello, Laureti, and Leogrande (2022), which identified disparities in lifelong learning opportunities among less economically developed EU nationsThese nations are categorized as small to medium-sized economies in Europe. Additionally, it is noteworthy that, except for Greece, the other countries in this cluster are among the most recent members of the European Union. Bulgaria, Romania, and Greece are key players in agricultural production and food exports, while Greece, Croatia, Cyprus, and Bulgaria are prominent destinations in the tourism sector. These countries rely heavily on EU funds for economic development, the enhancement of education policies, and infrastructure projects. The heavy reliance on EU funds for development and education policies underscores the importance of external support in addressing structural barriers. As noted by Crick, Broadfoot, and Claxton (2004), the interplay between individual, institutional, and systemic factors is critical in fostering lifelong learning. For Cluster 3 countries, the development of localized and inclusive adult education programs is essential to bridge these gaps.

In evaluating Cluster 4, it is notable that it includes Germany and France, which are the most populous countries in the cluster, making it the largest in terms of total population. Germany and France, recognized as significant economic powers within Europe, are also home to leading universities and research institutions, establishing themselves as frontrunners in science and technology. Austria, known for its robust economy and high standard of living, is distinguished by its well-developed educational system. This cluster, featuring Germany, France, and Austria, illustrates the dual dynamics of economic powerhouses and emerging educational initiatives. The findings align with Hwu and Peng's (2023) analysis of the significance of continuous learning and the adaptability of adult education programs to diverse learner profiles. The strong participation rates and educational attainment levels in this cluster emphasize the importance of aligning lifelong learning policies with national economic and social goals. In contrast, Hungary, Slovakia, and Latvia, with their smaller and developing economies, are experiencing improvements in educational standards and active participation in EU educational initiatives. The presence of developing economies like Hungary and Slovakia within this cluster further highlights the potential for knowledge transfer and the dissemination of best practices.

When evaluating the results across the variables, the participation rates of adults in education are highest in Cluster 4 and lowest in Cluster 3. The proportion of individuals using the internet for any learning activity is highest in Cluster 1 and lowest in Cluster 3. When considering general government expenditure on education as a percentage of Gross Domestic Product (GDP), the highest value is found in

Cluster 1, while the lowest is in Cluster 3. The ratio of adults to the total population is quite similar across all clusters, and thus can be considered nearly identical. Finally, the rate of adult employment is highest in Cluster 1 and lowest in Cluster 3. Overall, it has been observed that in regions with higher population density, adult participation in education is more prevalent, and the use of the internet for learning activities, education expenditures, and adult employment rates are higher in countries with advanced education systems and higher living standards.

Policymakers should focus on increasing adult participation in education, especially in countries where participation rates are low. They should target regions with lower levels of education and economic development by implementing localized adult education programs. The results obtained from this study highlight that economically advanced countries with high living standards also possess the highest levels of education. As digital skills become increasingly important for navigating the modern labor market, EU member states should invest more in digital literacy programs and vocational training. By focusing on adult learning, countries can increase employment, enhance the digital skills of adults, and contribute to greater societal awareness. It also aids in promoting social justice and increasing opportunities for equality. Countries with strong education systems, such as those in Cluster 1 and Cluster 4, should be encouraged to share successful adult learning models with countries in Cluster 3. Education programs should include elements of cultural integration, social justice, and citizen participation, thus promoting stronger, more inclusive communities.

The study's findings highlight the need for differentiated policy strategies across clusters. For example, countries in Cluster 3 could benefit from adopting successful models from Clusters 1 and 4, focusing on digital literacy, vocational training, and workforce reskilling. The disparities identified in education expenditure and participation rates underscore the importance of equitable resource allocation and tailored interventions. As emphasized by Merriam and Bierema (2013), adult education should not only address economic imperatives but also foster personal and societal development, encouraging active citizenship and cultural integration.

This study contributes to the literature by providing a comparative and classificatory analysis of adult learning across EU countries, using updated data and methodologies such as cluster analysis. The literature encompasses numerous studies on adult learning in Europe, with the majority being descriptive and focusing on the development of adult learning within individual countries. However, this study addresses adult learning in the context of evolving educational and training processes, particularly in the post-pandemic period, shaped by technological advancements and emerging opportunities. Rather than being merely descriptive, this research takes a more comparative and classificatory approach. Unlike descriptive studies, it offers a nuanced understanding of how countries align with or diverge from each other in terms of lifelong learning indicators. Expanding the study's scope to include additional countries with accessible data would allow for broader regional or continental analyses. Additionally, future studies could incorporate qualitative analyses to explore the lived experiences of learners and educators, enriching the quantitative findings presented here. The insights derived from this study, which may serve as a preliminary foundation for research on adult education in the European Union, are anticipated to make a meaningful contribution to the relevant literature.

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