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Adult Participation in Learning in Digital Age: Profiles of Clustered European Union Countries

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Abstract*: In this paper, we investigated whether and to what extent digitalisation and research intensity in a country (e.g. Slovenia, Croatia) affect the participation of adults in learning (APinL). Statistical analysis for EU28 countries for 2018, carried out by combination of different statistical methods highlighted strong positive correlations of APinL and selected variables (human capital; use of internet services; integration of digital technology; research expenses in GDP - GERD). Clustering and profile chart analysis clearly revealed three clusters of countries differing by achieved level of digitalisation, which conforms closely to the level of APinL. High APinL in digitally advanced countries could be mainly assigned to increased educational needs and new innovative education forms.*

Keywords: *cluster analysis; Digital Economy and Society Index (DESI) dimensions; Gross Domestic Expenditure on Research and Development (GERD); profile chart.*

JEL codes: *C31, C38, D83*

Udeležba odraslih v izobraževanju v digitalni dobi: profili držav Evropske unije po skupinah, oblikovanih po metodi razvrščanja

Povzetek: *V tem prispevku smo raziskali ali in v kolikšnem obsegu digitalizacija in raziskovalna intenzivnost v državi (na primer v Sloveniji, Hrvaški) vplivata na vključenost odraslih v izobraževanje. Statistična analiza za 28 držav EU za leto 2018, ki smo jo izpeljali s kombinacijo več različnih statističnih metod, je pokazala močne pozitivne povezave med vključenostjo odraslih v izobraževanje in izbranimi spremenljivkami (človeški kapital; uporaba internetnih storitev; integriranost digitalne tehnologije; delež raziskovalnih izdatkov v bruto domačem proizvodu). Z metodo razvrščanja in grafično analizo profilov smo odkrili tri zelo različne skupine držav glede na raven digitalizacije, s katero se zelo dobro ujema raven vključenosti odraslih v izobraževanje. Visoko vključenost odraslih v izobraževanje v bolj digitaliziranih državah lahko v glavnem pripišemo povečanim izobraževalnim potrebam in tudi novim, inovativnim, tehnološko podprtim oblikam izobraževanja v teh državah.*

Ključne besede: *izobraževanje odraslih; analiza skupin na osnovi razvrščanja; Dimenzije indeksa digitalne ekonomije in družbe (DESI); bruto domači izdatki za raziskave in razvoj (GERD); grafikon profila.*

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1 Introduction

Adults' learning is one of the indispensable topics of national education policies and important also for quality life and successful professional development of and individual in today society characterised by continuous social, economic, demographic and technological changes. In this paper, a special attention is devoted to the analysis of impact of different factors related to digital and innovative society on adult participation in lifelong learning. Several variables have been examined and analysed regarding both, direction and strength of existing correlations with share of adults that are participating in learning, with a goal of building valid and meaningful regression models, and recognizing comprehensive clusters of similar countries regarding all the variables considered within European Union. The pattern of revealed differences among the clustered countries could discover elements, which encourage and stimulate adults to continue learning after regular formal education.

Percentage of adults participating in lifelong learning, i.e. Adult Participation in learning indicator (APinL) belongs to official statistic development indicators in EU. Eurostat named it simply Lifelong Learning until 2016, but since then it changed the name to Adult Participation in Learning, always being defined as percentage of population aged 25 to 64. An increasing value of APinL has many beneficial effects for an individual and for society. Engagement of adults in learning and training leads to the improvement of individual's competences and skills including various dimensions of literacy, and thus enhancing individual's perspective for employability at labour market and with increased employment pushing also economy growth. It also facilitates social advancement regarding digital readiness of individuals for many important issues, like better usage of internet services, participation in democracy development using more adequate information on time, online learning, better citizenship, self-employment, etc. A higher value of APinL indicator could raise individual satisfaction of adults of all generations, enabling older (silver) population to easily use medical and social care support and services by themselves (European Commission, 2019e). A focus on adult learning is, therefore, vital for Europe to overcome economic challenges it is currently facing, as well respond to the demand for new skills and sustained productivity in an increasingly digitalised world economy (European Commission, 2019f). Considering this overarching goal of adult learning, study of the impact of digital and innovative society factors on adult learning deserves an attention regarding analysing both, direction and strength of existing correlations, with a target of building valid and meaningful regression models, and comprehensive clusters of countries within European Union. After exploring impacts of several digital society and economic development indicators on APinL, four among them were selected for statistical exploration and multivariate analysis, with the goal to ensure comprehensive conclusions with focus on them, leaving the other considered indicators as groups of variables for the future multivariate investigation when explaining their impact on APinL over countries and over time.

A number of our previous research reports and articles on the topic of lifelong learning and so on APinL, are published, as well. Dumičić (2013) conducted multivariate analysis of life-long learning indicator in European countries, while Dumičić and Milun (2018) focused on a case of Croatia regarding adult learning as an opportunity for improving statistical literacy of decision makers.

Paper by Dumičić, Milun and Antić (2019) analysed adult participation in lifelong learning centring education as a resource for decreasing skill gaps in terms of better employability in 33 European countries. The variable APinL is shown to be positively correlated with many variables considered, with Gross Domestic Product per capita in Purchasing Power Standards (Pearson correlation was r=0.5404); with employment rate (r=0.5462); with Participation rate in education and training, as % of persons with tertiary education (levels 5-8) (r=0.5242); and, expectably, the strongest correlation was recognized between APinL and Individuals who have basic or above basic overall digital skills, (r=0.8032). The lower levels of education variables (0-2 and 3-4) shown to have very weak negative correlation with APinLL, and therefore these variables were excluded from regression analysis. Sweden, Finland and Denmark, with the highest level of ICT and digital performances had in 2017 very high level of both, APinL and Gross Domestic Product per capita, as well.

In Dumičić, Milun and Antić (2019), it might be seen, that in 2017 the same countries were positioned at the top and the same at the bottom when ranked according to APinL or according to Internet u7se for doing online course variables.

Scandinavian countries, led by Sweden were ranked highly, at the top, and Bulgaria and Romania have been at the bottom for both variables.

According to strategic document "Europe 2020" adults' participating level in lifelong learning is targeted at 15% by 2020 (European Commission, 2010). According to Eurostat data, this indicator set an increase in many European countries, being for the EU28 aggregately in 2006 at 9.6%, and in 2017 at 10.9%. In many European Union's countries, it was in 2017 still below 10%. In Croatia, APinL fell from 3% in 2006 to 2.5% in 2017, and North Macedonia decreased in the same period from 2.9% to 2.4%. In Slovenia, in the same period APinL dropped down from 15.2% to 12%. In 2017, among the developed European countries, the highest value of 30% was present in Sweden, while in developed Germany, it was surprisingly low with only 8.5%.

In 2017, according to Dumičić and Milun (2018) adults' participation in lifelong learning indicator was positively correlated with the following variables: Gross Domestic Product per capita, employment rate, and percentage of higher educated persons. The strongest positive correlation was found with percentage of those having basic or above basic digital skills. It showed weak negative correlations with secondary and elementary education level indicators. Two valid regression models described impact factors of APinL. Four clusters of similar countries were designed. Some of them included certain countries opposite to our expectations. Thus, economically developed Belgium, Germany, Italy and some other countries were classified in the cluster consisting mainly of less developed countries. Exploring data using descriptive statistical methods and performing cluster and regression analysis for 33 European countries, the paper by Dumičić, Milun and Antić (2019) investigates the economic and the information and communications technology (ICT) development indicators' impacts on adults' participation in lifelong learning indicator. Regarding the considered variables, the clusters of European countries were recognized. Authors evaluated possibility of reaching 15% target value of APinL in the EU28, as the European Commission (2010) projected. The paper by Dumičić and Žmuk (2017) provides a description of the unexploited potential of Croatian enterprises due to their limited education regarding statistical methods acquaintance level, and their use respectively. In Dumičić and Žmuk (2018), lifelong learning development level is analysed in selected European countries with a perspective for improving statistical literacy, as well. Both papers are emphasising the role of digital literacy. Recent methods of reasonably priced learning are commonly related to the Internet usage. The paper by Păvăloaia et al. (2019) studied Romanian case regarding the public sector employees' digital maturity and attitude concerning the lifelong learning, as an element of Education for Sustainable Development (ESD). In European Commission (2018), the outcome of technological development on EU and EU countries national policies is analysed and reported, stressing the significance of new skills agenda and the key competences developing needed for lifelong learning related to digital skills. This document reports on recent employment and social developments in Europe, showing quarterly tendencies by sectors and population cohorts.

The mentioned research results indicate that in addition to traditional development factors there are some other elements, which have to be considered when investigating today adult learning landscape. Nowadays, if the workforce and citizenship training and learning should be efficient and successful, they should rely on the digital society advantages to increase the noticed skill shortage as compared to the labour market demand. Possibilities of lifelong learning enable workforce to raise skills and competences on literacy, reading, writing, maths language, communication and others. E-learning and online learning are of prime importance for increasing adult rate participation in learning, since they considerably improve access and flexibility of education, being both among the key drivers for making education feasible for adults.

2 Research outline

Following the findings of our previous research, we decided to introduce dimensions of digital and innovative society into analysis of APinL in EU. In EU, overall Digital Economy and Society Index DESI index (European Commission, 2019d) is used for monitoring the state of digital society.

DESI is a composite index that condenses 30 relevant indicators on Europe's digital performance, currently monitoring the evolution of EU28 countries performances, tracking the five DESI dimensions: Connectivity, Human Capital, Use of

Internet Services, Integration of Digital Technology, and Digital Public Services. DESI has been calculated as the weighted average of the five DESI dimensions: 1- Connectivity (25%); 2- Human Capital (25%); 3- Use of Internet (15%); 4- Integration of Digital Technology (20%); and 5- Digital Public Services (15%). Therefore, regarding analysing the variable that expresses the percentage APinL, it seems to be challenging to evaluate the impacts of each of DESI dimensions to that variable.

According to European Commission (2019d), the first, Connectivity dimension measures the distribution of broadband infrastructure regarding its quality, for which an admittance to fast broadband-enabled services is a basic circumstance for competitiveness. The fifth, Digital Public Services dimension measures the digitisation of government and public services, centring on e-Government and e-Health as the prerequisites for easier living and citizenship. Modernisation and digitisation of public services can lead to efficiency gains for the public administration, citizens and businesses alike. In this research only the second, the third and the fourth DESI dimensions appear to be significant in the regression models developed for explanation of the main variable Y_APinL2018: Human Capital dimension, Use of Internet Services dimension and, finally, Integration of Digital Technology dimension. The Human Capital dimension measures the skills required to make digital advantage possible. The Use of Internet Services dimension enables online activities, including consumption of online content, like games etc., communicating by video calls as well as online ordering and buying goods or services. The Integration of Digital Technology dimension measures the digitisation of enterprises and e-commerce. By adopting digital technologies, businesses can develop efficiency, cut costs and better involve customers and business partners. Moreover, the Internet is a kind of outlet for sales, which simplify access to markets, increasing their size growth and removing the borders. In addition to the selected three dimensions of DESI Index (Human Capital; Use of Internet Services; Integration of Digital Technology) we introduced into analysis also indicator of Gross Domestic Expenditure on R&D (GERD). According to Eurostat (2019b), these indicators measures percentage of gross domestic expenditure on R&D of all sectors (business sector, government, higher education, non-profit sector) in Gross Domestic Product (GDP). After the OECD Frascati Manual (2002), research and experimental development (R&D) cover inventive work undertaken in order to increase knowledge, including culture and society and the use of this knowledge to invent new applications. We assume that encouraging favourable conditions and enhancing R&D as expressed by GERD generates the needs for new knowledge and competences and thus stimulates adult participation in learning.

We found it interesting to analyse the impact of the three DESI dimensions and of the share of GERD on APinL simultaneously. On one hand, the level of the selected factors frames the conditions, and on the other hand, they create the needs for adult learning. Higher level of human capital encourages higher participation in lifelong learning. Similar impact on APinL by GERD could be expected, since its higher share contributes to stimulation of an innovative environment and creates needs for continuous professional development. Higher rate of integration of digital technology and use of internet service point highly digitalised environment, which assures favourable conditions for modern, innovative adult learning and training.

Research questions would be, whether and to what extent selected DESI dimensions and GERD affect the APinL performance. The research hypothesis was set as follows: Percentage of adults practicing lifelong learning, expressed as APinL, is highly correlated with DESI dimensions Human Capital, Use of Internet Services, and Integration of Digital Technology, as well as with GERD. Level of the values of the mentioned variables might influence clustering of similar countries within EU28. In this research paper, this assumption was tested using data exploration, Pearson correlation, hierarchical cluster and profile chart analysis.

This paper uses Eurostat data for the EU28 countries on five variables, Table 1. Adult participation in learning (Y_APinL2018), as the main variable under study, is treated as a dependent variable in correlation with four independent variables. Y_APinL2018 is the percentage of population aged 25 to 64, in 2018 participating in formal and non-formal education and training. The reference period for the participation is four weeks preceding the interview according to the methodology of Labour Force Survey. Eurostat (2019c). This analysis includes three selected DESI dimensions for 2018. Since the GERD data for 2018 are still not available, the last available data for 2017 were used, assuming that a one-year delay is acceptable, allowing that the real effect of GERD on APinL could be visible one year afterwards.

Table 1: List of variables

Notation	Variable	Data source
Y_APinL2018	Adult participation in learning (% of population aged 25 to 64) in 2018	Eurostat, 2019a
HC(w)2018	DESI dimension Human Capital (weighted)	European Commission, 2019a
UseInt(w)2018	DESI dimension Use of Internet (weighted)	European Commission, 2019c
IDigitTech(w)2018	DESI dimension Integration of Digital Technology (weighted)	European Commission, 2019b
GERD2017	Gross domestic expenditure on R&D for all sectors (% of GDP) in 2017	Eurostat, 2019b

Source: Authors' creation.

3 Results

3.1 Trends for APinL in EU28, Croatia and Slovenia

The trend analysis for APinL was performed in the period 2002 to 2018, Figure 2. According to Figure 1, the EU28 data for APinL in 2002 was 7.1% and in 2018 it was 11.1%, and Ordinary Least Square (OLS) estimated linear trend appeared to be most adequate, with coefficient of determination R^2=0.74), and a slope showing a yearly increase of 0.18 percentage points, and the linear trend forecast in 2020 of close to 11.5% for APinL, which is visibly below strategically planned 15%.

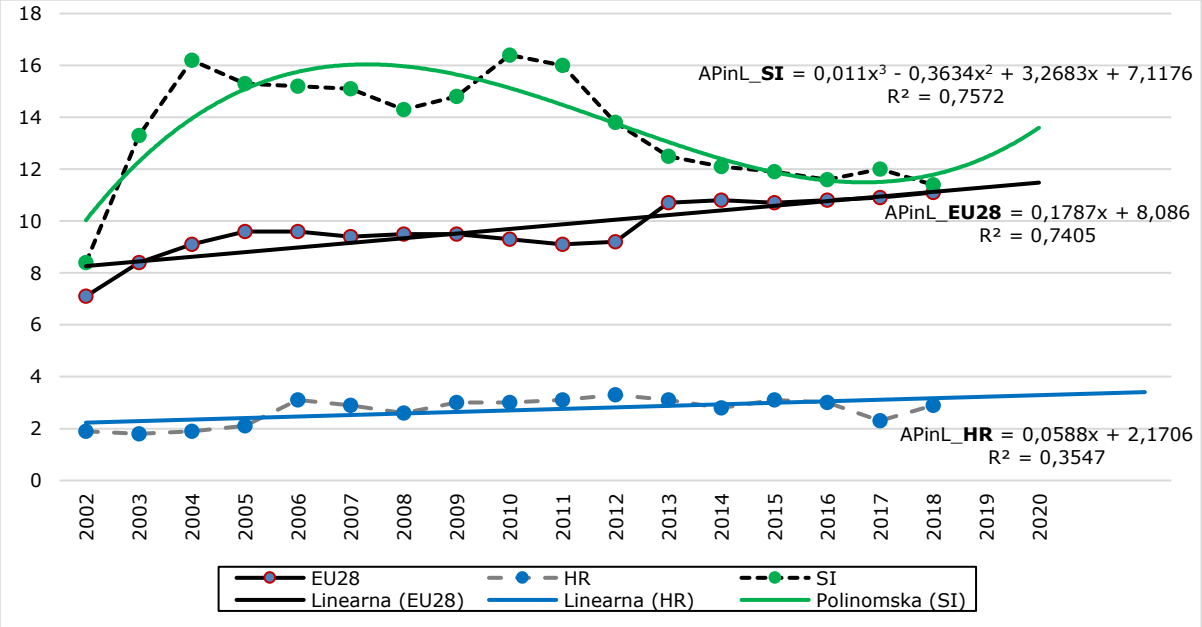

Figure 1: Adult participation in learning in EU28, Slovenia and Croatia, over the period 2002 to 2018, and trends forecasts to 2020. Source: Authors' creation, Eurostat data.

In Croatia, APinL in 2002 equals 1.9% and in 2018 it was 2.9%, being with 2.3% at the bottom in 2017. The OLS estimated linear trend appeared to be most adequate (with coefficient of determination R^2=0.36), with a slope showing a yearly increase of 0.05 percentage points, and a forecast in 2020 of close to 3.1% for APinL.

In Slovenia, data for APinL in 2002 was 8.4% and in 2018, it was 11.4%, being with 16.4% at the top in 2010 and 16.2% in 2004. After 2010, sharp slowdown followed which could be assigned to economic crisis accompanied by severe financial restrictions of adult education, in particular in public sector. The OLS estimated third order polynomial trend appeared to be most adequate (R2=0.75), and a rather optimistic forecast in 2020 of close to 13.7% for APinL.

3.2 Exploratory data analysis for each variable

In Tables 2 and 3, descriptive statistics for all variables for EU28 countries in 2018 are given, where top and bottom countries are especially notified.

Table 2: Descriptive statistics, EU28 countries in 2018

	Variable				
Descriptive statistic	*Y_APinL2018*	*HC(w)2018*	*UseInt(w)2018*	*IDigitTech(w)2018*	*GERD2017*
count	28	28	28	28	28
mean	11.49	12.19	7.93	8.43	1.57
sample std. deviation	7.55	3.27	1.71	2.67	0.88
minimum	0.90	7.13	4.79	3.63	0.50
maximum	29.20	19.38	11.11	13.74	3.40
range	28.30	12.26	6.32	10.12	2.90
skewness	0.91	0.44	0.27	0.19	0.75
kurtosis	0.20	-0.54	-0.40	-0.55	-0.59
Coeff. of variation	65.70%	26.81%	21.53%	31.66%	56.19%
Country at min.	Min_RO	Min_BG	Min_RO	Min_BG	MIn_RO
Country at max.	Max_SE	Max_FI	Max_DK	Max_IE	Max_SE

Source: Authors' calculation. Eurostat data.

Data distributions for all variables are positively skewed and differently dispersed, Table 2. The greatest coefficient of variation (CV) appears for Y_APinL2018, CV=65.7%, where the highest skewness 0.91 is found, as well, followed by GERD2017, with CV=56.19% and skewness amounted 0.75. Therefore, it would be useful to compare their average values, 11.49% and 1.57%, with their medians, given in Table 3, which are 9.4% and 1.31%, respectively. The UseInt(w)2018 data distribution is the less dispersed over 28 countries with the mean of 7.93 weighted scores and CV= 21.53%, having the median of 7.59 weighted scores.

Table 3: Descriptive statistics, EU28 countries in 2018

Variable	Y_APinL2018	HC(w)2018	UseInt(w)2018	IDigitTech(w)2018	GERD2017
1st quartile	6.45	9.89	6.98	6.81	0.89
median	9.40	11.67	7.59	8.08	1.31
3rd quartile	15.83	14.28	9.09	10.05	2.04
interquartile range	9.38	4.39	2.11	3.24	1.15
mode	8.50	#N/D	#N/D	#N/D	1.35

Source: Authors' creation. Eurostat data.

Table 4: Normal curve Goodness-of-Fit test (GOF), EU28 countries in 2018

Variable	Y_APinL2018	HC(w)2018	UseInt(w)2018	IDigitTech(w)2018	GERD2017
p-value	0.172	0.246	0.666	0.206	0.246
chi-square(df=3)	5.000	4.143	1.571	4.571	4.143

Source: Authors' creation. Eurostat data.

When testing for normality, a Chi-square GOF test was performed, as given in Table 4, which allow the conclusions that, at 5% significance level, for all five variables, the null hypothesis that the distributions of data are normal may not be rejected. The outliers' exploration also proved that assumption for all the variables, since neither serious, nor mild outliers are present.

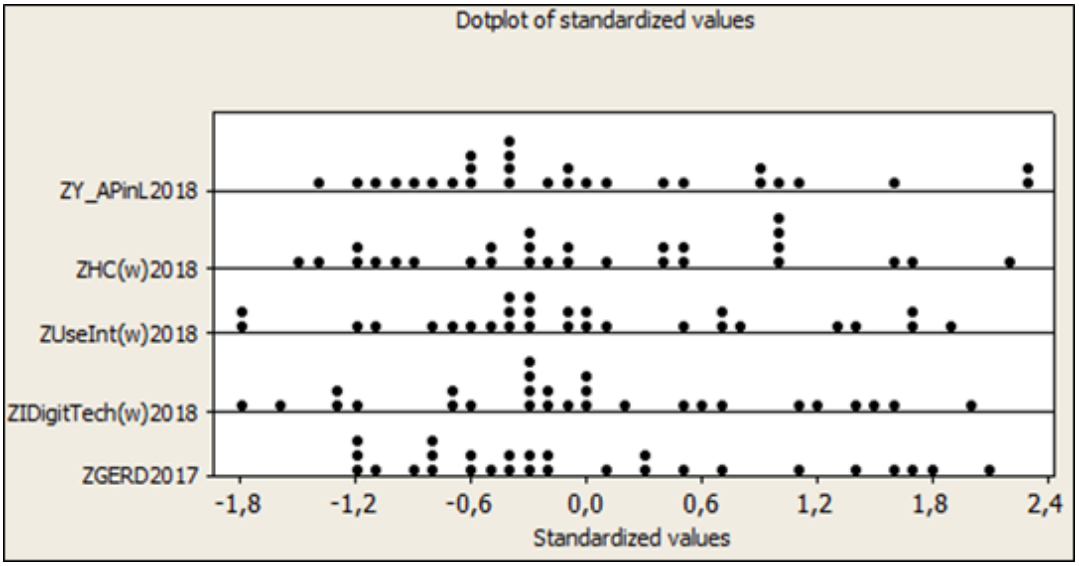

Figure 2: Dot Plots of standardized values for all five variables, EU28 countries in 2018. Source: Authors' creation, Eurostat data.

Figure 2, with multiple Dot Plots, and Figure 3, with multiple Box Plots, compare the data dispersions based on standardized values. The highest variability is seen at ZY_APinL2018 and ZGERD2017, supporting the numerical results from Table 2. No outliers exist for any of the data distributions considered.

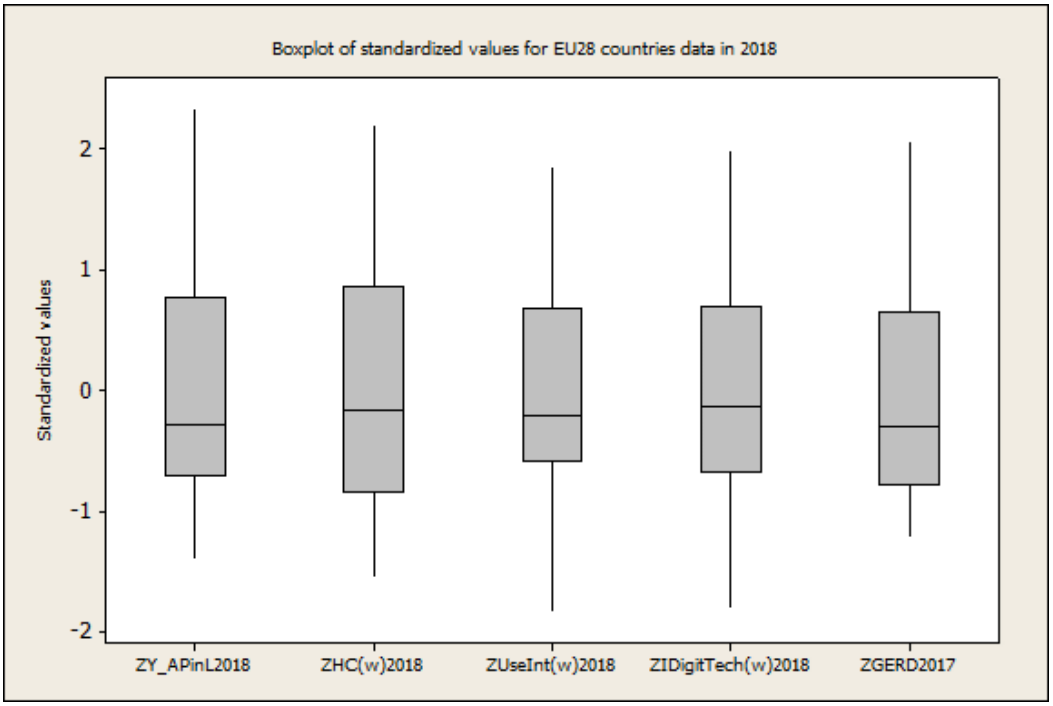

Figure 3: Box Plots of standardized values for all five variables, EU28 countries in 2018. Source: Authors' creation, Eurostat data.

Focusing on APinL2018 only, regarding its high its variability might be tested using Anderson Darling normality test, with p-value of 0.041, giving enough evidence at 1% significance level, that the APinL2018 distribution might be normal, Figure 4.

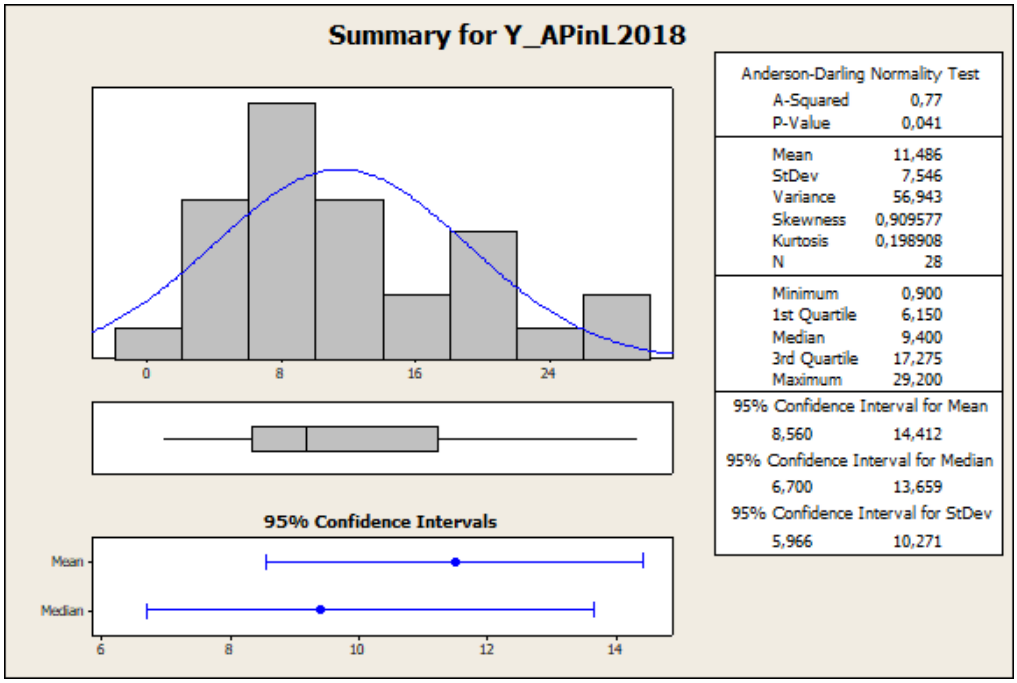

Figure 4: Summary statistics for APinL, with Anderson Darling normality test included, EU28 countries in 2018. Source: Authors' creation. Eurostat data

Focusing on GERD2017 only, regarding its high its variability might be additionally tested for normality using Anderson Darling test, with p-value of 0.012, giving enough proof at 1% significance level, that the GERD2017 distribution might be normal, Figure 5.

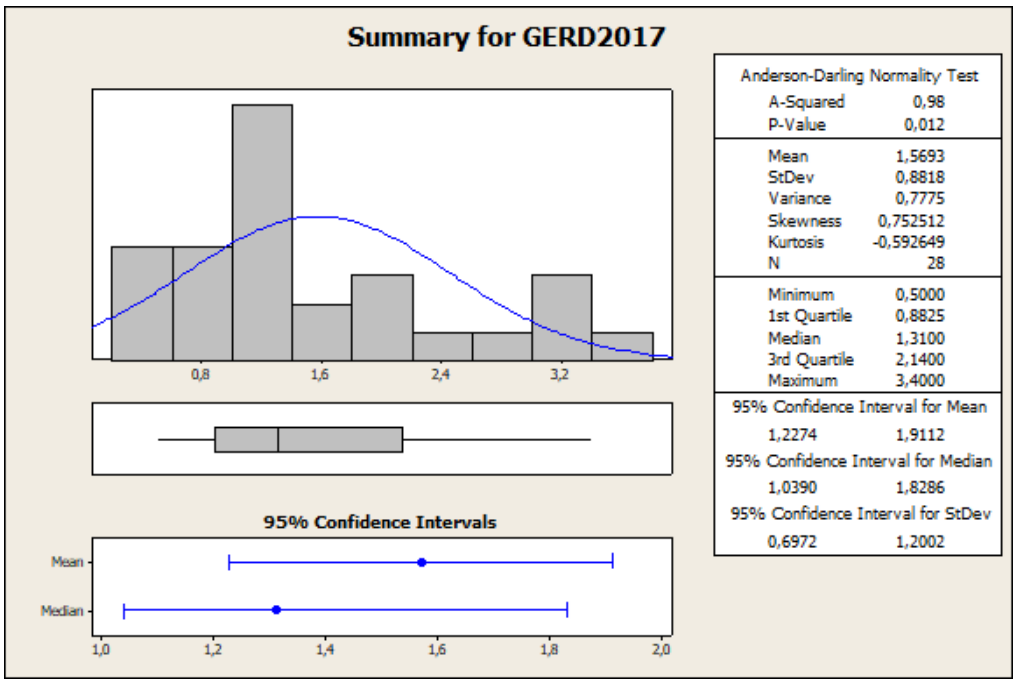

Figure 5: Summary statistics for GERD2017, with Anderson Darling normality test included, EU28 countries in 2018. Source: Authors' creation, Eurostat data

Figure 4 and Figure 5 are showing that both variables, Y_APinL2018 and GERD2017, having very high coefficients of variation, might influence the forming of clusters of countries. Figure 6 shows DESI index broken into five dimensions in the EU28 countries in 2018.

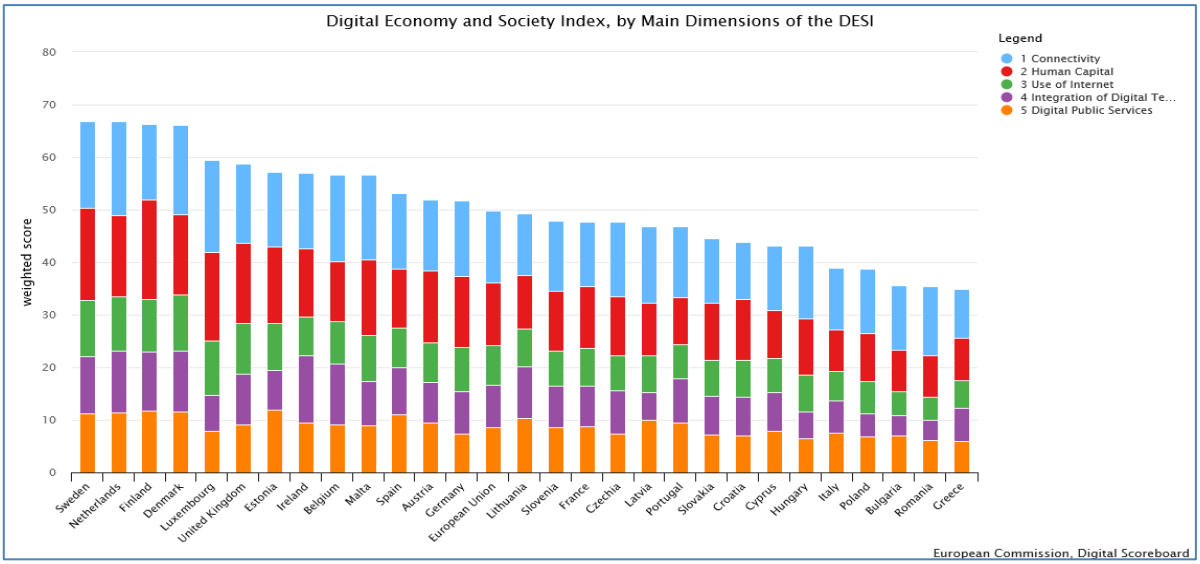

Figure 6: DESI composite index with DESI dimensions, EU28 countries in 2018. Source: European Commission (2019c).

Figure 6 presents DESI composite index with the structure of five dimensions in the EU28 countries in 2018. The leading country is Sweden with overall weighted DESI of 65%, followed by the Netherlands, Finland and Denmark with very similar score. Greece is positioned at the very bottom, with 45%, having neighbours Romania and Bulgaria very close. Both, Slovenia and Croatia are ranked below the EU28 average, Slovenia lagging two ranks and Croatia positioned in the middle among below-average countries.

3.3 Correlation analysis

Correlation matrix with Pearson coefficients shows primarily the correlations of the dependent variable Y_APinL2018 towards all the others, showing also all other possible correlations, as given in Table 5.

Table 5: Correlation matrix for five variables, EU28 countries in 2018

Variables	Y_APinL2018	HC(w)2018	UseInt(w)2018	IDigitTech(w)2018	GERD2017
Y_APinL2018	1.000				
HC(w)2018	0.860	1.000			
UseInt(w)2018	0.821	0.913	1.000		
IDigitTech(w)2018	0.639	0.674	0.764	1.000	
GERD2017	0.687	0.611	0.585	0.515	1.000

Source: Authors' calculation, Eurostat data.

All Pearson correlation coefficients are positive and quite strong. The strongest positive correlation is found between the variable Y_APinL2018 and HC(w)2018, followed by the correlation with UseInt(w)2018, GERD2017 and it is the weakest with IDigitTech(w)2018.

4 Cluster analysis and discussion

4.1 Hierarchical cluster analysis

Figure 7 shows the hierarchical clustering resulted dendrogram, with Ward linkage and squared Euclidean distances, applied on standardized data for Y_APinL2018 and four other considered variables for the EU28 countries in 2018. The countries included within each cluster are listed in Table 6.

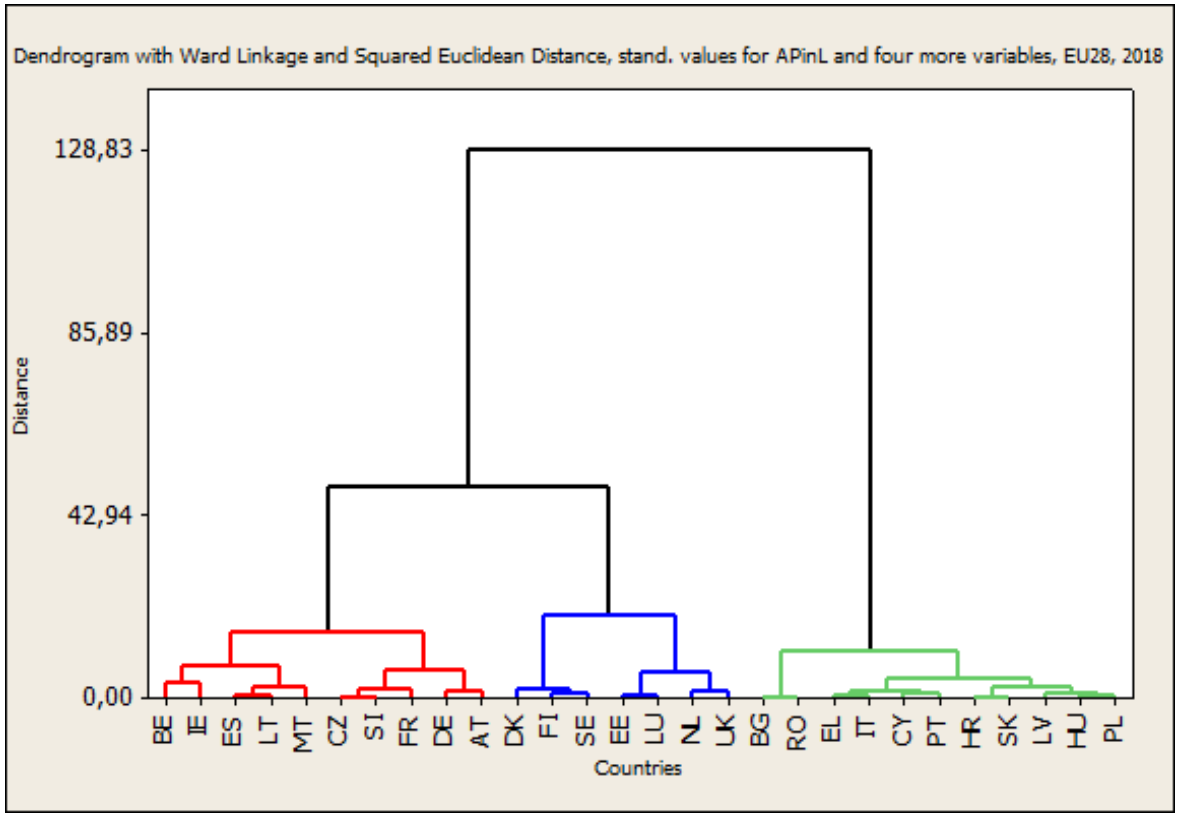

Figure 7: Dendrogram with standardized data on five variables, Ward linkage and squared Euclidean distances, EU28 countries in 2018. Source: Authors' creation, Eurostat data

Table 6: Hierarchical clustering three-cluster solution

Cluster titles	*No. of countries*	*Countries*
Cluster 1: Countries entering digital society	10	Belgium, Ireland, Spain, Lithuania, Malta, Czechia, **Slovenia**, France, Germany, Austria
Cluster 2: Lagging digital society countries	11	Bulgaria, Romania, Greece, Italy, Cyprus, Portugal, **Croatia**, Slovakia, Latvia, Hungary, Poland
Cluster 3: Leading digital society countries	7	Finland, Sweden, Denmark, Netherlands, Estonia, Luxembourg, United Kingdom

Source: Authors' creation, Eurostat data

As the result of cluster analysis, three quite homogenous groups of countries were designed. The key difference among these groups is general level of the digitalisation of the countries is in part visible in profile charts in Figures 8, 9 and 10, respectively. We named the clusters accordingly: lagging digital society countries (cluster 2), countries entering digital society (cluster 1), and leading digital society countries (cluster 3).

Table 7: Distances between cluster centroids

Cluster titles	Cluster 1: Countries entering digital society	Cluster 2: Lagging digital society countries	Cluster 3: Leading digital society countries
Cluster 1: Countries entering digital society	0.0000	2.2268	2.4479
Cluster 2: Lagging digital society countries	2.2268	0.0000	4.4569
Cluster 3: Leading digital society countries	2.4479	4.45693	0.0000

Source: Authors' creation, Eurostat data

Table 7 includes distances between Custer centroids. The largest distance is found between Cluster 2 for Lagging digital society countries, which might be considered in general as the less developed within EU28, and Cluster 3 for the most developed Leading digital society countries, which does not surprise.

4.2 Profile charts within clusters: position of Croatia and Slovenia

Profile charts are useful in displaying position of countries regarding more standardized variables, as given in Figures 8, 9 and 10.

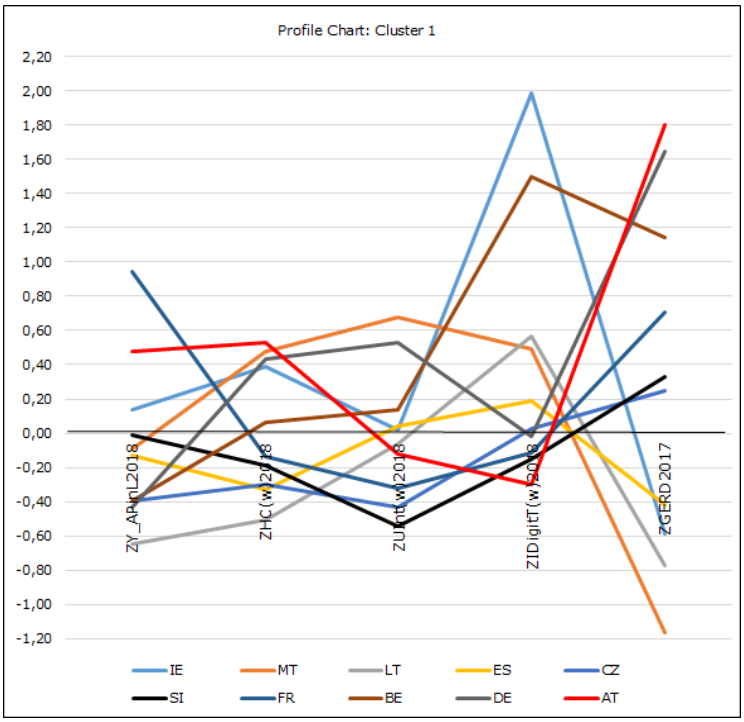

Figure 8: Profile chart for Cluster 1 "Countries entering digital society",-with Slovenia (SI). Source: Authors' creation, Eurostat data

Table 8: Top and bottom positioned countries within Cluster 1, 10 EU28 countries in 2018

	ZY_APinL2018	ZHC(w)2018	ZUInt(w)2018	ZIDigitT(w)2018	ZGERD2017
Min	Min_LT	Min_LT	Min_SI	Min_AT	Min_IE
Max	Max_IE	Max_AT	Max_MT	Max_IE	Max_AT

Source: Authors' creation. Eurostat data

All the countries classified in Cluster 1 perform adult learning participation (APinL) rather close to EU28 average, the only exception is France. Near to the average are also the values of variables indicating dimensions of human capital, use of internet services and integration of technology, with some substantial upward deviations (Czech and Belgium for dimension of integration of technology). GERD exhibits the highest variability.

It is interesting to analyse profile at country level separately. Here, we focus on Slovenia. Generally, profile of Slovenia is not very favourable since majority of the variables examined exhibit values below or near to EU28 average. The most problematical is the usage of internet services, which is the lowest among all countries of the cluster. Notably below the average are also indicators of human capital and integration of digital technology. At the average level is adult participation in learning, while share of expenses on R&D (GERD) deviates upward. Decomposition of the former indicator by sectors pointed that high value of GERD in Slovenia is due to extremely high share of R&D expenses in business sector (Slovenian Research Agency, 2019). However, this sector has only indirect and smaller effect on adult learning compared to expenses in higher education and government. Factors, which assure favourable conditions and initiatives for lifelong learning in digital society in Slovenia, are not very encouraging in long run, although short term forecast for meeting Europe 2020 target on APin L next year is quite optimistic.

Table 9: Top and bottom placed countries within Cluster 2, 11 EU28 countries in 2018

	Variables				
Data value	ZY_APinL2018	ZHC(w)2018	ZUInt(w)2018	ZIDigitT(w)2018	ZGERD2017
Min	Min_RO	Min_BG	Min_RO	Min_BG	Min_RO
Max	Max_PT	Max_HR	Max_HR	Max_PT	Max_IT

Source: Authors' creation. Eurostat data

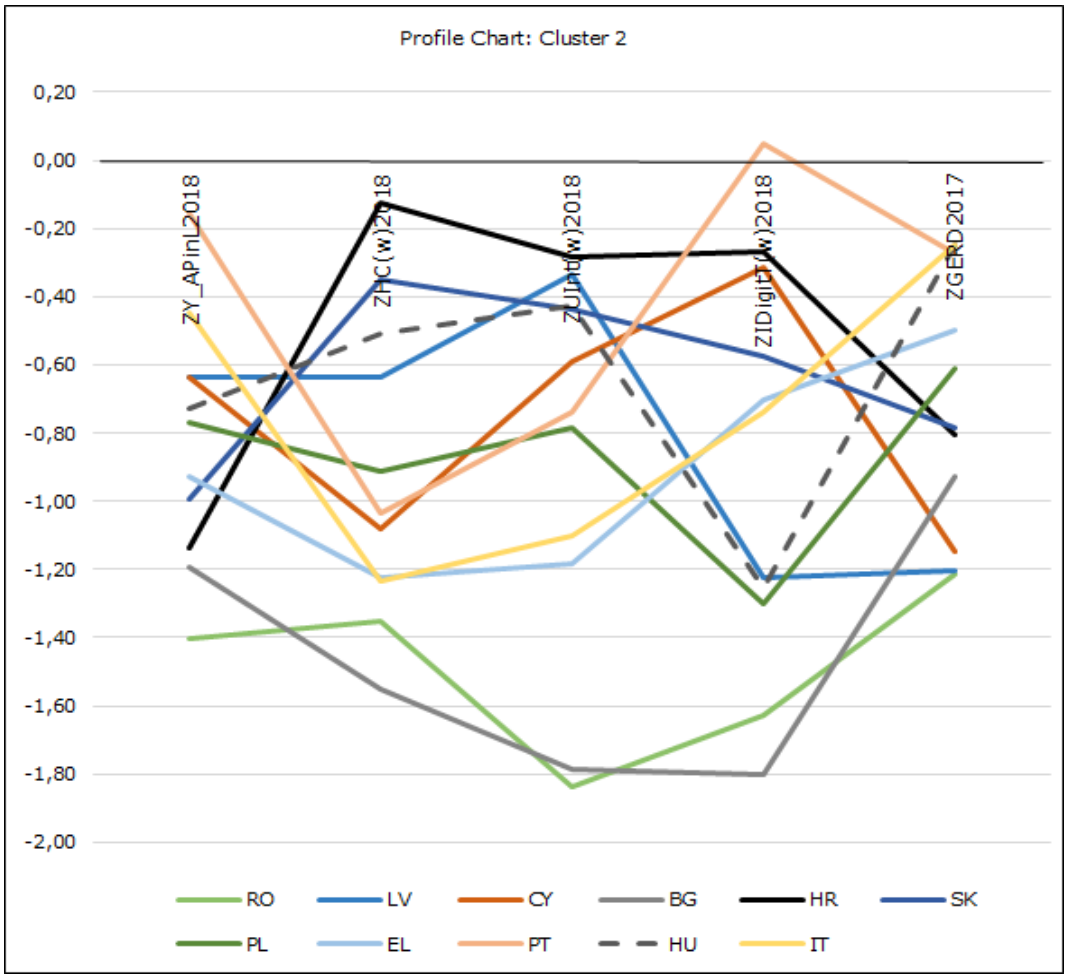

Figure 9: Profile chart for Cluster 2 "Lagging digital society countries", with Croatia (HR). Source: Authors' creation, Eurostat data

Striking feature of the cluster 2 is that all countries are considerably below EU28 average, with some serious downward extremes (Romania and Bulgaria). Croatia is at the top of these lagging countries, not so distant form EU28 average level, except for adult participation rate and GERD, where Croatia is close to the bottom countries. This indicates that

Croatia is paying too little attention to research and adult education, two key drivers of competitiveness of a modern society.

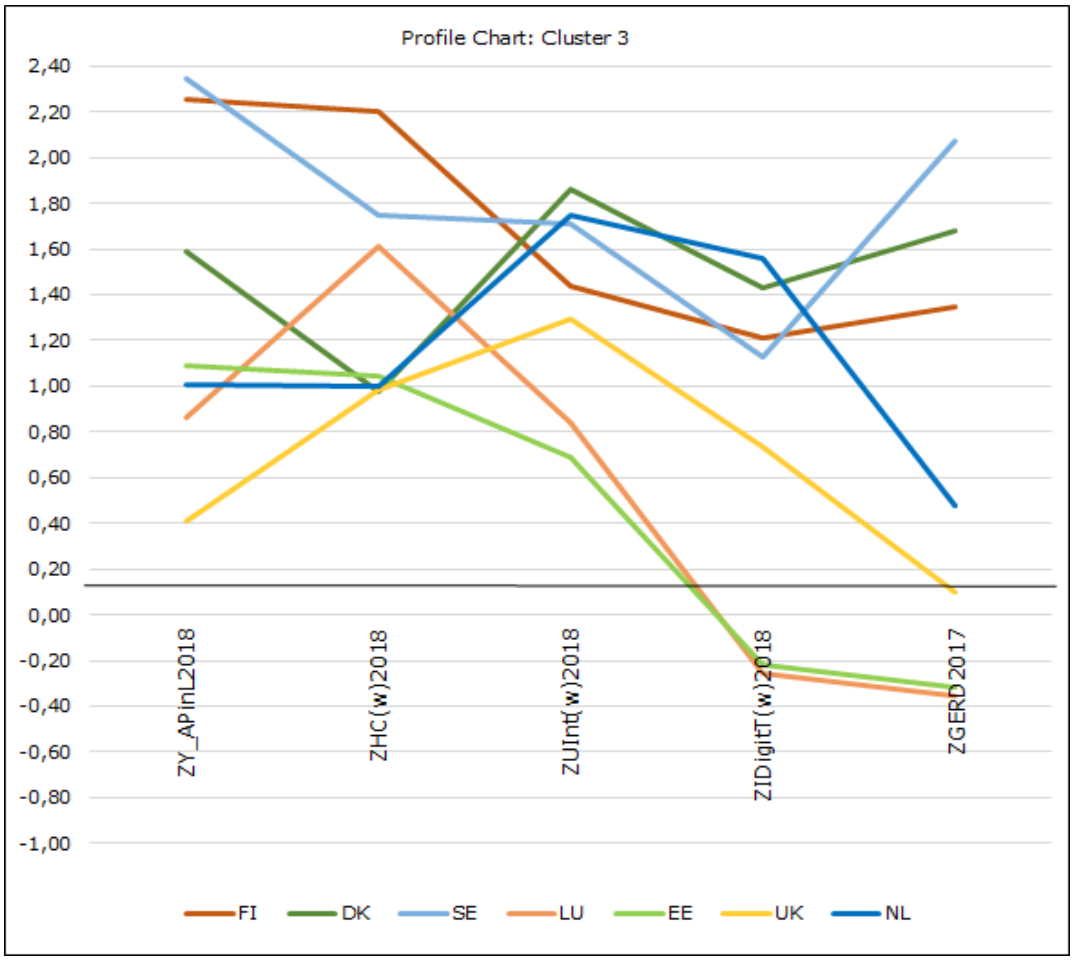

Figure 10: Profile chart for Cluster 3 "Leading digital society countries". Source: Authors' creation, Eurostat data

Table 10: Top and bottom positioned countries within Cluster 3, seven EU28 countries in 2018

	ZY_APinL2018	ZHC(w)2018	ZUInt(w)2018	ZIDigitT(w)2018	ZGERD2017
Min	Min_LU	Min_UK	Min_EE	Min_LU	Min_LU
Max	Max_FI; SE	Max_DK	Max_FI	Max_DK	Max_SE

Source: Authors' creation. Eurostat data

Custer 3 is assembling countries with excellent performance compared to EU28 for all variables. These are all Scandinavian countries together with United Kingdom and Luxembourg. The distinguished feature of the countries of cluster 3 is that they have extremely high level of adult participation in learning. According to the here presented research, those countries are the most successful adopters of innovative and technology enhanced education, e.g. E-learning and open learning. These countries have a clear vision on modernisation of education (including also adult learning) supported by national strategies and policies, strong tradition in distance education and e-learning, being also leaders in implementing innovation in formal and non-formal education (Bregar, Zagmajster and Radovan, 2019).

5 Conclusions

Even though APinL has been tending to increase in the period of last fifteen years for the EU28, our estimates indicate that EC determined target value of 15% could hardly be achieved in 2020. APinL is varying a lot across the EU28

countries in 2018. In the best performing countries regarding APinL, the target value is almost doubled (e.g. 29.20% in Sweden), while in some other countries APinL is almost negligible (in Romania, APinL is below 1%).

When focusing Croatia, APinL is at the very low level in general since 2002 to 2018, with considerable oscillations in this period. In 2018, it increased slightly compared to 2017. In Slovenia, APinL is at higher level than in Croatia, close to the level of EU28 average. Slovenia is catching the position held before the economic crisis.

Statistical analysis for EU countries in 2018 carried out by combination of different statistical approaches (correlation analysis, regression modelling, clustering and analysis profile charts) highlighted strong correlation of APinL and selected variables of digital and innovative society, indicating thus evident interconnection of adult participation in lifelong learning and digitalisation level of the society. Digitalisation of society as demonstrated by numerous phenomena (new products and services, new communication channels, new production processes, new skills and professions, etc.) necessitates continuous update of knowledge and skills on one hand. On the other hand, it provides favourable conditions for learning of adults and motivating them to join open and flexible learning and training formats increasingly tailored to individual needs. Consecutively, better-educated and skilled population is empowered to cope with economic, social and other problems more efficiently, thus contributing further to the welfare and progress at individual and social level. Clustering and profile chart analysis clearly revealed the features of such interrelation for Scandinavian countries and United Kingdom. In EU28, many of countries are distant from 'Scandinavian model'. These countries, including Slovenia and Croatia are at risk to miss or underexploit benefits of digitalisation, where modern adult learning is one of the key drivers of this process.

Investigation of adult learning in EU examined through the lens of digital society clearly indicates the need and the path of the future research. One direction of future research would be refinement of statistical analysis by splitting dimension variables and introducing some additional ones. Qualitative analysis of the formats of adult learning together with its institutional framework and government policies for some representative countries would be necessary supplement of the extended quantitative analysis.

References

1. Bregar, L., Zagmajster, M., Radovan, M. (2019). E-izobraževanje za digitalno družbo. Andragoški Center Slovenije (in print).
2. Dumičić, K. (2013). Multivariate Analysis of Life-long Learning in European Countries. Proceedings of the ISI_59th World Statistics Congress (WSC) on the Web. Hong Kong, 25-30, August 2013; ISBN: 978-90-73592-34-6; Online: http://2013.isiproceedings.org/. Available at: http://www.statistics.gov.hk/wsc/CPS205-P3-S.pdf. [Accessed: 01. 09. 2019].
3. Dumičić, K., Milun, T. (2018). Adult Learning as a Chance for Improving Statistical Literacy of Decision Makers: Focusing the Case of Croatia, In: M. A. Sorto, A. White & L. Guyot (Eds.). Looking back, looking forward. Proceedings of the Tenth International Conference on Teaching Statistics (ICOTS10, July 2018), Kyoto, Japan. Voorburg, The Netherlands: International Statistical Institute. Available at: http://iase-web.org/Conference_Proceedings.php?p=ICOTS_10_2018. [Accessed: 30. 08. 2019].
4. Dumičić, K., Milun, T., Antić, J. (2019). Adult participation in lifelong learning for better employability in selected European countries. University of Tourism and Management in Skopje (UTMS) Journal of Economics, Vol. 10 (1): 41-55. Print ISSN 1857-6974; Electronic ISSN1857-6982. Available at: http://utmsjoe.mk/files/Vol.%2010%20No.%201/UTMSJOE-2019-1001-03-Dumicic-Milun-Antic.pdf. [Accessed: 30. 08. 2019].
5. Dumičić, K., Žmuk, B. (2017). Enhancing statistical culture – the unused potential of Croatian enterprises. Chapter in Baldacci, E., Benoist, G., Boldsen, C., Galambosne Tiszberger, M., Gerendás, J., Karlberg, M., Manninen, A., Nymand-Andersen, P., Poggi, J. M., Sándor, G., Vereczkei, Z. (Eds.). *Selected papers from the Conference of European Statistics Stakeholders - Special issue,* Eurostat. Working papers. Luxembourg: Publications Office of the European Union, pp. 61-71. DOI: 10.2785/091435. ISBN print: 978-92-79-73629-2; Online: ISBN 978-92-79-73628-5; Online: Available at: http://ec.europa.eu/eurostat/documents/3888793/8435601/KS-TC-17-006-EN-N.pdf/68310461-0930-4c1d-b935-dfdcd9f36f53. [Accessed: 07. 09. 2019].
6. Dumičić, K., Žmuk, B. (2018). Lifelong learning development level in selected European countries: a perspective for improving statistical literacy. In e-Proceedings of Challenges and Innovations in Statistics Education Multiplier Conference of

ProCivicStat (Editor: Kovács, P.), Szeged, Hungary, September 07-09, 2017, Szeged: University of Szeged, Faculty of Economics and Business Administration, pp. 1-6, ISBN: 978-963-306-575-4. Available at: http://www.eco.u-szeged.hu/english/research/scientific-publications/challenges-and-innovations-in-statistics-education. [Accessed: 07. 09. 2019].

7. European Commission (2010). Europe 2020 - A European strategy for smart, sustainable and inclusive growth, Communication from the Commission, European Commission, Brussels. Available at: https://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf. [Accessed: 01. 09. 2019].
8. European Commission (2018). Employment and Social Developments in Europe Annual Review 2018. Available at: http://ec.europa.eu/social/BlobServlet?docId=19719&langId=en. [Accessed: 07. 09. 2019].
9. European Commission (2019a). DESI composite index, Digital Single Market, Digital Scoreboard, Human Capital. Available at: https://digital-agenda-data.eu/charts/desi-composite#chart={"indicator":"desi_sliders","breakdown":{"desi_1_conn":5,"desi_2_hc":5,"desi_3_ui":3,"desi_4_idt":4,"desi_5_dps":3},"unit-measure":"pc_desi_sliders","time-period":"2019"}. [Accessed: 07. 09. 2019].
10. European Commission (2019b). DESI composite index, Digital Single Market, Digital Scoreboard, Integration of Digital Technology. Available at: https://digital-agenda-data.eu/charts/desi-composite#chart={"indicator":"desi_sliders","breakdown":{"desi_1_conn":5,"desi_2_hc":5,"desi_3_ui":3,"desi_4_idt":4,"desi_5_dps":3},"unit-measure":"pc_desi_sliders","time-period":"2019"}. [Accessed: 07. 09. 2019].
11. European Commission (2019c). DESI composite index, Digital Single Market, Digital Scoreboard, Use of Internet. Available at: https://digital-agenda-data.eu/charts/desi-composite#chart={"indicator":"desi_sliders","breakdown":{"desi_1_conn":5,"desi_2_hc":5,"desi_3_ui":3,"desi_4_idt":4,"desi_5_dps":3},"unit-measure":"pc_desi_sliders","time-period":"2019"}. [Accessed: 07. 09. 2019].
12. European Commission (2019d). Digital Economy and Society Index (DESI). Digital Scoreboard, Digital Single Market. Available at: https://digital-agenda-data.eu/datasets/desi/indicators. [Accessed: 07. 10. 2019].
13. European Commission (2019e). Policies for Ageing Well with Information and Communication Technologies (ICT). Digital Scoreboard, Digital Single Market. Policies. Available at: https://ec.europa.eu/digital-single-market/en/policies. [Accessed: 07. 10. 2019].
14. Eurostat (2019a). Adult participation in learning by sex (APinL). Available at: https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=sdg_04_60. [Accessed: 07. 09. 2019].
15. Eurostat (2019b). Gross domestic expenditure on R&D by sector (GERD). Available at: https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=sdg_09_10. [Accessed: 07. 09. 2019].
16. Eurostat (2019c). Statistics Explained. Adult Learning Statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Adult_learning_statistics [Accessed: 15. 10. 2019].
17. OECD Frascati Manual (2002). Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002. ISBN 92-64-19903-9. [Accessed: 15. 09. 2019].
18. Păvăloaia, V.D., Georgescu, M.R. Popescul, D, Radu, L.D. (2019). ESD for Public Administration: An Essential Challenge for Inventing the Future of Our Society. *Sustainability.* 11(3), 880. DOI: 10.3390/su11030880.
19. Slovenian Research Agency (2019). Total Intramural Expenditure (GERD) % GDP. Available at: https://www.arrs.si/en/analize/odlicnost/izdatki.asp [Accessed: 15. 10. 2019].