

Article

# Lifelong Learning as a Factor in the Country's Competitiveness and Innovative Potential within the Framework of Sustainable Development

Aleksandra Kuzior <sup>1,2,\*</sup> , Dariusz Krawczyk <sup>1</sup> , Kateryna Onoprienko <sup>3</sup>, Yuriy Petrushenko <sup>3</sup>, Iryna Onoprienko <sup>4</sup> and Volodymyr Onoprienko <sup>5</sup>

<sup>1</sup> Department of Applied Social Sciences, Faculty of Organization and Management, Silesian University of Technology, 41-800 Zabrze, Poland

<sup>2</sup> Oleg Balatskyi Department of Management, Sumy State University, 40000 Sumy, Ukraine

<sup>3</sup> Department of International Economic Relations, Education and Research Institute for Business, Economics, and Management, Sumy State University, 40007 Sumy, Ukraine

<sup>4</sup> Department of Marketing and Logistics, Sumy National Agrarian University, 40007 Sumy, Ukraine

<sup>5</sup> Department of Ecology and Botany, Sumy National Agrarian University, 40007 Sumy, Ukraine

\* Correspondence: aleksandra.kuzior@polsl.pl

**Abstract:** The aim of this paper is to examine the interdependence between adult education and the competitiveness and innovative potential of the economy in the conditions of sustainable development. To examine the mentioned, we used a sample of data that includes European countries. The Global Competitiveness Index and its components were taken for research as a numerical display of the country's competitiveness. For indicators of lifelong learning, the share of persons aged 18–64 years involved in education was taken. The paper applies correlation and regression Pearson analysis of comparative data sections. The non-parametric Kruskal–Wallis test and the Wilcoxon–Mann–Whitney test were applied to verify the data, and Vosviewer software was used for bibliometric and graphical analysis. The research findings indicate a strong correlation between lifelong education and the competitiveness and innovative potential of the economy.

**Keywords:** lifelong learning; sustainable development; competitiveness; innovations



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## 1. Introduction

General trends in the development of the global economy show that innovations and knowledge become the main factors that determine the competitiveness of the country. Therefore, in modern socio-economic conditions, the development of the country can only be ensured by creating an innovative economy based on scientific knowledge and achievements, and this, in turn, can be created only by a person who is engaged in lifelong education.

The question of interdependence between lifelong education and the competitiveness of the country is becoming more and more discussed and requires an increasingly thorough study to present measures that can be taken in the future to improve the country's economic indicators, that ensure the country's competitiveness. Therefore, the research asked the question: «Can adult education affect the country's competitiveness and its innovative potential»? To answer this question, we hypothesized that lifelong education has a positive effect on the country's competitiveness and is related to innovation potential.

## 2. Materials and Methods

The article uses two main methods—bibliometric analysis and Pearson correlation-regression methods.

Bibliometric analysis is a powerful tool to quantify scientific production, quality, and impact. This technique also provides readers with full information related to intellectual,

conceptual, and social structures of a certain area together with its evolution over time [1]. In general, bibliometrics can be described as a systematic review approach that allows the (scientific) literature to be analyzed statistically [2]. Analytics from the Scopus database and Vosviewer software were used for bibliometric analysis, which allows us to graphically see connections between keywords and their density. In the study, articles were taken for analysis by the keywords “competitiveness” and “learning”, the database revealed 4957 (on the date of the study) documents that were taken for graphical analysis.

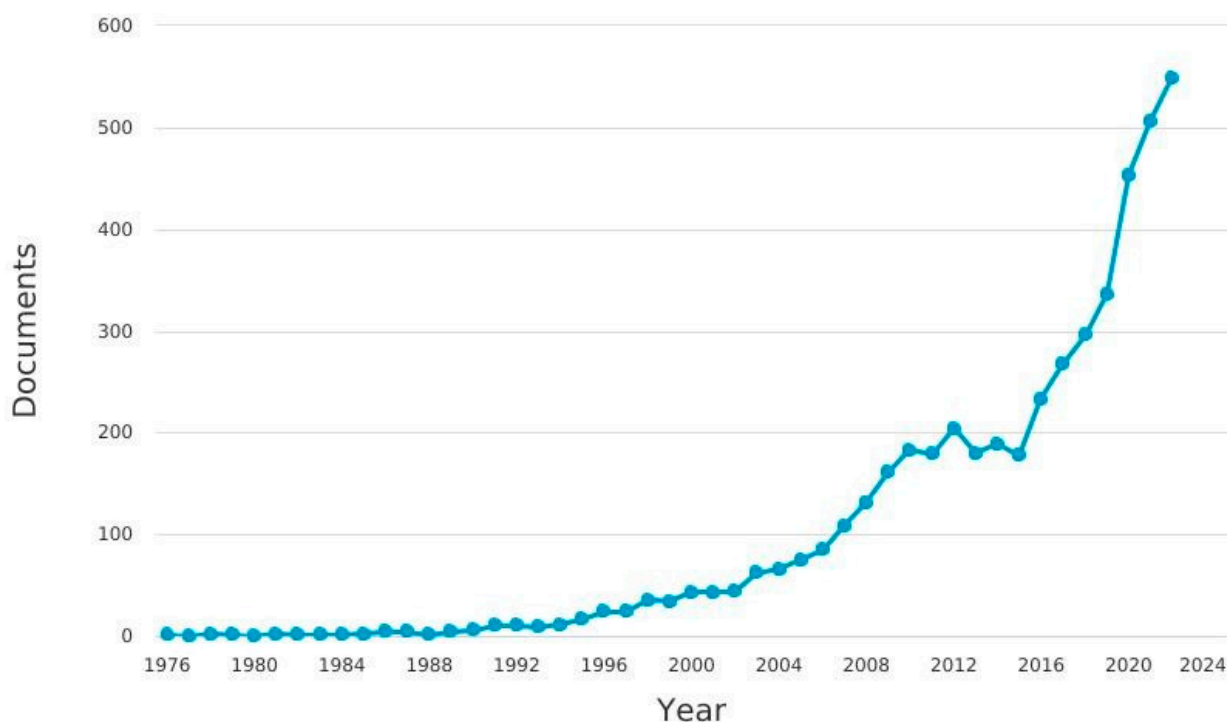
The Pearson correlation–regression method was chosen for the main study. The application of correlation–regression methods makes it possible to understand the deep essence of the processes of interrelationships. Correlations are found between two terms in this article—between The Global Competitiveness Index and the share of adults participating in education. In these relationships between cause and effect, there is no complete correspondence, but only a certain relationship in the form of a coefficient is observed. That is, when the dependent variable decreases or increases, the effective indicator will increase or decrease.

The Global Competitiveness Index and its components for 2012–2021 year were taken for research as numerical display of the country’s competitiveness. For indicators of adult education, the share (%) of persons aged 18–64 years involved in education was taken from Eurostat database. For the study, 12 parameters of the Competitiveness Index for 36 European countries and indicators of the share of participation in adult education for 10 years were taken.

### 3. Literature Review

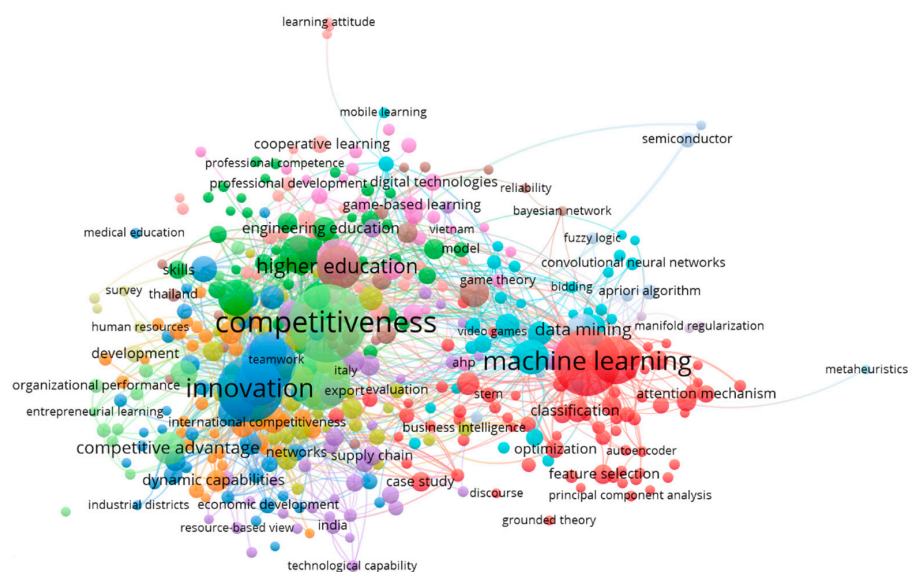
Many researchers agree that education and skills will be a key factor in increasing competitiveness, and one of the most important preconditions for achieving this goal is quality lifelong education. The economic component in education is described in the research of Tanjung, E.F. [3], Akpoviroro, K.S. [4]. About the impact of education on the country’s competitiveness writes Chentukov Y. [5], Fojtíková L. [6], Mendez, S. [7]. Tanjung, E.F. points, that public wellness, government effectiveness, literacy rate, and population growth significantly impact the quality of education and country’s competitiveness [3]. Fojtíková L notes, that in order to attain highly skilled human capital, economic entities should improve their competitiveness and increase investments in education, science, and technology [6]. Chentukov Y. claims, that the internationalization of curricula is considered to be a recognized tool for improving the quality of education and as the next step—increasing competitiveness [5].

Among others, Shmygol, N. et al. [8], Kuzior et al. [9,10], Vidic, F. [11], and Kharazishvili, Y. et al. [12] indicate innovation and education interdependence. Vidic, F. notes that knowledge assets—technological and human capital—have been recognized as key resources for sustainable competitive advantage in a dynamic turbulent environment. Existing knowledge is not enough to be competitive in the future market. Firms must collect, disseminate, and create innovative knowledge capital [11]. Analyzing the Scopus database using the keywords “competitiveness” and “learning”, the number of scientific works for such keywords reached 4957 articles, while for the keywords “competitiveness” and “lifelong education” the system showed only 17 scientific works, which increases the relevance of this research. We see a rapid increase in the number of scientific works from 2016 and from 2019, that is, from the year when the world was gripped by a pandemic, which led to the emergence of new methods of education [13], new types of work [14] and as a consequence to innovation and additional education. This year, the number of scientific studies was twice as much as compared to 2012 (Figure 1).



**Figure 1.** The trend of the number of scientific works by the keywords «competitiveness» and «learning». Source: Scopus database.

Using the Vosviewer software, the found scientific works from the Scopus database were analyzed for the density of connections between words such as “competitiveness”, “innovation”, and “education”. We see that these concepts are closely related. Additionally, the infographic shows that innovation is quite close to competitiveness and education, and the sectors are large and close to each other. This means that many world scientists in their research paid attention to the relationship between competitiveness and education and more, to other concepts reflected in small circles (Figure 2).



**Figure 2.** Networks map between the keywords of articles published on competitiveness. Source: Built by the author using Vosviewer software.

It is also clear from the infographic that competitiveness is connected not only with economic concepts, as was commonly believed, but also with education. Moreover, the large cluster on the right is occupied by the cluster of machine learning, that is, with the help of innovative tools and technologies. We believe that this will be the next level of education development and, as a result, its quality will affect the economic indicators of countries.

#### 4. Results

The objective need for the competitive development of the country, the formation of an innovative economy put forward a new system of requirements for a person as a link in the economy. Gradually, the need is realized even for an established specialist to update knowledge and change the scope of professional activity several times throughout his life, constantly adapting to changing socio-economic conditions, to the situation on the labor market, and to changes in the knowledge-based economy [15].

It is important to note that back in the middle of the last century, knowledge doubled every 50 years, and this allowed a person who received an education to be satisfied with the professional education he received once throughout his working life [16]. At the beginning of the 21st century, experts argued for the need to update knowledge every six years. Today, experts say that the amount of knowledge is doubling every three years and will double every 11 days in the coming years [17,18].

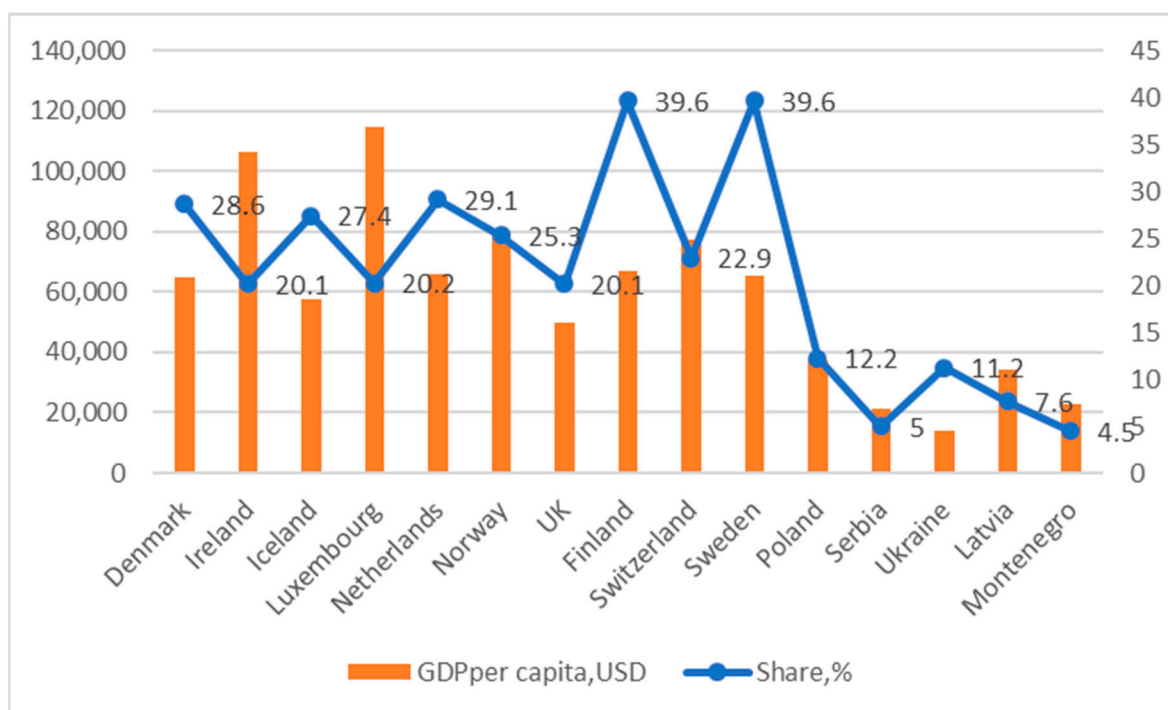
In the specialized literature, there is even a special unit for measuring the obsolescence of a specialist's knowledge—the so-called “competence half-life” [16], which reflects the length of time after graduation from a professional educational institution, when, as a result of the obsolescence of the acquired knowledge, as new information becomes available, the competence of a specialist decreases by 50%. Accordingly, the competitiveness of the country is determined by how quickly a person can again meet the needs of the economy at a particular stage [19].

Today, population aging is observed in almost all countries. According to UN estimates, in the next 15 years, the number of elderly people (60 years and older) will increase by 56% on a global scale: from 901 million people in 2015 to more than 1.4 billion by 2030 [20]. If these predictions come true, by 2030, for the first time in history, the number of elderly people will exceed the number of children under the age of 9, and by 2050, teenagers and young people aged 10–24 [21].

At the same time, adults will be forced to work longer than previous generations. Finding ways to improve their skills and professional reorientation due to technological changes and globalization will become a vital necessity for them and for ensuring the country's competitiveness [22]. Adults will also look for new learning opportunities to continue their professional and personal development, and the country must look for ways to educate adults so that they can respond competently to the changing economy and ensure their competitiveness [23].

The most competitive economies in Europe are also the most innovative and those where the share of adults in education is high compared to other countries (Figure 3). Switzerland, Sweden, Denmark, Finland, the Netherlands, and Germany are leaders in innovation in the world, as well as examples of successfully functioning adult education systems.

What they all have in common is that they all have strong knowledge-based economies [24]. They are characterized by a strong research and development sector with good international connections and a broad and constantly renewed talent base. GDP per capita illustrates the level of economic development of the country, and the share of participation in adult education, in turn, has the same fluctuations as GDP, which gives reason to assert that the level of economic development of the country is related to adult education and vice versa (Figure 3).



**Figure 3.** GDP per capita and the share of the population (18–64 y.o.) involved in lifelong learning in European countries in 2022. Source: Built by the authors.

The awareness of the importance of the implementation of lifelong education is prompted by numerous external factors [25], mostly documents and initiatives of the UN, UNESCO, initiatives of the International Labor Organization, the Council of Europe, and the European Commission, as well as resolutions, conventions, recommendations approved by many global and regional forums on lifelong education issues as a key element of lifelong learning [26]. The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals, which are an urgent call for action by all countries—developed and developing—in a global partnership [27]. According to this strategy, it is necessary to achieve three forms of growth: sustainable growth, which implies promoting a resource-efficient, green, and competitive economy; smart growth, which means the development of a society based on knowledge and innovation; and inclusive growth, which implies a high-employment economy [28].

International institutions create indices based on which they measure and rank countries according to various aspects, including competitiveness. The methodology of measuring the competitiveness of the economy of the World Economic Forum is based on the Global Competitiveness Index [29]. The competitiveness of economies is monitored through the 12 pillars of competitiveness. The index is calculated for all economies in the same way, and the final value of the index is a simple average of the 12 components. Such indicators are:

1. Institutions;
2. Appropriate infrastructure;
3. Stable macroeconomic framework;
4. Good health and primary education;
5. Higher education and training;
6. Efficient goods markets;
7. Efficient labor markets;
8. Developed financial markets;



9. Ability to harness existing technology;
10. Market size—both domestic and international;
11. Production of new and different goods using the most sophisticated production processes;
12. Innovation [15,30].

As the Industrial Revolution 4.0 continues, all competitiveness factors are considered to equally affect the competitive position of an economy regardless of income level, so each pillar can be considered as a potential priority.

However, the analysis of the foundations of competitiveness in the WEF reports clearly shows that in many countries the main reasons for slow development and growth are the inability to use the new opportunities provided by the fourth industrial revolution in the form of modern information and innovative technologies, and the “old” problems of social development in the form of «poor» institutions, infrastructure, and skills available to workers [31].

## 5. Results

As already mentioned, information and innovative technologies and skills are the fundamental drivers of competitiveness. In addition, the quality of the institutional environment largely determines the level of innovation and the development of physical and human capital, which are the main sources of income inequality (GDP) in countries.

It is important to say that the prevailing view in science is that the education system, as a key factor in the competitiveness of the modern economy, plays an essential role in socio-economic development.

It should be noted that the fifth measure of the Global Competitiveness Index, called Higher Education and Training, has eight sub-pillars or dimensions of economic competitiveness:

- 5.01 Secondary education enrollment rate;
- 5.02 Tertiary education enrollment rate;
- 5.03 Quality of the education system;
- 5.04 Quality of math and science education;
- 5.05 Quality of management schools;
- 5.06 Internet access in school;
- 5.07 Local availability of specialized training services;
- 5.08 Extent of staff training [21,22].

Analyzing all eight, we did not see a mention of lifelong education, but it is the driver of a person as the main component of human capital and economic benefit for the country. This became the basis for the hypothesis: does participation in adult education affect the competitiveness of the country? The Global Competitiveness Index and its components for 2012–2021 year were taken for research as numerical display of the country’s competitiveness. For indicators of adult education, the share of persons aged 18–64 years involved in education was taken from Eurostat database. For the study, 12 parameters of the Competitiveness Index for 36 European countries and indicators of the share of participation in adult education over 10 years were taken. The tools of Pearson’s correlation–regression analysis became a mathematical method for proving or refuting a hypothesis.

In the process of calculations using the method of general regression, as well as regression clustered by years or countries, it was found that the general regression gives the most reliable data, namely, the coefficient = 0.0018. In our case, it means a positive change in the index by 0.0018 points when the share of participation increases by 1%.

Analyzing the countries further, they were divided according to the principle of “developed” and “developing”, respectively, further group “1” and group “0”. In addition, for the reliability of the distribution, the distribution of countries by GDP per capita was made, and the countries were divided into groups of GDP per capita more and less than 40,000 dollars. This distribution confirmed the distribution by parameters of development and the groups turned out to be the same (Table 1).

**Table 1.** Distribution of countries by GDP per capita.

Developing	Developed
Ukraine	Spain
North Macedonia	Estonia
Serbia	Cyprus
Montenegro	Lithuania
Bulgaria	Slovenia
Turkey	Czech Republic
Greece	Italy
Slovakia	Malta
Croatia	UK
Latvia	France
Romania	Germany
Portugal	Finland
Hungary	Iceland
Poland	
	Austria
	Belgium
	Sweden
	Netherlands
	Denmark
	Switzerland
	Norway
	Ireland
	Luxembourg

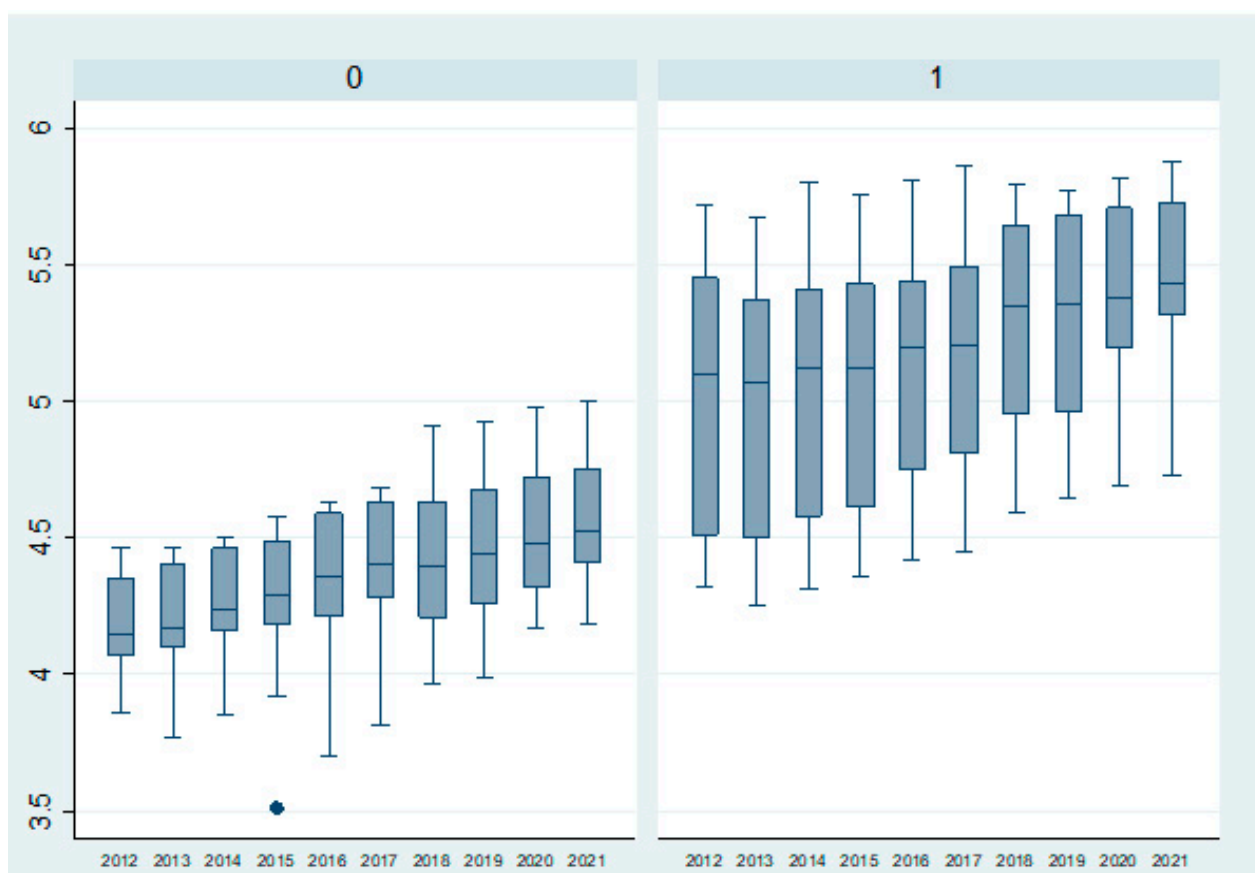
Conducting research using the general regression model revealed no significant data for both groups. However, the next stage of the research was clustering by years. As a result of the calculation, an interesting result was revealed: developing countries have a positive relationship between the index and the education of adults, i.e., coefficient = 0.0078. The coefficient in developing countries is higher than in developed countries. This is due to the fact that when the education system is already developed, the demand for it is not high, because at this stage the economy of the country is functioning efficiently. At the same time, in developing countries, the education sector is also developing, which means that it has a closer influence on economic indicators, and within the framework of our study, on indicators of the country's competitiveness (Table 2).

**Table 2.** The general results of all data sets between the share of the population (18–64 y.o.) involved in lifelong learning and competitiveness index.

Name of Parameter	General Regression	Clustering by the Years. Developed Countries	Clustering by the Years. Developing Countries
AE_Coef	0.0018	0.0043	0.0078
R <sup>2</sup>	0.92	0.71	0.91
Number of studies	359	139	220
P >  t	0.28	0.068	0.008
T	1.08	3.08	4.82

Given that the index for the study was taken on a scale of 1–7, the coefficient is quite high and influential on the overall picture of the relationship between adult education and the global competitiveness index. The non-parametric Kruskal–Wallis test and The Wilcoxon–Mann–Whitney test were chosen to verify the results. Both tests rejected the hypotheses that: developed and developing countries are the same, and that the population in both groups of countries is homogeneous, that is, the differences between the samples are statistically significant.

Considering that the study was actually divided into two groups, for more visible results, our next step was the analysis of two groups of countries using a graphical method (Figure 4). We were interested in the limits of the Global Competitiveness Index and the limits of the share of adult education for the two groups of countries, because we proved that the groups are different, and the data for the two groups also do not overlap.

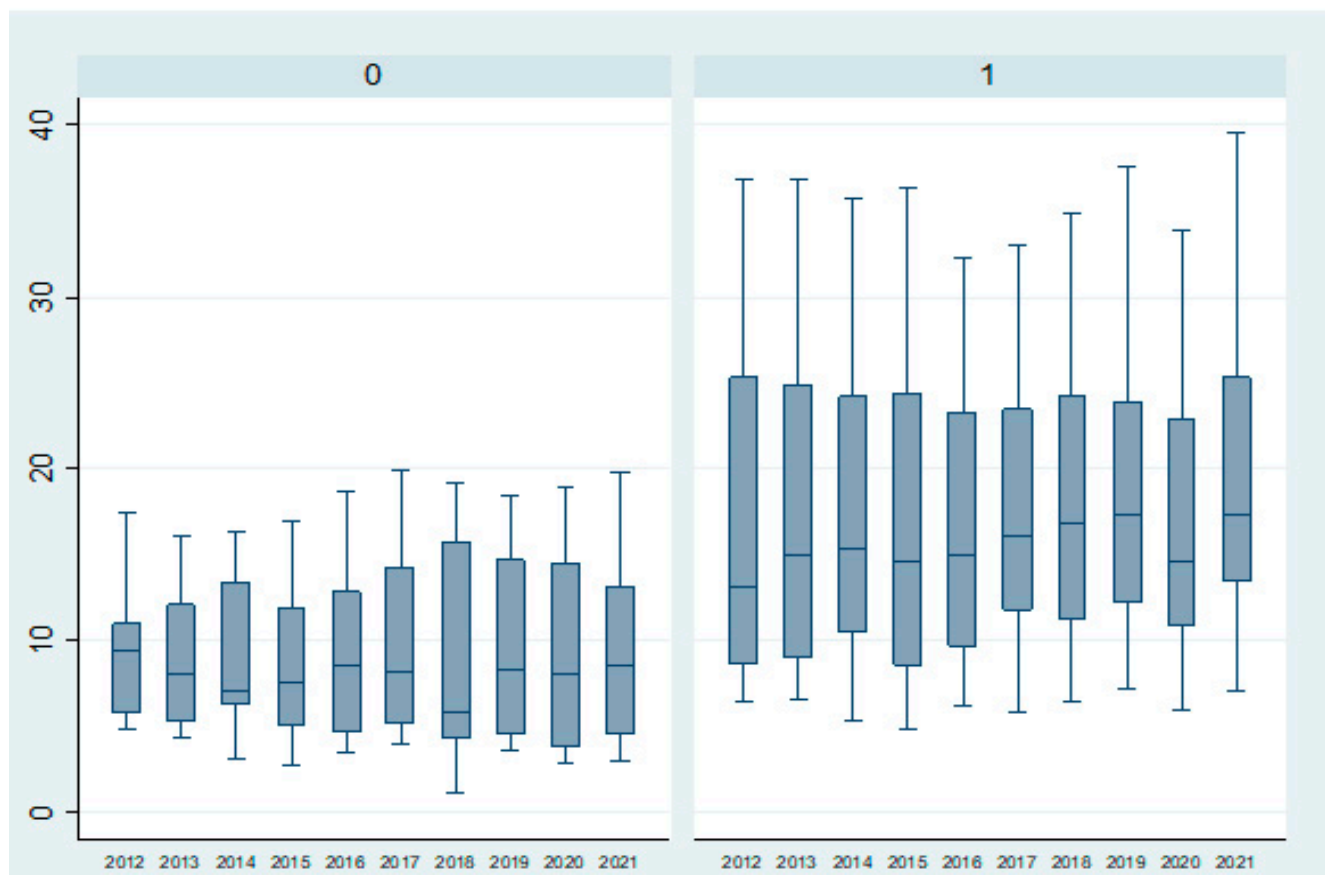


**Figure 4.** Dynamics of the Global Competitiveness Index in two groups of countries, developing (0) and developed (1). Source: Built by the authors.

Therefore, on this graph of the dynamics of the Global Competitiveness Index, we can see the situation for two groups of countries “0” and “1”, where “0” is developing, and “1” is developed countries. The difference between the indicators immediately draws attention, where in the developed group the maximum is 6.4, and in the developing group, the maximum is 5 on a scale from 1 to 7. Observing the fluctuations over the years, we can see relatively not strong fluctuations in the “1” group and a constantly growing trajectory in group “0”. In 2016, the “0” group experienced a downward “jump” for the minimum value of the index, but the same fluctuation is not observed for the value of adult education. Therefore, we can claim that adult education was not the factor behind such a minimal value of the index.

Graphically, we can see that the two groups of countries differ significantly in the indicators of participation in adult education (Figure 5). If in group “0”, which is responsible for developing countries, the maximum indicator is 20, and the minimum is 3, then in the group of developed countries the maximum indicator is almost 40, which is twice as much as in the group of developing countries. Additionally, the graph shows that 90% of the sample is within the color box. The horizontal bar in the box itself represents the sample mean for each individual year.





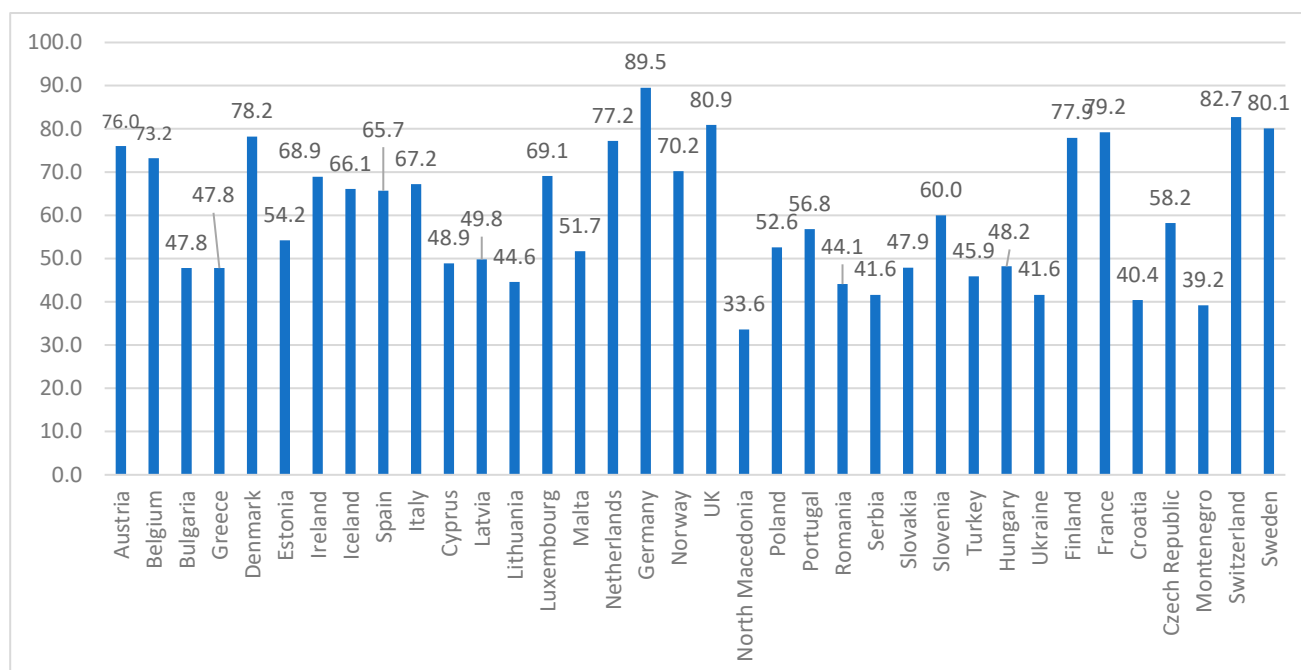
**Figure 5.** Dynamics of the share of the population (18–64 y.o.) involved in lifelong learning in two groups of countries, developing (0) and developed (1), %. Source: Built by the authors.

Analyzing by year, we see a different, interesting situation of fluctuations in 2016–2017 for two groups of countries. In the “0” group, 2017 became the peak year, and after that, the share of adults’ participation decreased. For the “1” group, 2017 became the minimum year after 2016. That is, it was in 2016 that such events occurred that led to an increase in the education of adults in the “0” group and a decline in the “1” group. We see this as a basis for further research since the factors of such fluctuations can be not only economic, but also political, social, and financial.

## 6. Discussion

Another point of research is the innovation potential of the country and its connection with lifelong education. Choosing the Global Competitiveness Index for analysis and researching it, we found among the 12 indicators a sub-index of education and a sub-index of innovation. This, in turn, gives reason to assert that for the study of the global competitiveness index, and therefore of the country, indicators of both education and innovation are taken, and therefore they are related to each other. Developed countries have high indicators of education, as well as innovation. (Figure 6) The bibliometric analysis also showed a close connection between education, innovation, and competitiveness.

We see that developed countries have the highest indicators of innovation, namely those where a negative relationship between adult education and the competitiveness index was found.



**Figure 6.** Indicator of the level of innovation in European countries for 2022. Source: Built by the authors.

It is too early to say what exactly influenced such a result, but we can say that innovation is one of the factors that directly shows: the more developed the country, the higher its innovation indicators. The graph shows countries such as Austria, Denmark, Germany, and Switzerland have the highest marks. Moreover, this trend was not only in 2021, as shown in the graph, but also throughout the 10 years studied.

The relationship between lifelong learning and innovative technology is an important factor in the development of countries in the modern era. The use of the latest technologies and their improvement is a factor in the development of countries in accordance with modern global standards of digitalization, as well as increasing their competitiveness in the international space [30]. Analysis of the impact of lifelong learning on the Global Competitiveness Index showed that increasing the number of adults engaged in education can contribute to increasing the competitiveness of the economy and, thus, achieving sustainable development.

In this sense, the corrective activity of the competent authorities should be aimed at developing the skills of an adult by organizing new internship programs, forming university business incubators, and ensuring an increase in financial incentives for the entry of as many companies and universities into the dual education system as possible, stimulating stronger ties between science and the economy by introducing tax and other benefits, motivating educated people to return to their homeland, etc. [19,31,32]. It is very important that the competent authorities in the analyzed states take into account the specifics of their own economy and the specifics of their own education systems when developing the above recommendations [33].

## 7. Conclusions

Lifelong education and learning is one of the most important tasks facing the countries under the Sustainable Development Goals 2030, since possession of innovative knowledge and qualification, the ability to study throughout life is one of the modern variables in the world [34].

Our research confirms the key role of lifelong education and shows that the global index of the country's competitiveness depends positively on the level of lifelong education.

A total of 65% of human capital has been accumulated in the world, while the accumulated material resources account for only 16% of social wealth. Human capital is 70–80% of national wealth in developed countries and about 30% in developing countries [35].

Therefore, lifelong learning is an important factor in increasing competitiveness, as well as the innovative development and potential of the country. Thus, the development and investment in lifelong education should be perceived rather than expenses, but as an investment in the future. In addition, it can be seen that the research will be useful for the process of lifelong education advocacy in the international arena.

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