

Digital Agenda, New Technologies and Education for the Integration of Europe: an Economic Study

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 <http://dx.doi.org/10.5755/j01.eis.1.15.28296>

New technologies are a key factor for integration in Europe by enabling citizens to solve their daily problems and interact with people everywhere. The European Commission established the Digital Agenda for Europe with the aim of improving the speed of navigation, establishing a single market for telecommunications and achieving a digital single market. We highlight the importance of applying new technologies in the field of education, since teaching and learning through these means will contribute to increasing creativity and reasoning capacity, allowing for more interactive and participative learning. The Horizon Report and the new emerging technologies proposed by that report are analysed, and are aimed not only at facilitating learning, but also at enabling a more integrated Europe. It also presents some technological ideas to be developed in the educational field that will enhance the development and integration of the EU Member States. Furthermore, in order to analyse the influence of the use of the Internet and new technologies on other socio-economic variables, a regression analysis has been carried out. The objective is to study whether in any way the fact that citizens use the Internet affects variables such as Gross Domestic Product, unemployment or Human Development Index which may affect the integration of Europe.

KEYWORDS: Europe, integration, new technologies, education, socio-economic variables.

The development of new technologies is a key element for globalisation in Europe. They are essential for competitiveness in an increasingly digitalised world economy. Therefore, more than 20 billion Euros from the European Regional Development Fund (ERDF) and the Cohesion Fund are available for investments in the field of Information and Communication Technologies (ICT) during the 2014-2020 funding period (Nigohosyan and Vutsova, 2018). These investments are aimed at creating a single digital market, where all people can interact globally.

The specific objective of ICT research and innovation is to enable Europe to support, develop and exploit the opportunities offered by the progress of new technologies for the benefit of its citizens, businesses and scientific communities. To ensure a secure, open and fair digital environment, the European Commission has developed the Strategy for the Digital Single Market (Frosio, 2017; Lucian, 2018), which is structured around three pillars: improving access of consumers and businesses to digital goods and services in Europe, creating the right conditions for the success of digital services and networks, and realising the full growth potential of the digital economy.

The European Commission measures through the Digital Economy and Society Index (DESI) (Russo, 2020) the progress of the different European Union countries towards a digital society and economy, providing information on the digital performance and competitiveness of European countries.

EIS 15/2021

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Submitted 03/2021

Accepted for publication 06/2021

Abstract

Introduction



For this reason, this paper reviews the DESI Report and the Horizon Report to analyse their latest advances and evidence, and it provides a regression analysis to study whether in any way the fact that citizens use the Internet and new technologies affects some variables socio-economics.

Digital Technologies

The DESI report is structured around 5 dimensions (Table 1), the first two contributing 25% each to the overall value of the index. The integration of digital technology represents 20%, the use of internet services by citizens and the dimensions of digital public services each contribute 15%.

Table 1

Students' self-assessment in recognizing false information

	Dimensions	Meaning
1	Connectivity	Fixed broadband, mobile broadband, fast and ultrafast broadband and prices
2	Human capital	Internet user skills and advanced skills
3	Use of Internet	Citizens' use of internet services and online transactions
4	Integration of digital technology	Business digitisation and e-commerce
5	Digital public services	e-Government and e-health

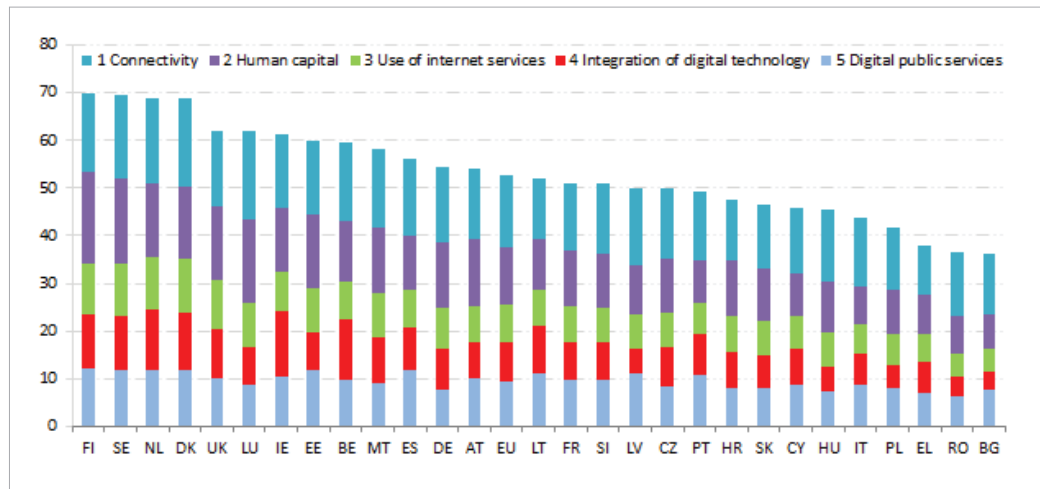
Source: own elaboration

Figure 1 shows the countries with the most advanced digital economy by 2019, i.e., with the highest digital performance. Finland, Sweden, the Netherlands and Denmark and the United Kingdom are the countries with the most advanced digital economy. On the other hand, Bulgaria and Romania occupy the last positions in this ranking. These countries are among those with a lower per capita GDP (GDPpc), and can be associated, among other things, that having a lower GDPpc influences the level of digitalization of the country.

Figure 1

Countries with advanced digital economies in the EU in 2019

Source: DESI 2019, European Commission



Europe must work to reduce this technological gap between countries, encouraging investment in very high capacity networks to meet the growing connectivity needs of Europeans.

Currently, the progress of countries is based on increasing the knowledge of their citizens, which is a challenge in the field of education, since it requires the incorporation of ICTs. Education drives growth, innovation and job creation. This is why it is so important for Europe to invest in digital skills on a continuous basis in order to achieve greater development and integration among its Member States.

It is undoubtedly very important that new technologies should advance and that Europe should take steps to implement them among its citizens. It is also essential, however, that they are introduced in the field of education, an area fundamental to Europe's development.

Since 2004, and on an annual basis, the Horizon Report has been published, showing the trends, challenges and technological developments that will have an impact on teaching and learning (Jonhson et al., 2012; Adams Becker et al., 2017). The 2019 report (Alexander et al., 2019) forecasts 6 technologies that will be implemented in the short, medium and long term in educational institutions (Table 2).

Short term (one year or less)	Medium term (two to three years)	Meaning
» Mobile learning	» Mixed reality	» Blockchain
» Analytics technologies	» Artificial intelligence	» Virtual assistants

Horizon Report

Table 2

Emerging technologies predicted by the 2019 Horizon Report.

Both mobile learning and analytical technologies are already implemented in many education systems. Among their advantages, the total accessibility and interaction of the contents, the connectivity and the access at any time and place stand out. Augmented, virtual and mixed reality have enabled mobile learning to become more active and collaborative. Lai and Hwang (2014) highlight the ease of consulting the necessary information in real time through mobile devices. Berns et al. (2017) and Martín-Ramos et al. (2017) relate the use of mobile devices to classroom teaching and pedagogical evaluation using various techniques: simulations in the case of the former and the collaborative agenda on the part of the latter.

In the context of big data and artificial intelligence arises the use of analytical technologies in everyday life. With them, all existing data can be interpreted to improve institutions and the experiences of students and teachers (Reyes Dixson and Nuñez Maturel, 2015; André et al., 2017; Malik, 2019). Some institutions have already implemented Business Intelligence systems (Cobo et al., 2016) and are using it, for example, to help students who need support, customize content, reduce workloads and produce educational applications.

Mixed reality (combination of virtual reality and augmented reality) allows the creation of new spaces in which both objects and real or virtual people interact so that students can access simulations that help them to better approach real situations within their learning process and experience them first-hand. Many studies focus on the progress this method is making (Lindgren et al., 2016; Birt et al., 2017; Chen and Duh, 2018).

The advances that will take the longest to apply to the educational system are Blockchain technology and virtual assistants. The first of these began to be applied in the financial world and now the education sector is studying how to adopt it for use in transactions such as smart contracts or identity verification. The works of Grech and Camilleri (2017) and Chen et al. (2018) show us some of its applications such as improving the security of grades, academic records, minutes ..., and the student can have his academic certificate anywhere or anytime.

Virtual assistants are used to answer user questions. Students can use them, for example, to measure study time and become more efficient. One strategy for improving interactivity is to use virtual teaching assistants to augment and amplify interaction with human teachers (Goel and Polepeddi, 2016). A virtual reality assistant based enhanced technology for learning primary geography is proposed by Lv and Li (2015).

Through any of the technologies discussed, students will be able to engage in more active and dynamic learning, and it will serve them in many aspects of their lives. It will not only enable the student to better develop his or her skills, but it will also enable him or her to have more knowledge in the future. Thus, through mobile learning students can quickly access content and information, learn more about other cultures or communicate with other students and people anywhere in the world. By enhancing this learning in the classroom we can have a more cohesive Europe where the use of technologies is promoted. That is why budgets should be allocated to buy tablets and mobile devices for the classroom so that students can develop their technological skills. However, not only must we invest in the purchase of technological materials, but also in ensuring adequate Internet speed that allows immediate and effective communication.

Other actions in which Europe must invest are the creation of online platforms for self-learning (artificial intelligence), with the aim of optimising training and improving student participation. This would increase completion rates. Some platforms already use artificial intelligence to examine data and find patterns to help identify which lessons are effective and which need to be improved. An answer correction system could be put in place to enhance errors in the following questions so that the parts where the student fails are further reinforced. In this way, the user is not only evaluated by his or her successes, but also learns from his or her own mistakes. These tools could, for example, contribute to improve the learning of a language, favouring a greater cohesion among European citizens, by knowing a greater number of languages.

On the other hand, it would be a good idea to invest in educational robotics, so that robots act as tutors in virtual courses. This digital learning will provide students with a more complete learning experience, and they will be able to obtain help more easily. They could access knowledge when they need it, by having the opportunity to ask questions in natural language as they would with another student or a teacher. In this way, if the implementation of intelligent tutors is promoted, it will be possible to optimize the search and use of content among an immense amount of available resources.

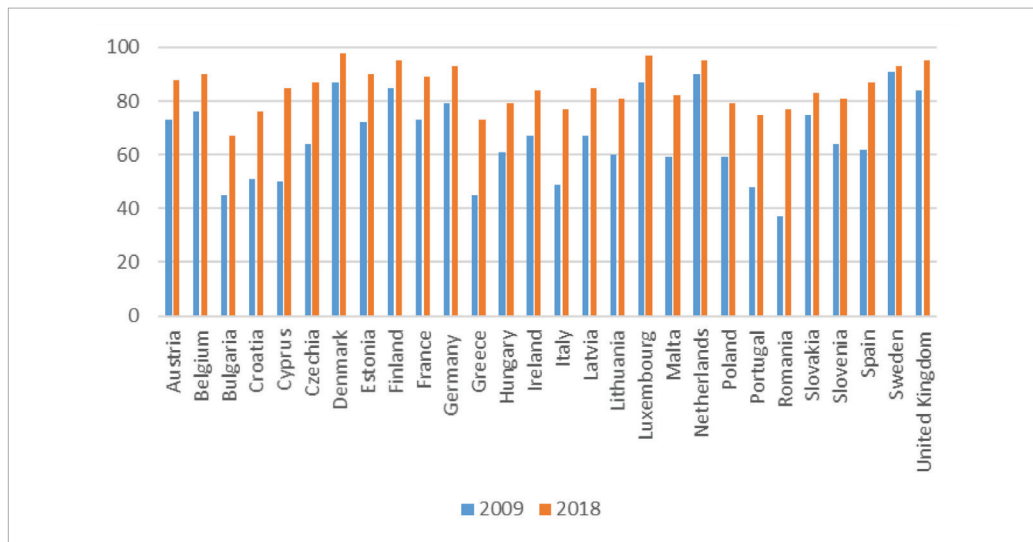
A regression analysis is set out in the following sections to highlight the importance of new technologies and the use of Internet in Europe.

Methodology

Education and new technologies are key to European integration. For this reason, in this work we wanted to verify the importance that ICT and the Internet are having in Europe. From the data obtained from Eurostat, we have obtained the percentage of individuals who use the Internet during the year on some occasion. Two periods have been compared, 2009, during the economic crisis, and 2018, the recovery period. Furthermore, in order to analyse the influence of the use of the Internet and new technologies on other socio-economic variables, a regression analysis has been carried out. The objective is to study whether in any way the fact that citizens use the Internet affects variables such as Gross Domestic Product (GDP), unemployment or Human Development Index (HDI). It is assumed that the countries whose citizens use the Internet most have also received more education in its use.

Results

All countries have significantly increased the number of users using the Internet through new technologies (Figure 2). Luxembourg tops the list of European countries whose population is using the Internet most in 2018, with 97 per cent of the population having used it at some time during that year, compared to 87 per cent in 2009. It is followed by the United Kingdom, the Netherlands and Finland with 95% of the population. These countries also tend to be the most advanced in education, generally performing well in the PISA report produced by the OECD, especially Finland, which stands out for having one of the best education systems (Simola, 2005; Kupiainen et al., 2009; Rautalin, 2018). If we compare 2009 with 2018, Romania (+52%) and Cyprus (+42%) have experienced the greatest variation in the increase of individuals using the internet in this period. Investment in

**Figure 2**

Percentage of individuals who have used the Internet during the year 2009 and 2018. Source: own elaboration based on Eurostat database.

new technologies and education, and greater connection through the Internet can be very satisfactory for the development of future generations and for the integration of Europe.

Table 3 shows the bivariate correlations between the different variables in 2009 and 2018. There is a strong direct correlation in both years between the new technologies (measured as the percentage of interacting citizens who use the Internet at some time each year) and the logarithm of GDP. These data reveal that the countries with the greatest economic development are those that use the Internet the most. This may be due to the fact that a greater allocation of economic resources may make it possible to invest more in the purchase of technologies and in teaching them.

		ICT	log GDP	Unemployment	HDI
ICT	2009	1	0.662	-0.130	0.282
	2018	1	0.794	-0.354	-0.094
log GDP	2009	0.662	1	-0.120	0.301
	2018	0.794	1	-0.168	-0.042
Unemployment	2009	-0.130	-0.120	1	0.042
	2018	-0.354	-0.168	1	0.135
HDI	2009	0.282	0.301	0.042	1
	2018	-0.094	-0.042	0.135	1

Table 3

Correlation matrix

In order to analyse the influence of the use of the Internet and new technologies on other variables related to the specific socio-economic context of each country (Ionescu, 2013; Chen and Neshkova, 2020), a regression analysis has been carried out. The dependent variable is the percentage of citizens using the Internet. The independent variables are the logarithm of GDP per capita, the unemployment rate and the HDI. The GDP aims to measure the country's economic growth (Angelache, and Sacla, 2016), while the HDI measures human development through other indicators such as life expectancy, educational attainment and income (Eren et al., 2014). The HDI data are taken from the Human Development Report published worldwide by the United Nations Development Programme (UNDP) and the GDP and unemployment data from the Eurostat database.

Table 4

Coefficients of the regression model

	2009		2018	
	Unstandardized Coefficients	Standardized Coefficients	Unstandardized Coefficients	Standardized Coefficients
(Constant)	-79.847** (35.191)		-13.478 (16.392)	
Log (GDP)	32.749** (8.395)	0.626	23.130** (3.582)	0.755
Unemployment	-0.225 (0.588)	-0.058	-0.442* (0.234)	-0.223
HDI	9.645 (15.974)	0.096	-1.025 (3.667)	-0.033
R2	0.670		0.825	
R2 Adjusted	0.449		0.681	

*Standard error in parentheses**** p-value <0.05, *pp-value<0.1*

The data in Table 4 show that, in the two years studied, the regression model has a high explanatory power, especially in 2018 (see adjusted R^2 , which indicates what percentage of the variation in the dependent variable is explained jointly by all the independent variables and varies between 0 and 1, the closer to 1 the model's adjustment to the variable to be explained).

Standardised regression coefficients allow the relative importance of each independent variable within the equation to be assessed. In general, a variable is more important the higher (in absolute value) its normalized coefficient is. The variable with the highest weight in 2009 and 2018 is the one related to GDP.

Conclusion

It would be very positive to encourage collaborative learning through new technologies, since it will be possible to make groups of like-minded people to carry out tasks together, increasing the effectiveness of learning. These groups could be interconnected all over the world.

It has become clear that there are many benefits associated with digital education and that its practice is, and will be, even more essential. Europe must therefore ensure that all citizens have access to the internet and the necessary digital skills, working to develop quality education. We are at the beginning of the fourth industrial revolution and the digitisation of EU countries to be able to compete in the era of the data economy and artificial intelligence are issues that must be on the Union's agenda. It is essential for Europe to invest in technologies for education, as this is a key aspect of promoting integration between countries. Relations between Member States and citizens would be strengthened.

However, at present, there are still countries that do not have the same opportunities in terms of technologies because they do not have the necessary financial resources. The European Union must try to alleviate these problems, since the new technologies are bringing those who use them closer together, but excluding those who do not. Therefore, education policies have a lot to say in terms of preventing or, at least, compensating for these inequalities in access to information and knowledge. Within the education system, it will be necessary to articulate measures that benefit the learning and use of new technologies for less advantaged groups. In this process, teachers should be provided with the appropriate tools and training to use ICT at all levels of education, promoting more inclusive and personalised education and training systems.

Europe must create a dynamic digital single market to access the benefits of the digital age. The

governance and transparency of collective rights management must be improved and adapted to technological progress. The challenge is great, but the benefits will be even greater, leading to a truly equitable, fair and inclusive society.

It was important to raise awareness of the need to learn new technological methods. This acquired knowledge can be put into practice during your working and personal life, contributing to a greater connection between all regions. The new technologies are an incredible advance in society and Europe must continue to promote and propose measures such as those described for the implementation of these technologies in all areas.

Therefore, we wanted to check, through a regression analysis, the influence of the use of the Internet and new technologies on other socio-economic variables.

It has been realized that the most economically developed countries are those that use the Internet the most. This may be due to the fact that a greater allocation of economic resources may allow more investment in the purchase of technologies and their teaching.

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