

Skills demand, digital skills and skill formation in the European Union in the digital era

Laura Tandi

Developed economies have recently become more complex than ever before. As the European Union is transforming into a knowledge-based economy, more and more attention is paid to skill formation, in view of the fact that skills have become the most valuable resource in the twenty-first century, often available only scarcely for economic actors. All this implies that, in order to maintain and/or develop competitiveness of the European Union - as well as of the member states -, the knowledge capital base of an economy has to be developed and continuously maintained. Digital skills started to play an important role in the process and the COVID-19 pandemic has accelerated digital skills demand in many occupations, especially non-ICT ones. The aim of this paper is to examine the needs and the importance of digital skills in occupations across the EU through a literature review and descriptive statistics, and to outline possible solutions to develop digital skills use in this forming new ecosystem of economies, digital technologies and the humans operating and applying them.

Keywords: digital skills, competitiveness, knowledge-based economy, European Union

1. Introduction

In the twenty-first century an economy's power is strongly dependent not only on its size, the amount of raw materials available, or the size of the population. For societies and economies in the global economic competition new concepts such as education, training, culture and knowledge have become relevant. Already in 1957, Robert Solow revealed that something more was influencing the production function. He called it "technical change", divided it into two parts, and identified them as human capital and technological change (Solow 1987). Additionally, according to new paradigms in economics like endogenous growth theory, growth is due to indefinite investment in human capital (Barro–Sala-i-Martin 2004, Romer 1990). Moreover, technological development has accelerated, and information processing is constantly upgrading (Sulyok 2002). Developed economies have become more complex than ever before. Instead of being the labour force operating the physical infrastructure built from capital and thus producing the output of economic activities, people have developed into a 'human resource'.

All this implies that, in order to maintain and develop competitiveness in the European Union, the knowledge capital base of the economies of the member states has to be developed and continuously maintained (OECD 2012, Pelle–Laczi 2015). Information and communication technologies (ICTs) are at the core of this fast-changing global economy (van Laar et al. 2017). However, although ICTs are a foundation for innovation, in themselves they do not create a knowledge-based economy. Innovation starts with people, making the human capital within the workforce decisive (Anderson 2008, Kefela 2010, Lanvin–Kralik 2009, Lanvin–Passman 2008).

The current workplace requires highly skilled workers worldwide, faced with increasingly complex and interactive tasks. Employees do not only need excellent technical preparation; they also need sufficient skills to adapt to the changing requirements of the job (Ahmad et al. 2013, Carnevale–Smith 2013).

The development of the global knowledge society and the rapid integration of ICT make it imperative to acquire digital skills necessary for employment and participation in society (van Laar et al. 2017). Digitalisation has considerable impact on labour markets as well. New business models, products and machines create new jobs, while automation contributes to the elimination of jobs or their relocation to countries with lower labour costs. To remedy this situation in the European Union, developing the digital skills of the workforce is essential (Kiss 2017). Besides, digital skills are a major EU policy concern as figures in the information and communication technologies sector show that despite continued high levels of unemployment, the share of enterprises that found it hard to fill ICT specialist vacancies stood at 37% in 2013 and has risen to 58% by 2018 (Eurostat 2020). In the current economic situation of the digital era, a successful policy to foster the skills needed for a digital transformation could secure Europe a technological advantage and resilience in global competition (Kiss 2017). The outbreak of the COVID-19 pandemic has accentuated the digital skills gap between EU member states and the need to increase digital education (EP 2020), thus proving to be challenging for the European Union as well. After the imposing of nation-wide lockdowns, digital literacy turned out to be the key for continuing activities online (Akhvlediani 2021).

After defining digital skills within the 21st century skills, the paper discusses the measuring of those skills. The next section reveals the geographical and social distribution of digital skills at EU member state level and by age, gender and educational attainment, through processing available Eurostat datasets. The aim of this paper then is to reveal the impact of digitalisation in the EU labour market using the defined digital skills measurement categories and comparing the results with the 2015 data, thus tracing the last five year's trends. Finally, after examining the actions taken at the EU level to reach the digital transformation, the paper terminates with providing the conclusions of the information acquired from literature, data, and EU initiatives, and outlining the potentials for further improvement.

2. Twenty-first century skills and digital skills

Neither economic theory, nor applied economic policy should underestimate the importance of the human factor in productivity or the general success of any economic and social model. In fact, skills have become the most valuable resource in the twenty-first century, often being scarcely available for economic actors (Mayer–Solga 2008). The formation of the concept of 21st century skills was preceded by a discussion at the turn of the 21st century, regarding what kind of skills and understanding citizens must have in the knowledge society (Csapó 2019). However, 21st century skills are not necessarily underpinned by information and communication technologies, and digital skills are considered as a more practical tool to understand and to use information from a variety of digital resources, so there is a close connection between the two concepts (van Laar et al. 2017).

2.1. Twenty-first century skills

At the turn of the 21st century three IT companies, Cisco, Intel and Microsoft launched a comprehensive project to define those desired skills of the new “digital era” and to get them measurable (Csapó 2019). The working group published those ten 21st century skills – grouped in four categories – in a measurable form (Binkley et al. 2012). The first category, “Ways of Thinking” includes three skills such as *Creativity and Innovation*, *Critical Thinking*, *Problem-solving*, *Decision-making* and *Learning to learn*, *Metacognition*. The category of “Ways of Working” subsumes *Communication* and *Collaboration or teamwork*, while “Tools for Working” category incorporates *Information literacy* and *Information and Communication Technology (ICT) literacy*. The fourth category, known as “Ways of Living in the World” is comprised of *Citizenship* (local and global), *Life and career*, and *Personal and Social responsibility*.

Table 1 The twenty-first century skills

WAYS OF THINKING	<ul style="list-style-type: none"> •CREATIVITY AND INNOVATION •CRITICAL THINKING, PROBLEM-SOLVING, DECISION-MAKING •LEARNING TO LEARN, METACOGNITION
WAYS OF WORKING	<ul style="list-style-type: none"> •COMMUNICATION •COLLABORATION OR TEAMWORK
TOOLS FOR WORKING	<ul style="list-style-type: none"> •INFORMATION LITERACY •ICT LITERACY
WAYS OF LIVING IN THE WORLD	<ul style="list-style-type: none"> •CITIZENSHIP (LOCAL AND GLOBAL) •LIFE AND CAREER •PERSONAL AND SOCIAL RESPONSIBILITY

Source: own construction based on Binkley et al. (2012)

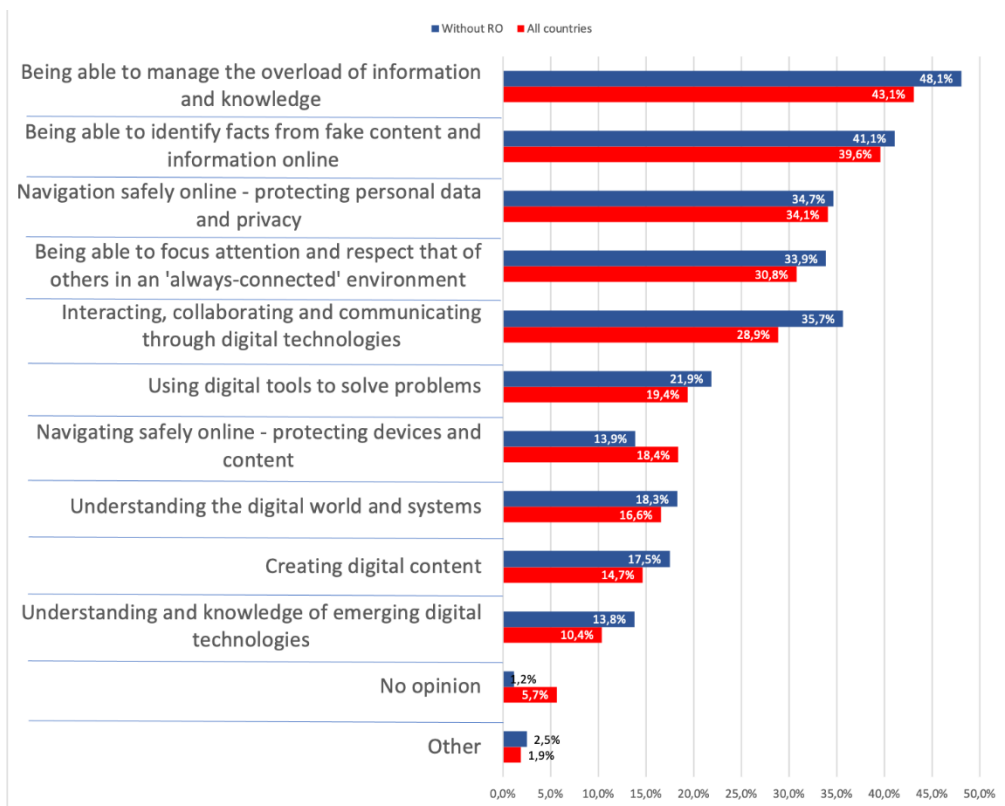
In 2016, based on The World Economic Forum report – Future of Jobs – the ten leading skills of 2020 were predicted (Zahidi and Leopold 2016). In the list of the top ten skills the first three are from the list above, specifically complex problem solving, critical thinking and creativity. In the VUCA (Volatile, Uncertain, Complex, Ambiguous) world these key 21st century skills are essential to live in and manage our lives successfully (Fadel et al. 2015).

2.2. Digital skills

21st century skills and digital skills are both concepts that emphasize a broad spectrum of skills (van Laar et al. 2017). It is essential to define digital skills and see their place related to the 21st century skills as indispensable to live in the digital era. Digital skills encompass a range of basic to highly advanced skills that enable the use of digital

technologies and, in addition, all basic cognitive, emotional or social skills necessary for the use of digital technologies (Kiss 2017). It is also important to share the definition of digital literacy or digital competence as they are often used synonymously to describe digital skills. Digital literacy or competence is the ability to find, evaluate, utilize, share and create content using information technologies and the Internet (Cornell University 2015). Thus, digital literacy must be more than the ability to use digital sources effectively, it is a mind-set that enables users to perform intuitively in digital environments, and to both easily and effectively access the wide range of knowledge embedded in such environments (Martin 2008).

Figure 2 Most important digital skills and competences for living and working in the 21st century



Source: own construction based on OPC consultation on the new Digital Education Action Plan 2020

The European Commission launched an Open Public Consultation (OPC) with the aim to ensure that the new Action Plan – Digital Education Action Plan 2021–2027 – would draw lessons from the experiences during the COVID-19 crisis and would support education and training through the long-term digital transformation. The results of the

OPC are shown on *Figure 2*. Ministries of Education and the Members of the European Parliament stressed the need to address the issue in a strong life-long learning and inclusive perspective, equipping young people and adults with the skills to engage with information critically (EC 2020a). The results in the OPC were parallel to all the previous definitions of digital skills and digital literacy, stressing that in the digital era it is indispensable to possess digital skills because digital technologies are inevitable both in people's professional and personal lives.

21st century skills and digital skills they are strongly intertwined, as *Critical Thinking* is needed to manage the overload of information and knowledge and to identify facts from fake content and information online. Or the use of digital tools can make Problem-solving more successful as well as understanding the digital world and systems and understanding and knowledge of emerging digital technologies are part of the ICT literacy.

Low levels of digital skills pose risks and act as a barrier to social inclusion. EU "citizens' exposure to large-scale disinformation, including misleading or false information, is a major challenge for Europe and it has become even more evident with the COVID-19 crisis. The virus outbreak dominated the media and it has been accompanied by an 'infodemic', a term indicating a massive amount of information that has made it hard for people to find trustworthy sources and reliable guidance. The need for all citizens to have a critical understanding of and interaction with the media and digital environments, to become resilient to disinformation and improve their participation in democratic processes has never been as vital as it is in today's digital world" (EC 2020a, 44.).

2.3. Measuring digital skills

The European Commission launched the Digital Competence (DigComp) Framework in 2011 to produce a set of digital competence descriptors for all levels (Kiss 2017). Based on DigComp, the Commission Directorate General for Communications Networks, Content and Technology and the Eurostat Information Society Working Group agreed to create and publish a 'Digital Skills Indicator', in 2014 (Kiss 2017).

According to the Eurostat description, digital skills indicators are composite indicators which are based on selected activities related to internet or software use performed by individuals aged 16–74 in four specific areas (information, communication, problem solving, software skills). It is assumed that individuals having performed certain activities have the corresponding skills. Therefore, the indicators can be considered as proxies of the digital competences and skills of individuals (Eurostat 2021).

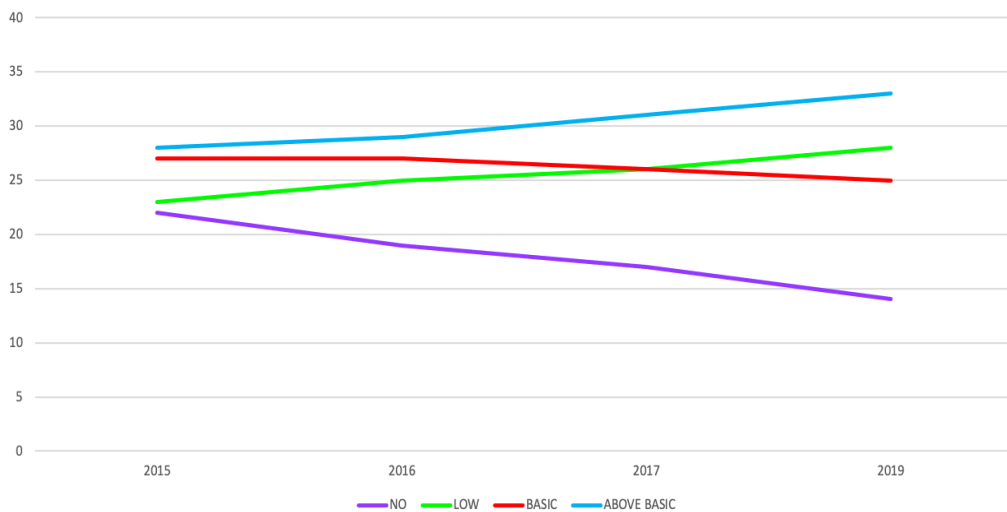
In line with the variety or complexity of activities performed, two levels of skills (basic and above basic) are computed for each of the four dimensions. Finally, based on the component indicators, an overall digital skills indicator is calculated as a proxy of the digital competences and skills of individuals (no skills, low, basic or above basic) (Eurostat 2021). The figures are also merged into the Digital Economy and Society Index (DESI), which is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU member states in digital competitiveness (EC 2020b).

3. Distribution of digital skills in the European Union

This section discusses two main types of distribution of digital skills in the EU to demonstrate the current state of digital skills level: geographical (member states level) and social distribution. Among social differences the paper reveals gender-specific, age-specific peculiarities and the distribution of individuals by educational attainment.

The overall picture is summarized in Figure 3. The share of individuals with no digital skills decreased by 8% from 22% in 2015 to 14% in 2019 and those individuals from 2015 might acquire digital skills as the share of individuals with low digital skills increased by 5%, from 23% in 2015 to 28% in 2019. This growth is less than the decrease of the share of people with no digital skills, because those people with low digital skills in 2015 might obtain enough knowledge to have basic digital skills in 2019.

Figure 3 Digital Skills Indicator by digital skills level in the EU between 2015–2019



Source: own construction based on Eurostat data (2021)

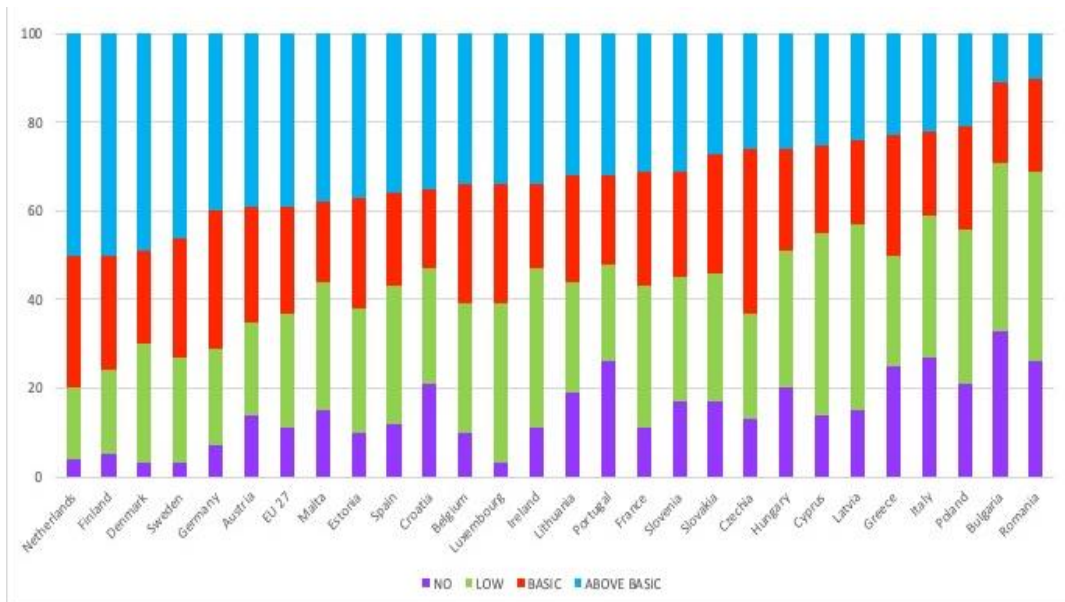
The situation is similar with basic and above basic digital skills as well. The share of individuals with basic digital skills decreased by 2%, from 27% to 25%, and the share of individuals with above basic digital skills raised by 5%, from 28% to 33%. This increase is more than the decrease in the rate of people with basic digital skills because those people with low digital skills in 2015 could have the knowledge needed in 2019 and thus could obtain basic digital skills.

The share of EU citizens with basic or above basic digital skills was 58% in 2019, while the rate of EU citizens with no or low digital skills is 42%, which means that almost the half of the EU population do not have enough digital skills to manage their lives in the digital age.

3.1. Geographical distribution of digital skills in the European Union

According to the Digital Skills Indicator from 2019 (Figure 4), 11% of Europeans (in the 27 EU countries) can be considered as having no digital skills, based on the criterion that they are not using the internet. It ranges between 3% (Denmark and Sweden) and 33% (Bulgaria).

Figure 4 Distribution of all individuals in EU member states by digital skills level in 2019, %



Source: own construction based on Eurostat data (2021)

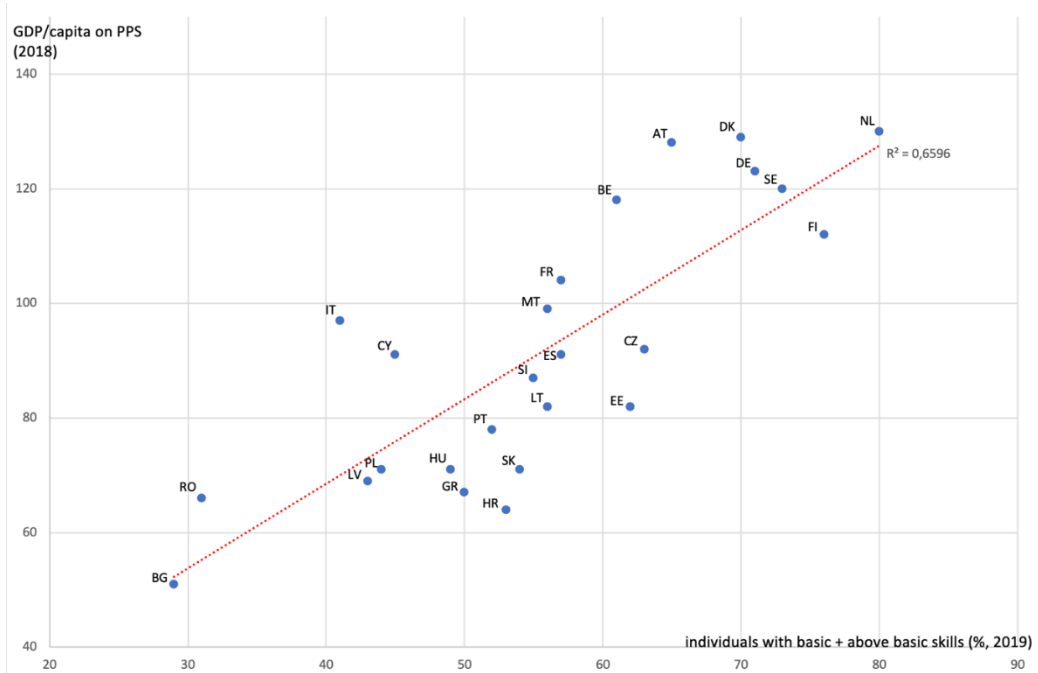
While in 2015 30% or more of the population had no digital skills in eight countries (Bulgaria, Croatia, Cyprus, Greece, Italy, Poland, Portugal, and Romania), in 2019 only Bulgaria and Italy had populations with around 30% having no digital skills, and the other mentioned countries were between 20 and 25%. Compared to the 2015 data, where 21% of EU citizens had no digital skills, it is noticeable that Europeans are acquiring digital skills.

To function in a digital society, an individual needs more than low-level skills (Kiss 2017). Considering this statement 37% of EU citizens lack enough digital skills – having no or low digital skills – even though 21 member states out of 27 have even higher shares. The area is Bulgaria where this rate is 71%, followed by Romania and Bulgaria, and the most outstanding member states are the Netherlands (20%), Finland (24%) and Sweden (27%).

When constructing a scatterplot (Figure 5) with the GDP per capita of the EU member states and the share of individuals having enough digital skills (basic and above basic) to live and perform in the digital age, the results clearly show that there is significant correlation ($R^2=0.6596$) between the two examined variables. Therefore,

the higher the level of digital skills of a population in an EU member state, the more likely it is to be paired with higher value of GDP per capita.

Figure 5 EU member states' GDP per capita as a function of the share of individuals having basic and above basic level of digital skills



Source: own construction based on Eurostat data (2021)

Note: Ireland and Luxembourg were eliminated from the variables because of their outlier value of GDP/capita and their small population

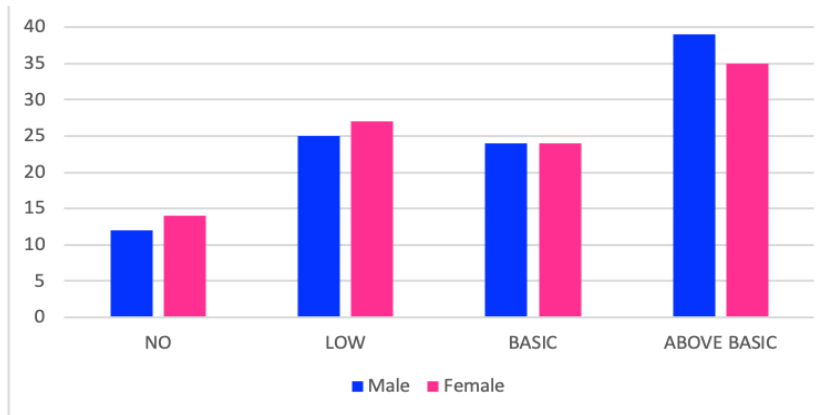
Furthermore, several other conclusions can be made after examining the figure. Values of EU member states vary in a wide range, both in terms of the share of individuals with basic and above basic skills (from 29% to 80%), and in terms of the value of GDP per capita on purchasing power standard (from 51 to 130). Two or three main groups can be defined based on the trend line: Western and Northern European member states are located at the upper end of the trend line, while member states at the Eastern and Southern periphery are located at the lower end of the trend line, with Bulgaria and Romania lagging behind.

3.2. Gender distribution of digital skills in the European Union

In the European Union, men often have greater advantages than women when it comes to the digital skills necessary to thrive in the digitalised world of work (EIGE 2020).

Figure 6 demonstrates that the share of men only exceeds the share of women in above basic digital skills, which means that the higher the level of digital skills we look at, the higher the share of men.

Figure 6 Digital skills by gender in the EU in 2019, % of individuals



Source: own construction based on Eurostat data (2021)

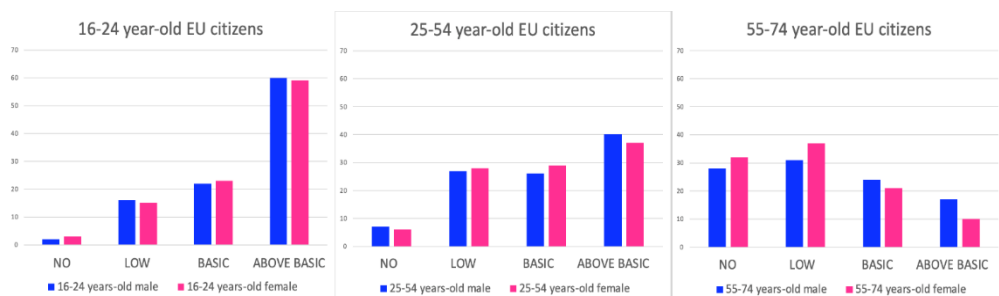
3.3. Age distribution of digital skills

To complement gender differences to measure digital skills distribution, age grouping can play an important role.

Figure 7 shows more social differences regarding digital skills in the European Union. The 2019 Eurostat survey demonstrates slight differences between the 16-24- and 25-54-year-old groups, the digital skills of men and women between 16-54-year-olds are quite the same.

The youngest age group – 16-24-year-old EU citizens – represents generation Z, which is the first social generation to have grown up with access to the Internet and portable digital technology, and is often called as “digital natives” (Zarándy 2012). As shown in Figure 7, 60% of male and 59% of female digital natives have above basic digital skills, and almost the entire generation Z has at least low digital skills (males 98%, females 97%) while 82% of both male and female 16-24-year-olds have satisfactory – basic and above basic – digital skills.

Figure 7 Digital skills of men and women in different age groups in 2019, % of individuals



Source: own construction based on Eurostat data (2021)

Examining the active age group, 25–55-year-old EU citizens, it can be stated that more men have above basic skills (40%) than women (37%), but if we compare the basic or above basic digital skills in the two gender groups, we find that their rate is the same (66-66%). However, it should be noted that one third of both active males and females currently in the labour market do not have enough digital skills (no or low categories) to live and perform in the digital society.

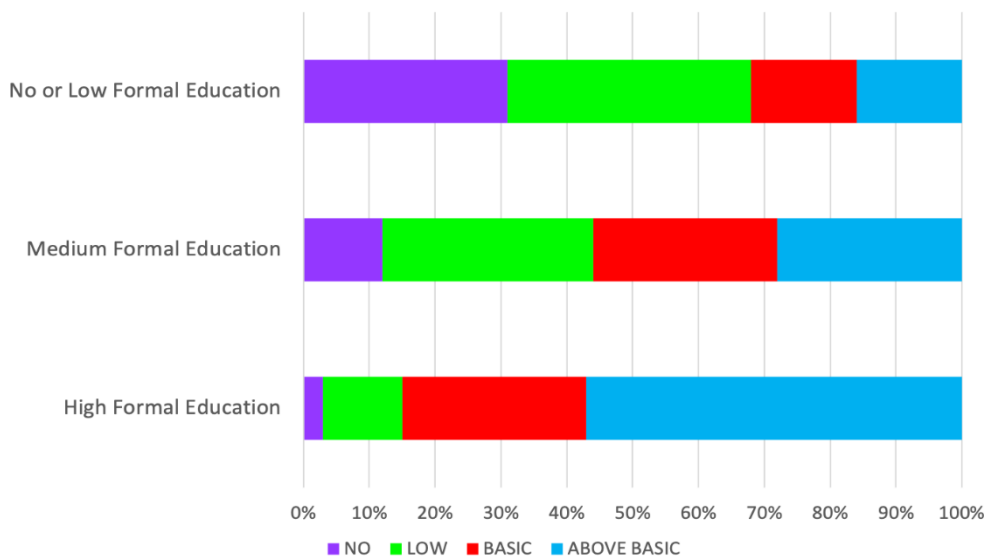
The elderly population – 55–74-year-old EU citizens – is characterised by insufficient digital competences, although the retirement age is 65 (and rising) in most of the member states, so they would need training to keep abreast of the times.

It may look like there will be no problem regarding the obtainment of higher digital skills as almost 60% of the 16–24-year-old population has above basic digital skills, but this paper has not examined the change in the share over time in the age groups. It can be possible that having children, certain social traditions, or other factors may affect the development of women’s digital skills negatively.

3.4. Educational attainment and the digital skills indicator

The base of a knowledge economy is the ability of innovation and the ability of learning (Tamási 2006). As is well known, the correlation between higher qualifications, developing knowledge capital and the competitiveness of the economy is relevant (Vass 2020). “The EU considers continuous advancement of education and training to be of profound importance. Widespread access to quality education and training is a driver of economic growth, social cohesion, research and innovation – and dramatically increases citizens’ prospects for personal development” (EC 2021a).

Figure 8 Distribution of individuals in the EU with various educational attainment levels by level of digital skills in 2019, %



Source: own construction based on Eurostat data (2021)

It is worth examining if there is any relationship between the level of the educational attainment of an individual and the level of their digital skills. First, the levels of formal education have to be defined. Three main levels of educational attainment are distinguished in this section: no or low formal education, which means someone has only pre-primary, primary and lower-secondary education or no education at all. Medium formal education level corresponds to upper secondary and post-secondary non tertiary education, and high formal education refers to tertiary education (Kailis and Pilos 2005).

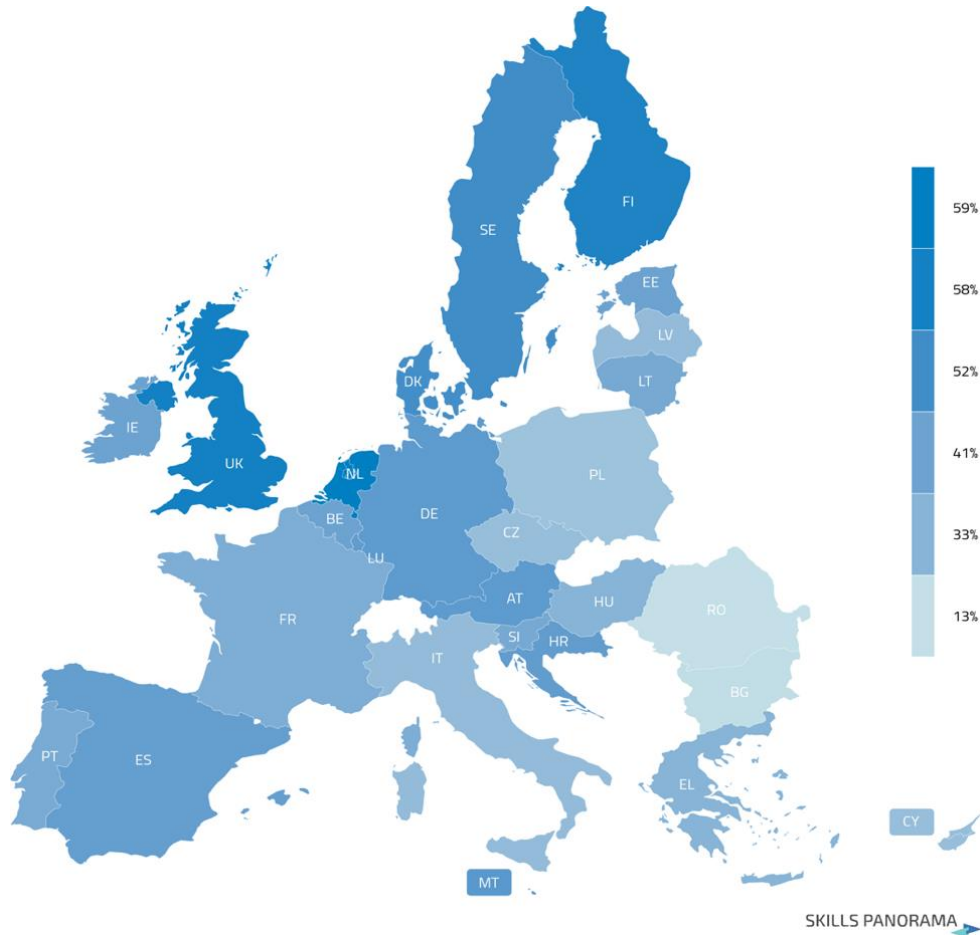
Figure 8 shows the share of individuals with different digital skills by educational attainment. Apparently, the level of educational attainment is directly proportional to the level of digital skills possessed. While 68% of individuals with no or a low level of formal education had no or low digital skills in 2019, 85% of EU citizens with high formal education level had basic or above basic digital skills and moreover, 67% of them had above basic level in digital skills. As a result of the comparison the conclusion is clear that the higher the level of education someone has, the more digital skills someone possesses. Thus, the formation of the EU 'competitiveness union' is crucial and urgent (Pelle 2013), and it is now inevitable to the population of Europe to be highly educated with good access to information and to relentlessly focus on training (Demeter et al. 2011).

4. Digital skills in the EU labour market

While basic digital skills, such as the use of search engines or digital bank services, are necessary, advanced digital skills open opportunities for access to well-paid jobs for which there is significant demand in the European digital economy (EIGE 2020). Skills Panorama is developed by the European Commission, the Directorate General for Employment, the Social Affairs and Inclusion powered by Cedefop, the European Centre for the Development of Vocational Training. The project turns labour market data into accurate and timely intelligence to offer new insights into skill needs in the European Union (Skills Panorama 2021a). Skills Panorama created the Digital skills use indicator (Figure 9), which provides the share of people whose digital skill use is above basic.

According to Skills Panorama research, the demand for digital skills is high in the EU labour market. A rapid digital transformation took place in some sectors like finance, business administration, science and engineering, education, health care, trade and manufacturing, and in line with this transformation, digital skills become relevant in managerial, professional and even in clerical occupations as well. It is also noticeable that other types of work tasks are also linked to ICT tasks. As already highlighted, 21st century skills and digital skills are strongly related, and digital skills can help improve those skills for adapting in the field of work. Online job advertisements (OJAs) have become the main platform for employers and job-seekers during COVID-19 pandemic and the growing importance of digital skills and knowledge in OJAs during 2020 is a sign of progressing workplace digitalisation (Skills Panorama 2021b).

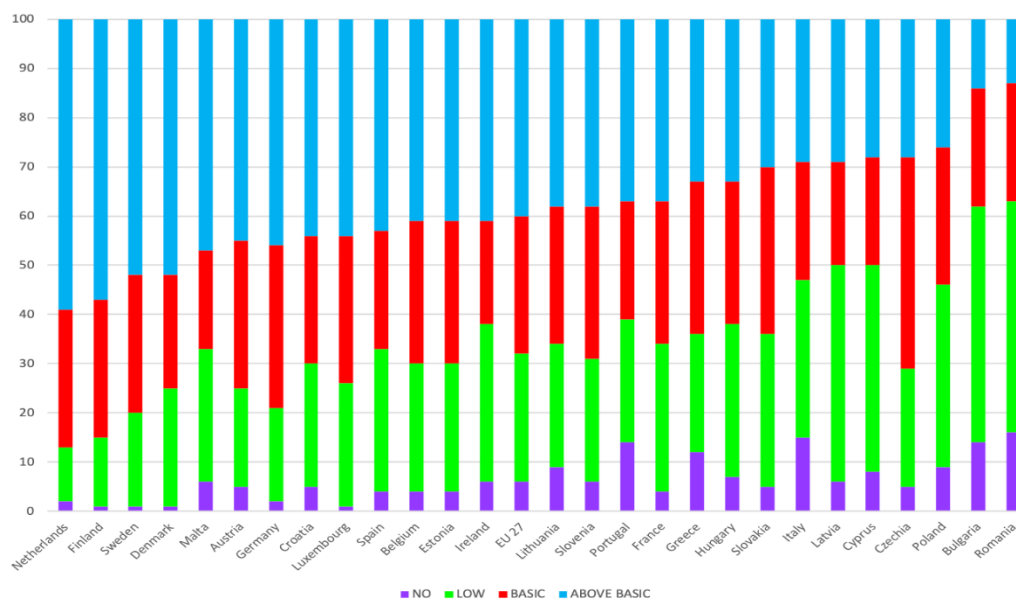
Figure 9 Share of all in employment in 2019 with above basic digital skills across European countries



Source: Skills Panorama (2021)

According to Eurostat data (Figure 10), 6% of EU workforce had no digital skills at all in 2019. The worst performing member states with shares above 10% were Romania (16%), Italy (15%), Portugal (14%) and Greece (12%). In addition, 32% of EU labour force had insufficient (no or low) digital skills and this share is higher in 15 member states, where Bulgaria (63%) and Romania (62%) performed the worst as more than half of their employed population lacked at least basic digital skills. Comparing these data to 2015, the progress is measurable, though, as Bulgaria improved by 1% in 4 years' time and Romania reduced the 70% share to 62%. Although it should be mentioned that the level of digital skills of the EU working population is higher than that of the whole population.

Figure 10 Distribution of EU labour force* by digital skills level in 2019, %



Source: own construction based on Eurostat data (2021)

*Note: labour force includes employed population, self-employed population and family workers

Digitalisation has a great impact on the labour market as well. New business models, products and machines create new jobs, while automation contributes to the elimination or destruction of jobs or their relocation to countries with lower labour costs (Kiss, 2017), and the workplaces most affected are the medium-skilled jobs (Csapó, 2019). Without the right amount of digital skills, it would be difficult for an unemployed individual to re-enter the labour market.

5. Actions improving digital skills level of the EU population

The different pace of digitalisation of the EU member states is a real concern, causing a widening digital skills gap. Skills, labour mobility and information technologies are part of EU policy (among other things), they are key essentials in achieving desired competitiveness level in the world. Skills upgrading is not just a luxury for the highly qualified high-tech professionals, but a necessity for everyone (Kiss 2017). The digital skills gap – expanding as a result of the outbreak of COVID-19 pandemic – required an increase in digital education (EP 2020), thus proved to be challenging for the European Union as well. Several initiatives at the EU level have been taken to remedy this situation.

Education as an investment in human capital is an indispensable precondition to attract financial capital as well. Actions at the EU level also stress the importance of education in the process of digital transformation. All the mentioned EU programmes prioritise financial and non-financial investments in education. The main question is

how motivating financial assistance can be for the EU member states, and what other tools can be used to encourage the development of digital skills at member states' level since the success of these measures may be questionable without the contravention of the sovereignty of the member states.

Table 2 EU actions to improve digital skills level of the EU population

INITIATIVE	ENCOMPASSING PROJECT	PERIOD	RESOURCE	OBJECTIVES CONCERNING DIGITAL SKILLS
2010 Digital Agenda for Europe	Europe 2020	2010-2020	commissions	- enhancing digital literacy skills and inclusion - applying ICT to address societal challenges such as climate change and ageing population
Skills Guarantee	New Skills Agenda	2016	funds from enterprises and governments	helping the access to upskilling for those who have left initial education to acquire a minimum level of literacy, numeracy and digital skills
Digital Europe Program	EU budget	2021-2027	€580 million	- supporting the design and delivery of specialized programmes and traineeships for the future experts in key capacity areas like data and AI, cybersecurity, quantum and HPC - supporting the upskilling of the existing workforce through short trainings reflecting the latest developments in key capacity areas
The Recovery and Resilience Facility	NextGenerationEU	2021-	€672.5 billion (initiative; loans & grants)	reskilling and upskilling by education and training to support digital skills
European Skills Agenda	-	2020-2025	funds from enterprises and governments	raising the share of adults aged 16-74 having at least basic digital skills from 56% (2019) to 70%
Digital Education Action Plan	-	2021-2027	commissions	- fostering the development of a high performing digital education ecosystem - enhancing digital skills and competences for the digital transformation

Source: own construction based on EC initiatives (2021)

Prior to the current crisis induced by the pandemic, as part of the Europe 2020 strategy for smart, sustainable and inclusive growth, the *2010 Digital Agenda for Europe* was already among its seven flagships and some of its priority areas were focusing on enhancing digital literacy skills and inclusion, and applying ICT to address societal challenges such as climate change and an ageing population (EC 2010). In 2014, more than 90% of the actions were completed already (Kiss 2017). In 2016, New Skills Agenda aimed to improve the quality of skills throughout the whole spectrum of education. Within the agenda, the *Skills Guarantee* was launched to provide access to

upskilling for those who have left initial education to acquire a minimum level of literacy, numeracy and digital skills (EC 2016).

The *Digital Europe Program 2021–2027* is part of the next long-term EU budget – with a budget of 7.5 billion EUR – to accelerate the recovery and drive the digital transformation of Europe (EC 2021b). Among other outcomes, it will strengthen investments in advanced digital skills with 580 million EUR by supporting the design and delivery of specialized programmes and traineeships for the future experts in key capacity areas like data and AI, cybersecurity, quantum and HPC and by supporting the upskilling of the existing workforce through short trainings reflecting the latest developments in key capacity areas (EC 2021b).

NextGenerationEU is a temporary instrument that allows the European Commission to raise funds to help repair the immediate economic and social damage brought about by the COVID-19 pandemic (EC 2021c). *The Recovery and Resilience Facility* is the key instrument at the heart of NextGenerationEU with a budget of 672.5 billion EUR and one of its flagship areas for investments and reforms is to reskill and upskill by education and training to support digital skills.

The *European Skills Agenda* is a five-year plan to help individuals and businesses develop more and better skills and to put them to use (EC 2021d). One of the objectives to be achieved by 2025 is to raise the share of adults aged 16-74 having at least basic digital skills from 56% (2019) to 70%.

The *Digital Education Action Plan 2021–2027* outlines the European Commission’s vision for high-quality, inclusive and accessible digital education in Europe (EC 2021e). The Action Plan “addresses the challenges and opportunities for digital education in different learning environments – formal, non-formal and informal – and extends its scope to lifelong learning” (EC 2020a, 23). Its priority areas are fostering the development of a high performing digital education ecosystem, and enhancing digital skills and competences for the digital transformation.

To sum up, we can state that the European Union has acknowledged the importance of digital skills in the global technology-driven competition, and the relevance of improving digital skills among the EU population and labour force is prevalent in an ever wider scope of EU initiatives and actions. In addition, digital competences and performance of individuals is more and more linked to European competitiveness.

6. Conclusions and room for improvement

The digital transformation of the world is inevitable and the only question for an economy is the pace of its adaptation. In the current economic situation of the digital era, a successful policy to foster the skills needed for a digital transformation could secure Europe a technological advantage and resilience in global competition. The European Union has a leading role in shaping the global economy in the 21st century and, thus, has to progress to keep its competitiveness. As Pelle and Laczi (2015) found, an inclusive society is a necessary precondition for a competitive economy in the EU, but low levels of digital skills pose risks and act as a barrier to social inclusion, which is a great concern as 42% of EU citizens – almost half of the EU population – do not have sufficient digital skills to manage their lives in the digital era.

The analysis of data reveals relevant differences in digital skills levels across EU member states and across various social groups. The share of individuals with basic and above basic digital skills in EU member states varies between 29%-80%, which is a noticeable difference and confirms the centre vs. periphery contrast, as the core countries tend to account for the higher shares, while the periphery countries exhibit the lower ones. Examining the group of men and women, the higher the level of digital skills we analyse, the higher the share of men in the digital skills level group.

This paper has not focused on the change in the share of individuals at different digital skills levels over time, but motherhood, certain social traditions and further socio-cultural factors may affect the development of women's digital skills negatively. Moreover, one third of both active males and females does not dispose of sufficient digital skills to successfully participate and perform in the digital society and in the EU labour market, which harms EU competitiveness as well. As shown above, the higher the level of digital skills of a population in an EU member state, the more likely it is to be paired with a higher value of GDP per capita. Presumably, the development of people's digital skills could have a positive effect on the GDP per capita of a member state and, thus, could increase the competitiveness of the European Union on the global market. As the European Union has recognized this impact, numerous initiatives have been launched, already discussed in the fifth section of the paper. It comes up against a difficulty to identify the method of developing the overall status of the digital skills of the European population by EU level initiatives, and compared to that, it is gratifying that a number of programs have been launched and several funds have been created trying to solve the disputed point. Another engaging question is whether the European Union would have recognized the importance of digital skills without a pandemic.

Accordingly, both the EU and its member states should place a special emphasis on policies and programmes that aim at improving digital skills of the population and the labour force, especially on the lower end, as the individuals in those groups are at serious risk of social and labour market exclusion. Targeted local and broader programmes and projects for women, elderly age groups, and people with lower educational attainment would contribute to the narrowing of the digital skills gap in the EU. Obviously, regular education systems of the member states should embrace digital technologies and the preparation of the students for applying them in various subject fields. So, the improvement of digital skills should be a horizontal intervention in education and training systems and initiatives.

Development of digital skills is therefore essential, and even more so in the situation caused by the COVID-19 pandemic from 2020 onwards, which might act as trigger to boost actions. The skilling, upskilling and reskilling processes should tend to narrow the digital skills gap across the EU member states as well. The process of converging digital skills should result in an "upward-convergence", in other words, while training and educating underperforming EU member states and social groups to reach the level of highly performing ones', those outstanding actors (member states and social groups) have to maintain their leading positions in terms of digital skills attainments. Further research is required to explore the actions for the development of digital skills already implemented by the EU member states.

References

- Ahmad M. – Karim, A.A. – Din, R. – Albakri, I.S.M.A. (2013): Assessing ICT competencies among postgraduate students based on the 21st century ICT competency model. *Asian Social Science*, 9, 16, 32–39.
- Akhvlediani, T. (2021): *Digital Literacy in times of the Covid-19 in the Eastern Partnership Countries*. EaP CSF COVID-19 Policy Paper Accessed: April 27, 2021.
- Anderson, R. (2008): Implications of the information and knowledge society for education. In Voogt, J. – Knezek, G. (eds.): *International handbook of information technology in primary and secondary education*. New York: Springer, 5–22.
- Barro, R.J. – Sala-i-Martin, X. (2004): *Economic Growth*. New York: McGraw-Hill.
- Binkley, M. – Erstad, O. – Herman, J. – Raizen, S. – Ripley, M. – Miller-Ricci, M. – Rumble, M. (2012): Defining twenty-first century skills. In: Griffin, P. – McGraw, B. – Care, E. (eds.): *Assessment and Teaching of 21st century skills*. New York: Springer, 17–66.
- Carnevale, A.P. – Smith, N. (2013): Workplace basics: The skills employees need and employers want. *Human Resource Development International*, 16, 5, 491–501.
- Csapó, B. (2019): A jövő elvárásai és a tudás minősége. In: Kónyáné Tóth, M. – Molnár, C. (eds.): *Az oktatás átalakulása a tudástársadalom és a mesterséges intelligencia korában*. Debrecen: Suliszerviz Pedagógiai Intézet, 182–192.
- Cornell University (2015): *Cornell University Digital Literacy resource: Digital literacy is ...* Cornell: Cornell University
- Demeter, K. – Chikán, Á. – Matyusz, Z. (2011): Labour productivity change: Drivers, businesses impact and macroeconomic moderators. *International Journal of Production Economics*, 131, 215–223.
- European Commission (2010): *A Digital Agenda for Europe*. Communication, EC.
- European Commission (2013): *The Survey of Adult Skills (PIAAC): Implications for education and training policies in Europe*. EC
- European Commission (2016): *Proposal for a Council Recommendation on establishing a Skills Guarantee*. Communication, EC.
- European Commission (2020a): *Digital Education Action Plan 2021–2027. Resetting education and training for the digital age*. Commission Staff Working Document, EC
- European Commission (2020b): *The Digital Economy and Society Index (DESI)*. <https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi> Accessed: April 28, 2021.
- European Commission (2021a): *Education and Training. About education and training in the EU*. https://ec.europa.eu/education/education-in-the-eu/about-education-and-training-in-the-eu_en Accessed: April 29, 2021.
- European Commission (2021b): *Digital Europe Programme: A proposed €7.5 billion of funding for 2021–2027*. <https://digital-strategy.ec.europa.eu/en/library/digital-europe-programme-proposed-eu75-billion-funding-2021-2027> Accessed: April 29, 2021.

- European Commission (2021c): *The Recovery and Resilience Facility*.
https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en Accessed: April, 29, 2021.
- European Commission (2021d): *European Skills Agenda*.
<https://ec.europa.eu/social/main.jsp?catId=1223> Accessed: April 29, 2021.
- European Commission (2021e): *Digital Education Action Plan (2021–2027)*.
https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en Accessed April 29, 2021.
- European Institute for Gender Equality (EIGE) (2020): *Gender Equality Index 2020: Digitalisation and the future of work*.
<https://eige.europa.eu/publications/gender-equality-index-2020-report/digital-skills-and-training> Accessed: April 28, 2021.
- European Parliament (2020): *Skills to fit the digital age and boost the COVID-19 recovery*. Briefing, EP
- European Union (2012): *Employment and Social Developments in Europe 2012*. Publications Office of the European Union
- Eurostat (2020): *Hard-to-fill ICT vacancies: an increasing challenge*.
<https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200221-1>
Accessed: April 27, 2021.
- Eurostat (2021): European Statistics.
https://ec.europa.eu/eurostat/cache/metadata/en/tepsr_sp410_esmsip2.htm
Accessed: April 28, 2021
- Fadel, C. – Bialik, M. – Trilling, B. (2015): *Four-Dimensional Education*. Boston: Center for Curriculum Redesign.
- Kailis, E. – Pilos, S. (2005): *Statistics in Focus: Population and social conditions. Lifelong learning in Europe*. Working Document. EC
<https://ec.europa.eu/eurostat/documents/3433488/5574436/KS-NK-05-008-EN.PDF/417e9b51-ae3-42c8-88f3-314e2cdd7a96> Accessed: April 29, 2021.
- Kefela, G.T. (2010): Knowledge-based economy and society has become a vital commodity to countries. *International NGO Journal*, 5, 7, 160–166.
- Kiss, M. (2017): *Digital skills in the EU labour market*. In-Depth Analysis. European Parliamentary Research Service.
- Lanvin, B. – Kralik, M. (2009): E-skills: Who made that big dent in my flat world? *Information Technologies and International Development*, 5, 2, 81–84.
- Lanvin, B. – Passman, P. (2008): Building e-skills for the information age. *The Global Information Technology Report 2007–2008: Fostering innovation through networked readiness*. Hampshire: Palgrave Macmillan, 77–80.
- Martin, A. (2008): Digital literacy and the ‘digital society’. In: Lankshear, C. – Knobel, M. (eds.): *Digital literacies: Concepts, policies and practices*. New York: Peter Lang, 151–176.
- Mayer, K.U. – Solga, H. (2008): *Skill Formation. Interdisciplinary and Cross-National Perspectives*. New York: Cambridge University Press.
- OECD (2013): *New Sources of Growth: Knowledge-Based Capital Driving Investment and Productivity in the 21st Century*. Synthesis Report, OECD

- Pelle, A. (2013): The European Social Market Model in Crisis: At a Crossroads or at the End of the Road? *Social Sciences*, 2, 3, 131–146. <https://doi.org/10.3390/socsci2030131> Accessed: April 30, 2021
- Pelle, A. – Laczi, R. (2015): Inclusive Society as a Necessary Condition for Knowledge-Based Competitiveness in the European Union. *Managing Global Transitions*. Koper: University of Primorska. 13, 4, 307–329.
- Romer, P. (1990): Endogenous Technological Change. *Journal of Political Economy*, 98, 5, 71–102. <http://www.jstor.org/stable/2937632> Accessed: April 30, 2021.
- Skills Panorama (2021a): <https://skillspanorama.cedefop.europa.eu/en> Accessed: March, 5, 2021
- Skills Panorama (2021b): *Digital skills: Challenges and opportunities*. https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/digital-skills-challenges-and-opportunities Accessed: April 29, 2021.
- Solow, R. M. (1987): *Growth Theory and After*. Lecture to the memory of Alfred Nobel. http://www.nobelprize.org/nobel_prizes/economics/laureates/1987/solow-lecture.html Accessed: February 28, 2013)
- Sulyok, T. (2002): Az oktatás és az információs társadalom. *Tudásmenedzsment*, 3, 1, 49–60.
- Tamási, P. (2006): Néhány gondolat a tudás- és gazdasági klaszterek kialakulásáról és működéséről. *Magyar Tudomány*, 167, 7, 857–861.
- van Laar, E. – van Deursen, A.J.A.M. – van Dijk, J.A.G.M. – de Haan, J. (2017): The relation between 21st-century skills and digital skills: A systematic literature review. *Computers in Human Behavior*, 72, 577–588.
- Vass, V. (2020): A tudásgazdaság és a 21. századi kompetenciák összefüggései. *Új Munkaügyi Szemle*, 1, 1, 30–37.
- Zahidi, S. – Leopold, T. (2016): *What is the future of your job?* <https://www.weforum.org/agenda/2016/01/what-is-the-future-of-your-job/> Accessed: February 8, 2021.
- Zarándy, Z. (2012): Európából e-urópába. Az IKT-készségek és a digitális kompetencia fejlesztésének trendjei Európában. *Könyv és Nevelés*. 14, 3, 71–84.