CENTER FOR POLICY STUDIES

CEU Democracy Institute

NINA BEGICEVIC REDEP

Comparative overview of the digital preparedness of education systems in selected CEE countries

2021/8

WORKING PAPER SERIES

ABOUT THE PROJECT

The “**Future Challenges to Education Systems in Central Eastern European Context” (**EDUC, https://cps.ceu.edu/research/educ) is a two year comparative research project aiming at assessing the ability of the education systems of five Central-Eastern European countries to adapt to various ongoing changes, such as technological changes and their impact on labor markets, demographic changes, populist politics and autocratic governance, old and new inequalities, changing gender roles, globalization, etc. The research focuses on the adaptability of education systems determined by the interplay between governance and the institutional operation of schools in Poland, Hungary, Slovakia, Serbia and Romania. This report was supported in part through a grant from the Open Society Foundations.

ABOUT THE PAPER SERIES

Working Papers reflect the on-going work of academic staff members and researchers associated with the Center for Policy Studies/CEU. They are intended to facilitate communication between CPS and other researchers on timely issues. They are disseminated to stimulate commentary and policy discussion among an international community of scholars. These Working Papers are results of research stemming from projects started by the CEU Center for Policy Studies. The CEU Center for Policy Studies has merged into the CEU Democracy Institute as of September 1, 2020. For more information see https://democracyinstitute.ceu.edu.

ABOUT THE AUTHORS

Nina Begicevic Redep is a full professor at Faculty of organization and informatics, University of Zagreb. She is also a dean of the Faculty of organization and informatics. Her special field of interest is strategic planning and decision making, educational policy analysis, digital technologies in education, e-learning. She can be contacted at nina.begicevic@foi.unizg.hr.

The paper was reviewed by **Peter Rado**, research fellow at the Democracy Institute of Central European University in Budapest, Hungary, lead researcher of the project “Future Challenges to Education Systems in Central Eastern European Context (EDUC)”.

TERMS OF USE AND COPYRIGHT

CENTER FOR POLICY STUDIES / DEMOCRACY INSTITUTE
CENTRAL EUROPEAN UNIVERSITY
Nádor utca 9, 1051 Budapest, Hungary
http://cps.ceu.edu, cps@ceu.edu

COMPARATIVE OVERVIEW OF THE DIGITAL PREPAREDNESS OF EDUCATION SYSTEMS IN SELECTED CEE COUNTRIES

Nina Begicevic Redep

CONTENTS

INTRODUCTION

This thematic comparative study on digital preparedness was prepared within the scope of an OSF/ESP funded comparative research project by the Center for Policy Studies at Central European University called "Future Challenges to Education Systems in Central Eastern European Context" (EDUC).

The project aims at assessing the ability of the education systems of five Central-Eastern European (CEE) countries – Poland, Hungary, Slovakia, Serbia, and Romania – to adapt to various ongoing changes, such as technological changes and their impact on labor markets, demographic changes, populist politics and autocratic governance, old and new inequalities, changing gender roles, and globalization. The research in the project was focused on the adaptability of education systems determined by the interplay between governance and the institutional operation of schools in Poland, Hungary, Slovakia, Serbia, and Romania. The EDUC project aims at mapping the capacity of educational systems to adapt to the challenges of ongoing and future changes by enabling students to individually adapt.

This thematic comparative study is focused on assessing the actual digital preparedness of the educational systems and the institutional conditions of further development in the CEE countries. In preparing this study, analysis of policies, programs, and school evaluation reports was undertaken, as well as analysis and interpretation of various statistical data sets and data about student achievement. Relevant documents and statements issued by the government, government agencies, EU agencies, and stakeholder organizations were also analyzed, and results are presented in this comparative study.

Key themes of this thematic comparative study are:

1. The role of digital technologies in work and in social life in general and in the CEE countries.
2. Digital inequalities and their relationship with other dimensions of inequalities.
3. Expectations towards education in relation to digital presence end preparedness. An assessment of investment into the development of digital skills so far.
4. The various reference frameworks for digital learning outcomes and for the digital preparedness of schools and teachers.
5. The contextual relevance of international frameworks in the CEE countries, and national frameworks in the CEE countries and their implementation.
6. The digital preparedness of schools and governance systems in the CEE countries.
7. The use of blended learning and purely digital instruction and learning methods, and the use of online learning instruments in the CEE countries.

8. The conditions for developing online learning in the CEE countries.

9. The potential role of big data analytics in educational assessment, quality evaluation, and the management and governance of education.

The study consists of nine chapters. After the introduction, in the second chapter the role of digital technologies and digital transformation in work and in social life is described. The topic digital skills and digital inequalities in CEE countries is presented in Chapter 3. The digital preparedness of school systems in the CEE countries as a main topic of this study is interpreted in Chapter 4. To provide more data and evidence regarding digitization in education and digital technologies in learning, the European Commission published the final report of the "2nd Survey of Schools: ICT in Education" study. The various reference frameworks for the digital preparedness of schools and teachers and their implementation in CEE countries is presented in Chapter 5. Experience with emergency remote teaching and online learning in Serbia, Poland, Hungary, and Slovakia during the COVID-19 pandemic is described in Chapter 6. The potential impact of Covid-19 on e-learning enrolments is briefly explained in Chapter 7. In Chapter 8, the potential role of big data analytics for improving the quality of education is introduced.

1. THE ROLE OF DIGITAL TECHNOLOGIES AND DIGITAL TRANSFORMATION IN WORK AND IN SOCIAL LIFE

Tremendous changes in the economic, social, and technological sphere pose new challenges for work and social life. Digital technologies are among the main change accelerators that can drastically change the world. Due to the rapid development of digital technologies, society is facing a variety of challenges which drive the creation of new innovative approaches and the establishment of new infrastructure.

Although the digital transformation is in most cases connected to the business world, it is also discussed in the context of social life. However, the digital transformation does not only refer to a shift in technology. According to Stolterman and Fors (2004), digital transformation can be understood as the changes that digital technology causes or influences in all aspects of human life. According to Solis (2017), digital transformation may be defined as "the realignment of, or new investment in, technology, business models, and processes to drive new value for customers and employees and more effectively compete in an ever-changing digital economy." From an organizational point of view, digital transformation can be seen as a deep and accelerating transformation with regard to processes, activities, competences, and models. It allows organizations to take advantage of the changes and opportunities offered by digital technologies (Begičević Ređep et al., 2020).

Uhl and Gollenia (2016) enrich the digital transformation concept and argue that the adoption of technology-based change is focused on four technology enablers: (1) cloud, (2) mobile, (3) social, and (4) big data – analytics. Hence, digital transformation draws on these four pillars to locate the business context for the technologies, while taking advantage of them to support innovation (Virkus, 2019). Schlepp (2019) refers to "[t]he novel use of digital technology to solve traditional problems in new ways and enable new types of innovation." From the social perspective, digital transformation refers to a process whereby humans re-shape the way society works by way of interpreting and understanding society, including the usage of digital technologies in everyday life (Norqvist, 2018).

The recent updates of EU key competences, specifically the digital competence, highlights the problem that there are people that need to adapt faster and better to societal transformations. In the OECD report (OECD, Going Digital, 2017), the following key activities are claimed to be necessary for coping with digital transformation: 1) Seizing opportunities and mitigating challenges, 2) Fostering access and effective use, 3) Facilitating social adjustment and ensuring inclusion, and 4) Leveraging the digital transformation for better policies. In the digital transformation process, strengthening digital competencies for all workers and citizens is recognized as crucial. It is essential to continuously assess and anticipate changing skill needs and foster the provision of more responsive education and training. In education systems, it is crucial to adapt the curriculums and pathways that are offered, and to guide pupils and students towards choices that lead to good employment outcomes in the future (OECD, Going Digital, 2017).

"The digital transformation will provide new job opportunities for many but raises challenges for others. Making the digital transformation work will require inclusive, coherent and well-coordinated policies, reflecting a multi-stakeholder and whole-of-government approach to policy making [...] that pro-actively consider[s] those who will benefit from the digital transformation and those who risk being left behind" (OECD, Going Digital, 2017).

1.1. The role of digital technologies and digital transformation in educational systems

Digital technologies have already changed the education system across Europe and will continue to do so. They affect every level of education, from primary and secondary schools to universities. The digital transformation of the educational system does not occur instantly, but is a journey that needs a staged approach with a clear roadmap, data, and facts. (Power, Heavin, 2018).

Main five digital transformation trends in education for 2020 are: 1) customized learning experiences, 2) accessibility, 3) the Internet of Things, 4) security, and 5) the fact that "schools are strapped [for money]" (Newman, 2019). Digital technologies can make it easier for students of different learning types to learn in the way that is most appropriate for them – for example, by using learning management systems, gamification, modelling tools, etc. Digital technologies are also the answer to the accessibility issue in education. Educational technology can improve the delivery of education to some of the most underprivileged groups of people.

The Internet of Things as a trend for 2020 is helping save money in terms of improving energy and lighting use. It is also helping to keep schools and students safer and more connected. In the coming years, an important trend in digital transformation will be security, in the form of a push for more transparency in and control of online learning. Schools must evolve to embrace new learning styles and digital technologies that can motivate students and maintain the integrity of knowledge in "less attractive" areas, such as in literature or history (schools are strapped) (Newman, 2019).

Learning analytics, artificial intelligence, and machine learning are playing an important role in analyzing student learning and, based on the results thereby obtained, in preparing recommendations for improving and customizing learning approaches.

Due to the digital transformation, educational systems have had to transform teaching, learning, and assessment practices for teachers and students. In the new digital era, in which educational systems operate in a competitive environment, the innovative use of digital technologies is becoming a main tool of survival and a policy priority across Europe.

From the perspective of digital education policies, the most important factor for the integration of digital technologies into educational systems is a commitment to supporting teachers and strengthening their digital capacity (Digital Education Policies in Europe and Beyond, 2017).

The digital transformation challenge in education involves how to improve learning and to facilitate the collaborative preparation of teaching materials to be with the use of digital technologies, which will be an in-demand skill in the future educational system. Teachers and students who know how to work on and connect through digital technologies will have better chances on the future job market.

Digital technologies in educational institutions promise to empower the transformation of business, learning, and teaching processes, to enhance the competencies and skills of students and teachers in digital literacy and beyond, to boost the former's readiness for facing challenges in the labor market, and to shape the potential for taking advantage of educational opportunities and improvements in the future.

They enable educational institutions to implement transformation by using innovative methods of teaching and learning, such as group learning, project-based learning, hybrid learning, Massive Open Online Courses (MOOC), the global delivery of materials, facilitating student interaction, and transforming learning communities with digital pedagogy (Virkus et al., 2020).

The use of digital technologies and open educational resources enables self-directed and choice-based learning (Ossiannilsson, 2016). Digital technologies can play a role as tools which afford learners the potential to engage with activities.

The NMC "Horizon Report: 2018 Higher Education Edition" (NMC Horizon Report, 2018) identifies one of the key trends accelerating the adoption of education technologies as "Growing Focus on Measuring Learning" and "Analytics technologies," which is an important development in technology for education. As the use of digital technologies has expanded in education, the traditional classroom environment has evolved to include a range of modalities, from the traditional face-to-face approach to the use of information technology to "blended" face-to-face and online learning, to fully online courses/programs. The increase in the use of digital technologies in education is generating huge amounts of data about students and their learning processes that provide a foundation for learning analytics, and teaching staff have begun using them to measure students' engagement in online contexts (Beer et al., 2010).

The development and uptake of e-Learning and MOOCs and advances in Technology Enhanced Learning in the last two decades have contributed to the availability of unprecedented amounts of data about all aspects of teaching and learning. In parallel, advances in data mining, big data analytics and statistics, and their application to the education and training sector now mean that educational data mining and learning analytics are promising approaches to using data to digitally transform and improve learning and teaching.

How to integrate digital technologies in a decisive way is one of the main challenges. For the educational system, digital transformation brings new digital technologies, methodologies, and even more importantly, new mindsets.

Strong leadership and strategic planning, as well as the systematic integration of digital technologies, are prerequisites for the digital transformation of educational systems. Guidance can be introduced through the adoption of new methods and techniques for the strategic planning of the integration of digital technologies.

1.2. How to cope with the challenges of digital transformation?

Changes influenced by technological development pose new challenges to the educational system, which generates the future participants and bearers of the social environment. Educational institutions should address these challenges through the coordinated strategic planning and operationalization of plans, according to the following priorities (Begičević Ređep et al., 2020):

- using modern teaching and learning methods
- updating teaching and related content
- the application of digital technologies in teaching and non-teaching processes
- encouraging creativity and innovation
- strengthening enactment competencies and skills.

By understanding the transformational efforts in the economy and government which happen by taking advantage of the opportunities which are enabled by digital technologies, educational institutions can imitate and adopt some useful paradigms. A comparison of useful paradigms redrawn in relation to the determinants of digital transformation (Pihir et al., 2019) is given in Table 1. In the first column in Table 1, digital transformation determinants in organizations from the real sector are briefly outlined. In the second column, the mapping of the determinants from the real sector on the educational sector is described in order to compare the two sectors and illustrate their similarities and differences.

Introducing digital technologies and business-related operating models into educational institutions' processes increases the digital maturity level of educational institutions. In this sense, "going digital" has become an imperative in contemporary digital societies. Consequently, ways of acquiring competencies and skills must undergo some digitally inspired changes as well.

An assessment of the digital maturity entry level in relation to strategy-oriented endeavors involving digital technologies is essential for identifying the potential benefit of the strategic initiatives needed for realizing the organizational mission and vision. Also, identifying internal as well as external impact factors is required for creating feasible strategic goals, and ensuring the existence of key tools and resources needed for strategy realization.

Table 1: Comparison of useful transformation determinants between the real sector and educational institutions (EIs) (the production of the author, 2020)

Real sector determinants Description of scope of determinant	**EI's determinants** Description of scope of determinant
Strategy orientation Vision, mission and strategic goals for achieving business initiatives defined by management. Leadership directs efforts required for the accomplishment of goals in accordance with business models (Business model canvas, Osterwalder, 2014).	**Strategy orientation** EI's strategy orientation comprises two perspectives: bottom up (school-to-government) and top down (government-to-school) that are contained in a clear vision and which are translated into EI's strategic goals Management is crucial in relation to turning strategic goals into feasible action. Leadership capabilities define the level of effort required to accomplish goals. Equivalent to business models in the real sector, EI's need to continuously question their role in the society and fine-tune their strategic plans.

Customer-centricity Customer-centricity shapes organizational behaviour in relation to customer expectations. Planning, designing, and tracking customers' experiences, as well as predicting and forming the customer's journey, impact the market value of products and services.	**Student-centricity** Besides caring about equal opportunities for all students, the focus on the benefits of learning lead to a student-centric paradigm. The final output shows if a product or a service has any market value. To apply this paradigm to the educational sector, students' ability to participate in the global market demands a student centric-based approach within Learning Experience Management. Identifying expectations and deliverables in the form of students' readiness to take part in the labour market or through their own accomplishments requires new methods and techniques within the EI teaching processes.
ICT and process infrastructure ICT resources, business processes and data infrastructure contribute to products and services. Introducing technology into business processes increases agility in terms of reacting to environmental challenges.	**Supporting IT infrastructure; teaching and learning process infrastructure** Although digital transformation is not primarily about technology, the potential of new digital technologies needs to be considered and implemented into EI infrastructure. This infrastructural set includes the following elements: the operating business model (i.e. EI's processes), its supporting IT infrastructure (applications supporting process execution), its devices and communications infrastructure, its learning content management, and other infrastructural subsets.
Talent, capability, and capacity strengthening Readiness of an organization to nurture a culture of continuous upgrading of skills, knowledge, and capacities required for improving organizational performance. Due to the increasing speed at which new technologies are introduced, readiness to acquire new knowledge becomes essential.	**Twofold aspect: student-related and teacher-related talent, capability, and capacity strengthening** Continuous efforts to acquire new skills, knowledge, and capabilities are important at several levels: at the national level, at the local community level, at the EI level, and at the individual level of employee and student. Activities related to this determinant need to be well-coordinated, strategically aligned, student-focused, talent-oriented, and future-capacity strengthening.
Innovation culture and organizational commitment Ensuring working environments which are motivating and supporting surroundings depends heavily on organizational commitment to innovation and change.	**Innovation culture related to teaching and learning and organizational commitment to continuous transformation** EI's short and long-term commitment to encouraging creativity and innovation is essential for ensuring that the working environment is supportive of innovation and change. Organizational commitment that is dedicated to enabling constant improvement becomes a prerequisite for transformation.

2. DIGITAL INEQUALITIES AND THEIR RELATIONSHIP WITH OTHER DIMENSIONS OF INEQUALITIES

According to Sen (1992) "the idea of equality is confronted by two types of diversities: (1) the basic heterogeneity of human beings, and (2) the multiplicity of variables in terms of which equality can be judged." When it comes to human beings, "equality is judged by comparing some particular aspect of a person (such as income, or wealth, or happiness, or liberty, or opportunities, or rights, or need-fulfilments) with the same aspect of another person, thus judgments and measurement of inequality [are] thoroughly dependent on the choice of the variable (income, wealth, happiness, etc.) in terms of which comparison are made." There are many forms of inequality (areas that may lack equality) such as those in economics (income inequality), social sciences (education inequality, gender inequality), and health inequality.

According to the United Nations (n.d.) "inequalities are not only driven and measured by income, but are determined by other factors – gender, age, origin, ethnicity, disability, sexual orientation, class, and religion." Furthermore, the elements of inequalities of opportunity which are determined by the former factors continue to persist, while in some parts of the world the divide is becoming more pronounced. Additionally, gaps in newer areas, such as access to online and mobile technologies, are emerging.

Addressing inequality and its different aspects, drivers and indicators (technological innovation, climate change, urbanization and international migration, income, gender, health, education, tax, regions, well-being, etc.) is the focus of many organizations, such as the UN – United Nations (2020), OECD – Organisation for Economic Co-operation and Development (OECD, n.d.), (OECD COPE, n.d.), the World Bank (n.d.), UNESCO – United Nations Educational, Scientific and Cultural Organization (2018), as well as others that exist on the county/regional level.

Nowadays, people are either more or less privileged regarding access and usage of ICT/digital technology, leading to a gap called/known as the "digital divide." The Organization for Economic Co-operation and Development – the OECD – defines the term digital divide as "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to both their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities." Because of the importance of and interest in this matter, the OECD (2001) has started to measure the digital divide through indicators such as communications infrastructure, computer availability, and potentially the availability of alternative forms of access to digital content through TVs or mobile phones, and internet access (which are called "readiness" indicators).

According to the OECD (2001), the digital divide among households appears to depend primarily on two variables – income and education – while other variables, such as household size and type, age, gender, racial and linguistic background and location, also play an important role. The OECD (2001) emphasizes that other important indicators involve differences in the profiles of countries, individuals, and businesses that use and make the most use of the opportunities offered by the new information technologies and the internet.

It is obvious that one (in)equality very often leads to another. For example, "largely through its effects on income, the higher the level of education, the more likely individuals are to have access to ICTs" OECD (2001).

The digital divide is nowadays evolving to digital inequality – i.e., the socio-economic disparities inside the "online population" such as the quality and the cost of connections to the internet, the skills and the knowledge to find the required information, etc. (Stiakakis et al., 2009).

Disparity regarding ICT/digital technologies has moved to a higher level. Now the question is not only if somebody has internet access, but how they are able to benefit from access to it. For example, Romania Insiders (2017) emphasizes that (according to a World Bank report) "Romania has top internet infrastructure but fails to reap the digital dividends." To be more specific, Romania ranks second in the European Union by number of subscriptions to fast broadband networks (available to 59% of users) but less than half of all businesses in Romania (or Bulgaria) have a web presence, and fewer than 10%

of firms use cloud computing, while just 5% percent of individuals in Romania use the internet to download official documents from public websites.

DiMaggio and Hargittai (2001) call attention to five broad forms of digital inequality:

1. inequality in technical apparatus (inequality in the adequacy of hardware, software, and connections); i.e. variation in the technical means (hardware and connections) by which people access the Web.
2. inequality in autonomy of use – i.e., variation in the extent to which people exercise autonomy in their use of the Web – for example, whether they access it from work or home, whether their use is monitored or unmonitored, or whether they must compete with other users for time online.
3. inequality in the skill that people bring to their use of the internet – i.e., inequality in users' possession of "know-how, a mix of professional knowledge economic resources, and technical skills, to use technologies in ways that enhance professional practices and social life" (Kling, 1998)
4. inequality in the availability of social support (such as formal technical assistance from persons employed to provide it – office staff in workplaces, customer support staff in businesses, librarians, and teachers); technical assistance from friends and family members; and emotional reinforcement from friends and family).
5. variation in the purposes for which people use the technology.

Digital technology and the digital transformation (and related digital divide/inequality) are affecting people's lives. An OECD (2019) report documents 11 key dimensions of this change – Income and wealth, Jobs and earnings, Housing, Health status, Education and skills, Work-life balance, Civic engagement and governance, Social connections, Environmental quality, Personal security, and Subjective well-being. In the report, a summary of studies highlights 39 key impacts of the digital transformation on people's well-being (presented in Table 2) that may have a potentially positive impact as digital technologies continue to expand the boundaries of information availability and enhance human productivity, but which also present risks to people's well-being, ranging from cyber-bullying to the emergence of disinformation and cyber-hacking. It is emphasized in the report (OECD, 2019) that "making digitalization work for people's well-being would require building equal digital opportunities, widespread digital literacy and strong digital security."

One of the indicators of digital inequality is the Digital Economy and Society Index (DESI) – a composite index that summarizes relevant indicators about Europe's digital performance and tracks the evolution of EU Member States in terms of digital competitiveness.

According to DESI (EU, 2020), the leading countries for "4a business digitization" are Finland, the Netherlands, and Belgium, with scores above 60 points, while Bulgaria, Hungary, Poland, Romania, Latvia and Slovakia lag behind in the adoption of e-business technologies, scoring fewer than 40 points.

Table 2: Key opportunities and risks of the digital transformation for people's well-being (OECD, 2019)

	Opportunities	Risks
ICT access and use	*Access to digital infrastructures* is a prerequisite to reaping the benefits of the digital transformation	There may be *inequalities of Internet usage*, even when there is equality in access
	Diversity of Internet uses brings greater benefits to individuals	
Education and skills	Students and adults need *digital skills* to participate in a digital society and economy	Emergence of a *digital skills gap* between those who do and those who do not have digital skills
	Digital resources at school can help prepare students for a digital society and economy	The adverse effects of digital resources in the classroom may reduce learning outcomes
	Online education and digital learning tools can allow for lifelong learning and new learning models	
Income and wealth	Digital skills confer a *wage premium* upon workers	
	Online consumption and the *sharing economy* have the potential to increase consumer surplus	
Jobs and earnings	*New jobs in ICT and in other sectors* become available	Digital technologies may destroy *jobs at risk of automation*
	Online job search helps job seekers find employment opportunities	The digital transformation may lead to *job polarisation*
	Workers with computer-based jobs are less subject to *job strain*	*Jobs in the digital economy may be associated with higher stress in the workplace*
Work-life balance	*Teleworking* allows people to save time and combine their work and personal lives	Constant connection to work may increase worries about work when not working
Health	Healthcare delivery becomes more efficient due to *improved communication with healthcare providers and universal health records*	Extreme use of digital technologies may be associated with *negative mental health effects*
	The *digitalisation of health technologies* has the potential to improve health outcomes	
	Health information online has the potential to improve patient experiences	
Social connections	*Increased online interactions* with friends and in social networks	*Cyberbullying* and *online harassment* can negatively impact the social experiences of children
	The Internet may help people overcome *loneliness and social exclusion*	*Discrimination against minority groups* using hate speech
Governance and civic engagement	Improved *engagement of citizens* in civic and political communities, crowed-sourced funding of specific project	Changes in how people get information may contribute to the spread of disinformation undermining trust in society and the government
	Digital technologies enhance the capacity of public authorities to *improve service delivery*	*Exclusion from digital government services* due to lack of skills
	Open data allows for improved transparency and accountability of government	
Personal security	The *uptake of blockchain-based technologies* may enhance safety of transactions and information exchange	Individuals are at risk of *data privacy violations* in various domains
		Digital security incidents may compromise people's online safety and compromise trust
Environmental quality	A *reduction in energy and resource use* can stem from improved energy efficiency of networks and de-materialisation of consumer products	Digital technologies generate rebound effects that *increase energy use*
		E-waste can increase as people consume more technological products
Housing	*Smart home technologies* can improve house management	
Subjective well-being	Overall *net benefits of Internet access for life satisfaction, affect and eudaimonia*	

2.1. Digital skills and digital inequalities in CEE countries

"Basic" or "above basic" overall digital skills represent the two highest levels used on the overall digital skills indicator, which is a composite indicator based on selected activities performed by individuals on the internet in four specific areas (information, communication, problem solving, and software). It is assumed that individuals who have undertaken certain activities have the corresponding skills; thus the indicator can be considered a proxy of the digital competences and skills of individuals.

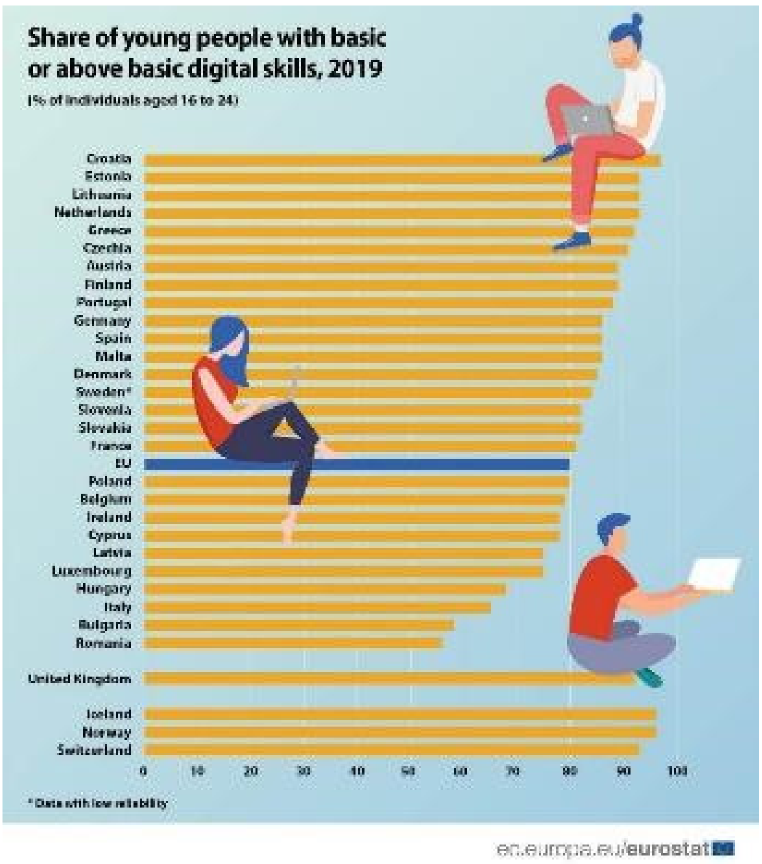
The indicator was developed based on the Digital Competence Framework, and in the context of the Digital Single Market strategy. In 2019, four in five young people (80%) aged 16 to 24 in the European Union (EU) had basic or above basic digital skills. This was 24 percentage points more than the share of individuals aged 16 to 74 (56%) (EUROSTAT, 2019).

Among EU Member States, Croatia had the largest share of individuals aged 16 to 24 with basic or above basic overall digital skills (97%), followed by Estonia, Lithuania, and the Netherlands (all three 93%), as well as Greece (92%) (EUROSTAT, 2019).

By contrast, the lowest shares were observed in Romania (56%), Bulgaria (58%), Italy (65%), Hungary (68%), Latvia and Luxembourg (both 75%) (EUROSTAT, 2019).

Poland has a share of individuals aged 16 to 24 with basic or above basic overall digital skills that is equivalent to the EU average (80%). Slovakia has share greater than Poland, Romania, and Hungary, as well as greater than the EU average (82%) (EUROSTAT, 2019).

Figure 1. Share of young people with basic or above-basic digital skills, 2019 (EUROSTAT, 2019)



Hungary

According to the OECD (2019), compared to other OECD countries Hungary is highly exposed to the risks of the digital transformation, while only experiencing limited benefits from its opportunities, and has a very high level of inequality of internet use. Notwithstanding the limited use of the internet, Hungary is in the top three OECD countries in terms of the share of people reporting digital security incidents, and is the country with the largest share of people reporting a lack of skills as a reason not to use e-government services. The positive side is that national data show that 29% of Hungarian people have submitted completed forms to the websites of public authorities, corresponding to the EU average. The internet is not widely used for key economic activities, although the share of information industries in employment is well above the OECD average. In Hungary, the share of extreme internet users among children is also above the OECD average, and Hungary is ranked second in terms of children reporting cyberbullying.

Poland

In general, Poland demonstrates mixed performance in terms of reaping the benefits of the digital transformation, but is also somewhat less exposed to the risks than other OECD countries. The rate of access to the internet in Poland has increased since 2005 when the share was only 30.4%. Nowadays (2019) in Poland, almost 78% of households are connected to broadband internet. This percentage is slightly above the OECD average. However, the share of people using the internet remains low, and the variety of uses of the internet is limited, while there is substantial inequality in use of the internet. Despite the fact that teachers do not consider themselves lacking in ICT skills, people in Poland have relatively low levels of digital skills. Due to the relatively small share of workers with computer-based jobs, the negative impacts of associated job stress and worries about work when not working are more limited than in other countries. Exposure to disinformation online and the extreme internet use of children in Poland are below the OECD mean (23.4%).

Slovakia

Compared to other OECD countries, Slovakia's exposure to the opportunities and risks of the digital transformation is mixed. At 64.4%, Slovakia's share of jobs at risk of automation is highest across all OECD countries. However, Slovakia benefits more from a decrease in extended job strain associated with computer-based jobs than any other OECD country, potentially because of reduced physical demand.

People in Slovakia are less engaged online in the political and social spheres, with only 7% of people expressing political opinions online. The level of risk in the important areas of digital security and governance and civic engagement is relatively constrained.

In Slovakia, 81.3% of households were connected to broadband internet in 2019. This is an enormous advance compared to the share of households connected to internet in 2005 (only 23%). Inequality of use of the internet is at the average level of OECD countries.

Romania

According to data provided by the CEU's Center for Media, Data and Society (CMDS) in their report "Media influence matrix: Romania" the number of households with an internet connection in 2018 stood at 80%, but broadband coverage (fixed and mobile combined) was slightly lower (74% in 2017, according to the latest data available) (Holdis, 2019).

Fixed broadband penetration is slightly lower, with 60% of households in Romania having a subscription. Also, the results reveal a digital divide between urban and rural residents in terms of access and internet penetration.

Serbia

According to a survey entitled "Usage of Information and Communications Technologies in the Republic of Serbia" in 2019 (Usage of ICT in the Republic of Serbia, 2019), 73.1% of households in Serbia have a computer, which is an increase of 1% (5%) in relation to 2018 and 2017. Differences arise when the availability of computers in urban and other areas of Serbia are examined.

In the Republic of Serbia 80.1% of households have an internet connection, which is an increase of 7.2% and 12.1% compared to 2018 and 2017. In 2019, 71.9% of individuals had used a computer in the last three months, 1.4% more than three months ago, and 5.0% more than one year ago. There is even a smaller share (21.7%) of individuals who have never used a computer.

3. THE DIGITAL PREPAREDNESS OF SCHOOL SYSTEMS IN THE CEE COUNTRIES

In 2019, the European Commission published a final report entitled the "2nd Survey of Schools: ICT in Education" (EC, 2019) to provide more data and evidence regarding digitization in education and digital technologies in learning.

The survey was carried out in 31 countries (EU28, Norway, Iceland, and Turkey), by conducting interviews with head teachers, teachers, students, and parents (ISCED level 1: primary schools: ISCED level 2: lower secondary schools; ISCED level 3: upper secondary schools). A range of different topics was covered, including (EC, 2019a): Access to and use of digital technologies, Digital activities and digital confidence of teachers and students, ICT related teacher professional development, Digital home environment of students, and Schools' digital policies, strategies and opinions.

The 2nd Survey of Schools: ICT in Education had two objectives:

Objective 1: Benchmark progress in ICT in schools – provide detailed and up-to-date information related to access, use, and attitudes towards the use of technology in education;

Objective 2: Model for a 'highly equipped and connected classroom' – define a conceptual model for a 'highly equipped and connected classroom' (HECC), presenting three scenarios to describe different levels of a HECC, and estimating the overall cost of equipping and connecting an average EU classroom with advanced components of the HECC model.

The key findings related to Objective 1: Benchmark progress in ICT in schools, are as follows:

- **Connectivity** – being connected to the internet is a prerequisite for schools to be able to, for example, access up-to-date resources or access online learning platforms, and the latter are increasingly requesting bandwidth-demanding applications such as video streaming or video conferencing; however, the results of the study show that less than one out of every five European students attend schools which have access to high-speed internet of above 100 mbps, and additionally, there are large differences between and within European countries;
- **Coding and related gender gap** – as the EC (2019a) states, "digital skills including coding skills are essential so that everyone can take part in society and contribute to economic and social progress in the digital era," and "coding helps practice 21st century

skills such as problem solving or analytical thinking"; however, the results of the 2nd Survey of Schools: ICT in education show that students rarely regularly engage in coding/programming activities at the European level – 79% of lower secondary school students and 76% of upper secondary school students never or almost never engage in coding or programming at school; the results are less favorable for female students – on average, more than four out of every five female European students attending secondary schools never or almost never engage in coding at school.

- **Teacher training** – teacher training / continuous professional development (CPD) is key for enabling teachers to integrate digital technologies into their teaching practices, emphasizes EC (2019); the results of the 2nd Survey of Schools show that more than six out of ten European students are taught by teachers that engage in professional development activities about ICT in their own time; in contrast, participation in compulsory ICT training is less common – in conclusion, as teacher training in ICT is rarely compulsory, most teachers end up devoting their spare time to developing these skills.
- **Parents** – there is no doubt that in the new era of pervasive technology, the positive attitude of parents towards digital technologies is key for the successful implementation of ICT at schools; surveys reveal that the majority of European parents – who, in contrast to their children, were (usually) not born into a completely digitized world – believe that digital technologies can help their children to study more efficiently; additionally, over 90% of European parents believe that the use of ICT at school will potentially help their children find jobs on the labor market.

The target population of the 2nd Survey of Schools encompassed 400 schools (ISCED levels 1, 2 and 3) per country. The methodology was based on interviews with head teachers, class teachers, students, and parents and online questionnaires – i.e. parent and head teacher surveys.

Within the results of the 2nd Survey of Schools: ICT in Education, specific country profiles are available (EC, 2019a) illustrating:

1. The share of digitally equipped and connected schools: "highly digitally equipped and connected schools have (among other features) a high provision of digital equipment (laptops, computers, cameras, whiteboards) per number of students and a high broadband speed"
2. Schools' internet speed (proportion with high-speed connectivity above 100 mbps)
3. Share of students who use a computer at school on a weekly basis
4. Existence of students' own equipment used for learning
5. Share of digitally supportive schools: "schools with a strong policy, strong support have (among other features) existing school strategies in place to use digital technologies in teaching and learning and strongly promote teachers' professional development"
6. Students' confidence in their digital competence (digital competence is defined according to the DigComp framework in the following areas: Information and data literacy, Communication and Collaboration, Digital content creation, Safety, and Problem solving)
7. Coding/ programming activities of female vs. male students

8. Teachers' confidence in their digital competence (digital competence is defined according to the DigComp framework in the following areas: Information and data literacy, Communication and Collaboration, Digital content creation, Safety, and Problem solving)

9. Type of training of teachers

10. Parents' confidence that children will be taught to use internet safely and responsibly.

In Table 3 the key findings across indicators and ECC countries based on the country reports are presented.

Table 3: Key findings across topics/indicators and ECC countries (except for Serbia) based on country reports (the production of the author, 2020)

Country / Theme/ indicator	Hungary (EC, 2019b)	Poland (EC, 2019c)	Romania (EC, 2019d)	Slovakia (EC, 2019e)
1. Share of digitally equipped and connected schools (compared to the European average)	Compared to the European average there are **fewer** highly digitally equipped and connected schools at all ISCED levels	Compared to the European average there are **fewer** highly digitally equipped and connected schools at ISCED levels 2 and 3, but there are **slightly more** highly digitally equipped and connected schools at ISCED level 1	Compared to the European average there are **substantially fewer** highly digitally equipped and connected schools at all ISCED levels	Compared to the European average there are **fewer** highly digitally equipped and connected schools at ISCED level 1 and 3, while the share is **slightly above** the European average at ISCED level 2
ISCED level 1	fewer	slightly more	substantially fewer	fewer
ISCED level 2	fewer	more	substantially fewer	slightly more
ISCED level 3	fewer	more	substantially fewer	fewer
2. Schools' Internet speed (share of schools with high-speed connectivity above 100 mbps compared to the European average)	High-speed connectivity above 100 mbps: **larger** share at ISCED levels 1 and 2 but **smaller share** at ISCED level 3, compared to the European average	High-speed connectivity above 100 mbps: **smaller share** at ISCED level 2 but **larger** share at ISCED levels 1 and 3, compared to the European average	High-speed connectivity above 100 mbps: **slightly larger** share at all ISCED levels, compared to the European average	High speed connectivity above 100 mbps: **smaller share** at ISCED levels 1 and 2, compared to the European average High speed connectivity above 100 mbps: **larger** share at ISCED level 3 compared to the European average
ISCED level 1	larger	larger	slightly larger	smaller
ISCED level 2	larger	smaller	slightly larger	smaller
ISCED level 3	smaller	larger	slightly larger	larger

Country / Theme/ indicator	Hungary (EC, 2019b)	Poland (EC, 2019c)	Romania (EC, 2019d)	Slovakia (EC, 2019e)
3. Share of students who use a computer at school on a weekly basis (compared to the European average)	**Larger** share at ISCED level 2, but **smaller share** at ISCED level 3, compared to the European average	insufficient response	**Smaller** share in Romania at ISCED level 2 and 3 compared to the European average	Results in Slovakia are similar to the European average
ISCED level 2	larger	insufficient response	smaller	similar
ISCED level 3	smaller	insufficient response	smaller	similar
4. Own equipment used for learning (own tablet, laptop or smartphone)	**Smaller** share in Hungary at ISCED levels 2 and 3 – **except for use of own smartphone (ISCED 3)**, compared to the European average	insufficient response	**Larger** share of own smartphone usage in Romania compared to the European average at ISCED levels 2 and 3 ISCED 2: **smaller share** of own tablet and laptop usage ISCED 3: **larger** share of own tablet and laptop usage	Results in Slovakia are **similar** to the European average
ISCED level 2	smaller – except for own smartphone	insufficient response	**smaller** – for own tablet and laptop	similar
ISCED level 3	smaller – except for own smartphone	insufficient response	**larger** – smaller own tablet and laptop usage	similar
5. Share of digitally supportive schools (strong policy, strong support: compared to the European average)	Strong policy, strong support: **Smaller** share in Hungary at all ISCED levels, compared to the European average	Strong policy, strong support: **Larger** share in Poland at all ISCED levels compared to the European average	Strong policy, strong support: **Larger** share in Romania at ISCED level 1, and **smaller share** in at ISCED levels 2 and 3 compared to the European average	Strong policy, strong support: **Smaller** share in Slovakia at all ISCED levels compared to the European average
ISCED level 1	smaller	larger	larger	smaller
ISCED level 2	smaller	larger	smaller	smaller
ISCED level 3	smaller	larger	smaller	smaller
6. Students' confidence in their digital competence (compared to the European average)	**Slightly higher** confidence of students in Hungary at ISCED levels 2 and 3 in all digital competence areas – **except in digital content creation** (ISCED 2) compared to the European average	insufficient response	**Higher confidence** of students in Romania at ISCED levels 2 and 3 in all digital competence areas compared to the European average – **except in communication and collaboration**	**Slightly lower** confidence of students in Slovakia at all ISCED levels in all digital competence areas compared to the European average **except in safety** (ISCED 2 and 3) and **problem solving** (ISCED 3)

Country / Theme/ indicator	Hungary (EC, 2019b)	Poland (EC, 2019c)	Romania (EC, 2019d)	Slovakia (EC, 2019e)
ISCED level 2	slightly larger - except in digital content creation	insufficient response	larger – except in communication and collaboration	slightly smaller – except in safety
ISCED level 3	slightly larger	insufficient response	larger – except in communication and collaboration	slightly smaller – except in safety and problem solving
7. Coding/ programming activities of female vs. male students (compared to the European average)	**Female students less frequently** engage in coding/ programming compared to male students at ISCED levels 2 and 3 At ISCED level 2, there is a **slightly larger** share of female and male students who never or almost never code or program apps in Hungary, compared to the European average At ISCED level 3, programs there is a slightly **smaller share** of female but a **larger** share of male students who never or almost never code and program apps or programs in Hungary, compared to the European average	insufficient response	**Female students less** frequently engage in coding/ programming compared to male students at ISCED levels 2 and 3 At ISCED levels 2 and 3, there is a **larger** share of both female and male students in Romania who code and program apps or programs at least several times a month compared to the European average	**Female students less frequently** engage in coding/ programming compared to male students at ISCED levels 2 and 3 At ISCED level 2 and 3 the share of female students and male students who never or almost never code and program apps or programs in Slovakia is **comparable** to the European average
ISCED level 2	**female students less frequently** engage in coding/ programming compared to male students **slightly larger** share of female and male students, who never or almost never code and program apps	insufficient response	**female students less frequently** engage in coding/ programming compared to male students **larger** share of both female and male students in Romania who code and program apps or programs at least several times a month	**female students less frequently** engage in coding/ programming compared to male students share of female students and male students, who never or almost never code and program apps or programs in Slovakia is **comparable** to the European average

Country Theme/ indicator	Hungary (EC, 2019b)	Poland (EC, 2019c)	Romania (EC, 2019d)	Slovakia (EC, 2019e)
ISCED level 3	**female students less frequently** engage in coding/ programming compared to male students slightly **smaller share** of female but a **larger** share of male students, who never or almost never code and program apps or programs	insufficient response	**female students less frequently** engage in coding/ programming compared to male students **larger** share of both female and male students who code and program apps or programs at least several times a month	**female students less frequently** engage in coding/ programming compared to male students share of female students and male students, who never or almost never code and program apps or programs in Slovakia is **comparable** to the European average
8. Teachers' confidence in their digital competence (compared to the European average)	**Less or similar** confidence of teachers in Hungary at ISCED levels 1 and 2 in all digital competence areas – **except in problem solving** (ISCED 2), compared to the European average **Higher** confidence of teachers in Hungary at ISCED level 3 in all digital competence areas – **except in safety** and **digital content creation**, compared to the European average	insufficient response	**Slightly lower** confidence of teachers in Romania at ISCED level 1 in all digital competence areas – **except in communication and collaboration** as well as **problem solving** compared to the European average **Slightly higher** confidence of teachers in Romania at ISCED levels 2 and 3 in all digital competence areas compared to the European average, **except in information and data literacy** at ISCED level 3	**Slightly higher** confidence of teachers in Slovakia at all ISCED levels in all digital competence areas compared to the European average except in **information and data literacy** (ISCED 1 and 3)
ISCED level 1	smaller or similar	insufficient response	slightly smaller - except in communication and collaboration as well as problem solving	slightly larger - except in information and data literacy
ISCED level 2	smaller or similar – except in problem solving	insufficient response	slightly larger	slightly larger
ISCED level 3	larger – except in safety and digital content creation	insufficient response	slightly larger – except in information and data literacy	slightly larger – except in information and data literacy

Country / Theme/ indicator	Hungary (EC, 2019b)	Poland (EC, 2019c)	Romania (EC, 2019d)	Slovakia (EC, 2019e)
9. Type of training of teachers – courses on the pedagogical use of ICZ in teaching and learning, subject-specific training on learning applications, equipment-specific training (compared to the European average)	**Smaller** share in Hungary at all ISCED levels, compared to the European average	insufficient response	**Smaller** share in Romania at all ISCED levels compared to the European average	**Larger** share in Slovakia for **courses on pedagogical use of ICT in teaching and learning** at ISCED level 1 **Smaller** share in Slovakia for **subject-specific training on learning applications** at all ISCED levels compared to the European average **Larger** share in Slovakia for **equipment-specific training** at all ISCED levels compared to the European average
ISCED level 1	smaller	insufficient response	smaller	larger – for courses on pedagogical use of ICT in teaching and learning smaller - for subject-specific training on learning applications
ISCED level 2	smaller	insufficient response	smaller	smaller – for subject-specific training on learning applications larger – for equipment-specific training
ISCED level 3	smaller	insufficient response	smaller	smaller – for subject-specific training on learning applications larger – for equipment-specific training

Theme/ indicator \ Country	Hungary (EC, 2019b)	Poland (EC, 2019c)	Romania (EC, 2019d)	Slovakia (EC, 2019e)
10. Parents' confidence about teaching child to use internet safely and responsibly (compared to the European average)	The share of parents in Hungary who feel "highly confident" about teaching their child to use the internet safely and responsibly is **smaller** at ISCED levels 1 and 2 and **slightly larger** at ISCED level 3 compared to the European Average	insufficient response	The share of parents in Romania who feel "highly confident" about teaching their child to use the internet safely and responsibly is **larger** at ISCED level 1 and **smaller** at ISCED levels 2 and 3 compared to the European average	The share of parents in Slovakia who feel "highly confident" about teaching their child to use the internet safely and responsibly is **larger** at ISCED levels 1 and 3 and **smaller** at ISCED level 2 compared to the European average
ISCED level 1	smaller	insufficient response	larger	larger
ISCED level 2	smaller	insufficient response	smaller	smaller
ISCED level 3	slightly larger	insufficient response	smaller	larger

*ISCED level 1: primary schools: ISCED level 2: lower secondary schools; ISCED level 3: upper secondary schools

If we compare countries to the European average based on the share of digitally equipped and connected schools, in Hungary there are fewer highly digitally equipped and connected schools at all ISCED levels (primary schools, lower secondary schools, and upper secondary schools). In Slovakia the situation is similar, while the share is slightly above the European average at ISCED level 2 (lower secondary schools). In Romania, there are substantially fewer highly digitally equipped and connected schools at all ISCED levels. In Poland there are slightly more highly digitally equipped and connected schools at ISCED 1 (primary schools), but compared to the European average there are fewer highly digitally equipped and connected schools at ISCED level 2 (lower secondary schools) and level 3 (upper secondary schools).

Comparing countries based on schools' access to high-speed connectivity (above 100 mbps), Romania performs slightly better at all ISCED levels compared to the European average. In Slovakia a smaller share of schools have access to the former at ISCED levels 1 and 2, compared to the European average but a larger share at ISCED level 3. In Hungary there is a larger share of high-speed connectivity above 100 mbps at ISCED levels 1 (primary schools) and 2 (lower secondary schools) but a smaller share at level 3 (upper secondary schools) compared to the European average. In Poland the distribution of high-speed connectivity is less than the EU average at lower secondary schools, but greater at the primary school level and upper secondary school level.

The share of students who use a computer at school on a weekly basis in Hungary is larger at level 2 (lower secondary schools) but smaller at ISCED level 3 (upper secondary schools) compared to the European average. In Romania there is a smaller share at ISCED levels 2 and 3 compared to the European average. Results in Slovakia are similar to the European average.

Comparing types of training of teachers in the pedagogical use of ICT in teaching and learning, subject-specific training about learning applications, and equipment-specific training, the best situation is found in Slovakia. The country has a larger share than the EU average of courses on the pedagogical use of ICT in teaching and learning at ISCED level 1, a smaller share for subject-specific training on learning applications at all ISCED levels compared to the European average, and a larger share for equipment-specific training at all ISCED levels. Teachers' confidence in their digital competence is lower or similar to the confidence of teachers in Hungary at ISCED levels 1 and 2 in all digital competence areas – except in problem solving. Slightly lower confidence of teachers in Romania is found at ISCED level 1 in all digital competence areas – except in communication and collaboration as well as problem solving. In Slovakia there is slightly higher confidence of teachers at all ISCED levels in all digital competence areas compared to the European average, except in information and data literacy (ISCED 1 and 3). In terms of comparing students' confidence, we find higher a higher level of confidence of students in Romania at ISCED levels 2 and 3 in all digital competence areas compared to the European average – except in communication and collaboration. In Hungary students are slightly more confident at ISCED levels 2 and 3 in all digital competence areas – except in digital content creation, but in Slovakia the confidence of students at all ISCED levels in all digital competence areas is slightly lower than the European average, except as regards safety (ISCED 2 and 3) and problem solving (ISCED 3).

4. THE VARIOUS REFERENCE FRAMEWORKS FOR THE DIGITAL PREPAREDNESS OF SCHOOLS AND TEACHERS

The significance of digital transformation is recognized as priority of the European Commission (EC) and through its digital education policies the EC encourages the use of digital technologies in educational systems and the development of digitally mature schools.

The use of digital technologies in educational institutions is no longer a matter of individual enthusiasm, but requires a systemic approach that is planned and implemented at the level of educational institutions in accordance with state and local policies.

The process of raising the level of digital maturity of educational institutions is progressing at different speeds and with different aims and outcomes in different countries in Europe. There is still a relatively low level of digital maturity in the educational institutions that is derived from the complex nature of educational institutions as part of the educational ecosystems across Europe.

In view of this fact, there is a need for developing and implementing framework(s) for fostering the integration and effective use of digital technologies by educational institutions.

4.1. Frameworks focused on the digital maturity of educational institutions

The European Commission has recognized the significance of the digital transformation of educational institutions by raising the level of their digital maturity, so it offers support throughout its policies and programs (Kampylis et al., 2015).

Digital technologies are enablers of change in learning and teaching, but change that is both sustainable and at scale requires a multi-faceted systemic approach, including investment in infrastructure and in teachers' professional development, curriculum change, rethinking student assessment and teacher appraisal, making the right decisions about curriculum-related content, promoting collaboration and open content and practices, and integrating all these within an environment that ensures good governance and oversight of quality (Kampylis et al., 2015).

A digitally mature educational institution is an organization with a high level of integration of digital technologies and a systematized approach to the use of digital technologies in teaching, learning, and organizational practices. In digitally mature institutions, the appropriate use of digital technologies contributes to the efficient and transparent management of the institution, the development of digitally competent teachers prepared for the application of innovations in their own pedagogical practices, and the development of digitally competent students who are prepared for the continuation of their schooling and who are competitive on the labor market (Jugo et al., 2017).

Table 4: Overview of framework of analysis (the production of the author, 2020)

Name	Framework / Instrument	Level	Areas Elements	Approach	Application area	Best practice
Ae-MoYS	Framework and online self-assessment questionnaire	Elementary	5/-/30	Qualitative Quantitative	Elementary and high-school	EU
DigCompOrg	Framework	Advanced	7/15/74	Qualitative	Elementary and high-school, Higher Education Institution (HEI)	World
eLearning Roadmap	Framework and matrix	Advanced	5/-/27x4	Qualitative	Elementary and high-school	Ireland
eLEMER	Framework and self-assessment questionnaire	Advanced	4/40/100	Qualitative Quantitative	Elementary and high-school	Hungary
ePOBMM	Framework and matrix	Advanced	7/-/60x5	Qualitative	Mostly HEI	EU
FCMM	Framework and self-assessment questionnaire	Advanced	5/-/5x5	Qualitative	Elementary and high-school	EU
HEInnovative	Framework and self-assessment questionnaire	Elementary	7/-/44	Qualitative	HEI	World
JISC	Framework and self-assessment questionnaire	Advanced	6/-/69	Qualitative Quantitative	HEI	EU
LIKA	Framework and self-assessment questionnaire	Elementary	4/-/78	Qualitative	Elementary and high-school	Sweden
Microsoft Framework	Framework and self-assessment questionnaire	Advanced	4/16/16x6	Qualitative Quantitative	Elementary and high-school	World

Name	Framework / Instrument	Level	Areas Elements	Approach	Application area	Best practice
NACCE SRF	Framework and self-assessment questionnaire	Elementary	6/11/55x4	Qualitative Quantitative	Kindergartens, elementary and high-school	United Kingdom
OPEKA	Framework and self-assessment questionnaire	Advanced	3/17/145	Qualitative Quantitative	Elementary and high-school	Finland
SCALE CCR	Framework	Beginning	8/28/-	Qualitative	Elementary and high-school	Europe
SCHOOL MENTOR	Framework and self-assessment questionnaire	Advanced	6/-/30x5	Qualitative Quantitative	Elementary and high-school	Norway
VENSTRESS	Online self-assessment questionnaire	Beginning	20 indicators	Qualitative	Elementary and high-school	Netherlands
FDMS	Framework and online self-assessment and external assessment questionnaire	Advanced	47 indicators	Qualitative	Elementary and high-school	Croatia

In the process of raising the level of digital maturity of educational organizations there is a need for using a framework for digital maturity to foster the integration and effective use of digital technologies by educational organizations.

The framework for digital maturity consists of areas and elements that contribute to the digital maturity of educational organizations, as well as for planning the integration and use of digital technologies (Begičević Ređep et al., 2017). It is needed to enable the identification of areas and elements that contribute to the digital maturity of educational institutions, as well as for planning the integration and use of digital technologies. It is important to stress that different maturity levels in frameworks have been established for educational institutions to plan their journeys: i.e., that describe where are they now, and where they would like to be in the future. The different levels should not be read as "judgments," but as stages in a maturation process.

The policy creators and the decision-makers in the education system can exploit existing frameworks for the digital maturity of educational institutions in the development of policies and initiatives aimed at the successful integration of digital technologies into the educational system (Begičević Ređep et al., 2017).

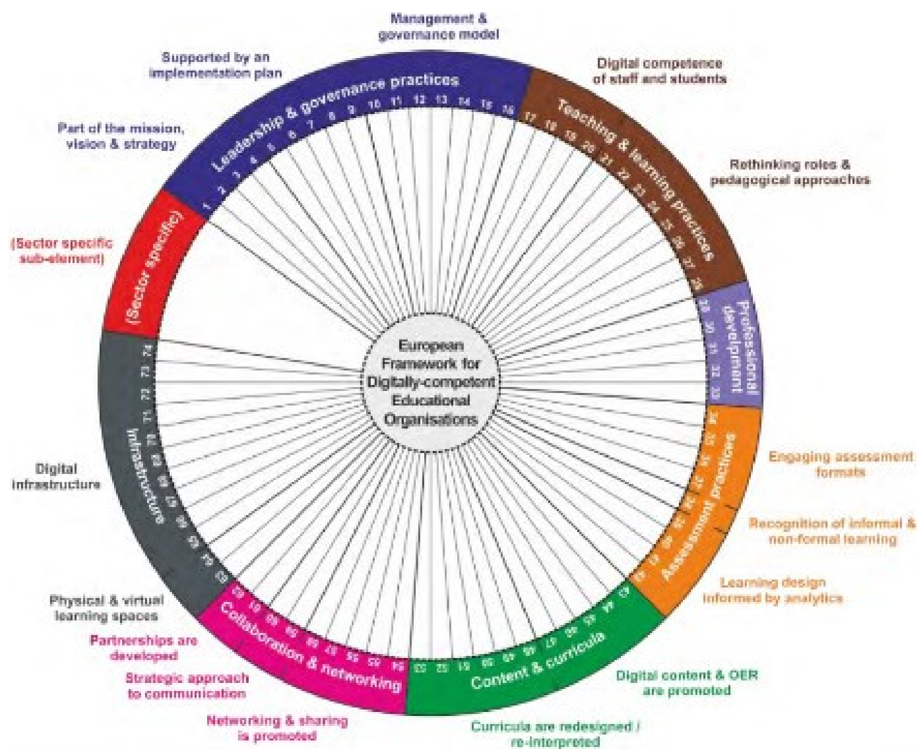
There are several frameworks across Europe that have been designed in relation to the digital maturity of educational institutions: Assessing the e-Maturity of your School (Ae-MoYS); Framework for Digitally competent Educational Organisations (DigCompOrg); European Framework for the

Digital Competence of Educators (DigCompEdu); eLearning Roadmap; eLemer; The ePortfolios & Open Badges Maturity Matrix (ePOBMM); Future Classroom Maturity Model (FCMM); HEInnovative; Jisc Strategic ICT Toolkit (JISC); Ledning, Infrastruktur, Kompetens, Användning (LIKA); Microsoft Innovation Framework & self-reflection tool; NACCE SRF; OPEKA; Up-scaling Creative Classrooms in Europe (SCALE CCR); School mentor; VENSTRESS; FDMS (Begičević Ređep et al., 2017); and the SELFIE tool. An overview of the analysis of the frameworks is presented in Table 4 (Begičević Ređep et al., 2017).

The results of a literature review and of qualitative analysis of the selected frameworks (Begičević Ređep et al., 2017) have shown that there is no generic framework and instrument that could be implemented in schools with aim of identifying areas and elements crucial for establishing a system of digital mature schools, along with assessing the level of schools' digital maturity and giving recommendations about how to increase the level of digital maturity. However, the Framework for Digitally-Competent Educational Organisations (DigCompOrg) best describes the comprehensive field of the digital maturity of schools.

The DigCompOrg framework is a comprehensive conceptualization that takes into account all aspects of digitalization for learning in educational organizations (Panagiotis et al., 2015). It helps educational organizations with self-reflection and self-assessment related to their process of digitalization, and it enables policymakers to develop policies for digital learning. DigCompOrg has been developed to reflect three fundamental dimensions in the process of the digitalization of education; namely, the pedagogical, technological, and organizational dimensions, and it defines seven key elements within these dimensions: infrastructure, collaboration and networking, content and curricula, teaching and learning practices, assessment practices, professional development, leadership and governance practices (Figure 2).

Figure 2. Areas of the Framework for Digitally-Competent Educational Organisations – DigCompOrg (Panagiotis et al., 2015)



The mostly commonly used instrument for assessing the digital maturity of educational institution is the SELFIE tool developed by the European Commission and education experts from across Europe (SELFIE, 2019). SELFIE represents the practical implementation of DigCompOrg in terms of operationalizing and assessing the digital readiness of schools, and providing initial evidence concerning how the Framework can be used in reality. It is flexible enough to be applied in any educational sector. Its main purpose is to generate a map of the digital capability of individual schools. Schools can take a snapshot of where they stand as regards their use of digital technologies, while the self-assessment process can help with starting to prepare a strategy within the school concerning potential areas for improvement. It also helps schools to monitor their progress with digital maturity over time.

Seven key areas for identifying the digital maturity of schools are identified in SELFIE: 1. Teaching and Learning Practices; 2. Assessment Practices; 3. Content and Curricula; 4. Networking and Collaboration; 5. Professional Development; 6. Leadership and Governance Practices, and 7. Infrastructure (SELFIE, 2019).

A specific school may differ in some aspects from a typical representative of a particular level. In the process of self-assessment and external assessment of the digital maturity level, each school receives feedback based on their characteristics and regarding the maturity level it has been appraised at.

Based on examining frameworks for the digital maturity of educational institutions, the common goals of digital transformation initiatives can be identified:

- Contemporaneity of educational processes
- Collaboration between participants and stakeholders
- Student-centricity
- Content excellence
- Creativity and innovation culture
- Commitment to continuous change
- Cooperation with stakeholders
- Concern for equal opportunities and others.

To conclude, the framework and tool for the digital maturity of educational institutions can be used to assess a school's digital maturity level, but also to identify areas for improvement that could enable the growth of the scale of digital maturity, and improve the overall reputation of the educational institution.

Through the implementation of the framework and tool for assessment, educational institutions can develop their own digital strategies to enhance teaching, learning, and business processes and undertake the digital transformation by using digital technologies.

4.2. Frameworks focused on developing the digital competences of teachers and students

In the context of digital transformation, there are two main challenges for educational organizations: 1) competence clarification – i.e., what relevant digital competences in terms of knowledge, skills, and attitudes do students and teachers need in order to cope with digital transformation? and, 2) competence development – i.e., how to organize, design, and support learning and teaching that contributes to digital competences and digital transformation (Seufert, Meier, 2016; Virkus et al., 2020).

To cope with these challenges, a large number of frameworks have been created, most of them focused on developing the digital competences of teachers and students and on skills development and the ability to use a specific set of tools and applications (Seufert, Meier, 2016).

First, we must define digital competence. Digital competence can be defined as "the set of knowledge, skills, attitudes that are required when using digital technologies and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socializing, consuming, and empowerment" (Ferrari, 2012).

The most general framework is the Digital Competence Framework for Citizens (DigComp) (Carretero et al., 2017), which describes the digital competence that all citizens need in digital society. In this framework, 21 digital competences are defined and arranged into five areas: information and data literacy, communication and collaboration, digital content creation, and safety and problem solving, which together constitute the capacity to interact with digital technology.

The Digital Competence Framework for Educators, DigCompEdu, provides a more specific reference, merging digital skills with skills that are key for educators to foster the latter's digital competence as a prerequisite for digital learning (Redecker 2017). DigCompEdu has been developed in response to the acknowledgement of the need for educators to master a set of digital competences specific to their job in order to harness the potential of digital technologies in education and training. The DigCompEdu (Redecker, 2017) helps educators at all levels of education, from early childhood to higher and adult education, to assess their competence, identify their training needs, and access targeted training. It is a scientifically sound framework which helps to guide policy and can be directly adapted to implementing regional and national tools and training programs.

The DigCompEdu Framework aims to capture and describe educator-specific digital competences. It proposes 22 elementary competences organized into six areas: 1) professional engagement (using digital technologies for communication, collaboration, and professional development), 2) digital resources (sourcing, creating, and sharing digital resources), 3) teaching and learning (managing and orchestrating the use of digital technologies in teaching and learning), 4) assessment (using digital technologies and strategies to enhance assessment), 5) empowering learners (using digital technologies to enhance inclusion, personalization and learners' active engagement), and 6) facilitating learners' digital competence (enabling learners to creatively and responsibly use digital technologies for information, communication, content creation, wellbeing and problem-solving).

As defined in DigCompEdu (Redecker, 2017), areas 2-5 are the core of the framework and explain educators' digital pedagogical competences – i.e., "the digital competences educators need to foster efficient, inclusive and innovative teaching and learning strategies." Area 1 is "directed at the broader professional environment – i.e. educators' use of digital technologies in professional interactions with colleagues, learners, parents and other interested parties, for their own individual professional development and for the collective good of the organization." Area 6, relates to "the specific pedagogic competences required to facilitate students' digital competences."

In the European Framework for Digitally-Competent Educational Organizations: DigComOrg (Kampylis et al., 2015), the Leadership and Governance Practices element refers to the role of leadership in the organization, and to the wide integration and effective use of digital technologies with respect to teaching and learning goals and activities. This factor consists of three sub-elements: 1) integration of digital-age learning as a part of the overall mission, vision and strategy, 2) strategy for digital-age learning supported by an implementation plan, and 3) the management and governance model. A "digitally-competent educational organization" refers to the effective use of digital technology by the educational organization and its staff in order to provide a compelling student experience and to realize a good return on investment in digital technology (Kampylis et al., 2015; Virkus et al., 2020).

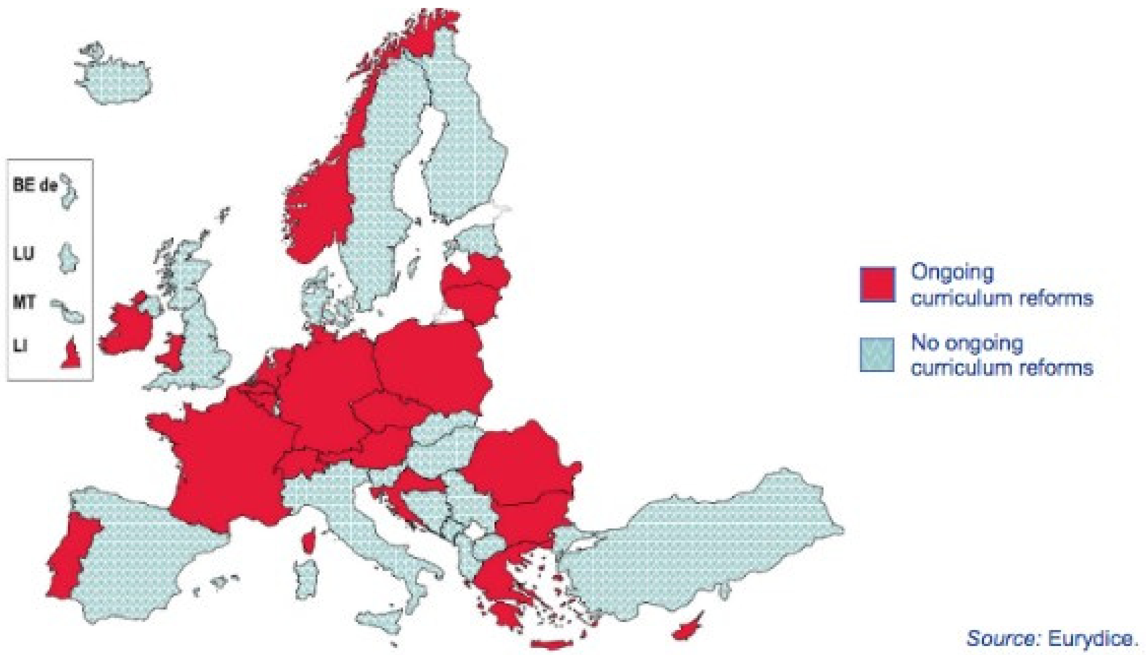
Besides the element of Leadership and Governance Practices, DigCompOrg encompasses the element of Infrastructure. Both elements may be seen as organizational responsibilities, while other elements such as Teaching and Learning Practices refer more to individual responsibilities (Kampylis et al., 2015). It has been emphasized that a "digitally-competent educational organisation needs a combination of strong leadership and governance (for vision and top-down strategies) and at the same time needs staff and stakeholders who are individually capable of taking responsibility for self-initiated actions and bottom-up efforts and initiatives (Kampylis et al., 2015)."

The three main presented European frameworks (DigComp, DigCompEdu, and DigCompOrg/SELFIE) aim to provide a common language and common ground for discussions and developments at national, regional, and local levels. Moreover, they offer a consistent set of tools for self-reflection at the European level, addressing citizens and learners (DigComp), educators (DigCompEdu), as well as schools (DigCompOrg/SELFIE).

4.3. The contextual relevance of international frameworks in the CEE countries

Based on the Eurydice Brief report (2019), half of the European education systems are currently engaged in curriculum reform related to digital competence. This revision is focused on introducing digital competence into the curriculum or making the subject area more relevant. Most of these reforms involve changing the curriculum approach, updating content, or strengthening areas such as coding, computational thinking, or safety. In Figure 3, countries with ongoing curriculum reforms related to digital competences in primary and general secondary education in year 2018/19 are presented.

Figure 3. Ongoing curriculum reforms related to digital competences in primary and general secondary education - 2018/19 (Eurydice Brief report 2019)



The majority of education systems in Europe have included learning outcomes related to all five digital competence areas defined in the DigComp framework: namely, information and data literacy, digital content creation, communication and collaboration, safety, and problem solving (Eurydice Brief report, 2019).

Most of the learning outcomes related to digital competences are associated with lower secondary education. For primary education, the number of countries with related learning outcomes is the lowest, but still around 30 education systems (including **Romania** and **Hungary**) cover the first four areas, and 24 education systems (Bulgaria, Czechia, Germany, Estonia, Greece, Spain, France, Italy, Cyprus, Malta, **Poland**, Portugal, **Slovakia**, Finland, Sweden, the United Kingdom, Switzerland, Iceland, Montenegro, North Macedonia, and **Serbia**) also cover problem-solving (Eurydice Brief report, 2019).

Some of the countries have developed their own digital competence frameworks for teachers. **Serbia** as well as Croatia, Estonia, Spain, Lithuania, Austria, and Norway have completed full mapping of the essential competences, including those related to the pedagogical use of technologies. These developed frameworks can help teachers to assess their digital competencies and plan how to raise the level of their digital competence.

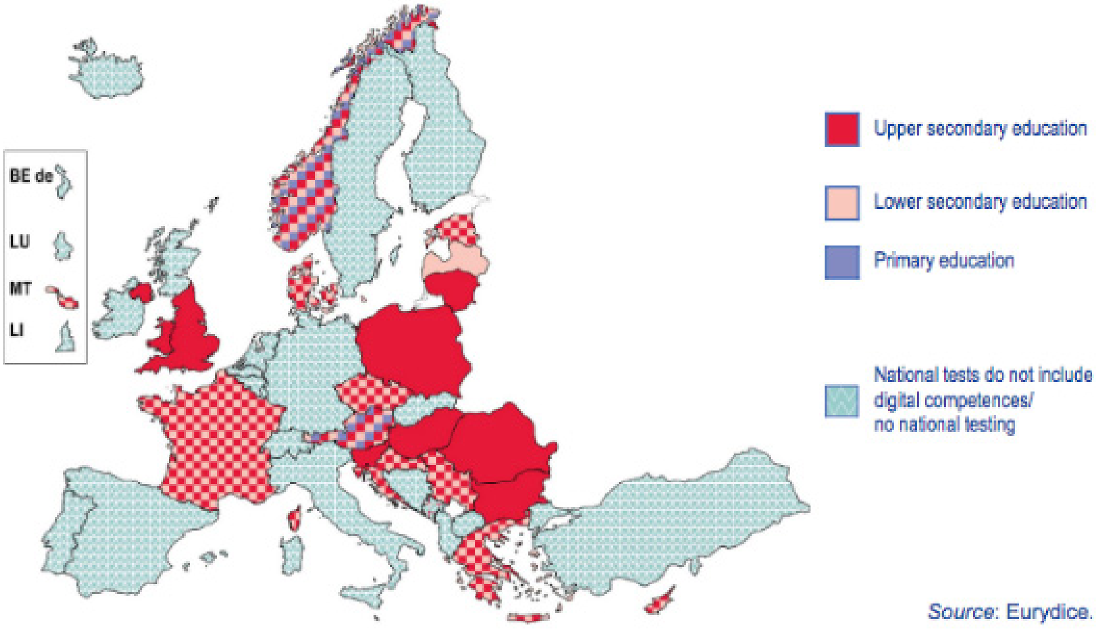
If we compare the number of recommended hours allocated to information and communication technologies (ICT) as a compulsory separate subject in primary education, Lithuania and Cyprus allocate the highest number of hours during lower secondary education, but **Romania** has the highest number of hours related to digital competence as a compulsory separate subject in upper secondary education (Eurydice Brief report, 2019).

Serbia is one of the countries that has promoted the use of self-assessment tools such as SELFIE. Other education systems that have promoted tools for the evaluation of the level of digital competence are Bulgaria, Czechia, Estonia, Spain, France, Cyprus, Austria, Portugal, Slovenia, Finland, the United Kingdom, and Switzerland.

There are a lot of educational systems in Europe where digital competences are never assessed at school through national testing. Only Austria and Norway have tests in digital competences at all levels of school education. **Serbia** tests digital competences only at lower secondary level. In fewer than ten education systems (including **Poland** and **Romania)**, digital competences are tested only at general upper secondary level (Eurydice Brief report, 2019).

In the following education systems (Greece, France, Croatia, Cyprus, Lithuania, **Hungary, Poland**, Slovenia, the United Kingdom, and Norway) digital competence tests that are carried out for assessment purposes only involve students who are on a particular educational pathway (e.g. STEM), or those who decide to take the specific test. Only in Bulgaria, Denmark, Malta, and **Romania** are all upper secondary education students required to take a national test to assess their digital competence (Eurydice Brief report, 2019) (Figure 4).

Figure 4. Overview of countries where national tests are taken to assess students' digital competence (ISCED 1-3), 2018/19 (Eurydice Brief report, 2019)



5. ONLINE AND BLENDED LEARNING IN EDUCATION

The most general definition of e-learning is that e-learning is a term for all forms of electronically supported learning and teaching. E-learning can be described as using technology to create, distribute and give data, information, information, learning and knowledge in order to improve performance at work, in an organization, and to ensure personal development. **E-learning** can be also defined as a process of education (learning and teaching process) conducted using information and communication technology that improves the quality of the process itself and the quality of its results. Despite some differences, we can conclude that in the process of e-learning, learning is facilitated by the use of digital tools and content and it needs to enhance and enable quality education and/or training (Divjak, Begičević, 2006).

Online learning is education that takes place over the internet (any form of learning conducted partly or wholly over the internet). Online Learning involves internet-based courses offered synchronously and/or asynchronously. However, online learning is just one type of "distance learning": that is, any learning that takes place over a distance and not in a traditional classroom.

It is also important to make a distinction between intentionally designed online learning and teaching online due to emergency measures (Bates, 2020):

- **Emergency Remote Teaching:** "is a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances. It involves the use of fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face or as blended or hybrid courses and that will return to that format once the crisis or emergency has abated."

- **Online Learning:** A form of distance education in which a course or program is intentionally designed in advance to be delivered fully online. Educational institutions use pedagogical strategies for instruction, student engagement, and assessment that are specific to learning in a virtual environment.

Blended learning is a combination of face-to-face teaching and online learning, especially outside the classroom. This can take a number of forms – for example, *flipped classroom* or *hybrid learning* (Bates, 2019).

In **fully online learning**, students study entirely online, which is one form of distance education (Bates, 2019).

5.1. Emergency Remote Teaching in Serbia, Poland, Hungary, and Slovakia during the COVID-19 pandemic

The recent coronavirus pandemic has shown that, for most educational institutions, online learning and distance education were the only alternatives in an emergency. The Covid-19 pandemic led to the closing down of schools, and countries fought to keep schooling available for children by implementing emergency remote learning.

Most of the countries chose a strategy of combining TV broadcasts with on-demand video lessons. Examples of countries that pursued this strategy are Croatia, Estonia, **Romania,** and **Serbia**.

In **Serbia**, the ministry of education launched the My School web portal to ensure access to lessons hosted on the state broadcaster's video-on-demand service. Lessons are also being broadcast live to reach those pupils who do not have access to the internet. In addition to the broadcasts and the online videos, schools have also been instructed to come up with their own ways of conducting remote learning using collaboration-based software. A number of textbook publishers have offered free digital versions to pupils. Timetables have also been shared through text messages and social networks (using Viber groups and similar networks).

The Ministry established a repository of educational video content for elementary and high school students on the free RTS My School mobile phone application, on the RTS website, on the online learning platform RTS Planeta, as well as on the national online platform My School. All broadcast lessons were also available on the RTS Planeta. A set of tools for online communication between students and teachers (Viber, Zoom, Microsoft Teams) were also available and used. Copyrighted teaching materials were shared among practitioners. Parents could receive additional information regarding distance learning as a form of learning support by calling the hotline assigned for this purpose (World Bank, 2020). Through new information and communication online platforms, a pilot test for student progress assessment was organized. Official data from the Ministry of Education, Science and Technological Development (MoESTD) (Minister of Education, media appearance) indicates that 66,000 students participated in the online platform for online testing in the form of a pilot for this student progress assessment.

Results from the big piece of research which included almost every school in the Republic of Serbia that was undertaken by the Institute of Psychology supported by UNICEF showed that 0.7% of primary-school students were not included in distance learning, while 1% of students were not included from secondary schools. Results from same research showed that in primary schools 1.6% of students were included in alternative forms of distance learning (e.g. working with paper materials delivered at home) in primary schools and 1.7% in secondary schools. There were no support systems organized for teachers, but teachers were provided with guidelines concerning how they should react.

According to the guidelines of the Ministry, based on the materials that teachers provide to students and based on student feedback after watching TV lessons (classes) and other educational content, teachers should record data about student progress. Students can submit their work and homework to teachers via e-mail (pictures, files) or within the selected online platform.

The situation was almost the same in **Romania**, where the public service broadcaster TVR has been running educational broadcasts and a learning website was launched by Bucharest City Council. A number of schools have also begun holding online lessons using the Webex videoconferencing application. Lessons were being held at the same time as they would be in schools to ensure that children can maintain something resembling a routine.

The priorities of the Ministry of Education in Romania were to ensure the necessary framework for maintaining school-like situations for all pupils and students in the Romanian education system, and for both students and teachers to take final exams in safe conditions (Romania social briefing, 2020). The learning process continued with home-schooling through alternative solutions: online support courses, and lessons using national Romanian Television. Classes took place on the online platforms. The Ministry established a partnership with Romanian Television to facilitate access to education for those children who could not access online platforms. According to some estimations, about 32% of the pupils in Romania do not have the resources to participate in online activities due to lack of access to the internet, to programs, applications, or digital platforms. The government decided that the final exams would not include the subjects taught during this period and announced a RON 150 billion plan for purchasing equipment for these children who were having difficulty keeping in touch with teachers during this period.

In **Slovakia**, pandemic measures were introduced at a time when there was a new incoming government following the general election, thus was no government to take systemic control of the sector and manage the transition to online teaching. Schools were left without assistance and had to rely on their own skills in adapting to the new situation. Based on the aforementioned research, almost two-thirds of parents stated that teachers were merely sending their children homework and that there was no interactive teaching. But more than half of parents stated that their child's teacher was communicating daily with their child. When the situation regarding overall responsibility for the education sector began stabilizing, the state issued guidance on how to proceed in the emergency situation. One of the first instruments that was prepared was guidance for primary school assessments during the emergency situation. However, during the time of school closure, students were to study via distance learning organized by the primary school, depending on the students' and teachers' resources.

The Ministry of Education, Science, Research and Sport of Slovakia specified two categories of distance learning areas – namely, a) main learning areas (Language and communication; Mathematics and information handling; People and society; People and nature), and b) complementary learning areas (People and values; People and the world of work; Arts and culture; Health and physical education). The former decided that elective classes do not need to be included in distance learning activities. The pandemic in the Slovak Republic has influenced not only the educational process as such, but also how evaluation, school-leaving exams, and state exams are carried out. Whole-Slovakia knowledge testing has been cancelled this year.

In **Poland**, the government decided to close all schools and universities and launched several programs to support students and teachers: these included gamification, financing technological equipment, websites for teachers with online textbooks, TV lessons, and internet bundles. In the gamification program students were introduced to learning about customized applications in the form of webinars – e.g., how to create their own games, or about techniques for creating online presentations. The biggest excitement was caused by the creation of a server in the Minecraft game where a competition to create replicas of famous buildings was held.

The government allocated 42 million euros to purchase laptops and tablets for students. It was also possible to buy the necessary software, hardware insurance, mobile internet access, and other accessories needed for remote learning. These finances were transferred together with the guidelines to local government units all over Poland. Websites for teachers were also used, but the online textbooks were not interactive and not interesting to students. The state television, in cooperation with the Ministry of Education, started to broadcast lessons on a few television channels, but the quality of the materials was not so good. Together with the Ministry of Digitalization, the government has held talks with mobile operators to provide teachers and students with free or cheap (for a symbolic amount) internet, so that students have equal opportunities to use the remote learning tools that are available.

In Hungary, the government decided to switch to online teaching and learning without any preliminary preparations. The government support provided to schools, teachers, pupils, and parents for online teaching and learning remained very poor throughout the entire period of the closure of offline schooling. In 2016, the government approved the Digital Education Strategy of Hungary. For the implementation of the strategy the government established the Center for Digital Pedagogical Methodology, but the activities of the center were limited to the development of regulatory instruments and to piloting small-scale experimental projects.

In different schools the shift to online teaching and learning was dealt with without support from government or local authorities. In the majority of schools, the shift to online teaching was considered to be the task of individual teachers, with very poor institutional support and internal cooperation. Management and teaching staff cooperated to establish a common platform and protocol for online teaching, organized rapid training for teachers who had no prior experience in using the platform, and provided ongoing ICT support. The official online platform for the "digital working arrangement" was the "E-Chalk" platform, an online administrative registry platform that was introduced in all public schools in 2016. The big problem was internet connections. The majority of teachers worked using their private internet accounts and the proportion of pupils who have been denied access to online learning due to the poverty among all disadvantaged pupils is high. In the process of online teaching and learning, multinational IT companies (Google, Microsoft, Facebook, etc.) and Hungarian NGOs have done more than the government.

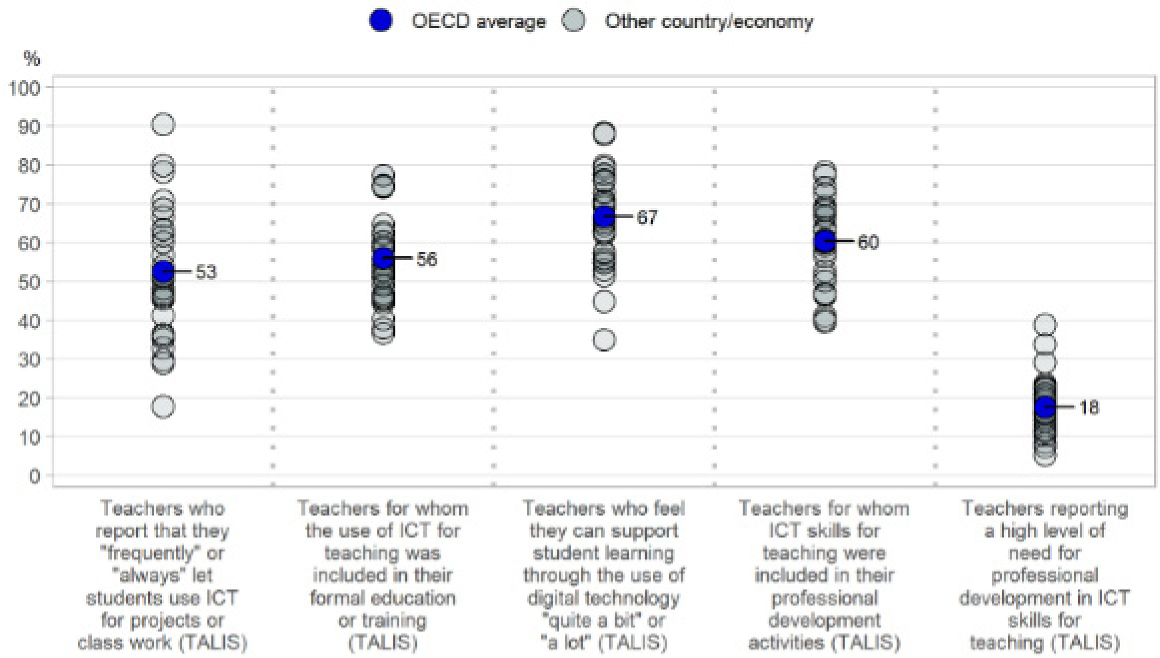
5.2. Preparedness of CEE countries for ICT-based teaching prior to the crisis

The preparedness of CEE countries for ICT-based teaching will be analyzed based on three indicators: a) Teachers' preparedness for ICT-based teaching prior to the crisis, b) School and student preparedness for ICT-based learning prior to the crisis, and c) Teachers' preparedness for ICT-based teaching prior to the crisis.

During the COVID-19 pandemic, schools were forced to replace time in class with online learning and emergency remote teaching, in most cases facilitated by teachers and parents. Based on the OECD country note about Poland (OECD Country Note Poland, 2020), "excluding the non-compulsory part of the curriculum, each week of school closures represents about 24 hours of face-to-face compulsory instruction time at school (lower secondary school – general orientation), that is to say 2.8% of annual compulsory instruction time."

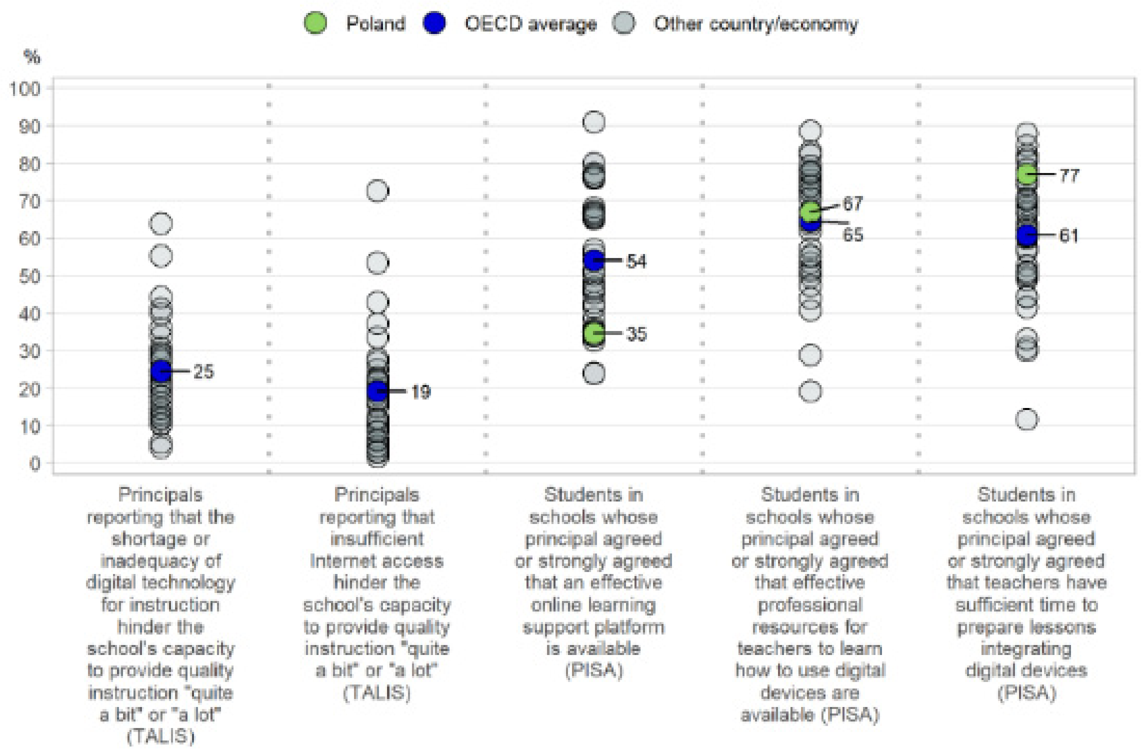
In the following figure, teachers', students', and schools' familiarity with the use of ICT for teaching and learning in OECD countries prior to the crisis is presented (OECD Country Note Poland, 2020).

Figure 5. Teachers' preparedness for ICT-based teaching prior to the crisis (OECD Country Note Poland, 2020).



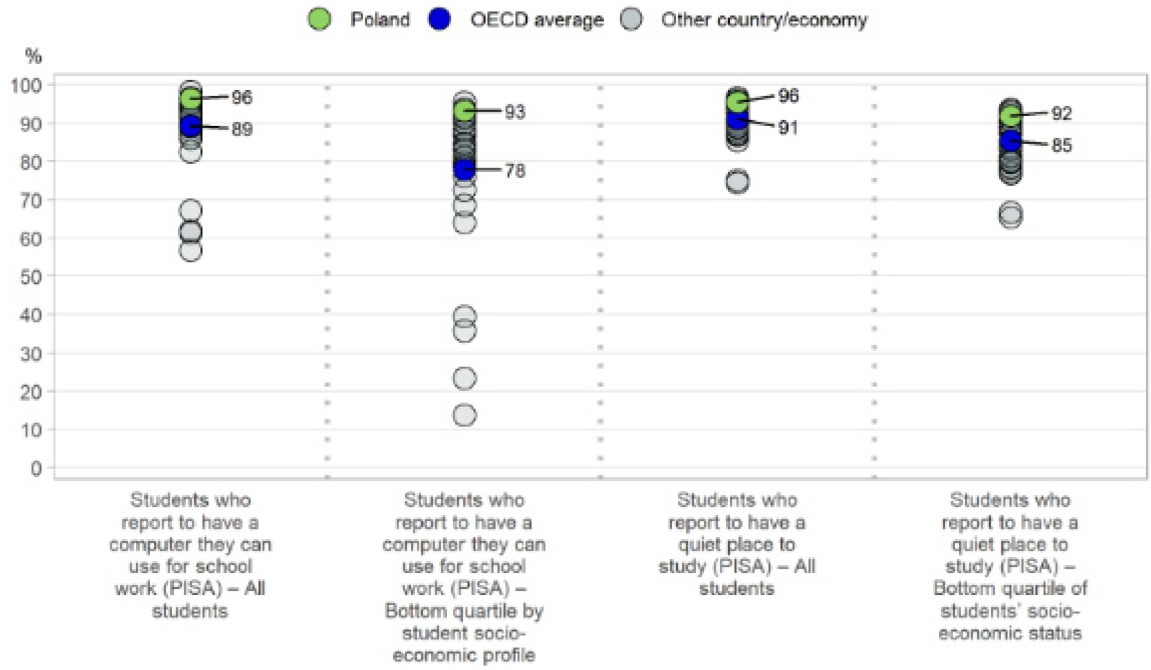
In Figure 6, school and student preparedness for ICT-based learning in OECD countries prior to the crisis is presented.

Figure 6. School and student preparedness for ICT-based learning prior to the crisis – Poland (OECD Country Note Poland, 2020).



In Poland, 96% of students reported having a computer they could use for school work, which is a higher proportion than the OECD average (89%). For those from the bottom quartile of the socio-economic distribution, 93% of students reported having a computer they could use for school work, which is also higher than the OECD average (78%) (OECD Country Note Poland, 2020).

Figure 7. Students' home settings for online learning prior to the crisis – Poland (OECD Country Note Poland, 2020)



In the OECD Country note for Poland, results from the 2018 Teaching and Learning International Survey (TALIS) prior to the crisis show that, on average across participating OECD countries and economies, only slightly more than half of lower-secondary teachers (53%) reported that students use ICT for projects or class "frequently" or "always." In Hungary, this was the case for 48% of teachers, which is a smaller proportion than the average of the OECD countries participating in TALIS.

In Hungary, 51% of teachers reported that use of ICT for teaching was included in their formal education or training – a figure lower than the average of the OECD countries taking part in TALIS (56%). In Hungary, 79% of teachers felt that they could support student learning through the use of digital technology, which is more than the average of the OECD countries participating in TALIS (67%) (OECD Country Note Hungary, 2020).

Figure 8. Teachers' preparedness for ICT-based teaching prior to the crisis – Hungary (OECD Country Note Hungary, 2020)

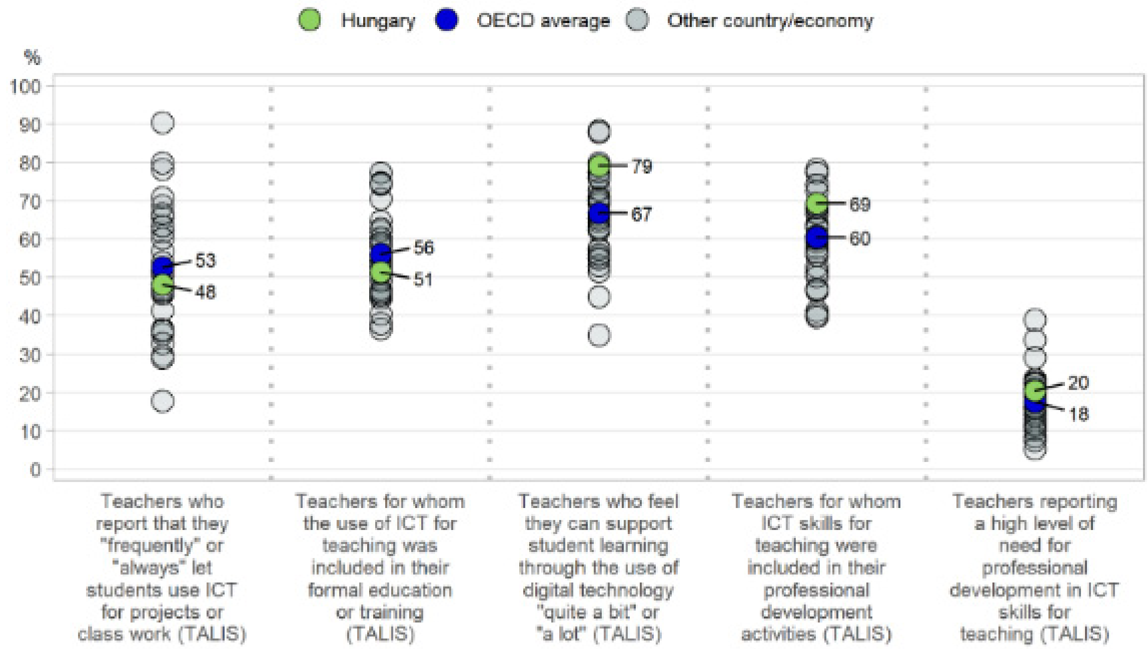
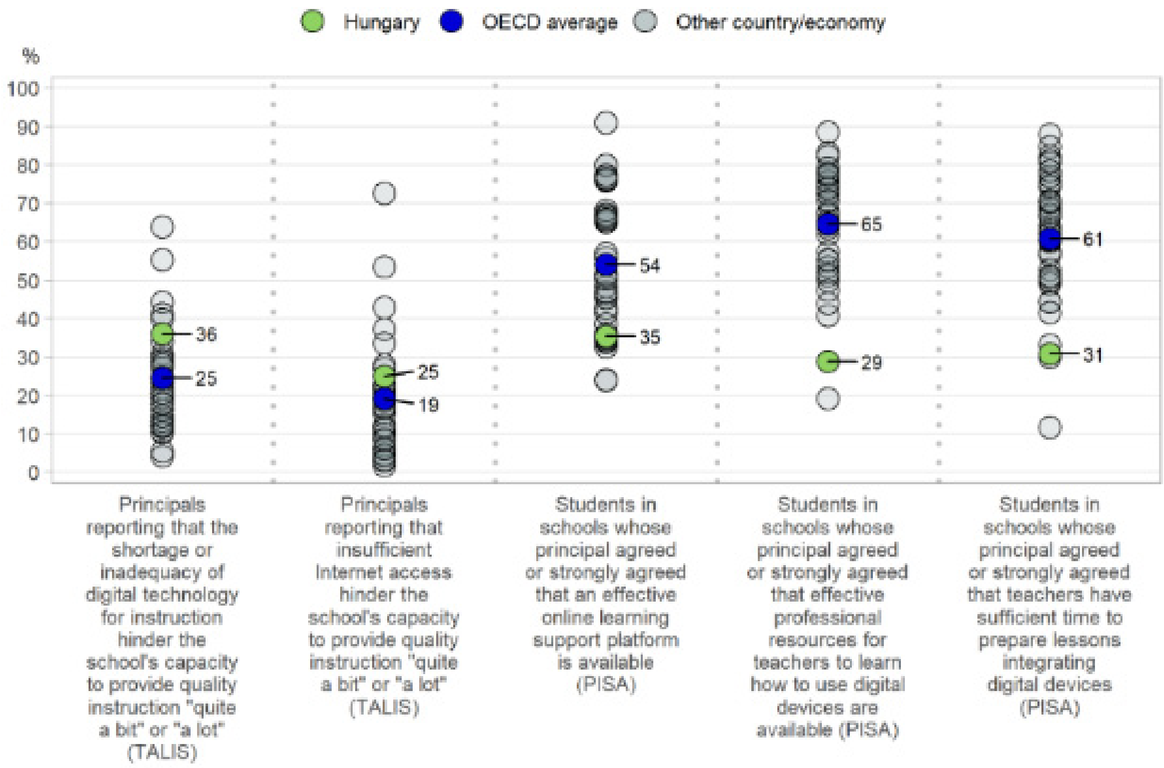
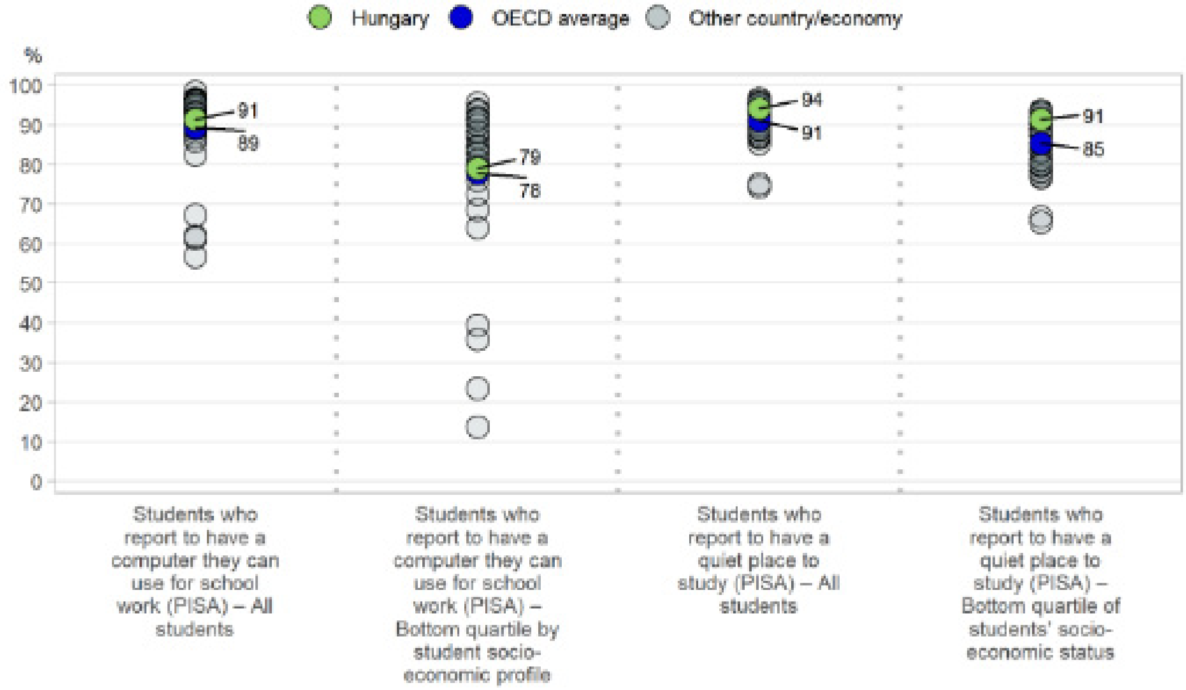


Figure 9. School and student preparedness for ICT-based learning prior to the crisis (OECD Country Note Hungary, 2020)



In Hungary, 91% of students reported having a computer they could use for school work, which is higher than the OECD average (89%). For those from the bottom quartile of the socio-economic distribution, 79% of students reported having a computer they could use for school work, which is statistically not significantly different from the OECD average (78%) (OECD Country Note Hungary, 2020).

Figure 10. Students' home settings for online learning prior to the crisis – Hungary (OECD Country Note Hungary, 2020)



Results from the 2018 Teaching and Learning International Survey (TALIS) show that in the Slovak Republic, 62% of teachers reported that use of ICT for teaching was included in their formal education or training, which is higher than the average of the OECD countries taking part in TALIS (56%). At the time of the survey, 70% of teachers in the Slovak Republic felt that they could support student learning through the use of digital technology, which is higher than the average of the OECD countries participating in TALIS (67%).

Figure 11. Teachers' preparedness for ICT-based teaching prior to the crisis – Slovak Republic (OECD Country Note Slovak Republic, 2020)

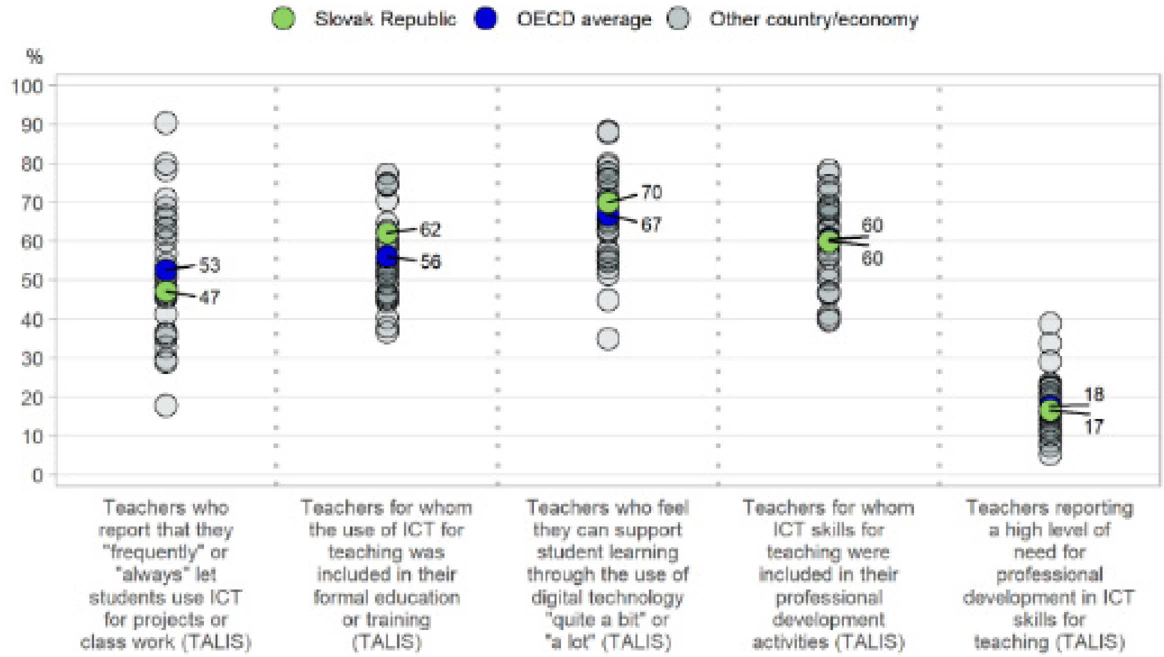
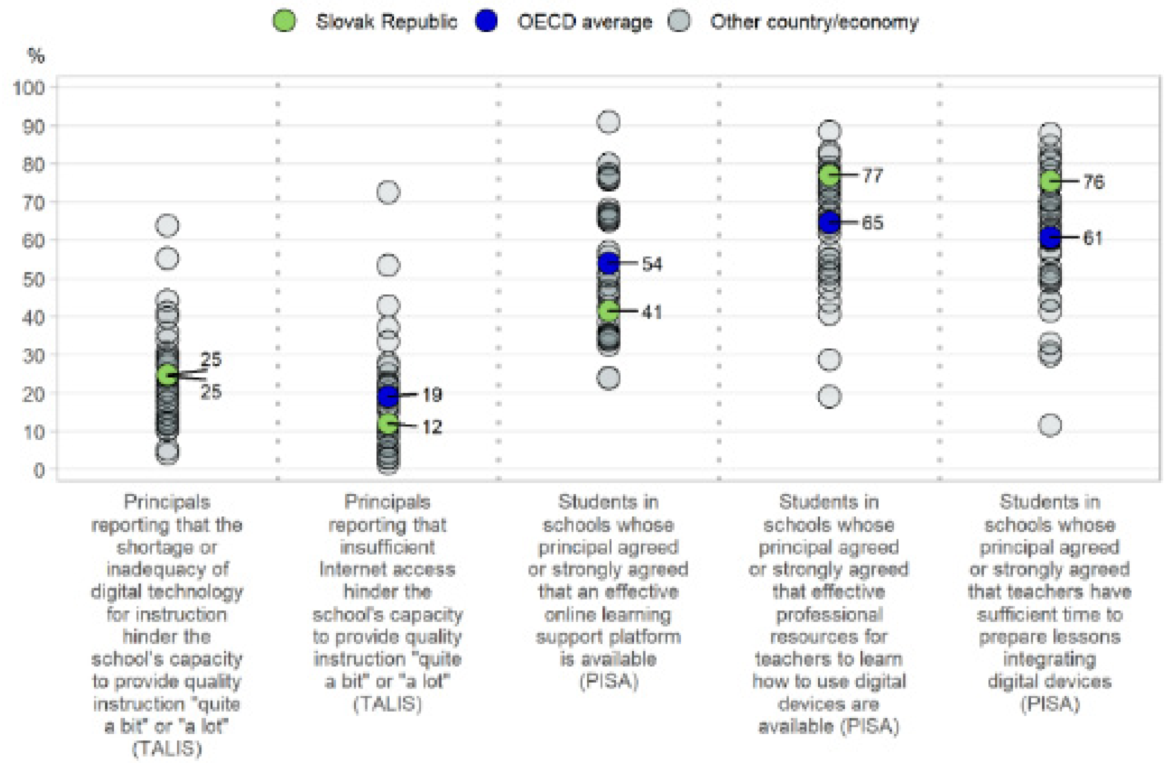
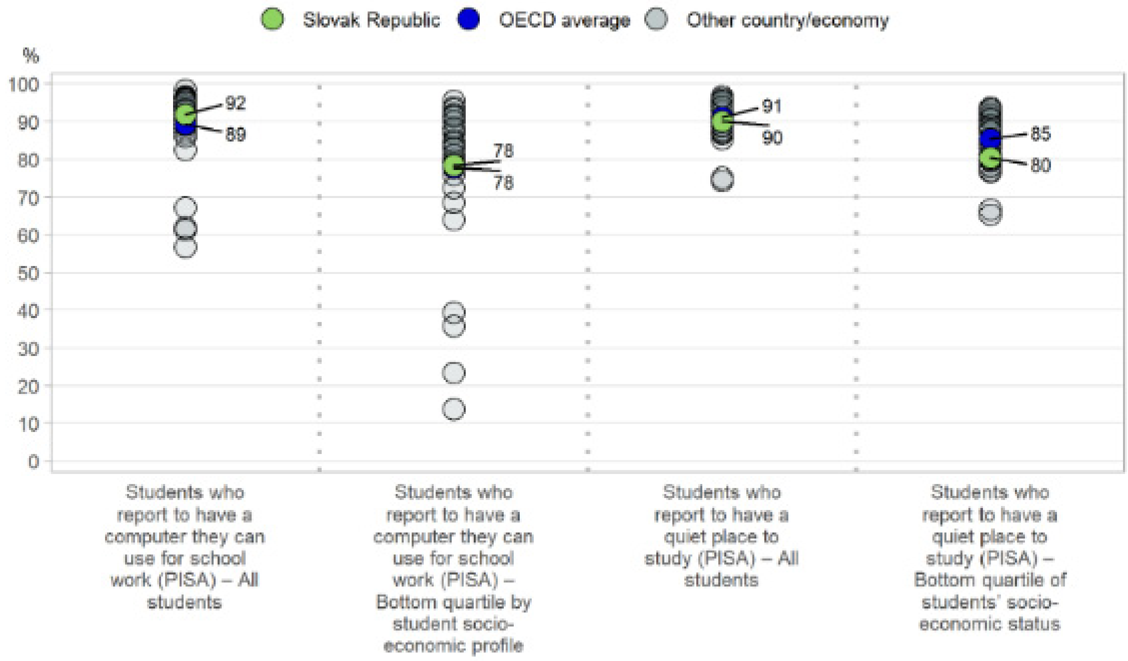


Figure 12. School and student preparedness for ICT-based learning prior to the crisis – Slovak Republic (OECD Country Note Slovak Republic, 2020)



In the Slovak Republic, 92% of students reported having a computer they could use for school work, which is higher than the OECD average (89%). For those from the bottom quartile of the socio-economic distribution, 78% of students reported having a computer they could use for school work, which is the same as the OECD average (78%) (OECD Country Note Slovak Republic, 2020).

Figure 13. Students' home settings for online learning prior to the crisis – Slovak Republic (OECD Country Note Slovak Republic, 2020)



5.3. Examples of funding sources for digital education services and development in CEE countries

In **Serbia**, the government defined digitalization and education reform as top two priorities, so the government decided to ask for a European Investment Bank (EIB) loan. The European Investment Bank backed a €65 million loan to upgrade digital infrastructure and digital teaching materials, as well as teacher training (with UNICEF support) in Serbia. Taking into account the importance of the project, the Bank is financing almost 60% of the total €111 million project cost. With this investment, the aim is for all schools to go digital by the end of 2021. Within the scope of this project, more than 1800 larger schools will be fully covered with high-speed wireless internet access, while the remaining remote ones will be connected using mobile broadband units. Besides the digital infrastructure, the project entails nation-wide teacher training.

In **Romania**, investment in the flagship program for digital education involved €2.6 million for a project called Digitaliada financed by the Orange Foundation. Digitaliada is a digital education program carried out with the approval of the Ministry of National Education, which is designed to encourage the use of technology in the classroom in order to improve school performance in pre-university education. The digital platform digital.educred.ro offers recommended e-learning platforms and online learning resources in one place. It hosts tutorials and other learning materials designed to train teachers to manage learner activities on online learning platforms. The platform was based on the experiences and results of an ESF joint-financed project designed to provide free-to-access educational resources for learning communities and help ensure the widespread use of new technologies in teaching and learning. In the scope of ESF projects, together with NGOs, universities, IT companies and individual professionals, learning and business community webinars for teachers on the use of online work tools were organized free of charge. Another source was the Euro 200 program that offered financial support (EUR 200) for learners to buy a PC, but only for those from very poor families. School inspectorates and schools, in cooperation with local authorities, also support providing access to online learning for learners. The aim of the government is to start with a EUR 30 million national program entitled "School at home in 2021" that will support the purchase of digital devices with an internet connection for schools to aid distance learning for disadvantaged students for an estimated 250,000 learners in Romania.

In **Poland**, many polish pupils, students and teachers were unable to pursue education online due to a lack of equipment and training. The government reacted to the problem of digitally excluded students but too late. Two days after online learning had become compulsory, the Ministry of Digital Affairs announced a program that would allocate 180 million zloty for computer equipment and internet access for students and teachers. Each administrative municipality received at least 40,000 zloty from the grant.

Two European Social Fund (ESF) projects have helped Poland overcome the digital divide. A project called "Support for children placed in foster care during the COVID-19 epidemic" with a total budget of over €25 million, half-funded by the European Social Fund (ESF), coordinated the provision of IT equipment (including laptops, desktops, software, and audio-visual equipment) and interactive software for remote learning. The plan is to use the ESF co-financed projects to provide IT equipment for teacher training centers and libraries until the end of 2021. The project will also give IT training to teachers and staff – around 32,000 teachers will benefit through resources made available on the Integrated Educational Platform funded by the ESF. The provision of broadband access for schools is defined in a Ministry of Education and Ministry of Digitisation law. The National Education Network (OSE) aims to offer symmetrical 100 Mbs broadband access to 30,500 schools and educational institutions. With OSE, the cost to schools of internet access will be paid by the government. All other schools are to get broadband access through projects financed by the Polska Cyfrowa program, which is co-funded by the European Commission's European Regional Development Fund and Cohesion Fund.

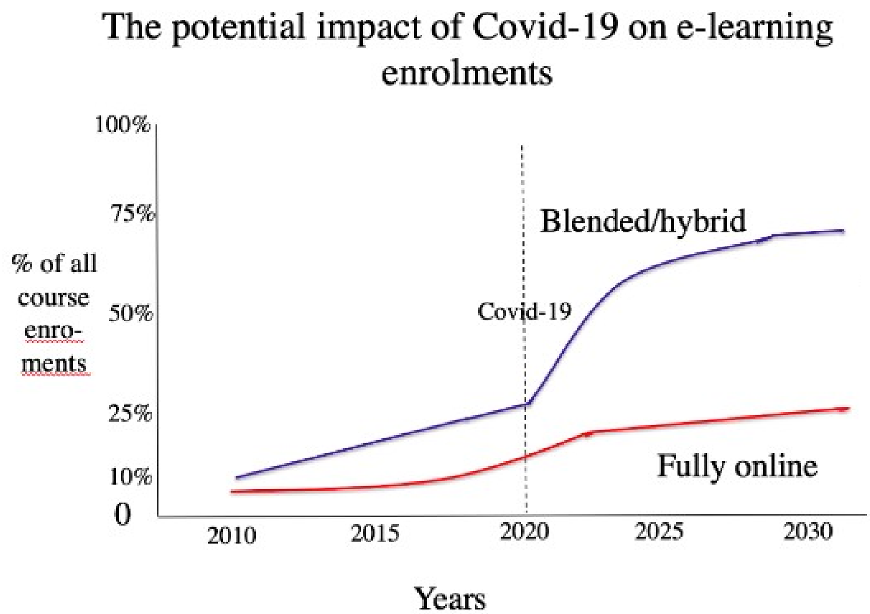
In **Hungary**, a European Investment Bank **(EIB) loan helps schools improve the quality of education, social inclusiveness, and the educational performance of their pupils, as well as their social opportunities and employability.** The EIB has so far invested EUR 911 million into the education sector in Hungary. **One example of this was a** loan of 150 million euros in 2020 for the construction and rehabilitation of eight schools, 16 classroom extensions, and 20 new sports halls in schools, as well as the construction of 26 swimming pools and 17 larger gymnasiums in public schools across the country.

The Hungarian government offers free internet for primary school students and teachers. In November 2020, the government made fixed internet access services free of charge for high school educators and students transitioning to a digital work schedule during the coronavirus crisis. Those entitled to the service – namely, educators, teachers, students, or their parents – could indicate their need for the free option to their service provider. In 2021, the Deputy Minister of Innovation and Technology extended its free fixed internet campaign to a total of nearly 800,000 students and teachers in primary education.

6. THE IMPACT OF COVID-19 ON E-LEARNING ENROLMENT AND RECOMMENDATIONS FOR EDUCATIONAL INSTITUTIONS

One of the world's most well-known e-learning experts, Tony Bates, predicted that over the next 10 years, fully online learning will grow to account for about 20-25% of all course enrolment, and hybrid learning, in the sense of the integration of campus-based teaching and digital learning, will grow to cover about 70-80% of all course enrolment (Figure 14).

Figure 14. The potential impact of Covid-19 on e-learning enrolments (Bates, 2020)



The impact will depend on:

- the changing nature of work, requiring more emphasis on the development of high-level intellectual skills, such as critical thinking, multiple modes of communication, and digital literacy embedded within a subject discipline, which in turn will require changes in curricula and teaching methods
- student demand for more flexibility in terms of delivery of programs and for more lifelong learning
- the effectiveness of institutional plans and strategies for supporting e-learning
- the willingness and readiness of faculty and instructors to not only embrace hybrid and online learning, but also to change their teaching methods to enable effective teaching in these modes.

Recommendations for educational institutions (universities, faculties, schools) and governments concerning how to support hybrid and online learning include the following (Bates, 2020):

1. Educational institutions need to prepare a plan for implementing hybrid and online learning, especially one which ensures quality and encourages innovation and new designs and teaching methods.

2. There will be an increase in demand for support staff (instructional, technical, user support staff) – such as instructional designers, media producers, and software developers to help institutions to move more effectively into digital learning.

3. There is a need for more and better development and training for teachers and students. For example, a move to 70-80% hybrid learning and 30% online means that almost all teachers will need to know how to teach well digitally. More qualifications will be required for teaching for a digital age (short courses; more on-demand resources for instructors in the form of 'how to' videos and web sites; on-demand resources and online courses in digital teaching and learning) to avoid duplication and to rapidly increase resources.

4. Government role and support. It needs to be emphasized that while online and hybrid learning will become essential in developing the knowledge and skills that students will need in a digital age, this still requires the use of highly knowledgeable and skilled teachers. Teaching high-level skills such as critical thinking and good communication is still going to be relatively labor-intensive. Second, institutions are facing a huge human-resource challenge: the need for the radical retraining of their main workforce. This is going to be difficult, if not impossible, without some external intervention and support from government. The priority of the government must be investment in the training of teachers, because a well-trained instructor workforce will be essential for developing the skills and knowledge for an effective digital-age economy.

7. THE POTENTIAL ROLE OF BIG DATA ANALYTICS FOR IMPROVING THE QUALITY OF EDUCATION

In education systems around the world, schools are slowly starting to use data to define areas for making improvements in the quality of education. Data can be used for school improvement at different levels – at the student, classroom, school, and system level. A lot of new tools are being developed that can help schools to collect, store, and analyze data. Different stakeholders at different levels are involved in this process but policy-makers are required to make sense of different types of data to develop policy (Schildkamp, 2019).

The new areas include the use of formative assessment data, educational research study findings, and big data. The data can be collected and used to visualize and analyze by using data warehouses, dashboards, data lockers, data analytics, data mining tools, and machine learning. This will lead to new opportunities for unlocking the potential of data use for improving the quality of schools, as well as for developing high-quality tools.

Different stakeholders at different levels are involved in this process, but policy-makers are required to make sense of different types of data to develop policy. At this level, sense-making of standardized assessment data often plays an important role (Rickinson et al., 2017).

Big data are characterized by the so-called "three Vs": Volume, Variety, and Velocity. Big data involves huge amounts of data (Volume), in varied forms (Variety), which is continuously added to and updated (Velocity). These data can be used to monitor as well as to predict the performance of an organisation (Veldkamp et al., 2017). The use of big data by policy makers can lead to different types of improvement initiatives and to new opportunities for unlocking the potential of data use for improving the quality of schools, as well as addressing significant challenges such as curriculum changes and making formative assessments instead of an over-reliance on summative assessment (Gelderblom et al., 2016).

The crucial role in this process is played by the school leader. The school leader must understand the purpose of data-based decision-making for school improvement and must employ data literacy skills to monitor, model, scaffold, guide, and encourage the use of data (Hoogland et al., 2016).

CONCLUSION

The main objectives of the project "Future Challenges to Education Systems in Central Eastern European Context" (EDUC) are: 1) Contextualizing the future challenges in CEE countries through an assessment of their relative weight, 2) Assessing the actual preparedness of the education systems of the CEE countries for change, 3) Mapping out the institutional conditions of adaptation to external expectations, and 4) Developing recommendations for policies and developments for improving the preparedness of the education systems of the CEE countries. This comparative study contributes to the second objective of the project, and helps with testing the actual preparedness of educational systems.

The main analysis of the digital preparedness of school systems in the CEE countries was based on a survey by the European Commission undertaken in 2019 and published in the final report entitled "2nd Survey of Schools: ICT in Education" (EC, 2019). In this survey, a wide range of topics was covered: Access to and use of digital technologies, Digital activities and digital confidence of teachers and students, ICT-related teacher professional development, the Digital home environment of students, and Schools' digital policies, strategies and opinions. A detailed analysis of the results of the comparison of CEE countries based on these topics (indicators) is presented in Chapter 4.

The preparedness of CEE countries for ICT-based teaching is also analyzed based on three indicators: a) Teachers' preparedness for ICT-based teaching prior to the crisis, b) School and student preparedness for ICT-based learning prior to the crisis, and c) Teachers' preparedness for ICT-based teaching prior to the crisis. Results are analyzed in Chapter 6 for Slovakia, Hungary, and Poland based on the OECD Country Notes, and Teaching and Learning International Survey (TALIS) results.

Based on the results analyzed in this study, we conclude that the stage of building the fundamental institutional conditions for school-level change cannot be skipped. If we compare CEE countries to European ones based on the average share of digitally equipped and connected schools, we find fewer highly digitally equipped and connected schools at all levels (primary schools, lower secondary schools, and upper secondary schools). Before any investment into improving the ability of schools is made, the main conditions must be ensured. Most CEE countries are planning to use a systematic approach to equipping schools by using ESF funds and EIB loans. After ensuring the main conditions, the next phase for schools is a reconstruction process with major emphasis on the consolidation of the processes in school that enable them to adapt digital technologies and improve the quality of teaching and learning. This process must be based on the know-how approach and professional expertise. Schools must be able to absorb external resources and apply professional support. To reach this objective, it is necessary to use a systematic approach and create a governance environment that supports schools in this process.

REFERENCES

Bates, T. (2019). *Teaching in a Digital Age - Second Edition. Guidelines for designing teaching and learning.* Vancouver, B.C.: Tony Bates Associates Ltd. URL: https://pressbooks.bccampus.ca/teachinginadigitalagev2/

Begičević Ređep et al. (2019). Framework for Digitally Mature Schools. *European Journal of Open, Distance and E-Learning (EURODL)* 2019, special issue – best of EDEN 2017. URL: http://www.eurodl.org/?p=special&sp=articles&inum=10&article=783

Begičević Ređep, N., Klačmer Čalopa, M., Tomičić Pupek, K. (2020). The Challenge of Digital Transformation in European Education Systems. Eds: Moos et al., *Educational Leadership, Improvement and Change: Discourse and Systems in Europe*. Palgrave Studies on Leadership and Learning in Teacher Education. Cham: Palgrave Pivot, pp. 103-120. URL: https://doi.org/10.1007/978-3-030-47020-3_8

Beer C., Clark K., Jones D. (2010). Indicators of Engagement. Eds: C.H. Steel, M.J. Keppell, P. Gerbic & S. Housego, *Curriculum, technology & transformation for an unknown future*. Sydney: Ascilite, pp.75-86.

Conrads et al. (2017.) *Digital Education Policies in Europe and Beyond: Key Design Principles for More Effective Policies.* Eds: Redecker, C., P. Kampylis, M. Bacigalupo, Y. Punie. Luxembourg: Publications Office of the European Union

DiMaggio, P. and Hargittai, E., 2001. From the 'digital divide' to 'digital inequality': Studying Internet use as penetration increases. *Princeton: Center for Arts and Cultural Policy Studies, Woodrow Wilson School, Princeton University*, 4(1), pp.4-2.

Divjak B., Begičević, N. (2006). Imaginative Acquisition of Knowledge - Strategic Planning of E-Learning. ITI 2006 - *28th International Conference on Information Technology Interfaces*, University Computing Centre SRCE, University of Zagreb, pp. 47-53.

European Commission/EACEA/Eurydice, 2019. *Digital Education at School in Europe.* Eurydice Report. Luxembourg: Publications Office of the European Union. URL: https://eacea.ec.europa.eu/nationalpolicies/eurydice/sites/eurydice/files/eurydice_brief_digital_education_n.pdf

Ferrari A. (2012). *Digital competence in practice: An analysis of frameworks.* JRC Technical Reports. Luxembourg: Joint Research Centre, Institute for Prospective Technological Studies, URL: http://ftp.jrc.es/EURdoc/JRC68116.pdf

Gelderblom et al. (2016). Data-Based Decision Making for Instructional Improvement in Primary Education. *International Journal of Educational Research,* 80, pp. 1-14.

Holdis, D. (2019). *Media influence matrix: Romania: Technology, Public Sphere and Journalism.* Budapest: CEU's Center for Media, Data and Society (CMDS).

Hoogland et al. (2016). Prerequisites for Data-Based Decision Making in the Classroom: Research Evidence and Practical Illustrations. *Teaching and Teacher Education,* 60, pp. 377-386.

Jugo et al. (2017). Development of a Model to Assess the Digitally Mature Schools in Croatia. *Tomorrow's Learning: Involving Everyone. Learning with and about Technologies and Computing.* Eds: Tatnall, A., Webb, M. Cham: Springer, pp.169-178.

Kampylis P., Punie, Y., Devine, J. (2015). *Promoting Effective Digital-Age Learning - A European Framework for Digitally-Competent Educational Organisations*. Luxembourg: Publications Office of the European Union.

Kling, R. (1998). Technological and Social Access on Computing, Information and Communication Technologies. *White Paper for Presidential Advisory Committee on High-Performance Computing and Communications, Information Technology, and the Next Generation Internet.*

Osterwalder et al (2014). Value proposition design. Hoboken, New Jersey: John Wiley &Sons.

Power J. D., Heavin C. (2018). Data-based Decision making and Digital Transformation. New York: Business Expert Press.

Sen, A. K. (1992). *Inequality reexamined*. New York: Oxford University Press.

Stiakakis, E., Kariotellis, P., Vlachopoulou, M. (2009). From the digital divide to digital inequality: A secondary research in the European Union. Eds: Alexander B. Sideridis, Charalampos Z. Patrikakis. *Next Generation Society, Technological and Legal Issues*. Third International Conference, e-Democracy 2009, Athens, Greece, September 23-25. Heidelberg, Berlin: Springer.

Stolterman, E. and Fors, A. C. (2004). Information technology and the good life. Eds: Kaplan B., Truex D.P., Wastell D., Wood-Harper A.T., DeGross J.I., *Information Systems Research. IFIP International Federation for Information Processing.* Vol 143. Boston, MA: Springer.

OECD (2017). *Going Digital: Making the Transformation Work for Growth and Well-Being.* OECD – Better Policies for Better Lives. Paris: Meeting of the OECD Council. URL: https://www.oecd.org/mcm/documents/C-MIN-2017-4%20EN.pdf

Ossiannilsson E. (2016). *Handbook of Research on Learner-Centred Pedagogy in Teacher Education and Professional Development*. Hershey: IGI Global.

Panagiotis, K., Yves P., Jim D. (2015). *Promoting Effective Digital-Age Learning: A European Framework for Digitally-Competent Educational Organisations*. Luxembourg: Publications Office of the European Union. URL: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/promoting-effective-digital-age-learning-european-framework-digitally-competent-educational

Pihir I., Tomičić-Pupek K., Tomičić Furjan M. (2019). Digital transformation playground - literature review and framework of concepts, *Journal of Information and Organizational Sciences*, 43 (1), pp. 33-48.

Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu.* Eds: Punie, Y. Luxembourg: Publications Office of the European Union.

Rickinson et al. (2017). What Can Evidence-Use in Practice Learn from Evidence-Use in Policy? *Educational Research,* 59 (2), pp.173-189.

Schildkamp, K. (2019). Data-based decision-making for school improvement: Research insights and gaps. *Educational Research,* 19, pp. 257-273.

Seufert, S., Meier, C. (2016). From eLearning to digital transformation: a framework and implications for L&D. *International Journal of Corporate Learning (iJAC)*, 9 (2), pp. 27-33.

Uhl, A., Gollenia, L. A. (2016). *Digital enterprise transformation: A business-driven approach to leveraging innovative IT,* (e-book), London: Routledge, URL: https://www.taylorfrancis.com/books/edit/10.4324/9781315577166/digital-enterprise-transformation-axel-uhl-lars-alexander-gollenia

Veldkamp et al. (2017). Rapport: Verkenning Data-Gedreven Onderwijsonderzoek in Nederland. *Report: Exploration of Big Data in Education in the Netherlands*. Enschede: Universiteit Twente.

Virkus, S. (2019). The use of Open Badges in library and information science education in Estonia. *Education for Information*, 52 (2), pp. 1-18.

Virkus, S., Kirinić, V., Begičević Ređep, N. (2020). The Role of E-Learning and Information Culture in Educational Institutions in Transforming European Education. Eds: Moos, L., Alfirević, N., Pavičić, J., Koren, A., Čačija, L.N., *Educational Leadership, Improvement and Change: Discourse and Systems in Europe*. Cham: Palgrave Pivot, pp. 121-138. URL: https://doi.org/10.1007/978-3-030-47020-3_9

Internet sources

Ae-MoYS. Assessing the e-Maturity of your School. URL: http://e-mature.ea.gr (March 16, 2020)

Bates, T. (2020). Online enrolments after Covid-19: a prediction, part 2 – policy implications, Online Learning and Distance Education Resources, URL: https://www.tonybates.ca/2020/04/16/online-enrolments-after-covid-19-a-prediction-part-2-policy-implications/ (April 16, 2020)

Carretero, S., Riina V., Yves P. (2017). DigComp 2.1. The Digital Competence Framework for Citizens with Eigth Proficiency Level and Examples of Use. URL: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp2.1pdf_(online).pdf (April 1, 2020)

DigCompOrg (2017). Digitally Competent Educational Organisations. URL: https://ec.europa.eu/jrc/en/digcomporg/framework (March 15, 2020)

Europorfolio. *ePOBMM. The ePortfolios & Open Badges Maturity Matrix*. URL: http://www.eportfolio.eu/matrix (March 15, 2020) e-Schools: Establishing a System for the Development of Digitally Mature Schools (pilot project). URL: http://www.carnet.hr/e-skole (March 15, 2020)

EC - European Commission. (2020). Digital Economy and Society Index (DESI) 2020: Thematic chapters. URL: https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=67086 (March 18, 2020)

EC - European Commission. (2017). 'European Semester Thematic Factsheet: Addressing Inequalities'. URL: https://ec.europa.eu/info/sites/info/files/file_import/european-semester_thematic-factsheet_addressing-inequalities_en_0.pdf (March 18, 2020)

EC - European Commission. (2019). 2nd Survey of Schools: ICT in Education. URL: https://ec.europa.eu/information_society/newsroom/image/document/2019 10/ictineducation_objective_2_report_final_4688F777-CDED-C240-613EE517B793385C_57736.pdf (March 18, 2020)

EC - European Commission. (2019a). 2nd Survey of Schools: ICT in Education. URL: https://ec.europa.eu/digital-single-market/en/news/2nd-survey-schools-ict-education (March 18, 2020)

EC - European Commission. (2019b). 2nd Survey of Schools: ICT in Education - Hungary Country Report. URL: https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=57806 (March 18, 2020)

EC - European Commission. (2019c). 2nd Survey of Schools: ICT in Education - Poland Country Report. URL: https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=57816 (March 18, 2020)

EC - European Commission. (2019d). 2nd Survey of Schools: ICT in Education – Romania Country Report. URL: https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=57818 (March 18, 2020)

EC - European Commission. (2019e). 2nd Survey of Schools: ICT in Education - Slovakia Country Report. URL: https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=57819 (March 18, 2020)

EUROSTAT (2019). Do young people in the EU have digital skills? URL: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20200715-1 (March 16, 2020)

FCMM. Future Classroom Maturity Model. URL: http://fcl.eun.org/hr/toolset2 (March 16, 2020)

HEInnovative. URL: https://heinnovate.eu/ (March 15, 2020)

Hunya, M. (2013). *eLEMER. Self-evaluation of ICT usage at Hungarian schools*. URL: http://ofi.hu/publikacio/self-evaluation-ict-usage-hungarian-schools (March 16, 2020)

JISC. Jisc Strategic ICT Toolkit. URL: https://www.jisc.ac.uk/guides/managing-course-information (March 16, 2020)

LIKA. Ledning, Infrastruktur, Kompetens, Användning. URL: http://www.iktpedagogerna.se/lika-it-tempen-pa-skolan/ (March 16, 2020)

MICROSOFT IF & SRT. Microsoft Innovation Framework & self-reflection tool. URL: from http://www.is-toolkit.com/self_reflection.html (March 21, 2020)

Ministerial Level. URL: https://www.oecd.org/mcm/documents/C-MIN-2017-4%20EN.pdf (March 22, 2020)

NACCE SRF. URL: https://www.naacesrf.com/ (March 16, 2020)

Newman, D. (2019). Top 5 Digital Transformation Trends In Education For 2020, URL: https://www.forbes.com/sites/danielnewman/2019/08/01/top-5-digital-transformation-trends-in-education-for-2020/ (April 1, 2020)

NMC Horizon Report (2018). EDUCAUSE Publications, URL: https://library.educause.edu/resources/2018/8/2018-nmc-horizon-report (April 5, 2020)

Norqvist, L. (2018). Analysis of the Digital Transformation of Society and its Impact on Young People's Lives; Youth partnership. URL: https://pjp-eu.coe.int/documents/42128013/47262517/Analysis+of+the+Digital+Transformation+of+Society+its+Impact+on+Young+People+Lives+-+Lars+Norqvist.pdf/efaff33a-89bc-3947-b618-01160e693872 (April 3, 2020)

OECD (2001). Organisation for Economic Co-operation and Development. Understanding the Digital Divide. URL: http://www.oecd.org/dataoecd/38/57/1888451.pdf (March 20, 2020)

OECD (2019). Organisation for Economic Co-operation and Development. How's Life in the Digital Age?: Opportunities and Risks of the Digital Transformation for People's Well-being, OECD Publishing, Paris. URL: https://www.oecd-ilibrary.org/docserver/9789264311800en.pdf?expires=1595503006&id=id&accname=guest&checksum=23E45A034D0868423A819C50D5471365 (March 20, 2020)

OECD (2015). Organisation for Economic Co-operation and Development. Students, computers and learning: Making the connection. URL: https://www.oecd-ilibrary.org/docserver/9789264239555en.pdf?expires=1595494436&id=id&accname=guest&checksum=71662038DF1A5B8208AB9DA9AC5A1F93 (March 20, 2020)

OECD (2006). Organisation for Economic Co-operation and Development. *Digital Divide*. URL: https://stats.oecd.org/glossary/detail.asp?ID=4719 (March 20, 2020)

OECD (n.d.). Organisation for Economic Co-operation and Development. Inequality. URL: https://www.oecd.org/inequality.htm (March 20, 2020)

OECD COPE (n.d.). OECD Centre for Opportunity and Equality. URL: http://www.oecd.org/inclusive-growth/inequality-and-opportunity/ (March 20, 2020)

OECD Country Note Hungary (2020). School education during COVID- 19 Were teachers and students ready? URL: http://www.oecd.org/education/Hungary-coronavirus-education-country-note.pdf (March 20, 2020)

OECD Country Note Poland (2020). School education during COVID- 19 Were teachers and students ready? URL: http://www.oecd.org/education/Poland-coronavirus-education-country-note.pdf (March 20, 2020)

OECD Country Note Slovak Republic (2020). School education during COVID- 19 Were teachers and students ready. URL: http://www.oecd.org/education/Slovak-Republic-coronavirus-education-country-note.pdf (March 20, 2020)

OPEKA. URL: http://opeka.fi/Opeka-SystemDesign-1.0.pdf (March 16, 2020)

PDST Technology in Education (n.d.). *E-learning Roadmap*. URL: http://www.ncte.ie/elearningplan/roadmap/ (March 16, 2020)

Romania Insiders. (2017). Romania has top internet infrastructure but fails to reap the digital dividends. URL: https://www.romania-insider.com/world-bank-romania-has-top-internet-infrastructure-but-fails-to-reap-the-digital-dividends (March 16, 2020)

Romania social briefing (2020). The education system in Romania goes online, at least by the end of the academic year. Entry posted in China – CEE Institute and tagged Oana Cristina Popovici, Romania. URL: https://china-cee.eu/2020/05/25/romania-social-briefing-the-education-system-in-romania-goes-online-at-least-by-the-end-of-the-academic-year/ (March 16, 2020)

SCALE CCR. Up-scaling Creative Classrooms in Europe. URL: http://is.jrc.ec.europa.eu/pages/EAP/SCALECCR.html (March 16, 2020)

Schlepp, C. (2019). Cloud ERP: Another Step in Your Digital Journey. https://www.interdynartis.com/blog/cloud-erp-another-step-in-your-digital-journey

SELFIE (2019). Supporting schools for learning in the digital age. European Commission. URL: https://ec.europa.eu/education/schools-go-digital_en (April 5, 2020)

SCHOOL MENTOR. The Norwegian Centre for ICT in Education. URL: from http://www.skolementor.no/index.php/en/omradeguide-en (March 16, 2020)

Solis, B. (2017). Digital Transformation – The six stages of digital transformation. URL: http://www.briansolis.com/2017/01/definition-of-digital-transformation/ (April 5, 2020)

Usage of ICT in the Republic of Serbia (2019). Households/Individuals Enterprises; Statistical Office of the Republic of Serbia; Belgrade. URL: https://publikacije.stat.gov.rs/G2019/PdfE/G201916014.pdf (March 16, 2020)

UN - United Nations. (2020). World Social Report 2020. URL: https://www.un.org/development/desa/dspd/world-social-report/2020-2.html (March 15, 2020)

UN - United Nations. (n.d.). *Inequality – Bridging the Divide*. URL: https://www.un.org/en/un75/inequality-bridging-divide (March 15, 2020)

UNESCO (2018). - United Nations Educational, Scientific and Cultural Organization. World inequality report 2018. URL: https://en.unesco.org/inclusivepolicylab/publications/world-inequality-report-2018 (March 17, 2020)

VENSTRESS. URL: from https://www.scholenopdekaart.nl/ (March 21, 2020)

World Bank. (n.d.). GINI index (World Bank estimate). URL: https://data.worldbank.org/indicator/SI.POV.GINI (March 16, 2020)

World Bank. (2020). How countries are using edtech (including online learning, radio, television, texting) to support access to remote learning during the COVID-19 pandemic. URL: https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learning-during-the-covid-19-pandemic (March 16, 2020)