CONNECTIVITY IN EDUCATION

STATUS AND RECENT DEVELOPMENTS IN 9 NON-EU COUNTRIES

Version 1.0

Living Document

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The final version of this document is to be released following the ITU Regional Forum for Europe on Meaningful Connectivity, taking into consideration the discussions held and feedbacks received from different stakeholders.

As school connectivity implementation is an dynamic process this document is treated as a living document that can be amended at any point of time depending on the availability of additional information.

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1. Introduction

1.1 The recent landscape

The discussion concerning Internet connectivity in public institutions as a driver of digital transformation at the country level has been widespread over the past years. In the wake of the global pandemic, this trend has increased as restrictions on freedom of movement have put pressure on public administrations to undergo adaptations through digitalisation, just as the private sector has. But even before the World Health Organization's announcement of the COVID-19 as a global pandemic in March 2020, the digitalisation of government services had already been widely recognized as a priority to support a more user-friendly and efficient digital environment for citizens at a lower cost.

Among the variety of public institutions, schools and various other organizations offering educational services have attracted particular attention in terms of Internet access over the past two years. School connectivity not only allows for a better administration of the scholastic system, from the central or local government to the school itself, it can also impact curricula and enrich the substance of education by allowing teachers to engage in novel pedagogic practices and offer students a plethora of learning experiences. In order to respond to the current and future demands for digital skills in the workplace, several countries around the world have been early adopters of policies aimed at elevating digital skills among the young population. However, such a vision requires adequate infrastructure at the school and country level, including access to appropriate ICT devices and reliable connection to the Internet .

As lockdowns and other restrictive measures adopted by many governments around Europe and the world have temporarily moved education from the classroom to the household, potentially shadowing the need for action improving schools' ICT equipment and connectivity, the shift has also forced adaptation to distance learning and digitally-delivered education. This has raised the importance of connectivity, the availability and access to appropriate devices, and the development of adequate digital skills necessary to thrive in the future.

As the pandemic eases and students make their way back to the classroom, it is critical to foster investment in this important area. Digitalising educational systems whilst expanding teachers' portfolio of competencies and students' daily learning processes towards the development of digital skills has become a policy imperative for the years ahead.

1.2 Purpose of the Paper

European Union countries play a leadership role in school connectivity globally, and this translates in both the efficient management and use of resources from a public administration perspective, as well as the possibility of implementing educational policies that include digital skills development in curricula. Some non-EU countries of Europe region, instead, face high barriers in this area, frequently characterized by the high costs of both network deployment and access to ICT equipment coupled with inadequately trained human capital, which often results in the lack of a sound strategic approach at the national level.

ITU's goal is to ensure that these longstanding gaps are reduced substantially, leading to educational systems fit for purpose and for delivering education that prepares for an increasingly digital society. With the goal of accelerating the countries' digital transformation and support the attainment of UN Sustainable Development Goals, for its part ITU seeks to promote a favourable environment for investments in school connectivity and the infrastructure underpinning it by engaging with relevant stakeholders at the local, regional, and international level.

It is to this end, and as part of the ITU Regional Initiative 1 on "Broadband Infrastructure, broadcasting and spectrum management," that the ITU Office for Europe has developed this background document addressing the situation by offering a clearer picture on the status of many factors relating school connectivity in selected non-EU countries of Europe Region.

While portraying a picture of educational systems and their relationship with connectivity, there is no intention of benchmarking or developing a full-fledged comparative assessment, because every situation is country specific. Nevertheless, each country profile will follow a standardized structure including the following sections:

1) Overview of the education system and status of broadband;
2) Government strategies, status of the quality of education, and the role of ICTs;
3) Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity ;
4) National responses to COVID-19 and pedagogic initiatives for distance education.

Beyond the broad picture of the national context, the main focus will be on gaps in ICT equipment and connectivity in schools and the policies and actions undertaken to address this investment gap by national stakeholders as well as multilateral and regional institutions. Countries in the scope of this study are those characterized by a relative potential for improvement in this area: Albania, Bosnia and Herzegovina, Georgia, Moldova, Montenegro, North Macedonia, Serbia, Turkey, and Ukraine.

The paper will begin by presenting some aggregate data and findings from each section enabling the identification of key trends characterizing the development of educational systems vis-à-vis broadband connectivity, in order to provide all stakeholders interested in the region with the necessary information for effective decision making.

2. Regional Overview

2.1 Overview of the education system and status of broadband

The first section of each country profile seeks to outline the specific national context to set the basis for the overview. Drawing upon extensive research of the country's main institutions pertaining to education and telecommunication, the section presents statistical data for both policy areas, thereby providing an updated snapshot of the situation as of 2021.

In most of the nine countries, large educational reforms can be traced back to the early 2000s, and in many others, smaller reforms have been made over the past five years to either update school curricula. Similarly, telecommunication policy reforms aimed at fostering the spread of investment in connectivity over the same period. For each country, these sections will present the latest data available pertaining to education and telecommunications from various sources, including ITU and UNESCO.

The following subsections will provide a bigger picture by pooling data from all nine countries and providing aggregate insights in order to identify general trends. By no means should this be understood as a comparison, as all countries have been making progress over time. Despite all, the investigation of the aggregate numbers will help make a few considerations and distinctions in relation to other countries in the region.

Education Systems Data

As outlined in Table 1, around 25 million pupils between ages 6 and 17 and around 130,000 schools are under the scope of this paper. Notably, while less than seven years of compulsory education were often required only 20 years ago, now all require eight or more years, with the nine countries considered as a whole averaging more than 10 years of compulsory schooling.

Table 1 – 2019 School data (multiple sources)

	Number of children aged 6-17 in schools[i]	Number of schools[ii]	Length of compulsory education[i]	Number of children and adolescents out of school[i]
Albania	428,375	3,808	9	8,654
Bosnia and Herzegovina	422,645	2,427	9	96,909
Georgia	584,947	2,309	9	2,037

Moldova	415,489	1,373	11	46,482
Montenegro	101,995	277	9	2,435
North Macedonia	304,224	626	13	N/A
Serbia	824,883	2,083	8	10,608
Turkey*	16,258,037	86,398	12	600,962
Ukraine*	4,528,083	30,000	11	207,725
Totals	**23,868,678**	**129,301**	10.11	**975,812**

[i] Source: UNESCO (http://uis.unesco.org/en/)

[ii] Source: EACEA National Policies Platform (https://eacea.ec.europa.eu/national-policies/)

*All data refers to 2019 apart from Turkey (2018) and Ukraine (2014)

Importantly, according to UNESCO, 975,812 children or adolescents between 6 and 17 are still out of school in these countries, representing almost 4% of the total school population. This testifies that while the out-of-school population has been substantially reduced over the years, there is still a good margin for improvement from an inclusion point of view.

Connectivity Data

With regards to Internet connectivity, Table 2 presents statistics on various indicators from the ITU World Telecommunication/ICT Indicators Database for 2019. With the aim of providing a picture of the status of connectivity in each of the countries, indicators include the percentage of Internet usage across the population, the estimated percentage of households with Internet access at home; the estimated percentage of households with a PC at home; the number of fixed and mobile broadband subscriptions per 100 inhabitants; and the percentage of the population covered by 4G/LTE.

Table 2 – 2019 data for selected indicators

2019	% Internet usage	Est. % Households with Internet access at home	Est. % Households with PC at home	Fixed bb subscriptions/ 100 inhabitants	Mobile bb subscriptions/ 100 inhabitants	% pop with 4G coverage

Albania	69.6	32.9[i]	20.2[i]	15.1	62.1	95.0
Bosnia and Herzegovina	69.5	72.0	64.8	22.6	59.1	82.0
Georgia	68.9	79.3	62.0	23.6	79.8	99.7
Moldova	76.1[ii]	60.8	59.5	16.6	58.9	98.0
Montenegro	73.5	74.3	70.1[iii]	28.5	80.5	97.7
North Macedonia	79.2[i]	79.3[i]	67.3[ii]	21.3	69.8	99.5
Serbia	77.4	80.1	73.1	18.5	71.3	96.9
Turkey	74.0	88.3	55.3	17.1	74.8	96.7
Ukraine	62.6[i]	61.9[i]	62.3[i]	16.2	47.2[i]	78.1
Total	**107,013,408**	**33,423,445**	**26,903,152**	**26,056,201**	**99,729,157**	**138,049,318**
Remaining Gap	**44,105,432**	**11,779,486**	**18,299,780**	N/A	N/A	**130,69,522**

Source: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicators “"i99H", "xHH6_IDI", "xHH4_IDI", "i992b", "i911mw", "i271GA", "i61","i62".)

Notably, it remains the case that 44 million individuals do not make use of the Internet , representing around 30% of the total population of these countries and around 8% of the population of Europe region considered as a whole. However, as shown in Tables 3, 4, and 5, some additional 27 million people have been brought online over the past five years, which corresponds to a significant 35% increase and testifies a positive transformation in these countries, although with some degree of variability in terms of impact.

Similarly, a close look at Table 2 above reveals that more than 11 million and 18 million households do not have access to the Internet and are not in possession of a PC, respectively. While the 2015-2019 growth for household connectivity almost reaches 30%, in line with the growth in overall Internet usage, the figure for the number of households with PCs at home only grew by 7.9% over the five-year period, bringing the 2019 figure to 57.5% with still more than 18 million households lacking a PC at home. The persistent lack of PCs in households is particularly significant in times during which lockdowns triggered by the global pandemic facilitated the transition of economic activity to the digital sphere and transferred both educational and work activities to the household, thereby exacerbating already-existing inequalities in the areas of gender, rural and other communities vs. urban, high vs. low income and other. However,

this trend is offset by the adoption of mobile devices such as smartphones and tablets, which have lower fixed costs, require very limited digital skills, and allow for greater geographic mobility. Although no statistic is measured at the ITU level due to the complex nature of the indicator and the impossibility of standardization for each country, as it will be shown below, the growth of mobile usage is indisputable and also has a greater positive impact on economic activity.[1]

As we turn to look at market data for the telecommunication sector, it is possible to identify a real "boom" in the number of mobile subscriptions per 100 inhabitants and a more modest, though an important number of new fixed subscriptions between 2015 and 2019. In 2019, more than 55 million active mobile broadband subscriptions have been reported throughout the countries—more than one in three people and an almost 80% increase compared to 2015. With regards to fixed broadband subscriptions, the growth figure stands at 42.2%, though in absolute terms, 7.7 million subscriptions have been activated since 2015—a number which cannot be neglected. Finally, with regards to mobile coverage, it is important to underscore that the population covered by 4G/LTE technology has seen an almost 800% increase in only five years with total coverage of 91.4% of the population for 2019, a figure that tends towards universal coverage and demonstrates the efficient work undertaken by operators, NRAs and governments.

Table 3 - 2015 data for selected indicators

2015	% Internet usage	Est. % Households with Internet access at home	Est. % Households with PC at home	Fixed bb subscriptions/100 inhabitants	Mobile bb subscriptions/100 inhabitants	% pop with 4G coverage
Albania	63.3	25.0	20.2	8.4	44.9	35.0
Bosnia and Herzegovina	52.6	56.0	60.0	18.5	37.3	0.0
Georgia	47.6	45.1	49.7	15.8	54.0	82.0
Moldova	69.0	68.0	68.0	13.1	43.9	84.0
Montenegro	68.1	67.5	71.7	17.9	57.7	65.0
North Macedonia	70.4	69.4	68.4	17.5	54.3	71.0

[1] ITU Publication on "The economic contribution of broadband, digitization and ICT regulation: Econometric modelling for the ITU Europe region" (https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-EF.BDT_EUR-2020-PDF-E.pdf)

Serbia	65.3	63.8	64.4	14.9	57.3	56.7
Turkey	53.7	69.5	55.6	12.1	49.7	0.0
Ukraine	48.9	50.2	58.8	11.6	8.0	0.0
Total	**79,152,360**	**25,723,919**	**24,923,363**	**18,328,346**	**55,589,659**	**14,652,048**
Remaining Gap	**68,134,567**	**17,669,580**	**18,470,136**	N/A	N/A	**132,634,878**

Source: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicators ""i99H", "xHH6_IDI", "xHH4_IDI", "i992b", "i911mw", "i271GA", "i61","i62".)

Table 4 - 2015/2019 percentage change for selected indicators

2015-2019 %change	**% Internet usage**	**Est. % Households with Internet access at home**	**Est. % Households with PC at home**	**Fixed bb subscriptions/100 inhabitants**	**Mobile bb subscriptions/100 inhabitants**	**% pop with 4G coverage**
Albania	10.1%	31.7%	0.0%	80.2%	38.4%	171.4%
Bosnia and Herzegovina	32.1%	28.6%	8.0%	22.0%	58.5%	N/A
Georgia	44.7%	75.6%	24.7%	49.1%	47.9%	21.6%
Moldova	10.3%	-10.7%	-12.5%	26.3%	34.3%	16.7%
Montenegro	7.9%	10.0%	-2.2%	58.8%	39.6%	50.2%
North Macedonia	12.5%	14.3%	-1.7%	21.7%	28.6%	40.1%
Serbia	18.5%	25.7%	13.5%	24.4%	24.4%	70.7%
Turkey	37.7%	27.0%	-0.5%	40.9%	50.4%	N/A
Ukraine	28.0%	23.2%	5.9%	38.8%	490.7%	N/A
Total change	**35.2%**	**29.9%**	**7.9%**	**42.2%**	**79.4%**	**728.8%**

Source: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (computations based on indicators ""i99H", "xHH6_IDI", "xHH4_IDI", "i992b", "i911mw", "i271GA", "i61","i62".)

Table 5 - 2015/2019 absolute change for selected indicators

2015-2019 absolute change	Internet usage	Est. Households with Internet access at home	Est. Households with PC at home	Number of fixed bb subscriptions	Number of bb mobile subscriptions	Pop. with 4G coverage
Albania	177,936	63,476	926	193,322	491,877	1,725,192
Bosnia and Herzegovina	489,031	164,242	43,758	110,900	672,841	2,706,820
Georgia	837,479	324,219	113,373	305,835	1,019,023	502,630
Moldova	269,353	-94,477	-108,705	136,137	595,934	354,317
Montenegro	34,364	12,229	-2,941	66,387	144,085	1,287,122
North Macedonia	186,039	57,286	-6,479	79,935	326,091	1,132,841
Serbia	993,418	435,602	216,808	302,583	1,167,217	252,533
Turkey	19,515,615	3,820,470	294,463	4,727,384	23,340,163	80,684,781
Ukraine	5,357,815	2,916,479	1,428,586	1,805,372	16,382,267	32,789,192
Total added	**27,861,049**	**7,699,526**	**1,979,789**	**7,727,855**	**44,139,498**	**121,435,427**

Source: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (computations based on indicators “"i99H", "xHH6_IDI", "xHH4_IDI", "i992b", "i911mw", "i271GA", "i61","i62".)

These achievements in the market have been facilitated by an efficient interplay between these actors and other main stakeholders to unlock the necessary investment in infrastructure. As investment requires strategic policies, accurate information about the market and a good dialogue between authorities and operators, the role of broadband strategies, spectrum policies, broadband mapping and the related consultation processes is of utmost importance. In these sections, a short account of the main programmes and tools (such as broadband mapping systems) is also presented for each country.

2.2 Government strategies, status of the education quality, and the role of ICTs

When it comes to the governance of education systems, it is important to note first and foremost that all nine countries consider education policy as a strategic priority. In fact, at different points in time over the past eight years, almost all countries have undertaken reforms in this area aimed at innovating and modernizing education through strategic programs covering, on average, the subsequent five to six years.

In terms of education quality, the Programme for International Student Assessment (PISA) carried out by the Organisation for Economic Co-Operation and Development (OECD) contains useful insights into each country. Notably, while some countries have been making significant improvements since past assessments, others have only volunteered to be assessed for the first time in 2018, resulting in wide margins of improvement.[2]

Overall, there are two significant factors that characterize underperformance in school at the national level: the urban versus rural divide and the high-income vs. low-income divide. This pattern is common to many other policy areas, such as telecommunications, and is found more consistently in these nine countries than in the OECD average, although with particular nuances in each country. In addition, PISA assessments also provide good insights into the shortages in staff or school infrastructure, which often vary depending on the rural or urban setting of the school.

With regards to school governance, centralized information systems have been established in most countries in order to collect, manage and utilize education data more efficiently across the education system. These developments fall into a wider trend of digitalisation of public administrations and public services; they occurred at different points in time depending on the country, often related to the pace of digital transformation observable in the country, and thus presenting very heterogeneous outcomes.

Regarding the role of ICTs in schools' public administration, it is worth mentioning that the failure to digitalise information about school infrastructure, to display and storage of up-to-date demographic data, to collect education statistics at the national levels can hinder efficient decision making at both local and national government levels. In some cases, the failure in these areas can even limit the government's ability to effectively enumerating and gather relevant georeferenced data on the totality of schools and children enrolled within a given territory.

On the contrary, some best practices are also observable in education management. Some countries are currently implementing and operating Education Management and Information Systems (EMIS), which according to UNESCO are key to promoting "information within the Ministry of Education for policy planning, planning and implementation, decision making, monitoring and evaluation of the education

[2] https://www.oecd.org/pisa/ The PISA test which is carried out every three years has been shifted by 1 year due to the global pandemic. The next PISA tests are therefore planned for 2022 and 2025.

system."[3] As previously highlighted, developments in these fields are often dependent on the overall pace of digital transformation experienced within the country.

The presence or absence of digital innovation in the management of school systems is also directly related to the presence or absence of appropriate ICT infrastructure in schools. Table 6 below summarizes available data and number of computers per student (primary and secondary school) and percentage of PCs in schools connected to the Internet.

Table 6 - Computers in schools and connected computers

	Number of computers/student in schools	**% of PCs in schools connected to the Internet (min 2Mbps)**	***Source***	***Date***
Albania	0.15	66%	https://bit.ly/3ojMHdz	2015
Bosnia and Herzegovina	0.08	74%	http://measurebih.com/uimages/MEASURE-BiH20BEA20Follow-on20Assessment20Final.pdf	2018
Georgia	0.30	96%	https://bit.ly/3ojMHdz	2015
Moldova*	0.50	71%	https://bit.ly/3ojMHdz	2015
Montenegro	0.07	N/A	https://bit.ly/35h3SoN	2016
North Macedonia	0.63	N/A	https://bit.ly/3ngE02t	2018
Serbia	N/A	N/A	N/A	N/A
Turkey	0.16	89%	https://bit.ly/3ojMHdz	2015
Ukraine	0.06	N/A	http://ceur-ws.org/Vol-2105/10000302.pdf	2017
OECD average	0.77	96.4	https://bit.ly/3ojMHdz	2015

* An Order from the Ministry of Education, Culture and Research from 2019 established minimum standards for ICT equipment for each public school (https://mecc.gov.md/sites/default/files/standarde_dotarecabinetescolarefinalordin.pdf , p.30). However, no minimum requirement on Internet connection was established.

Although the data points come from different sources and correspond to the latest available from official

[3] Source: UNESCO (https://unesdoc.unesco.org/ark:/48223/pf0000220621)

international sources, the idea is to provide a sense of the existing gap with the OECD average. More accurate information at the country level would be strongly needed, but there is enough to highlight the remaining divide both in terms of the number of available devices per student and computers connected to the Internet.

Such an infrastructure gap inherently translates into a digital skill gap observable in these countries. [4] While it is not the intention of the paper to assess digital skills development in education systems, the relationship between digital infrastructure in schools and the digital skills development is self-evident. While it is appreciable that almost all countries within the scope of the study have to some degree incorporated digital skills development into official national curricula, the determinant limiting factor largely remains infrastructure. ICT laboratories and computers dedicated to education are, in fact, essential to implementing efficient programmes to develop digital skills that are nationwide and have the intended effect.

As ICT infrastructure is established as the main pillar not only for the efficient management of the education system but also and as an enabler for the introduction of digital skills development at the curricular level, taking into consideration the data from Table 6 above and combining it with data from UNESCO in Table 1, it is possible to estimate the number of PCs needed in schools to reach OECD average: more than 14 million devices, approximately, as shown in Table 7. While those in Table 7 are very rough and preliminary computations, they provide insight into the financial and logistical magnitude of the gap. Moreover, existing devices becoming obsolete with time is also a factor that must be taken into account and which raises the overall figure.

Table 7 - Estimated number of PCs needed to reach the OECD average

	Number of students in primary and secondary schools[i]	Est. number of PCs in schools[ii]	Est. number of PCs needed in schools to reach OECD average
Albania	428,375	64,011	265,837
Bosnia and Herzegovina	422,645	33,347	292,089
Georgia	584,947	172,745	277,664

[4] ITU Digital Skills Assessment for Europe (forthcoming).

Moldova	415,489	209,006	110,920
Montenegro	101,995	6,936	71,600
North Macedonia	304,224	191,661	42,591
Serbia	824,883	N/A	N/A
Turkey	16,258,037	2,653,590	9,865,098
Ukraine	4,528,083	283,005	3,203,618
Total	**23,868,678**	**3,614,302**	**14,129,420**

i Source: UNESCO (http://uis.unesco.org/en/)

ii Source: UNESCO and data from Table 6

The crux of the paper lies in the discussion about how investment in ICT infrastructure development in schools can be fostered to ensure that schools are equipped with the infrastructure necessary to operate efficiently and be empowered to implement digital skill development through the provision of digital public goods, in line with the country's education policy and programme.

The main assumption is that additional ICT infrastructure in schools, mainly through devices and appropriate and reliable Internet connectivity, would provide impulse for policymakers to strengthen school curricula and thoroughly implement digital skills development programmes in order to meet the demands of the labour market and train a skilled workforce in a wider perspective of digital transformation at the country level. As a potential outcome, such a multi-strategic approach can catalyse the much-needed conditions toward the digitalisation of education management as well as policy planning and assessment, thus spurring a virtuous circle that is able to sustainably propel digital development and enrich the education sector at the national level.

2.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

Some countries have recently established minimum requirements for equipment in public schools that include the distribution of PCs and the allocation of public budget to the provision of minimum equipment. This represents a fraction of the funding needed to achieve levels of computers per student similar to those in the OECD.

In addition to the problem of equipment, connectivity is also a great challenge from both a financial and, more importantly, technical and logistical perspective, with schools often located in remote geographic areas where adequate provision of service is not available or even commercially viable by operators.

Ministries of Education and Research, which oversee resources and define procurement policies for the education systems, often sacrifice ICT equipment investment in favour of other fundamental school infrastructure such as A, B, C, and D. On the other hand, ministries in charge of the ICT development portfolio tend to prioritise the financing of ICT infrastructure with the ultimate goal of reaching all households and covering the largest possible share of the population with the highest quality of services. Only recently have these policies started to include requirements for public services, on both sides of procurement and connectivity, to align public administrations with the digital transformation process at the country level. However, schools have often been neglected, especially in rural and remote areas, thus increasing the risk of schools being excluded by both government programmes in the quest for better ICT infrastructure.

However, even though projects and specific budget allocations are hard to be found, international financial mechanisms for broader broadband infrastructure investment are present. For example, in the context of the Western Balkans, the Western Balkans Investment Framework is a good mechanism whereby the European Investment Bank, the European Bank for Reconstruction and Development and the World Bank contribute financially and by providing project assistance and implementation to the countries. Over the past years, however, Ministries in charge of the education portfolio as well as other relevant Ministries that oversee the digitalization of other public services, have failed to capture these opportunities.

The international development community has identified this gap and started seeking to remedy it, with the ITU and UNICEF at the forefront of the field after launching the Giga project in 2019. While strongly related to Giga, this paper is not intended to enter the details of the project, but rather seeks to provide a grassroots picture of the situation in selected countries of Europe region, eventually providing the basis for intervention of the project in the future. Moreover, it must be noted that these more specific initiatives focusing on meaningfully connecting schools and communities are supported at the highest level of the UN system, thanks to the UN Secretary General's Roadmap for Digital Cooperation[5] launched in 2018,

[5] https://www.un.org/en/content/digital-cooperation-roadmap/

whose goal lies in bridging the digital divide and leveraging the potential of ICTs to achieve the Sustainable Development Goals.

Amid the global impulse on digital divide issues, which has education as one of its pillars, all countries have come to recognize the importance of ICT infrastructure in schools, not only to put public institutions on the path towards digital transformation, but also to lay the groundwork for the successful implementation of digital skills programmes that would equip students with the knowledge necessary to succeed in their lives, as outlined in the previous section.

In this context, international organisations and international financial institutions have been active in closing the gap by providing technical assistance or funding for projects. Increasingly, these have focused more generally on fostering household connectivity or the procurement of devices and connectivity contracts in public administration institutions rather than school connectivity in particular. Nevertheless, the essential core of these initiatives have demonstrated the positive impact of raising the overall importance of ICTs and connectivity on the nationwide level toward the achievement of the SDGs.

2.4 National responses to COVID-19 and pedagogic initiatives for distance education

In March 2020, all nine countries in scope of this study faced school shutdowns due COVID-19 outbreak impacting 23 million primary and secondary school students and at least an equal number of households, with parents also switching to remote working when possible.

What first seemed a temporary closure, translated into longer periods up to even more than two months, and often resulted in the academic year ending remotely. All nine countries in scope of this study responded swiftly to this status of emergency, of which education was only one component, but the responses emerged were various as each situation was country-specific with technical, political, societal and organizational variables determining the outcomes. For all children, however, transferring education from the classroom to the household was only possible through the use of ICTs.

The most widespread solution implemented across countries was using television broadcasting to transmit lessons and other educational material. This fix allowed for the broadest reach, no matter geographic location, digital skills possessed or technological capability for Internet access, resulting in high engagement rates.

The second most common solution implemented has been the creation or strengthening of national online distance learning platforms, often in partnership with local players or international organizations, to deliver digital content through the Internet. The rates of participation in these platforms vary

substantially depending on the countries with constraints arising from the lack of access to connectivity, lack of appropriate devices, and overall limited financial resources necessary to ensure children's online engagement.

A rarer solution, which substantially relied on ICTs, was the organisation of online classes replicating the physical classroom in the virtual environment. While this way was qualitatively superior to the previous two solutions mentioned, it was also logistically more difficult to organize it supposes and requires that all children of a certain class have access to connectivity through an appropriate device, and for an almost unlimited time during the day. According to a recent joint UNICEF - ITU publication,[6] the portion of students having Internet access at home in East Europe and Central Asia stands at 59%, with rural areas averaging 45% against 65% for urban areas, and the figure for low-income households being as low as 40% versus high-income households at 89%[7]. While not a direct measure of the status in each of the nine countries in scope of this paper, these figures provide a better sense of the existing connectivity gaps exacerbated by the global pandemic.

Throughout the countries, another major effort has been that of coordinating at the level of the education system and with teachers who have been the final implementers and coordinators of their classes' distance learning activities during lockdowns. This has also been a substantial challenge requiring rapid elaboration of guidelines from the competent Ministries as well as swift training of teachers to ensure a coordinated rollout. Despite the efforts, a reduced quality of learning impacted all students, to a greater or lesser degree depending on the solutions implemented and their efficacy. Moreover, most countries have reported a portion of students who were unable to access education content and benefit of continuity of education, mainly due to economic and other reasons. While the private sector and NGOs often chipped in to fill the gap, there is a looming risk of increasing school dropout rates, a highly negative possibility considering the substantial reforms implemented over the past 20 years to improve that figure.

As the COVID-19 pandemic ameliorated, some countries re-opened schools, often establishing hybrid solutions or organising classes in turns to bring education services towards a new normal. As the objective of most governments remains to bring students back to the classrooms, it is important to re-focus on

[6] UNICEF, ITU, "How many children and young people: have internet access at home?" (2020) (https://www.itu.int/en/ITU-D/Statistics/Documents/publications/UNICEF/How-many-children-and-young-people-have-internet-access-at-home-2020_v2final.pdf)

[7] "Low income" is identified as the lower quintile of the distribution whereas "High income" is identified as the highest quintile.

school connectivity as an enabling factor for education. Making connectivity available in schools and increasing its uptake not only would ensure a smarter administration of the education system or strengthen the presence of digital in school curricula, but would importantly ensure that hybrid solutions can be sustained in times of crisis or as an integral part to the educational experience of children for a more meaningful participation in an increasingly connected society.

3. Country Profiles

3.1 REPUBLIC OF ALBANIA

3.1.1 Overview of the education system and status of broadband

Education in Albania is considered a public good and service. Over the past decades, the country has passed significant reforms toward the decentralization of school governance. These changes brought about a competency-based curriculum across the country's public education system, contributing to significant improvement in key education indicators.[1] In combination with other socio-economic reforms, the mobilization of financial resources by the Albanian government has improved instruction quality, textbooks, school buildings and infrastructure throughout the country.[2] Moreover, starting from 2003, regional education directorates and education offices emerged under the auspices of the Ministry of Education, Sports, and Youth to support the implementation of national education policies in schools. In terms of organization, the Albanian pre-tertiary education system includes pre-school education, basic education (comprising primary and lower secondary education) and upper secondary education (often referred to in Albania as simply "secondary education".[3] Compulsory education lasts nine years, from age 6 to 16.[4]

There are about 3,818 schools in both urban and rural areas in Albania, including kindergarten, basic and lower secondary, upper secondary, vocational schools and institutions providing special needs education.[5] From pre-primary to upper-secondary education, these schools enrol nearly 520,759 students in the country.[6] United Nations Children's Fund (UNICEF) data show that the literacy rate for the 15-24 years age group in Albania corresponded to 99.3%, while the completion rate of upper secondary education for youth of school age is 77.9%.[7] Albania's Institute of Statistics reported that in 2019 about 34,982 students graduated from basic education.[8] In 2019, UNICEF reported that there were about 3,359 children and 5,304 adolescents out of school in Albania.[9]

With regards to broadband development, ITU data indicates that 69.6% of individuals in Albania used the Internet in 2019.[10] The number of fixed-broadband subscriptions per 100 inhabitants was 15.1 in 2019.[11]

Between 2013 and 2020, fixed-broadband penetration for both population and family has increased more than twofold, growing by 10%-15% annually, although it remains well below both the EU average and the penetration levels of neighbouring countries.[12] Despite the significant increase, ITU data show that the proportion of households with Internet access at home was 32.9%.[13] In 2018, the number of active mobile-cellular subscriptions per 100 inhabitants was 91.3.[14] Moreover, the number of active mobile-broadband subscriptions per 100 inhabitants was 62.1 in the same year.[15] In total, 63% of Albanians use mobile broadband.

According to the Digital Agenda for 2015-2020, the physical extent of Albania's fibre-optic infrastructure reached 5,000km in 2015, and the network has been growing ever since.[16] Broadband is currently supplied through various fixed and mobile technologies including DSL, FTTH/FTTB, FTTx in combination with NGA. Most DSL lines are combined with fibre-optic and copper networks (FTTN /FTTB). Broadband is also supplied via coax cable (HFC) and electricity lines (BPL). Increased investments in fibre optics (FTTH and FTTB) are ongoing by fixed-network operators. Yet, broadband speeds, according to reports and Feasibility Study's results from The Electronic and Postal Communications Authority (AKEP) of Albania, are low: the existing bandwidth in fixed and mobile networks is less than 30 Mbps.[17]

In terms of mobile technologies, broadband is supplied via 3G/HSPA/HSPA+ and 4G/LTE networks, as well as satellite technologies. In 2019, 99.2% of the population had 3G network coverage, while 4G covers about 95% of the population in Albania.[18] During the same year, mobile-broadband Internet traffic within the country corresponded to 0.069 exabytes.[19]

AKEP benefits from a broadband infrastructure mapping system, the ATLAS mapping system,[20] established in 2012. The system includes a registry of all fixed and mobile telecommunication infrastructure in GIS format, providing transparent information on the availability of broadband to the market and consumers. The system, which comprises 220 infrastructure and three mobile operators, also supports infrastructure sharing and the efficient allocation of public funding.[21]

3.1.2 Government strategies, status of the education quality, and the role of ICTs

In January 2016, Albania adopted the Pre-University Education Development Strategy 2014-2020, delineating a vision for the future and an implementation plan complete with specific activities, responsibilities and deadlines.[22] The four priorities for education include: I) Improving the governance, leadership and management capacities of pre-university education system resources; II) Quality and

inclusive learning; III) Quality assurance based on comparable standards with EU countries; and IV) Modern teacher training and development.[23]

The seven principles for reform that guided the drafting of the strategy include:[24]

- Qualitative and Inclusive Education: Provide students with the right to quality education, equal opportunities to be educated and the right to be different;
- Uniform Education System: Ensure, as much as possible, that learning conditions in educational institutions are comparable to the regional and European educational systems;
- Education for Life: Create the conditions for students to build new knowledge and competences that enable them to respond to the country's development and changes in the labour market;
- Quality Assurance of Standards Achievement: Provide pre-university education on the basis of educational standards and both internal and external evaluations;
- Decentralisation: Create conditions for centralised management of a decentralised education system by fostering the autonomy of educational institutions;
- Accountability and Transparency: Increase the legal framework, mechanisms and procedures needed for accountability and transparency;
- Community Support: Provide financial support from all possible sources of society to both public and private pre-university education institutions.

OECD 'Programme for International Student Assessment' [25] (PISA) results indicate that, between 2015 and 2018, Albania experienced improvements, on average, in the reading, mathematics and science performance of their students throughout their participation in PISA.[26]

In terms of school governance, Albania has started to establish some of the components integral to system evaluation. The Educational Services Centre (ESC) in the country is developing a modern Education Management Information System (EMIS) called Socrates which, by the end of 2020, is set to store information related to students, teachers, curricula and schools in pre-tertiary education. As a data tool, Socrates emerges as an excellent opportunity for Albania to modernise the collection, management and use of education data across its education system. In the face of the ongoing challenges regarding the system and within the framework for data collection, the OECD and UNICEF recommend that the Albanian government should: I) Address gaps in the development of Socrates and establish it as the central source

of education data; II) Develop Socrates into a functional tool to inform decision-making; and III) Establish the national indicator framework to guide the development of Socrates.[27]

To further decentralize core functions and improve service delivery, Albania has recently restructured key agencies responsible for school support.[28] As a result of the reform and other ongoing government initiatives, Albania maintains high access to primary and basic education with a Net Enrolment Rate of 96 percent. However, disparities in opportunity and outcomes persist across population groups in the country, as there is still a significant number of children from Roma ethnicity or children with disabilities who do not enjoy the same right to education. Albania also has one of the highest rates of dropout in the Western Balkans, and many graduates leave school without mastering basic educational competencies.[29]

In rural areas, there are about 17 students per class in public basic education, as compared to about 21 students per class on average across all Albanian basic education public schools.[30] Similar to other countries in the region, educational outcomes in Albania tend to be lower in rural areas. Studies have shown that the average educational attainment in rural regions is about two years of schooling lower than in urban regions.[31]

Additionally, data from PISA indicate that a significantly greater number of extracurricular activities are offered in urban schools than in rural schools, thus contributing to disparate educational outcomes. Furthermore, data indicate that only half of the computers are connected to the Internet . Other challenges that remain barriers to an equitable educational system include poor infrastructure around schools (e.g., road, transport system, heating system, etc.)[32] and the difficulty of recruiting quality teachers to rural areas, which largely contributed to the regional differences in student access to education and job opportunities, as well as the overall learning experiences among students.[33]

According to a 2018 UNESCO report on “Situation analysis of Education in Albania: toward SDG4 Education 2030”, about 1,800 schools in Albania benefited from Internet service in 2013 with an average speed between 2 Mbps, though only 714 of schools, or less than 50%, had ICT laboratories.[34] In 2016, the country expenditure per student in the secondary level of education corresponded to 9.82% of Albania’s GDP per capita, while the European Union countries’ average for the same period was 23.02%.[35] According to the Organisation for Economic Co-operation and Development (OECD), there were about 0.15 computers per student in Albania in 2015, with about 65.7% being connected to the Internet .[36]

3.1.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

In 2009, UNDP provided financial support to the "e-school programme" in Albania, which provided the country's primary and secondary schools with modern computer labs, high-speed, reliable Internet access and training in information technology skills. Hundreds of schools were equipped, and thousands of teachers equipped with ICT training.[37]

In 2012, the Albanian government selected Eutelsat Communications as the satellite provider for the "Digital Age of Communications Agenda," which was initiated to increase free public Internet access for Albanian citizens. In partnership with Albania-based Tring Communication, the project's goal was to connect 850 post offices, schools and local government offices in rural areas to the Internet using the KA-SAT satellite.[38] In the context of the One-Laptop Per Child initiative in Albania, a previous government-led project focused on satellite-enabled Internet facilitated a partnership between Albtelecom and StarSat to deliver broadband via ASTRA2Connect.[39]

By 2014, the Albania Education Excellence and Equity Project (EEEP)[40]—a 75-million-dollar partnership between Albania's government, the International Development Association (IDA), the World Bank, and the European Investment Bank (EIB)—supported the construction or rehabilitation of 607 classrooms and laboratories and the provision of over 24,000 computers and Internet connectivity to schools. According to official data, the student-computer ratio fell from 46 to 14 (urban) and 133 to 13 (rural).[41]

In the 2012 Broadband Strategy for Albania, the government had already signalled its goal to provide high and secure Internet access at schools with the goal to have at least one broadband connection in every classroom and cover 100% schools in the country.[42] Further government-led projects related to connectivity in schools have been in discussions ever since.

In June 2020, the Albanian government approved and adopted the National Plan for Sustainable Development of Digital Infrastructure, Broadband 2020-2026. The new National Broadband Targets ("NBTs") stated that of the government's goal is to have 100% of schools connected with high-speed broadband connectivity of 1 Gbps and access in every classroom by the end of 2025.

3.1.4 National responses to COVID-19 and pedagogic initiatives for distance education

In March 2020, the Albanian Council of Ministers mandated the closure of schools as part of the country's measures to slow the spread of COVID-19.[43] Since then, the COVID-19 emergency became one of the main priorities of Albania's Ministry of Education, Sport and Youth, which developed a Task Force to address

challenges related to distance education and implement novel pedagogic strategies to ensure students' learning continuity and success.

With the school closures directly affecting more than half a million learners, the Ministry of Education, Sport and Youth published the guidelines for learning in a home setting due to COVID-19 on the 30th of March.[44] Furthermore, the Independent Trade Union of Education (SPASH-ITUEA) urged the Ministry of Education to make lessons for all classes available daily on all national TV channels.[45] This would allow for a broader reach and would help ensure that every child, no matter his or her geographic location or technological capability for Internet access, would be able to access educational resources.

Despite these initial efforts, the closure directly impacted the quality of learning, especially on most of the vulnerable groups who lack connectivity, necessary equipment for online options, and a suitable household environment—frequently placing an extra burden on women. Recent data suggest that at least 11,000 students have been identified as not having access to online learning, many of them living in remote and rural areas with no Internet or devices at home, especially Roma children and children with learning difficulties and disabilities.[46] UNICEF estimates that the percentage of "low performers" is likely to increase by about 8% due to school closures from mid-March to June.[47]

In April 2020, the Vodafone Albania Foundation launched the #RedForKids initiative. Partnering with the Albanian Ministry of Education, Vodafone Albania donated 5,000 smart devices and SIM cards with unlimited online learning data access to those children most in need.[48]

In May 2020, the Ministry of Health and Social Protection announced that the second phase of reopening would begin with the opening of preschools on the 1st of June.[49] In September 2020, primary and secondary schools returned to in-class instruction and were required to follow strict hygienic and sanitary protocols[50] by the Ministry of Health and Social Protection in order to prevent the spread of COVID-19. Schools with over 1,000 students shall alternate classes in two, three or four shifts, and each class shall have no more than 20 students.[51]

In July 2020, UNESCO established with Albania's Ministry of Education to pilot a program on Media and Information Literacy (MIL) in formal education, organized in the framework of the EU-funded project "Building Trust in Media in South-East Europe and Turkey – Phase 2."[52] As a response to the growing concerns of misinformation and disinformation concerning the COVID-19 pandemic, the project's main goal is to enhance youth MIL skills through the introduction of MIL in the formal educational system in the region. It is being developed in cooperation with Bosnia and Herzegovina. UNESCO announced that the partnership will allow the stakeholders to map and engage with all relevant MIL

resources and key actors in the field of education. Moreover, UNESCO also announced that the drafting of the pilot MIL curricula for primary and secondary schools in Albania is well underway.[53]

As a response to the pandemic, the Albanian Ministry of Education, Sport and Youth launched "Akademi.al,"[54] a free online platform available to support student learning across different levels. The platform hosts an estimated number of 5000 video-explanations by selected teachers from all over the country covering a wide variety of school subjects.[55] All video lessons are in the Albanian language and students aged 3-18 from across Albania can also watch on national television.[56] In terms of staff training for more effective distance teaching, other initiatives have been developed to help teachers prepare their lessons and make them as accessible as possible for students.[57]

Moreover, the interactive platform allows students and parents to collaborate in real-time, and track educational outcomes through grades, the status of tasks/homework, attendance, etc. More than 250,000 students and 20,000 teachers have benefited from online learning to date, and it is expected that the number will grow through the platform by 2021 through more personalized end-to-end learning experiences. UNICEF has contributed to the project and recently uploaded 1,100 new video lessons to support students with their national university entrance exams. Although the platform already complies with accessibility digital standards, the development of a mobile application is part of Akademi.al and UNICEF near future objectives.[58] UNICEF is also engaging with the Ministry of Education in dialogue to ensure that the most vulnerable children also have access to digital learning through the provision of tablets.[59]

A recent assessment on the impact of COVID-19 on the well-being of children from World Vision in Albania has found that 1 in 10 children cannot access education activities online. The figure is even more stark for children with disabilities, half of whom do not have access.[60] Furthermore, the national study on children's experience online carried out by UNICEF Albania during 2018-2019 "One Click Away" has found that parents' digital skills are much lower than those of children's, with parents from low socio-economic groups being most affected.[61]

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3.2 BOSNIA AND HERZEGOVINA

3.2.1 Overview of the education system and status of broadband

The right to primary education is enshrined in the Constitution and legislation of Bosnia and Herzegovina. Primary education is free for all children in the country. As for compulsory education, the primary level lasts nine years from age 6 to age 14.[1] It is most commonly implemented under the social status criterion to ensure full and equal access to the regular education system. Secondary education, however, is not compulsory.[2] While reforms to the education system are still in progress, the education system remains highly decentralised, which tends to perpetuate inefficiencies and inequities across levels of education and results in an inefficient allocation of school resources.

The country has one of the lowest levels of access to primary education, and overall learning outcomes are below the EU average—challenging for the planning and execution of policy frameworks. At present, the Ministry of Civic Affairs, the United Nations Educational, Scientific and Cultural Organization (UNESCO), and Bosnia and Herzegovina's Agency for Statistics are working on the development of indicators for reporting on Sustainable Development Goal (SDG) 4 and the Incheon Declaration on Education 2030.

In terms of organization, the education system in Bosnia and Herzegovina is highly fragmented, with as many as fourteen government bodies responsible for the education of about 422,645 students enrolled from the pre-primary to upper-secondary education level.[3] Consequently, the staffing costs for teachers, school staff and relevant others account for over 90% of education spending, compared to an EU average of 77%.[4] This leaves very little room to buy learning materials and equipment, provide training for teachers, or upgrade school learning environments. Moreover, the education system continues to lack common standards for the different levels of education, as well as for teacher training and performance evaluation.[5]

A 2019 World Bank assessment shows that the country's expenditure on education is about 4.6 per cent of GDP,[6] while the European Union countries' average was 4.7% in 2017.[7] This means that Bosnia and Herzegovina spend more than some peers in the region, but less than the EU and OECD averages. Despite that, the distribution of education spending is inefficient and inequitable as it is disproportionately skewed towards personnel, which leaves little room for needed investments to improve the quality of service delivery.[8]

The United Nations Children's Fund (UNICEF) data show that the literacy rate for the 15-24 years age group in Bosnia and Herzegovina corresponded to 99.7%, while the completion rate for children of primary school age is 99.6%.[9] Moreover, the adjusted net attendance rate for youth of upper secondary school age is 91.8%.[10] Furthermore, as reported by the European Commission, early childhood education and care enrolment remains very low, but the trend is positive, and the figure now stands around 12%. As for 3-6-year-old preschool enrolment, Bosnia and Herzegovina has the lowest enrolment figure in Europe with 25%, which includes only 3% for Roma children. Access to primary and secondary education in the country is satisfactory, with 97.6% of children attending primary and 84.6% attending secondary education. Among Roma children, 69% attend primary education, while that figure drops to 23% for those attending secondary education.[11]

Regarding broadband development in the country, Bosnia and Herzegovina's Agency for Statistics shows that in 2018 alone, 70.1% of individuals in the country used the Internet .[12] Despite existing ICT divides, data estimates show a significant increase in terms of Internet penetration over the years, particularly from 2013 onwards. In 2019, the number of fixed-broadband subscriptions per 100 inhabitants was 22.6.[13] According to the Communication Regulatory Agency (RAK), Bosnia and Herzegovina currently has 67 Internet service providers.[14] In 2019, ITU data show that the proportion of households with Internet access at home was 72%,[15] which is similar to what is found in other countries in the Western Balkan region. RAK data also show that the dominant type of Internet access remains xDSL, which accounted for 56.8% of total broadband subscriptions, followed by cable access with 33.4%.[16] The regulator also stated that further liberalization of the telecommunications market and the introduction of new technologies are expected in the upcoming years.

Concerning the mobile sector, Bosnia and Herzegovina had a penetration of 59.1 mobile-broadband subscriptions per 100 inhabitants in 2019.[17] In terms of coverage, 3G covered 96% of the population in 2019, while 4G/LTE covered 82% of Bosnia and Herzegovina's population.[18] In the context of schools, a 2020 study by UNICEF and RAK surveying habits and parent's attitudes on media usage reveals that 93% of children in the country have access to a smartphone, with about 90% of these of children aged 7-18 using mobile phones/smartphones daily and use increasing with age.[19]

With the recent advances on pieces of legislation, Bosnia and Herzegovina has attempted to mirror the EU regulatory framework in terms of broadband mapping in the country, thus establishing two main geo-portals[20] that provide a good basis for use and integration of spatial data.[21] However, Bosnia and Herzegovina is not endowed with a nation-wide broadband mapping system for telecommunication

infrastructure or services.[22] The country's Communications Regulatory Authority (RAK) is currently undertaking substantial work on service mapping at the level of statistical gatherings, though not yet in a geo-referenced manner, as it is foreseen for service mapping. Additionally, a fragmented jurisdictional system that prevents collaboration and the lack of regulations setting the obligation for operators to provide the agency with data on infrastructure and services remain two of the main barriers to progress in the field. It is important to note that RAK is currently taking steps, together with the Ministry of Communications and Transport, to adopt a broadband strategy and create an enabling environment to both coordinate the development of broadband infrastructure and service mapping and to introduce investment and demand mapping layers by relying on existing geoportal databases, in line with the EU regulatory framework.[23]

3.2.2 Government strategies, status of the education quality, and the role of ICTs

In 2003, the Parliamentary Assembly of Bosnia and Herzegovina adopted the "Framework Law on Primary and Secondary Education," which covered aspects related to the levels of education, common curricula, standards in education, the right and obligations of parents, the role and responsibilities of schools, and other details pertinent to school management. Accordingly, the framework also established the general goals of education in the country in creating a value system for the national, historical, and cultural, and religious traditions of the country. According to the documents, the general goals of education are:[24]

- Providing access to knowledge as a basis for understanding oneself, others and the world in which one lives;
- Ensuring optimal development for each person, including those with special needs, in accordance with their age, abilities and mental and physical abilities;
- The promotion of respect for human rights and fundamental freedoms, and the preparation of every person for life in a society that respects the principles of democracy and the rule of law;
- Developing awareness of belonging to the state of Bosnia and Herzegovina, its own cultural identity, language and tradition, in a way appropriate to the achievements of civilization, getting to know and respecting different people, respecting differences and fostering mutual understanding, tolerance and solidarity among all peoples, nations and communities in Bosnia and Herzegovina and the world;

- Ensuring equal opportunities for education and choice at all levels of education, regardless of gender, race, nationality, social and cultural origin and status, family status, religion, psychophysical and other personal characteristics;
- Achieving quality education for citizens;
- Achieving standards of knowledge that can be compared at the international or European level, which ensure the inclusion and continuation of education in the European education system;
- Encouraging lifelong learning;
- Promotion of economic development;
- Involvement in the process of European integration.

According to the 2018 OECD's 'Programme for International Student Assessment' [25] (PISA) results, Bosnia and Herzegovina showed low levels in reading, mathematics and science literacy.[26] The results also indicated that minimum level of achievement is not reached by 58% students in mathematics, 54% in reading and 57% in science, and, at the same time, less than 1% of examinees achieved maximum results.[27] Following the same trend found in other Western Balkan countries, economically advantaged students outperformed disadvantaged students in reading.

Regardless, about 13% of disadvantaged students in Bosnia and Herzegovina were able to score in the top quarter of reading performance, indicating that economic disadvantage does not always determine performance. The PISA results also showed that school principals in Bosnia and Herzegovina reported less staff shortages and more material shortages than the OECD average, but there was no significant difference in staff shortages between advantaged and disadvantaged schools.[28] Moreover, a 2020 assessment report by the European Commission shows that access to early childhood education and care is still low, while school enrolment rates have dropped in most sections of the education system, partly a result of demographic dynamics, such as declining birth rates and the emigration of young families.[29]

As shown by a series of UNESCO reports, the provision of basic rights to education is often jeopardized by a few challenges, which are primarily manifested due to the lack of sufficient financial resources. According to the Ministry of Civil Affairs of Bosnia and Herzegovina, some of the core reasons why some children leave education or remain excluded from education are systematically embedded in the country's difficult social and economic situation, including the unemployment and education structure of parents, the network of primary schools, difficulties related to the registration of children (especially when it comes to Roma children—about 58,000 in the country[30]—and children from socially marginalized families), traffic-separated areas, poor infrastructure and lack of support for children with disabilities.[31]

Moreover, schools located in remote areas still lack infrastructure and preschool programs, which disproportionately affect marginalized communities. For instance, a World Bank study on Bosnia and Herzegovina has shown that children from poor and rural backgrounds are also less likely to attend secondary school and more likely to drop out of school.[32] This is particularly relevant for the Roma community, which is recognized as the largest, most neglected and most vulnerable minority in Bosnia and Herzegovina.[33] Despite recent improvements, Roma enrolment in education is significantly lower than non-Roma students, especially in primary and secondary education. In terms of school infrastructure, there are strong indications demonstrating that learning outcomes are highly correlated with students' aspirations, socioeconomic status, and other school characteristics. Moreover, rural girls in Bosnia and Herzegovina tend to get less education than boys,[34] and, despite the geographic challenges, rural children overall average as many, or more years of education as those in urban areas.[35]

Mapping the location of schools has also long been a challenge of Bosnia and Herzegovina. As the country underwent urbanization and developed more economic structures throughout its territory, communities moved to different geographic regions, which presents a challenge to understanding how to best locate schools in relation to the populations served.[36] Correspondingly, the scattered availability of statistics and a lack of up-to-date, comprehensive, country-wide surveys and data collection systems in several sectors remain one of the core challenges for effective evidence-based decision-making at the school level.[37] While there is a legal framework regulating the collection and systematization of data for the country at state as well as canton levels, education and school statistics and data are scattered.[38]

In terms of the digitalisation of the school system, there is no unique or harmonized data system collecting data on education. Furthermore, ICT infrastructure differs from school to school, between and within cantons, despite the recent reforms attempting to tackle this issue. In terms of computer and Internet access at schools across Bosnia and Herzegovina, secondary schools are better equipped with computers compared to primary schools.[39] According to combined data from the World Bank and the Agency for Statistics of Bosnia and Herzegovina, there are about 33,358 computers in schools in Bosnia and Herzegovina, or one every 12.7 students, 73.6% of which have Internet connection available. Nevertheless, when taking into account the number of teachers and students, both primary and secondary schools are poorly equipped. The report shows that there is one computer per four teachers on average in primary schools, while there is one per three teachers in secondary schools. For students, there is one computer per 14 students in primary schools, and one per 12 students in secondary schools.[40]

When it comes to the digitalisation of curricula, a low level of digital skills competencies among teachers and other school staff hinder progress. The country's Common Core curriculum provides a comprehensive approach to integrating digital skills and competencies. In particular, the document "Priorities in integrating entrepreneurial and digital competence into education systems in Bosnia and Herzegovina 2019–2030" aims to bring digital skills competencies in line with the European Digital Competence Framework (DigComp). However, while employment in the ICT sector is increasing by approximately 15% annually, ICT and digital skills training programs are still in the development phase. Distance learning in the country is in its infancy stage, and despite the recent development in e-learning tools, teachers still struggle to adapt to new pedagogic techniques.[41]

3.2.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

The Policy of Electronic Communications Sector of Bosnia and Herzegovina (2017-2021),[3] which is aligned with the Digital Agenda of Europe,[42] elaborates on the expansion of broadband infrastructure in less developed and populated areas. In the context of Internet connectivity in schools across the country, the policy's action plan explicitly focuses on technical preconditions for the implementation of broadband Internet access to all users, especially schools and educational institutions.[43] However, no additional detail or specific programme for the delivery of school connectivity is identifiable in the country.

3.2.4 National responses to COVID-19 and pedagogic initiatives for distance education

In mid-March 2020, in-class instruction across Bosnia and Herzegovina ceased as schools closed due to COVID-19. As a result, many teachers had to relocate their activities to digital platforms and nearly half a million students had to adapt to new ways of learning and keeping abreast with the Common Core programme. This has exacerbated already-existing discrepancies among certain groups, especially those part of minority communities and/or those from rural areas. From innovations such as app developments to web portals for learning, many students, teachers and families encountered ways to circumvent the challenges imposed by the closure of schools.[44] Additionally, separate online platforms for the Bosnian and Croat language curricula are used in the Herzegovina-Neretva and Central Bosnia cantons.[45]

Despite the initial challenges, the continuation of education was ensured primarily through *ad hoc* solutions for distance learning as well as the delivery of learning content through TV. As for enrolment in early childhood education and care as well as in first grade, the majority of institutions have issued

instructions for online applications. Enrolment to secondary schools and universities will be conducted online by a limited number of institutions.[46]

As the pandemic evolved in Bosnia and Herzegovina, education authorities attempted to quickly establish different mechanisms for distance learning and also partnered with relevant international organizations. To help safeguard effective and continuous learning in the face of the challenges presented by the COVID-19 pandemic, UNICEF put forth an initiative in May 2020 in collaboration with the education authorities in Sarajevo and Canon, connecting teachers to experts in the area of pedagogy, EdTech, government administration and quality of online education.[47] UNICEF also provided Internet access to 1,968 children in Republika Srpska to ensure their learning continuity. Additionally, UNICEF delivered learning materials (ECD kits, school-in-a-box, televisions/receivers for distance learning, tablets) to government counterparts (MoE), children—including those in the most disadvantaged families and in boarding schools for children in contact with the law—and at refugee reception centres.[48]

In September 2020, elementary school students up to the fourth grade returned to classrooms in the Republika Srpska entity in the Sarajevo and Gorazde cantons in the country (with shorter teaching periods and classes with a maximum of 15 students), following strict hygiene measures such as obligatory mask-wearing.[49] On 25 October, the Republika Srpska provisionally suspended teaching in primary and secondary schools, bringing all classes online.[50]

In terms of emergency policy interventions, UNICEF brought together international organizations working in education to Bosnia and Herzegovina to harmonize approaches and interventions. UNICEF presented the findings from a rapid need assessment on children's learning, and the report has been shared with stakeholders and donors.[51] UNICEF also compiled a document entitled "Open Digital Educational Tools for Interactive Communication," containing a list of tools for educators to use in their pedagogic practices.[52]

Aside from the computer-based forms of learning, the government of Bosnia and Herzegovina has also organized an educational program on the public broadcast of Bosnia and Herzegovina radio-television for its elementary students. Although the learning platforms are free of charge, the starting approaches have differed significantly in the initial weeks from canton to canton, depending on access to the technical resources, digital competences of the educational workers and local politicians' capacities to respond to the extraordinary situation.[53] However, there are discrepancies in the scope and quality of these services of education broadcasting within the country, mainly because of a lack of both necessary equipment and an overall strategy for teachers and students to ensure quality in distance learning, including the assessment of students' progress.[54]

Endnotes

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5 See: https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/bosnia_and_herzegovina_report_2020.pdf

6 See: http://documents1.worldbank.org/curated/en/719981571233699712/pdf/Bosnia-and-Herzegovina-Review-of-Efficiency-of-Services-in-Pre-University-Education-Phase-I-Stocktaking.pdf

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15 See: https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2019/CoreHouseholdIndicators.xlsx

16 See: https://www.sarajevotimes.com/bh-communications-regulatory-agency-issues-report-on-number-of-Internet -users/

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18 See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicator “i271G and i271GA”)

19 See: https://www.unicef.org/bih/en/press-releases/93-children-bosnia-and-herzegovina-have-access-smartphones

20 See: http://www.fgu.com.ba/en/572.html & http://www.geoportal.rgurs.org/geoportal/

21 See: https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Events/2019/Mapping%20Warsaw/KOVACEVIC%20-%20BB%20Mapping_%20B%26H_%20July%202019.pdf

22 See: https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Events/2020/RRF/20-11-26%20Background%20Paper_Broadband%20Mapping%20Systems%20in%20Europe%20and%20Regional%20Harmonization%20Initiatives_final.pdf

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25 See: The OECD ‘Programme for International Student Assessment’ (PISA) tests reading, mathematics and science performance of 15-year-old pupils across the world every three years. In the context of the European Union, PISA results are particularly important because they feed into the strategic cooperation framework ‘Education and Training 2020’ (ET2020). Correspond, they are the basis for one of the ET 2020 benchmarks: the rate of underachievers in reading, mathematics or science among 15-year-olds in the EU should be less than 15% by 2020. Underachievers in PISA are those pupils who fail to reach the minimum proficiency level necessary to participate successfully in society. More info on the PISA indicators for the EU indicators: https://ec.europa.eu/education/sites/education/files/document-library-docs/pisa-2018-eu_1.pdf

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28 See: https://www.oecd.org/pisa/publications/PISA2018_CN_BIH.pdf

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31 See: https://unesdoc.unesco.org/ark:/48223/pf0000229929

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33 See: According to the latest BiH population census (2013), 12,479 people in BiH self-identified as Roma, which corresponded to approximately 4 per cent of the total population. Nevertheless, as shown by the World Bank, the number may be underestimated due to social stigma.

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37 See: https://www.unicef.org/about/annualreport/files/Bosnia-and-Herzegovina-2019-COAR(1).pdf

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39 See: https://www.etf.europa.eu/sites/default/files/2020-06/digital_factsheet_bosnia_and_herzegovina_0.pdf

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49 See: https://balkaninsight.com/2020/09/01/some-balkan-central-european-states-open-schools-despite-covid-19/

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3.3 GEORGIA

3.3.1 Overview of the education system and status of broadband

Under Article 35 of the Constitution of the Republic of Georgia,[1] everyone has the right to education, as education is a fundamental human right and essential for the exercise of all other human rights. In 1997, the parliament of Georgia approved the Law on Education, defining the main principals of the state educational policy and safeguarding the right to education for every citizen regardless of race, ethnicity, nationality, sex, religion, and socioeconomic condition. The legislation foregrounds the importance of having a unified education system throughout the country. It also creates conditions for a decentralized administration and knowledge transfer, as well as a system that values the humanistic, scientific and democratic character of education for upward social mobility.

The 2005 Law on General Education established a twelve-year cycle of school education and made education compulsory from the age of five. Georgia's general education system is divided into three stages: primary education (grades 1 to 6), basic education or lower secondary (grades 7 to 9) and upper/general secondary education (grades 10 to 12).[2] Formal vocational education and training (VET) is split into two stages: initial vocational education (apprenticeship) and higher VET. Over the past two decades, in particular, significant improvements in the educational outcomes in the country have occurred, though that progress has not been equitable across all population groups.[3] To address these and other challenges, the government has approved several reforms in the past two decades, focusing on the decentralisation of school governance and the development of competence-based curricula coupled with effective teacher development.[4]

In terms of organization, the education system in Georgia falls under the responsibility of the Minister of Education, Science, Culture and Sports, together with four deputy ministers. With a highly decentralized system, schools in Georgia operate with significant autonomy, allowing them to proceed with teacher hiring, adaptations to the national curriculum and management of financial resources from the government. With such freedom, schools can tailor education to the needs of their own student bodies. As pointed out by the OECD, however, there is evidence that, even among schools with the same number of students, some schools request and receive up to three times as much funding as others. While schools in Georgia may require effective central supports, there are inadequate oversight mechanisms to systematically identify critical issues and provide support where it is most needed.[5]

According to data from the Ministry of Education, in the 2020-21 academic year, there are about 2,309 public and private schools in Georgia—including 2086 public and 223 private schools.[6] These schools enrol about 609,095 students.[7] At the beginning of the 2020/2021 school year, 62,699 teachers were employed in general education institutions, which is 1.7% less compared to the same indicator of the previous year.[8]

The most recent data indicate that the country's public spending on education and training was 3.5% of the country's GDP in 2018, while the European Union countries' average for 2017 was 4.7%.[9] The Georgian government is currently planning to increase expenditure in the coming years, although how the greater funding will be allocated is still in discussion. In March 2019, the government announced that it plans to designate about 6% of the country's GDP in investments in the educational system by 2022.[10]

United Nations Children's Fund (UNICEF) data show that the literacy rate for the 15-24 years age group in Georgia corresponded to 99.64% in 2017, while the completion rate for children of primary school age is 99.9% in 2018.[11] However, the completion rate for youth of upper secondary education school age was 80.9% the same year.[12] According to the National Statistics Office of Georgia, during the 2019-2020 school year, 8,247 students abandoned studying, which is 31.6 percent lower compared to the same indicator of the previous year. Among those, girls are 41.0 percent and boys are 59.0 percent.[13]

Concerning broadband development in the country, ITU data show that 68.9% of individuals in the Democratic Republic of Georgia used the Internet in 2019.[14] In the same year, the number of fixed-broadband subscriptions per 100 inhabitants was 23.6.[15] ITU data also show that 75.8% of households in Georgia had Internet access at home.[16] Wireline broadband networks (using fibre-optic or cable networks) are limited in their reach outside of urban areas.[17] Data published by the Georgian National Communications Commission (GNCC) from May 2020 indicate that that Tbilisi and Adjara are the regions with the highest Internet penetration in the country, while the north-western region of Abkhazia has the lowest penetration rate.[18]

Since 2014, fibre infrastructure has been steadily expanding in the country while xDSL has been diminishing. In 2018, 75% of total subscriptions were for FTTx technology, compared to only 31% in 2010 (when xDSL accounted for 59% of total subscriptions). Today, fibre is by far the most widely used technology in Georgia, and Wi-Fi the second most common—mostly in rural parts of Georgia where FTTx connections are not available.[19]

According to ITU data, in 2019 the number of active mobile-broadband subscriptions per 100 inhabitants was 80.[20] Moreover, with very low prices compared to many other regional and European countries, 2G and 3G networks cover 99.98% of Georgia's population,[21] while 4G/LTE covers 99.7%.[22] While all of the

MNOs have been investing to expand the reach and capabilities of LTE infrastructure to areas outside of Tbilisi,[23] Magticm and Veon Georgia are the operators with most mobile Internet traffic in the country.[24]

Due to significant investments made by Georgian MNOs to improve telecom infrastructure and achieve higher coverage, Internet traffic has grown from 1.5 million Gb in 2013 to 63.7 million Gb in 2018.[25] In 2019, Georgia had 0.09 exabytes of mobile-Internet traffic.[26]

The Law on Electronic Communications, which is the main pillar for the telecommunication sector in the country, does not provide any specific recommendation for broadband mapping.[27] However, it provides the possibility for the regulator, the Georgian Nation Communication Commission (COMCOM) to obtain data from operators in the field of electronic communications to fulfil the duties conferred by the law (Art. 11). Moreover, it is relevant to notice that the country is in the process of implementing a new specific infrastructure-sharing law aimed at reducing the cost of deployment and promoting competition in the telecommunication sector. In April 2020, COMCOM published a resolution on "Approval of the information forms to be submitted by the authorized and/or license holders in the field of electronic communications for the purpose of mapping the telecommunication infrastructure on a single digital map",[28] which is a milestone in the broadband mapping effort started by COMCOM in 2018. While substantial work is being done in the field of infrastructure mapping, service and investment plans are not yet mapped in the country and could provide new avenues for development in the future.[29]

3.3.2 Government strategies, status of the education quality, and the role of ICTs

In 2017, Georgia's Ministry of Education, Science, Culture and Sport developed the "Unified Strategy for Education and Science for 2017-2021" to direct the country's education system and to provide high-quality education for all. The main priorities of the Unified Strategy include incorporating student-oriented teaching strategies, investing in the teaching workforce and creating a safe school environment.[30] There are five specific goals in the strategy:[31]

- Increase access to high-quality pre-school education and prepare children of school age for school;
- Ensure access to high-quality secondary education and educational results relevant to national and international standards in order to prepare students for future life;
- Increase the number of professional students to support the socio-economic development of the country, and ensure their competitiveness by developing professional and general skills;

- Internationalize higher education and ensure quality higher education to improve personal and professional development and employment;
- Modernize and internationalize the science, technology and innovation system for creating new knowledge and promoting the sustainable development of the country.

As identified in an OECD assessment, one challenge that Georgia faces in terms of the strategy's implementation and monitoring is that fact that, despite being the highest-level strategic document of the education sector, the Unified Strategy is not regarded by stakeholders as a definitive point of reference. Many teachers and principals have not seen it or even heard of it. High-level initiatives are frequently introduced, sometimes at odds with the Unified Strategy and often without sufficient documentation.[32]

Furthermore, according to 2018 results of the OECD's 'Programme for International Student Assessment' [33] (PISA), Georgian students' scores for reading, mathematics, and science were lower than the OECD average.[34] PISA 2018 results in Georgia were significantly below those observed in 2015 in reading and science,[35] reversing most of the gains observed between 2010 and 2015.[36] Only mathematics results in PISA 2018 remained significantly above the level observed in 2010.[37] Particularly in the context of socio-economically disadvantaged schools, Georgia has one of the largest percentages of low performers in reading among socio-economically advantaged and disadvantaged students. Even among the top performers, Georgia is among the participating countries with the lowest scores. [38] PISA 2015 data confirm that Georgian schools have high levels of autonomy compared to those in OECD countries. In 2018, PISA data also showed that only a small share of students attend schools whose principal reported that the school's capacity to provide instruction is hindered to some extent or a lot by a lack of teaching staff.[39]

PISA data also suggest significant gaps dependent upon geographic location within Georgia. For instance, students from rural areas scored below their peers in cities, equivalent to a nearly 1.5year gap in schooling. Additionally, outcome gaps observable in Georgia in PISA 2015 have widened PISA 2009. In 2009, students from cities scored 30 score points more than students from rural areas. By 2015, this gap increased to 44 points. The difference in science scores between students who speak mainly Georgian at home and those who speak mainly another language at home also widened from 40 score points to 60 points, equivalent to almost two years of schooling.[40]

For general education in the country, the curriculum is implemented according to the national curriculum, developed by the National Curriculum Department of the Ministry of Education and Science. The first

national curriculum was launched in 2005, establishing key desired learning outcomes and the distribution of instruction hours for all subjects and grades.[41] Changes implemented in the 2011 and 2018 versions of the curriculum emphasized a more holistic approach to learning, focusing on developing student competencies and social and emotional skills rather than on memorising facts.[42] Alongside the updated curriculum, new textbooks were developed and published.[43]

Moreover, one of the relevant actions concerning evaluation and assessment and improving education quality in the Unified Strategy for 2017 and 2021 was updating the national curriculum for primary and secondary education. As a result, 2018 reforms introduced a stage-based approach, whereby learning outcomes for students are organised around learning stages, rather than grades. While such changes offer teachers greater flexibility to adapt instruction to different levels of student learning, they also raise questions about whether teachers are prepared to use such an advanced curriculum.[44]

In terms of school infrastructure, major government-led projects have been implemented to improve the country's educational facilities so that institutions comply with modern instructional standards in all levels of education. These initiatives have been carried out in the framework a nation-wide project entitled "Iakob Gogebashvili – Rehabilitation of Public Schools in Georgia."[45] Furthermore, there has also been activities pertinent to the development of small-scale schools in rural areas, as well as the provision of modern technologies for learning.[46] Data from the Georgian Statistical Office in 2010 show that there were about 29,084 computers installed in schools throughout the country, which meant that about 93.5% of schools had computers available to students.[47] However, no recent data is available in the public domain.

In terms of school mapping and data collection on the educational system, in 2012, the government passed a public law under the Ministry of Education and Science of Georgia to establish the details to overhaul the national Education Management Information System (EMIS). Until that point, EMIS was a structural unit of the Ministry and played an important role in the introduction of modern IT in the education field.[48] An OECD-led assessment has characterized Georgia's information systems for education as modern, widely used and highly trusted.

While EMIS collects data from all schools throughout the country, the National Assessment and Examinations Centre (NAEC) is the government body responsible for storing assessment data and conducting the examination of it for students and teachers. This configuration has limitations, as both bodies mostly work with their own data and neither is responsible for the evaluation of the system as a

whole. Moreover, accessing the information, particularly in an analytical manner, remains a challenge in the country.[49]

Despite these limitations, Georgia's Ministry of Education, Science, Culture and Sport has a designated space on its website with a geographic illustrating ongoing infrastructure projects in the country[50], as well as a portal called "e-Catalog," which is an electronic catalogue of educational institutions containing complete information about general education public schools. This system allows the user to retrieve information about the infrastructure of the institution, the learning process, teaching, teachers and student achievements.[51] The layers for the mapping of projects include: I) Educational Resource Centers; II) Newly built schools; III) Construction underway; III) Tbilisi public schools; IV) MCA-Georgia Millenium Program; and V) Partially refurbished public schools.[52] Each data point on the map compiles the following information:[53]

- Name of the school;
- Region;
- District;
- School Address;
- Identification code;
- School phone;
- Email;
- Level of instruction;
- Data on Students and Teachers;
- School building area;
- Yard area;
- Classrooms/Sport fields/Gym; and
- Information on infrastructure adaptations for people with disabilities;

As of December 2020, this interactive map with information on school-related infrastructure has been visualized about 150,000 times. In addition to this interactive map of infrastructure projects, statistical data on the country's education system is available on the National Statistics Office of Georgia website

for each of the main levels of education—including numbers of students, schools by type, region, grade and age, as well as data on teachers and infrastructure, such as the number of computers.[54] Despite the wide variety of indicators, some of the ICT-related data points are outdated, with the latest indicators being from the 2009-2010 period.[55]

With regards to the role of ICTs, the OECD reports that, in 2015, Georgia had 0.3 computers per student, or 1 in three—almost half of the OECD average (0.77). This amounts to a total estimated number of PCs of 170,000.[56] In terms of connectivity, according to a 2020 report by Georgia's Institute for Development of Freedom of Information (IDFI), there are about 78,000 vulnerable students in Georgia who do not have access to the Internet —95% of them living in an area that may have coverage, but without the financial viablility to afford it. [57] In the context of COVID-19, a 2020 joint report between UNICEF and ITU show that 15% of school-age children in Georgia do not have Internet connection in their homes.[58] Furthermore, Georgia's EMIS shows that 20% of children in Georgia have access to neither computers nor the Internet , significantly limiting their attainment of their right to education. In addition to unequal access to ICTs and reliable connectivity, there is also a discrepancy in terms of geographic location. Rural areas are likely to be home for students with lower household income, which has a direct link to students' academic performance, as students in urban areas outperform those living in rural settings.[59] As financial pressures mount for many families during the COVID-19 pandemic, these disparities are likely to worsen.[60]

3.3.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

Internet Starting in 2011, the Education Management Information System (EMIS) started to supervise the process of provision of computers, servers, and Internet access at all public schools in Georgia.[61] EMIS connects schools in Georgia through two main providers—MagtiCom Ltd[62] and Delta Com Ltd. MagtiCom Ltd, for example, signed a contract with the Ministry of Education and Science of Georgia to connect 2,000 public schools (including schools in rural and high-mountain areas) to the Internet by the end of 2011.[63]

As of 2014, Delta Com Ltd connected up to 553 public schools via optical channels, the school connection speed was up to 50 Mbps. MagtiCom Ltd, on the other hand, connected 1,512 public schools with EVDO technology and 19 public schools with satellite. The speed involved with MagtiCom Ltd was up to 256 kbps for 632 schools; up to 512 Kbps for 737 schools; up to 1 Mbps for 162 schools; and up to 50 Mbps for the remaining 553 schools (Delta Com).[64] The amount paid annually from Georgia's national budget is about 1.1 million EUR (4,397,269 GEL).[65]

In 2018, the Georgian Ministry of Education announced a comprehensive reform of general education with the goal of introducing digital education to all public schools in the country. The main objective of the program included: I) implementing more diverse digital initiatives in public schools; II) guaranteeing continued, high-quality education to all students; and III) boosting student creativity by making learning fun, exciting, and engaging.[66] In partnership with Microsoft and the country's Education Management Information System (EMIS), the government managed to equip computers with software such as Microsoft 365 to digitally revamp its educational environment. The partnership also included a series of training workshops designed for teachers in the country.[67]

More recently, Georgia's National Broadband Network Development Strategy for 2020-2025[68] mandates that schools, highways and public facilities must be provided with Internet access at a download speed of 1 Gbps by 2025, aligned with both EU plans and plans for 5G development in the country.[69] The strategy aims not only to create infrastructure, but also to establish Georgia as a digital and information hub in the region between Europe and Asia, while also upgrading knowledge and skills, leading to employment growth.[70]

Although not directly related to school connectivity, the World Bank is currently working in the development of broadband through the Log-in Georgia Project, a 32.7 EUR million support package[71] with the goal of expanding access to affordable broadband in rural settlements and of supporting the development of Georgia's digital economy.[72] The three major project outcomes include: (i) increasing access to affordable broadband Internet ; (ii) promoting the use of broadband-enabled digital services; and (iii) supporting project implementation.[73] The project expects to connect up to 1,000 villages, including settlements in mountainous regions, to high-quality and affordable broadband service. Nearly 500,000 people, residing in locations currently unserved by high-quality broadband services, stand to benefit from deployment of the broadband infrastructure envisaged by the Log-in Georgia Project.[74] This project will likely have a positive impact on school connectivity in rural settlements.

Building upon previous initiatives such as Educare Georgia,[75] other projects related to providing computers and Internet access to vulnerable communities[76] have also been carried out by GiveInternet .org, a social start-up that became a local partner for the Alliance for Affordable Internet in Georgia.[77] As of 2019, more than 300 underprivileged families have benefited. The majority of the beneficiaries are refugees living in rural areas, as well as communities living in the Internationally Displaced Settlements.[78] Funding for the purchase of laptops comes from private stakeholders such as Ernst & Young, Bank of Georgia, KPMG, Huawei, TBC, and individual donors. Some of the donors also sponsored Internet fees.[79]

Other impactful initiatives to provide laptops to schools have been carried out by the government with support from INTEL.[80]

Important connectivity projects have also been carried out by the Georgian Research and Educational Networking Association (GRENA) through projects such as the 2003 Networking Infrastructure Grant, "Secondary School Internet Connectivity in Georgia," and the 2004 Information Program Grant, "Expansion of GRENA Network to Rustavi and Setup of Computer Classes with Internet Connectivity for 5 Secondary Schools."

Moreover, partnership with private stakeholders such as UGT, Green Systems, and Orient Logic are underway for the provision of IT-related equipment in schools. In 2019 alone, these stakeholders provided 220 schools with local wireless (Wi-Fi) connections throughout Georgia. The public-private partnership also enabled the installation of software on public elementary school laptops and the maintenance of computers when needed.[81]

In 2018, the Ministry of Education identified wireless Internet as a viable option for Internet access in Georgian schools. A decision of the Government of Georgia, the LEPL "International Education Centre" operating in the field of governance of the Ministry, received authorization to purchase wireless Internet infrastructure for public schools. At the first stage, the Agency would provide 69 public schools with wireless Internet , most of which are located in the following regions: Akhaltsikhe, Samtredia, Poti, Martvili, Sachkhere, Tsageri, Tskaltubo, Tianeti, Adigeni, Bolnisi, Akhmeta, Kazbegi, Lanchkhuti, Chokhati, and Ozurgeti. Based on the results of the market research, the amount of required financial resources was estimated at 435,091 EUR (1,740,000 GEL).[82]

3.3.4 National responses to COVID-19 and pedagogic initiatives for distance education

About 661,500 children were directly affected by school closures due to COVID-19 on the 21st of March 2020. The state of emergency ended on 23rd of May; however, several restrictions remain in place. Some schools reopened in September 2020, but distance learning will continue.[83]

In March 2020, the Ministry of Education, Science, Culture and Sport of Georgia and the First Channel of Georgia launched a project called "Teleskola."[84] The project's main goal is to provide educational content for students of all grades and in different subjects across the country's schools via TV, thus allowing students without access to the Internet to nevertheless retrieve content for learning purposes.[85] The Ministry of Education prepared a table of lessons in accordance with the National Curriculum. The TV

lessons are conducted by experienced teachers in various subjects, covering both Georgian and non-Georgian (Armenian, Azerbaijani) affairs, and taking into account the interests of ethnic minorities. TV lessons have been provided with in-depth translation, and filming has been occurring since the start of the pandemic—both in the studio and in outdoor locations depending on the specifics of the subject.[86]

The government signalled that Teleskola will remain a long-term project and will continue even after overcoming the threat of coronavirus. Moreover, within the scope of the project, the Second Channel of Georgia will be gradually transformed into an educational platform called "First Channel—Education", which will translate and showcase the world's best educational programs in the future.[87]

In May 2020, a Memorandum of Cooperation (MoC) was signed by the Ministry of Education, Science, Culture, and Sport of Georgia, UNICEF, the Georgian Coalition for Education for All (EFA), and the Education Management Information System (EMIS), with support of UK Aid, to cooperate within the framework of education in times of COVID-19. A project called “iSchool”[88] was created with the goal of simplifying the teaching processes; providing support to the fundamentals in education; helping with the development of creative thinking; and increasing motivation among teachers and students. As a not-for-profit project, the cooperation aims to popularize the use of online learning and electronic materials so that anyone across Georgia can access the educational resources they need in one place.[89] Students can download assignments and complete them independently, as well as get acquainted with the necessary materials. Teaching materials are also available for teachers.[90]

Around the same time, a Memorandum of Cooperation (MoC) was signed by the Kant Academy, a leading non-formal education platform for adolescents, and UNICEF Georgia. The partnership aims to build the resilience of adolescents in coping with challenges—especially the emerging needs during the COVID-19 pandemic—and will focus on improving their knowledge-base and transferrable skills, as well as promoting a healthy lifestyle.[91] In addition, more than 40 online events will be organized with the aim of establishing online networks among adolescents, enabling them to discuss their concerns and to share their experiences. The partnership includes the organization of online training for young people and support for peer-to-peer education.[92]

In September 2020, the Ministry of Education, Science, Culture and Sport of Georgia established a partnership with the Estonian Embassy and UNICEF to launch a program to support educators (e.g., teachers and school administrators) with distance teaching at 100 schools throughout Georgia, including remote and mountainous areas.[93] The focus for elementary school teachers was on competency-based

teaching and learning methodology, while school administrators were trained in educational environments and school management.

Other initiatives have been carried out by UN agencies and other development partners in advocating for improved access to computers and the Internet for the most vulnerable children to enable equal participation in continued learning.[94] A UNICEF report has shown that children and young people from the poorest households, (i.e. rural and lower-income communities) in Georgia are falling even further behind their peers in the educational sphere and are left with very little opportunity to ever catch up.[95] As a result, UNICEF, in partnership with the CSO Coalition Education for All and the Ministry of Education, is developing teaching and learning resources for effective distance/online learning. It has also been developing an education platform to support distance learning in Abkhazia.[96] Additionally, the Ministry of Education has created Microsoft Office 365 user profiles for about 600,000 students at Georgian public schools and up to 55,000 teachers and staff through the Education Information Management System (EMIS). A portal has been created that allows students and their parents to access students' data without the direct involvement of the school administration and teachers.[97]

To support continued access to education, UNICEF has also delivered entertainment and educational materials for kindergartens and a youth centre, as well as computers, projectors and network devices for schools in Pankisi Gorge. With UNICEF support, in partnership with CK-12 Foundation,[98] the Education for All Coalition is translating and adapting interactive online teaching and learning resources for students and teachers of Georgia.[99] The adapted content and learning resources have also been made available on the Ministry's designated website called "Electronic Resources Portal."[100]

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3.4 REPUBLIC OF MOLDOVA

3.4.1 Overview of the education system and status of broadband

The government of the Republic of Moldova identifies education as a national priority and recognizes the role of education in building a knowledge-based society. According to Article 35 of the Constitution, the right to education is a fundamental right of every citizen.[1] As such, access to education is equal, free, and merit-based, and state education is free and secular. The national education sector has been regulated by the Education Code since 2014.[2] In terms of the organization of the education system, preschool education is for children up to the age of seven. The primary education is between grades one through four and typically involves children between the ages of eight and 12. Secondary education consists of two tracks: general and vocational. General secondary education from grades 5-9 is called the gymnasium, and grades 10-12 is called *liceul* (lyceum).[3] In other words, Compulsory education lasts 11 years from age seven to 18.[4]

Since 2014, reforms have occurred with support from the European Union to help the country transform and modernize its educational sector according to labour market needs and European standards. The country's challenges concerning strengthening the network of general education institutions, enhancing the autonomy and accountability of educational institutions, implementing performance-based funding mechanisms, modernizing curricula, institutionalizing external evaluations, renewing the initial and in-service training for teachers and managerial staff all remain critical areas for further policies.[5]

There are approximately 333,144 students enrolled in primary and general secondary education in Moldova.[6] This number corresponds to 139,174 enrolled students in primary education,[7] while the secondary level of education enrolled about 224,148 students.[8] In 2020, Moldova had 1255 registered schools—104 primary schools, 783 lower secondary (gymnasium), 353 upper secondary schools (high schools/lyceum), and 13 schools for children with intellectual and physical disabilities.[9] Of the total number of educational institutions, the vast majority is public; all private educational institutions are located in cities.[10]

UNESCO data show that the literacy rate for the 15-24 years age group in Moldova corresponded to 99.8%.[11] In 2018, the country expenditure per student at the secondary level of education corresponded to 5.4% of Moldova's per capita GDP, while the European Union countries' average for 2017 was 4.7%.[12] In the context of the COVID-19 pandemic, the issues of children out-of-school, drop-outs and absenteeism demand even more attention than before. During the 2018-19 school year alone, 10% of primary school-

age children and 15% of lower secondary school-age children were out of school. According to UNESCO numbers, this indicates that 16,045 children and 28,863 adolescents were out of school in 2019 in Moldova.[13]

Concerning broadband development in the country, ITU data shows that 72.1% of individuals in the Republic of Moldova used the Internet in 2017.[14] A report by the National Regulatory Agency for Electronic Communications and Information Technology in Moldova (ANRCETI) highlights that the country also had one of the lowest fixed broadband costs globally in 2015.[15] In 2019, the number of fixed-broadband subscriptions per 100 inhabitants was 16.6[16], with 94 active Internet service providers.[17] However, more recent data from ANRCETI shows that fixed broadband household subscriptions in Moldova amount to 25 every 100 inhabitants, and if an average of three persons per household is considered, then ANRCETI estimates 75.0% of the population enjoys fixed access at home 2019.[18]

In 2019, half of the fixed Internet access subscriptions offered data access and transfer speeds between 30 and 100 Mbps, while 13.8% enjoy speeds over 100 Mbps.[19] FTTx connections increased by 14.7%, reaching 452,300, while coaxial cable connections increased by 20.6% to reach 53,500. FTTx technology now connects 66.6% of total subscriptions,[20] with a significantly high rate in Chișinău and other major cities, while xDSL technology is the most common in smaller towns and rural areas.[21] Moreover, the number of subscriptions making use of xDSL connections decreased by 10.5% to about 163,000.[22]

According to ANRCETI data, in 2019, the number of active mobile-broadband subscriptions per 100 inhabitants was of 88.8, an increase from the same figure the year prior, which stood at 79.4.[23] The mobile market sector now accounts for the majority of total telecommunication revenue in the country.[24] In terms of network coverage, 3G covers 99% of Moldova's territory,[25] and 4G networks provide coverage of 95% of the territory[26]—serving 98% of the population according to ITU data.[27] The traffic generated by mobile broadband users via smartphones increased by 47.2% to about 52.4 million GB out of the total of 104.7 million GB consumed during the reference period in the country, which increased by 24%.

Despite the overall decline in telecommunication revenues between the 2016-2019 period, ANRCETI data indicate that there has been a significant increase in sales from 2018 onwards.[28] In 2019, the total number of users accessing mobile broadband based on 4G technology registered a significant increase when compared to 2018.[29] In the same year, the market for fixed broadband Internet access services in Moldova registered a significant increase, with the volume of sales rising by 6.1% year-to-year to reach 1.16 billion lei (59.1 million EUR).[30] In 2019 alone, the total amount of mobile-broadband Internet traffic within the country corresponded 0.1 exabytes.[31]

As of today, Moldova does not have particular provisions enshrined in law empowering the regulator to request operators for georeferenced data on infrastructure and services. The prevalent rationale adopted in the past was based on the request for information only for statistical purposes.[32] As a result, the country has not yet introduced a mapping system specifically targeting broadband development, although ANRCETI publishes statistical information via an interactive map.[33] However, a more detailed analysis of broadband mapping in Moldova has been carried out in the "Eastern Partnership Countries (EaP) Broadband Infrastructure Development Strategy" project financed by the EU4Digital project, which will provide a comprehensive overview of the regulatory and technical developments in the field of broadband mapping as well as country recommendations.[34]

3.4.2 Government strategies, status of the education quality, and the role of ICTs

In 2014, Moldova adopted the "Education Development Strategy 2014-2020" (Education 2020), which is the main policy guiding education in the country and has strong alignment with other relevant documents. The strategy envisions the following objectives:[35]

- Increase access and level of participation in education and training by expanding access to quality pre-school education, providing access to inclusive schooling and a 12-year general compulsory education, increase attractiveness and access to vocational/technical education, and increase participation in higher education and adult training programs.
- Ensure relevance of studying for life, active citizenship, and career success through adjusting the content of early education, ensuring the relevance of primary, secondary, and vocational/technical education, modernizing university curricula, and promoting scientific research.
- Ensure the effective integration of ICT in education through providing educational institutions with modern equipment, developing digital literacy, and increasing the efficiency of school management through information technology.
- Develop, support, and motivate teachers to ensure quality education through increasing the attractiveness of the teaching profession, balancing the supply and demand of teachers, improving initial teacher training, and creating an efficient system of continuous training.

- Design and institutionalize an effective system of evaluation, monitoring, and quality assurance of the education system through developing national standards and creating an institutional framework for quality assurance.
- Optimizing resource management through improving educational institutions planning and management, achieving efficiency in educational financing, modernizing the infrastructure of educational institutions, and providing textbooks and teaching materials.
- Achieving social cohesion while providing quality education through expanding students' participation in decision-making, ensuring effective parent education, and developing partnerships in the field of education.

According to 2009 results from the OECD's 'Programme for International Student Assessment [36] (PISA), Moldovan students' scores for reading, mathematics and sciences are among the lowest in the region.[37] According to results from 2015, overall student performance increased by 15 points in science (to 428); by 28 points in reading (to 416); and by 23 points in math (to 420).[38] In 2018, however, students in Moldova scored lower than the OECD average in reading, mathematics and science. Compared to the OECD average, a smaller proportion of students in Moldova performed at the highest levels of proficiency (Level 5 or 6) in at least one subject; at the same time, a smaller proportion of students achieved a minimum level of proficiency (Level 2 or higher) in at least one subject. Moreover, a large share of students in Moldova[39] attend schools whose principal reported that the school's capacity to provide instruction is hindered to some extent or a lot by a lack of educational material.

In Moldova, socio-economically advantaged students outperformed disadvantaged students in reading by 102 score points in PISA 2018. This is larger than the average difference between the two groups (89 score points) across OECD countries. In PISA 2009, the performance gap related to socioeconomic status was 80 score points in Moldova (and 87 score points on average across OECD countries).[40] Data from the 2018 PISA results also suggest that students in urban areas gained more practical knowledge and skills in three areas than their rural peers. The geographical disparity in scores was 64 points in reading, 56 points in science and 55 points in mathematics.[41]

In one of the initiatives within the framework of Education 2020, the government prioritizes the improvement of resource management in education. While Moldova is among the European countries allocating the highest share of the GDP to the education system, its performance still shows modest results, which may suggest low efficiency in the budget allocations invested in education. As reflected in

the country's strategy on education, an analysis of the education system shows that inefficient use of the school network capacity does not enable investment in the upgrading of institutions nor the adequate provision of equipment. Therefore, the government is currently undergoing reforms to improve the planning and management of the network of educational institutions by implementing an educational Management Information System, comprising a register of schools, pupils and teachers based on the school census, as well as regular and accurate collection of data in schools.[42]

Other priority actions in this context include the:

- Mapping the network of education institutions by education levels.
- Upgrading of the network of education institutions by education level in line with regional development prospects of settlement and the demographic situation.
- Diversification of complementary education structures.
- Development of the normative framework to facilitate the provision of private services in education and establishment of sectoral, cross-sectoral, national and international partnerships.

The broader objective of improving resources for enhanced management of the education system also has implications for funding allocation, upgrades of school infrastructures and protocols, and the provision of relevant materials such as textbooks.

In terms of Internet access in the scholastic context, students are familiar with ICT due to the Computer Science school subject, which is compulsory since the 7th grade.[43] However, the Moldovan government recognizes that the student familiarization with ICTs is limited by an insufficient provision of computers and their use at a later age. According to data from Moldova's National Bureau of Statistics, schools around the country are endowed with about 32,501 computers, out of which 28,500 are used for teaching purposes.[44] The problem is rooted not only in the insufficient number of computers for the number of enrolled students—which is lower if compared with the EU computer-student ratio—but also that most computers are outdated. Around 24,000 are over 5 years old and thus warranted replacement in order to conform to the standards adopted by the Ministry of Education, Culture and Research in 2015.[45] Many of these computers are intended and adapted for in-class use and not to be distributed to students and teachers nor used outside the classroom as providing IT and other technical support would also be challenging.[46] This data, however, contradicts the 2015 figures presented by the OECD, which reports 0.5 computers per student at school, compared to an OECD average of 0.77. This suggests a need for

clarification on methodologies adopted and the relationship between national and international methodologies.[47]

According to the National Bureau of Statistics, 52.3% of Moldovan families have at least one computer at home, with families from rural areas having a visible disadvantage when compared to those from cities. At the same time, only 41% of the population of Moldova has a computer and only 38.7% have Internet access.[48] Those digital inequalities have become a more poignant issue in the context of distance learning induced by the COVID-19 pandemic. Overall, unequal access to ICTs and Internet access has proven to be a demanding challenge for the 16,000 students (4.8% of total) and 3000 teachers (10.6% of total) who lack access to ICTs (laptop, tablets, computers, or even Internet access).

There is also an additional layer of challenges with unequal access to distance learning when considering children and youth who are left behind (e.g., children with disabilities, low-income families, etc.). This condition has made remote education an enormous challenge even before considering the organization of lessons and monitoring of student learning outcomes for a significant number of students, mostly in families with a lower level of education located in rural areas.[49] This is also relevant for children from the Roma community. In Moldova, Roma children are already more prone to drop out of school in favour of household work; the lack of adequate equipment, like a computer or connection to the Internet , as well as high levels of illiteracy among parents, creates additional obstacles to benefiting from distance learning.[50]

3.4.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

Internet provision in schools and universities in Moldova can be traced back to as early as the mid-1990s when international NGOs expanded the early Internet networks in the country.[51] Furthermore, even before 'Digital Moldova 2020', ICT implementation had been undertaken by the government since 1997, when programs such as "SALT" and other such funding mechanisms focused on offering broadband Internet access, the procurement of didactic software, and the installation of at least one computer classroom in every school. Although the equipment level of general educational institutions rose, the lack of efficient management, maintenance and budgeting for computer labs also became a challenge.[52]

In one of the strategic directions of the National Strategy 'Moldova 2020', Internet connectivity at school facilities is articulated as a priority action. In particular, the strategy recommends that educational policies should support the training of youth to enable them to actively engage in building and developing a society

of knowledge that is the engine of competitive social-economic development of the country as a whole. Within the specific objective of enhancing access to quality education by providing educational institutions with modern equipment useful to the educational process, the following specific priority actions are developed:[53]

- Implementation of the pilot project 'One computer for each pupil' in 10 schools, since 2013.
- Elaboration of a medium-term plan on provision of education institutions with modern equipment, access to the Internet and the infrastructure necessary for successful implementation of information and communication technologies in the educational process.
- Provision of school libraries with modern equipment and access to the Internet so that the needs of information and documentation of pupils and teachers are met.
- Provision of access to quality education by enacting distance learning models, especially for pupils in small schools.
- Facilitation of the creation of networks of communication and of the exchange of best practices among teachers.
- Provision of schools with special equipment needed to train people with disabilities.

Alongside the infrastructure aspect of Internet provision, Digital Moldova also details the importance of digital literacy and ways in which the national curriculum can be adjusted to a more well-rounded use of ICTs for students and teachers alike.[54]

In October 2013, the Moldovan government approved a decision to provide 1,200 computers, 220 printers, 50 multipliers and free Internet for schools across the country. The action aims to increase access to information and create better conditions for education, development and realization of young people's potential. The list of beneficiary institutions was developed by the Ministry of Education based on the needs of each institution.[55]

In June 2020, the Ministry of Education launched a nation-wide campaign titled 'Donate Computer for Education' as part of its goal to help digitize Moldova's education system.[56] The campaign's main goals include: endowing schools with computers and connection to the Internet ; creating conditions for people interested in donating computers to pupils; inter-connecting of companies that can provide donations consisting of computers and IT technology with the schools in need of these endowments.[57] Within the framework of this initiative, the Ministry developed an interactive map with which potential donors can

identify the number of teachers and students who do not have computer technology in each district.[58] Accordingly, donors can find out the telephone number of the representatives of the local specialized bodies in the field of education, who explains the necessary steps to ensure the donation reaches the chosen recipient. To ensure transparency and visibility, donors receive a donation document that must be completed and signed.[59]

3.4.4 National responses to COVID-19 and pedagogic initiatives for distance education

In mid-March, Moldova shut down all schools in response to the COVID-19 outbreak, thus mandating schools in the country to provide distance learning opportunities for over 434,000 students.[60] In face of the emergency, Moldova undertook many activities to ensure that learning continued under the new conditions imposed by the global pandemic.

In late March 2020, the UNICEF office in Moldova received a 70,000 USD grant from the Global Partnership for Education (GPE) to support the Ministry of Education in developing a COVID-19 response plan in coordination with donors and development partners. Since then, the country has used the funds to increase access to distance learning by providing IT devices for students and teachers and by distributing learning packages to the most disadvantaged children with no access to technologies.

To deal with the lack of appropriate ICT equipment and gaps in Internet connectivity, the Ministry distributed educational packages for children with disabilities[61] and children with no access to technologies, as well as on-line informational materials regarding free on-line resources for distance learning and positive parenting during the pandemic and subsequent recovery period.[62] Initiatives addressing the ICT and connectivity gaps also came from other third sector organizations. Arigatou International – End Child Poverty, through a partnership in Moldova with the Global Network of Religions for Children (GNRC), facilitated the purchase of tablets and Internet connectivity for several children living in poverty who were not able to participate in online learning due to a lack of Internet and Internet - accessible gadgets.[63] The Moldovan government also launched teachers' training on remote education, positive parenting and video and TV tutorials for national examination preparation.[64]

Moreover, CCF Moldova and UNICEF, with support from USAID, prepared a guide for parents of children in primary and general secondary schools in preparation of the reopening of schools in scholastic year 2020-2021.[65] The Ministry disseminated the guides before the start of the school year on September 1. Additionally, relevant government agencies in Moldova, in cooperation with UNICEF, WHO and UFPA,

developed a guide for students[66] of primary and general secondary education for the preparation for the 2020-21 academic cycle. Particularly in the context of minority students such as Roma children in the Nicoreni village, Drochia district, UNICEF—with USAID support—provided supplies and educational kits for these communities.

In July 2020, a Memorandum of Understanding (MoU) entitled "Development of Digital Skills, IT and STEM throughout Life" was signed by the Ministry of Economy and Infrastructure, the Ministry of Education, Culture and Research, the National Association of Information Technology and Communications Companies and the Tekwill ICT Training and Innovation Centre in response to the COVID-19 crisis.[67] This document provides information on the use of digital technologies at all school levels. By specifying teachers' role in preparing students for digital transformation and by involving teacher training in the adoption and promotion of information technologies, the document ensures the quality and relevance of ICT skills for professional activity in a digital economy and harmonises ICT education in Moldova with current labour market requirements.[68]

In early September, UNICEF chaired the weekly regular meeting of the UN Coordinated Education Task Force for COVID-19 where the participants were updated on the actions of authorities and partners to ensure the start of the new school year 2020-2021 in safe conditions. UNICEF also informed of the Paper "Education and COVID-19 in Moldova: Grasping the opportunity the learning crisis presents to build a more resilient education system"[69] with the UN Resident Coordinator Office, the Ministry of Education and GPE. The Paper highlights the Moldovan context, while also building upon the recommendations mentioned in the UN Policy Brief document on "Education during COVID-19 and beyond."[70] The meeting also discussed further needed assessments to be carried out in the area of education to better plan interventions for remediation.

In late September, the Ministry of Education of Moldova signed a Memorandum of Understanding (MoU), which will support the education system in using the most innovative information technologies. The agreement will enable educational institutions in the country to gain access to Office 365 A1, interactive platforms for teachers' training, and support in implementing the distance learning and mixed model.[71]

Furthermore, the government sought to establish several public-private partnerships to alleviate gaps in digitalization and their negative impacts on educational outcomes for students. One example is the campaign 'Connecting Teachers,' which was made possible with the support of Orange Moldova. Additionally, Moldtelecom and Moldcell, in cooperation with the Ministry, provided free access to 50 Gb data packages[72] to teachers during the first two months of the COVID-19 pandemic.[73] Another example

was the launch of websites entitled 'Education Online'[74] and 'Învat.Online,[75] developed under the leadership of the Mayoralty of Chisinau and Association of ICT Companies, respectively. These are two examples of education content digitization to facilitate the distance teaching process. Some schools have also installed Wi-Fi in order to give their staff a place to work, but many schools do not have sufficient resources to do so.

However, these innovations did not originate only in the context of the pandemic. Prior to COVID-19, the United Nations Development Program (UNDP)[76] and the Association of ICT Companies, in partnership with Tekwill and Simpals, had already developed a platform called 'Studii',[77] which became a solution not only for organizing distance learning activities but also served as an instrument for education process management, exemplifying the digitization of governance in education. By July 2020, over 70 public schools with 77,000 users utilized the platform for learning, evaluation, management, and reporting. Shortly after the decision on emergency lockdown and home-schooling, Studii.md added new functionalities:[78]

- The ability for teachers to upload videos on the lesson page and attach files and links to homework;
- The opportunity for students to send homework for review in electronic format;
- A video conferencing feature that allows for conducting lessons in real-time;
- A library with electronic textbooks for grades 1 – 12 in all languages of instruction, as well as a section with school courses in various subjects;
- A simplified registration process for students and parents, allowing teachers to connect students via links;
- Automatic calculation of average scores and absences, saving teachers' time. During the quarantine period, users fill out a mandatory health report, which is automatically displayed in the classroom's journal;
- Progress monitoring for parents by accessing their students' profile, with information on grades, absences and mentors' comments;
- The possibility to directly add comments on uploaded homework photos, without having to download the files.

The Ministry of Education, Culture and Research has set up the National Group for the Coordination of Safety in Education to monitor the processes and discuss policy options.[79] However, student responses to remote learning indicated that about 35% of students report limited or lack of free time or time for rest, with an accentuated gender disparity (40% girls comparing to 29% boys).[80] To address these socioemotional impacts, the Ministry developed an "Instruction on the organization of psychological assistance for children/pupils, parents and teachers during the suspension of the educational process,"[81] methodological guidelines on healthy lifestyle during quarantine, and subsequently launched an educational programme for psychological assistance for young people, parents, teachers and psycho-pedagogues.

For the 2020-2021 school year, the government has proposed seven models for the organization of the education process. Accordingly, each school is advised to select from the proposed models in consultation with the Local Education authorities and the school community, including parents, teachers, and students.[82] The Ministry of Education also created several resources, including a master list of recommended remote education technologies, alongside other methodologies[83] on remote education.[84] The document establishes a blueprint for the continuation of the educational process in primary, secondary and high school institutions in quarantine conditions when the physical presence of students in classrooms is restricted.

Another public-private educational project that has been launched with the support of the government and other stakeholders is the Future Classroom Lab.[85] This is a pilot project implemented in Moldovan educational institutions. It brings a new concept in pedagogy, offering an open and inspirational learning space with interdisciplinary and innovative approaches, through the use of digital technologies, which favour a student-centric learning process. The Class of the Future is a public-private partnership (PPP) between the Ministry of Education,[86] Culture and Research, the Moldova Competitiveness Project funded by USAID, the Government of Sweden, UK aid; the Orange Moldova Foundation and the Liechtenstein Development Services Foundation (LED).[87]

Despite these extensive tools and initiatives, a nation-wide survey with educators in Moldova revealed that some teachers still struggle to appropriately use the recommended technologies.[88] On the other hand, some wished that the government guidelines could have been tightened somewhat by their own school or institution, because using the same platforms could have enabled staff to better assist one another during the transition.[89]

Endnotes

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3.5 MONTENEGRO

3.5.1 Overview of the education system and status of broadband

In Montenegro, education is considered a key factor of societal development, and the country has continuously implemented reforms in this area to make the educational system compliant with modern trends and quality. As a way to overcome previous historical challenges, Montenegro has started an extensive process of education system reforms at all levels, through the adoption of the main strategic document, the "Book of Changes" in 2001. This corresponded with the country's reforms in the ICT sector with the introduction of the Telecommunications Law and the establishment of the regulator, the Agency for Electronic Communications and Postal Services (EKIP).[1] Reforms were preceded by the adoption of new laws and amendments, changes for the appropriate level of education, and harmonization with EU legislation. As articulated in the 2002 General Law on Education,[2] primary education is compulsory for all children from the ages of 6 to 14 years,[3] regardless of gender, race, religion, social background or any other personal characteristic.[4] It lasts for nine years divided into three cycles, meaning that primary and lower secondary education in Montenegro are organised as a single structure system. General secondary education, on the other hand, is not mandatory[5] and is offered in gymnasia, combined secondary schools (offering general and vocational education), vocational schools and art schools.[6]

Data from 2018 show that the country's expenditure on education is about 4% of GDP,[7] while the European Union countries' average for 2017 was 4.7%.[8] A 2020 assessment by the European Commission has shown that investments in school infrastructure and equipment resulted in the construction or refurbishment of schools across the country, with an additional 107 projects in the pipeline by 2020. Though works to remove physical barriers were completed at several schools during 2019, physical accessibility remains an important issue to address.[9]

In terms of organization, educational policy is created at the central level under the auspices of the Ministry of Education.[10] As such, the public financing of the pre-university education is carried out entirely at the Ministry level, with some contribution from the regional and municipal governments. There are 162 public primary schools; 4 private international primary schools; 50 public, 1 state-private and 3 private secondary schools, and 2 state education centres.[11] According to data from the Statistical Office of Montenegro referring to the 2019-20 academic year, these schools enrol about 118,551 students—23,080 children were enrolled at the preschool level;[12] 68,025 students in primary/elementary education[13] and 27,446 students at the secondary level.[14]

United Nations Children's Fund (UNICEF) data show that the literacy rate for the 15-24 years age group in Montenegro corresponded to 99.1%, while the completion rate for children of primary school age is 99.9%.[15] Moreover, the adjusted net attendance rate for youth of upper secondary school age was 93.1% in 2013.[16] Furthermore, as reported by the European Commission, the importance of early childhood education and care (ECEC) continued to be promoted, and kindergarten outreach services are available in some rural areas. Participation rates for 0-5-year-olds showed a small increase from 48% in 2018 to 52% in 2019.[17] According to UNESCO figures, there were about 1,097 children out of school in Montenegro in 2017. In 2019, 2,433 adolescents were out of school in the country.[18]

Concerning broadband development in the country, ITU data shows that 73.5% of individuals in Montenegro used the Internet in 2019.[19] The northern region of Montenegro remains the least connected, having only about 64.8% of households with some level of Internet usage.[20] The same data report also shows that while 80% of households in urban areas were connected in 2019 (representing a 3.7% increase compared to 2018), the percentage for rural areas was 62.8%. In terms of household connectivity, data from country's State Statistical Office show that 74.3% of the surveyed households had access to the Internet in 2019, which represents an increase of 2.1% in relation to the previous year.[21]

In 2019, the number of mobile-broadband subscriptions per 100 inhabitants was equivalent to 80.50.[22] In 2019 alone, the percentage of households connected via mobile increased by 5.1% when compared to 2018. In terms of the quality of mobile networks, Montenegro's the Agency for Electronic Communications and Postal Services (EKIP) has recently made public that Crnogorski Telekom's mobile network offers the highest download speed in urban areas, at 47.5Mbps, followed by Telenor (43.5Mbps) and M:tel (22.5Mbps).[23] As of 2019, 4G/LTE networks cover 97.65% of the population of Montenegro,[24] with an average download speed of 10 Mbps.[25] 3G coverage is available to 98% of Montenegro's population.[26] In 2019 alone, mobile-broadband Internet traffic within the country was equivalent to 0.041 exabytes.[27]

In Montenegro, the rules regulating the mapping of electronic communications include three main pieces of legislation.[28] Based on these documents, EKIP has implemented a system for mapping of electronic communications infrastructure which aims to provide appropriate data access to stakeholders.[29] The mapping system seeks to I) increase the common use of electronic communications infrastructure (ducts, antenna poles, buildings/facilities, cable drainage, low voltage poles and public lighting posts); II) Improve planning documentation; III) Accelerate NGN development; IV) Increase investment; and V) Increase of broadband access availability. The system is made of a georeferenced database where EKIP collects data

from operators through a web application based on the Esri ArcGIS server platform. Data is provided in shapefile format and kept in the Posgtgre SQL database run by EKIP. Moving forward, EKIP is taking steps to improve the georeferenced database as well as to align its regulatory framework with the best technical practices observed in the European Union.[30]

3.5.2 Government strategies, status of the education quality, and the role of ICTs

There are a few strategies in the field of education in Montenegro: I) Strategy of Preschool Education (2016-2020); II) Strategy of Vocational Education (2015-2020); III) Strategy of General Secondary Education (2015-2020); IV) Strategy for Inclusive Education in Montenegro (2019-2025), among others. The Montenegrin government is also preparing a draft "Lifelong Entrepreneurial Learning Strategy (2020-2024)", while primary and secondary schools are further involved in classes developing key competences and basic skills, including socio-emotional learning, digital skills, critical thinking and problem-solving.[31] While these different strategies suggest a wide variety of tailored goals and targets depending on the educational level, the overall goals of the education system in Montenegro are to:[32]

- Provide the possibility for comprehensive individual development regardless of sex, age, social and cultural background, national and religious affiliations and physical conditions;
- Meet the needs, interests, demands and ambitions of individuals for lifelong learning;
- Develop the awareness, the need and the capabilities for the maintenance and the improvement of human rights, legal state, natural and social environment, and multi-ethnic diversity;
- Develop the awareness on national affiliation to the Republic of Montenegro, its culture, tradition and history;
- Enable individuals' involvement in work and activities in line with their capacities;
- Facilitate the process of integration into Europe.

According to the OECD's 'Programme for International Student Assessment' [33] (PISA) results from the 2006 and 2009 period, Montenegrin students' scores for reading, mathematics and sciences were significantly below the OECD average.[34] In particular, reading and mathematics performance in Montenegro has been increasing since its first participation in PISA in 2006. However, the 2018 results showed limited improvement from 2015, and remain below the OECD average.[35] In reading, most of the improvement occurred in earlier cycles. The long-term change in reading performance for Montenegro's participation

in PISA shows one of the strongest increases among PISA-participating countries and economies.[36] In mathematics, most of the improvement was observed over the most recent period, and it shows one of the strongest increases among PISA-participating countries.[37] In 2018, science performance returned to 2006 levels after an initial slump.[38] These results show that the reform efforts have, until now, produced significant positive effects when it comes to mathematics and literacy, but not science.[39]

Results also show that socio-economically advantaged students outperformed disadvantaged students in reading by 55 score points in PISA 2018. This is smaller than the average difference between the two groups (89 score points) across OECD countries.[40] Moreover, school principals in Montenegro reported less staff shortage and more material shortage than the OECD average; and school principals of disadvantaged schools more often reported staff shortage than principals of advantaged schools. In Montenegro, 5% of students are enrolled in a disadvantaged school, and only 1.7% of students attended schools whose principal reported that the school's capacity to provide instruction is hindered to some extent or a lot by a lack of teaching staff.[41] However, unlike in most other countries participating in the PISA study, the socio-economic status of students in Montenegro is correlated to a much lesser degree with their performance—only 5% of all differences in performance can be accounted for by the socio-economic status of students. According to this indicator, Montenegro ranks among the European countries with very high equity in education.[42]

The content of the educational program in Montenegro is aligned with, and the curriculum defined in accordance with the General Law on Education and Upbringing. Since the 2017/2018 academic year, primary schools have operated under a new set of courses and areas of focus. The main underpinning principles include the following: subject matter; a uniform syllabus structure for all levels of education; outcome-based pedagogy, together with the means and criteria of outcome; and cross-curricular linkages and topics. There are two kinds of subject goals: cognitive (the type of knowledge to be acquired) and process-related (the skills and values to be acquired). Potential subject goals are divided into four groups, relating to:[43]

- Cognitive skills: the ability to learn, problem-solving, critical thinking, creativity and innovation;
- ICT literacy: mastering information technologies and their application in solving different types of problems;
- Social and emotional skills: self-awareness and self-regulation, establishing and maintaining good interpersonal relations (communication, collaboration, conflict resolution, etc.);

- Responsible attitude to oneself and the environment: health, environment, civic education, career education (entrepreneurship).

However, the revised curriculum does not specify how these goals are to be implemented in teaching/learning,

Through the development of the Montenegrin Education Information System (MEIS),[44] the Government of Montenegro has been collecting relevant data on education and schools. MEIS was adopted in 2004 and has since received the government's recognition as a basic component for implementing ICTs in the educational system.[45] In 2017, MEIS was upgraded to enable the establishment of an early warning system concerning students' progress in the curriculum. Along with this, initial steps were taken to upgrade MEIS to produce the school profile card, i.e., feedback to schools in the format of user-friendly and relevant data. Both the early warning system and the school profile card were piloted in 20 schools in 2018.[46]

As a result, data on ICT surveys, as well as the conditions of different schools across diverse geographic contexts, has enabled the construction of a picture of the state of schools not only in terms of student body and staff, but also with respect to infrastructural conditions.[47] Additionally, MEIS also helps define the necessary resources, concrete methods and technologies for the implementation of a modern ICTs in education. Consequently, basic country-wide data on education is openly available via the portal of the Statistical Office of Montenegro.[48]

Additionally, thanks to the cooperation of UNICEF and Telenor, Montenegro has become the first country to have comparable data on the digital skills of children, parents and teachers within the Global Kids Online research network, which is being implemented by UNICEF and the London School of Economics and Political Science. In the face of the pandemic, UNICEF is also providing support to ensure the sustainability of the MEIS, making the system suitable for online enrolment and other relevant processes.[49]

In terms of ICTs access, Montenegro's Strategy for the Information Society Development (2016-2020) indicates the student-computer proportion was of 1 computer for every 16 students at the elementary level and 1 computer for every 14 students at the secondary level of education in 2016. In terms of Internet speed, the average was 4 Mbps for fixed connectivity and 8 Mbps for satellite-enabled Internet . OECD data from 2015 show that the ratio was 1:5, suggesting that both methodologies adopted and the relationship between national and international methodologies must be clarified.[50]

The percentage of teachers in Montenegro trained in basic IT skills stood around 20%.[51] Particularly for students at the age of 15-years-old, more recent OECD data indicates that is only one computer is available at school for every 4 Montenegrin students.[52] In the context of rural schools and disadvantaged communities, these indicators present even more inequalities.

In 2019, the Ministry of Education launched a scholarship competition for Roma[53] and Egyptian high school and university students. Despite increased attendance rates and fewer dropout cases observed since 2016, the overall number of school-going Roma and Egyptian children, and children with disabilities, remains low; most concerning is the low level of Roma and Egyptian children completing compulsory education.[54]

While the Strategy for the Information Society Development recommends the use of digital and online methods in education to diversify knowledge acquisition and develop students' digital skills, the inequalities surrounding access to ICTs have also been exacerbated in the context of the COVID-19 pandemic.

3.5.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

Montenegro's Strategy for the Information Society Development (2016-2020) encompasses three major components: I) Infrastructure; II) Cybersecurity; and III) E-economy, which involves e-business, e-inclusion, e-government and research, and innovation and development in the field of ICT. Harmonized with the Digital Agenda for Europe by 2020, one of the strategic priorities for ICT and broadband development in Montenegro includes the provision of e-education. In particular, the strategy envisions that the computer-student proportion should be 1:10 by 2020.[55] The strategy indicators also show that Montenegro plans to provide 100% Internet coverage in regional school units at a minimum fixed Internet speed of 20 Mbps by 2020.[56]

In 2019, the European Union awarded 600,000 EUR to Montenegro at the 20th meeting of the Management Board of the Western Balkans Investment Framework on June 25-26, 2019 to fund the "Broadband Infrastructure Development in Montenegro" (PRJ-MNE-DII-001), which is currently being implemented.[57] Based on the complete mapping process of the infrastructure, the goal of this project is to analyse the current situation and examine the potential of the market to eliminate the existing infrastructural gap. There are three expected results and benefits:[58]

- Increase broadband coverage and availability of new generation broadband networks to the currently uncovered (mostly rural) areas in Montenegro;
- Offer adequate infrastructure for fast and secure Internet to all households, businesses, educational and health institutions in order to support the digital transformation of society and the economy;
- Increase the percentage of households equipped with NGA (Next Generation Access) network from 70% to 95%.

Furthermore, initiatives with private and third-sector stakeholders focused on Internet provision to schools have also been active in Montenegro. Since 2007,[59] Telecom operator Crnogorski Telekom has provided free broadband Internet to about 250 primary and secondary institutions in Montenegro, as well as preschool institutions in the country.[60] In 2017, strategic cooperation with the Ministry of Education was renewed, and an agreement was signed that enables educational institutions with technical capabilities to use optical transmission services and TurboDSL, which will provide schools with increased service stability and higher data flow. The value of donated services during 2017 was of 71,000 EUR.[61] In June 2019, the operator partnered with the Ministry of Education to expand Internet coverage to about 150 regional schools. The project will be implemented in the 2019-2021 period and will provide said educational institutions with free access to 4G mobile Internet .[62]

Between the 2015-2019 period, UNPD completed a 350,000 EUR project in Montenegro to address, among other things, the insufficient capacities and inadequate physical conditions of educational facilities in the country. While not focused specifically on connectivity, the project's main objective was to support the reform of the educational system by creating infrastructural conditions that will meet the needs of all students and enable their acquisition of a quality education equally in urban and rural areas.[63] Through the project, the UNDP offered to support the capacities of national and local authorities in improving and optimizing the network of educational institutions and their facilities, thus increasing the potential to provide quality educational services in line with both modern education requirements and EU/UN standards. Two main areas of activities included:[64]

- Upgrading the existing network and facilities of educational institutions in Montenegro;
- Developing new facilities for the provision of preschool, primary-school, high-school and university education.

3.5.4 National responses to COVID-19 and pedagogic initiatives for distance education

With the closure of schools as a response to COVID-19, 118,000 students have been directly affected in Montenegro. In March, the Ministry of Education started applying the new concept of distance learning called #UčiDoma (#StudyAtHome).[65] This project includes the recording and broadcasting of lectures in accordance with the national curriculum. About 1,700 lectures were recorded and a number of schools started to partake in the project. The broadcasting of content for primary school was carried out on two channels, the YouTube channel #UčiDoma,[66] a website created for the program[67] developed by Amplitudo,[68] as well as on the mobile app. Lectures were recorded and broadcast in the Albanian language as well. Lessons have also been broadcast via three TV channels—TVCG 2, MNE Sport and MNE Sport 2, now called Study at home channels.[69] According to the survey conducted in late March by Ipsos, with the support of UNICEF, over two-thirds of citizens have watched the TV channel "#StudyAtHome" at least once in the previous week, and most of them were satisfied with the quality of the content.[70]

While the continuity of education was maintained by the Ministry of Education via TV and the Internet , the distance learning system was not accessible to all children in the country. For communities that lack reliable Internet access, other partnerships with private stakeholders are being considered, including a potential agreement with telecom operators to provide unlimited data plans for the students least likely to have reliable broadband access.[71] Data from the 2020 UN Rapid Social Impact Assessment, collected first in April and again in June 2020, highlighted that a significant percentage of households with children and adolescents of school age did not have computers/laptops (21%) or tablets (51%) connected to the Internet that could be used for distance learning in Montenegro.[72] Moreover, to provide support to certain families, the government announced a decision entitling one of the parents of a child under the age of eleven and one of the parents of children with special educational needs to paid leave benefits.[73]

The United Nations has worked with partners to support access to continuous education services in response to the COVID-19 a pandemic. In combination with other initiatives, UN response in the country anticipates actions in the following areas:[74]

- Distribution of paper-based learning materials for Roma and Egyptian children who do not have access to distance learning channels;
- Enhancing and consolidation of Montenegrin Education Information System (MEIS) based services, including for online enrolment;

- Capacity building for teachers to use digital tools in quality and effective manner in everyday teaching;
- Development of a platform for online learning and collaboration, in cooperation with UNICEF HQ, University of Cambridge, and Microsoft;
- Online safety programs for adolescents through non-formal education.

With UNICEF as the implementing UN agency, one of the outputs of these actions is the anticipation of the launch of a centralized and interactive platform for online teaching, learning, and collaboration, as well as the creation of a quality, inclusive digital curriculum and teacher training for quality and inclusive instruction and learning through digital tools, with the approximate cost of 350,000 USD and an implementation timeframe of 18 months since the start of the pandemic.

In June 2020, the Ministry of Education and UNICEF co-hosted an education sector coordination meeting to bring together a wide range of bilateral and international partners to ensure a targeted, inclusive response to children's educational needs and ensure a smooth transition from recovery to normalization.[75] Actions by UNICEF also included the digitization of non-formal education and skill-building platforms for adolescents and youth, including UPSHIFT, skills-building workshops and programmes for mental health. UNICEF is also undergoing an Education Sector Analysis which will consider the impact of the COVID-19 crisis on the education system to ensure long-term responsiveness to risks through quality planning and sustained financing of reforms.[76] Teacher training to equip teachers with ICTs and digital skills are also underway.[77]

In a UNICEF survey of a nationally representative sample consisting of 1,037 parents of school-age children in Montenegro, data show that as many as 80% of parents are satisfied with the support that their children and themselves received from the school during the distance learning period induced by COVID-19. Most of them (86%) are satisfied with communication and cooperation with teachers during this period. However, most parents think that, in the long-run, distance learning can lead to a decline in children's motivation to learn.[78] Parents of Roma and refugee children, as well as those of children with disabilities and children affected by poverty, point to the need for greater support, primarily in terms of ensuring access to new technologies and the Internet , as well as to the skills to use digital tools effectively during online classes.[79]

In July 2020, the Ministry of Education, with the support of the UN Office in Montenegro, has prepared an electronic platform for enrolment in kindergartens, primary and secondary schools. Through this e-

platform, schools will be able to offer parents online enrolment procedures in a safer, simpler, and faster way.[80] UNDP anchors this initiative through its work with the Ministry of Public Administration, and with the support of the EU, on the establishment of electronic services for citizens and the development of a national system for the exchange of data among state registers.[81] Additionally, a new portal eDnevnikMNE was developed for parents, which contains information on students' grades and behaviour.[82]

In October 2020, the Montenegrin Ministry of Education announced that students from the first to sixth grades of primary school and the first grade of secondary school (ages six to 13 and 15 to 16) would resume in-person classes. Students from other age groups will continue online learning and proceed with in-person consultations at school every 15 days.[83]

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25 See: https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Events/2019/Regulatory%20Forum/3.%20EKIP.pdf For more information please consult http://www.ekip.me/zastita/kvalitet.php (only Montenegrin language)

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31 See: https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/montenegro_report_2020.pdf

32 See: http://www.ibe.unesco.org/sites/default/files/Montenegro.pdf

33 See: The OECD 'Programme for International Student Assessment' (PISA) tests reading, mathematics and science performance of 15-year-old pupils across the world every three years. In the context of the European Union, PISA results are particularly important because they feed into the strategic cooperation framework 'Education and Training 2020' (ET2020). Correspond, they are the basis for one of the ET 2020 benchmarks: the rate of underachievers in reading, mathematics or science among 15-year-olds in the EU should be less than 15% by 2020. Underachievers in PISA are those pupils who fail to reach the minimum proficiency level necessary to participate successfully in society. More info on the PISA indicators for the EU indicators: https://ec.europa.eu/education/sites/education/files/document-library-docs/pisa-2018-eu_1.pdf

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35 See: https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/montenegro_report_2020.pdf

36 See: https://gpseducation.oecd.org/CountryProfile?primaryCountry=MNE&treshold=10&topic=PI

37 See: https://www.oecd.org/pisa/publications/PISA2018_CN_MNE.pdf

38 See: https://www.oecd.org/pisa/publications/PISA2018_CN_MNE.pdf

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3.6 REPUBLIC OF NORTH MACEDONIA

3.6.1 Overview of the education system and status of broadband

The basic principles of the national education system in North Macedonia are set in the Articles 44-48 of its Constitution, which stipulates that all individuals are entitled to education and that education shall be accessible to all under equal terms.[1] The Law on Primary Education specifies that all children from 6 to 15 years of age shall attend school for a compulsory nine years. The Law on High School Education specifies that all adolescents from the ages of 15-19 must attend high school for four years (or three years—depending on the type of school).[2] Since the early 2000s, North Macedonia has improved access to education, and actions to promote inclusiveness in the country have been carried out by the government. Moreover, important efforts have occurred since 2010 to improve education in the country.[3] Reforms in the school curriculum have been occurring since the 2014-15 academic year, and new incentives have been put in place to modernize the current, traditional teaching and learning methods and to introduce more interactive approach in the educational process.[4]

In terms of organization, the Macedonian education system is decentralized, with the State providing financial resources for education in each municipality in the form of block grants. At the policy level, the Ministry of Education and Science is responsible for developing strategic and legal documents and for defining and implementing policies for all levels of education, except pre-primary. On the other hand, pre-primary education is under the shared responsibility of two ministries: the Ministry of Labour and Social Policy and the Ministry of Education and Science.[5]

According to data from the 2019-20 academic year from the State Statistical Office of Macedonia, there are about 1,119 schools in North Macedonia—987 institutions of elementary education and 132 institutions of secondary education. These schools enrol about 254,042 students – 185,955 in elementary/primary and 68,087 in the secondary level of education.[6] About 18,272 teachers are working in regular elementary schools and about 7,479 in secondary schools.[7] A recent priority of North Macedonia has been adult education, an activity which is regulated by the Law on Adult Education and Law for Vocational Education.[8] Most recent data show that the country's public spending on education and training was 3.7% of the country's GDP in 2019, while the European Union countries' average for 2017 was 4.7%.[9] Between 2011 and 2016, North Macedonia's public spending on education as a percentage of GDP fell from 4.6% to 3.7%. The share of total government expenditure allocated to education also declined from 13.3% to 11.6%, falling below the United Nations benchmark of 15-20%.[10]

United Nations Children's Fund (UNICEF) data show that the literacy rate for the 15-24 years age group in North Macedonia corresponded to 98.6% in 2014, while the completion rate for children of primary school age is 99.5% in 2011.[11] However, the completion rate for youth of upper secondary education school was 74.4% in the same year.[12] Furthermore, as reported by the European Commission, government investment in early childhood education and care increased, and 1284 additional public pre-school places were made available in 2019. However, the overall level of enrolment remains low. Whereas the EU Education and Training target for 2020 on early childhood education and care attendance is set at 95%, only 40.2% of children from 3-6 years of age in North Macedonia were enrolled in licensed early childhood education and care institutions in the 2019/2020 school year.[13] According to UNESCO statistics, there were about 781 children out of school in North Macedonia in 2018. There is no data on out-of-school adolescents in the country.[14]

Concerning broadband development in the country, ITU data shows that 79.2% of individuals in the Republic North Macedonia used the Internet in 2018.[15] In 2019, the number of fixed-broadband subscriptions per 100 inhabitants was 21.3.[16] Moreover, according to the latest Broadband Competence Office Report[17] on the country's broadband development, the Republic of North Macedonia reports the following indicators:

- Fixed broadband coverage (% of households) is 97.97%;
- Fixed broadband take-up (% of households) is 72.9%;
- 4G coverage (% of households) is 99.4%;
- Preparedness for 5G (% of harmonized spectrum) is 22.2% (14.07.2020);
- Fast broadband (NGA) coverage (% of households) is 78%;
- Fast broadband take-up (% of households) is 27.4%;
- Ultra-fast broadband (NGA) coverage (% of households) is 43.8%;
- Ultra-fast broadband take-up (% of households) is 1.7%.

Detailed information in the National Operational Broadband Plan for 2019-2029 (NOBP) shows that coverage with fast broadband networks is roughly the same as the average in the European Union. However, the existing coverage with ultra-fast broadband networks (43.8%) is lower than the EU average (58%).[18] For enterprises (with 10 or more employees) in 2019, 85.8% of them had fixed broadband connection, an increase of 4.3 percentage points compared to the previous year.[19] Additionally, the

wholesale broadband market in North Macedonia is highly concentrated with few providers, and high wholesale broadband prices prevent investments, especially among the smaller or regional operators.[20]

Concerning the mobile sector, the mobile-broadband subscriptions per 100 inhabitants were equivalent to 69.9 in 2019.[21] Moreover, according to ITU data, 3G population coverage in North Macedonia is 99.88%, while 4G/LTE coverage is 99.5%.[22] In 2019, alone, mobile-broadband Internet traffic within North Macedonia was equivalent to 0.045 exabytes.[23]

In accordance with the instructions of two important pieces of legislation,[24] the Agency for Electronic Communications (AEC) is the responsible authority for collecting and organizing the geodetic information on broadband data development as provided by operators—physical infrastructure, equipment, etc. This geographic information is also accompanied by a short technical description of the electronic communications network and accompanying assets with a minimum set of data according to the type of electronic communication network and associated assets.[25]

Based on these legal requirements, since 2017, AEC has implemented a project to build a Web GIS Collector that (i) provides full electronic data delivery for newly built electronic communications and associated facilities, (ii) automatically verifies the correctness and completeness of the submitted data, and (iii) provides three user roles, namely for geodetic companies, operators, and AEC employees.[26] Moreover, the system supports the AEC's efforts regarding the mapping of service coverage and the availability and recognition of operators' future plans for the identification of white and grey zones to ensure more efficient allocation of state aid.[27]

3.6.2 Government strategies, status of the education quality, and the role of ICTs

In 2018, the government of North Macedonia launched the "Comprehensive Education Strategy for 2018-25" and an associated Action Plan for 2020.[28] The main priorities of the strategy include: I) developing student-centred instruction; II) measuring learning in terms of outcomes (rather than focusing solely on knowledge acquisition); and III) introducing a national assessment. Other areas of action include national curriculum reforms to make learning more relevant to the labour market. Such actions concerning evaluation and assessment and improving education quality include:[29]

- Significantly increasing the share of children in pre-school and introducing a compulsory year of pre-primary education (ages 5-6);

- Reforming the curricula and programmes for compulsory education to increase their relevance and attractiveness, better aligning them to children's stages of development and focusing more on learning outcomes;
- Supporting the development and consistent use of quality textbooks while reducing reliance on textbooks for teaching;
- Better orienting vocational education programmes towards the needs of the labour market;
- Strengthening the competence of teaching staff at all educational levels;
- Strengthening capacities at the central, local and school levels in management, and ensuring harmonised and transparent policies; and
- Developing a national assessment by 2020, a new concept for the state *matura* and final examination for secondary vocational school students, and the Macedonian Qualifications Framework.

As assessed by OECD, however, the strategic documents do not set out any specific goals for the sector. There is a notable absence of targets to raise learning outcomes, despite the country's low performance in international student assessments. The strategy also lacks an implementation plan or a defined process to monitor progress.[30]

According to results from the OECD's 'Programme for International Student Assessment' [31] (PISA) over the period from 2015-2018, North Macedonian students' scores for reading, mathematics and sciences were lower than the OECD average.[32] However, North Macedonia was the country in the region with the greatest improvement, ranking 11th from the bottom in 2018, compared with 4th from the bottom in the 2015 results.[33] Though increasing, these results are modest and remain well below the mean scores for the EU and the OECD group of countries.

In 2018, the percentage of low performers in each subject shrank by at least nine percentage points. Moreover, improvements were observed throughout the performance distribution, as the lowest- and highest-achieving students improved their proficiency between 2015 and 2018. The highest- and lowest-performing students in mathematics saw similar improvements in performance, while the highest performing students in science improved significantly more than the lowest-performing students. The difference between girls' and boys' in mathematics performance is among the highest compared to other countries. Despite that, the percentage of 15-year-old girls expecting to work as ICT professionals at age

30 is one of the largest among countries and economies participating in PISA—placing North Macedonia 1st in the rank of 77 countries.[34]

In terms of education inequality, North Macedonia has among the largest rural-urban performance gaps of all PISA-participating countries and economies. 15-year-old students in rural areas perform 47 score points behind their peers in urban settings in science (compared to the average difference across OECD countries of 17 score points). This gap is equivalent to nearly 1.5 years of schooling.[35] Limited access to educational institutions at all levels in rural areas may be one of the factors behind students' underperformance. At 61%, net enrolment in upper secondary levels in rural areas is significantly lower than in urban areas (75%).[36] Children in urban areas are also six times more likely to be enrolled in pre-primary education than their rural counterparts. Evidence indicates that learning conditions are poorer in rural settings (e.g., damaged floors, old electrical networks), reflecting the greater concentration of double-shift and satellite schools.[37]

For the primary and general secondary levels of education, it is the Bureau for Development of Education that prepares the curricula.[38] For the vocational subjects, the curricula are planned by the Centre for Vocational Education and Training.[39] As a result, North Macedonia's schools have little autonomy over the curriculum.[40] The quality assurance in the educational institutions is under supervision of the State Educational Inspectorate.[41] Other reforms also related to amendments of the curriculum proposed in the Comprehensive Strategy for Education (2018-25) have been published and some are currently underway, given that a New Law on Primary Education was adopted in 2019.[42] Additionally, a recent trend has been observed over the years, showing that the country is moving towards introducing a more competency-based curriculum in the upper secondary grades.[43]

In terms of infrastructure, indicators show that about one-third of schools in North Macedonia require major repairs, and satellite and multiple-shift schools are particularly prone to infrastructure problems—as well as lack of appropriate supplies and learning materials and insufficient support for teachers. In terms of disadvantaged groups, children and students from Roma communities continue to face barriers to regular and quality education and training. As assessed by the European Commission, separation along ethnic lines continues in education and training.[44]

In terms of school mapping and data collection, the Ministry of Education and Science has developed and implemented an Education Management Information System (EMIS) in 2010. However, an OECD-led study argues that the major factor impeding evidence-based policymaking in North Macedonia is underdeveloped and under-utilized data systems.[45] Central databases for school inspection and student

examination results, for example, are not integrated with EMIS and data are collected multiple times from schools by different parts of the ministry. Data are also not comparable across the sector, for example, as the State Statistical Office and EMIS use different definitions for key indicators like school drop-out.[46]

Data on the key indicators for education is available on the page of the Republic of North Macedonia's State Statistical Office. Relevant data from recent years on the number of regular elementary/primary, secondary, and tertiary institutions, as well as on the number of students and teachers, are available. In addition to the MakStat interactive database catalogued by school year and indicators,[47] the publication on primary and secondary education[48] also includes data such as sex, the ethnic affiliation of both students and teachers, as well as information on the language of instruction.[49] While public information on the geographic distribution of educational institutions is not available on the website of relevant bodies of the Government of North Macedonia, in 2012, USAID published a map of all primary schools in Macedonia that were a part of the USAID Primary Education Project (PEP) that ran from 2006 to 2012. [50]

With regards to the role of ICTs in schools, a 2019 OECD report on the country finds that North Macedonia has high computer-per-student ratios (0.63), similar to the average in OECD countries (0.77). In total, this amounts to more than 190,000 computers available in primary and secondary schools. However, it must be reported that most of these computers are now obsolete according to the same study.[51] Moreover, access to broadband connectivity—particularly for marginalized and low-income populations—and low levels of ICT adoption remain enormous challenges for equitable access to education in the context of the COVID-19 pandemic. While relevant government bodies have started to provide Internet access to poorer households,[52] the gap remains significant—especially in the context of disadvantaged schools and communities located in rural areas.[53] Despite the efforts made by the government to ensure the continuity of learning, the management and organization of the learning process was left largely to the discretion of individual schools and teachers.[54]

In theory, digital competencies for teachers are among general teacher competence criteria in North Macedonia.[55] However, a study has revealed that computers have only been used minimally by teachers in the country. With support from the Foundation Open Society, a Metamorphosis Foundation study on the conditions and challenges of distance education in elementary schools has shown that almost one-third of the teaching staff (31.6%) stated that their Internet access at school is limited to their mobile phone.[56] The study also reiterated the fact that there are locations where schools do not offer any Internet access. Among the numerous recommendations regarding the improvement of the IT infrastructure are those regarding the availability of educational materials for all students, especially for the students who

attend classes in the languages of the smaller communities, as well as the promotion of the use of open educational resources as an alternative to the classic textbooks and teaching aids.[57]

Regarding the ICT gaps in the context of the COVID-19 pandemic, a UNICEF survey from July 2020 with selected North Macedonian school directors, teachers, and parents, showed that access to the Internet and ICTs was a barrier for some households—37% of parents reported that children needed to share laptops and computers with other family members and others reported not having stable Internet ; only 5% reported not having access to a laptop or computer. Student-teacher communication has also been pointed out as a factor impacted by unequal access to ICTs. Almost 77% of teachers could not maintain regular communication with students during distance learning. Close to 80% of parents had difficulty supporting their children with distance learning, and close to 65% had technical difficulties accessing necessary equipment (including lack of connectivity, computer, printer, etc.).[58] Furthermore, a survey conducted by the Ministry of Education showed that at least 30,000 pupils from disadvantaged backgrounds do not have the conditions necessary to follow online classes.[59]

3.6.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

In 2002, the Chinese government donated more than 5,300 personal computers[60] to primary and secondary schools between 2003 and 2005,[61] which later supported what was to become the "E-Schools Project" of the Ministry of Education and Science, a project that ran between 2003-2008. Within this project's framework, nearly 460 computer labs in all primary and secondary schools were built.[62] Also, a series of training programs was conducted for most of the secondary and primary school teachers, focusing on the use of ICT through project-based learning strategies and networking.[63]

In 2003, the Ministry of Information Society and Administration established a partnership with USAID to co-fund the deployment of the "Macedonia Connects" (MC) project.[64] Building upon other education-related initiatives such as the Primary Education Project (PEP), this three-year project aimed to bring connectivity to rural areas using the then-existing Wi-Fi-based Internet access point infrastructure rolled out in remote areas, as well as an academic broadband network,[65] which relied largely on a Motorola-enabled wireless technology solution set—a pre-WiMAX solution.[66] The canopy solution enabled the majority of the country's rural schools to be connected to the Internet with speeds of up to 1 Mbps, and a local company called On.net was contracted to provide wireless access for all of Macedonia's schools.

Both MC Connects and PEP were USAID supported initiatives executed through the Academy for Educational Development (AED).[67]

In providing connectivity, the Ministry of Education did not favour any technology. However, broadband service provision in schools relies on asymmetric DSL which, in turn, is either dependent on the existing cooper infrastructure constructed decades ago by Macedonia's former Postal Telephone and Telegraph Service (PTT) and later transferred into the ownership of Makedonski Telekom, or on the use of infrastructure provided by USAID's Macedonia Connects Project.[68]

A 2014 World Bank assessment identified that the governmental intervention had a positive effect on local rural development and had gone beyond the results initially foreseen. In terms of schools with poor connectivity or no connectivity at all, the project enabled free broadband for educational and administrative purposes. Wi-Fi kiosks[69] supplied Internet access to 115 schools that faced fixed-line connectivity issues in the 2013-14 school year.[70]

With the end of the project in 2007, USAID announced that not only were all the nation's schools connected to the Internet , but the project design also provided coverage for access by private sector businesses, the government, individuals, etc.[71] Over time, private operators have filled the gap and have found a business case to start providing Internet access, and other operators started to drastically reduce the cost of Internet access.[72] In 2014, however, in 522 out of 680 locations, high deployment and maintenance costs still posed constraints to commercial Internet access development.[73]

In 2007, the government announced an international tender for purchasing 100,000 computers within the framework of "The Computer for Every Student" project. For that purpose, more than 20 million EUR were projected for the 2007 and 2008 Budgets—one of the largest projects relating to ICTs in education in the country, though nearly 60 million EUR were spent.[74] The Macedonian government has opted to use Client-Server based technology rather than offer one laptop per child.[75] As mentioned previously, this resulted in North Macedonia having high computer-per-student ratios (0.63), similar to the average in OECD countries (0.77), though the updating of equipment which is now obsolete proves a major financial challenge.[76]

In 2019, the government adopted the NOBP, which is an important strategy that built upon the previous ICT-related policy frameworks, comprised of the National Strategy for the Development of Electronic Communications with Information Technologies and the National Strategy for Information Society Development and Action Plan. This new plan relied on information from the national broadband mapping depicted in Section 2, as well on the expected investments by telecom operators in the near future.

Aligned with the objectives of the Digital Agenda for Europe and the EU's Gigabit Society, one of the goals of the strategy is to ensure that all public institutions (schools, universities, research centres and other educational institutions, healthcare facilities, ministries, courts, local self-governments and other state authorities and bodies) have symmetrical Internet access with a speed of at least 1Gbps by 2029.[77]

3.6.4 National responses to COVID-19 and pedagogic initiatives for distance education

On March 10th, 2020, the Government of North Macedonia closed all schools and kindergartens in the country as a result of the spread of COVID-19. Despite a swift education sector response to the COVID-19 pandemic in North Macedonia, learning losses are anticipated.[78] The government managed to mount a quick response and started to offer many options of live broadcast and on-line lessons tailored to primary and secondary institutions across the country in a variety of topics and subjects. As part of UNICEF's support under the #Inno4Edu initiative, which aims at "setting up an environment for quality teaching and learning through co-creation and innovation," two projects, in particular, stood out from the early phases of the COVID-response collaboration in North Macedonia: TV-Classroom and E-classroom.

The TV-Classroom provides educational programs for younger children in the country. It is a collaboration between the Ministry, the Bureau for the Development of Education, UNICEF, children's television producer OXO and the national broadcaster Macedonian Radio and Television. The initial classes were offered in all five languages of instruction in North Macedonia: Macedonian, Albanian, Turkish, Serbian, and Bosnian. In addition to the volunteer teachers, the educators engaged with TV-classroom are already part of a UNICEF and a UK government-funded programme to introduce social-emotional learning in pre-schools, which aims to help children cope with stress and trauma, manage their emotions and develop skills such as empathy, resilience, kindness and self-confidence.[79]

The E-classroom, on the other hand, builds on the UNICEF-supported EduIno online learning platform, a portal where students can access recorded classes, live lessons and play-based learning activities.[80] This online learning platform was already in place in North Macedonia to support early learning and was due to be launched sometime in 2020.[81] Within three days of the school closures, the Ministry and UNICEF issued a joint call for teachers to volunteer to film lessons for the platform, which counted 1,000 teachers answering the call. The classes are organised by topic and grade and are available via Eduino's YouTube channel.[82]

The E-classroom can be accessed by up to 100,000 users at the same time and is being improved continuously in response to feedback from students, parents and educators; it is registered with the domain name of the Bureau for Development of Education, the government body responsible for the country's curriculum and the professional development of teachers. Given the high access number and usability of the platform among parents, students and educators, plans are underway to expand the content still further to cover children of pre-primary and upper-secondary age and remain in place beyond the context of the pandemic.[83] The E-Classroom is also part of a UNICEF initiative funded by the United Kingdom Government through the British Embassy in Skopje, in cooperation with the Ministry of Labor and Social Policy, Ministry of Education and Science and the Bureau for Development of Education and implemented by SmartUp - Social Innovation Lab.[84]

Other initiatives include a compilation of play-based learning tools for children aged 3 to 10,[85] which feature storybooks on socio-emotional development. The materials are a combination of UNICEF resources and activities that educators across the country have prepared for EduIno.[86] Moreover, UNICEF has also compiled a list of free and open digital tools to support distance learning that can be useful for educators in North Macedonia.[87]

In August 2020, the Roma Education Fund (REF) provided hundreds of tablets with free Internet access to Roma students enrolled in primary, secondary and tertiary education levels in North Macedonia to support students with distance learning.[88] The funds have been guaranteed by the Roma Education Fund to two implementing partners in North Macedonia. The Roma Democratic Development Association (SONCE) was contracted to the amount of 20,306 EUR with the aim of improving the quality of schooling among the most vulnerable Roma children, and to invest in smart devices necessary for distance learning. Under the project, "Improving learning environment for primary school students", SONCE distributed a total of 222 tablets with free Internet in municipalities across the country.[89]

The other implementing partner of the Roma Education Fund was the Citizens' Association Romaversitas Skopje, which received 17,810 EUR order to reduce the probability of dropout among Roma students in secondary and tertiary education through the provision of mentoring and IT equipment for the student beneficiaries. Under the project "Romaversitas in emergencies, we care about your education", Romaversitas Skopje (in cooperation with the civil initiative AVAJA) awarded 210 tablets to Roma secondary school students along with 10 GB of free Internet .[90] The eligible beneficiaries are Roma students from families at risk, i.e., receiving minimum social assistance, low-income families or households which do not have adequate facilities or smart devices.[91]

As COVID-19 progressed in the country, the government announced that the 2020-21 academic year would start mostly online, except for the students from first to the third grade of primary schools and a few small classes. Government protocols also anticipated the maximum capacity of 20 students per class for effective social distancing.[92] In October 2020, North Macedonia gave greater powers to the inspection services that sanction violators of COVID's health protocols and introduced emergency teaching methods for primary and secondary schools, enabling student assessments to be carried out without their physical presence.[93]

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3.7 REPUBLIC OF SERBIA

3.7.1 Overview of the education system and status of broadband

Serbia's constitution and relevant laws guarantee that all children have access to and are included in education.[1] The country's educational system offers a free and mandatory program of primary education and preparatory pre-school levels. Secondary education is free but not mandatory. Children enter compulsory education at the age of 5.5 years old, when they start the pre-school preparatory pathway, followed by eight years of primary education—from age 7 to 14.[2] Since 2009, the Serbian government has engaged with significant changes and policy reforms in the education system, focusing on the improvement of the quality, equity and efficiency dimensions of education.[3] However, despite some progress, the quality, equity and relevance of education and training do not fully meet labour market needs, and the question of inequality in education remains a challenge in the country.[4] Due to the reforms and new national strategies on standards, teacher training and school evaluations, the educational system continues to update curricula in all 12 years of general education.[5] In the face of existing gaps concerning disadvantaged students, pieces of secondary legislation were recently adopted to provide for more effective support to students in need, including to better include minority groups such as the Roma population.

The organization of the secondary education in the country falls under the responsibility of the Serbian Ministry of Education, Science and Technological Development in cooperation with the local authorities. About 850,000 students are attending the primary and secondary levels of education in the country.[6] According to the Statistical Office of the Republic of Serbia, there were 3,317 active regular primary schools in Serbia in the 2018-19 academic year. In total, about 524,518 students attended these schools.[7] In terms of secondary education, official data show that 515 regular high schools enrolled about 249,455 students during the same period.[8]

In 2018, Serbia's expenditure on education stood at around 3.1% of GDP.[9] Serbia also received significant assistance from the European Union in improving its education system. Since 2003, the European Union has invested over 100 million EUR to reform and modernize education in Serbia. Enrolment rates remained high in both primary and lower secondary education, at close to 100%, and at around 90% in the upper secondary level. United Nations Children's Fund (UNICEF) data show that the literacy rate for the 15-24 years age group in Serbia corresponded to 99.7%,[10] while the completion rate for children of primary school age is 98.7%.[11] Moreover, the adjusted net attendance rate for youth of upper secondary school age is 98.2%.[12] However, as reported by the European Commission in 2019, only half of the children

aged three to five are attending formal early child care, while only 9% of the children from Roma settlements aged three to five are enrolled, compared to 28% of children from the richest households. Moreover, in 2017, the rate of early school leavers fell to 6.2% from 7.4% in 2015, while lifelong learning remains low at 4.4%, far below the EU 2020 target of 15%.[13]

Regarding broadband development in the country, ITU data shows that 77.4% of individuals in the Republic of Serbia used the Internet in 2019.[14] In 2010, the ITU figure for the country was 40.9%.[15] In 2018, the number of fixed-broadband subscriptions per 100 inhabitants was 17.6,[16] being the majority through xDSL (37.8%) or cable access (44.8%)[17]—although the number of users of xDSL users have been slowly decreasing over the years.[18]

Serbia's xDSL subscriptions structure has changed significantly over the years, with a significant increase of the number of users of VDSL technology accounting for 42% of the total number of xDSL users, due to greater demand for packages with greater throughput.[19] Wireless broadband access, however, has remained stable in the 2013-2018 period,[20] although the average data rates were improved by all operators in 2019.[21] While the northern districts of Belgrade and South Bačka have the highest household penetration rates in terms of broadband subscriptions, the southern districts Jablanica and Pčinja have the lowest.[22] ITU data show that 72.9% of households in Serbia had Internet access at home.[23] Moreover, Serbia is the country with the highest penetration rates for mobile services in the Balkans.[24] In 2019, the number of active mobile-broadband subscription per 100 inhabitants was 71.3.[25] With a relatively equally distributed market share, the total revenue of all mobile network operators has been constant over the last three years, but individual net realized profits are declining at the same time.[26]

For the first quarter of 2020, the Regulatory Agency for Electronic Communications and Postal Services (RATEL) reports that the majority of mobile subscriptions (around 47%) connected to the Internet benefited from connectivity speed of over 50 Mbps, while around 42% accessed the Internet at between 10 Mbit/s and less than 30 Mbit/s.[27] In comparison to the previous year, data transmission over mobile networks has shown growth, amounting to 101.3 million GB in Q1 2019, meaning that a mobile broadband subscription benefitted on average of 183 MB daily, or almost 5.6 GB a month.[28] In total, mobile-broadband Internet traffic within Serbia in 2019 was equal to 0.3 exabytes.[29] Furthermore, according to data from RATEL published in the market overview for 2018, all three MNOs have a high 3G and 4G/LTE mobile network coverage, covering between 96% and 97% of the population[30] and between 72% and 78% of the territory of the Republic of Serbia.[31]

Based on the 2014 Electronic Communications Law (Art. 53),[32] and in line with EU's BCRD, RATEL established an infrastructure mapping system in late 2016[33] with the expectation of optimizing infrastructure deployment through better planning and cost-sharing to accelerate the development of NGNs in a competitive and efficient way.[34] The data, which is subject to the request to operators, includes four main criteria consisting of: (i) type (e.g. cables, other ground pieces of equipment, antenna towers, masts), (ii) availability, (iii) geographical location, and (iv) for shared use/access only.[35] As a result, the data is displayed through a GIS web application to which only operators and RATEL have access. RATEL's current plans include an extension to reach all electronic communication infrastructure, the creation of synergies for co-deployment with other sectors (power distribution, geodetic), guidelines for infrastructure sharing and an overall, open data approach. At the moment, no plan for service mapping or investment mapping is foreseen in the country.[36]

3.7.2 Government strategies, status of the education quality, and the role of ICTs

In October 2012, the Government of the Republic of Serbia adopted the "Strategy for the Development of Education in Serbia by 2020."[37] This document focuses on making pupils literate for life in the modern world and complies with a holistic and open approach to education and its development.[38] Emphasis is placed on developing enriching teaching and extra-curricular activities (including scientific, technical and entrepreneurial activities, as well as media literacy) and improving the quality of teacher training.[39] The strategy acknowledges the need to continue equipping schools with computers and Internet connections. Given the gap between cities and villages in Serbia, the strategy encourages the use of resources provided by school libraries, and pushed for communication technologies to be used in teaching/learning.[40] According to the strategy, the most important goals in education include:

- Increasing the quality of educational processes and outcomes to the maximum attainable level;
- Increasing the population coverage at all education levels;
- Achieving and maintaining the relevance of education and conforming the education system structure to the needs of individuals, and to those of the economic, social, cultural, research, education, public, administrative and other systems;
- Increasing the overall effectiveness in the use of education resources.

According to the results of the 2018 OECD 'Programme for International Student Assessment' [41] (PISA), Serbia scored lower than the OECD average in reading, mathematics, and science.[42] The results also

indicated that mean performance in reading and mathematics improved since the country first participated in PISA in 2006; however, performance in science remained stable, on average. Across all three subjects, improvements were more marked amongst the highest-achieving students, and a widening of performance gaps was observed.[43] Following the same trend found in other Western Balkan countries, socio-economically advantaged students outperformed disadvantaged students in reading by 73 score points. This is smaller than the average difference between the two groups (89 score points) across OECD countries.

In comparison to neighbouring countries, Serbia saw students achieve higher results in all three domains, even if the results were worse than in 2012.[44] More importantly, Serbia has the highest share of students who have level four proficiency or above in reading.[45] In terms of school governance, PISA revealed that Serbia reported less staff shortage and more material shortage than the OECD average; but there was no significant difference in staff shortages between advantaged and disadvantaged schools.[46] A 2019 report by the European Commission shows that some progress was made in increasing the participation of disadvantaged students in all levels of education in Serbia. However, the implementation of measures to reduce drop-out rates and segregation has yet to be strengthened. The action plan on inclusive education has not been adopted.[47]

In terms of the national curriculum, the government recognizes that it is extensive and inflexible and uniformly applied without taking into account local conditions. Moreover, the concept of elective courses is neither well-developed nor fully implemented. As programmes are still written as a list of topics and contents, there is little correlation between the subjects, which prevents content integration and thematic teaching.[48] While the development of cross-curricular competencies is rather new, there is a long tradition of integrating digital competencies into other subjects, and this approach is now also supported by national strategies.[49]

Through the “Digital School” project, which was launched by the Serbian government in 2008, about 95% of schools (2808) obtained a computer-equipped classroom.[50] However, many schools, particularly in underdeveloped areas, still have no computers or Internet connections, nor do the children have access at home, particularly in rural areas. For instance, an OECD-led assessment revealed that approximately 9% of 15-year-old students did not have a desktop computer available to use at home.[51] Similarly, 17% of 15-year-olds in Serbia did not have a portable laptop or other device available to use at home. These indicators also pointed out that about 3% in Serbia did not have an Internet connection available to use at home.[52]

In rural areas, 38% of all households own a computer and Internet connection – mainly households with a monthly income of 600 euros and more (87.1%), and in the case of households with an income less than 300 euros – only 36.7% of households do. The gap between the urban and rural areas is large and has slightly increased relative to 2010 (the rate of growth of the number of computers in urban areas was 2.1%, but 1.4% in rural areas).[53] Moreover, the gap is not only regarding ICTs. According to the relevant data by the Serbian government, only two-thirds of schools in the country have libraries. [54]

With the adoption of the 2017 Law on the Foundations of Education System[55] and the 2018 Law on Higher Education, the Serbian government structured a Unique Education Information System (UISE), which contains four important data points relevant to school mapping: 1) a register of institutions; 2) a register of employees;a 3) a register of children, students and adults; and 4) a register of accredited study programs. The UISE was introduced in the early 2000s as the ministry's official education management information system.[56] This system maintains records in schools, in which students have been assigned a Unique Education Number (UEN). The UEN serves as a unique identifier for each child, student, and adult in the education system, enabling schools to officially provide the anonymization of data on children, students, and adults. The type of data stored in the UISE and how it should be used, updated and kept secure is regulated by the national education law.[57]

Another purpose of the UEN is to assure the data used for the calculation of statistical indicators, which, in turn, will be used for the evaluation of the education system.[58] In 2018, e-diary was developed, and it was one of the measures that enabled the quick adaptation of the Serbian education system into distance learning modality.[59] E-diary provides records on educational work at the school, as well as records of students' success and conduct. This measure was presented by the government as beneficial also to parents, as it gives them constant insight into the success and conduct of their children, introduces more transparency and reduces the need to physically go to their children's school to get information. By 2019, e-diary was introduced in all schools in the Republic of Serbia.[60]

However, there are challenges around national data collection. Before 2018, Serbia had not conducted a national assessment since 2006. Even when information is available, the lack of staff with relevant experience hinders comprehensive system evaluation.[61] As assessed by the OECD, the monitoring and evaluation of Serbia's education strategy and action plan are neither a systematic process nor are its findings made publicly available.[62]

Serbia is among the few European education systems that have developed specific frameworks referring to digital competences of teachers (Spain, Croatia, Lithuania, Austria, Norway and Serbia) or describing

the standards (Estonia and Ireland). In Serbia, the definition from the national digital competence framework puts the emphasis on the pedagogical use of technology.[63] Such a framework seeks to ensure the deliberate, flexible and safe use of the technologies, as well as improve the teaching and learning process and activities in both on- and off-line environments.[64]

In addition to the broader strategy, there is also a specific top-level policy paper on digital education. The guidelines present quantitative and qualitative data that reflect the current state of play and present 71 recommendations for further developments in this area.[65] Finally, a New Strategy for Development of Education for the period 2020-2030 is expected.[66]

3.7.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

The Serbian government has, over the past few years, provided computers and Internet connectivity to several schools across the country. Since 2017, in a collaboration between the Ministry of Education, Science and Technological Development and the Ministry of Trade, Tourism and Telecommunications, the government has been implementing the "Connected Schools" project,[67] which was an ITU WSIS Prize Contest Nominee in 2020. The project focuses on developing ICT infrastructure for educational institutions, by providing fast, stable and secure Internet access through the Academic Network of the Republic of Serbia (AMRES)[68] to all users within the institutions.

The project supports the national digital education investment programme by improving digital infrastructure and teaching materials in schools, notably through the provision of new digital equipment, the upgrade of the academic network and central locations and the rollout of Wireless Local Area Network (WLAN), as well as by providing teachers with training in digital skills. The project also envisions the development of teaching materials and teacher training in ICTs and digital skills, as mandated by the new education curricula approved by the Serbian government. The overall result anticipates an improvement in youth employability.[69]

The project's overarching goal is to connect all elementary and secondary schools in the country, which includes providing wireless local area network for over 4000 base schools and detached school units, thus encompassing approximately 850,000 students.[70] Despite these efforts, many schools, especially in rural areas far from urban centres, will not be covered by this project.[71] By November 2020, the project has enabled Internet access in 500 schools across Serbia, reaching about 11,000 classrooms and over 220,000 additional students.[72] According to public information, 10% use dark fibre (including 1G optic cables to

gymnasiums) and 85% are using DSL with a speed of 20Mb to connect with the AMRES network. The remainder is connected via mobile networks, especially schools in rural and mountainous areas of Serbia. By the end of 2021, wireless local area network will be provided in all schools in the Republic of Serbia, both in base and detached school units.[73] As an inter-ministerial project, "Connected Schools in Serbia"[74] is receiving a 70 million EUR support from the European Investment Bank (EIB), summing to a total amount of about 111 million EUR.

As part of a boosted partnership with the Serbian government, whereby it is taking on the role as the primary connectivity provider for all Serbian schools, AMRES is further participating in two pilot projects: E-education and Wi-Fi for schools. These projects leverage experience gained as a connectivity provider.

In E-education, AMRES provides the technical infrastructure for a newly tested Software for the School Information Systems (to provide information such as online class attendance, test results, and reporting for parents). This pilot is run by the Ministry of Education, Science and Technological Development, and 100 schools are currently participating in this pilot with plans to increase the total number to 200 schools by the end of the year.[75]

In Wi-Fi for Schools, AMRES is rolling out wireless networks in about 40 schools. The pilot is limited to providing Wi-Fi access to teachers in the first iteration. Also, BYOD (Bring Your Own Device) scenarios are being tested to enable Wi-Fi access to more users and a wider community.[76]

Both pilot projects target different schools with different technical setups. This allows AMRES to assess the most suitable infrastructure set-up providing insight into whether, for example, symmetric links are sufficient, or whether fibre would be required to provide such services to all schools. Moreover, eduroam is one of the services that is in the planning phase to be rolled out in schools. Currently, technical feasibility is being assessed, with an initial access limited to teachers only. In the future, there is a plan to broaden the authentication process so that not only teachers, but also students, will be able to connect to eduroam.[77]

Additionally, the "Next Generation Broadband Connectivity for Rural Schools in White Zones" project, planned within the context Western Balkans Investment Framework (WBIF), is in the preparation phase and will benefit from a 72 million EUR loan provided by the European Bank for Reconstruction and Development (EBRD).[78] This project will enable development infrastructure and interconnection of the two existing operators' networks and schools in rural (white) zones. Schools will obtain fibre connectivity (1 Gbps+), while neighbouring households (private investment portion that will follow middle-mile CAPEX

investment by the government) will obtain 30+Mbps connectivity.[79] According to the project's plans, the following results and benefits are expected:

- Completion of detailed fixed broadband availability mapping in intervention areas;
- Connection of rural-White zone schools) to broadband with appropriate speed: 600 schools (in the 2-year II phase) and 900 schools (in the III phase);
- Provision of next-generation (above 30Mbit/s) connectivity to households in rural-white zones: 90,000 households in the II phase and 135,000 households in the III phase;
- Improvement of the quality-of-education in schools, employment of IT teachers, and the integration of Internet usage training in everyday schoolwork, for students in rural-white zones;
- Improvement of the quality of living in the rural zones, due to better access to services and information, where broadband connection with appropriate speed is enabled.

School connectivity and ICT infrastructure support in educational institutions also occurred with the support of telecom operators in the country. In September 2019, Telekom Serbia announced donations of IT equipment to Serbian elementary schools within the framework of the project titled *"We Create Knowledge",* which was carried out for the third year in a row in cooperation with the Ministry of Education, Science and Technological Development. Between 2016 and 2019, the project has equipped classrooms in 60 elementary schools throughout Serbia.[80]

3.7.4 National responses to COVID-19 and pedagogic initiatives for distance education

In mid-March 2020, all education institutions closed in Serbia—preschool education, elementary and secondary schools, vocational education and training, as well as higher education institutions.[81] In a rapid and adaptive response to address the disruptions caused by COVID-19, the Ministry of Education, Science and Technological Development came up with extensive projects to address the disruptions caused by COVID-19. The government launched a centralised website intended to provide support to students, teachers and parents and to contribute to overcoming the COVID-19 emergency, including timely information on the schedule of broadcasting educational content and other relevant initiatives that contribute to the realization of the intended teaching and learning outcomes.[82]

The Ministry envisages and supports the implementation of educational activities through various channels and forms of communication:[83]

- By broadcasting specially prepared and adapted educational content for primary school students on TV channels RTS 2 and RTS 3 of the Public Media Service of Serbia;
- By establishing a repository of educational video content for primary and secondary school students on the free application "RTS My School" for mobile phones, on the RTS website and on the multimedia Internet platform RTS Planet; and
- By making available a set of tools for online communication between students and teachers.

As a result, the government reported that 770,000 students from 3,744 elementary and secondary schools in Serbia moved to distance learning through the Radio Television of Serbia (RTS).[84] According to a monitoring report by OECD, Serbia requires schools to provide any students who lack home computers with printed materials or school resources such as computers or tablets.[85] Despite these efforts in distance learning, data indicate that as much as 25% of children belonging to vulnerable groups (including Roma children in need of additional educational support and children with disabilities) have not been able to participate in distance learning due to a lack of appropriate equipment and lack of learning support.[86]

The Office for IT and e-Government of Serbia also launched a portal called Digital Solidarity,[87] where it publishes in one single place all the information about free platforms for distance learning, work from home, free online books, courses, movies, music, television content during the COVID-19 pandemic.[88] Accordingly, the government also called upon all companies and other organisations that are ready to enable a free-of-charge use of their digital platforms, content and solutions to citizens, businesses and countries to apply. The United Nations Development Program (UNDP) helped the Government of Serbia to consolidate more than 90 tools and services on this platform, including options for educational and cultural materials.[89]

In addition, the Ministry of Education has launched an e-learning management system named Moja Škola (My school)[90], which is an open-source software widely used in Serbia to access lessons hosted on the state broadcaster's video-on-demand service.[91] Moreover, schools have also been instructed to come up with their own ways of conducting distance learning using collaboration software, and a number of textbook publishers have offered free digital versions to students in the country.[92] Additionally, the Serbian government received support from UNICEF and purchased the software *Camtasia* for recording distance learning classes in schools—which had about 79 software licenses procured.[93]

Government responses also supported the use of other digital tools through public-private partnerships. For example, Microsoft and their local partner *Informatika* prepared instructions for teachers on the use

of its Office 365 platform.[94] The video-conference platform Zoom started to be offered in schools across Serbia through free Internet by MTS Telecom and Telenor mobile networks. Additionally, the Ministry of education also formalized cooperation with the Viber app.[95] Local press also reported that students followed classes on television through many online platforms such as Google Classroom.[96]

It was also announced that a local hardware company Comtrade donated the platform "My classroom TeslaEDU" for online teaching and testing of students of the final year of elementary school. This platform was free for teachers and students during the crisis. Furthermore, students enrolled in the eighth and final year of elementary school, who did not have access to online classes, got Internet and devices (mobile phones and tablets) from Huawei (100 tablets), Comtrade (300 mobile phones), Telecom (800 Internet cards and 800 mobile phones), VIP (800 Internet cards and 400 mobile phones) and Telenor (with the same total as VIP).[97]

From preschool to primary, secondary, higher and adult education, the European Union's ongoing assistance to education in Serbia totals 35 million EUR, which has helped the country to acquire equipment for the preparation and delivery of teaching, but also teacher training,[98] infrastructure improvement and curricula modernisation.[99] EU assistance in IT-related tools in the country alone is worth 3.2 million EUR.[100] In the context of COVID-19, EU funding also supports distance and online education in Serbia.

UNICEF and the Government of Serbia, with support from the European Union, are also addressing questions about the prevailing digital divide in the country, and how it is affecting learning outcomes across different communities and geographic regions.[101] For example, UNICEF has already supported national education authorities to provide distance learning, thus supporting over 790,000 children.[102] In particular, the Ministry of Education has engaged with UNICEF to develop a national response plan of the preschool education system to the COVID-19 pandemic, with a focus on preschool children and their families. Additionally, the Government of Serbia has expressed interest in UNICEF's RapidPro platform, an open-source platform of applications that can help governments deliver rapid and vital real-time information and connect communities to lifesaving services.

Concerning teacher training in ICTs, UNICEF has assisted the Ministry of Education in supporting teachers with the development of interactive materials for the national platform of online learning, thus ensuring teacher training in digital skills. A newly instated web portal with a repository of resources for psychologists and pedagogues to help teachers in preparing teaching materials for distance learning is also underway as part of the partnership between Ministry of Education, UNICEF and the Pedagogic Society of Serbia.[103]

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3.8 TURKEY

3.8.1 Overview of the education system and status of broadband

Article 42 of the Constitution of the Republic of Turkey states that no one shall be deprived of the right to education, which is free of charge for compulsory education.[1] Founded in 1924, the contemporary Turkish education system established new secular schools based on contemporary scientific and educational principles, under the supervision and control of the State.[2] With the implementation of reforms and the development of the country in past decades, education has become central to Turkey's emergence as a unified republic.[3] In 2012, Turkey increased compulsory schooling from 8 to 12 years, with the aim of expanding participation in upper secondary education. The school starting age was also lowered from 6 to 5.5 years. The system in Turkey includes optional pre-primary (O*kul Öncesi*) education for children from age three to six years, as well as compulsory primary education (*İlköğretim*) for all children from age 5.5-7 to 14-15. The first part of compulsory education lasts eight years (1st to 8th grade), and it is also free at public schools. Secondary education (*Lise*) is for students from age 14-15 to 18-19 and lasts four years (9th to 12th grade). It includes general, vocational, and technical high schools.[4] This model is known as the "4+4+4 model."[5]

In terms of organization, Turkey has a highly centralized governance structure where education policy is steered by the Ministry of National Education and, at the tertiary level, by the Council of Higher Education (YÖK). There are about 54,000 public and private schools in the country employing over 1 million teachers and enrolling nearly 18 million pupils throughout the country (2018-19),[6] thereby making Turkey the largest school system in Europe by far.[7] Given the magnitude of the system operating in a centralised manner, schools also face challenges in determining curriculum and assessment policies. As noted by the OECD, among European countries, only in Greece and Luxembourg does the central government concentrate a similar degree of decision-making authority, and their school systems are markedly smaller than Turkey's.[8] As a result, coordination across directorates throughout the country is challenging.[9] The country has signalled its intention to decentralize education governance, but the delegation of responsibilities to local governments or schools is yet to be accomplished.[10]

Although nearly all public funding for education in Turkey comes from the central government, it is often the case that schools have little autonomy and capacity to address their local needs. This means that it falls under the purview of the Ministry to determine the allocation of human and financial resources to schools via its Provincial Directorates.[11] To meet the demands of a fast-growing education system, the overall expenditure on education in Turkey substantially increased in recent years. The most recent data

show that the country's public expenditure on education was 5.8% of the country's GDP in 2018 (and 5.7% in 2017)[12], while the European Union countries' average for 2017 was 4.7%.[13] The level of education which witnessed the steepest increase from 2017 to 2018 (regarding education expenditure by financing source) was upper secondary education with 26.2%. This was followed by lower secondary school with 22.7%. Turkey is also known for having one of the highest shares of educational spending coming from private sources, including international sources, in comparison to OECD countries. Despite increases in overall spending, Turkey's per-student spending is around half the OECD average for primary and secondary education and around two-thirds at ECEC and tertiary levels.[14]

In recent years, government-led efforts aimed at enhancing access to education, improving the quality of education and training, as well as revamping the institutional capacity of the education system have been the focus of the country's strategies. As a result, Turkey has become one of the few countries that managed to improve student achievement while increasing access to education.[15] United Nations Children's Fund (UNICEF) data show that the literacy rate for the 15-24 years age group in Turkey corresponded to 99.8% in 2017,[16] while the completion rate for children of primary-school age was 98.4% in 2014.[17] However, the completion rate for youth of upper-secondary-education-school age was 47.5% in 2013.[18] Over the years, there has been a positive increase in the net enrolment of students, particularly in pre-school education, which increased from 58.8% in 2017 to 66.9% in 2018. Moreover, the net enrolment rates in primary school increased from 91.2% in 2017 to 91.7% in 2018 yet fell in lower secondary school from 95.7% to 94.5% over the same period. In secondary education, the net enrolment rate increased from 82.5% in 2017 to 83.6% in 2018.[19] According to UNESCO numbers, there were about 266,561 children and 334,401 adolescents out of school in 2018 alone.[20]

Concerning broadband development, data from the Turkish Information and Communication Technologies Authority (BTK - *Bilgi Teknolojileri ve İletişim Kurumu*) for the first quarter of 2020 shows that 79.0% of individuals in Turkey used the Internet —an increase compared to official ITU data[21] from 2019 standing at 73.98. In 2018, the number of fixed-broadband subscriptions per 100 inhabitants was 17.1.[22] BTK data which will feed into ITU 2020 statistics show that 90.7% of households in Turkey had Internet access at home, either via fixed, mobile or other services, in 2020.[23] While 50.8% of households used fixed broadband connection (ADSL, cable, optic fibre, etc.), as reported by Turkstat,[24] ITU data shows that 98.6% of households relied on mobile broadband connections to access the Internet . Over the years, fixed-broadband usage has increased considerably, reaching about 3.3 million subscriptions relying on

fibre technology (FTTH/FTTB) by the first quarter of 2020. In 2019, 93.3% of enterprises used a fixed-broadband connection to access the Internet .[25]

BTK data also shows that Turk Telekom has the widest fibre infrastructure in the country with a 308,000-kilometre network, while other operators' fibre length was 89,000 kilometres in 2020.[26] Compared to the OECD average of 31.4% fixed broadband population penetration rate, Turkey has important growth potential with its 17.5% penetration rate.[27]

According to the latest BTK data, in the first quarter of 2020, the number of active mobile-cellular subscriptions per 100 inhabitants was 98.4,[28] while the same official ITU data from 2019 reports 96.8%.[29] Moreover, according to ITU statistics, mobile broadband subscriptions per 100 inhabitants amount to 74.8.[30] 4G LTE networks are well developed and cover about 98% of the population in the country;[31] the official figure for 2019 stood at 96.7%.[32] In 2019, the mobile-broadband Internet traffic within the country corresponded to 4.1 exabytes.[33] As of 2020, BTK data show that the average monthly mobile data usage per active LTE subscription in Turkey was 9.1 GB. In terms of broadband mapping, no information has been made publicly available for Turkey.[34]

3.8.2 Government strategies, status of the education quality, and the role of ICTs

Since 2010, the government has developed five-year strategic plans with the objective of setting out clear targets for medium-term goals to inform work at the central, provincial, and district levels. In 2018, the Ministry of National Education launched the document entitled, "For a Stronger Tomorrow: Education Vision 2023,"[35] aiming to reform the education system starting from the four central elements of the document: students, parents, teachers and schools. Building upon the previous "Strategic Plan of Ministry National Education (2015-2019),"[36] the new Turkey Education Vision 2023 promotes a holistic, human-centred approach to education. There are 8 concrete targets:[37]

- Reduce gaps between schools;
- Improve school learning environments;
- Improve the attractiveness of vocational educational training (VET);
- Reduce exam pressure;
- Develop 21st-century skills;
- Improve educators' job satisfaction;

- Expand Early Childhood Education and Care (ECEC); and
- Improve inclusive practices for students with special educational needs

The vision establishes 44 sub-goals based on equity, inclusiveness, quality and effectiveness in teaching. It also is aligned with other recommendations from the OECD in terms of student agency, school governance and evidence-based decision-making.[38] Each of the main goals has a policy timeline, often including piloting phases. While the goals set as solutions to well-identified problems, the document does not present details on the methods or action plan for each of the 44 sub-goals. The Education Vision 2023 School Development Model aims for a more equal and inclusive allocation of funding, by taking into account differences between students, schools and geographic locations throughout the country.[39]

According to 2018 results from the OECD's 'Programme for International Student Assessment'[40] (PISA), Turkey's scores for reading, mathematics, and science were lower than the OECD average.[41] In particular, Turkey's mathematics scores increased by 4.1 score points and science by 6.1 in 2018.[42] However, in comparison to the results from 2009 or 2012, the 2018 results show that, in all three subjects, the country's mean performance was not significantly different, though higher than the levels observed in 2003 and 2006. If taken into account, the 2015 results—which were considerably lower—were anomalous, and neither the decline between 2012 and 2015 nor the recovery between 2015 and 2018, reflect the long-term trajectory. Overall, the educational outcome trajectory is positive in both mathematics (over the 2003-18 period) and science (2006-18). In mathematics, improvements were more pronounced at the bottom of the performance distribution, amongst the lowest-achieving students, who caught up to the higher-performing students. About 27% of said students were enrolled in a disadvantaged school.[43]

Another identified trend by the OECD shows that these numbers might reflect the period of rapid expansion of secondary education in Turkey and the fact that educational attainment has been positive in the country.[44] For instance, between 2003 and 2018, Turkey added more than 400,000 students to the total population of 15-year olds eligible to participate in PISA; consequently, the proportion of 15-year-olds covered by PISA samples more than doubled, from about 36% in 2003 to 73% in 2018. This expansion in education opportunities likely dampened a more positive underlying trend in student performance. Indeed, a simulation that assumes that the top-scoring 25% of 15-year-olds were eligible to take the test in any given year shows a positive trend amongst this population in mathematics (since 2003) and science (since 2006) Furthermore, Turkey's growth in the share of young adults with an upper secondary

qualification was the second largest among OECD countries between 2008 and 2018 and the largest at the tertiary level.[45]

A 2019 evaluation by the European Commission states that quality and inclusiveness are amongst the main priorities in reducing disparities between urban and rural areas. It reiterates the importance for the country to increase the quality of teachers through continuous professional development and in-service training, reducing gender inequalities, updating curricula to include transferable skills, etc.[46] In the context of inclusion, UNICEF reports that different groups of vulnerable children face different challenges in Turkey, with refugee children particularly at risk of not accessing any form of education. It highlights that, in 2016, only about 320,000 refugee children were enrolled in school (approximately 36% of the school-age refugee population), posing a significant challenge for the education sector to accommodate an unprecedented number of additional children in school.[47] Other non-native Turkish speakers might also be at disadvantage.

Another poignant issue is the unequal access to primary and secondary education as it relates to gender.[48] Turkey is still behind other countries in the European region in terms of gender parity index at all stages of education, as well as for the expected number of years formal schooling for females from primary school to higher education.[49] As a result, the proportion of girls not enrolled in preschool or elementary school is higher than for boys.[50] Moreover, while gender diversity in secondary education has shrunk, gender inequality, especially in the eastern region of Turkey, remains at a significant level. This observation is also relevant to the context of ICTs access and distance learning. A recent study by the World Bank also showed that girls may be more disadvantaged than boys in accessing home-based education in Turkey in the future, as they are expected to undertake more household chores, particularly in large and/or conservative families.[51]

The proposed curriculum-related changes articulated in Turkey's Education Vision 2023 make the case for more flexible learning, which shall be linked to skills sets across all educational levels. This would allow for a curriculum tailored and organized according to the interests, skills and goals of students. As a result, the government envisions a common and country-wide curriculum that emphasizes production, active learning, interaction and deepening in topics instead of traditional testing and lecturing. In this context, the plan includes the establishment of design-skill workshops that will serve as the instrument of such an approach toward the national curriculum, and which had already begun as a pilot program during the 2019-2020 academic year. Furthermore, the strategy also sets out that in-classroom hours and types of compulsory lessons shall decrease so that a more modular schedule is possible.[52]

In terms of school mapping and data collection,[53] Turkey's Education Vision also sets critical goals for monitoring, evaluating, and developing management and learning activities nationwide. The document sets the foundation in this matter by identifying that one of the most pressing needs of the Ministry of National Education is to implement system integration and design as a result of the process and functional analyses. In particular, the strategy foresees four particular goals that are relevant for school mapping:[54]

- An online platform will be established by which the ministry and school administrators can monitor school development plans at the district, provincial, regional, and national levels;
- A Geographical Information System will be established to identify the capacities of schools in the planning of educational resources;
- A new platform will be developed on the Data Information System, and this platform will ensure interaction among teachers-parents schools;
- Students in need of support will be identified through data analysis, and necessary actions will be included in the school-level development plans.

In this context, the government made available an e-school module supported by the MEBBIS (Ministry of National Education Information Systems) database, which can be accessed by all schools. School administrators, teachers, students and parents can annually feed data into the system through the self-evaluation design, which in return offer schools the data necessary to develop self-improvement plans. The tool aims to aid in school empowerment and is part of the school decentralisation plans.[55]

Furthermore, within the aforementioned scope reflected in Turkey's Education Vision 2023, in 2019 the Turkish government launched the Ministry of National Education Geographical Information System (MEBCBS), which includes data on schools as well as facilities that are affiliated with the Ministry.[56] The Ministry emphasized that the GIS information pertaining to schools is key for the successful activities related to planning, producing, monitoring and supervising schools, as well as in developing modern, environmentally-friendly and original infrastructure.[57] A list of all schools and their geographic data, filtered by provinces, is available on the Ministry's website.[58] For each school, it contains relevant information such as the number of classrooms, as well as numbers of teachers and students.

In terms of access to ICTs and broadband in the school environment, initiatives to reduce the gap have been taken by the government, particularly to expand the number of computers and computer classes in primary and secondary schools and provide increased access to the Internet through community use of

school computers.[59] According to OECD data, there are 0.16 computers per student in the country, amounting to over 2.5 million PCs available in schools, though this is far from the OECD average of 0.77.[60]

Despite that, 2018 PISA results show that only 61 % of 15-year-old students in Turkey had access to both computer and Internet at home. There was also a wide gap in access across socio-economic strata. While 92% of students of the richest quintile had access to computer and Internet at home, only 22 % of students of the poorest quintile did.[61] Moreover, gaps in digital literacy in the educational context have been identified. In the International Computer and Information Literacy Study (ICILS) 2013, Turkey stood last among the 21 participating education systems, and 67 % of grade 8 students in Turkey did not have a functional working knowledge of computers (as compared to ICILS 2013 average of 17 %).[62]

3.8.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

Public-private partnerships between Intel and Turkish organizations have been in place to support ICTs and connectivity in the school context. They include, for example, “My First PC Initiative”, which occurred thanks to a partnership between Intel, Microsoft, Turk Telecom and the Ministry of Education to provide 75,000 families with a technology package that included a low-cost computer with Microsoft software, free ADSL Internet connections, parental control software, and after-sales support. Through another public-private partnership, approximately 220,000 PCs had been donated for school labs across Turkey by 2008, and the acquisition of laptops by teachers was facilitated across the country through economic subsidies and affordable instalment plans.[63]

In 2010, Turkey launched a project entitled, “Movement to Enhance Opportunities and Improve Technology (Firsatlari Arttirma ve Teknolojiyi Iyilestirme Hareketi—FATİH)[64] with the goal of extending and enhancing the use of ICTs in pedagogic practices and learning.[65] Initially, the project was a collaborative effort led by the Ministry of National Education with the support of several other ministries such as the Treasury and the Scientific and Technological Research Council. Over time, FATİH became one of the leading projects seeking to foster digital skills and bridge the ICT gap found in Turkish schools. FATİH’s line of actions included:

- Establishing the necessary infrastructure, including broadband Internet connection, tablets, interactive boards, and online platforms;
- Developing and managing online educational content and resources;

- Promoting the effective application of ICT in teaching programmes;
- Offering professional development to teachers including face-to-face and online training; and
- Ensuring the ethical, reliable, manageable, and measurable use of ICT.

The project's expected results include connectivity and use of ICTs in the following levels: I) For every school: VPN-Broadband Internet Access, Infrastructure and High-speed access; II) For every classroom: Interactive Board and Wired/Wireless Internet Access; III) For every teacher: EBA[66] applications, EBA Market, Cloud Account and Sharing Course Notes; IV) For every student: EBA Market, Cloud Account, Digital Identity, Sharing Homework and Individual learning Materials.

The FATiH project was initially intended to run for five years, with Phase 1 focused on high schools, Phase 2 on vocational schools and Phase 3 on primary and pre-schools.[67] According to an assessment by Research Triangle Institute from 2013, the early phase of national roll-out benefited 84,000 classrooms, and 63,000 tablets were distributed.[68] Professional development opportunities related to ICTs have also been in place to support the pedagogies of more than 680,000 teachers in the country.[69] Concerning distance learning, FATİH also fostered the establishment of clusters as 'Distance Learning Centres' across all provinces to facilitate professional development in the future. Administrative support was strengthened: by 2018, there were 500 FATİH trainers in schools helping to solve school-level issues, with a further 700 rotating between schools.[70]

A 2020 OECD observation of the FATİH project indicates that the targeted coverage of the digital infrastructure reached 47,158 schools by 2019, more than the original target of 40,000 schools.[71] By 2015, over 700,000 tablets had been distributed to upper secondary level students and teachers in 81 cities.[72] By 2019, the number of distributed tables increased to over 1.4 million.[73] Moreover, nearly 430,000 Interactive White Boards (IWBs) were installed and approximately 1 million teachers had enrolled in either online or onsite professional development.[74]

In summary, a total of 3,100 schools from Phase 1 and 10,500 schools in Phase 2 have been actively connected to the Internet through the project.[75] In 2020, approximately 13.800 schools are equipped with VPN broadband created exclusively for the FATİH project, and 13,229 schools have been actively using the service.[76] Moreover, there are about 2,072 schools without wired Internet network access that are being provided with mobile network and 1.206 schools with satellite Internet .[77]

In June 2020, the World Bank approved a 143.8 million EUR loan to Turkey for the development of the "Safe Schooling and Distance Education Project," which is to be implemented by the Ministry of National

Education. The goal of this project is to enhance the capacity of the education system to equitably provide e-learning to school-age children during and following the COVID-19 pandemic and future shocks.[78] Moreover, the project also intends to focus on the needs of vulnerable students—children and youth in remote areas, communities of low-income backgrounds, the disabled, refugees and other non-native Turkish speakers.[79]

More specifically, the project entails three main components:[80]

- Emergency Connectivity and IT Infrastructure for Education in Emergencies. This component finances the expansion of the country's e-learning platform, Digital Education Platform (EBA), as part of the Ministry's response to COVID-19. The component also supports the development and roll-out of a New Digital Education System (NDES) for the future.
- Digital Content for Safety and Quality. This component will finance goods, services, consultants, training and small refurbishments to support the distance education content, during the period of school closures due to COVID-19, for a gradual return to classroom-based teaching, and to strengthen blended teaching and learning (classroom-based and online).
- Institutional Capacity for Education Technology Resilience. This component will strengthen the Ministry's capacity for the coordination, management, monitoring and evaluation of the Project and the continued delivery of safe and equitable digital education services.

Concerning equity and connectivity, the project also includes strategies to support access to the Internet and digital resources. For students from poor and vulnerable families without Internet and digital devices, the project will leverage partnerships with schools, municipalities and other organizations already supporting home-based schooling in low-income households, to extend these models in other areas. Vulnerability mapping and an analysis of closing the digital gap is planned, and it is expected to tackle the potential social inequalities in access and outcomes.[81] Additionally, there are planned activities to address gender-based distance education needs as well as risk mitigation, and monitoring indicators are disaggregated by gender.[82]

Furthermore, the 'Digital Content and Pedagogy for Safety and Quality' component, which will use nearly one-third of the project's total budget, has a direct relation to broadband development in the school context. Under this umbrella, funds are expected to be used to mobilize and motivate public partnership for broadband access by education stakeholders. This component also encompasses the establishment of an EdTech Innovation Hub, which will support the development, testing, and roll-out of more than 30,000

new digital educational materials and pedagogical tools for K-12, special education and blended learning.[83]

3.8.4 National responses to COVID-19 and pedagogic initiatives for distance education

On March 13th, the Turkish government announced the closure of schools of all levels as a way to slow down the spread of COVID-19 in the country.[84] According to an OECD-led assessment, policies implemented over recent years, such as the expansion of open education, the Movement to Enhance Opportunities and Improve Technology project (2010) and higher education's Digital Transformation Project (2017) played an important role in Turkey's response to online learning in the context of COVID-19.[85]

In mid-April 2020, the Turkish Ministry of National Education's Directorate General of Innovation and Education Technologies launched a free hybrid TV-online ad hoc model expanding the EBA project,[86] thus becoming the cornerstone of Turkey's educational response to the COVID-19 pandemic. As a two-fold strategy for distance learning involving both broadcasting lessons on TV and—as complementary catch-up measure—utilizing digital learning and teaching resources to deliver curriculum via EBA, the project covers the main subjects articulated in the country's curriculum, thus serving nearly 18 million students[87] as well as their teachers and parents.[88] Three TV channels have been reserved to undertake the project in the context of the pandemic,[89] including the establishment of a TV channel called Eğitim Bilişim Ağı TV[90] (Educational Informatics Network TV [EBA TV],[91] in partnership between Turkish Radio Television (TRT) and EBA).[92] As of mid-October 2020, the Ministry reported that 10,703,812 students and 842,438 teachers have actively benefited from the online EBA platform.[93]

While the EBA website was already underway as early as 2011 in Turkey,[94] local press has reported that EBA has been recently re-developed in order to offer user-friendly, pedagogical, suitable, reliable and accurate e-content for all grades supported by smart technologies such as artificial intelligence—especially for 11th and 12th grades. Before the pandemic, in 2018, a report by the Ministry showed that EBA had already received nearly 1 billion visits,[95] which paved that way for EBA to become the cornerstone of distance learning in the context of COVID-19.

More recently, the platform also began to host live synchronous classes (with priority to those teaching national examination candidates), and machine learning-powered adaptive support tools.[96] There are more than 1,600 lessons, as well as more than 20,000 interactive types of content available. Thousands

of books and a question bank to be used by teachers are also available, and the online resources can be accessed via desktop, tablets, mobile phones and other smart devices. The three major MNOs in the country also offered 5-8 GB of free data access for those enrolling in the EBA platform.[97] Data from the EBA platform allows teachers and families to track the students' progress and overall learning performance.[98]

Additionally, the Ministry of Education announced a collaboration with Turkish Radio Television (TRT) and Turksat, whereby they launched 3 HD and 3 SD education channels for all K-12 students. The Ministry offers hotline support via a call centre staffed by 1,375 counsellors based across the country to provide support to students and their families. The Ministry has also provided guidebooks to parents with relevant information on how to help youth keep up with the distanced classes.[99] In addition, the Turkish government has continued with numerous courses to teachers via both EBA and a YouTube channel. With support from UNESCO, Turkey developed 17 new online courses aiming at reaching around 125,000 teachers during the closures. Despite the significant developments and outcomes, there are still many students who cannot participate in distance learning due to lack of access to ICTs, high-speed Internet , and a financially stable household.[100]

With the initial re-opening phase of schools in late August, the government also created so-called EBA Support Point areas, which were established in schools and institutions to ensure network access for students who do not have a computer or Internet access at home.[101] Moreover, with UNICEF support, the Turkish Ministry of National Education has improved EBA's bandwidth of coverage of the EBA distance learning platform. In this context, local press in Turkey has also reported that the government finalised the procurement process of acquiring 500,000 tablets, and that the distribution of these devices shall be completed by the end of 2020.[102]

Concerning inclusion and information sharing tailored to minority groups, UNICEF has collaborated with the Turkish government on sending information related to COVID-19 to support Syrian refugees using Rapid Pro SMS technology. The messages included tips on parenting during the COVID-19 pandemic, as well as information on school registration and distance learning.[103] Moreover, UNICEF reports that Syrian and vulnerable Turkish families across Southeast Turkey continued to receive daily phone calls and WhatsApp messages from a network of more than 200 teachers containing tips, instructions and guidance for parents and caregivers on key early learning activities.[104] EBA Support classrooms for vulnerable children who need education support in accessing distance and online learning have been established in

the Hatay province.[105] Other projects on Syrian refugees and distance learning have also taken place with support from UN agencies,[106] as well as from NGOs such as Télécoms Sans Frontières (TSF).[107]

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39 See: http://www.oecd.org/education/policy-outlook/country-profile-Turkey-2020.pdf

40 See: The OECD ‘Programme for International Student Assessment’ (PISA) tests reading, mathematics and science performance of 15-year-old pupils across the world every three years. In the context of the European Union, PISA results are particularly important because they feed into the strategic cooperation framework ‘Education and Training 2020’ (ET2020). Correspond,

they are the basis for one of the ET 2020 benchmarks: the rate of underachievers in reading, mathematics or science among 15-year-olds in the EU should be less than 15% by 2020. Underachievers in PISA are those pupils who fail to reach the minimum proficiency level necessary to participate successfully in society. More info on the PISA indicators for the EU indicators: https://ec.europa.eu/education/sites/education/files/document-library-docs/pisa-2018-eu_1.pdf

41 See: https://www.oecd.org/pisa/publications/PISA2018_CN_TUR.pdf

42 See: http://www.oecd.org/education/policy-outlook/country-profile-Turkey-2020.pdf

43 See: https://www.oecd.org/pisa/publications/PISA2018_CN_TUR.pdf

44 See: https://openknowledge.worldbank.org/bitstream/handle/10986/27852/754470NWP0Box30pportunity0Education.pdf?sequence=1&isAllowed=y

45 See: educational attainment has been positive

46 See: https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/20190529-turkey-report.pdf

47 See: https://www.unicef.org/turkey/media/6636/file/UNICEF%20TURKEY%20ANNUAL%20REPORT%202018.pdf

48 See: https://www.unicef.org/policyanalysis/files/Eliminating_Gender_Disparity_in_Primary_Education_Turkey(1).pdf

49 See: https://www.researchgate.net/publication/287268677_A_Comparison_of_Gender_Inequality_in_Turkish_Education_System_with_that_of_EU_Countries

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52 See: https://www.conexioconsulting.com/2023-turkey-education-vision-announced/

53 See: https://mebbisyd.meb.gov.tr/

54 See: http://planipolis.iiep.unesco.org/sites/planipolis/files/ressources/turkey_education_vision_2023.pdf

55 See: https://www.oecd-ilibrary.org/sites/a85d5b7b-en/index.html?itemId=/content/component/a85d5b7b-en

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59 See: http://documents1.worldbank.org/curated/en/873111468120293312/pdf/691700ESW0P12000Broadband0in0Turkey.pdf

60 See: https://gpseducation.oecd.org/IndicatorExplorer?plotter=h5&query=34&indicators=N051*N055*N160*S016*S017*S018*N052*N056*N057*R001*R005*N037*N038*N039*N040*N041*N042*T012*T013*C076*P005*P006*N050*T037*A256*A258*A263*A264*A265*P819*N122*N123*N236*N237*N238*N239

61 See: http://documents1.worldbank.org/curated/en/788991593396173808/pdf/Turkey-Safe-Schooling-and-Distance-Education-Project.pdf

62 See: https://www.iea.nl/studies/iea/icils/2013

63 See: https://www.intel.com.br/content/dam/doc/case-study/learning-series-elearning-in-turkey-study.pdf

64 See: http://fatihprojesi.meb.gov.tr/en/about.html

65 See: https://blogs.worldbank.org/edutech/observing-turkeys-ambitious-fatih-initiative-provide-all-students-tablets-and-connect-all-classrooms

66 EBA stands for Eğitim Bilişim Ağı (Education Information Network) and is website that has been designed and is currently run by the Innovation and Educational Technologies General Directorate, which is affiliated with the Turkish Ministry of National Education. The network is the foundation portal that offers online access to the teachers and students for course materials under FATİH project.

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68 See: https://www.rti.org/publication/turkeys-fatih-project/fulltext.pdf

69 See: https://www.rti.org/publication/turkeys-fatih-project/fulltext.pdf

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72 See: https://www.oecd-ilibrary.org/sites/a85d5b7b-en/index.html?itemId=/content/component/a85d5b7b-en

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74 See: http://www.oecd.org/education/policy-outlook/country-profile-Turkey-2020.pdf

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76 See: http://fatihprojesi.meb.gov.tr/en/altyapi-erisim.html

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78 See: https://www.worldbank.org/en/events/2020/09/24/responding-to-covid-19-looking-beyond-lessons-from-turkeys-education-emergency-response-digital-education-reforms-for-new-way-of-teaching-learning

79 See: https://www.worldbank.org/en/news/press-release/2020/06/25/responding-to-covid-19-and-looking-beyond-turkey-invests-in-safer-schooling-and-distance-education-with-the-world-bank-support

80 See: http://documents1.worldbank.org/curated/en/788991593396173808/pdf/Turkey-Safe-Schooling-and-Distance-Education-Project.pdf

81 See: http://documents1.worldbank.org/curated/en/788991593396173808/pdf/Turkey-Safe-Schooling-and-Distance-Education-Project.pdf

82 See: https://www.worldbank.org/en/news/press-release/2020/06/25/responding-to-covid-19-and-looking-beyond-turkey-invests-in-safer-schooling-and-distance-education-with-the-world-bank-support

83 See: http://documents1.worldbank.org/curated/en/788991593396173808/pdf/Turkey-Safe-Schooling-and-Distance-Education-Project.pdf

84 See: http://www.meb.gov.tr/bakan-selcuk-koronaviruse-karsi-egitim-alaninda-alinan-tedbirleri-acikladi/haber/20497/tr

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87 See: https://www.dailysabah.com/turkey/education/turkey-2nd-country-with-nationwide-remote-education-after-china-education-minister-says

88 See: https://medium.com/@goyucel/education-children-and-covid19-the-turkish-model-a8cd07d2c6f0

89 See: https://www.unicef.org/turkey/en/media/11411/file

90 See: https://epale.ec.europa.eu/sites/default/files/asas.pdf

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92 See: https://epale.ec.europa.eu/en/content/turkey-online-education-starts-amid-covid-19-outbreak

93 See: https://reliefweb.int/report/turkey/unicef-turkey-covid-19-response-monthly-situation-report-october-2020

94 See: https://epale.ec.europa.eu/sites/default/files/asas.pdf

95 See: http://sgb.meb.gov.tr/meb_iys_dosyalar/2019_03/01175437_MillY_EYitim_BakanlYY_2018_YYlY_Ydare_Faaliyet_Raporu_YayYn2.pdf

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102 See: https://www.aa.com.tr/en/turkey/turkey-to-resume-distance-learning-as-of-nov-20/2048518

103 See: https://reliefweb.int/report/turkey/unicef-turkey-covid-19-response-monthly-situation-report-october-2020

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3.9 UKRAINE

3.9.1 Overview of the education system and status of broadband

In accordance with Article 53 of the Constitution of Ukraine, everyone is entitled to the right to education.[1] In addition to ensuring accessible and free education, the constitution also states that citizens who belong to national minorities are guaranteed, in accordance with the law, the right to receive instruction in their native language or to study their native language in state and communal educational establishments and through national cultural societies.[2] With the recent reforms, the New Law on Education (of September 5, 2017, No. 2145-VIII) considers education as the basis of intellectual, spiritual, physical and cultural development of individuals as well as collective values for the country's development.[3] In 2018, Ukrainian compulsory schooling was extended from 11 to 12 years, as it now includes four years of elementary education, five years of middle school education and three years of upper secondary (specialized) education. Education is compulsory through grade 12.[4]

In terms of organization, Ukraine operates a centralised education system[5] managed by the Ministry of Education and Science located in the country's capital of Kyiv. In total, there are more than 5 million students enrolled from pre-primary to upper-secondary education in Ukraine.[6] According to UNESCO data, about 1.7 million pupils were attending primary education in Ukraine in 2017.[7] Moreover, the number of schools in Ukraine is 16,317. Of these, 16,176 institutions are of secondary education, and they enrol about 3.9 million students and employ 441,000 teachers.[8]

School funding is provided through an education subvention. Specifically, all school funds are channelled through the Ministry of Education and Science and sent directly to regions and districts, where they ultimately are distributed to schools.[9] Ukraine is known for having one of the highest rates of public spending on education in the world. Most recent data show that the country's public spending on education and training was 5.4% of the country's GDP in 2017,[10] while the European Union countries' average for the same year was 4.7%.[11] Despite this large quantity of funds, education financing decreased by 1.2% from 2013 to 2017. However, the Ukrainian government is currently planning to devote at least 7% of GDP to education, although the allocation of such funding increased is still in discussion. As assessed by the World Bank, inequality persists in the educational system, and infrastructure that enables effective and sustainable learning has been inadequate, resulting in a significant impact on teachers.[12]

United Nations Children's Fund (UNICEF) data indicate that the literacy rate for the 15-24 years age group in Ukraine corresponded to 99.97% in 2012, while the completion rate for children of primary-school age

was 99.6% in the same year.[13] However, the completion rate for youth of upper-secondary-education age was 96.8% the same year.[14] Data show that the number of students in the school system has declined by 41% since Ukraine's independence in 1991: from 7.1 to 4.2 million.[15] However, over that same period, the number of schools declined by only 11 percent and the number of teachers fell just 5 percent.[16] This means Ukraine now has one teacher for every nine students, resulting in one of the smallest average class sizes in the world. According to UNESCO numbers, there were about 136,260 children out of school in Ukraine in 2014. In 2019, 71,465 adolescents were out of school in the country.[17]

Concerning broadband development in the country, ITU data shows that 62.6% of individuals used the Internet in 2018,[18] with the majority being in urban areas. In 2019, the number of fixed-broadband subscriptions per 100 inhabitants was 16.7,[19] and DSL remains the most used technology platform, while fibre continues to grow due to the efforts by operators build networks based on Fibre-to-the-Premises (FTTP).[20] While most cities have access to fibre-optic networks operated by several private stakeholders, the urban-rural gap regarding Internet coverage is significant in Ukraine, given that the country has more than 17,000 settlements not covered by this technology.[21]

The government recently announced that about 65% of Ukrainian villages are not covered by high-quality broadband, which corresponds to about 5.75 million citizens.[22] For rural areas not covered by optical fibres, the cost of connection exceeds the average market cost by about 150%. Continued growth in community wireless platforms based on Wi-Fi and WiMAX technologies is expected to attract investments and shape the average price for Internet connectivity.[23]

In 2018, the number of active mobile-broadband subscriptions per 100 inhabitants corresponded to 47.7.[24] Over the past years, significant investment has been made in extending 3G infrastructure, while operators have more recently concentrated on LTE. Kyivstar, Ukraine's largest operator, announced that 3G coverage corresponded to nearly 80% in 2018, although a large portion of the territory still lacks 4G/LTE coverage.[25] With the recent expansion of LTE in Ukraine, it is expected that the majority of the country's territory will be covered in the next years.[26]

Additionally, data from ITU show that in 78.1% of the population in Ukraine had 4G/LTE coverage in 2019, while 3G coverage corresponded to 89.1%.[27] In August 2020, the government announced that 4G is now available in nearly half of the underground stations of the Kyiv metro, a result of a partnership between the country's MNOs and Huawei.[28]

As of December 2020, Ukraine did not have a nation-wide broadband mapping system in place. However, the Ministry of Digital Transformation has started a collaboration with the World Bank and the Ministry

of Culture to adopt a state policy for broadband access and to update the basic legislation to support broadband mapping development with regard to fixed broadband coverage (and therefore presumably focusing on service mapping).[29] This activity falls under the scope of the project "Eastern Partnership Countries (EaP) Broadband Infrastructure Development Strategy" financed by the EU4Digital project, which will produce a report on "Broadband Mapping Recommendations" by December 2020. Consequently, this will provide an in-depth assessment of the legal framework as well as recommendations into the actions to be undertaken both from the regulatory and technical side to advance broadband mapping, thus endowing the country with an important tool for policymaking aimed at advancing broadband development.[30]

3.9.2 Government strategies, status of the education quality, and the role of ICTs

In 2013, the Ukrainian government launched the National Strategy for the Development of Education in Ukraine for the period up to 2021. There are two overarching goals that the strategy encompasses: I) to increase the availability of quality, competitive education to every citizen in accordance with the requirements of innovative sustainable development society; and II) to ensure the personal development of citizens in accordance with their individual abilities, needs and aspirations in life.[31]

The strategic directions of state policy in the field of education should focus on:[32]

- Reforming the education system, which will be based on the principle of human priority;
- Updating the regulatory framework of the education system in accordance with the requirements of the time;
- Modernizing the structure, content and organization of education on the basis of the competence approach;
- Creating and providing opportunities for the implementation of various educational models, and creating of educational institutions of various types and forms of ownership;
- Building an effective system of national education, development and socialization of children and youth;
- Ensuring the availability and continuity of lifelong learning;
- Cultivating the formation of a safe educational environment, greening of education;

- Accelerating the development of scientific and innovative activities in education, improving the quality of education on an innovative basis;
- Modernizing the informatization of education, with a focus on the improvement of library and information-resource provision of education and science;
- Ensuring national monitoring of the education system;
- Raising the social status of pedagogical and scientific-pedagogical workers; and
- Creating a modern material and technical base of the education system.

According to the 2018 results of the OECD's 'Programme for International Student Assessment'[33] (PISA), Ukrainian scores for reading, mathematics, and science were lower than the OECD average.[34] PISA 2018 results also show that socio-economically advantaged students outperformed disadvantaged students in reading by 90 score points, not significantly different from the average difference between the two groups (89 score points) across OECD countries.[35] The data show that only 25.9% of students in Ukraine achieved reading literacy, 36% achieved mathematical competency, and 26.4% achieved natural science minimum standards.[36] Moreover, In Ukraine, low- and high-performing students are clustered in the same schools to the same extent as the OECD average.[37] Concerning school infrastructure and staff availability, school principals in Ukraine reported less staff shortages and more material shortages than the OECD average. However, there was no significant difference in staff shortages between advantaged and disadvantaged schools.[38]

While Ukraine has high rates of enrolment in pre-primary education by international standards, access remains unequal.[39] For example, in urban areas, the net enrolment rate for children ages three to five is 85 percent on average nationwide, compared to 58 percent in rural areas.[40] Socioeconomic inequality from an early age persists as the students progress up the educational ladder, which prevents them from acquiring the foundational skills needed to succeed in higher education or the labour market. Rural areas in the country lack learning materials,[41] and ICTs are more likely to have shortages of subject teachers.[42]

However, some of the most vulnerable children and students in Ukraine live in close proximity to the 'contact line' between the government-controlled area (GCA) and the non-government-controlled area (NGCA). According to report by the United Nations Office for the Coordination of Humanitarian Affairs (2020), the armed conflict in eastern Ukraine has led to a chaotic and fragmented educational system, impacting nearly 657-000 school-aged children living in the region. Another study by the Organization for Security and Co-operation in Europe (OSCE) shows that that at least 93 educational facilities have been

damaged in more than 40 settlements across Luhansa and Donestka oblasts. In the context of the COVID-19, more than half of children residing near the 'contact line' were left without adequate access to education during quarantine and thus unable to following distance learning assignments, given that they lacked equipment and Internet access.[43]

The 2017 Framework Law on Education and New Ukrainian Schools (NUS)[44] reforms addressed the country's need for new curricula and other reforms. Elements of the New Ukrainian School include: I) school curricula focused on 21st-century skills and competencies; II) teacher professional development, emphasizing student-centred learning; III) system management and school administration, emphasizing greater local decision-making powers; and IV) a different role for the central government with a focus on setting and monitoring learning standards. The actions for these and other goals can be broken down into three main phases: Phase I (2016-2018), Phase II (2019-2022), and Phase III (2023-2029). It is the role of the State Inspectorate of Educational Institutions of Ukraine to oversee matters related to quality assurance, curriculum development, teaching methodology, examinations in the school system and vocational education.[45]

Since 2016, all education institutions are required to record and provide educational data. To make this possible, Ukraine's Ministry of Education and Science established the Institute of Educational Analytics (IEA)[46] in 2014.[47] IEA's mandate is to collect, analyse and disseminate education data, which is available on the Open Data section of its website.[48]The combined legal framework of ministerial orders, decrees and the IEA Statute ensure that data from all primary and secondary schools is captured and validated in the State Information System of Education (DISO), an existing, functioning EMIS that is managed by the IEA. As shown in a 2014 World Bank report, data collection on schools focuses primarily on administrative data, but does not include financial, human resource or learning outcome data. DISO is also not integrated with other education sector databases nor are there provisions for facilitating inter-ministry data sharing. Based on clear data stipulations, responsibilities and timelines, the local education departments oversee the process of data entry and check data for accuracy. Despite that, local governments in Ukraine lack the ability to produce sophisticated education analyses and thus, data is barely used in their decision-making processes.[49]

Furthermore, the New Ukrainian School plan acknowledges the importance of ICTs both in the educational process and in the management of educational institutions. The plan also lists ICTs and digital skills as one of the key ten competencies for the education system. The overarching goal points to the need to

harmonize all levels of education in both liberal arts/humanities and science and technology, in maintaining good traditions and securing a high level of education in science and ICT in every school.[50]

In December 2019, Ukraine's Ministry of Digital Transformation estimated the percentage of digital literacy of citizens. The results show that 37.9% of Ukrainians aged 18-70 scored below-average in terms of digital skills. Another 15.1% do not have access to ICTs at all. Thus, 53% of Ukrainians are below the "average level" according to the assessment methodology of the European Commission.[51]

In July 2020, the Ministry of Digital Transformation made public the details of a study on the availability of public access to high-speed fixed Internet , which showed that 17,000 settlements in the country do not have optical networks at all.[52] The results on the location of these points are available on an open data portal.[53] A map of fibre-optic network coverage can also be accessed freely.[54] According to the data, all cities have fibre-optic networks. However, about 65% of villages are not covered by high-quality broadband.

According to the State Statistics Service of Ukraine, there were 16.0 students per school computer in 2017, amounting to approximately 280,000 PCs for schooling purposes available in the country. In 2011, that number was 27.0.[55] Regarding Internet connectivity, local press reported that most schools in urban areas can afford to connect to high-speed Internet at the expense of the local budget, however, there are still thousands of schools across the country that need government assistance in this regard. According to research by the Ministry of Digital Transformation during the 2019–2020 period, tenders were held for Internet connection and local area networks in almost 10,000 Ukrainian schools. The data indicators reveal that there are 16,317 schools in Ukraine—about 60% of them have an Internet connection using fibre-optic technologies (9,773), while 40% lack Internet infrastructure (6,544).[56] Most of these institutions are located in villages and small towns. The ministry has developed an interactive map plotting all Ukrainian school connectivity to the connection data.[57]

However, in the context of the challenges that emerged during the COVID-19 pandemic, the discussions of Internet connectivity in schools presented different referential data. According to an internal assessment by the Ministry of Education and Science, there were only 74 schools in Ukraine that were not provided with Internet facilities as of September 2020. According to the Ministry of Education and Science, these are schools located on mountainous areas in the north, as well as some locations of the Odessa region.[58] At the beginning of 2020, 750 schools in Ukraine were not connected to the Internet .[59]

3.9.3 Multi-stakeholder partnerships and financing mechanisms fostering investment in school connectivity

Through the National Doctrine of Education Development (2002), the government prioritized the use of ICTs for the development of a cohesive national education system. Through this early document, the Ukrainian government signalled its intention to support the process of informatization of education and the use of ICT in the education system; the government promotes the provision of educational institutions with computers, modern learning tools, and the creation of global information and education networks.[60] While action plans and subsequent initiatives have occurred ever since—such as the Strategy for the Development of the Information Society (2013)—it has particularly been since 2018 that various joint initiatives between the public and private sectors came about to strengthen the provision and adequate use of digital technologies in educational settings.[61]

In January 2017, the Chinese government gave 23,500 new computers to 2,400 schools across Ukraine, which was part of a broader contribution by China supporting the development of education in Ukraine.[62] The government stated that the Chinese contribution would allow the country to establish computer classes such as programming in the national curricula.[63] In the past, China has donated computers and other IT equipment to Ukraine to be used in the context of schools.[64]

In January 2018, the Government and State Agency for e-Governance of Ukraine published the new "Digital Agenda for Ukraine 2020,"[65] which aims to guide the country's digital development. The agenda has seven main pillars: I) Telecommunications and ICT Infrastructure; II) Digital Skills; III) e-Market; IV) Digital Governance; V) Innovation and R&D; VI) Trust and Cybersecurity; and VII) Benefits from ICT for Society and Economy.[66] The digitalization of education is listed as one of the priority sectors alongside other initiatives aiming to bridge the digital divide through the development of digital infrastructure.[67]

According to the Ministry of Education and Science, a total subvention of 29.16 million EUR (1 billion UAH)[68] was included in the budget for 2019 for the "Internet ization" and "computerization" of schools in Ukraine.[69] The government's plan to use the funds included the acquisition of computer equipment for students and teachers, as well as the expansion of high-speed Internet in schools. To avoid the mismanagement of funds, the government informed that the distribution of these funds would be based on a predetermined algorithm that considers the following criteria:[70]

<u>Purchase of school computers:</u>

- The share of students in secondary education who do not have computers;

- The share of secondary-education schools in in which the ratio of the number of students per 1 personal computer exceeds 10:1.

Purchase of Internet access is directed to local budgets:

- In proportion to the number of institutions that do not have access to the Internet ;
- In proportion to the number of support institutions and schools of I-III, II-III, III degrees with the number of students 100 and more who have an Internet access speed of less than 100 Mbps;
- In proportion to the number of other schools that have an Internet access speed of less than 30 Mbps.

The purchase of computers will be carried out on a co-financing basis, meaning that local governments will have to pay a certain share of the cost of equipment. Thus, the resolution provides for the following ratios for co-financing:

- For cities of regional significance: not more than 70% of the funds are paid from the subvention, and no less than 30% from the local budgets;
- For districts: not more than 90% of the subvention and no less than 10% from local budgets;
- For villages (settlements) that have the status of mountain settlements, and on the line of contact: not more than 95% of the subvention and no less than 5% from local budgets.

3.9.4 National responses to COVID-19 and pedagogic initiatives for distance education

On March 12th, 2020, the Ukrainian government imposed a three-week nationwide quarantine and shut down all educational institutions in the country. The Ukrainian Government also launched a centralized website containing all relevant information on the changes in the educational process implemented through the quarantine period.[71] In particular, this platform provides information on distance learning, school completion, and current year exams, among other things. Moreover, it contains key information for teachers, Q&A for families and students.

It must be noted that, before COVID-19 was declared a global pandemic by the World Health Organization, the Ministry of Digital Transformation had already launched a national digital literacy program entitled "Diia: Digital Education"[72] in January 2020.[73] This platform was created in the form of "edutainment," where free series are combined with experts and celebrities to explain how to use websites, the possible applications of smartphones and laptops, basic Internet safety rules, use of online services, and courses

on how to find jobs and how to acquire new skills to combat rising unemployment. The courses were developed by the EdEra Online Education Studio with the support of Google, Microsoft, DTEK Academy, UNDP, EGAP, CISCO, Osvitoria and Global Teacher Prize.[74]

In April 2020, the government launched the Ukrainian Online School Initiative for pupils for grades 5-11. The project's main goal is to provide hybrid TV-and-Internet educational content to all students facing the challenges imposed by COVID-19. This project was launched in the context of a joint partnership involving the Office of the President of Ukraine, the Ministry of Education and Science, the Ukraine Committee on Education, Science and Innovation, the Ukrainian NGO Osvitoria and UNICEF. In the early stages of the project, a team of 80 teachers from Kyiv and the surrounding areas came together to plan and prepare these hybrid lessons. The opportunity to join the broadcast of video lessons is open to all Ukrainian TV channels.[75]

Overall, classes covered 14 different subjects ranging from Ukrainian language and literature to world history, Ukrainian history, art and science. These classes were catered to students at every stage of the Ukrainian education system ranging from year one to year eleven. Lessons were published on the Ministry's YouTube channel[76] and were also broadcast every morning on Ukrainian TV and via partnerships with several Ukrainian channels which agreed to dedicate two hours per day to educational programming. During the first two months, the project attracted hundreds of thousands of subscribers from across Ukraine and has produced over 1,700 lessons for schoolchildren of all ages.[77]

In April, UNICEF and Microsoft announced the expansion of the Learning Passport,[78] a global learning platform to help children and youth affected by COVID-19 continue their education at home. Ukraine was one of the first countries to roll out part of their online curriculum through the Learning Passport. The content was first available to schoolchildren and included online books, videos and additional support for parents of children with learning disabilities.[79]

In May 2020, UNICEF and the NGO Smart Education, with the support of the Ministry of Education and Science, developed and launched distanced biology lessons on coronavirus infection.[80] In mid-August, UNICEF together with the Ministry of Education and Science launched a communication campaign on quality preschool education for parents and preschool teachers to increase their awareness of quality and facilitate developing children's competencies at home, particularly during the COVID-19 pandemic. The campaign rolled out on TV, social media, an online platform and outside billboards, targeting areas where the access to preschool education is the most challenging, including conflict-affected areas.[81]

A technical document containing all the details for distance learning was launched in September 2020[82] and came into force in October 2020. The regulation stipulates that the interests of students must be taken into account during distance learning:[83]

- The organization of the educational process should ensure regular and meaningful interaction of teachers with students;
- During distance learning, conditions should be created to ensure full participation in the educational process of persons with SEN with mandatory consideration of the individual development program;
- The educational institution should provide regular monitoring of students' learning outcomes, as well as the need to provide them with support in the educational process;
- For students who cannot participate in the synchronous mode of interaction for valid reasons, the institution should provide the use of other means of communication available to students, such as telephone or mail;
- The organization of the educational process must be carried out in compliance with the requirements for personal data protection, as well as sanitary rules and regulations for the formation of training sessions, eye and posture exercises, continuous duration of educational activities with technical means of learning, time for homework and more.

UNICEF and the Institute of Educational Analytics, under the Ministry of Education and Science, conducted a national survey to better understand the readiness of schools, communities, and the general education system to resume education in the conditions of the global pandemic.[84] The government also launched a document with recommendations from the Ministry of Education and Science on strategies to create safe conditions at general secondary education institutions throughout the country to prepare for the 2021-21 academic year.[85] Moreover, changes to the state budget also occurred to address the socio-economic challenges related to COVID-19. To help fund the new expenditure, the Cabinet of Ministers submitted a draft law amending the state budget, ordering the government to cut subsidies, regional budgets, sporting programmes, expenditure on elections and the census, as well as financial assistance dedicated primarily to schools and teachers.[86]

Later, the government permitted kindergartens to reopen as long as they met the imposed epidemiological criteria. In September, schools across Ukraine reopened for in-person classes, except for schools in “red zone” areas where infection rates were highest. All children in the fifth grade and above

are required to wear masks around schools. In October, the government announced that universities and other institutions of higher education would switch to distance learning due to COVID-19.[87] In November, the Ukrainian government prohibited the attendance of educational institutions to more than 20 people, except for pre-school, school, and after-school activities institutions. Institutions operating at these three levels of education must operate at a maximum of 50% attendance capacity.[88]

Endnotes

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4. Conclusions

Over the past decade, the intersection of the policy areas of education and telecommunications has become more evident, consistent with a wider trend of the "digitalization of everything," whereby more and more places digitalize as a horizontal policy integration.

As highlighted in the executive summary and throughout the country profiles, this integration between education and the digital has evolved in three main directions:

- ICTs as a tool for public administration in education;
- ICTs as a medium to ensure continuity of digital services in education; and
- ICTs as an integral part of education curricula to create a workforce fit for the job market.

These intersections are favoured by policies which foster connectivity infrastructure and the fruition of devices in schools, primarily, and households, especially as a result of the COVID-19 pandemic. School connectivity is, therefore, widely recognized as a means to a more efficient administration of educational systems, a more innovative way of distributing education content, and, most importantly, a fundamental prerequisite to endow pupils with the digital skills necessary to thrive in the job market.