# 2 Digital readiness in Croatia

This chapter provides an overview of the Croatian higher education system, including its main features, trends in learner enrolment and outcomes, and policy context. It then provides an assessment of digital readiness as it relates to the higher education system in Croatia, based on an examination of Croatia's position in comparative indices of digitalisation, and a review of national policies, priorities and organisations supporting digitalisation in the higher education system.

Overview of the Croatian higher education system

Croatia has undergone significant political and economic changes since the country's declaration of independence in the 1990s, including in its higher education system. In recent years the country has worked to modernise its universities, improve the quality of education and research, and increase international co-operation. Today, Croatia has a binary system of higher education comprising universities and professionally oriented institutions. In total, the system includes more than one hundred higher education institutions with the status of legal entities (Agency for Science and Higher Education, 2022[1]): 12 universities (*sveučilišta*) (9 public and 3 private), 71 faculties, departments and art academics which are part of universities, 18 polytechnics (*veleučilišta*) (12 public and 6 private), and 18 colleges (*visoke škole*) (2 public and 16 private).

Academic programmes up to the doctoral level are based on the Bologna three-cycle system and are offered at universities and their components. Professional studies are delivered at polytechnics and colleges at undergraduate and graduate level (Figure 2.1). While polytechnics implement professional study programmes in at least three fields, colleges provide specialised professional study programmes in fewer fields and are thematically focused – for example on professional education for the health sector or police.

Figure 2.1. Structure of the higher education system in Croatia
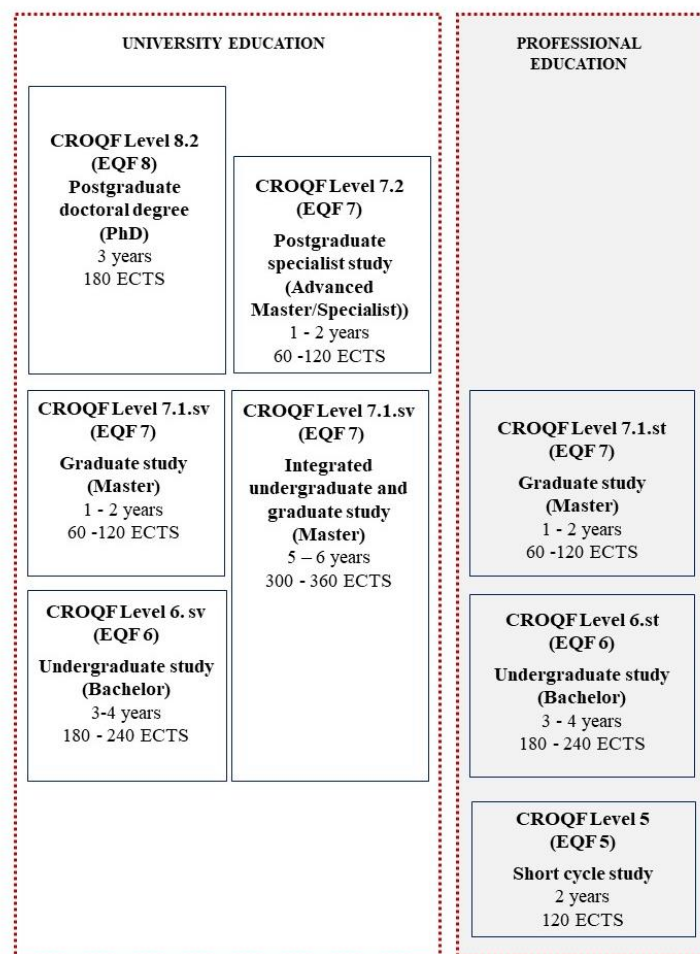
Source: Provided to the OECD team by the Croatian Ministry of Science and Education.

The apparently large number of higher education institutions compared to population size is explained by the fact that the four largest universities (University of Zagreb, University of Split, University of Rijeka and University of Osijek) are non-integrated, meaning that their constituent faculties, departments and academies are distinct legal entities maintaining their own administration, professional staff and campus, and enjoy substantial financial and administrative autonomy (OECD, 2019[2]). The remaining universities are integrated: steering and governance of the whole institution is led by a single university-wide rectorate and senate, and discrete departments within the university are not separate legal entities. This latter organisational model is by far the more common in Europe.

Enrolment in higher education is heavily concentrated both in the largest institutions, and in Zagreb. The University of Zagreb is the largest university in Croatia, enrolling about 40% of the country's students. It has more than three times as many students as the second largest university (the University of Split). (Agency for Science and Higher Education, 2021[3]). Moreover, most of the private institutions are in Zagreb. In total, higher education institutions located in Zagreb together enrolled more than 82 000 students in 2019/20 (51% of the total number of students enrolled in the country).

Trends in learner enrolment and outcomes

In 2019/20, more than 161 000 students were enrolled in institutions of higher education in the Republic of Croatia (Table 2.1). The vast majority (about 90% in 2020) study at public institutions, and students are primarily enrolled at universities (81%) rather than other categories of institution (15% at polytechnics and 4% at colleges). Croatia also has a notably high share of students studying part-time. In 2019, 30% of all of Croatia's students enrolled in tertiary education were studying part-time. The EU average for the same year was 15% (Eurostat, n.d.[4]).

Table 2.1. Number of students in each type of institution (2019/20)

Type of institutions	2019/20
Universities	**131 526**
Public universities	128 132
Private universities	3 394
Polytechnics	**23 496**
Public polytechnics	17 276
Private polytechnics	6 220
Colleges	**6 605**
Public colleges	1 231
Private colleges	5 374
Total	**161 627**

Source: Agency for Science and Higher Education (2021[3]), Higher education institutions in the Republic of Croatia, https://www.ASHE.hr/en/higher-education/higher-education-institutions-in-the-republic-of-croatia.

In recent decades, Croatia has succeeded in widening access to higher education, allowing a greater proportion of the population to acquire tertiary qualifications. There was a particularly strong period of enrolment growth following Croatia's declaration of independence in 1991. Higher education institutions saw an 82% increase in students from the 1990s to 2005 (Babić, Matković and Šošić, 2007[5]). By 2020, one-quarter of the population aged 25-64 had a tertiary education qualification.

Eurostat data shows that in 2020, Croatia was ranked as having the lowest proportion of early leavers from school and training in the EU, at 2.2% (Figure 2.2). This is an improvement from a rate of 5.0% in 2011 (Eurostat, 2021[6]), and indicates that Croatia continues to increase the proportion of its young people eligible to proceed to tertiary education.

Increasing the supply of tertiary graduates is an important policy goal for Croatia. Overall tertiary education attainment in Croatia in 2020 for adults aged 30-34 remains below the EU average (34.7.1% vs. EU-27 average of 41.0%) and fell short of the 2020 national target of 40% for this benchmark (Eurostat, 2021[7]). Enrolment in higher education has also tapered off in recent years. In 2013/14 166 000 students were enrolled across all types of higher education providers, while just under 162 000 were enrolled in 2019/20 (Agency for Science and Higher Education, 2021[3]).

For most of the first decade of the 2000s Croatia was experiencing net positive immigration. However, following accession to the European Union there was a rise in emigration, (Draženović, Kunovac and Pripužić, 2018[8]) and emigration now outpaces immigration. The sharpest loss began in 2013, after accession to the EU, and peaked in 2017 (Eurostat, 2021[9]). Recent figures from the Croatia Bureau of Statistics indicate that the negative net migration pattern is continuing. In total, 34 046 people emigrated in 2020, with most re-settling in Germany (Croatian Bureau of Statistics, 2021[10])[1]. The majority of emigrants are of prime working age and the average age of emigrants has been falling, reaching 33.6 years old in 2016 (Eurydice, 2021[11]; Draženović, Kunovac and Pripužić, 2018[8]).

Figure 2.2. Early leavers from education and training in selected EU and OECD countries, 2020
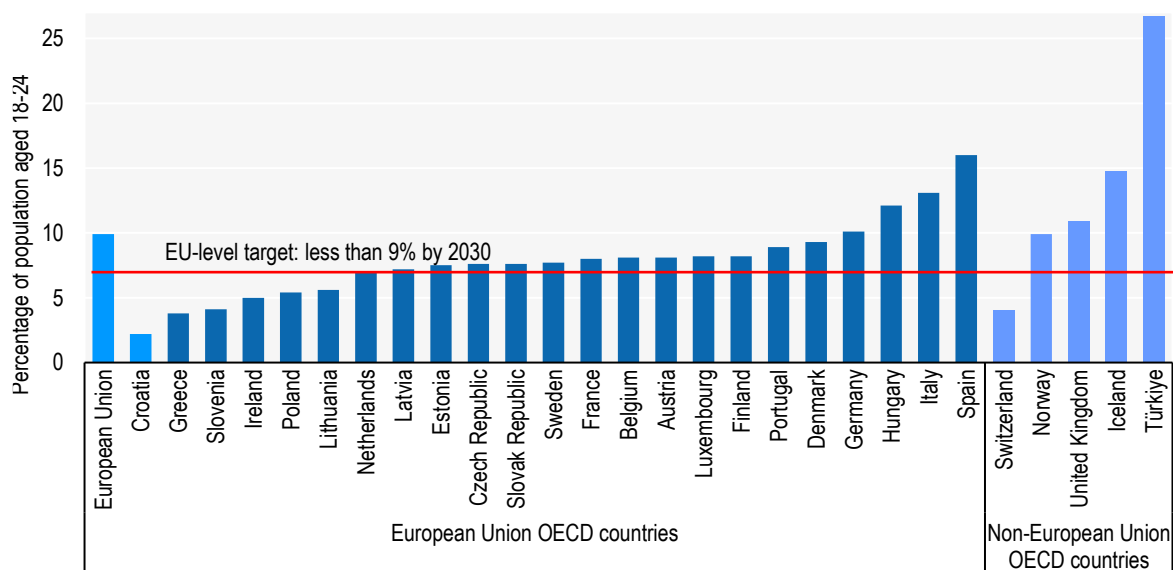
StatLink 🖳 https://stat.link/vjkitm

Declining tertiary enrolment numbers, negative net migration, and decreasing enrolment figures in secondary programmes foreshadow a likely decline in graduates after 2025 if current trends continue (Matković and Marcelić, 2020[12]). Alongside the high levels of migration out of Croatia, declining birth rates and longer life expectancies also contribute to population decline and a rapidly ageing population. Croatia's population currently stands at 4.1 million people. According to the United Nation's "World Population Perspectives" the country will continue to see a decreasing population, reaching a projected 3.877 million by 2030, 3.365 million by 2050 and 2.183 million by the year 2100 (United Nations - Department of

Economic and Social Affairs, 2019[13]). Thus, given its current trajectory, Croatia is projected to lose more than 15% of its population by 2050 (Figure 2.3).

Internationalisation is one means by which countries may seek to maintain vibrant higher education systems in the face of demographic decline. There were approximately 5 700 international students in 2019 (about 3% of all Croatian students), a share largely below the EU average and other European countries, including many of its neighbouring states (Eurostat, 2021[9]). Croatia also has one of the lowest proportions of international doctoral students across European countries. While the COVID-19 pandemic disrupted international student flows, the popularity of Croatian higher education institutions among students from abroad is growing. This is driven in part by relatively low tuition fees and cost of living. The Croatian government also makes scholarships available to international students through bilateral programmes, while European structural funds and support programmes such as Erasmus provide increasing possibilities for student mobility (Rončević, 2020[14]).

Figure 2.3. Population projection for Croatia and selected European countries (2020-2100)
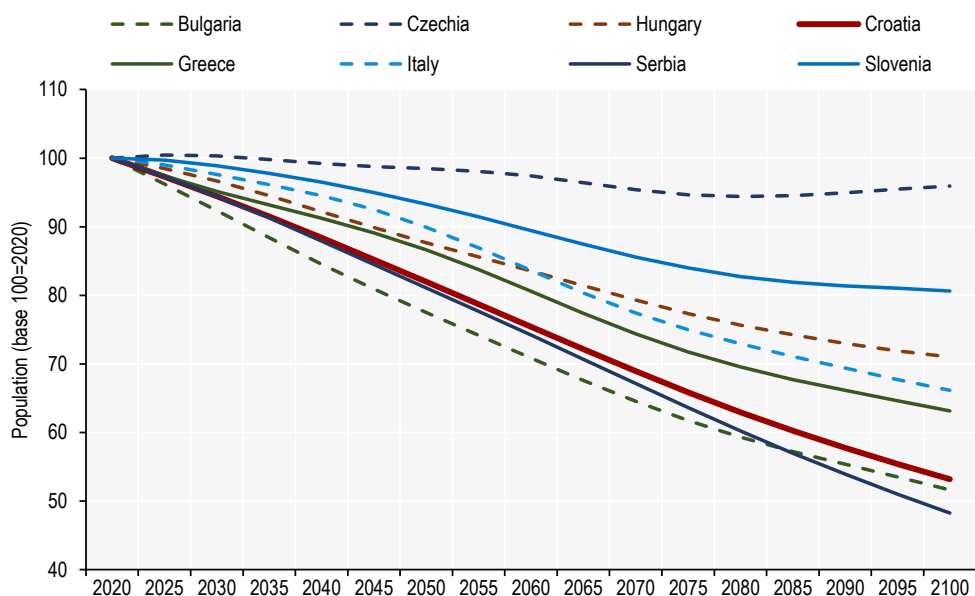
Source: United Nations - Department of Economic and Social Affairs (2019[13]). World Population Prospects 2019, https://population.un.org/wpp/DataQuery/.

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Adult education participation rates in Croatia are currently amongst the lowest in the EU. Croatia's participation rate in 2020 was just 3.2%, compared with the European Union average of 9.2% (Figure 2.4). Financial barriers, relevance and perceived quality of education or training provided may all be obstacles to participation in lifelong learning (OECD, 2020[15]). A 2017 survey for the Croatian Agency for Vocational Education and Training found that 30% of respondents cited cost as a reason for their lack of participation in adult education (Vučić, 2017[16]).

Although participation in adult education is low, Croatian adults show a high interest in learning according to some measures. The 2016 Adult Education Survey found that 91.9% of Croatian adults (aged 25-64) participated in informal learning, mainly through printed materials (45.5%), computers (60.3%), or television, radio and video (51.3%) (Eurostat, 2021[17]). This share is considerably higher than the EU-27

average rate of participation (59.5%) and may reveal a dormant demand for adult education programmes in higher education.

Croatia also faces challenges with the integration of young graduates into its labour market. The percentage of young people not in employment, education or training (NEET) in 2020 was slightly above the European Union average (12.2% v. 11.1%). It has been suggested that the very generalised secondary system, a high drop-out rate and prolongation of higher education in Croatia account for the relatively high unemployment rate among the NEET population (Tomić et al., 2019[18]). A 2018 study also noted a slow school-to-work transition in Croatia; many individuals that have completed (or dropped out of) education are inactive for months after leaving school (Tomić, Botrić and Žilić, 2018[19]).

Figure 2.4. Participation rate of adults aged 25-64 in education and training (2021)

Participation within the previous 4 weeks, Croatia and EU average
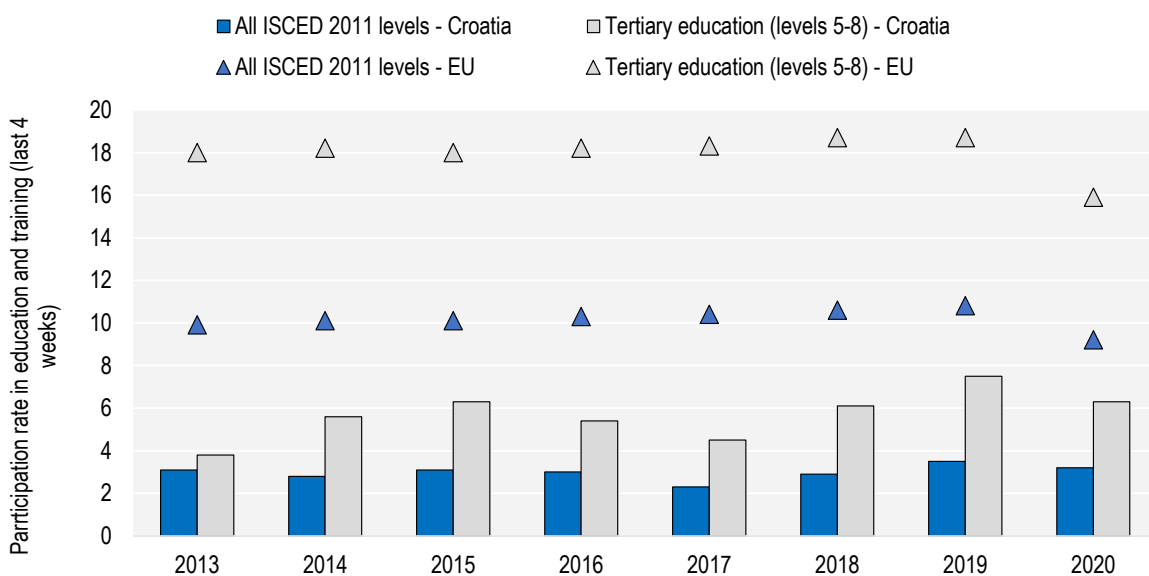
Source: Eurostat (2021[20]), Participation rate in education and training (last 4 weeks) by educational attainment, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=trng_lfse_03&lang=en.

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Another highly visible trend in Croatia, as in much of Europe, is the gap in tertiary education attainment between cities, towns and suburbs, and rural areas. Croatia's share of adults who have attained tertiary education aged 30-34 in rural areas, towns & suburbs and cities was 23.1%; 31.8% and 51.9%, respectively. While the attainment gap between rural areas and cities in 2012 was 18.0%, it has since expanded to 28.8% (Eurostat, 2021[7]). Croatia thus faces a challenge familiar to many neighbouring European countries: finding a balance between ensuring widespread access to higher education across its regions and maintaining efficient resource provision in the face of changing demographic conditions.

The development of high-quality online and hybrid education programmes is one avenue that Croatia, along with other countries, is exploring to provide more flexible access to higher education that can cater for a wider variety of learner needs and circumstances. Providing remote access to learning opportunities could increase the supply of highly qualified graduates and narrow attainment gaps between regions and population groups. However, as discussed throughout this report, providing online content alone is unlikely to be sufficient to achieve these goals. Multiple complementary enabling actions are necessary to create a widely accessible and successful digitalised higher education offer.

Funding, governance and reforms

Investment in higher education creates societal and economic benefits by supporting a more prepared workforce and a more educated citizenry. As in most European countries, the main funding source for public higher education in Croatia is the state, although approximately 30% of spending on tertiary education came from the private sector in 2018. Private institutions are funded from their own income streams. These sources of revenue are primarily tuition fees, although private institutions may qualify for targeted subsidies from the state budget for special projects of national interest, or if they fulfil a demand not met through the provision of public education and their offer complies with criteria set by public authorities (Eurydice, 2021[21]).

Budgetary funding agreements between the state and public higher education institutions are based on an annual negotiation process. Capacity, cost of study programmes, and quality assessment are all considerations in the funding allocation model for public institutions. An increasingly important source of financing is provided according to contractual agreements between the Ministry of Science and Education and higher education institutions, known nationally as "programme funding" (Ministry of Science and Education, 2021[22]). The European Commission reported that in 2020 higher education institutions received a 20% increase in funding awarded through performance contracts, compared to the previous year (European Commission, 2020[23]). It is likely that programme funding will play an even more prominent role in the new funding model foreseen in Croatia's National Programme for Recovery and Resilience 2021-2016, part of its plans for the modernisation of the higher education system (see Box 2.1)

The global financial crisis of the late 2000s placed governments under severe financial pressure, with public funding to the higher education sector often reduced as a result. Croatian higher education institutions faced a systemwide 10% reduction in funding between 2008 and 2012. However, renewed investment in public higher education allowed Croatia to begin the process of reversing these losses and reducing its funding gap, returning funding to pre-recession levels in 2017. Since 2018 funding has increased at rates higher than economic growth rates. More recently, demographics have shifted and enrolment of full-time students in public institutions has trended downward, easing pressure on the system (European University Association, 2021[24]).

Successful implementation of any digitalisation strategy or action plan requires governance conducive to the effective deployment of digital technologies, aligned with a clear and shared vision for optimal integration and uptake. Croatia's *Science and Higher Education Act (2003)*, last amended in 2022, guarantees academic freedom and organisational autonomy for its public universities (European Commission, 2021[25]). Integrated universities have centralised management, where decision making is led by a rector and senate. Universities following a non-integrated structure have faculties and academies that are recognised legal entities. Each autonomous faculty maintains its own professional staff and administration and is self-governed on matters of finance and administration (OECD, 2019[2]). Polytechnics and colleges are governed by deans, assisted by vice-deans. Institutional representative bodies also play a prominent role in collaboration and negotiation with national authorities. Sectoral representation is carried out by the Council of Polytechnics and Colleges of the Republic of Croatia (VVIVŠ) and the Croatian Rector's Conference, which consists of all public university rectors.

Despite the strong focus on independence of individual faculties overall, Croatian universities are less autonomous on average in some respects than universities in other European countries. According to the European University Association (EUA) autonomy scorecard[2] Croatia ranks lower in autonomy on several indicators and lowest in staffing autonomy. From a field of 29 countries, Croatia ranked 18th in terms of organisational autonomy, 15th in financial autonomy, 21st in academic autonomy (European University Association, 2021[26]).

Previous OECD analysis has identified the need to balance between ensuring the beneficial impacts of autonomy of Croatian higher education institutions, on one hand, and mitigating the strategic co-ordination

and administrative challenges that can arise when defining individual faculties and academies as independent legal entities on the other (OECD, 2008[27]; OECD, 2019[2]). Challenges encountered at non-integrated universities may include limited steering power available for overall leadership, limited co-ordination of strategy, and limited ability to benefit from economies of scale at the university level.

The current governance structure of Croatian universities also creates management inefficiencies from the perspective of the national government, which must interact with more than 90 separate public entities when planning operating budgets, quality assurance procedures and strategies. This number is far higher than in many countries with similar sized population (for example, Denmark, Ireland, New Zealand or Norway). Previous efforts to negotiate reforms in order to strengthen university-level governance at non-integrated universities were met with strong resistance, and the underlying arrangements persist today (OECD, 2014[28]).

Quality assurance for higher education institutions is the responsibility of the institutions themselves, the Agency for Science and Higher Education (ASHE), and the Ministry of Science and Education. A National Council for Science and Higher Education (NVZVOTR) addresses strategic issues in higher education and has traditionally played a strong role in defining quality criteria for the system, including criteria for accreditation of programmes, appointing and evaluating teaching personnel, and delivery of online learning. The ASHE is responsible for the application of national and international standards, for the formation and reaccreditation of higher education institutions, and the reaccreditation of study programmes, while university senates have responsibility for the initiation of individual study programmes. ASHE also plays a wider role in the system, managing programme application and admission processes, and providing analytical and statistical reports drawing on the wealth of available data generated by their activities.

Croatia is steadily reforming and modernising many policies and processes relevant to higher education (Box 2.1).

Box 2.1. Recent and upcoming national reforms impacting higher education in Croatia.

Croatia has embarked on an ambitious reform agenda in recent years, targeting its entire education system including higher education. One of the priorities of the current National Reform Programme is to improve the education and training system to make it more relevant to labour market needs, including higher education and adult education. In July 2021 a new Adult Education Act was adopted by the Croatian Government. The Act ensures the quality of adult education programmes and institutions, monitoring of the adult education system and recognises unofficial and informal acquired competencies and skills in the CROQF. Other planned measures include the definition and entry of qualification and occupational standards to the Croatian National Qualifications Framework (CROQF).

In 2019, Croatia released a new National Plan for the Social Dimension of Higher Education 2019-2021. Its aim is to improve data collection processes related to higher education equity issues, improve student guidance and linkages with lower levels of education, improve student financial support, counselling services and equity of programme completion, and introduce standards relating to the social dimension of higher education into the Croatian quality assurance system.

The Law on Scientific Activities and Higher Education aims to encourage better competitiveness among public scientific organisations and public universities, ensure an incentivised system of financing public scientific organisations and public universities, increase the quality of study programs, incentivise scientific mobility and introduce accountability principles in science and higher education. The Law was revised in late 2022.

Croatia's National Plan for Recovery and Resilience (NPRR) 2021-2026 encompasses several other higher education reforms. A model for reorganisation of higher education institutions and scientific

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institutes has been developed by independent external experts and adopted by the Ministry. The NPRR envisages that at least six reorganisations of higher education institutions and scientific institutes will be finalized by 2025. A new funding model is also in development, based on transparent criteria and performance indicators linked to an institution's objectives. The introduction of the new funding model is expected to be implemented through programme agreements regarding research and teaching activities, with a funding period of two years. A new specific fund for investment in higher education infrastructure ("e-Universities") also began in 2022.

Other reforms aim to simplify administrative processes for new higher education providers, including a simplified mechanism for entry into the Register of Scientific Organisations, digitalisation of application and admission processes to higher education, and student support funding, and requests for academic recognition of qualifications.

Sources: Council of the European Union (2021[29]), Council Implementing Decision on the approval of the assessment of the recovery and resilience plan for Croatia, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0401; Eurydice (2021[30]), National Reforms in Vocational Education and Training and Adult Learning, https://eacea.ec.europa.eu/national-policies/eurydice/content/national-reforms-vocational-education-and-training-and-adult-learning-11_en; Government of the Republic of Croatia (2020[31]), National Reform Programme 2020, https://vlada.gov.hr/UserDocsImages/Europski%20semestar%202020/National%20reform%20programme%202020.pdf

Digital readiness in Croatia

As discussed in the introduction, digital readiness in higher education can be defined as the capacity at the policy level of the system to support digitalisation effectively. It is a concept recognising that effective digitalisation in higher education depends not only on the actions of individual institutions, but also on the extent to which digital technology and skills are embedded in the wider country context, and the extent to which public policy actions support institutions in their digital transformation agendas (OECD, 2021[32]).

The development of digital education occurs within the framework of the wider digital economy. Citizens regularly exposed to beneficial digital technologies and processes across economic and social sectors are more likely to build the skills required to navigate digitally enhanced education programmes successfully, whether as teachers or learners. In addition, the digital transformation of higher education institutions depends on their access to connectivity and technologies often rolled out at a national level, such as broadband and 5G connections. Therefore, a country's overall digital development serves as the foundation for the digital transformation of its education systems.

A second component of digital readiness is the extent to which the public policy framework for higher education supports and incentivises higher education institutions in embedding sound digital practices and ongoing support and training for its employees and students. Developing coherent assessments of the digital readiness of education systems is challenging for most jurisdictions, due to substantial data gaps and the fact there is only a nascent data infrastructure for monitoring digitalisation (OECD, forthcoming 2023[33]). Some insight can be gained, however, by reviewing Croatia's position in international and national indices of digital performance, and from examining elements of Croatia's national policy framework that may support digital readiness in higher education. The following sections review each of these in turn.

Croatia's position in comparative national indices of digital performance

This section reviews Croatia's performance on five existing international and national indices measuring digital performance and readiness at country level. Taken together, these measures provide a range of insights regarding various aspects of digital readiness in Croatia including connectivity, human capital, digital competitiveness, availability of digitalised services, geographic disparities in digitalisation and the existence of digital strategies and processes (Table 2.2).

Table 2.2. International and national indices of digital performance featuring Croatia.

Name of Digital Performance Index	Focus	Jurisdiction/publication date
Digital Economy and Society Index (DESI), based on DigComp	4 key dimensions, covering 37 indicators: 1) human capital; 2) connectivity; 3) integration of digital tech; 4) digital public services	EU countries Annual publication since 2014
Centre for the European Policy Studies' Index of Digital Readiness (IRLL)	3 primary pillars: 1) individual learning outcomes; 2) institutions and policies for digital learning; 3) availability of digital learning	27 EU member states Published in 2019
Portulans Institute - Network Readiness Index (NRI) 3rd edition	4 key dimensions providing a composite index: 1) technology; 2) people; 3) governance; 4) impact	130 global economies Published annually since 2019 (Portulans took over the index from the World Economic Forum in 2019)
Apsolon's Analysis of Digital Readiness of Croatian Cities	5 composite factors to indicate digital readiness: 1) availability and quality of e-services; 2) unified payment systems; 3) availability of city data; 4) citizen participation in decision making; 5) communication channels	20 largest Croatian cities Annual publication since 2019
Croatian Digital Index (HDI) - Apsolon	4 key indicators: 1) state of digitalisation and digital transformation; 2) digital readiness of companies; 3) digital strategy and process; 4) impact of digital transformation on business	300 Croatian companies Published in 2021

Digitalisation in Economy and Society Index (DESI) 2021

The European Union's DESI is a composite index tracking the digital performance of EU member states. The latest data were released in 2021, although it should be noted this data was collected prior to the pandemic. Among the 27 member states, Croatia ranked 19th position in 2021 (European Commission, 2021[25]). Its strongest rankings were in 5G readiness, the share of adults with above-basic digital skills, and open data initiatives (Table 2.3).

The DESI shows that Croatia's connectivity has steadily progressed in recent years. 86% of households now have fast broadband coverage, in line with the EU average of 87%. Additionally, Croatia has achieved complete 5G readiness and has created a dedicated comprehensive strategy for 5G introduction and deployment. A number of government initiatives currently underway, such as the National Plan for Broadband Development 2021-2027 (Republic of Croatia:, 2021[34]), will further improve connectivity, including very high-capacity networks and connectivity in more sparsely populated regions (European Commission, 2021[35]).

Croatia's overall human capital ranking in the DESI stands at 16th. Specialists in Information and Communication Technologies (ICT) account for only 3.7% of the workforce, compared to an EU average of 4.3%. In total 60% of enterprises, including many higher education institutions, report having difficulty filling ICT roles. At the same time, although digital skills in the overall population are similar to the EU average, in 2020, Croatia had the highest percentage of youth in Europe aged 16-24 who hold basic or above-basic digital skills (Eurostat, 2020[36]). This means there is a positive outlook regarding the digital competence of younger learners accessing higher education systems.

There is a steady decline in the number of citizens in Croatia who have never accessed the Internet, although a lower-than-average share of citizens uses the internet for online courses (6% vs. 11% EU average). This result may be linked to the relatively low participation in adult education in Croatia, and the fact that (at least before the pandemic) online study was not widespread. The DESI also shows increasing integration of digital technology in the business sector. Provision of digital public services, including digital services for citizens, is expanding rapidly.

Table 2.4. Croatia's Placement on Portulans Institute's Network Readiness Index 2021

Croatia's Network Readiness Index	41st (out of 130 world economies)
Pillars/sub-pillars	Rank (out of 130 world economies)
Technology (overall)	64
Technology (sub-pillars)	Access: 58, Content: 39, Future Technologies: 108
People (overall)	46
People (sub-pillars)	Individuals: 29, Businesses: 39, Government: 77
Governance (overall)	37
Governance (sub-pillars)	Trust: 41, Regulation: 38, Inclusion: 38
Impact (overall)	40
Impact (sub-pillars)	Economy: 65, Quality of Life: 27, SDG Contribution: 39

Note: The Portulans Institute took over the NRI from the World Economic Forum in 2019.
Source : Portulans Institute ; https://networkreadinessindex.org/country/croatia/.

Centre for European Policy Studies (CEPS) Index of Readiness for Digital Lifelong Learning

The CEPS Index of Readiness for Digital Lifelong Learning measures digital learning participation and outcomes, institutions and policies for digital learning, and availability of digital learning. The Croatian education system ranked positively on the CEPS Index, placing 13th in the EU. Croatia's ranking was heavily influenced by its 3rd place position in the "institutions and policies for digital learning" dimension; Croatia ranked highly in all sub-indicators in this category except governance and implementation, for which Croatia ranked 23rd in the EU.

The CEPS report concluded that governance quality can be improved in Croatia, as can digital policy implementation in its education sector. Croatia performed much lower in the other elements of the index, ranking 24th in learning participation and outcomes, and 21st in the availability of digital learning (Centre for European Policy Studies (CEPS), 2019[38]).

National indices of digital readiness – Apsolon

Few national level analyses of digital readiness have been published in Croatia. Two recent examples were conducted by Apsolon, a national consultancy firm. It carried out a study in 2019 regarding the digital readiness of Croatian cities, ranking 20 cities of varying sizes by digital readiness using several criteria, including the quality of city government e-administration, availability of data to citizens and timeliness of response to their inquiries (Apsolon, 2020[39]). These criteria help measure the extent to which cities are becoming "smart" – able to apply digital intelligence, technology, and data to improve public services (including education) and quality of life for citizens (McKinsey Global Institute, 2018[40]).

Rijeka and Zagreb ranked highest in digital readiness for large cities in Croatia while Pula and Karlovac scored the best among medium-sized cities. In total,12 out of the 20 cities analysed have increased their digital readiness in recent years, with Split, Dubrovnik and Rijeka noted as having made the greatest progress (Apsolon, 2020[39]). The degree of digital readiness of Croatian cities provides an indication of the underlying foundation of local digital readiness higher education institutions will encounter in their digitalisation efforts.

Another digitalisation-centred analysis by Apsolon was the 2018-2019 Croatian Digital Index (HDI) (Aposolon, 2019[41]). It was based on the results of an online survey of 300 varying-sized individual companies across different sectors, with a goal to capture the digital readiness of Croatian companies. The results indicated that companies in Croatia did not consider digital transformation a high priority. For

most companies (53%), digital transformation was not a top ten priority and only 15% of respondents indicated their business had a digital transformation strategy (Jurčević, Lulić and Mostarac, 2020[42]).

National policies and priorities for supporting digitalisation in higher education

Public policy can support digital transformation in education systems in several fundamental ways. While many national level digitalisation strategies tend to focus on economic growth, specific strategies for digital education can help to build a collective vision of how digital innovation should benefit education systems and learners. As of 2020, more than half of OECD countries have a written digital education strategy, while in other countries digital education is addressed as part of a broader national digital innovation strategy (van der Vlies, 2020[43]). In Europe, as of 2018, while 38 out of 50 European Higher Education Area jurisdictions had developed some sort of strategy or policy on the use of new technology in teaching and learning, only three had created one specifically for higher education. Many more had, though, mentioned new technologies in higher education within broader national strategies (Eurydice, 2018[44]).

While Croatia does not have a specific digital plan for higher education, the Ministry of Science and Education did prepare an Action Plan for the Implementation of Distance Learning (Ministry of Science and Education, 2020[45]) in response to the pandemic. Although this was primarily written to respond to emergency remote teaching needs, it was also intended to document steps that were taken, to provide a blueprint for potential future necessary transitions online. The report identified several systemic gaps and challenges that would need to be addressed in the future, including the requirement for improvements in strategic planning (organisation, assistance in implementation and management), training on implementation, equipment, and programme support.

The report specified 15 priority areas for teacher training for all levels of education (e.g. how to organise an online classroom, how to support students in an online environment, how to prepare one's own digital material, data protection and how to conduct digital assessment) and 12 areas for investment in digital infrastructure necessary to enable effective distance learning (Ministry of Science and Education, 2020[45]). Finally, the report proposed ways higher education could continue distance learning in 'normal' times: virtual classes, videoconferences, webinars, and the possibility of virtual mobility (e.g. ERASMUS+ Virtual Exchange, eTwinning).

National organisations and projects supporting digitalisation in higher education

Several national bodies support digitalisation within higher education in Croatia. The Croatian Academic and Research Network (CARNET) is the principal research and education network linking the academic, research and scientific community. It operates as an independent entity under the Ministry of Science and Education, providing ICT support to every level of education. Its three-pronged mission is to strengthen the educational community, develop advanced infrastructure and safeguard the nation's digital space. To this end, CARNET provides more than 70 services to its end-users, including several e-learning initiatives (teacher training, LMS hosting, national portal for distance learning, etc.) (Croatian Academic and Research Network (CARNET), n.d.[46]). CARNET has also overseen the implementation of e-Schools, a project to systematically improve digital maturity in Croatia's school sector (see Chapter 3).

In addition, the University Computing Centre (SRCE) was founded at the University of Zagreb in 2007 and has become a focal point for the planning, designing and support of e-infrastructure for academia and the scientific community. It plays an important role in the implementation and use of e-learning technologies by higher education students and staff, and on systems and services helping to modernise education. For instance, SRCE led the initiative on developing the Croatian Digital Academic Archives and Repository (DABAR) and is the lead architect of the Croatian Research Information System (CroRIS) and the Croatian Scientific and Educational Cloud (HR-OOZ). (Univeristy of Zagreb, 2021[47]); (Ministry of Science and Education, 2021[22]). SRCE also ensures the connection of Croatian e-services and infrastructure with pan-

European initiatives (SRCE, n.d.[48]); (EGI Federation, 2020[49]). SRCE's position as a key partner for many higher education institutions was further highlighted during the pandemic, as it provided a range of additional software and other supports to aid the transition to emergency remote instruction.

The ASHE and the National Council for Science and Higher Education also play a role in the quality assurance and enhancement of digital education. Responsibility for setting some quality criteria for the system traditionally rested with the National Council, including establishing the criteria for accreditation of fully online programmes. Following the revision of the Law of Quality Assurance of Science and Higher Education (see Chapter 4), the ASHE is now responsible for both setting the criteria for, and accrediting, fully online programmes. ASHE also often reflects on digitalisation of higher education when conducting its other mandated activities, such as the accreditation and reaccreditation of higher education institutions, and the reaccreditation of study programmes. The latest version of criteria for online learning for higher education date from 2016. Following the legislative changes in 2022, it is expected that the criteria will be reviewed in 2023.

Several ongoing national projects and policies support the development of digitalisation in Croatia's higher education system. One of the most prominent current national projects and policies supporting the ongoing digital transformation agenda for higher education is the e-Universities project, with EUR 84 million earmarked for investment in e-learning in higher education and the digitalisation of research and innovation activities in universities and research centres (European Commission, 2021[25]).

While most of the funding for e-Universities is reserved for upgrades to digital infrastructure (see Chapter 5), the project also includes several other activities to support the development of digital competence in higher education institutions. For example, the project includes a direct award of approximately EUR 6.5m for digital capacity enhancement in higher education institutions. Specifically, it will assist professors in the development and implementation of e-learning as well as digital evaluation tools, offer targeted support to stakeholders in the system, and link the Moodle-based e-Learning system used widely by higher education institutions with other information systems. A plan for learning analytics will also be included.

The e-Universities initiatives are additional to wider investments in access to connectivity, foreseen under the National Plan for the Development of Broadband Access. One of its main priorities is the development of a very large capacity network (VHCN) supporting broadband access, with speeds of at least 1 Gbit/s for public purposes, including higher education and scientific institutions. Other objectives of the national plan include introducing 5G networks in urban and rural areas to ensure end-users all have access to high-quality network services.

Conclusion

Overall, evidence on Croatia's performance in a range of digitalisation and digital readiness indices shows that Croatia continues to rank behind its European Union counterparts in many aspects of digitalisation. The evidence points to a low to average level of digital readiness of the higher education system in Croatia. While basic digital skills among the population in Croatia are, in general, similar to or higher than the EU average, participation and interaction with digitally delivered education remains relatively weak, and availability of digital learning is lower than in many other EU countries. The indices also may signal some weaknesses in governance of digitalisation within the system and challenges with prioritising strategic focus on, and investment in, emerging technological solutions in both government and businesses.

Croatia is rapidly catching up with many aspects of digitalisation, including connectivity and establishing a favourable regulatory environment for digitalisation in the wider economy. It has achieved success in several areas that will support progress towards digital readiness and maturity in its higher education sector. The Ministry of Science and Education was able to react quickly during the pandemic, drafting an

emergency action plan and pivoting to online learning at all levels of education. At institution level, Croatia has a robust foundation for digitalisation efforts due to the e-Schools project. Moreover, several national plans and policies for investing in digitalisation are in train, including investment directly in improving the digital maturity of higher education institutions. The existence of strong supports for institutions, in the form of CARNET and SRCE are also fundamental elements of driving forward digital readiness in Croatia.

On the other hand, more efforts may be needed to encourage take-up of digitally delivered teaching and learning in the higher education system. Although comparative data on the take-up of online learning across countries is lacking, there are reasons to conclude that participation in online learning is particularly low in Croatia. Overall participation in adult education is low, and national criteria for the evaluation of fully online study programmes state that students enrolled in these programmes cannot be considered as full-time students, limiting available supports. The absence of strategic policies to support distance learning, infrastructural challenges, and a general perception of online education as being of low quality have been identified as causes of low take-up (Bagarić, Plantak and Škof, 2021[50]). Moreover, there is a shortage of information on the digital competence of higher education teachers in Croatia (Müller and Varga, 2020[51]).

In conclusion, while Croatia is making strides in enhancing its digital readiness, more policy action is likely to be needed in the coming years if Croatia is to continue to improve the public perception, accessibility, and take-up of online and hybrid education options.

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Notes

[1] Note that these figures only include persons who have voluntarily registered the change in residency with Croatian public authorities and thus may be under-reported.

[2] The scorecard was launched in 2011. It is based on 30 indicators across four dimensions of autonomy: organisational, financial, staffing, and academic. Data from higher education systems is gathered from a survey of national rectors' conferences via questionnaires and follow-up interviews and subsequently weighted and scored by the EUA.
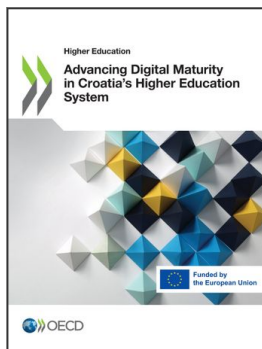
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