

# Digital readiness and digital maturity in Croatia's higher education system

## Diagnostic report

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This report provides an overview of the Croatian higher education system and an assessment of its digital readiness and the digital maturity of its institutions, based on desk research, interviews and site visits carried out by an OECD review team in Croatia in May 2022, and data from a digital maturity survey of Croatian higher education institutions fielded by the OECD and CARNET in February 2022.

A slightly abridged version will be included as part of the final published report of the project.

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# 1 Introduction

## Context and methodology

The Croatian higher education system has faced several challenges linked to the country's demographic decline and changes in the labour market. Enrolment rates in tertiary education are decreasing and dropout levels of tertiary students are above 40%, higher than the EU average. At the same time, the higher education offer does not fully respond to the demands of the labour market and the needs of learners. Unemployment rates of tertiary graduates are amongst the highest in the EU and the share of Croatian adults participating in lifelong learning is below the EU average.

To increase the attractiveness and relevance of higher education, the Government has proposed a comprehensive modernisation agenda, which builds on the 2020 National Reform Plan and is supported by Croatia's 2021 National Recovery and Resilience Plan. A key part of the modernisation agenda relates to enhancing digitalisation – an agenda accelerated by the Covid-19 pandemic. Digitalisation is viewed as a potential means to overcome key obstacles to enrolment and to increase the attractiveness and adaptability of the higher education offer. In particular, the National Plan for Enhancing the Social Dimension of Higher Education 2019-21 aims to provide wider and more equitable access to higher education, tackle the digital divide between students in urban and rural areas, and enhance digitalisation as a means of supporting students with disabilities.

However, the adequacy of digital infrastructure in Croatia and the difficulty of ensuring widespread access to high quality online learning present challenges to the successful implementation of the current policy agenda. The outputs of this project are intended to support Croatian authorities and higher education institutions in their efforts to successfully integrate digital technologies throughout the higher education system. Progressing Croatia's aims for improved digitalisation requires as a starting point an understanding of Croatia's general digital readiness, and an assessment of the digital maturity of its higher education institutions. This report provides the OECD's assessment of digital readiness and digital maturity in Croatia's higher education system. The assessment is based on three main sources of evidence:

- Desk research on digital readiness of the higher education system, comprising review and synthesis of evidence available to assess Croatia's level of digital readiness
- A survey of digital maturity in higher education institutions in Croatia, jointly fielded by the OECD and the Croatian National Research and Education Network (CARNET)
- An OECD fact-finding mission to Croatia to carry out a deeper exploration of the digital maturity of higher education institutions, consist of a series of site visits, interviews and roundtables with institution student and staff representatives, and other key stakeholder bodies.

## Key concepts and definitions

The two key concepts used in this report are “**digital readiness**” and “**digital maturity**”. Both terms have been defined in various ways by different actors and are often used in policy discourse and documents without any definition at all. For the purposes of this project, the terms are defined as follows:

- Digital readiness is used to refer to the capacity at the **system level** to effectively support digitalisation.

- Digital maturity is used to refer to the extent of development of digitalisation at the **organisation level** (i.e., individual higher education institutions).

**Digital readiness** is a concept that links higher education policies that impact digitalisation in higher education institutions with the wider extent of digitalisation in Croatia, including national and central policies, and the general digital skills of Croatia's population. It can also be thought of as **the extent to which the wider context, policies and practices related to digitalisation outside of higher education systems are aligned to support the development of digitalisation within them.**

The concept of **digital maturity** of educational organisations is becoming embedded in Croatian national policy discourse, recognising that digital maturity is multi-dimensional, and that organisations may be at different levels of development within each dimension. In general, digital maturity exists on a continuum; **organisations with greater levels of resources; competences; and strategic leadership necessary to plan and execute effective digital transitions can be considered to have higher levels of digital maturity.** Previous efforts to enhance digital maturity in the Croatian education system have mainly focused on the school level. The successful pilot and rollout of the “E-schools” project supported many schools to increase their level of digital maturity and provides inspiration for a similar initiative at the higher education level.

This project has activities that are aimed at both supporting digital readiness of Croatian central government policy and improving the digital maturity of individual higher education institutions. The following sections apply the concepts of digital readiness and digital maturity to arrive at a diagnostic assessment of the status quo in Croatia. Other outputs of the project (including a technical report for investment in digital infrastructure, a report on improving the quality of online and blended learning, and capacity building activities for institutions) will provide analysis and recommendations that are aimed at improving different aspects of digital maturity of higher education institutions across Croatia.

## Summary of findings

Box 1.1 provides a high-level summary of the findings of this report.

### Box 1.1. Digital readiness and digital maturity in Croatia's higher education system

This report evaluates digital readiness and digital maturity from the perspective of the Croatian higher education system. It finds that Croatia continues to rank behind its European Union counterparts on many aspects of digitalisation. While basic digital skills of the population in Croatia are similar to the EU average, and higher among youth, participation and interaction with digitally delivered education remains relatively weak, and availability of digital learning is lower than in many other EU countries.

Croatia is rapidly catching up on many aspects of digitalisation, including in connectivity and establishing a favourable regulatory environment for digitalisation in the wider economy. The existence of strong central supports for digital transformation are also helping to drive forward digital readiness in Croatia. However, it is likely that more policy action will be needed in the coming years if Croatia aims to continue to improve the public perception, accessibility, and take-up of online and hybrid education options.

An initial quantitative assessment was carried out on digital maturity in Croatia's higher education institutions, using data obtained from the CARNET-OECD digital maturity survey. The assessment evaluated Croatia's higher education institutions according to their digital leadership, digital infrastructure and digital competence and culture. Overall, institutions ranked highest with regard to digital competence and culture, while few institutions achieved a high rating on the set of digital infrastructure indicators. While the evaluation exercise was experimental and preliminary in nature, the results provide a crude indication that while some institutions have well-established digital

leadership, high quality infrastructure and an embedded digital culture, many other institutions have made few steps towards digital transformation of their activities.

The quantitative assessment is complemented by a qualitative evaluation of digital maturity, based primarily on interviews and site visits carried out by the OECD review team during a mission to Croatia in May 2022. The following points outline the key findings of the qualitative assessment:

#### Digital leadership

- Institution leaders view digitalisation as a concept that goes far beyond online education
- Higher education institutions mostly have strategies for digitalisation in place, but stakeholder involvement appears limited
- Institution leaders perceive a lack of public investment as one of the main barriers to successful digitalisation
- There is a lack of clarity about responsibility for digital transformation within some institutions

#### Digital infrastructure

- Higher education institutions are satisfied with the internet connection provided by CARNET, but most require at least some upgrades to their on-campus networks
- Most institutions rely on in-house support staff, and some experience severe difficulties with maintaining ICT support services
- Strong concerns are evident in some institutions about the quality of their existing digital technologies
- Croatian institutions would benefit from more centralised provision of software and services
- Institutions expressed a pressing need for certain types of audio-visual equipment

#### Digital competence and culture

- Some initiatives are in place to develop staff digital competence, but a more systematic and joined-up approach would be beneficial
- Many existing pedagogical practices for online and hybrid education lead to deficits in the social element of learning and lower student engagement
- Students enjoy a range of digitalised services, but could be more heavily included in institution plans for the development of digital competence and culture
- Some elements of innovative digital culture appear to be more developed than others in Croatian institutions

## 2 Overview of the Croatian higher education system

Croatia has a binary system of higher education that comprises universities and professionally oriented institutions. In total, the system consists of 117 higher education institutions with the status of legal entities (Agency for Science and Higher Education (AZVO), 2022<sup>[1]</sup>): 12 universities (*sveučilišta*) (9 public and 3 private), 71 faculties, departments and art academics as part of universities, 18 polytechnics (*veleučilišta*) (12 public and 6 private), and 18 colleges (*visoke škole*) (2 public and 16 private).

The seemingly large number of higher education institutions compared to the 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 that maintain their own administration, professional staff and campus, and enjoy substantial financial and administrative autonomy (OECD, 2019<sup>[2]</sup>). The remaining universities are integrated; steering and governance of the whole institution is led by a single university-wide rectorate and senate, and the distinct departments within the university are not separate legal entities. This latter model of university organisation is by far the more common one in Europe.

Academic programmes up to the doctoral level are based on the Bologna three-cycle system and offered at universities and their components. Professional studies are delivered at polytechnics and colleges at undergraduate and graduate level. (Agency for Science and Higher Education (AZVO), 2022<sup>[1]</sup>). 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 educating professions in the health sector or police. Figure 2.1 shows the locations of the main higher education institutions in Croatia, including both main and satellite campuses.

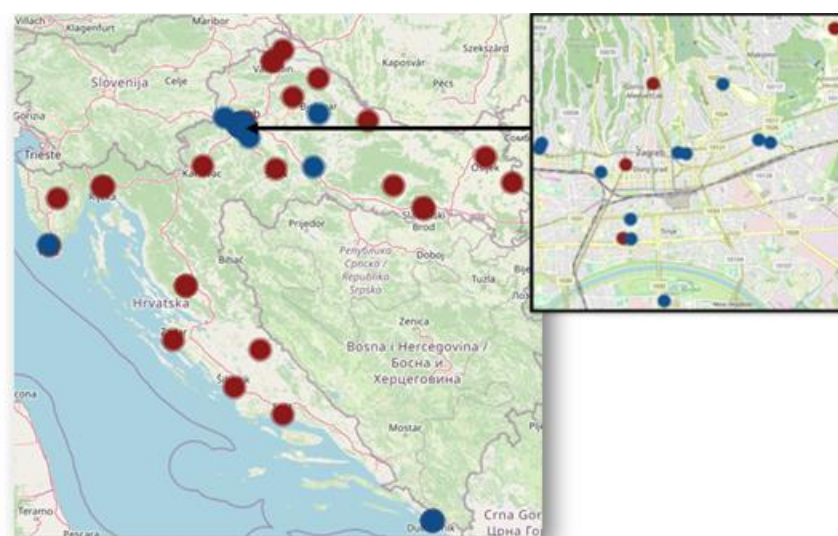
Enrolment in higher education is heavily concentrated in the largest institutions, and in Zagreb. The University of Zagreb is the largest university in the state, enrolling about 40% of all the students in the country, and with more than three times as many students as the second largest university (the University of Split). (Agency for Science and Higher Education (ASHE), 2021<sup>[3]</sup>). Moreover, most of the private institutions are in Zagreb. When considering other types of institutions, in total higher education institutions located in Zagreb enrolled more than 82,000 students in 2019/2020 (amounting to 51% of all students enrolled in the country).

### *Trends in learner enrolment and outcomes*

In 2019/2020 more than 161 000 students were enrolled in institutions of higher education in the Republic of Croatia (Table 2.1). The vast majority (90.7% in 2020) of students study at public institutions, and students are primarily enrolled at universities (81.3%) rather than other institution categories (14.5% 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 tertiary education students were studying part-time, compared to the EU average of 14% (Eurostat, n.d.<sup>[4]</sup>).

In recent decades, Croatia succeeded in widening access to higher education, allowing an increasing 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 absorbed an 82% increase in students from the 1990s to 2005 (Babić, Matković and Šošić, 2007<sup>[5]</sup>). By 2020, one-quarter of the population aged 25-64 had a tertiary education qualification.

Figure 2.1. Geographic location of Croatian higher education institutions (2016)



Note: Public institutions are indicated in red while private institutions are indicated in blue.

Source: Adapted from the Agency for Science and Higher Education (ASHE), *Geographic representation of private and public higher education institutions in the Republic of Croatia*; <https://www.ASHE.hr/en/higher-education/higher-education-institutions-in-the-republic-of-croatia>

Table 2.1. Number of students in each type of institution (2019/2020)

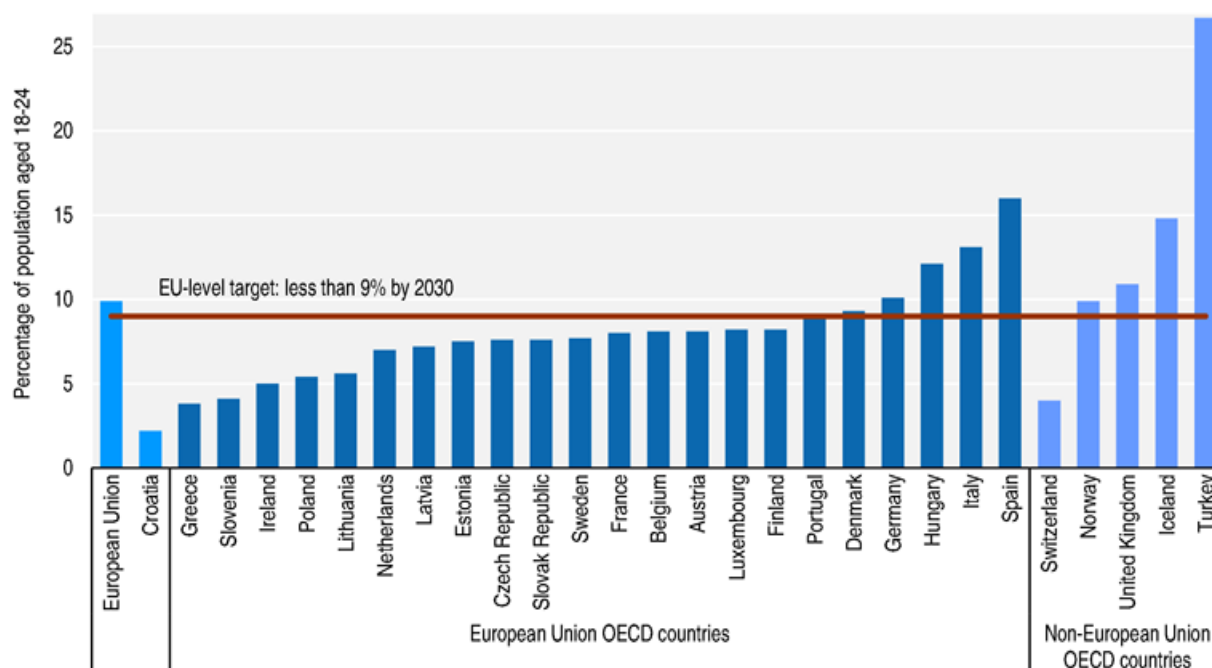
Type of institutions	2019/2020
Universities	<b>131,526</b>
Public universities	128,132
Private universities	3,394
Polytechnics	<b>23,496</b>
Public polytechnics	17,276
Private polytechnics	6,220
Colleges	<b>6,605</b>
Public colleges	1,231
Private colleges	5,374
<b>Total</b>	<b>161,627</b>

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

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 at 41.0%) and fell short of the 2020 national target of 40% for this benchmark (Eurostat, 2021<sup>[6]</sup>). Enrolment in higher education has also tapered off in recent years. Across all types of higher education providers 166,000 students were enrolled in 2013/15 while just under 162,000 were enrolled in 2019/20 (Agency for Science and Higher Education (ASHE), 2021<sup>[3]</sup>). Declining tertiary enrolment numbers, along with decreasing enrolment figures in secondary programmes, foreshadow a likely decline in graduates after 2025, if current trends continue (Matković and Marčelić, 2020<sup>[7]</sup>).

Eurostat data shows that in 2020, Croatia was ranked as having the lowest proportion of early leavers from school and training in the entire EU, at 2.2% (Figure 2.2). This is an improvement from a rate of 5.0% in 2011 (Eurostat, 2021<sup>[8]</sup>), and indicates that Croatia continues to improve the share of its young people eligible to proceed to tertiary education.

Figure 2.2. Early leavers from education and training in selected EU and OECD countries, 2020



Source: Eurostat; Early leavers from education and training, 2020;

Data for the United Kingdom refers to 2019 instead of 2020. The European Union average refers to 27 countries (European Union as of 2020)

[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Early\\_leavers\\_from\\_education\\_and\\_training](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Early_leavers_from_education_and_training).

Original dataset: <https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

For most of the first decade of the 2000s Croatia was experiencing net positive immigration. However, Croatia experienced a rise in emigration following accession to the European Union (Draženić, Kunovac and Pripuzić, 2018<sup>[9]</sup>), and emigration now outpaces immigration. The sharpest loss began in 2013, after accession to the EU, and peaked in 2017 (Eurostat, 2021<sup>[10]</sup>), but the most recent figures from the Croatia Bureau of Statistics (CBS) show 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<sup>[11]</sup>)<sup>1</sup>. The majority of emigrants are of prime working age and the average age of emigrants is dropping, reaching 33.6 years old as of 2016 (Eurydice, 2021<sup>[12]</sup>), (Draženić, Kunovac and Pripuzić, 2018<sup>[9]</sup>).

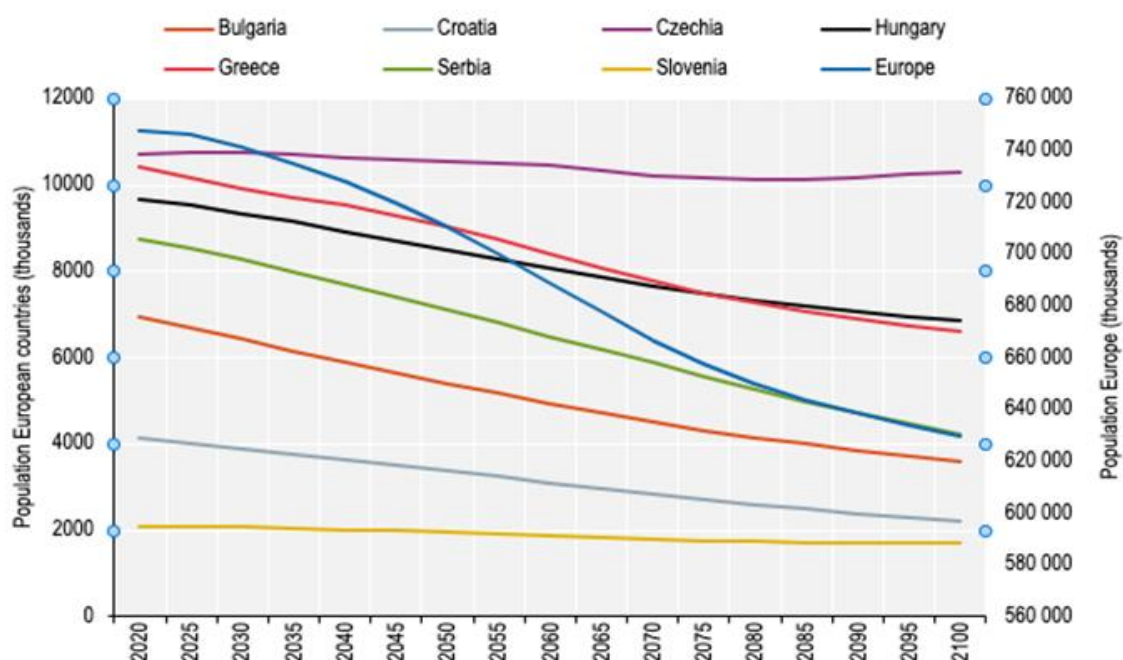
Alongside the high levels of migration out of Croatia, declining birth rates and longer life expectancies also contribute to the population decline and to a rapidly ageing population. Croatia's population currently stands at 4.1 million people. According to the United Nation's Report "World Population Perspectives" the country will continue to see a decreasing population, estimating a drop to 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<sup>[13]</sup>). Given its current trajectory, by 2050 Croatia is projected to lose more than 15% of its population (Figure 2.3).

One additional 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 tertiary-education adults aged 30-34 in rural areas, towns & suburbs and cities were 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<sup>[6]</sup>). Croatia thus faces a challenge familiar to many neighbouring European countries -

<sup>1</sup> 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.

balancing between ensuring widespread access to higher education across its regions and maintaining efficient resource provision considering changing demographic conditions.

**Figure 2.3. Population projection for Croatia and selected European countries (2020-2100)**



Source: UN World Population Prospects 2019; <https://population.un.org/wpp/DataQuery/>

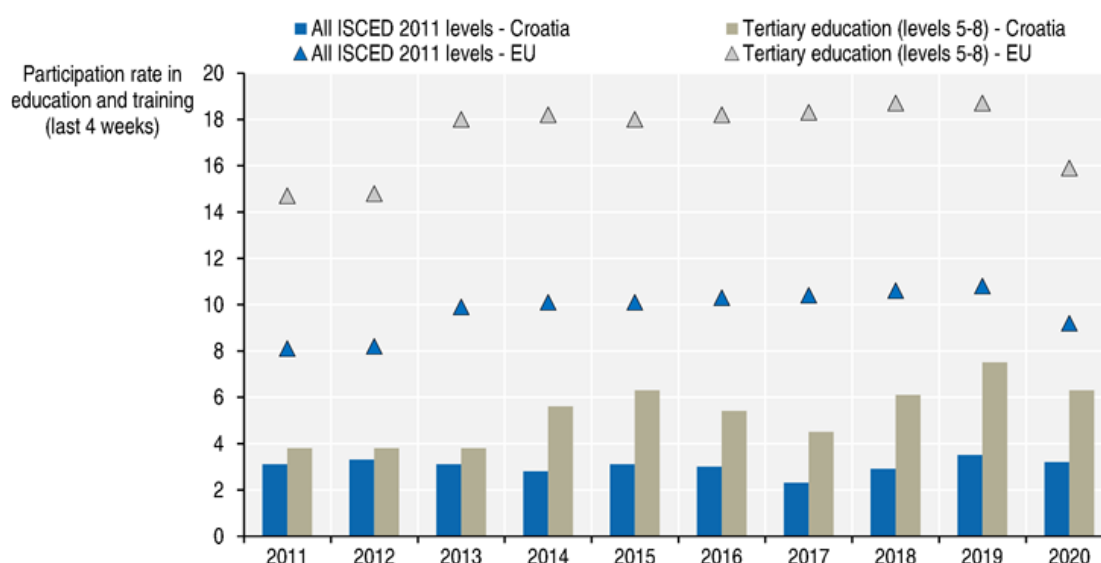
Internationalisation is one means by which countries may seek to maintain vibrant higher education systems in the face of demographic decline. There were approximately 5,700 international students in 2019 (3% of all Croatian students), a share largely below the EU average and other European countries, including many of its neighbouring countries (Eurostat, 2020). Croatia also has one of the lowest proportions of international doctoral students across European countries. While the COVID-19 pandemic is likely to have further disrupted international student flows, the popularity of Croatian higher education institutions among students from abroad is growing, 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<sub>[14]</sub>).

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 training provided may all be obstacles to participation in lifelong learning (OECD, 2020<sub>[15]</sub>). For example, a 2017 survey for the Croatian Agency for Vocational Education and Training (ASOO) found that 30% of respondents cite cost as a reason for their lack of participation in adult education (Vučić, 2017<sub>[16]</sub>).

Although adult education participation is low, Croatian adults exhibit a high interest in learning by some measures. According to the 2016 Adult Education Survey, 91.9% of Croatian adults (aged 25-64) participated in informal learning, mainly through printing materials (45.5%), computers (60.3%), or through television, radio and video (51.3%) (Eurostat, 2021<sub>[17]</sub>). This share is considerably higher than the EU-27 average rate of participation (59.5%) and may potentially reveal a dormant demand for adult education programmes in higher education.

**Figure 2.4. Participation rate in education and training, Croatia versus the European Union (2021)**

Participation within the previous 4 weeks



Source: (Eurostat, 2021<sup>[18]</sup>), *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](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=trng_lfse_03&lang=en).

Croatia also faces challenges with integration of young graduates into its labour market. The percentage of young people neither in employment nor in education and 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<sup>[19]</sup>). 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 exiting school (Tomić, Botrić and Žilić, 2018<sup>[20]</sup>).

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 holds the promise of increasing the supply of highly qualified graduates and narrowing 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 has societal and economic benefits, supporting a more prepared workforce and a more educated citizenry. As in most European countries, the main funding source for public higher education is the State, but Croatia also has a high share of spending by the private sector, reaching 36% of all expenditure on higher education by 2018. Private institutions are funded from their own income streams, primarily tuition fees, although they may qualify for targeted subsidies from the state budget for special projects of national interest, or if the private institutions fulfil a demand not met through the provision of public education and if the offer complies with criteria set by public authorities (Eurydice, 2021<sup>[21]</sup>).

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 with between the Ministry of Science and Education and higher education institutions, known nationally as “programme funding” (Ministry of Science and Education, 2021<sup>[22]</sup>). The European Commission reported that HEIs experienced a 20% year-on-year increase in funding in 2020 awarded through performance contracts (European Commission, 2020<sup>[23]</sup>). 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, part of its plans for the modernisation of the higher education system (see Box 2.1).

The global financial crisis of the mid-late 2000’s 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 system-wide 10% reduction in funding between 2008 and 2012. However, a recent 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. Starting in 2018, funding has notably increased again 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<sup>[24]</sup>).

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<sup>[25]</sup>). Integrated universities have a centralised management, where decision-making is led by a rector and senate. Universities that follow 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<sup>[2]</sup>). Polytechnics and colleges are governed by deans, assisted by their 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 rectors of public universities.

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

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 some of the strategic coordination and administrative challenges that can arise as a result of defining individual faculties and academies as independent legal entities on the other hand (OECD, 2008<sup>[27]</sup>) (OECD, 2019<sup>[2]</sup>). 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. It 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, far more than in many countries with similar sized population (for example, Denmark, Ireland, New Zealand or Norway). Previous efforts to negotiate reforms leading to

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<sup>2</sup> 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.

strengthened university-level governance at non-integrated universities met with strong resistance, and the underlying arrangements still persist today (OECD, 2014<sub>[28]</sub>).

Quality assurance of 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. The National Council for Science and Higher Education (NVZVOTR) addresses strategic issues in higher education and sets a number of 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, for example managing programme application and admission processes, and providing analytical and statistical reports than draw 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 all of its education system, including higher education. One of the priorities of the National Reform Programme 2020 is to improve the education and training system to make it more relevant to labour market needs, including higher education and adult education. Specific planned measures include revision of the quality system for adult education including higher education, improved andragogic education for adult education providers and the definition and entry of qualification and occupational standards to the Croatian National Qualifications Framework (CROQF) (Government of the Republic of Croatia, 2020<sub>[29]</sub>). In July 2021 a draft of the new Adult Education Act was adopted by the Croatian Government. The Act ensures quality of adult education programmes and institutions, monitoring of the adult education system and recognises unofficial and informal acquired competencies and skills by the CROQF (Eurydice, 2021<sub>[30]</sub>).

In 2019, Croatia released a new National Plan for the Social Dimension of Higher Education 2019-2021. Its aim was 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 (MZO, 2019<sub>[31]</sub>).

A new 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 (CEC, 2021<sub>[32]</sub>). The Law was adopted in late 2022.

Croatia's National Plan for Recovery and Resilience (NPRR) encompasses several other higher education reforms. A model for reorganisation of higher education institutions and scientific 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 the institution's development objectives. The introduction of the new funding model is expected to be implemented through programme agreements research and teaching activities, with a funding period of two years. A new specific fund for investment in higher education infrastructure ("e-Universities") also commenced in 2022 (CEC, 2021<sub>[32]</sub>).

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 (Government of the Republic of Croatia, 2020<sub>[29]</sub>) (CEC, 2021<sub>[32]</sub>).

### 3 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 effectively support digitalisation. It is a concept that recognises that effective digitalisation in higher education depends not only on the actions of individual institutions, but 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 the digital transformation agendas (OECD, 2021<sup>[33]</sup>).

The development of digital education occurs within the framework of the wider digital economy. Citizens who are regularly exposed to beneficial digital technologies and processes across economic and social sectors are more likely to build the skills required to successfully navigate digitally enhanced education programmes, as teachers or as learners. In addition, the digital transformation of higher education institutions also depends on their access to connectivity and technologies that are often rolled out at a national level, such as broadband and 5G connections (OECD, forthcoming). 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 of higher education systems relates to the extent that the public policy framework for higher education supports and incentivise higher education institutions in embedding sound digital practices in core activities, as well as ongoing support and training for its employees and students. Governments

Developing coherent assessments of digital readiness of education systems is challenging for most jurisdictions, due to substantial data gaps and only a nascent data infrastructure for monitoring digitalisation (OECD, forthcoming<sup>[34]</sup>). Still, some insight can be gained by reviewing Croatia's position in international and national indices of digital performance, and from examine elements of Croatia's national policy framework that may support digital readiness in higher education. The following sections review Croatia's position for 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 that measure digital performance and readiness at country level. Taken together, these measures provide a range of insights on 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 3.1).

**Table 3.1. International and national indices of digital performance featuring Croatia**

International Indices on Digital Performance	Focus	Jurisdiction/Time
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

<b>Centre for the European Policy Studies' Index of Digital Readiness (IRLL)</b>	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
<b>Portulans Institute - Network Readiness Index (NRI) 3<sup>rd</sup> edition</b>	4 key dimensions that make up 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)
<b>National Indices of Digital Performance</b>	<b>Focus</b>	<b>Jurisdiction/Time</b>
<b>Apsolon's Analysis of Digital Readiness of Croatian Cities</b>	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
<b>Croatian Digital Index (HDI) - Apsolon</b>	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 that follows the digital performance of EU member states. The latest data were released in 2021, although it should be noted that data was collected prior to the pandemic. Among 27 member states, Croatia ranked in 19th position on the DESI in 2021 (European Commission, 2021<sup>[25]</sup>). Its strongest rankings are in the use of ICT for environmental sustainability, the share of adults with at least basic digital skills, and its open data initiatives (Table 3.2).

**Table 3.2. Croatia and EU scores on selected DESI indicators**

<b>Dimension</b>	<b>Indicator</b>	<b>Croatia - DESI 2021</b>	<b>EU - DESI 2021</b>
<b>Broadband connectivity</b>	Overall fixed broadband coverage (% households)	73%	77%
	Fast broadband (NGA) coverage (% households)	86%	87%
	Fixed very high-capacity network (VHCN) (% of households)	47%	59%
	4G Coverage (% populated areas)	99.5%	99.7%
	5G Readiness (Assigned spectrum as a % of total harmonized 5G spectrum)	100%	51%
	5G Coverage (% populated areas)	0%	14%
<b>Human Capital</b>	At least basic digital skills (% individuals)	53%	56%
	Above basic digital skills (% individuals)	35%	31%
	ICT specialists (% individuals employed aged 15-74)	3.7%	4.3%
	ICT graduates (% graduates)	4.4%	3.9%
<b>Digital Public Services</b>	e-Government users (% of internet users)	52%	64%
	Digital public services for citizens (Score 0-100)	60	75
	Digital public services for businesses (Score 0-100)	73	84
	Open data (% maximum score)	82%	78%

Source: European Commission Digital Economy and Society Index – Croatia (2021) <https://digital-strategy.ec.europa.eu/en/policies/desi-croatia>

The DESI shows that Croatia's connectivity has steadily progressed in recent years. 86% of households now have fast broadband coverage (86% national and 39% rural), in line with the EU average of 87%. Additionally, Croatia has advanced to 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<sup>[35]</sup>) will further improve connectivity, including very high capacity networks and connectivity in more sparsely populated regions (European Commission, 2021<sup>[36]</sup>).

Croatia's overall human capital ranking in the DESI stands at 16<sup>th</sup>. ICT specialists account for only 3.7% of the workforce compared to an EU average of 4.3% and 60% of enterprises report difficulty fulfilling those roles, including many higher education institutions. 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 aged 16-24 who hold basic or above-basic digital skills in all of Europe (Eurostat, 2020<sup>[37]</sup>) creating a positive outlook on the competence 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 use 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, and provision of digital public services is rapidly expanding, including digital services for citizens.

### **Portulans Institute - Network Readiness Index (NRI) 2021**

The 2021 Network Readiness Index (NRI) by the Portulans Institute is one of the most comprehensive efforts to measure digital readiness globally. It ranks 130 global economies on technology development and the capacity of countries to capitalise on ICT opportunities, with four core pillars and 62 sub-indicators (Portulans Institute, 2021<sup>[38]</sup>). Croatia ranks 41<sup>st</sup> out of the 130 economies in the 2021 NRI (Table 3.3), mainly driven by higher performance on ICT skills, privacy protection, ICT regulatory environment, e-Participation and adult literacy. Technology has the largest scope for improvement; Croatia was ranked 64<sup>th</sup> place, with low ranking on indicators relating to investment in emerging technology and spending on computer software

**Table 3.3. Croatia's Placement on Portulans Institute's Network Readiness Index 2021**

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

Note: The 2021 Network Readiness Index (NRI) is a composite index measuring the ICT readiness of 130 economies. 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, ranking 13<sup>th</sup> in the EU. Croatia's ranking was heavily influenced by its 3<sup>rd</sup> place position in the "institutions and policies for digital learning" dimension;

Croatia ranked well in all sub-indicators in this category, except for 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 the education sector. Croatia performed much lower in the other elements of the index – it ranked 24th in learning participation and outcomes, and 21st in its availability of digital learning (Centre for European Policy Studies (CEPS), 2019<sup>[39]</sup>).

### ***National indices of digital readiness – Apsolon***

There have been few national level analyses of digital readiness published in Croatia. Two recent examples were conducted by Apsolon, a national consultancy firm. It carried out a study in 2019 on the digital readiness of Croatian cities, ranking 20 cities of varying sizes by their 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<sup>[40]</sup>). 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 citizens’ quality of life (McKinsey Global Institute (MGI), 2018<sup>[41]</sup>).

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 were noted as making the greatest progress (Apsolon, 2020<sup>[40]</sup>). The degree of digital readiness of Croatian cities provides an indication of the underlying foundation of local digital readiness that higher education institutions will encounter in their digitalisation efforts.

Another digitalisation-centred analysis by Apsolon was the 2018-2019 Croatian Digital Index (HDI) (Apsolon, 2019<sup>[42]</sup>), 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 selected as a top ten priority and only 15% of respondents indicated their business had a digital transformation strategy (Jurčević, Lulić and Mostarac, 2020<sup>[43]</sup>).

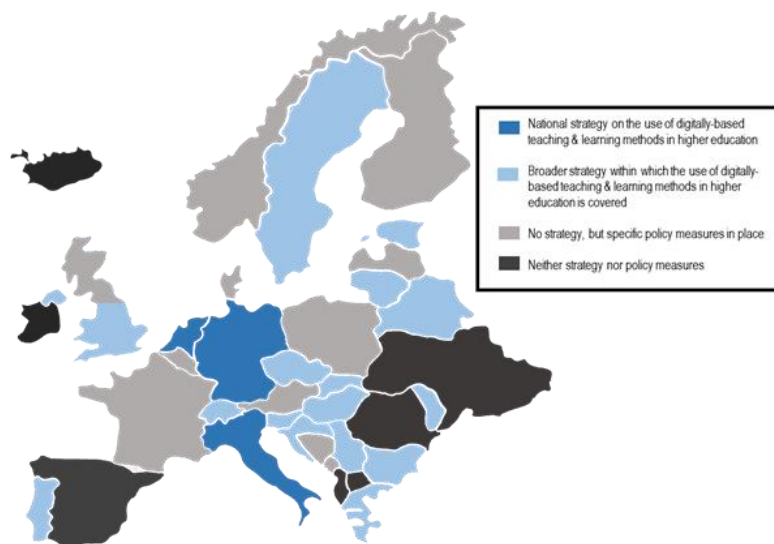
## **National policies and priorities for supporting digitalisation in higher education**

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 strategies can help to build a collective vision for how digital innovation should be progressed to benefit education systems and learners. More than half of OECD countries now have a written digital education strategy, while in other countries digital education is addressed as part of a broader national strategy on digital innovation (van der Vlies, 2020<sup>[44]</sup>). 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 3 had created one specifically for higher education, although many more mentioned new technologies in higher education within broader national strategies (Figure 3.1).

While Croatia does not have a specific digital plan for higher education, the Ministry of Science and Education prepared an Action Plan for the Implementation of Distance Learning (Ministry of Science and Education, 2020<sup>[45]</sup>) in response to the pandemic. Although 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 also identified several systemic gaps and challenges that would need to be addressed in the future, including the need for improvements in strategic planning

(organisation, assistance in implementation and management), training on implementation, equipment and programme support.

**Figure 3.1. National strategies on the use of new technologies in teaching and learning in higher education**



Source: Eurydice (2018): The European Higher Education Area Report (2018): Bologna Process Implementation Report; [https://eacea.ec.europa.eu/national-policies/eurydice/content/european-higher-education-area-2018-bologna-process-implementation-report\\_en](https://eacea.ec.europa.eu/national-policies/eurydice/content/european-higher-education-area-2018-bologna-process-implementation-report_en)

The report also identified 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, how to conduct digital assessment, etc.) and 12 areas for investment in digital infrastructure necessary for effective distance learning (e.g. personal digital tech; central support online assessment; open digital material, learning analytics for feedback) (Ministry of Science and Education, 2020<sup>[45]</sup>). Avenues for higher education to continue distance learning in 'ordinary' times were also identified: virtual classes, videoconferences, webinars, and the possibility of virtual mobility and international cooperation (e.g. ERASMUS+ Virtual Exchange, eTwinning).

### ***National organisations and projects supporting digitalisation in higher education in Croatia***

A number of 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-prong mission is to: strengthen the educational community, develop advanced infrastructure, and safeguard the nation's digital space. To this end, CARNET provides over 70+ services to its end users including many e-learning initiatives (teacher training, LMS hosting, acts as the national portal for distance learning, etc.) (Croatian Academic and Research Network (CARNET), n.d.<sup>[46]</sup>). CARNET also oversaw the implementation of e-Schools, a project to systematically improve digital maturity in Croatia's school sector (see Box 4.1).

In addition, the University Computing Centre (SRCE) was founded at the University of Zagreb in 2007, and has become the national key centre for planning, designing and support of e-infrastructure for academia and the scientific community. It takes a central role in the implementation and use of e-learning technologies by higher education students and staff, and on systems and services that help to modernise

education. For instance, SRCE lead the initiative on developing the Croatian Digital Academic Archives and Repository (DABAR). SRCE is also the lead architect of the Croatian Research Information System (CroRIS) and the Croatian Scientific and Educational Cloud (HR-OOZ). (Univeristy of Zagreb, 2021<sup>[47]</sup>); (Ministry of Science and Education, 2021<sup>[22]</sup>). SRCE also ensures the connection of Croatian e-services and infrastructure with pan-European initiatives (SRCE (The University Computing Centre), n.d.<sup>[48]</sup>); (EGI Federation, 2020<sup>[49]</sup>). SRCE's position as was a key partner for 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 National Council for Science and Higher Education and the ASHE also play a role in 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 programmes, appointing and evaluating teaching personnel, and delivery of online learning (particularly for course delivered fully online). The ASHE has a specific responsibility to review of the application of the criteria for fully online programmes, for the purposes of accreditation. At the same time ASHE also often reflects on digitalisation of higher education when conducting its other mandated activities, such as reviewing the application of national and international standards during 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 (Agency for Science and Higher Education (ASHE), 2016<sup>[50]</sup>). Following legislative changes in 2022, it is expected that the criteria will be reviewed in 2023.

A number of 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 a total €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<sup>[51]</sup>).

While the majority of funding for e-Universities is reserved for upgrades to digital infrastructure (see Box 2.1. and the technical report on investment in digital infrastructure) 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-classes as well as digital evaluation tools, offer targeted support to stakeholders in the system, and link the most e-Learning system provided by SRCE with other information systems in higher education. A plan for learning analytics will also be incorporated to improve targeted support for students.

These e-Universities initiative is additional to wider investments in access to connectivity, foreseen under the National Plan for the Development of Broadband Access, one of the main priorities of which 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 include introducing 5G networks in urban and rural areas to ensure end-users all have access to high-quality network services. (Republic of Croatia, 2021<sup>[52]</sup>).

## 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 on many aspects of digitalisation, and points to a low to average level of digital readiness in Croatia. While basic digital skills of the population in Croatia are in general similar to the EU average, and higher among youth, 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 within the

system and challenges with prioritising strategic focus on and investment in emerging technological solutions in government and businesses.

Croatia is rapidly catching up on many aspects of digitalisation, including in connectivity and establishing a favourable regulatory environment for digitalisation in the wider economy. Croatia 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 (see Box 4.1). 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 central supports, in the form of CARNET and SRCE, and the activities they are pursuing are also fundamental elements of driving forward digital readiness in Croatia.

On the other hand, more efforts may need to be made 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, while national criteria for the evaluation of fully online study programmes state that students enrolled in these programmes can only carry part-time status (Agency for Science and Higher Education (ASHE), 2016<sup>[50]</sup>). 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<sup>[53]</sup>). Moreover, there is a dearth of information on evaluating the digital competence of higher education teachers in Croatia (Müller and Varga, 2020<sup>[54]</sup>).

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

# 4 A proposal for evaluating digital maturity of Croatian higher education institutions

## Introduction

The concept of digital maturity, as used in this project, refers to the extent of development of digitalisation at the level of organisations – in this case, individual higher education institutions. Evaluating the digital maturity of an organisation is a complex, multidimensional process. Digital maturity may be influenced by both external and internal factors, including the digital readiness in the system in which the institution operates and its internal capacity for effective integration of digital technologies.

Much of the previous development of digital maturity frameworks was carried out with business organisations in mind or has focused on the development of specific organisation-wide tools such as management information systems (Proença and Borbinha, 2018<sup>[55]</sup>). Still, many frameworks, whether for commercial organisations or higher education institutions, focus on similar thematic areas, encompassing both organisation-level and individual-level factors that might drive or enable digital transformation, such as strategic leadership, governance, technology adoption, culture and expertise. (Ifenthaler and Egloffstein, 2020<sup>[56]</sup>; Rossman, 2018<sup>[57]</sup>)

Some digital maturity measurement frameworks have been proposed specifically for education organisations, although few attempts to systematically measure digital maturity of higher education institutions have been made. Croatia is one of the more experienced jurisdictions with respect to directly attempting to measure digital maturity, having developed a framework for school's digital maturity in its e-Schools project. The project entailed triangulating internal and external school evaluations to arrive at a “starting level” of maturity for each school, and then aimed for each school to advance by at least one level (Box 4.1). Many of the indicators used in the e-Schools Digital Maturity Framework found to be significant predictors of digital maturity are also applicable to higher education institutions (Table 4.1).

**Table 4.1. Significant predictors of digital maturity in the e-Schools framework**

Domain	Indicators
Planning, Management and Leadership	Plan and programme of school development from ICT perspective (PML2)
	Managing the integration of ICT in learning and teaching (PML3)
	Learning analytics (PML5)
	Regulated access to ICT resources (PML6)
	Use of ICT in teaching students with special education needs (PML7)
ICT in Learning and Teaching	Awareness (ICTTL1)
	Use (ICTTL 3)
	Digital content (ICTTL4)
Development of Digital Competence	Awareness and participation (DDC1)
	Planning (DDC2)
	Purpose of professional training (DDC3)
	Self-confidence in use of ICT (DDC4)
	Informal learning (DDC7)
ICT Culture	Access to ICT resources by educational staff (teachers) (ICTC1)
	Access to ICT resources by students (ICTC2)
	Communication, information and reporting (ICTC4)
	Projects (ICTC7)

ICT Infrastructure	Planning and procurement (ICT11)
	Network infrastructure (ICT12)
	ICT equipment in the school (ICT13)
	ICT equipment for educational staff (teachers) (ICT14)

Note: The instrument evaluation focuses on the digital maturity level of 151 primary and secondary schools in Croatia. 21 significant indicators, found to directly influence the maturity level of a school are included above.

Source: The Analysis of Digital Maturity of Schools in Croatia (Balaban, Redjep and Calopa, 2018<sup>[58]</sup>); <https://doi.org/10.3991/ijet.v13i06.7844>

#### Box 4.1. The e-Schools project in Croatia

At the primary and secondary level, the e-Schools programme is Croatia's flagship example of bolstering digital maturity. Launched over two phases in 2015 and 2018, the programme equipped school campuses with reliable and modern infrastructure, delivered up-to-date ICT devices to classrooms for teaching and learning, and provided e-content and digital platforms for schools as well as the provision of training and support for teachers. The project was coordinated by CARNET and funded by European Structural Funds (ESF), European Regional Development Funds (ERDF) and the State.

Digitally mature schools were defined as places where ICT integration was high and systematic approach is taken towards toward ICT in school management and educational processes (Balaban, Redjep and Calopa, 2018<sup>[58]</sup>). Teachers were able to develop their own digital content, use technology effectively to enhance teaching, and support independent learning and critical thinking skills in their students. This was likely to have been a key success factor for the project - evidence shows that digital education initiatives have more success with teachers' buy-in, participation, engagement and eventually ownership of the process (Conrads et al., 2017<sup>[59]</sup>).

Measurement was carried out using a Framework for Digital Maturity of Schools (FDMS), designed to identify the level of digital maturity of schools in Croatia, their progress towards integration and efficient use of ICT and areas for improvement. Its creators reviewed 15 existing maturity frameworks and selected the DigCompOrg and eLearning Roadmaps as the foundation for the construction of the FDMS rubric. The rubric, a "maturity matrix" has five evaluation domains (1. Planning, Management and Leadership; 2. ICT in Learning and Teaching; 3. Development of Digital Competence; 4. ICT Culture; 5. ICT Infrastructure), with 38 individual elements assessed across five maturity levels (basic, initial, e-enabled, e-Confident and e-Mature) (Balaban, Redjep and Calopa, 2018<sup>[58]</sup>).

The matrix, along with the self-evaluation responses and software, evaluated the digital maturity level of 151 primary and secondary schools in Croatia. To triangulate results, an external evaluation was also conducted. This revealed a visible gap between the evaluation findings, with more schools identifying themselves as further along in their digital maturity level (e.g., e-Confident or e-enabled) than did the external evaluation. The largest deviation was in Domain 1, Planning, Management and Leadership as schools were unaware of the strategic documents required for accurate reporting. The adaptation of strategic documents and upgrading schools' documents with ICT strategy is thought to affect the level of digital maturity.

The e-Schools approach to evaluating digital maturity may not translate directly to use for higher education institutions for several reasons. Firstly, the e-Schools framework was designed for schools and teachers, and as a result many of the indicators are heavily focused on the application of ICT in teaching. Higher education institutions have a much wider mission than schools, encompassing teaching but also research, innovative and entrepreneurial activity, the provision of wraparound services to students, and serving the wider population and local community. From the perspective of higher education institutions, digital maturity frameworks for higher education institutions will need to permit holistic evaluation and reflection across all the institution's activities.

Higher education institutions also have more complicated leadership and organisational structures than schools, with roles and responsibilities for digitalisation spread across individual faculties and departments. As a result, self-evaluation (and improvement) of digital maturity in higher education institutions is likely to require much greater levels of coordination among personnel than within schools. Moreover, unlike with e-Schools, most higher education institutions will not enter a maturity evaluation process as “digital beginners”. Many institutions in Croatia have a long history of independent development of digitalisation strategies and processes to increase digital maturity, tailored to their specific needs and circumstances (Box 4.2).

Finally, it is difficult to coherently apply the concept of “levels” of maturity across an entire higher education institution, given the wide range of staff and student categories who vary in digital competence, while the extent of leadership and infrastructure may vary across departments and activities. One-size-fits-all approaches to measuring digital maturity are unlikely to bear similar fruit in higher education institutions as in schools. For example, subject-specific e-content repositories would have limited utility for higher education institutions compared to schools, and the development of standardised infrastructure allocation models that cover diverse HEI circumstances will be more challenging than for schools.

#### Box 4.2. Examples of previous higher education institution strategies for digitalisation in Croatia

Higher education institutions across Croatia have developed various initiatives aimed at improving various aspects of digital maturity.

The University of Zagreb introduced a strategic initiative (the *Zagreb E-learning strategy for 2007-2010*) to strengthen e-learning. The university e-learning committee evaluated the program in 2012 and subsequently incorporated it into the university strategy for teaching and learning (2014-2025). The initiative establishes a National Centre for e-Learning in Higher Education, a University committee for E-learning, and the University Office for E-learning (University of Zagreb, 2021<sup>[60]</sup>), (Bralić, 2016<sup>[61]</sup>).

The University of Rijeka implemented a multi-year strategy, *Strategy for the introduction of e-learning* from 2006-2010 and 2011-2015 and founded a Centre for e-learning in 2009. Wave 1 of the strategy built a foundation for increasing delivery of e-learning content, supported teachers in moving from traditional to active learning methodologies. Wave 2 continued to build on high-quality e-learning, supported students in these endeavours and developed distance learning programs. The institution also created the *E-day of the UNIRI* while established annual awards for the best e-courses and grants for e-course development (Bralić, 2016<sup>[61]</sup>).

The University of Split also created a multi-year strategic plan to boost e-learning content in courses by 25% and worked towards a university-wide joint e-learning system. Similarly, the University of Osijek’s 2011-2020 plan focused primarily on building a join information and communication system on campus.

A 2016 survey administrated to 119 Croatian higher education institutions revealed that 84% of survey respondents do not have a dedicated fund for applying e-learning and developing e-learning resources (Bralić, 2016<sup>[61]</sup>).

One of the most detailed and comprehensive framework development processes available, specific to higher education, was carried by Durek et al (2018<sup>[62]</sup>). Based on an exhaustive review of existing frameworks, the researchers concluded that, as well as a systematic approach towards the use of technology in teaching and learning, a digital maturity framework for higher education institutions should also include other dimensions, such as leadership, planning and management; quality assurance; scientific research work; technology transfer and service to society, ICT culture and ICT resources and infrastructure. Durek et. al. provides a comprehensive set of indicators for assessing digital maturity that builds on previous frameworks in a holistic way and reflects the diverse set of activities carried out in higher education institutions (Table 4.2).

**Table 4.2. Digital Maturity Framework for Higher Education Institutions (DMFHEI) indicators**

Areas	Elements
Leadership, Planning and Management	Financial investment in the use of ICT in learning and teaching; research and development; and the business of the institution
	Strategic planning of ICT integration in HEI
	Managing the integration of ICT in learning and teaching at HEI
	Managing the integration of ICT in scientific research at HEI
	The planning and implementation of training for HEI employees in the field of digital competencies and ICT application
	The relationship between HEI and state from the aspect of ICT integration
	HEI policy in ICT integration and monitoring global trends
Quality Assurance	ICT quality assurance policies
	The monitoring and periodic review of study programs from the aspect of ICT application
	Work evaluation of teaching, research, administrative and technical staff
	The continuous monitoring of the results of scientific-teaching work and progress
	Procedures for determining the needs, development, or acquisition of ICT resources and their application
	Approved procedures and follow-up of student enrolment, progress through study, and completion of studies supported by ICT.
Scientific Research Work	The use of ICT in the preparation and publication of scientific papers
	ICT support in the preparation and management of scientific research work and projects
	ICT research (collaborative ICT research on HEI)
	A system of support for researchers at the beginning of their careers in applying ICT in scientific research
	Continuous training of researchers in applying ICT in scientific research
Technology Transfer and Service to Society	The networking and collaboration of researchers with ICT support
	Collaboration with stakeholders (employers, the local community, and pre-tertiary education) supported by ICT
	Applied research and professional projects supported by ICT and/or for ICT
Learning and Teaching	The networking of researchers and users of research (stakeholders) supported by ICT
	Preparation, storage, and use of digital content in learning and teaching
	Innovative learning and teaching methods with ICT
	The development of teachers' digital competence
	The development of students' digital competences
	The use of learning analytics to improve learning and teaching
	Ubiquitous learning and open curricula
support for under-represented groups by using ICT in learning and teaching	
ICT Culture	The network presence of HEI
	Using ICT in HEI promotion
	The development of digital literacy and the promotion of innovativeness in ICT application with HEI employees
	The self-confidence and motivation of employees in terms of the importance of ICT application
	Providing access to and motivation of employees in terms of the importance of ICT application
	Providing access to and support in the application of ICT infrastructure
	The application of ethical standards, copyright, and intellectual property in the ICT field
ICT Resources and Infrastructure	The availability of ICT resources (hardware and software) for learning and teaching
	Network infrastructures at HEI
	Access to ICT resources for students (both in and out of the classroom)
	The digital environment and information systems available to employees and students
	The technical support and maintenance of ICT resources at HEI
	The information security system

Source: (Durek, Kadoic and Begicevic Redep, 2018<sup>[62]</sup>)

Despite the completeness of the framework and the rigorous approach taken to its development, several important limitations arise with its application. Most of the proposed indicators cannot be measured in a

structured way by extant data systems. A demanding and expensive data collection workload would be required to collect all data required for the evaluation framework. The model developers envisaged that the involvement of field experts would be necessary to collect and analyse data and make subsequent judgements about levels of maturity (starting with ‘basic, followed by ‘initial’, ‘e-Enabled’, ‘e-Confident’ and ‘e-Mature’) indicated by each element of the framework. The selection process for field experts and how they would be funded and governed in their operations adds additional complexity to the measurement process. In addition, the model developers acknowledge that further validation of the assessment rubric would be needed (Durek, Kadoic and Begicevic Redep, 2018<sup>[62]</sup>).

Taking the considerations above into account, one can conclude that a framework for digital maturity for higher education institutions in Croatia and elsewhere needs to be more comprehensive than for schools. At the same time, the framework cannot be too prescriptive or excessively burdensome for institutions and stakeholders to work with. Taking these factors into account, the following section proposes a model to evaluate digital maturity in Croatian higher education institutions.

### A framework for evaluating digital maturity of higher education institutions

Recent OECD research identifies several enabling factors for supporting high-quality digitalised education, encompassing adequate infrastructure and equipment, strong leadership, a digitally competent and capable human infrastructure and capacity for monitoring and evaluation (OECD, forthcoming 2023). Similarly, the European Commission’s DigiCompOrg framework for digitally competent educational organisations stresses the importance of human capacities and organisational culture, as well as access to appropriate and sufficient digital technologies. Taking these results into account, and various other available digital maturity approaches proposed for Croatia (as detailed in the previous section), Table 4.3 proposes a simple conceptual framework for digital maturity evaluation of higher education institutions, summarised also in Figure 4.1.

**Table 4.3. A conceptual framework for digital maturity evaluation of higher education institutions**

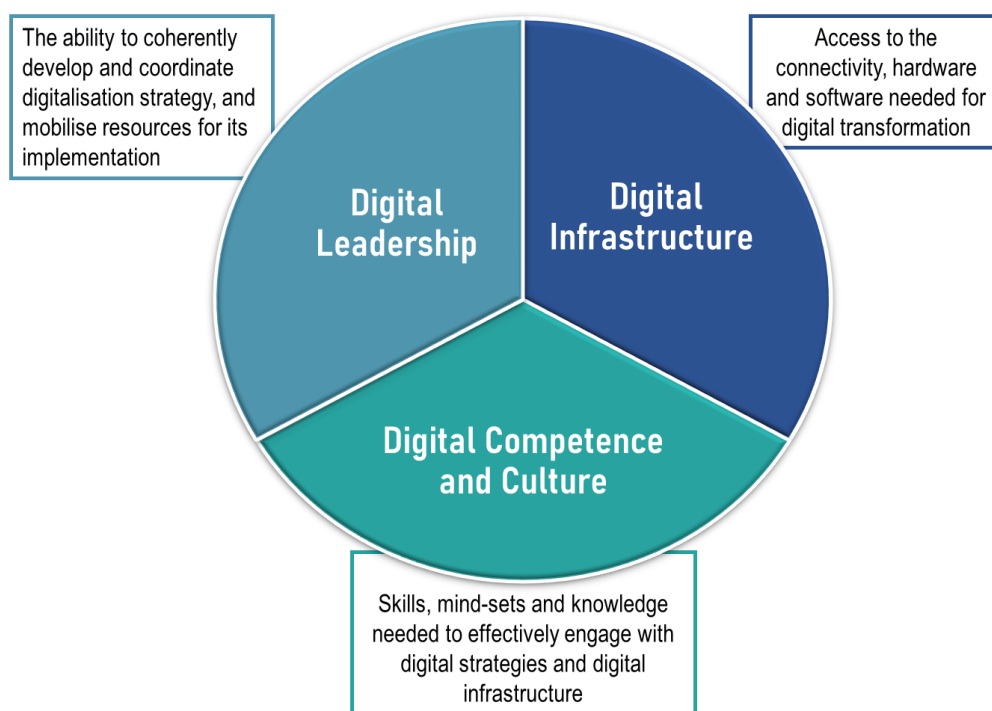
Enabling element	Definition statement
Digital leadership	The institution has a coherent and widely shared strategic vision for digital transformation at the level of the organisation and capacity to mobilise resources for its implementation. Internal activities and processes related to the enhancement of digital infrastructure, competence and culture are connected to the overall institution vision for digital transformation.
Digital infrastructure	The institution has adequate access to the connectivity, physical equipment, software and technical support services needed to allow all activities of the institution to benefit from digital transformation.
Digital competence and culture	The institution has active internal policies and practices that support the cultivation of the skills, mind-sets and knowledge that people (academic staff and leadership, administrators and students) need to successfully engage with and integrate digital technologies in their activities.

Source: Author’s elaboration

The framework evaluates the presence of three enabling elements – digital leadership, digital infrastructure and digital competence and culture. The stronger the presence of each of the enabling factors in the framework, the more likely that the organisation will advance towards full digital maturity. Each of the three

constructs in the proposed digital maturity framework can be measured in many ways. Specific evaluation and measurement strategies will depend on many factors, including whether the maturity framework is being used for accountability purposes or formative assessment and development; the level of available resources for data collection and assessment, and future national and institutional goals and priorities related to digital maturity.

**Figure 4.1. A conceptual framework for digital maturity evaluation and improvement**



Note: Author's elaboration

Trade-offs must also be made between what is ideal and what is possible – balancing the effort required for measurement with the value of the information provided. Evaluation measures for the framework should be formulated considering the information that may already be available and the ease of collecting additional data. Scarce resources are best focused on measuring areas where there is the greatest uncertainty, and where the measurement is crucial to the success of an initiative.

Assessments of digital maturity using the framework can be carried out qualitative basis, by defining specific indicators and approaches that aim to measure important attributes of each enabling element. The framework can also serve as a useful inception point for qualitative evaluation and as a basis for conversations about needed improvement (at institution or national level). The following sections apply the framework to conduct both a quantitative and qualitative evaluation of digital maturity in Croatia's higher education institutions, drawing on a digital maturity survey conducted as a joint exercise between the OECD and CARNET in February 2022, and interviews of higher education institution staff and students carried out in Croatia by the OECD team during a country visit in May 2022.

## 5 Quantitative assessment of digital maturity in Croatian higher education institutions

As part of the activities of this project, the OECD team, in collaboration with CARNET, launched a digital maturity survey of higher education institutions. The intention of the survey was to collect a baseline set of data on institution activities, internal policies and practices related to digital transformation. The CARNET-OECD was fielded in February 2022 and received 95 responses from public and private institutions (Table 5.1) together representing over 77% of student enrolments in 2020/2021.

**Table 5.1. Respondents to the 2022 CARNET-OECD survey, by type of institution.**

Institution type	Number of responses
University top-level (non-integrated universities)	4
Colleges	1
Faculty/Academy/Department	69
Integrated university	5
Public Polytechnic	9
Private institutions	7
Total	95

Source: CARNET-OECD survey of digital maturity of higher education institutions

The items covered in the survey included many variables that could be used to measure the elements of digital maturity, as laid out in the framework in Figure 4.1. Table 5.2 proposes a set of ten binary indicators that can be populated from the CARNET-OECD survey data for each of the three elements of digital maturity proposed in the conceptual framework. The indicators proposed are similar to many of those that appear in other frameworks for benchmarking and measuring the extent and impact of digitalisation in education, including the ACODE framework, EADTU's E-xcellence and the Commonwealth of Learning e-learning benchmarks (DIGI-HE, 2021). However, they are intended as an example and as a starting point only for collaborative deliberation and development on a national set of indicators of digital maturity.

**Table 5.2. Example indicators of digital maturity using the CARNET-OECD survey data**

Indicator Code	Indicator name	Value assignment from CARNET-OECD survey data
<b>Digital Leadership</b>		
DL1	Institution wide strategy or shared vision for digitalisation	1 if the institution reported the existence of either an institution-wide strategy or shared vision, 0 otherwise
DL2	Annual operational plans related to digitalisation	1 if the institution reported the existence of an operational plan, 0 otherwise
DL3	Wide ownership of the strategy	1 if the institution reported at least two of students, staff, external stakeholders included in strategy development, 0 otherwise
DL4	Diverse funding sources	1 if the institution reported at least two distinct funding sources are available for digitalisation, 0 otherwise
DL5	Specific locus of responsibility for digitalisation	1 if the institution reported a specific person or unit has an assigned responsibility for digital transformation, 0 otherwise
DL6	Recognition of the importance of leadership and management	1 if leadership was reported as one of the most important enabling factors for digitalisation, 0 otherwise

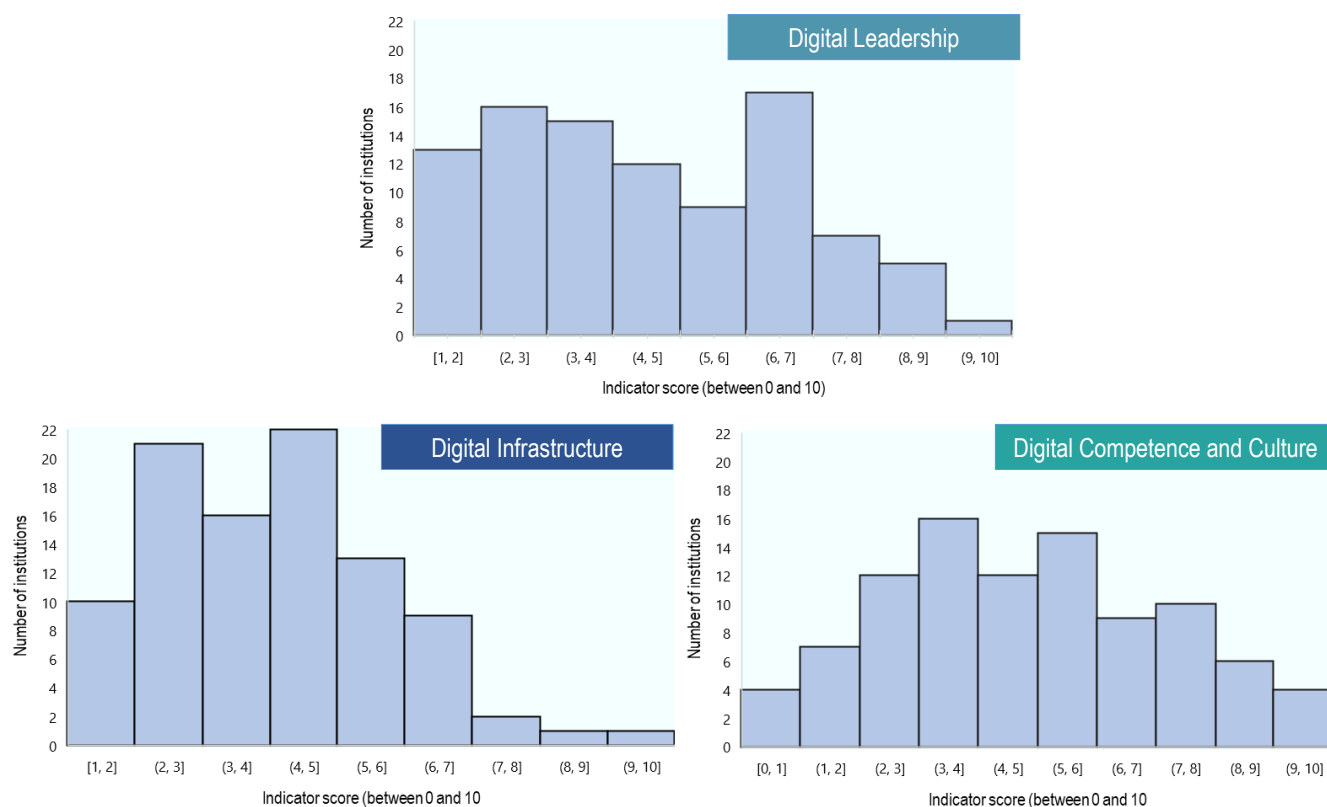
DL7	Procurement related to the overall strategic plan	1 if the institution reported digital infrastructure procurement strategy is linked to overall institution strategy, 0 otherwise
DL8	Strategy for digitalisation in teaching, learning and assessment	1 if the institution reported the existence of strategic goals for digital teaching and learning, 0 otherwise
DL9	Digital teaching and learning is considered in internal quality assurance processes	1 if the institution reported that digital teaching and learning is considered in internal QA, 0 otherwise
DL10	Central institution-wide support service available	1 if the institution reported that institution-wide support is available, 0 otherwise
<b>Digital Infrastructure</b>		
DI1	High quality internet connection is available	1 if the institution rated the quality of their connection as "4" or "5" on a five-point scale, 0 otherwise
DI2	High quality wired connection is available	1 if the institution rated the quality of their connection as "4" or "5" on a five-point scale, 0 otherwise
DI3	High quality wifi is available at the main location	1 if the institution rated the quality of their connection as "4" or "5" on a five-point scale, 0 otherwise
DI4	Adequate facilities for hybrid teaching	1 if the institution rated their need for hybrid teaching facilities as "1" or "2" on a five-point scale, 0 otherwise
DI5	Adequate facilities for lecture recording	1 if the institution rated their need for lecture recording facilities as "1" or "2" on a five-point scale, 0 otherwise
DI6	Digital security policy has been adopted	1 if the institution reported the existence of a digital security policy, 0 otherwise
DI7	Measures to raise awareness about cybersecurity - staff and students	1 if the institution reported that measures exist for both staff and students, 0 otherwise
DI8	Quality of servers and computing	1 if the institution rated the quality of the equipment as "4" or "5" on a five-point scale, 0 otherwise
DI9	Quality of support for maintenance	1 if the institution rated the quality of the available support as "4" or "5" on a five-point scale, 0 otherwise
DI10	Open technologies widely adopted across the institution	1 if the institution rated the extent of adoption of open technologies as "4" or "5" on a five-point scale, 0 otherwise
<b>Digital Competence and Culture</b>		
DCC1	Strategic objective related to digital competence - staff	1 if the institution rated the existence of specific digital competence objectives for staff, 0 otherwise
DCC2	Strategic objective related to digital competence - students	1 if the institution rated the existence of specific digital competence objectives for students, 0 otherwise
DCC3	Intention to offer fully online mode of delivery	1 if the institution reported its intention to offer some fully online education programmes (post-pandemic), 0 otherwise
DCC4	Intention to offer hybrid mode of delivery	1 if the institution reported its intention to offer some hybrid programmes (post-pandemic), 0 otherwise
DCC5	Mature use of hyflex tools	1 if the institution reported its maturity as at "project" or "service" level, 0 otherwise
DCC6	Maturity of use of digital tools to reform course design and/or pedagogy	1 if the institution reported its maturity as at "project" or "service" level, 0 otherwise
DCC7	Use of AI or learning analytics to support and/or personalise student learning	1 if the institution reported its maturity as at "project" or "service" level in the use of AI and/or learning analytics, 0 otherwise
DCC8	Academic support for students engaging with digital technologies	1 if the institution reported that measures exist to support students learning in a digital environment, 0 otherwise
DCC9	Supports for teachers are in place (training or support with course design)	1 if the institution reported that measures exist to support teachers teaching in a digital environment, 0 otherwise
DCC10	Deep integration of digital tools in research activities	1 if the institution reported that digital tools had been used in more than two-thirds of a list of 29 research-related activities, 0 otherwise

Note: The indicators are provided as an example and starting point only. Agreement on a final set of indicators of digital maturity for Croatian higher education institutions is best progressed as a national collaborative exercise.

Aggregation of the binary indicators for each element of the framework shows that, on average, institutions appear to have the highest rates of maturity in the digital competence and culture element (average

indicator score of 5.3 out of 10) and the lowest rates of maturity on digital infrastructure (average indicator score of 4.5 out of 10). Few institutions achieved an indicator score greater than 7 out of 10 on the maturity measure for digital infrastructure (Figure 5.1)

**Figure 5.1. Digital maturity indicator scores for each element of the maturity framework**



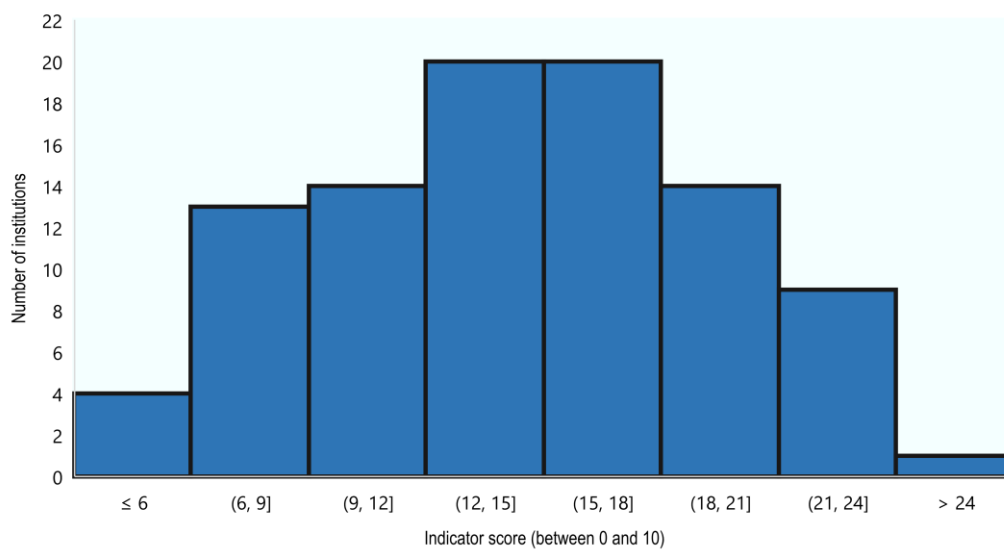
Source: OECD analysis of the CARNET-OECD survey data. Based on survey responses from 95 higher education institutions.

When data for each of the three elements of the framework are combined into an overall measure of digital maturity (out of a total possible score of 30), most institutions exhibit scores in the range between 12 to 18 (Figure 5.2) Slightly fewer institutions reach the highest levels of maturity according to this measurement than achieve the lowest scores – in total 14 institutions exhibit a combined indicator score of greater than 21, while 17 institutions show a combined indicator score of less than 9.

These results serve only as a very preliminary indicator of digital maturity in Croatian higher education institutions. More comprehensive validation of the proposed indicators and underlying data as the best measures of digital maturity would be required before integration of any framework into national and institutional deliberations on digitalisation.

Nevertheless, the results provide a crude indication that while some institutions have well-established digital leadership, high quality infrastructure and an embedded digital culture, many other institutions have made few steps towards digital transformation of their activities. The detail provided in the CARNET-OECD survey can allow for more comprehensive institution-level comparisons to be carried out, if required, to support conversations about future strategies for digital transformation.

Figure 5.2. Distribution of digital maturity scores in Croatian higher education institutions



Source: OECD analysis of the CARNET-OECD survey data. Based on survey responses from 95 higher education institutions

## 6 Qualitative assessment of digital maturity in Croatian higher education institutions

The final diagnostic element of this report is a qualitative evaluation of the digital maturity of Croatian higher education institutions, organised according to the framework proposed in section 4. It presents the key findings of the OECD review team related to digital maturity in Croatia, based on interviews and discussions the OECD conducted with institution staff and other stakeholders in Croatia, and illustrated in some cases by aggregate results from the CARNET-OECD survey.

### Digital Leadership

Digital leadership in higher education institutions is defined as an ability to coherently develop and coordinate organisation-level digitalisation strategies and mobilise resources for its implementation. It can also be indicated by robust institution-level strategies to monitor and improve the quality of its digital operations. Evidence from the CARNET-OECD survey and interviews with institution staff and students by the OECD team can be summarised in the following key messages about digital leadership in Croatian higher education institutions.

*Institution leaders view digitalisation as a concept that goes far beyond online education*

In Croatia, few fully online programs are accredited, and many stakeholders reported to the OECD team that appetite for fully online higher education in Croatia is limited, especially after the experience of emergency remote instruction. Some interviewees noted that during the emergency remote period, much of the planning for online delivery was made up of uneven ad hoc solutions unsustainable in the long run. Going forward, public authorities have a role to play in regularising the current situation with online and hybrid programs and updating national criteria for digitally delivered education.

OECD interviews with higher education institution leaders also indicated that most consider online tools and content as a valuable complement to face-to-face teaching, rather than a primary objective. There is a growing desire among students to have access to online learning material in addition to face-to-face instruction, to support, reinforce and, at times, replace their on-campus lectures. Some institutions have maintained online access to digital learning content developed during the pandemic, but differences are evident among institution leaders in the extent to which they are willing and able to provide such complementary digital content in the future.

It is also clear that institution leaders in Croatia do not view digitalisation only in the context of education provision – there is an imperative to integrate digital tools and technologies into all activities of higher education institutions. Specific requirements mentioned multiple times include the need for digital tools and software to streamline administrative processes, a need for wider access to digitalised content including e-books, research articles and databases, qualification and occupational standards, and requirement for specialised software licences and high-performance computing needed in many fields of study.

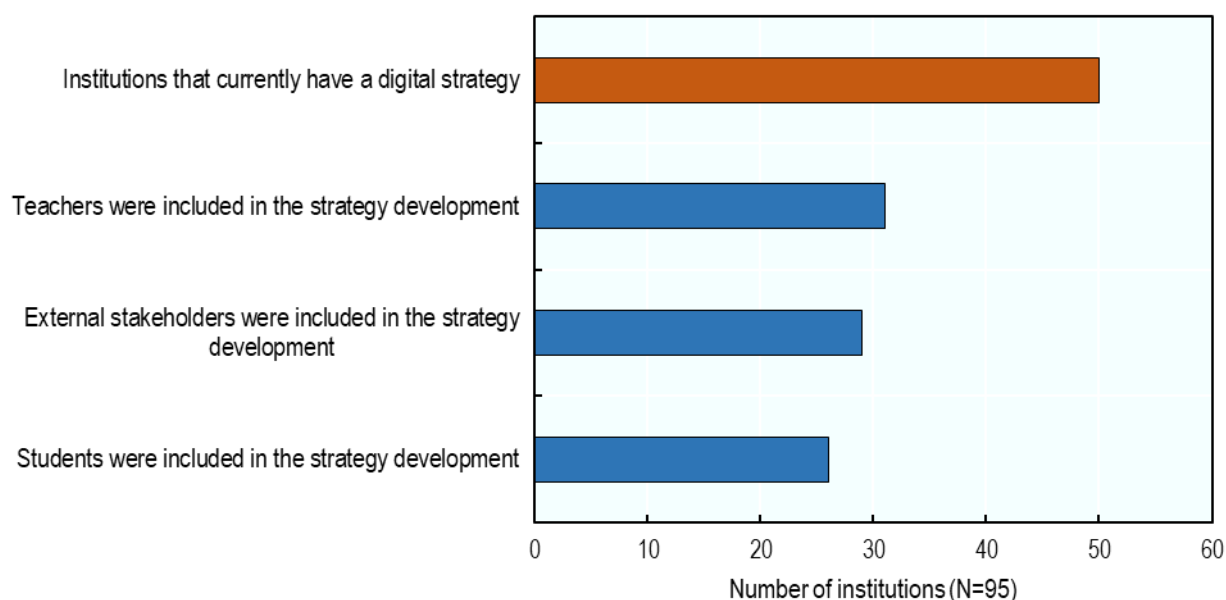
*Higher education institutions mostly have strategies for digitalisation in place, but stakeholder involvement appears limited*

Data from the CARNET-OECD survey of digital maturity in higher education institutions showed that more than 80% of responding institutions currently have a digital strategy in place. However, the results also show that in most cases, important stakeholder groups affected by digitalisation were not consulted during

the development process (Figure 6.1). Students were consulted the least of any group, while teachers were only consulted in the development of approximately 30% of institution strategies. Leaving students and staff out of the consultation process creates the risk that institution leaders develop strategies that are not relevant to actual needs or previous experiences of staff and learners.

The results indicate that more efforts may be needed to embed coherent institution-level digital leadership across Croatian higher education institutions. In OECD site visits, some interviewees acknowledged a need to improve leadership and strategic coordination. Within independent constituents of the non-integrated universities, for example, it was noted that change efforts at the faculty level are not sufficient but must be embedded across the entire University structure. However, even within an integrated university, strategic approaches to digitalisation can vary across departments and specialisms. It was also noted in interviews that an overly narrow view of digital strategy is sometimes taken both at central and institutional level, with a focus mainly on providing equipment rather than a more holistic capacity-building approach.

**Figure 6.1. Development of institutional strategies for digitalisation in Croatian HEIs.**



Source: CARNET-OECD survey of digital maturity of higher education institutions

*Institution leaders perceive a lack of public investment as one of the main barriers to successful digitalisation*

In the CARNET-OECD survey of digital maturity, a lack of access to public funds for digitalisation was identified as the greater barrier to digitalisation, followed by limited physical infrastructure, and a lack of available staff to support digital operations (Figure 6.2). In interviews, many institution leaders and senior staff expressed gratitude and appreciation for the range of services provided by CARNET and SRCE, but also noted that available public funding was not sufficient to meet national needs. Some interviewees also perceived a greater tendency to fund digital projects in STEM fields, even though there are emerging needs for access to digital technologies in all fields.

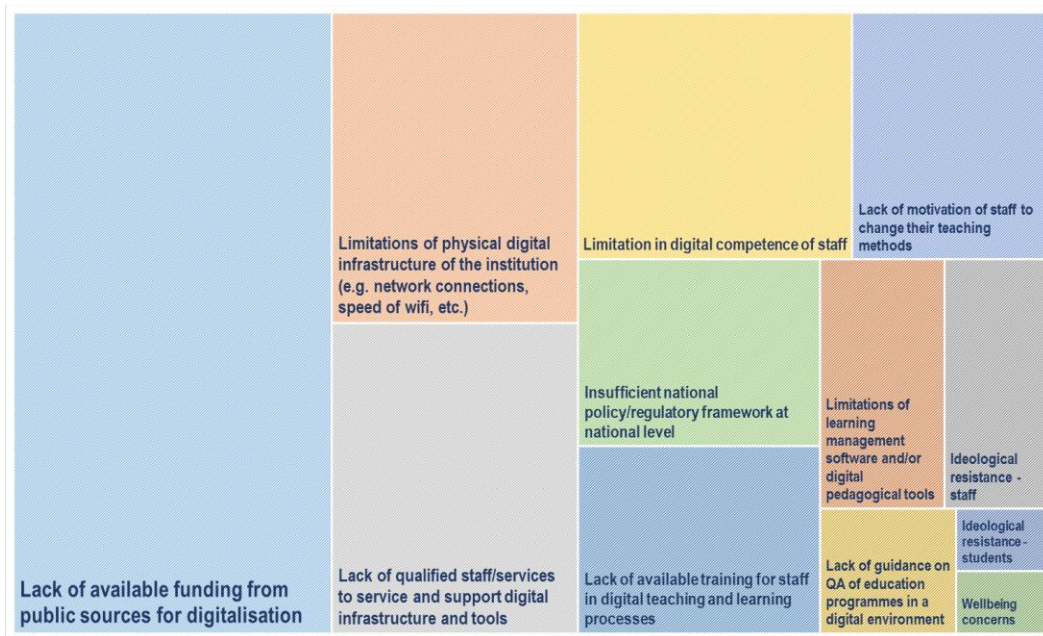
Capacity for strategy development can also vary according to the resources available to the institution. For example, stakeholder interviews with the OECD team highlighted that Croatia's polytechnics in general are

smaller than universities and tend to have less resources available for digital transformation. In addition, many institutions' current digital development strategy was produced before the pandemic and does not reflect the latest developments.

Institutions are not fully dependent on public sources for investment in digitalisation, and in fact institutions are most likely to fund digital tools from their own budgets rather than rely on public funds (Figure 6.3). At the same time, 15 survey respondents (17% of the total) reported that centralised public funding was their only source of funds for digitalisation, almost all of whom were faculties of non-integrated universities.

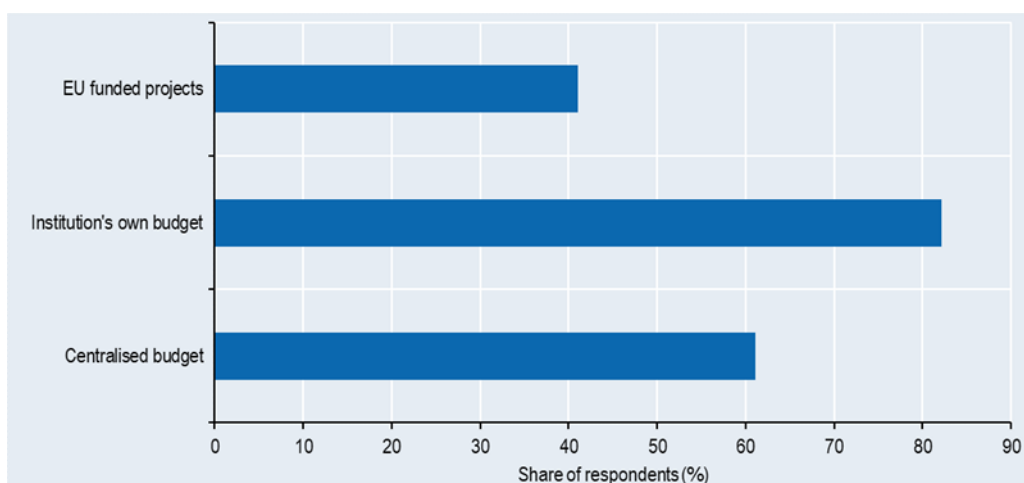
**Figure 6.2. Barriers to digitalisation identified by respondents to the CARNET-OECD survey**

The size of the rectangle denotes its relative importance in the set of responses



Source: CARNET-OECD survey of digital maturity of higher education institutions

**Figure 6.3. Sources of funding available to institutions for digital transformation**

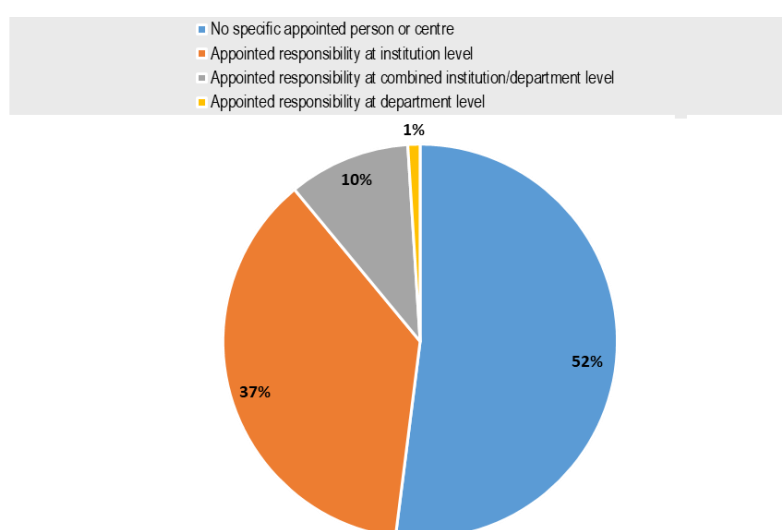


Source: CARNET-OECD survey of digital maturity of higher education institutions

*There is a lack of clarity about responsibility for digital transformation within some institutions*

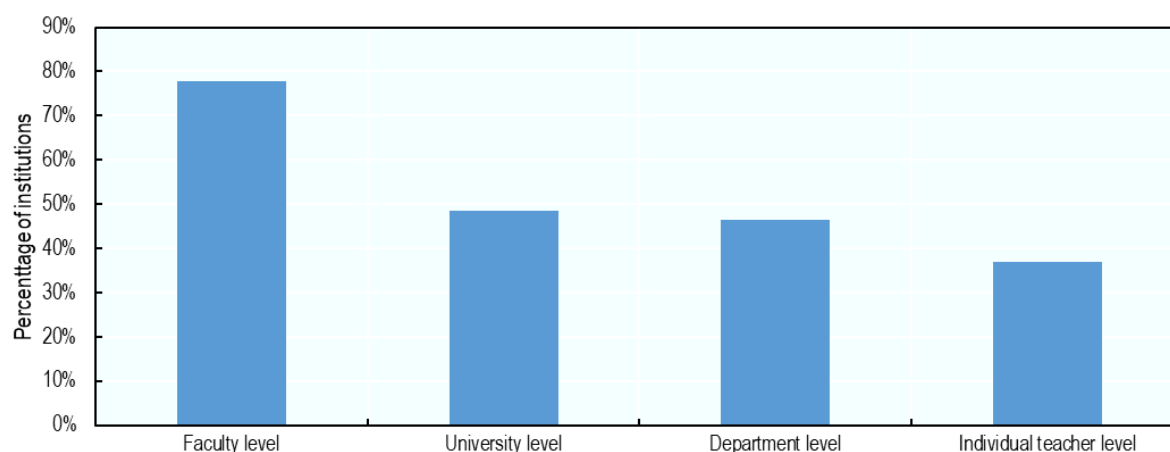
Data from the CARNET-OECD digital maturity survey highlighted disparities in the way that institutional responsibility is allocated for digital transformation. In total, about half of the respondents could not highlight a specific appointed person or unit within the institution with responsibility for digital transformation, while approximately one-third of respondents reported that responsibility for decisions lay at overall institution level (Figure 6.4). On the other hand, decisions about the acquisition of specific tools and technologies are most often made at the faculty level (Figure 6.5). Taken together, these results indicate some potential fragmentation in institution decision-making and responsibilities in some institutions, that may create inefficiencies and limit knowledge flows within the organisation.

**Figure 6.4. Institution-level allocation of responsibility for digital transformation**



Source: CARNET-OECD survey of digital maturity of higher education institutions

**Figure 6.5. Locus of decision making about the acquisition of digital tools and software within Croatian higher education institutions**



Source: CARNET-OECD survey of digital maturity of higher education institutions

This conclusion is supported to some extent by evidence gathered during the OECD team's site visits. Some stakeholders felt that institutions themselves could take on greater leadership and responsibility for their transformation efforts, playing a greater role in encouraging cultural change within their institution. On the other hand, some institutions and their representative bodies reported the need for a stronger legislative backbone for digital education and were awaiting clarity from public authorities on matters such as the revision of criteria for online and hybrid learning and the parameters of upcoming reforms (for example, the new Law on Science and Higher Education). The imminent finalisation of reforms in Croatia may create a clearer understanding within institutions of the emerging future policy framework in which they will operate and support the development of appropriate institution-level policies and practices for digitalisation.

## Digital Infrastructure

Investment in digital infrastructure is fundamental to enhancing higher education institutions' ability to achieve their digitalisation objectives. The following sections provide a selection of key findings from the institution digital maturity survey and interviews conducted during the OECD review visit. Additional perspectives on digital infrastructure are available in the technical report on digital infrastructure prepared during this project.

*Higher education institutions are satisfied with the internet connection provided by CARNET, but most require at least some upgrades to their on-campus networks*

The CARNET-OECD survey results show that most responding institutions were satisfied with the internet connection provided by CARNET. Average satisfaction among institutions on a scale of 1 (least satisfied) to 5 (most satisfied) was 4.59, with only four institutions (located in Zagreb and Osijek) rating their satisfaction as a "3". On the other hand, institutions overall reported much lower satisfaction with the quality of their wireless connectivity (Table 6.1). More than one-quarter of all respondents to the survey provided a ranking of 1 or 2 of the quality of their on-campus wireless network.

**Table 6.1. Average institution quality ranking of different types of network connectivity**

Type of connection	Average institution ranking (1-5)
Internet connection via CARNET	4.59
Wired LAN	4.11
Wireless LAN	3.32

Source: CARNET-OECD survey of digital maturity of higher education institutions

A lack of reliable network connectivity can have an adverse impact on institutions' abilities to conduct their day-to-day operations, and their capacity to improve their overall digital maturity. During interviews, many institution staff mentioned their satisfaction with the services and connectivity provided by CARNET, however, a few institutions reported that their existing internet connection was either no longer sufficient or was soon likely to become insufficient due to increased demand on-campus for network connectivity.

Conversely, and reflecting the results of the survey, many institution staff raised concerns during interviews about the state of their on-campus network equipment, which in some cases was reported as being up to 20 years old and requiring urgent upgrades. This has various impacts on institutions' operational efficiency. For example, one institution reported a need to outsource support for hybrid meetings, as the local network could not manage the connectivity required, and others noted that they had bandwidth issues when delivering online learning or large online meetings, limiting the extent to which participants could engage with meetings (e.g. needing to keep cameras off) or creating lags when accessing Merlin (the centrally provided installation of Moodle).

In other cases, institutions reported uneven access to connectivity in different parts of the campus, with some older buildings and buildings with thicker walls presenting more challenges for network upgrades, along with a lack of documentation on the current network structure.

*Most institutions rely on in-house support staff, and some experience severe difficulties with maintaining ICT support services*

Most institutions rely heavily on in-house specialist staff or their own IT department to maintain their local networks and computer hardware and to provide technical support to students and staff (Figure 6.6).

**Figure 6.6. IT support available within institutions for different functions**

Percentage of institutions reporting the existence of each type of support

Maintenance/repair of computer hardware	
Permanent specialist staff employed by the institution	61
Institution's IT department	50
External company or institution	30
Temporary contract staff	7
Maintenance/repair of the network	
Permanent specialist staff employed by the institution	60
Institution's IT department	47
External company or institution	32
Temporary contract staff	8
Student/Staff support helpdesk	
Permanent specialist staff employed by the institution	59
Institution's IT department	49
External company or institution	9
Temporary contract staff	7

Source: CARNET-OECD survey of digital maturity of higher education institutions

Almost all institution leaders interviewed by the OECD team during site visits raised the challenge of recruiting skilled IT staff to support their existing digital infrastructure. Higher education institutions are limited in the amount of salary that may be offered to their staff. This results in difficulties finding and retaining qualified staff, as the private sector offers attractive terms and conditions and is perceived by

candidates as offering a more stimulating job environment. Many institution leaders highlighted that IT staffing is at least as high a priority for their institution as upgrading their equipment.

Existing staff members are often overworked, and have a heavy burden of responsibility, particularly during the period of emergency remote instruction. While institutions express their high appreciation for the work they do, current regulations limit the means by which they can be rewarded explicitly. While institutions reported innovations in many different aspects of digitalisation, few of them have been able to arrive at a comfortable long-term solution for this difficulty, and are overdependent on existing staff members.

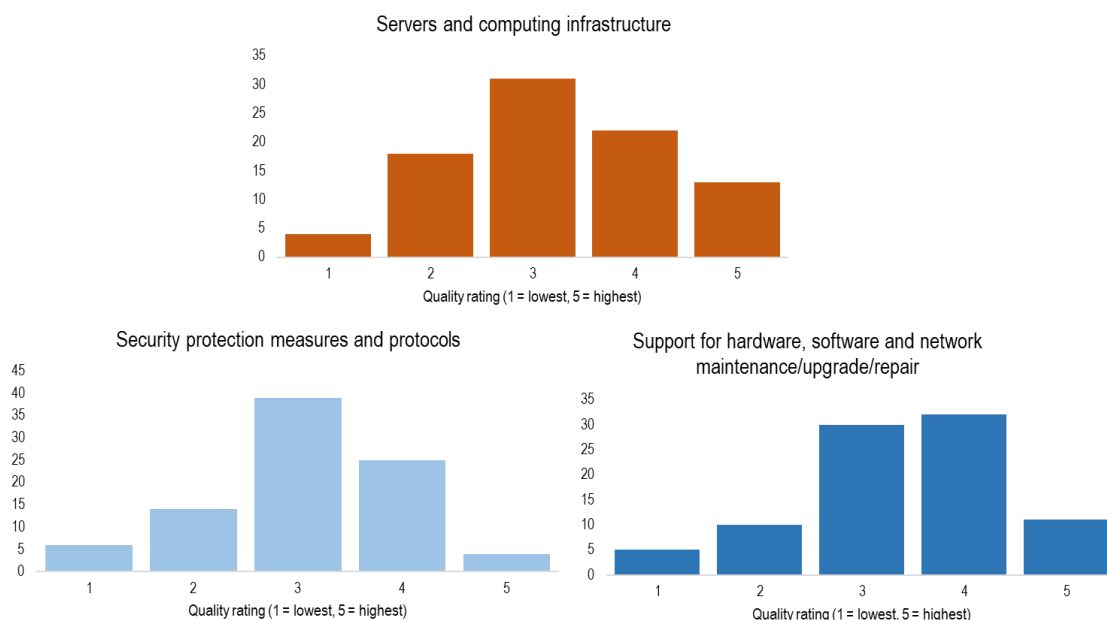
*Strong concerns are evident in some institutions about the quality of their existing digital technologies*

The OECD review team concluded, following its fact-finding mission to Croatia that many higher education institutions had been notably proactive and diligent in identifying infrastructure gaps and finding means to plug them. For example, some institutions noted a policy of applying for any available grant funding from national and international sources that could possibly be awarded to improve their digital maturity, including the use of research funds to purchase needed equipment, while others detailed their efforts to attract partners nationally and internationally to work with on digitalisation initiatives.

At the same time, many institution staff interviewed indicate concerns about the quality of some of their infrastructure, equipment and technical services. In the CARNET-OECD survey, when asked to rate the quality of various services on a scale of 1 to 5, the vast majority of institutions reported the medium score (3). While in general institutions had a more positive perception of the quality of their own support services, almost one quarter of institutions rated the quality of the servers and computing infrastructure as poor (with a score of either 1 or 2).

**Figure 6.7. Institution's quality rating of different elements of digital infrastructure**

Frequency of institution's quality rating, on a scale of 1 to 5



Source: CARNET-OECD survey of digital maturity of higher education institutions

*Croatian institutions would benefit from more centralised provision of software and services*

Institution staff interviewed by the OECD team expressed appreciation for the software services that are provided to them by public authorities (directly or through organisations such as SRCE and CARNET). Frequently cited examples of software in heavy everyday use included Merlin (a SRCE-provided and supported Moodle-based virtual learning environment) and the Microsoft Office 365 licence provided by the Ministry of Science and Education. There is a clear demand from institutions and their representatives for more centralised software solutions to be provided. Examples of services in high demand include the implementation of persistent academic identifiers for students and staff that would be operational up to European level, research tools and access to databases for research students and staff, and software that can support assessment and detect plagiarism.

Cybersecurity protection was also highlighted as essential by both institution staff and stakeholders, and uncertainty was expressed by some interviewees about the vulnerability of some software and open-source platforms to cyber-attacks. Smaller institutions and those with less capacity have reached out for support to resource providers like SRCE for assistance, while larger and more equipped institutions have developed and implemented their own solutions. The survey results also highlighted a general demand for central provision of services related to cyber and data security – for example 73 of the 88 respondents expressed interest in having an advanced firewall service provided, while 56 expressed interest in traffic encryption/decryption services.

A final area where institutions expressed a need for strong central support and guidance was in relation to online exams and assessments. Ensuring the integrity of assessment processes carried out online is a persistent challenge and many institution staff perceive a lack of central support, tools or guidance on this issue. During the pandemic, some institutions held exams online but still on university campus, with restricted Wi-Fi access, while others aimed to redesign exam questions to be less fact-based and more analytical in nature. While some institutions had concluded that in-person examinations were the only option to ensure integrity and quality, others noted that digital assessment tools offered the ability to automate some grading processes (e.g., for quizzes and some formative assessments) and expressed interest in building further capacity for high-quality digital assessment, with central support.

*Institutions expressed a pressing need for certain types of audio-visual equipment*

Croatian higher education institutions expressed a need to improve their on-campus audio-visual equipment, both during the site visits carried out by the OECD team, and in their responses to the CARNET-OECD digital maturity survey. In particular, the survey results indicate a pressing need for audio-visual equipment that can support the use of digital resources during lectures, and equipment that can be used for recording live lectures and hybrid teaching. Notably, these needs are ranked much more highly, on average, than the needs for end-user equipment stocks for students and staff (Table 6.2).

**Table 6.2. Croatian higher education institutions' perception of on-campus equipment needs**

Type of equipment/facility	Mean Need Ranking (1-5)
Lecture halls (with the ability to use digital resources in lectures; consists of projectors, lecturer computer and sound system)	4.31
Small halls/classrooms for hybrid teaching and recording lectures (ability for f2f and online instruction, AV recording of a live lecture in front of live audience; consists of camera(s) and lighting, audio equipment, projector/smart screen)	4.18
E-archipelago/e-laboratories - public spaces for learning (individual computer stations, pair/group learning, project rooms, libraries for quiet learning, linkable via video conferencing)	4.07

Simple AV studio (ability to produce video lectures and educational video; consists of video; audio recording equipment, lighting, editing SW, sound insulation)	3.54
Specialized hardware for learning (robots, microcomputers, 3D printers)	3.20
Computer lending services for students and teachers (lending/leasing when needed and in emergencies)	3.01
Professional AV studio (ability to produce more complex and advanced educational video such as experiment/demo recording, talk show recording, stop animation, audio recording; consists of video; audio recording equipment, lighting, editing SW, sound insulation)	2.86

Source: CARNET-OECD survey of digital maturity of higher education institutions

Evidence from interviews indicate that funding equipment for lecture recording may be a particular challenge, as it generally cannot be financed by project-based funding (i.e. for research). Recordings carried out during the pandemic was often not of professional quality and considered useful for emergency purposes only. Some institution staff highlighted the need not only for the audio-visual equipment itself, but suitable room environments to conduct the recording, with proper acoustics and lighting.

## Digital Competence and Culture

Digital learning in higher education is most successful, “when the socio-environment, supporting digital infrastructure, host institutions, and human participants are well prepared, or ready” (Blayone, 2018<sup>[63]</sup>). This requires digital competence of individual participants in higher education activities. Digital competence has been defined as “sets of knowledge, skills and attitudes relating to the purposeful and effective use of digital technologies” (Ala-Mutka, 2011<sup>[64]</sup>). It is considered at European level one of the core competencies necessary for learners in current and future society (European Commission, 2019<sup>[65]</sup>). Broad evidence indicates that academic staff often lack the necessary competences to progress beyond using basic digital technology (e.g. slide decks) in the classroom (Englund, Olofsson and Price, 2017<sup>[66]</sup>); (Schneckenerg, 2009<sup>[67]</sup>).

Croatia has a long history of supporting development of competence in e-learning in its higher education system (Kupres and Pašić, 2005<sup>[68]</sup>). However, as in other countries, there is limited evidence available on the extent of digital competence in higher education teaching staff, although a recent study highlighted differences in competences across both fields of study and generations (Box 6.1).

A teacher’s use of digital technology to create quality learning for their students can depend on their own knowledge, skills and attitudes towards digital technology (Hofer, Nistor and Scheibenzuber, 2021<sup>[69]</sup>). But it can also depend on the existence of supportive and like-minded colleagues with similar high commitment to maximising the value of digital technologies – in other words, the “digital culture” of the organisation. A strong digital culture within an organisation promotes collaboration above individual efforts, and aims to create a supportive, innovative environment where individuals feel empowered to act and experiment with digital technologies (BCG, 2018<sup>[70]</sup>).

The development of digital competence and culture also needs to consider the needs of learners. Young entrants to higher education today grew up surrounded by digital devices (Creighton, 2018<sup>[71]</sup>), but still may not automatically be proficient with using common digital tools and software used in higher education institutions, particularly as digital technologies become increasingly integrated to all fields of education.

With these considerations in mind, this section presents some findings from the CARNET-OECD digital maturity survey and interviews conducted during the OECD’s site visit that are relevant to the development of digital competence and culture in Croatia’s higher education institutions.

### Box 6.1. Assessing digital competence of higher education lecturers in Croatia

Few cross-national studies have been carried out addressing digital competence in higher education lecturers. A 2019 research study in Croatia (Müller and Varga, 2020<sup>[54]</sup>) aimed to fill the evidence gap. The study in Croatia was part of the wider 2015 DFGP study, “E-learning and Multimediakompetenz der Deutschen Initiative für Netzwerk Information” Research was also conducted in Germany and France. A representative sample (n=1800) of teachers and associates from institutions in Osijek, Split and Zagreb were polled through an online questionnaire regarding their level of digital competence and usage of modern technologies in their teaching practices.

One significant finding was the difference in digital competencies between faculties. Those working in technical faculties reporting being “more competent” in conducting scientific research and using of modern technologies than their counterparts in social sciences and humanities faculties. On the other hand, respondents from the humanities reported using technology in teaching more often and for their own scientific work than those in the technical and social sciences fields.

More than 70% of respondents noted they are ‘competent’ in the use of computers and new technologies. However, there is an apparent generational divide - 65% of assistant professors, teaching assistants and lecturers consider themselves part of the “digital generation” while only 33% of full-time professors felt the same, citing insufficient training on ICT technologies. There was also a difference in fields, between those in the technical field (56.8%) reporting a higher usage of e-Learning technology (e.g., Moodle) than those in social sciences (39.6%).

The study authors also highlight that flexibility and a critical approach to information is necessary to address the growing obsolescence of competences caused by the speed of advancement in technology. A clearer definition of digital competences is required (defined as “complex integration of cognitive processes and dimensions” along with a need to identify and development its different dimensions of digital competences, so teachers can respond to learner needs with the appropriate pedagogy and technology. The authors proposed a Multimedia Training and e-Learning program, tailored to education institutions that offer teacher training. The program would focus on honing basic levels of digital competence and include analysis and implementation of e-learning; methodology and didactics in e-learning and didactic basics such as models of e-learning platforms and techniques for using multimedia.

The authors also proposed 15 specific key competencies that all educators should acquire, including acquisition of basic digital knowledge and literacy, knowledge of the Microsoft Office productivity suite, ability to search, collect and process information and data, ability to independently design an education programme for use in an online environment, and capacity to understand and use different e-Learning tools (e.g., SCORUM, Open Content, MOOCs)

*Some initiatives are in place to develop staff digital competence, but a more systematic and joined-up approach would be beneficial*

During the OECD team review visit, many interviewees stressed the need to further improve digital competence in its staff members and outlined their efforts to do so. Some institutions have developed their own initiatives for digital competence development, while others encourage the use of CPD among their staff. The period of emergency remote instruction was also mentioned as indirectly providing general development of pedagogical skills – the large-scale upload and digitalisation of learning material was beneficial not only for students but for teachers to engage in peer-based learning, allowing younger professors to review the teaching practices of older and more experienced colleagues in a way that wasn't possible previously.

Regardless of progress made during the pandemic, many staff expressed a need for a more systematic approach to the development of digital competence and culture that require a rethinking of existing

academic staff terms, conditions and reward structures. In Croatia, as in most OECD countries, most academic staff begin teaching in higher education institutions without having or needing a formal teaching qualification or training, and there are no standardised requirements for professional development of staff to enhance their teaching skills (OECD, 2020<sup>[72]</sup>). As was pointed out multiple times to the OECD review team, this renders the efforts and progress of staff and organisations in improving digital competence largely invisible, with no clear channels available to either recognise or reward high performance.

Some interviewees felt that centrally provided training on digital competence could move more towards systematically imparting knowledge and evidence on the best pedagogical practices for engaging and supporting students in a digitalised environment. In some cases, current training offers, and competence-building initiatives were perceived to focus more on the use of technical tools, and sharing of content, rather than how to apply these resources effectively. More training is needed that can teach staff how to design and construct courses that are fit for a digital environment, rather than simply duplicating practices used in face-to-face instruction.

*Many existing pedagogical practices for online and hybrid education lead to deficits in the social element of learning and lower student engagement*

As is also the case in other countries, the period of emergency remote instruction in Croatia exposed many limitations in current pedagogical practices for delivery of online learning. Teaching staff reported several difficulties with supporting student learning in an online environment. Frequently mentioned challenges included:

- A lack of eye-contact and inability to read non-verbal feedback of students (i.e., facial expressions and body language), which provide vital signals to teachers about the level of understanding students have of the material being taught, and cues for which concepts and knowledge need ad-hoc reinforcement.
- An inability to provide adaptive instruction, particularly with asynchronously provided material. Each student is required to consume the same content, with no ability to reinforce learning by asking questions of the instructor or of peers in the classroom.
- The attention span of students in an online environment appears shorter, and online study provides easy access to a range of distractions, leading to reduction in student engagement.
- A lack of engagement of students in an online environment leads to greater inefficiencies in contact between instructors and students (e.g., instructors needing to respond to the same query multiple times to individual students, rather than dealing with it once during a live class).

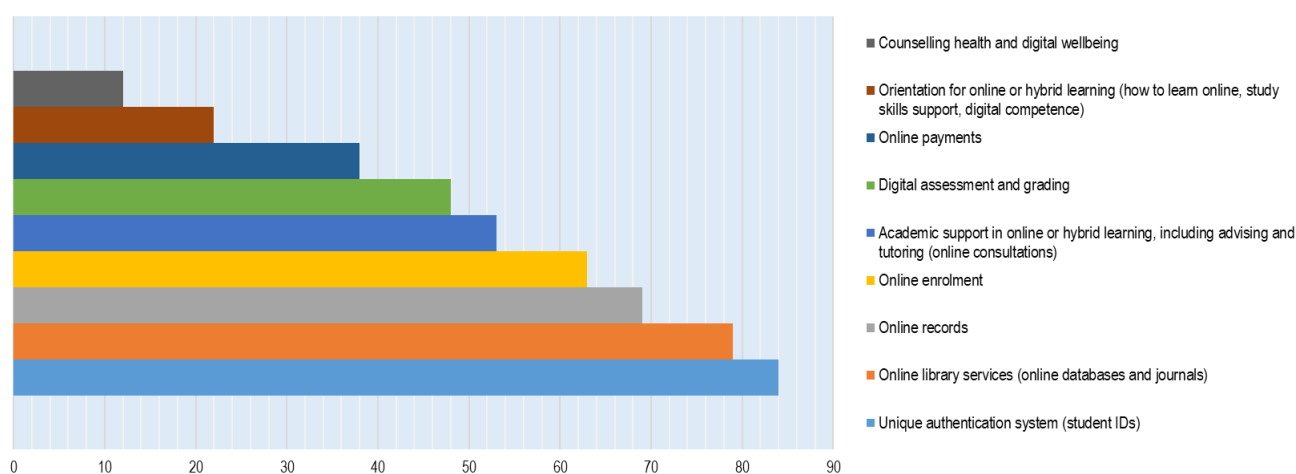
The online environment also created new pressures on teaching staff. Many staff made increased efforts to support students in a remote environment, becoming more available and responsive on a range of communication channels. This led in some cases to increased student expectations of immediate access to staff and quick responses to ad-hoc queries, even following the return of in-person education. Some teaching staff also reported that students increasingly expect digitalised content to be made available as a complement to their in-person lecturers, leading to a greater workload for staff.

It was acknowledged that many of the issues raised were heightened by the emergency context in which mass online learning was introduced, where staff had to adapt their content very quickly to an online environment. Nevertheless, the OECD review team concluded that successful mainstreaming of online education in Croatia would only be achieved with greater emphasis on pedagogical principles and practices for engaging students that are specifically designed to be effective in an online environment.

*Students enjoy a range of digitalised services, but could be more heavily included in institution plans for the development of digital competence and culture*

Students in many higher education institutions in Croatia enjoy access to a range of digitalised administrative, support and wraparound services that can simplify and streamline their educational pathways. Students in most reporting institutions have access to a common identity authentication service, online library services and online enrolment and records services, while about half of institutions report that digital assessment and grading and online academic support or tutoring is available to their students (Figure 6.8).

**Figure 6.8. Digitalised student services available in Croatian higher education institutions**



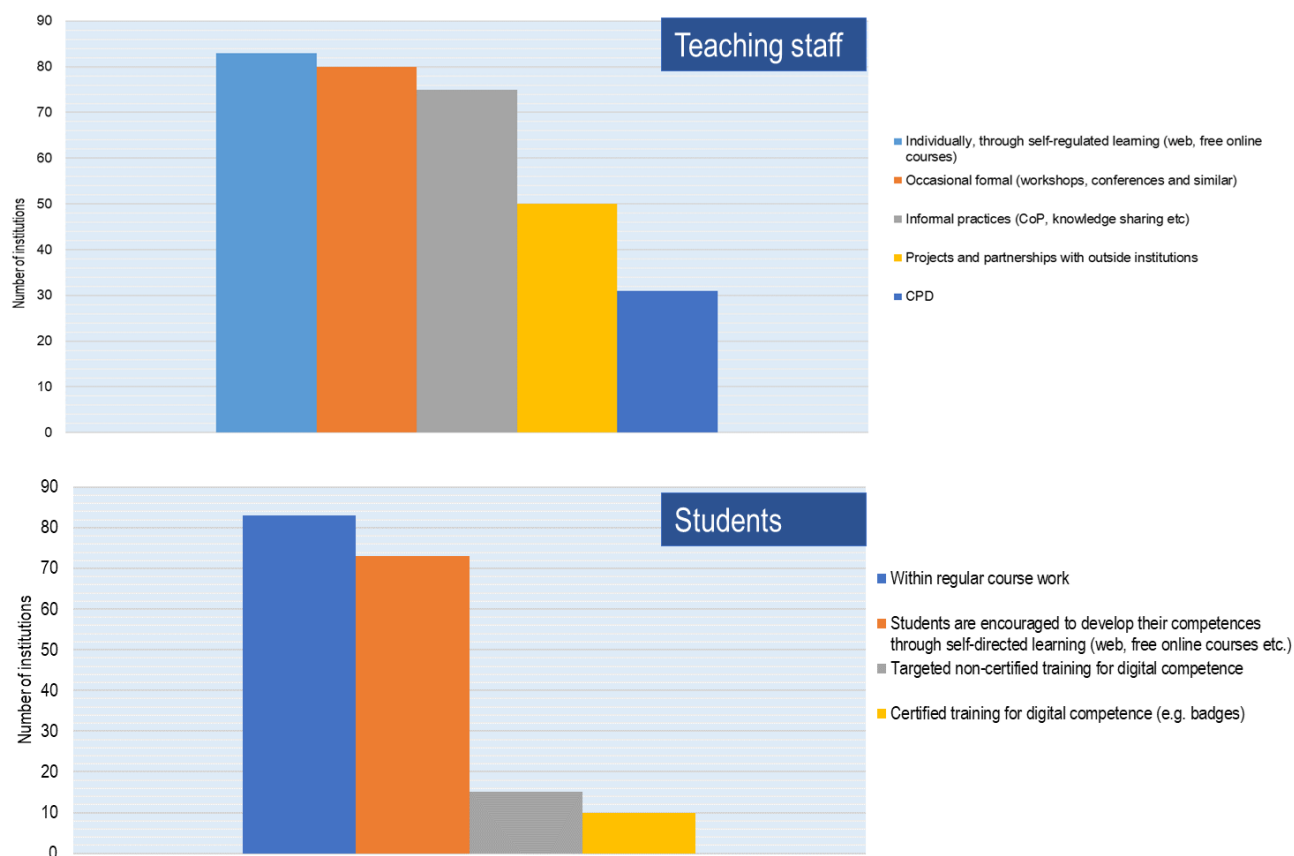
Source: CARNET-OECD survey of digital maturity of higher education institutions

On the other hand, far fewer institutions offer counselling online or orientation for online study or study skills support to students. The CARNET-OECD survey also indicated that in general, teachers have far more access to formalised opportunities to improve their digital competence than students (Figure 6.9). Teaching staff in almost all responding institutions have access to occasional formal training aimed at improving digital competence, while many also avail of informal learning through communities of practice and other forms of knowledge sharing. On the other hand, students are generally expected to build digital competence through their regular coursework, or through self-directed learning, although a few institutions offer targeting training and certification for students to acquire digital skills (Figure 6.9).

National studies and reviews of practice (e.g., from ASHE) have indicated a need for greater efforts to build students' digital competence. Student representatives themselves reported to the OECD that while institution staff made substantial efforts to support them during emergency remote instruction, many classmates struggled with stress and mental health issues, including before and during online assessments, and did not always feel able to ask for assistance. Students also reported difficulties communicating with some professors, particularly those with more limited experience working online.

However, overall, it was clear that students highly appreciated the efforts made by staff during the emergency period and were more likely to have encountered problems with connectivity and lack of access to on-campus equipment (e.g., for practical study) than difficulties with using the digital tools and content provided during the pandemic. Many students report that they have been able to improve their digital competence using resources located outside their institution (e.g., YouTube videos or asking friends).

Figure 6.9. Available means for teachers and students to improve digital competence



Source: CARNET-OECD survey of digital maturity of higher education institutions

Some student representatives highlighted that, despite being the target audience for much of the digital content being developed by instructors, there were rarely consulted on issues of pedagogical design or user experience, and they perceived substantial differences in the approach to online learning taken by their institutions, and that of professional education technology companies, such as edX or Coursera. Greater student involvement in digital learning design could improve the relevance of the content for students and increase their engagement.

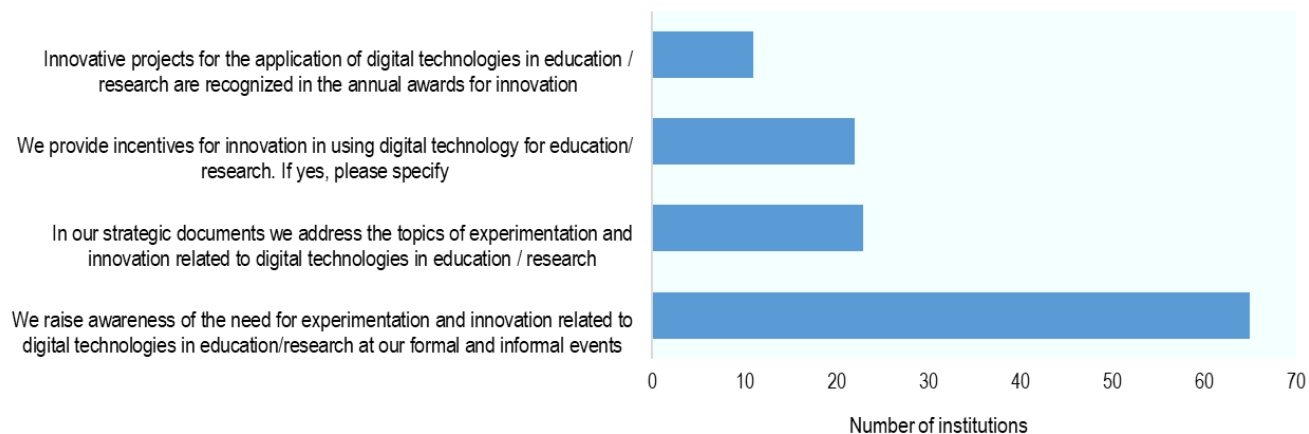
*Some elements of innovative digital culture appear to be more developed than others in Croatian institutions*

Digital culture entails building a comprehensively supportive environment for digital innovation and improvement across the entire organisation. Some items included in the CARNET-OECD survey provide an indication of the extent to which there is a culture for digital innovation embedded in Croatian higher education institutions. For the most part, Croatian institutions tend to focus on raising the general awareness of the need to innovate, at staff gatherings and events. Less emphasis is placed on more concrete steps, such as the development of an innovation strategy, providing incentives for innovation, or recognising and awarding innovative projects (Figure 6.10).

Challenges associated with innovation were also raised during site visits with the OECD team. While many institution staff mentioned examples of recent innovative digital initiatives, others reflected that innovation was dependent on the motivation and capacity of individual academic or ICT staff, rather than a product of the general culture of the institution. While some staff are enthusiastic and eager to become involved in

experimentation with digital technologies, others are less engaged or simply do not have the capacity to do so. Specific incentives and additional staff supports are necessary to establish a broader culture for digital innovation across Croatian higher education institutions.

**Figure 6.10. Supports for digital innovation in Croatian higher education institutions.**



Source: CARNET-OECD survey of digital maturity of higher education institutions

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