

THE ETF DIGITAL EDUCATION REFORM FRAMEWORK

**A framework to design inclusive and relevant
digital education reforms in a post-COVID world**

Acknowledgements

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ABBREVIATIONS

AI: Artificial intelligence

AR: Augmented reality

Cedefop: European Centre for the Development of Vocational Training

CNL: Creating New Learning

CEPS: Centre for European Policy Studies

CPD: Continuous professional development

EQF: European Qualifications Framework for Lifelong Learning

ERI-SEE: Education Reform Initiative of South Eastern Europe

ETF: European Training Foundation

ESCO: European Classification of Skills, Competences, Qualifications and Occupations

ICT: Information and communication technologies

ILO: International Labour Organization

LLL: Lifelong learning

LMS: Learning management system

MOOC: Massive Open Online Course

OECD: Organisation for Economic Co-operation and Development

OER: Open educational resource

SELFIE: Self-reflection on Effective Learning by Fostering the use of Innovative Educational technologies (free tool for schools)

STEM: Science, technology, engineering and/or mathematics

TALIS: OECD Teaching and Learning International Survey

TVET: Technical and vocational education and training

UNDP: United Nations Development Programme

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNEVOC: International Centre for Technical and Vocational Education and Training

VET: Vocational education and training

VR: Virtual reality

XR: Extended reality

WB: World Bank

WBL: Work-based learning

PREFACE

The COVID-19 pandemic has boosted the relevance of digital education¹, which was already high in many countries due to the need to find new and effective solutions to equip learners with digital skills and to increase the quality and inclusion of education and training systems through the use of digital means. The post-pandemic context is now calling for a deployment of digital education **policies that are able to offer better learning solutions and improve the equity of education and training.**

Responding to this increased priority for long-term and human-centric digital education strategies, the European Training Foundation has developed a **Digital Education Reform Framework** within its [Creating New Learning](#) (CNL) initiative, with the aim of supporting policy-makers and policy shapers to design relevant, effective and inclusive evidence-based digital education policies.

In line with the ETF approach encompassing top-down and bottom-up methods, the framework offers a lens for looking at digital education within lifelong learning systems, with particular attention to initial and continuing Vocational Education and Training (VET), and in particular with regard to developing and transition economies. However, since the challenges of digital education are rather transversal across education sectors and within countries, the framework could be relevant to different education sectors and different parts of education systems, from a LLL perspective, and within different countries.

In order to help policy-makers look from a new perspective at how a digital education reform can be structured, the framework is divided into two parts: the first **outlining the “what” and the second the “how” of digital education policies.** First, it presents **nine focus areas of digital education**, identifying for each area the main challenges, some specific initiatives with examples from around the world, and some tools for policy-making. Second, it discusses some transversal **critical factors of digital education reforms**, to guide policy-makers in designing successful initiatives by making the best decisions for their context.

¹ In line with the Digital Education Action Plan 2021-27 of the European Commission, this report defines **digital education** as both “the deployment of the vast and growing array of digital technologies (apps, platforms, software) to improve and extend education and training” and “the need to equip all learners with digital competences (knowledge, skills and attitudes) to live, work, learn and thrive in a world increasingly mediated by digital technologies” (European Commission 2022, p. 2).

EXECUTIVE SUMMARY

The ETF Digital Education Reform Framework

Even though digital education has been a policy focus for some decades across the globe, the COVID-19 pandemic has shown the critical potential of digital technologies to make lifelong learning systems more resilient, efficient and inclusive (ETF, 2020), and now a number of countries are planning to reform their education systems by making them more “digital”. When approaching digital education, policy-makers should be aware of the many existing policy options, understanding that the steps to implement, run and monitor a digital education initiative must be tailored to the dynamics and characteristics of contemporary digital ecosystems. Also, evidence-based policy-making is key: rational, rigorous and systematic approaches towards digital education are needed, and these need to be informed by available evidence and data (Pellegrini and Vivonet, 2020). Finally, digital education reforms should adapt to the degree of autonomy of schools and the role of local authorities: in many cases, a digital education reform designed at the national level is then implemented locally.

To facilitate the understanding of these complexities and therefore the design and roll-out of sustainable and human-centric digital education initiatives, policy-makers need to reach an understanding of the overall picture of contemporary digital education, namely all the possible types of policies and their challenges and potential impact. At the same time, they need to be exposed to the critical decisions that can shape these types of intervention.

To answer this need, the ETF has created the Digital Education Reform Framework, presented in Figure 1 below, aiming to inform policy-makers and policy shapers about the possible focus areas – and their connections – and the critical factors that can contribute to the success of a digital education policy. The framework aims to support the efforts of governments and stakeholders across the world to develop inclusive, effective and human-centric digital education policies and initiatives, by helping them to better understand what type of digital education initiatives can be launched in different areas (and for what purposes), and which critical factors need to be taken into account for their implementation. The framework does not have a prescriptive nature and aims to foster discussions, ideally involving different stakeholders, around digital education within countries willing to design new digital education policies and evaluate existing policies in order to improve them in view of generating better future initiatives.

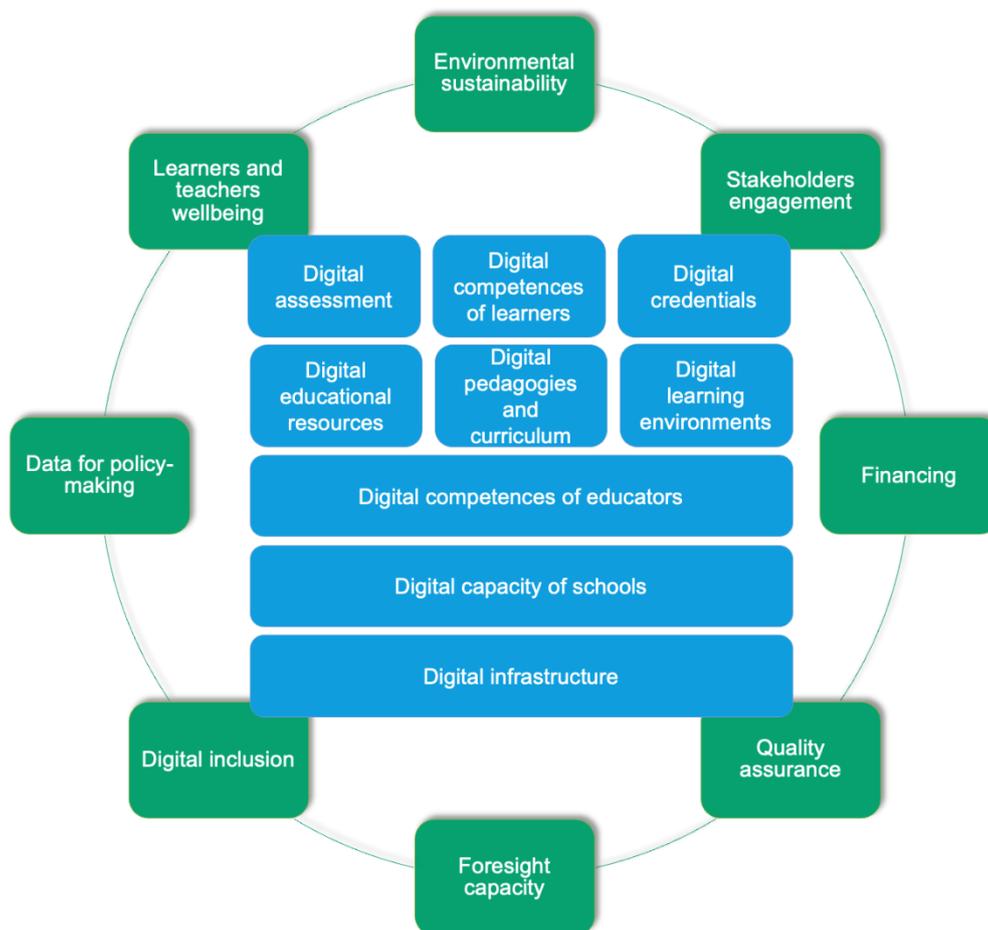


Figure 1. The ETF Digital Education Reform Framework (the suggested policy areas in blue, the transversal factors in green)

The central part of the framework (in blue) is about the “What” of digital education and aims at presenting the different possible policy areas with examples of real-life initiatives, so that policy-makers can learn from the experiences of other countries. Also, for each area, the main common challenges and the mostly used policy support tools are included. The outer part of the framework (in green) is about the “How” and outlines the main critical factors and the corresponding questions that may help policy-makers articulate key elements of digital education policies.

The ‘What’: focus areas for digital education reforms

The framework breaks down the complex field of digital education reforms into nine areas that can be at the focus of specific digital education policies:

- **Digital infrastructure** is the precondition for fostering the digitalisation of education systems and should guarantee access to adequate digital devices and sufficient internet connection, by privileging inclusive and sustainable approaches.
- **Digital competences of educators** should be addressed by equipping teachers with the necessary skills, knowledge and attitudes to effectively and confidently use digital

technologies as a result of the provision of relevant and innovative, high-quality initial and/or continuous professional development.

- **Digital capacity of schools** is key for blending traditional and digital teaching and learning approaches: policies can target issues such as school leadership, digital strategy development, and data management capacity.
- **Digital pedagogies and curriculum** are needed to take advantage of the potential of the digital revolution: policies should promote and monitor meaningful digital pedagogies and update the curriculum to develop both practical digital skills and digital citizenship.
- **Digital education resources** of high quality and accessible, possibly through open licences, are a key component of digital education: their use as well as the capacity of educators to produce and curate them should be fostered.
- **Digital learning environments** and online platforms can be the focus of digital education policies, both for the development of connected learning management systems and virtual labs within schools and the creation of digital learning environments at regional, national and school level.
- **Digital assessment** has the potential to support authentic, self-directed and peer learning and to multiply interactions with peers and professionals: by fostering formative and summative digital assessment practices, policies can have a strong impact.
- **Digital competences of learners** are essential in everyday life and should be a target of digital education initiatives: governments can act by including digital subjects in schools and by building digital skills, knowledge and attitude through informal learning, with attention to digital citizenship.
- **Digital credentials** are a rather new area for digital education reform, which keeps receiving increased attention from the policy level due to the potential impact of micro- and digital credentials on increased employability and innovations in reskilling processes.

Policies and initiatives in all these areas have been launched in the past years across the globe, in many cases as a response to the COVID-19 pandemic. Part 3 of this publication describes, for each area, which type of initiatives can be put in place, outlining the main challenges and briefly presenting policy examples and policy-support tools that can serve as inspiration for policy-makers.

The 'How': critical factors for digital education reforms

Whatever policy areas are prioritised, some transversal critical factors have to be considered in the design, implementation, monitoring and evaluation of digital education initiatives:

- **Data for policy-making.** Digital education policies should be based on sound evidence, and they should foster the collection and analysis of data according to international best practices; at the same time, policy-makers should be wary of how the data produced by digital education practices are collected, stored and used.
- **Digital inclusion.** Tackling digital and educational inequality should be the key driver of any digital education reforms, encompassing the provision of basic digital skills and specific measures to ensure that digitalisation increases inclusion and accessibility of education and training, and not the opposite.

- **Stakeholders' engagement.** Policy design, implementation, monitoring and evaluation should be an inclusive process that meaningfully involves stakeholders, including teachers, through various channels and in different phases of the policy process. The contribution of technology commercial providers should be carefully managed by the policy-maker.
- **Financing.** Available financial resources should be carefully planned, with attention given to sources' differentiation and sustainability. Innovative funding mechanisms, also with the participation of commercial actors, should be explored, ensuring that all parties involved, such as learners' families are considered.
- **Quality assurance.** An adequate mechanism for digital education quality assurance should be established, integrating new dimensions into the existing system to generate swift feedback rounds and immediate programme adaptation, to guarantee equity and innovation in a technology-neutral way.
- **Environmental sustainability.** The environmental impact relating to the introduction of digital practices in education should be kept in mind, to allow future-looking digital education reforms to fit environmentally sustainable standards and to foster the emergence of green and digital skillsets among learners.
- **Teachers and learners wellbeing.** As shown by the COVID-19 experience, introducing digital education can have a negative impact on the mental and physical wellbeing of teachers and learners. These risks should be taken into account by digital education initiatives, instilling virtuous circles of wellbeing support and development.
- **Foresight capacity.** Digital education initiatives have to be based on a sound understanding of possible future developments, in societal, technological and educational terms: for this to happen, the capacity of policy-makers to deeply understand the long-term impact and trends of digital technology must be built on and nurtured.

Each of these factors poses critical questions to policy-makers, that need to be well understood and carefully worked out. Part 4 of this publication briefly outlines these critical factors so that decision-makers can be ready to take informed decisions on these important issues.

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1. THE NEED FOR POST-PANDEMIC DIGITAL EDUCATION REFORMS

1.1 Defining digital education and digital education reforms

In line with the Digital Education Action Plan 2021-27 of the European Commission, this report defines **digital education** as both ‘the deployment of the vast and growing array of digital technologies (apps, platforms, software) to improve and extend education and training’ and ‘the need to equip all learners with digital competences (knowledge, skills and attitudes) to live, work, learn and thrive in a world increasingly mediated by digital technologies’ (European Commission 2022, p. 2). In other words, with the term ‘digital education’ used in this document we mean both the use of digital technologies within education and training settings and the development of digital competences (as a dynamic combination of knowledge, skills and attitudes).

With the term **digital education reform**, we mean the different forms of public policies and initiatives that aim to make education and training systems more effective and inclusive by fostering the use of digital technologies, while promoting digital skills. These policies and initiatives can be developed by governments or public agencies at different levels (local, national or supranational) in collaboration with other stakeholders and may take different forms (parliamentary rules, ministerial statutory documents, institutional statements, etc.). Finally, these reforms should take into account the fact that the implementation of such reforms actually happens in the schools and that any attempt to reform school-level practices needs to be based on a participative process.

1.2 The impact of digitalisation on education and training

The pervasive presence of digital technologies in our societies (see Figure 2 below) is having an impact on education and training systems, both in formal settings such as TVET programmes and in informal ones (Susskind and Susskind, 2017), in three main ways. First, it widens **access to learning**, by reaching potential learners that would have difficulties in taking part in traditional learning experiences due to a number of barriers such as lack of time during working hours or disabilities. Second, it can improve the **quality of learning**, fostering the engagement of learners’ categories that would not normally interact in physical spaces, and favouring the creation of personalised learning paths based, for example, on the starting competences of different groups of learners. Third, it can enhance the **relevance of learning**, thanks to the digitally-boosted possibility of recognising competences, for example by simulating work situations, and of fostering digital literacy, i.e. a fundamental transversal competence for living, learning and working in contemporary societies.

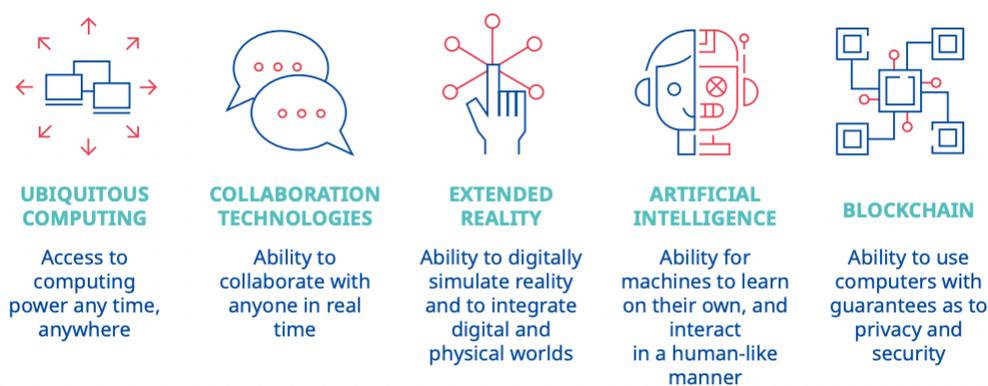


Figure 2. Five digital trends impacting education (Grech and Camilleri, 2017)

In parallel with these impact dimensions, an increased use of digital technologies within education and training can also contribute to widening existing divides and creating new ones. The issue of digital inclusion, which has been traditionally focused on access to digital technologies (Casado-Munoz et al., 2015; Graham 2010), is recently being framed in a way that goes beyond access, including the skills needed to meaningfully use digital technologies and the motivation to do so (Nguyen et al. 2020, Abah 2019, European Parliament, 2020). Also, evidence suggests that digital technologies such as artificial intelligence (AI) and robotics are polarising the workforce into high-skilled and low-skilled workers, diminishing the demand for intermediate-level skills (Bárány & Siegel 2015). The COVID-19 pandemic, and the consequent unprecedented wave of forced online learning, has confirmed this ‘double impact’ of digitalisation on education and training: on the one hand, the increased use of digital means has catalysed the innovation capacity of skills providers, while on the other it has fostered the risk of learners’ exclusion (ILO, UNESCO and the World Bank 2020). This impact was especially hard within Work-Based Learning (WBL): although during the pandemic most companies continued their activity through remote working, many education and training providers found it difficult to arrange procedures, tutoring, guidance and internships for their students (Cedefop 2020).

1.3 Digital education reforms in post-pandemic times

Digitalisation reforms in public administration have been ongoing for many years in several countries, in many cases targeting education and training. For example, already in 2011 all EU countries had formulated national policies for digital education, either as standalone initiatives or as part of wider national digitalisation strategies (European Commission, 2011). Examples of these policies are the ‘[INcoDe.2030 – National Digital Competences Initiative](#)’ in Portugal or the [Digital Pakt Schule](#) in Germany. Systemic implementation of these strategies has become more common after the forced period of school closure relating to the COVID-19 pandemic, mainly addressing initial education. Indeed, we can observe clear differences among the ‘before’, ‘during’ and ‘after’ pandemic stages in relation to conceptualisation and implementation of digitalisation reforms².

² This policy interest on digital education seems to reflect the understanding of citizens as shown by an EU-wide public consultation carried out in 2020, where 95% of consulted citizens and stakeholders defined the COVID-19 crisis as ‘marking a point of no return’ for how technology is used in education and training (European Commission, 2020b).

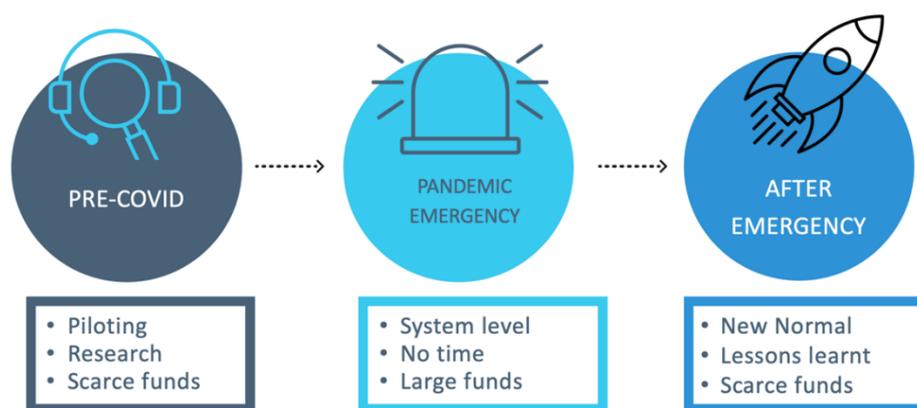


Figure 3. The impact of the COVID-19 pandemic on digital education policies

In the **pre-pandemic phase**, digital education reforms tended to follow an ‘iterative’ approach, initially taking the form of small-scale pilots, which after revision and modification were then scaled up and eventually mainstreamed. In most cases, evaluation and monitoring systems have been put in place to assess the success of an initiative and to adjust it if necessary. Even though examples of successful pilots can be found in several countries, for most countries the challenge has always been scaling up these policies at national level.

During the pandemic, digital education has become a key priority: many countries achieved good results, considering the challenges relating to time and resources constraints. In the EU, Member States have responded to the COVID-19 crisis through several digital education strategies, such as strengthening telecommunication infrastructures, adopting emergency laws and regulations, involving regional and local bodies, creating national platforms for distance learning (European Commission, 2021). During this *massive unsolicited learning experience*, stakeholders had a glimpse of the potential impact of digital education in terms of effectiveness and flexibility. To quote the European Commission’s Digital Education Action Plan, ‘this mass and unprecedented use of technology for learning revealed many opportunities for teachers to organise their teaching differently and to interact with students on a more personalised basis, focusing on their specific needs’ (European Commission, 2020, p. 3). As detailed in an ETF report, the majority of countries neighbouring the EU have experienced shortcomings in terms of interaction with students, lack of human contacts, learning efficiency, social dimension of learning and the difficulty to evaluate learning outcomes (ETF, 2020). **These challenges were particularly severe for VET providers**, which had trouble in finding meaningful digital educational resources, especially for work-based learning, which had an impact on the ability to cover the more practical part of their curriculum via distance learning (ILO 2020a).

The COVID-19 pandemic has helped to raise digital education on the policy agenda, and several countries have used this state of emergency to launch or to scale-up major digitalisation initiatives. To take some EU examples, in Portugal, the pandemic experiences of distance learning have helped to frame digitalisation as one of the main educational issues, which will be supported under the national resilience and recovery plan with an estimated EUR 538 million for digital infrastructure development and digital capacity building for teachers

and school leaders. Similarly, Belgium will invest, through its 2020 digital education initiative 'Digi Jump', EUR 375 million in digital infrastructure and digital education support measures. Similar initiatives have been launched following the COVID-19 pandemic, including in the EU neighbourhood, often with the support of international donors: in Kazakhstan, a new national digital education project has been launched to train and retrain over 3 million digital specialists across all economic sectors by 2030; in Türkiye the World Bank has invested EUR 143 million in the 'Safe schooling and distance education' project to enhance the capacity of the education system to provide digital education during and following the COVID-19 pandemic; and in Jordan a national platform for digital VET was launched in 2020 by the Ministry of Education.

Through these initiatives, countries are moving to a **'post-emergency' phase** which is characterised by a better understanding of the challenges of digital education, the availability of new tools developed during the COVID-19 pandemic, and an awareness of the importance to continue working on these reforms, going beyond initial education and including the digital upskilling of adults. As the European Commission's Digital Education Action Plan states: 'this pandemic exposed the shortcomings that need to be tackled in order to have successfully integrated digital technologies in education and training systems' (European Commission, 2020, p. 3). What became clear is the **complexity of digital education reforms** and the interconnection of the different organisational, pedagogical, and technological components of such initiatives (Marjanović, 2021). Also, while the pressure caused by the pandemic has forced governments to prioritise specific elements to guarantee teaching continuity, **the need for digitalisation reforms to be systemic and multistakeholder³ is increasingly recognised**: infrastructure and connectivity, which were the typical focus of the first wave of digital education policies, need to be accompanied by measures tackling digital leadership, pedagogic innovation and teacher professional development (European Commission, 2017; European Parliament, 2020). The challenge is to go beyond the assumption that the presence of connected digital devices in schools will organically lead to digital education, and to **move beyond the use of digital technologies towards a deep digital integration** that is fully embedded into the culture of educational systems, redesigning school infrastructures, teaching approaches, curriculum structures, classroom practices and modes of assessment (Kampylis et al., 2015, Cosgrove et al., 2013).

³ Because of the forced digitalisation wave relating to the COVID-19 pandemic, global digital commercial bodies have gained power and developed 'private governance mechanisms', characterised by information asymmetry that put data privacy and cyber security of users under threat. As noted recently by UNESCO, often governments lack both the awareness and the capacities needed to counterbalance this digital private governance. On the contrary, public policy should ensure the adoption of 'a humanistic approach on the use of technology, to counterbalance or regulate the governance imposed by the private sector, and to empower the end users to be sensitized and skilled in the ethical and safe use of technology' (UNESCO 2022a, p. 16).

Insight: the EU approach for digitalisation of Vocational Education and Training

The EU considers Vocational Education and Training (VET) to be a key driver of the European economy and society, and strongly promotes the integration of digitally-supported approaches. The idea is that if Europe wants to meet the challenges of contemporary digitally-driven societies, all generations must be equipped with the skills and competences needed for today and tomorrow's world, and the digital transition requires a high-performing digital education and training ecosystem, digital awareness of citizens and a digitally skilled workforce.

The 2020 [Council Recommendation on vocational education and training](#) aims to make VET more modern, attractive and fit for the digital and green transitions. Similarly, the [Osnabrück Declaration](#) clearly underlines the importance of digital education reforms in the field of VET:

- VET programmes should be agile in adapting to labour market changes, by offering a balanced mix of technical skills and key competences, including solid digital skills;
- VET providers should have, in line with the national context, an appropriate degree of autonomy, flexibility, support and funding to adapt their training offer to changing skills needs, green and digital transitions and economic cycles, while ensuring quality;
- VET should prepare for the digital transition, and as a consequence the VET offer should be adapted and/or expanded, especially for adults;
- Teachers, trainers and other VET staff should undertake initial and continuing professional development to foster technical and digital skills and effective innovative training methods, including teaching in a virtual environment.

In its [Digital Decade programme](#), the European Commission has set clear and ambitious targets: to equip 80% of people with basic digital skills and to have 20 million ICT specialists employed in the EU by 2030. The EU Skills Agenda and the European Pillar of Social Rights Action Plan call for collective action for the development of digital skills in the adult population, with 60% of adults participating in learning every year. Moreover, the Council Resolution on a strategic framework for European cooperation in education and training and the Digital Education Action Plan set out to reduce the share of low-achieving eighth-graders in computer and information literacy in the EU to less than 15% by 2030.

1.4 Scope and breadth of digital education reforms

The scope and breadth of digital education reforms can vary depending on the history and complexity of the national context: from encompassing the whole lifelong learning environment, including stakeholders such as employment agencies, employment offices and adult education providers, to focusing on one specific educational sector. This is a crucial decision as it affects the feasibility and potential impact of the reform. **System-wide education strategies** present a great challenge in terms of design, implementation and monitoring, but they can support, through whole-government approaches, the development of coherent lifelong learning systems where digital competence and skills are built along the different stages of education.

For example, such reforms allow policy-makers responsible for secondary education to plan in knowledge of the proficiency levels expected to be achieved by students by the end of primary education. At the other end of the spectrum, **education sectoral strategies**, such as strategies for higher education or VET, are easier to be designed and approved, but might require greater efforts in terms of harmonisation in the long term. Using the same example, in this case secondary schools would have to cope with first-year students with different sets of digital competences and would have to adjust the use of digital technologies accordingly. In the field of VET, a 2020 report by Cedefop shows that 67% of the 64 initial VET policies analysed have the explicit objective of strengthening digital competences (Cedefop, 2020). **Combined strategies** are also possible, where different initiatives are developed within specific education sub-sectors, but minimum digital competence standards are agreed for each level of education, also taking into account the connection with digital initiatives from outside education, such as general digital infrastructure plans.

Another element of complexity is the degree of autonomy of schools and the role of regional and local authorities: in several countries the digital education strategy is set at national level but implemented locally. For example, the German strategy, 'Deutschland Digital', sets an overall vision for the country's education system, allowing states to experiment with models to identify locally relevant approaches. Similarly, in Sweden, digitalisation has taken place through high levels of autonomy from municipalities operating within a clear national curriculum framework (Viennet and Pont, 2017).

This complexity is confirmed by a 2021 report by the European Commission, that has identified the **common enabling elements of digitalisation initiatives** recently launched by EU Member States: policy and funding stability and continuity, resources secured from multiple sources, a multidimensional approach with attention to both infrastructural and pedagogical development, active involvement of schools and municipalities, and appropriate scaling for impact. Within successful digitalisation reforms, these elements are often combined in a long-term perspective. In Finland, for example, six waves of national digital education strategies and hundreds of development projects have existed during the past 35 years. In Estonia, the high levels of school connectivity and teacher digital skills are the result of programmes which started in the 1990s and which were combined in 1997 within the 'Tiger Leap' initiative, and are still in place today (European Commission, 2021).

Insight: digital education policy as an emerging global priority

Also, due to the COVID-19 pandemic, in the last few years digital education policy has become a top priority at international level, as shown by the several reports focusing on this topic published by international organisations since the pandemic started.

- UNESCO (2022). [Guidelines for ICT in education policies and masterplans](#). This publication proposes a policy planning framework and an iterative roadmap to examine the digital readiness of education systems and to plan digital education programmes.
- OECD (2022). [How Learning continued during the COVID-19 pandemic](#). This report brings together 45 education continuity stories during the 2020 wave of school closures, with examples from low-, middle- and high-income countries in all continents.
- ILO (2021). [Digitalization of national TVET and skills systems](#). This report describes and updates the picture of digital VET, providing an overview of the issues surrounding digitalisation across the key functional areas of skills systems.
- OECD (2021). [Digital strategies in education across OECD countries: exploring education policies on digital technologies](#). This working paper identifies the OECD countries' interests in digital innovation in education by analysing their digital education policies and initiatives.
- European Commission (2021). [Enhancing learning through digital tools and practices: how digital technology in compulsory education can help promote inclusion](#). This study assesses the actual and potential role of digital technologies in promoting quality and equity in school education across Europe, with country cases and promising practices.
- Broadband Commission (2021). [Connecting learning spaces: possibilities for hybrid learning](#). This report draws attention to trends, promising practices, and positive deviants relating to the delivery of hybrid learning, including the changing role of the teacher and the value of diverse tools, open content and digital skills.
- ILO and UNESCO (2020). [The digitization of TVET and skills systems](#). This report provides an overview of how digitalisation is affecting skills systems and how it is likely to affect the management, delivery, assessment and certification of TVET.
- Centre for European Policy Studies (CEPS) and Google (2019). [Index of Readiness for Digital Lifelong Learning](#). This report attempts to shed light on the issue of LLL digitalisation by creating a scoring system and ranking EU Member States.

2. THE ETF FRAMEWORK FOR DIGITAL EDUCATION REFORMS

2.1 Components of the framework

In order to help policy-makers navigate the complexity of digital education and to reach a full understanding of what a reform in the field can entail, the ETF has analysed a set of recent national and regional digital education policies (set out in Annex 1) with the objectives of understanding the main digital education challenges and the policy solutions that are being implemented, and identifying those transversal critical factors that need to be taken into account when designing, implementing and monitoring digital educational initiatives. To facilitate the holistic understanding of digital education that is needed by policy-makers and to allow the possible connections between policy areas, we have structured the findings in a single framework, presented below in Figure 4.

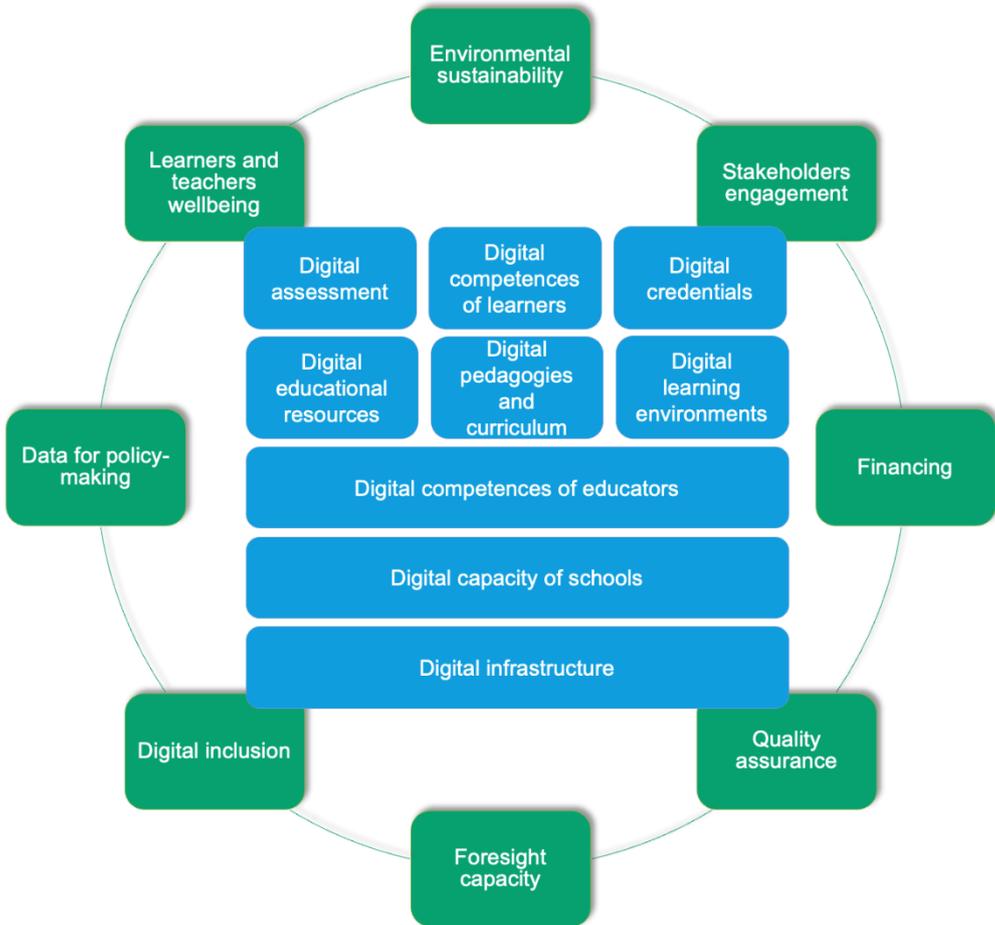


Figure 4: The ETF Framework for Digital Education Reform

The framework has two layers.

First, it identifies nine possible **digital education policy areas** (in blue in the figure above) on which digital education reform should focus in the modern days according to the ETF analysis of critical digital education success factors. These are composed of the preconditions for any sustainable digital education reform, namely digital infrastructure, digital competences of educators and digital capacity of schools, and of the specific components of education and training that need to be addressed (together or in different policy waves): digital education resources, digital pedagogies and curriculum, digital learning environments, digital assessment, digital competences for learners and digital credentials. For each of these nine areas, the **most common challenges** are presented, followed by some **policy pointers, intended as** typical types of policy initiatives, relating to the respective examples, that are emerging from the ETF analysis of promising and successful initiatives. This component should be used as a ‘compass’ to guide policy-making and define the focus of policy discussions, based on an analysis of the existing data about the state of digitalisation of education in a given country.

Second, it presents eight transversal, **critical factors of digital education reforms** (in green in the figure): data for policy-making, digital inclusion, stakeholders’ engagement, financing, quality assurance, environmental sustainability, teachers’ and learners’ wellbeing and foresight. By answering the key questions relating to these factors, policy-makers can discover the complex dynamics beneath digital education reform and determine the decisions that need to be taken in any of the policy areas. These factors are common in all educational policies, but with regard to digital education they bring important new elements into the discussion, which need to be known by policy-makers.

2.2 How the framework was developed

In order to develop the framework, the following methods have been applied:

1. Grey literature review (identification of focus areas and main challenges). An in-depth literature review was carried out by reviewing the reports presented on page 16, which explore existing patterns of digital education initiatives. Apart from some exceptions, we have considered only reports produced during and after the pandemic. This has allowed the definition of three elements for future analysis: i) the main possible areas of policy focus; ii) the main common challenges policy-makers face when implementing initiatives in these focus areas; and iii) selected tools (frameworks, reports, toolkits) that policy-makers use when designing initiatives in the field.

2. Analysis of existing policies (identification of policy pointers and examples). Once the areas were defined, an analysis of over 60 policies/initiatives/reforms in the field of digital education was run (the policies analysed are presented in Annex 1), focusing as much as possible on transition economies, but also including examples from other countries, when particularly relevant. Even though the analysis has not excluded any region, a certain prevalence of EU countries and ETF partner countries is present, in line with the ETF mission. When available, existing analyses of digital education policies have been reviewed. During this phase, we have

analysed policies launched before and after the pandemic. This phase has allowed the definition of a number of policy pointers that are typical types of initiatives in every policy area, relating to the respective examples. It represents the more ‘operational’ part of the framework, since it is based on existing policies and on their impact analysis, when available.

3. Scientific literature review (analysis of main transversal factors). A review of scientific literature was run to get an understanding of the transversal factors that can affect digital education initiatives, and the key questions that correspond to every factor. In order to define these questions, brainstorming sessions were run at the ETF to understand how the factors translate into potential concerns of policy-makers, and to ensure that the transversal factors identified apply to all the proposed policy areas. A list of the consulted literature is available in the references section.

2.3 How to use this framework

The ETF Digital Education Reform Framework aims to support the efforts of education and training policy-makers and stakeholders to develop inclusive, effective and human-centric digital education policies and initiatives. The framework is designed to do so by **informing decision-makers and policy shapers and by provoking critical policy reflection** regarding a) the types of digital education initiatives applicable in different policy areas (and their purposes); and (ii) the critical factors to be taken into account for their implementation.

The COVID-19 pandemic has shown that the success of introducing digital education depends on many factors, including the past history of investment on the digital education of countries, but also that every education ecosystem is different. Because of this, **the framework does not have a prescriptive nature and aims to foster discussions around digital education reforms**. The final aim is to allow policy-makers and policy shapers to better understand what type of digital education initiatives can be launched, depending on their context. The framework can be used both to design new policies and to evaluate existing policies in order to improve them and to generate better future initiatives. Figure 5 shows how the framework could be used.

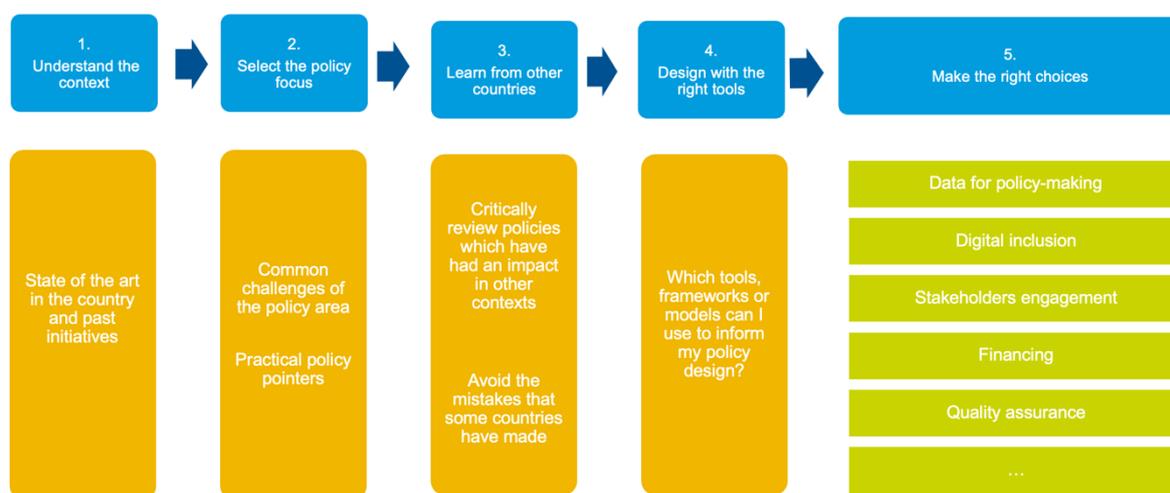


Figure 5 – Five steps to use the Digital Education Reform Framework

- Step 1 deals with **selecting the focus of the policy**, based on a sound understanding of the state of the art of the country in terms of digitalisation and digital education and on the assessment of the existing policy priorities and drivers across the country's public policy sectors. In order to do this, the current situation of the country should be matched with the possible focus areas presented in the framework. Existing data should be used (such as available administrative statistics and quantitative data from regular data collection instruments) and complemented by new quantitative and qualitative data if needed (through surveys and other instruments). Then, consultations and workshops might be organised to analyse and interpret the data, ideally involving stakeholders from the public and private sector as well as educators, parents and learners. If relevant, donors should also be involved in this phase. For example, a policy-maker might decide, based on existing data, that the main priority for the reform is educators' digital competences.
- Step 2 is about **deciding what specific initiative(s) should be implemented**. Once the policy focus area(s) have been identified, and considering that in many cases policies already exist, the main tasks here would be: a) reviewing and adjusting the existing policies – and legislation – and regulatory documents; and b) developing new, required policies and supporting documents focusing on the new priorities. To facilitate this, the framework provides a number of possible policy pointers that correspond to specific initiatives that countries have taken in each of the focus areas. During this phase, the involvement of national and/or international experts would help in designing the specific actions according to the national or local context. To follow on with our example, in the area of educators' digital competences, an exercise to define these competences with respect to the local context could be run, or if a digital competences framework for teachers is already in place, the action could directly focus on promoting capacity building actions for educators.
- **Step 3 provides the opportunity to learn from other countries** which have developed initiatives in the selected policy pointer(s). By critically exploring these initiatives through the links provided in Annex 1, possibly with the support of digital education experts, the design of these policies and – when available – their impact can be revealed, providing guidance on what could work in a specific context. In our example, a successful initiative of a given country could serve as inspiration to design the various capacity-building activities and mechanisms for teachers and to develop impact indicators.
- Step 4 is about discovering **international tools and standards** that can help policy-makers to inform the policy by recognised international practices. In the area of our example, policy-makers could decide to adopt the European Commission's framework for teachers' digital literacy (DigCompEdu, see paragraph 3.2) in order to identify the minimum set of educators' digital competences in the specific country's context and to monitor how these are acquired as a result of policy implementation.
- Step 5 deals with **asking the right questions** to ensure that the policy, whatever area and pointer have been selected, corresponds to a number of human-centric features. By going through these questions, again, with the support of digital education experts and by involving relevant stakeholders, policy-makers can shape policies that are data-based, digitally inclusive, engaging the right stakeholders, adopting the best possible funding approach, equipped with appropriate quality assurance, environmentally sustainable, attentive to learners and teachers' wellbeing, and equipped with a foresight component. To conclude our example, decisions should be taken to ensure that the policy pays attention to digital inclusion (for example by including among educators' skills the capacity to work with disabled learners through technology) and the wellbeing of educators.

3. POLICY AREAS OF DIGITAL EDUCATION

As previously stated, the European Commission’s Digital Education Action Plan 2021-2027 frames digital education as both the use of digital technologies to improve the quality and inclusiveness of education and training ecosystems and as the need to equip all learners with digital skills and competences. Indeed, this **holistic understanding of digital education** requires policies and initiatives working on several fronts, including infrastructure, strategy and leadership, teacher skills, learner skills, content, curricula, assessment and national legal frameworks (European Commission, 2020). In order to unpack the field of digital education, the ETF Digital Education Reform Framework identifies nine policy areas and a number of possible policy pointers that countries have typically been putting in place in each of the areas.

Policy area	Policy pointers
1. Digital infrastructure	<ul style="list-style-type: none"> • Include education within system infrastructure policies. • Increase access to appropriate digital devices in schools and among learners. • Guarantee high-speed connectivity for schools.
2. Digital competences of educators	<ul style="list-style-type: none"> • Define teachers’ digital skills and competences. • Foster teachers’ professional development in digital education. • Improve teachers’ training through innovative practices.
3. Digital capacity of schools	<ul style="list-style-type: none"> • Build digital leadership among school leaders. • Establish mechanisms to develop the digital capacity of schools. • Boost the data management capacity of schools.
4. Digital pedagogies and curriculum	<ul style="list-style-type: none"> • Foster the use of innovative digital pedagogies. • Innovate curricula for digital education. • Set up a monitoring system for digital pedagogies.
5. Digital educational resources	<ul style="list-style-type: none"> • Produce high-quality digital education resources. • Build the capacity of teachers and learners to create and use digital resources. • Foster the creation and use of Open Educational Resources.
6. Digital learning environments	<ul style="list-style-type: none"> • Develop and connect online environments within schools. • Develop national and local digital education platforms.
7. Digital assessment	<ul style="list-style-type: none"> • Foster the use of digital technologies for innovative assessment. • Review assessment criteria and approaches.
8. Digital skills and competences of learners	<ul style="list-style-type: none"> • Include digital subjects in schools and integrate digital competences across curricula. • Promote informal learning opportunities to build digital skills. • Promote critical digital literacy among learners.
9. Digital credentials	<ul style="list-style-type: none"> • Promote the uptake of microcredentials. • Support and promote national digital credentials platforms.

Table 1 – Policy areas and policy pointers for digital education reforms

Typically, successful digital education reforms tackle many of these areas at the same time. For example, the Finland's curricular reform of 2016 put emphasis on providing schools with the freedom to organise their curriculum (area 4), while at the same time ensuring that most Finnish textbooks were available online (area 5) and that local platforms for schools existed (area 6) together with a national education communication platform, to share school information, including student assignments, grades, teacher feedback (area 7) and other administrative information (area 3). Also, the Finnish Agency for Education is supporting a peer-learning community to foster digital competence among teachers (area 2) and encourages the pedagogical use of technology in the classroom (area 4) (National Centre on Education and the Economy, 2021).

3.1 Digital infrastructure

A fundamental area of digital education reform is the digital infrastructure that is needed to implement digital education. Affordable internet connectivity and access to appropriate digital devices are crucial prerequisites for fostering the digitalisation of education systems and for ensuring effective and inclusive digital learning experiences. In historical terms, while digital infrastructure was the focus of the first generation of digital education policies in the 1990s and in the early 2000s, it currently tends to be accompanied by systemic organisational change underpinned by pedagogical change (European Commission, 2020). Typically, initiatives aimed at improving the digital education infrastructure require the identification of the minimum level of infrastructure needed by all those involved, primarily schools but also teachers, households, companies providing work-based learning and other stakeholders. Also, digital infrastructure is a key dimension of digital inclusion and should be approached taking into consideration the needs of vulnerable groups of learners, including learners with disabilities. Initiatives focused on infrastructure should be driven by their long-term impact, with a system perspective: for example, the provision of connectivity and devices free of charge for a limited emergency period (such as the COVID-19 pandemic) can cause a problem as families have to begin paying once the free period is over (Williamson et al., 2020).

Common challenges

A first challenge is the availability of [appropriate digital devices](#) for learners, within and outside the classroom: the lack of appropriate equipment during the COVID-19 crisis has for example prevented some learners from continuing their educational practices at home (Dimitrova, 2021). [Insufficient internet connectivity](#) within schools, but also in households, is also a major challenge hindering educational policies from yielding the expected results (Conrads et al., 2017). In this respect, a lack of competition for broadband services is particularly problematic in rural and peripheral areas as it prevents the inclusion of the rural population in the education process (OECD, 2019). Finally, the [lack of an inclusivity-driven approach to infrastructure](#) may widen the gap of inequalities between less and more well-off population groups. Thus, cooperation among stakeholders (e.g. governments, schools and businesses) is important for supporting the participation of potentially excluded groups (OECD, 2020).

Policy pointers and examples

P1. Include education and training within systemic infrastructure policies. Policy-makers in charge of education should leverage on existing general digitalisation policies, since investments in digital infrastructure is often part of these strategies, which are in some cases based on cooperation between digitalisation authorities and telecom companies. Establishing strong collaboration with the authorities in charge of these digitalisation initiatives would facilitate and speed up the use of the needed infrastructure and has proved useful in fostering adaptation, experimentation and scalability (Conrads et al., 2017). An example of these policies is the **Australian National Broadband Network** project that had the objective of ensuring access for all citizens to fast broadband at affordable prices: research shows that students and schools particularly benefited from this investment thanks to the engagement of the Ministry of Education in the initiative (Government of Australia, 2018). Digital inclusion should be considered as a driver, as in the 2017 **UK Digital Strategy**, which funded the roll-out of fibre broadband networks across the country with a digital inclusion obligation: new

broadband internet service providers had to ensure for every individual, business and public premise (including schools) a sufficient broadband connection for making full use of the internet at a reasonable cost (UK government, 2017).

P2. Increase access to appropriate digital devices in schools and among learners.

Properly equipped computers, tablets and mobile learning devices can make the difference between an average and a great digital education experience (Van der Vlies, 2020). Research shows that devices should be provided to learners to ensure that they have agency over what they use them for, ensuring that families are not pushed into costing schemes that they cannot afford (Williamson et al., 2020). Importantly, these devices must be supplied with appropriate educational software to support digital inclusion (OECD, 2019b). Equipment maintenance is also key: the **US Digital Education Strategy** has, for example a specific support scheme to ensure that the equipment provided to schools and students is continuously maintained in terms of network management, technical support, upgrade, insurance, licensing, hosting and privacy protection (Department of Education of the United States, 2017). Finally, some countries are supporting the acquisition of high-tech devices, to allow experimentation and the development of advanced digital skills. **Hungary**, for example, is planning to equip special classrooms within each school with interactive 3D display devices and to have at least one 3D printer per every 500 students in primary and secondary schools, as well as a programmable robot for every three students (Government of Hungary, 2016).

P3. Guarantee high-speed connectivity for schools.

Digital teaching innovation cycles require high standards of connectivity (Van der Vlies, 2020), and this should be seen as a shared responsibility of all education stakeholders. The 2020 **California** policy includes, for example, commitments from companies, business leaders and philanthropists to provide internet access for hundreds of thousands of households for over 70 000 students, with USD 30 million available to help school districts ensure that families have internet access and computing devices for distance learning (Government of California, 2021). Another strategy for allowing affordable connectivity is the ‘zero-rating’ approach, applied for example by the **South Africa** Ministry of Education in cooperation with mobile telecom operators to ensure that data relating to specific educational websites and applications are charged a zero tariff for schools and students (World Bank, 2020). Notably, a number of existing initiatives tackle schools’ connectivity and equipment together: the **United States**, for example, lists connectivity as a key infrastructure element for schools, together with network management, technical support, maintenance and upgrade of devices and equipment, insurance, licensing and firewall protection (Department of Education of the United States, 2017). Finally, an example of low-tech connectivity comes from the **Ecuador** Ministry of Education, which is working in cooperation with the Telecom Ministry and with mobile providers to support online learning via SMS for remotely located teachers, learners and their families (World Bank, 2020).

Tools to support policy-making

- To explore the importance of inclusive infrastructure, policy-makers can refer to the European Commission’s [Digital Education Action Plan 2021-2027](#), which stresses that digital tools (e.g. computers, apps, games, online learning platforms, websites, etc.) should be used to support access to educational content and activities for all learners on an equitable basis, with emphasis on recognising the wide range of student disabilities that may have an impact on learning (European Commission, 2020).

- Low- and middle-income countries can take advantage of the [UNICEF Giga strategy](#), which is an initiative for creating the infrastructure necessary to provide digital connectivity to an entire country. GIGA has four main pillars: map every school's connectivity; develop regional business cases and bids to connect all schools; connect every school and empower young people with skills; and increase the number and scaling of proven digital public goods that are able to close connectivity gaps and support countries to scale solutions (Generation Unlimited, 2021).
- The [1:1 Pedagogy for schools](#) initiative by European SchoolNet provides information on one-to-one (1:1) initiatives around Europe, referring to the current trend where low-cost computer devices, ranging from mobiles and handhelds to laptops or netbooks, have gained ground in educational contexts.

Insight: the Digital agenda for the Western Balkans – a regional effort for digital connectivity

Within transition economies, digital infrastructure can also be developed through regional initiatives, typically with the support of donors. An example is the [Digital Agenda for the Western Balkans](#), which is a joint effort of the six Western Balkans countries – Albania, Bosnia and Herzegovina, Kosovo, Montenegro, the Republic of North Macedonia and Serbia – and the European Commission. It was launched in 2018 as one of the six flagship initiatives for an enhanced EU engagement with the Western Balkans. The initiative, which also includes a roadmap for lowering roaming charges, is based on four activities:

- **Investing in broadband connectivity.** Under the Western Balkan Investment Framework (WBIF), EUR 30 million in EU grants has been allocated to deploy broadband infrastructure in the region to mobilise strategic investments and foster socioeconomic growth.
- **Increasing cybersecurity, trust and digitalisation of industry.** To reach the common EU and Western Balkan objective of improving online security and trust, the Digital Agenda for the Western Balkans will support capacity-building in trust and security and the digitalisation of industry in the Western Balkans to ensure that all sectors, including education, benefit from digital innovations.
- **Strengthening the digital economy and society.** The Digital Agenda will support the deployment of eGovernment, eProcurement and eHealth tools and help increase digital skills among citizens. This will be done by enabling regional start-ups to connect and network with major European hubs; opening Digital Opportunity Traineeships to students and young people from the Western Balkans; and opening the EU Code Week for all Western Balkan partners, bringing coding skills and digital literacy to the region.
- **Boosting research and innovation.** The Digital Agenda will help set up national research facilities and develop state-of-the-art e-infrastructures in the Western Balkans, and will integrate them in an emerging digital European Research Area.

3.2 Digital competences of educators

A second precondition for successful digital education is a teachers' and trainers' population with knowledge of emerging technologies (e.g. underlying concepts, general principles, and mechanisms) and able to teach through and with the help of digital means (European Commission, 2022). Although the support for educators in applying emerging technologies is very often a key component of digital education reforms, educators report that they need additional professional development opportunities to gain new knowledge and skills for the pedagogic use of digital technologies (OECD, 2019c), and evidence suggests that traditional forms of teachers' professional development are not necessarily meeting teachers' needs (Joint Research Centre, 2019). To tackle this issue, teachers' digital professional development should move from simply acquiring skills to finding appropriate ways of tailoring technology to specific subjects, objectives and activities (Vuorikari et al., 2020). Finally, teachers' professional digital competences should be seen within the broader citizens' key competences discourse, since this could serve as an innovation leverage for transition economies, as shown by the recent work of the ETF in supporting key competence driven reforms in Georgia and Ukraine (ETF, 2021c).

Main challenges

The lack of training opportunities to develop digital skills has been reported as a major problem for teachers in some countries, including Japan (39%), Colombia (34%), Georgia (33%), South Africa (32%), China (Shanghai) (30%) and Kazakhstan (30%) (Conrads et al., 2017), and this is having a negative impact on improvements in students' learning, regardless of whether students are exposed to the technology or not (OECD, 2015). Around half the number of teachers and school managers also report that their participation in the professional development available is jeopardised due to a generalised **lack of economic and career-related incentives** (OECD, 2019c). **Insufficient use of digital technologies in teacher training** is also recognised as a big challenge: digital approaches in teachers' training in the OECD countries have been included to a certain extent (56%); however, upon completing their initial preparation, only 38% of teachers participate in induction to digital teaching (OECD, 2019c).

Policy pointers and examples

P1. Define teachers' digital skills and competences. A clear and shared understanding of the ideal set of competences that are integral to digital pedagogy can increase career development opportunities for teachers. The **European Commission**, starting from its work on key competences (European Council, 2018), has developed a number of frameworks and tools such as the DigCompEdu digital competence frameworks for teachers and the 'SELFIE for teachers' self-assessment tool. **Spain** has built on this work to publish a national framework for digital teaching with five main areas: information and data literacy; communication and collaboration; digital content creation; safety; and problem-solving, and has created a national institute for teacher training that provides training opportunities for teachers (European SchoolNet, 2018a). Similarly, **Hong Kong** has, for example, developed a digital framework for teachers, which has promoted the creation of communities of practice among teachers for disseminating new digital pedagogical methods (UNESCO, 2018). In **Norway**, the teachers' digital competences framework is used to foster conversations among school leadership and teachers for selecting training sessions based on teachers' needs (Kelentrić et al. 2017).

P2. Foster initial and continuous teachers' professional development in digital education. Equipping teachers with the necessary competences to effectively use digital technologies in their teaching should be a priority of any digital education policy (OECD, 2019a). In 2015, **Italy** reformed digital education by making in-service training on digital teaching mandatory, permanent and structural, by making a large financial investment of EUR 1.5 billion for training in areas of school autonomy, innovative teaching, 21st century digital skills and skills for inclusive education. The programme envisages a tailored approach by providing teachers an amount of EUR 500 per year to participate in training activities and purchase resources (Ministry of Education of Italy, 2015; Schleicher, 2020). All parties involved in teaching should be addressed, and possibly beyond teaching professionals. The digital education strategy of **Quebec** (Canada) has, for example, laid down the development of digital competences of teachers, non-teaching professionals and support staff as a key objective, starting from the development of a new competence framework for the teaching profession and investing in the continuous education of teachers and other related staff in digital pedagogy (Ministry of Education and Higher Education of Quebec, 2018). International donor projects can also be useful for teachers' digital capacity-building. For example, in **Armenia** the online training course 'Bridging Gap –Development of Digital and Crisis Management Skills for TVET Personnel', funded by the UNDP, aims to assist TVET teachers and management staff in getting acquainted with digital education technologies, raising the quality of learning materials and making online classes more interactive and appealing for VET students (UNDP 2021).

P3. Improve teachers' training through innovative practices. Digital skills development through informal and collaborative methods, in addition to face-to-face training and online courses, are reportedly preferred by teachers (Conrads et al., 2017). Also, teachers who participate in professional development courses through online collaborative communities are more likely to apply digital technologies in their classrooms (Arjomand et al., 2013). Teacher training and teaching activities should therefore build on a combination of measures, including the provision of training materials and digital teaching resources (OECD, 2019a), as well as the recognition of qualifications and the validation of non-formal and informal learning (European Parliament, 2020). The **UK** has launched online courses for teachers in partnership with the Chartered College of Teaching to improve the use of technology in teaching, alongside other training opportunities offered by industry providing online access for free for all educators (UK Department for Education, 2019). The **Belgian** national online portal for digital development of teachers is a platform 'by teachers and for teachers', where teachers can rate pedagogical practices and receive guidance on assessing different digital competence areas in the classroom (Minea-Pic, 2020). In **Ukraine**, since 2010, teachers can participate in Virtual EdCamps, which are online peer learning conferences built on the idea that teachers can learn from and inspire one another to enhance their professional skills with the goal of improving student outcomes. This initiative has reached over 10 000 teachers in Ukraine, Belarus, Georgia, Armenia and Moldova, showing how innovative teachers' training practices can work across the board (Modica 2022).

Tools to support policy-making

- The European Commission's [Digital Competence Framework for Educators](#) (DigCompEdu) is a comprehensive tool that can help policy-making to design profiles containing digital competences of educators. DigCompEdu is now equipped with an interactive self-assessment tool, [SELFIE for teachers](#).
- The ETF's [READY model](#) (Reference model for Educators' Activities and Development in the 21st-century) offers a structured way for educators, education providers, administrators, researchers and policymakers to identify the professional practices and development needs of 21st-century educators.
- The [UNESCO ICT Framework for teachers](#) (ICT-CFT) is a tool designed to help countries to develop national teacher digital competency standards. The framework highlights the role that technology can play in supporting the major education focus areas, and is available in English, French, Arabic, Chinese, Russian, Spanish, Khmer, Kyrgyz and Tajik.
- The [ICT in Education – Teachers' Professional Development Toolkit](#) contains a set of resources used to introduce digital technologies into Teacher Education. The utility of these resources includes collecting education data, considering approaches to advocacy, designing curriculum and materials development.
- The 2022 report [Digital skills development in TVET teacher training](#) by UNESCO-UNEVOC maps the main trends and challenges in the training of TVET teachers and trainers in the context of digitalisation, and provides examples of innovative TVET teacher training efforts that have proved successful.

Insight: how to capture the digital competence needs of educators through self-assessment

The **Digital Needs Analysis for Teachers Tool (DNATT)** is a bottom-up methodology based on a self-assessment process to identify and analyse the digital competences of teachers in South Eastern European countries, to assess the 'digital skills gap' of teachers. This approach, builds upon the European Digital Competence Framework for Educators ([DigCompEdu](#)), defines 22 digital competences organised in six areas and recognises that teachers, schools and systems must make judgements about which digital competences are most important to achieve their individual, organisational and national goals. DNATT was developed by the ETF in partnership with the Education Reform Initiative of South Eastern Europe ([ERI SEE](#)), and the EC [Joint Research Centre](#), and in 2020 was piloted in 123 schools, engaging more than 400 teachers, in **Albania, Montenegro, Moldova, North Macedonia and Serbia**. At national level, samples were designed so that the self-assessment survey could provide a representative picture of national needs by school type. At school level, the tool was piloted in two schools per country to understand how it can fit in with school-based professional development. Experience shows that regular use of DNATT or other similar tools can help policy-makers to understand teachers' needs at different levels, analyse how well training provision currently meets these needs, and address the issue of how data and information on needs at different levels should shape policy decision about the provision and coordination of training and support. Five country reports and a regional report, containing concrete examples of the information that can be extracted from the DNATT tool, are available [here](#).

3.3 Digital capacity of schools

A third transversal pillar for successful digital education reforms is the digital capacity of schools, since educators and learners need to work within a supportive digital ecosystem in terms of environments, methods and leadership. Evidence suggests that schools' development reforms can combine school leadership development, teacher training, curricula and content update (OECD, 2016). Specifically, the *whole-school approach to digital transformation* involves leadership and decision-making, strategies and codes of conduct, teaching and learning, assessment practices, curricula, infrastructure, hardware and software solutions, teaching methods and resources, teacher professional development, extracurricular activities and links with the community (Marjanović, 2021).

Main challenges

A first common challenge is the **lack of school strategies on digitalisation** that take into account the complexity of digital education: what investments are justified; what is the role and responsibility of teachers; what obstacles should be removed as they negatively influence the process of establishing online and blended teaching – these are new issues for school managers (OECD, 2016), especially in technical and vocational education and training systems (Van der Graaf et al., 2021) and in the case of potentially excluded learners (Schleicher, 2020). Also, the **insufficient cooperation between schools and stakeholders** is a major challenge, since stakeholders can contribute to building digital ecosystems around schools by providing digital solutions (Van der Graaf et al., 2021). With regard to companies, the consultation process should also consider insights relating to health and safety as well as learners' wellbeing (Gouédard et al., 2020).

Policy pointers and examples

P1. Build digital leadership among school leaders. School leaders are key for the sustainable implementation of digital education, since they are in a position to prioritise the issue and to operationalise it, for example by providing incentives to teachers active through digital strategies, by organising discussions on the subject within and around the school, and by ensuring that the issues of infrastructure and funding are properly addressed. In **Ireland**, the Digital Learning Framework contained in the national digital education strategy is, for example, adding the dimension of 'School Leadership and Management' to that of 'Teaching and Learning', clearly identifying the competences that digitally-ready school principals should master (Irish Department of Education and Skills, 2015 and 2016).

P2. Establish mechanisms to develop the digital capacity of schools. These initiatives aim at building digital ecosystems 'around' the school, for example by allowing teachers and support staff to exchange digital practices, by fostering contacts and learning from different stakeholders, and by engaging parents on digital education (Van der Vlies, 2020). During the past years, the Educational Media Department (EBA) of **Türkiye** has developed a comprehensive system centred around the school, with well-stocked repositories, virtual classrooms, dedicated studios for educational filming, expertise and know-how. This system was important for allowing a fast response in the country when the 2020 lockdown happened: from the very first weeks of distance learning, Turkish teachers were able to deliver virtual lessons, based on the content that they had co-created in the previous years (ETF, 2020).

P3. Boost the data management capacity of schools. Data can help school leaders to steer the digital transition of schools, guide teachers in personalising students' experiences and assist policy-makers in developing evidence-based education policies; it is therefore extremely important that schools are able to collect, store and analyse relevant data that can substantiate decisions at all levels. At the same time, it is important to consider the relationship between the datafication of education and the broader rise of surveillance mechanisms relating to learning analytics (Atenas et al, 2019). It is noteworthy that commercial bodies offer several products and tools that make use of data-driven solutions that do not always take data protection and privacy into account. Therefore, it is important to establish guidelines on the ethical use of data in education, including the use of anonymised data (European Parliament, 2020). **Japan** has included the use of learning analytics in its national digital education strategy, recognising their potential for providing useful data about students, but also noting that access to these data should be carefully managed (Ministry of Education, Culture, Sports, Science and Technology of Japan, 2022). Data circulation can also help the creation of Lifelong Learning systems, since it can foster a holistic understanding of learners' competences along their educational process. This is being applied in **Georgia**, where the Ministry of Education and Science, with assistance from the UNDP and the Government of Sweden, has developed an online information system of digital records for educational institutions that brings together educational records from schools, colleges and universities, making them interoperable and accessible by any educational stakeholder.

Tools to support policy making

- The European Commission's [Framework for Digitally-Competent Educational Organisations](#) (DigCompOrg) is a comprehensive tool to support policy-makers to assess the digital capacity of schools, as it encompasses key 'control levers' of digitalisation in educational organisations along three dimensions: pedagogical, technological and organisational. DigCompOrg defines seven key elements in these dimensions: infrastructure; collaboration and networking; content and curricula; teaching and learning practices; assessment practices; professional development; leadership; and governance practices (Kampilis et al., 2015). DigCompOrg can be practically applied through [SELFIE](#), a self-assessment tool for school leaders, teachers and students.
- [Guide to Developing Enabling Policies for Digital and Open Teaching and Learning](#), by the Irish National Forum for the Enhancement of Teaching and Learning in Higher Education. This guide is designed to support the development of enabling institutional policies for digital and open teaching and learning. The guide outlines five steps for developing policies for digital teaching and learning, and offers additional resources to support this process: case studies (Irish and international), a list of example policies for digital and open teaching and learning, and a list of references and other policy resources.
- The [School Leader Digital Learning Guide](#) by the US Department of Education (2021) is a resource for helping to consider, plan, fund, implement, maintain and adapt learning programmes, oriented toward digital education principles and practices that enable and empower students and teachers of all abilities while advancing student agency (i.e. initiative, intention and responsibility in pursuing their education), their personalised learning, their mastery of skills and competences, and protecting their privacy.

Insight: build schools' capacity through collective self-reflection: the SELFIE pilot for work-based learning in nine EU countries

At a recent European Commission meeting, in July 2020, the representative of Norway's Ministry of Education and Research highlighted that there were five challenges for schools' digitalisation strategies: (i) the digital gap that exists between students; (ii) the high proportion of teachers who lack skills and knowledge to implement digital teaching and learning; (iii) digital educational resources of inferior quality; (iv) wide differences between municipalities and counties on digital infrastructure and digital practices; and (v) the lack of research into digital education.

To help schools to tackle the above challenges, the EC developed the [SELFIE](#) tool to provide guidance through a collective self-reflection process on how to use digital technologies to support learning (ETF, 2021a). SELFIE is available in more than 30 languages and is currently being used by more than 26 000 schools, with over 3 million users in 88 countries. Specifically, [SELFIE for work-based learning \(WBL\)](#) is a dedicated version of the self-reflection tool to fit the specific context of vocational schools/colleges and for companies providing work-based learning. In 2020, SELFIE WBL was piloted in five EU countries and four ETF partner countries, involving almost 29 000 participants from 135 vocational schools and 280 companies. The participants' response to the SELFIE WBL tool was overwhelmingly positive, both in terms of its ease of use and its usefulness, with an average user satisfaction score of 7.4 on a scale of 1 to 10. Moreover, the exercise has helped policy-makers from the countries involved in better understanding the readiness and needs of their vocational and work-based learning's ecosystem, fostering bottom-up and participatory approaches to digital education reforms (ETF, 2021b).

Also, the pilot results can help to reflect on and foster consensus on possible improvements of existing training strategies, offering evidence-based priorities. More information on these pilots is available on the [ETF website](#).

3.4 Digital pedagogies and curriculum

The COVID-19 pandemic has shown that simply moving teaching from face-to-face to distance settings without changing the pedagogical approach towards engaging and interactive methods can support continuity of the learning process, but alone does not improve the learning experience. On the contrary, it may cause exclusion and isolation dynamics (Williamson et al., 2020). The pandemic did not allow time for proper implementation of engaging and collaborative digital pedagogy on a large scale, both in the countries that had successfully piloted digital education in the past and countries that had to move from classroom-based to online-teaching modalities in a short time. On the other hand, appropriate use of digital pedagogic approaches can enrich education and open learning experiences to an unprecedented wealth of information, providing a wide range of resources and tools applicable to any domain of knowledge and allowing learners to be not just knowledge consumers but also (co)creators. For example, when appropriate pedagogic approaches are in place, digital education can facilitate problem-based and interactive learning as well as enable personalisation of the learning experience. Because of this, digital education reforms could offer new means for the implementation of well-known pedagogical principles (personalisation, authentic learning, learner agency, etc.) while blending online learning methods with traditional ones.

Main challenges

A first challenge is the [lack of support to educators to tailor and apply innovative pedagogies](#) so that they can interact with their students on a regular basis in their teaching and learning environment (Masenya, 2021) and educate them effectively on digital skills (UNESCO, 2020a). This is particularly needed in the VET sector, where educators often fail to use learner-centred pedagogies or create practical, real-life situations for promoting learning, despite the applied nature of vocational education (OECD, 2021a). Also, [comprehensive monitoring and evaluation approaches for digital pedagogy](#) are often missing, while quantitative outputs receive the most attention (EIT Digital, 2022). For example, the emphasis is often on the number of educators trained rather than the quality of the training provided (Conrads et al., 2017). Finally, a generalised lack of flexibility when implementing digital education in curricula is a problem, with governments often maintaining [traditional formats and duration of school hours](#) also in digital settings, negatively influencing the engagement and motivation of both teachers and learners (Carretero Gomez et al., 2021).

Policy pointers and examples

P1. Foster the use of innovative digital pedagogies should be a priority, including blended learning, gamification, computational thinking, experiential learning and embodied learning (Paniagua and Istance, 2018). In **Belgium**, the Ministry of Education started already in 1998 with the KlasCement initiative for public schools that encompasses the exchange of new pedagogical practices among educators together with an incentive system to encourage teacher participation. Following the decision to close schools in March 2020, KlasCement started creating specific sections on its website devoted to distance teaching and learning, curated existing resources, and asked commercial and non-commercial partners to upload new content on relevant topics to support teachers (Minea-Pic, 2020). In **Spain**, the Amara Berri schools network works with a systematic pedagogical approach, putting the learner at the centre and stressing creativity, active pedagogy, socialisation, play, freedom and

globalism, and organising students according to their interests and needs rather than age (OECD, 2017). New digital pedagogies are often related to the use of digital resources, as shown by the Avanguardie Educative school network in **Italy**, that promotes the idea of going beyond the traditional textbook by involving students in co-developing the content of their books (INDIRE, 2021).

P2. Innovate curricula for digital education. Redesigning school's curriculum is a way of enhancing teaching and students' digital learning experience and should be done in line with the application of innovative pedagogical strategies in education (Masenya, 2021). In **England**, the Studio School model fosters the concept of personalised curriculum, allowing project-based learning and work with employers in the classroom as well as regular work placements for students and catering for diverse abilities (OECD, 2017a). In **Portugal**, the 2017 national Project for Autonomy and Curriculum Flexibility (PACF) allows schools to manage the curriculum in a flexible manner, while integrating digital teaching and assessment practices. Also, the initiative has established the 'Essential Core Curriculum' for elementary and secondary education, with digitalisation as curricular content across all 12 years of mandatory education (OECD, 2018a).

P3. Set up a monitoring system for digital pedagogies. The implementation of digital pedagogies should be monitored, to allow learning from the work done and to adjust the next waves of digital education policies. Monitoring levels of satisfaction of teachers, students and support staff can be done by allowing educators to regularly share aspects of their practice, such as content coverage and assessment criteria, making digital pedagogies more transparent and sharable. A good example is provided by the approach of the Innova Schools international project in **Peru**, a successful model of monitoring that involves different stakeholders: school directors, teachers, teacher coaches and researchers, in order to measure the actual use of the adopted pedagogical approach (OECD, 2017).

Tools to support policy-making

- The [*Innovating Pedagogy Report*](#) by the Open University UK explores new forms of teaching, learning and assessment, targeting teachers, trainers, policy-makers, education consultants, academics, students, researchers, instructional designers, educational software developers, and indeed anyone who is interested in pedagogical innovation and how education is changing.
- The [*digital pedagogy toolkit*](#) by JISC (UK) aims to support academic staff to make informed choices about how they use technology to underpin the curriculum, by providing ideas and inspiration for how staff can overcome barriers to using technology and promoting current approaches in curriculum design theory to ensure technology meets the learning outcomes of the study programme.
- The online open-access book [*Teaching in the Digital Age*](#) by Tony Bates (2018) examines the underlying principles that guide effective teaching in an age when all of us, and in particular the students we are teaching, are using technology. It also provides a framework for making decisions about digital teaching, while understanding that every subject is different and every instructor has something unique and special to bring to their teaching.

Insight: Lebanon piloting immersive learning experiences through XR technology

The integration of pedagogically sound Extended Reality (XR) technologies, both in the shape of Virtual Reality (VR) and Augmented Reality (AR), can complement in-class instruction, providing multiple benefits, including (i) accessibility to hands-on training where relevant labs or workplace are not available, (ii) keeping the pace with quickly changing technologies without the need to update/re-buy expensive equipment, (iii) offering a safe training environments that offer detailed analytics on students practices, without exposing students to danger context work-based learning environments (iii) offering learning "green ' learning opportunity.

In Lebanon, the [Safadi Foundation](#) offers training programmes that aim to empower vulnerable groups, including the jobless, school dropouts and refugees. To overcome the lack of labs to allow work-based learning practices for the development of technical skills for welding, in 2020 the Foundation launched the use of an Extended Reality (XR) platform for welding and heavy machinery (e.g., motor grader, excavator, etc.) where learners can have an immersive experience that offers detailed learning analytics for learners and teachers, highlighting progress achieved and areas for improvement. The total number of trainees since the launch date of the simulator training centre is 243, with a plan of increasing by 200 learners per year.

The analysis of this type of initiative can be inspirational to policy-makers and accelerate the acceptance of XR technologies in VET, highlighting benefits, pedagogical effectiveness in comparison to traditional training, barriers to XR implementation by VET institutions and helping to identify required resources, thus informing digital education reforms and related initiatives, e.g., a roadmap that can guide institutions step by step in setting up and implementing XR-based training provision.

3.5 Digital educational resources

Quality digital educational resources are a key component of digital education, for at least three reasons. First, because they can be updated by the teacher and thus remain up to date; second, because they facilitate participation if openly licensed and therefore accessible at no cost for students; and third, because they can foster teaching innovation through the processes of content co-creation. As recently noted by the European Commission's [Working Group on Digital Education](#), new trends relating to digital education content are emerging. On the supply side, traditional producers of educational content, such as publishers, are seeing the emergence of a competing or complementary supply of digital content from public authorities, teacher-generated content and new commercial digital players, not necessarily from the education sector. On the demand side, teachers and students are taking advantage of the increased supply of digital education content, and thus becoming themselves creators and curators of digital education content. Digitalisation allows for decentralised development of educational resources and for browsing existing online resources (including Open Educational Resources) to complement the educational offer and respond to the growing need for upskilling and reskilling. However, there is always a need to balance the availability and quality of educational content, so, quality assurance measures should be applied.

Main challenges

The pandemic has shown that [the lack of digital education resources](#) is challenging for educators and students, especially for those with disabilities and financial difficulties. Also, the [lack of skills among educators in producing digital content](#) negatively influences the development and implementation of digitalised course materials. Finally, the [low share of educators using digital content](#) in the classroom to support student learning is a problem (IIEP Learning Portal, 2021), this being mostly due to the lack of incentives for schools to use digital content (OECD, 2019a).

Policy pointers and examples

P1. Produce high-quality digital education resources. A mature digital education ecosystem requires high-quality content (European Commission, 2020) that can support online, in-person, or blended teaching. Educators should be encouraged not only to use digital content but to create it, making it flexible and tailored to their students' needs (European Parliament, 2020). In **Hungary**, the 2016 Digital Education Strategy has been funding the creation of digital educational content for both learners and educators, emphasising the importance of inclusion of and access to educational content (Government of Hungary, 2016). In **Israel**, the digital education policy implements the SAMR model that calls for the Substitution, Augmentation, Modification and Redefinition of digital content to guide meaningful usage of digital technology in teaching, providing teachers and trainers with a classroom-mapping sheet to allow them to plan their use of digital resources in the classroom (OECD, 2018). In **India**, the Ministry of Education has created the DIKSHA (Digital infrastructure for school education) platform, offering quality digital content as well as QR-coded textbooks for all grades. The platform is based on the principles of open architecture, open access, open licensing, autonomy and multilingualism.

P2. Build the capacity of teachers and learners to create and use digital resources. This was particularly important during the COVID-19 pandemic when greater access to online materials helped educators to keep up with distance teaching. For this to happen, capacity building and frameworks of usage have proved necessary for both educators and learners (Discovery Education, 2021). In **Greece**, the Digital Skills Action Plan 2019 included among digital competences both for educators and learners the ability to create and reuse digital content (Ministry of Administrative Reconstruction, 2019). In **Italy**, the national strategy for digital education included guidelines for designing and implementing prototypes as part of digital content in different subjects as well as a capacity-building component for the creation of digital educational content (Italian Ministry of Education, 2015).

P3. Foster the creation, use and sharing of Open Educational Resources (OER). The possibility to legally use OER is a great enabler of both inclusion and quality in training (UNESCO, 2019). A number of initiatives in the **United States** promote openly licensed educational resources as one of the most effective ways to provide high-quality learning materials, stressing that openly licensed materials allow money to be saved, are more accurate than traditional textbooks, and help teachers to exercise their own creativity and expertise (Department of Education of the United States, 2017). **Poland** has included OER in its digital education policy, meaning that all educational materials produced with public funds should be made accessible at no charge, with the possibility of unlimited modification and use (Tarkowski et al, 2016). Examples of other OER policies are **Germany's** OER strategy, that aims at fostering OER and MOOCs, and Ireland, which has a dedicated funding mechanism with emphasis on Open Access that includes OER. Finally, a number of countries, such as **Morocco** with the **MUN** (Maroc Université Numérique) and **Israel** with its **[national platform](#)**, have been supporting the establishment of national platforms for MOOCs (Massive Open Online Courses), starting with governmental funds and engaging national universities and stakeholders, in order to guarantee long-term sustainability.

Tools to support policy-making

- The **[UNESCO Guidelines on the Development of Open Educational Resources Policies](#)** provide a systematic approach to develop and implement OER policies in different contexts. Using a six-stage approach, the guidelines provide several templates and questions, along with theoretical underpinnings and practical examples, to help government officials and experts develop policies that are grounded in the needs of the stakeholders.
- The 2016 report **[Making sense of MOOCs: a guide for policy-makers in developing countries](#)** by UNESCO and the Commonwealth of Learning is designed to raise general awareness amongst policy-makers as to how MOOCs might be useful in terms of access to affordable quality education, both within higher education and VET.
- The 2019 ETF **[Video pedagogy for vocational education](#)** is a rubric of video-based teaching and learning theories and practices including, for example, the use of video for learning for (i) activity analysis and reflection on action; (ii) observational learning; and (iii) learning from errors. In this direction, digital education policies combining video pedagogy with the use of social media tools could inspire vocational teachers, trainers and learners' creativity, the production and consumption of videos for innovative teaching and learning, and to better connect the diverse learning environments.

Insight: the ETF emergency support to digital VET in Ukraine

In partnership with the Ukrainian government and local stakeholders, the ETF has launched an emergency support initiative, [UA Re-Emerge\(ncy\): e-learning and skills development to rebuild Ukraine](#), in response to the Russian military aggression which has had a devastating impact on the lives of Ukrainians and caused enormous disruption to daily life, education and training, with nearly 30% of the Ukrainian population now being considered to be either refugees or temporarily displaced. The ETF's support initiative aims to identify high-quality digital educational content in the EU and its neighbouring countries, and to localise it through translation and adaptation to the Ukrainian context and demand. The ETF has addressed the international community and works with the partners in the EU member states and globally to collect short learning experiences, professional modules and other resources that will give Ukrainian citizens the opportunity to enrol in high-quality VET, reskilling and upskilling training to acquire competences demanded by the local labour market and to obtain micro-credentials recognised by employers.

The initial phase of the UA Re-Emerge(ncy) programme focuses on the Dnipropetrovsk region and seeks micro-credentials in the following priority sectors: energy efficiency, construction and restoration, and green energy. The active engagement of employers and training providers will contribute to the recognition of acquired competences of learners and the immediate employability of successful graduates. The programme also aims at strengthening collaboration and quality assurance arrangements between the developers of micro-credentials and partners in Ukraine. The collected digital educational resources will be made available on the Ukrainian [National E-learning platform for TVET](#), connected to the national platform [All Ukrainian schools online](#), launched by the Ministry of Education and Science before the COVID-19 lockdown and fully adapted to the challenges faced by the Ukrainian education system now supporting learners who have been temporarily displaced, both within Ukraine and in many countries.

This ETF initiative shows how collecting, creating and curating high-quality digital resources, releasing them through open licences and boosting them through digital pedagogy can offer upskilling and reskilling solutions in times of emergency and beyond, thus increasing the resilience of VET ecosystems during crises.

3.6 Digital learning environments

During the pandemic, many countries created national online platforms to facilitate the implementation of digital education across their systems (Williamson et al., 2020). These platforms have the potential to form the core of national digital education ecosystems by connecting high-quality content, tools and services to maintain privacy and uphold ethical standards. At the same time, schools have been investing in setting up their own online teaching platforms (Learning Management Systems) to facilitate administration, communication, online publishing and assessment of courses. These platforms often use proprietary solutions (such as Google Classroom) and tools (such as Zoom), raising concerns about the use of participants' data and online privacy, which should be tackled by digital education reforms. Platforms should be designed with inclusiveness and learner-centered design principles in mind. Connecting the existing national platforms with the network of schools' platforms is also a key area for digital education reforms.

Main challenges

In schools, digital education platforms are often based on [low-performing and not always updated learning management systems](#) (LMS), and are supported by weak digital infrastructure in terms of equipment and cybersecurity (OECD, 2016). These platforms are often not connected to [regional and national platforms](#). If in place, such connections would create a comprehensive experience across schools and municipalities and would help to achieve cost reductions through the use of common technology solutions for all stakeholders (school, students, educators, parents and the community). Moreover, [financial resources are often insufficient](#) for covering the cost of professional licences for supporting online platforms, and this weakens the quality of innovative pedagogies in online learning (OECD, 2016).

Policy pointers and examples

P1. Develop (and connect) online environments of schools and training centres. The policy challenge is to go beyond the introduction of LMS solutions within schools by building learning ecosystems that simultaneously tackle school connectivity, equipment, digital capacity development, organisational culture, staff training, educational content, the respect of privacy and ethical standards (European Commission, 2021). In **Chile**, the 'Enlaces' project is expanding the digital infrastructure in schools through a network of connected online environments, with special attention to schools in rural areas (OECD, 2018). In **Denmark**, the 'User Portal Initiative' provides a public infrastructure for learning management systems and data exchange across schools at national level, that is a single-entry point for all educational data and digital services held and used by schools (Van der Vlies, 2020). In **Türkiye**, the Ministry of National Education has developed a national online Education Management System, which integrates an LMS, a content management tool, virtual classrooms, learner analytics and evaluation systems (UNDP 2021).

P2. Develop national digital education platforms. The COVID-19 pandemic encouraged the creation or strengthening (also in terms of accessibility and online safety standards) of national platforms for digital education that can support a wide range of services for school managers, teachers, students and parents, while dealing in a centralised way with the important issue of data exchange, privacy and storage (Conrads et al., 2017). In **Luxembourg**,

the 'Digital4Education' portal provides an online teaching and learning platform that enables teachers to deliver online lessons, a space to allow young people to promote their digital creations and a multilingual mathematics learning environment where learners can access various digital content and practice (Van der Vlies, 2020). In **Croatia**, a [national digital platform](#) was established to provide guidelines on how to organise distance learning, provide pedagogical advice on assessment and grading in virtual environments and set up psychological teams to help pupils, parents and teachers. In **Saudi Arabia**, the '[Madrasati Platform](#)' was created by the Ministry of Education in 2020 to ensure that students, teachers, education staff and parents have equitable access to distance education and training, regardless of their geographical location, income or physical abilities.

Tools to support policy-making

- The publication [Ensuring effective distance learning during COVID-19 disruption: Guidance for teachers](#) (UNESCO, 2020d) contains a learner-centred taxonomy of the functionalities of the main current digital platforms, and identifies the gaps for further upgrading.
- UNICEF's [Learning Passport](#) is an online platform that enables continuous access to quality education. Countries can adopt the Learning Passport as their national learning management system or use it to complement existing digital education platforms. The platform prioritises deployment in places with intermittent or no internet connectivity and serves local, contextualised content as well as global supplementary resources to support learners and improve learning outcomes.

Insight: national guidelines for using Learning Management Systems in Serbia

Despite the limited experience of Serbian school leaders, teachers and consequently students with online and blended learning, Serbian schools were able to respond to the COVID-19 pandemic, thanks to the widespread utilisation of Learning Management Systems (LMS). This was due to the fact that, already in 2013, the National Education Council had published the [Guidelines for Advancing the Integration of Information-Communication Technologies in Education](#), as a complement to the [Digital Education Policy in the Republic of Serbia](#), including practical suggestions on the use of LMS, recommending independent LMS management at school level, while being steered and supported at national level. Following the COVID-19 pandemic, the Ministry of Education Science and Technology Development is committed to widely promoting new organisational, technological and pedagogical approaches and opportunities to ensure education recovery and its further development.

This approach was taken up in 2021 by the 'Education Reform Initiative' of South Eastern Europe (ERI SEE), which, in cooperation with the ETF and the Austrian Agency for Education and Internationalisation (OeAD), has built on the above guidelines with the document [Whole School Approach to Online and Blended Teaching and Learning](#), which aims to transfer this successful initiative to the whole South East European region.

3.7 Digital assessment

Innovative forms of assessment can provide learners with an active role, making them aware of their learning processes and increasing their responsibility (European Commission, 2018). Research indicates that assessment can benefit from the use of digital technologies, specifically from assessment *of* learning to assessment *for* and *as* learning, providing opportunities for self-directed learning and interaction with peers (Looney, 2019). Digital technologies support the provision of rapid or real-time feedback and scaffolding of next steps for learning at an appropriate level of difficulty (Balanskat and Engelhardt, 2020). To implement reforms in this area, policy-makers need to focus on how to ensure secure and ethical use of students' data, guaranteeing trust and safety, data usability and ownership. Notably, both formative and summative assessments have been severely impacted by the schools' closure (OECD, 2020) as their modalities have been strongly dependent on students' physical presence: according to the analysis by UNESCO, 58 out of 84 surveyed countries had postponed or rescheduled exams, 23 had introduced alternative methods such as online or home-based testing, 22 had maintained exams, while in 11 countries, exams were cancelled altogether (UNESCO, 2020).

Main challenges

The main challenge in this area is the **cultural shift** that needs to happen among school managers and educators to allow formative assessment to become mainstream, moving towards the concept of assessment for learning, where progress and attainment data are shared with and used by learners and their parents (Conrads et al., 2017). Also, there is a **lack of new methods of assessment** that embed recent digital assessment trends (Conrads et al., 2017). For instance, even though an increasing number of OECD countries recognise the potential of digital technologies such as artificial intelligence (AI) for assessment, in most cases AI applications are still nascent and used in experimental and local contexts rather than at scale at the system level (Van der Vlies, 2020).

Policy pointers and examples

P1. Foster the use of digital technologies for innovative assessment. Several digital education initiatives mention the opportunities created by digital assessments (Van der Vlies, 2020), recognising that an appropriate use of digital tools has great potential to make assessment reliable and suitable to school needs. This is the case of **Israel**, that has placed emphasis in its digital education policy on alternative assessment methods (European SchoolNet, 2018), and **Ireland**, whose Digital Strategy contains a section on assessment reform, which encompasses simulations, digital games, virtual labs and e-portfolios (Department of Education and Skills of Ireland, 2015). In **Sweden**, the National Agency for Education published a list of technical requirements that schools must have in place to implement the digital national assessment tests already (Eurydice, 2021), while in the **United States** technology-based assessments and performance-based assessments are often part of local policies (Department of Education of the United States, 2017). New assessment methods can also help in cases of low connectivity: in **Nigeria**, for example, since 2018 through the national Edo-BEST database, students can access interactive quizzes through mobile phones on a daily basis and receive instant automated feedback.

P2. Review assessment criteria and approaches. Assessment criteria should be updated and become multidimensional, concentrating also on assessing aspects and effects that are either not easily quantifiable or where qualitative methods are considered preferential. In the case of **France**, national examinations at the end of lower and upper secondary education have been replaced by continuous assessment of the grades obtained during the year (Ministère de l'Éducation nationale et de la Jeunesse, 2020). Similarly, in **Norway**, most national exams for the last year of junior high and high school were cancelled and replaced by continuous assessment. The purpose has been to ensure that every student can graduate and continue their education (UNESCO, 2020b).

Tools to support policy-making

- The [*Guidelines for digital assessment policy*](#), developed by SURF, the Dutch agency for digital education, are aimed at employees who have been tasked with preparing and implementing a digital assessment policy, and can be used to update an existing digital assessment policy as well as in cases where a policy has yet to be drawn up.
- The 2020 report [*Strategies to include digital formative assessment in the Danish school system*](#) by European SchoolNet presents interesting policy-relevant examples of digital formative assessments implemented in Danish schools, rooted in 10 years of pioneering experiences of digital assessment as part of national tests organised at central level.
- The 2016 [*Guidelines for Online Assessment for Educators*](#) by the Commonwealth of Learning present an identification and description of relevant online assessment techniques, practical principles for online assessment, some tools that may be useful for teachers and educators and some online assessment resources.

Insight: the ETF partnership on digital formative assessment in VET: first results

As part of the ETF Innovative Partnership on Digital Formative Assessment in Ukraine and Moldova, the ETF is working with VET schools in Ukraine and Moldova to explore how digital technology can support and strengthen formative assessment, including peer- and self-assessment practices. Even though this activity was suspended in February 2022 with the start of the military aggression of Ukraine, the partnership will be relaunched as soon as conditions allow, bearing in mind that the restart of education in Ukraine will be based on digital education and related digital assessment practices.

Through this partnership, the schools involved have shared principles and good practice on formative assessment practices, including how digital technologies support and strengthen this form of assessment, and educators have been trained in the design of digital formative assessment projects for their schools.

The preliminary findings of this activity may be useful for informing policy in the area of digital assessment. First, the great majority of schools are still focused on summative practices as a means to formally assess students' performance, while formative assessment is often still at an embryonic phase, mainly used to complement summative practices. Yet, all the stakeholders involved recognised the value of formative assessment practices and the contribution of digital technologies as a way for allowing greater personalisation of learning and learners' agency.

3.8 Digital skills and competences for learners

Digital competences are crucial for lifelong learning, employability and participation in society, driven by developments such as the platform economy, the increasing importance of coding and data management in the context of Industry 4.0, or the increased use of digital technologies for the provision of public services for citizens. Even though by 2019 most European education systems had reformed their curricula, introducing components such as computational thinking or artificial intelligence (AI), initiatives that connect curricula with broader labour market trends and challenges have remained at a very early stage of development (Van Roy et al., 2021). This is especially true for the VET sector, even though between 2011 and 2018 almost all EU countries had started implementing policies that promoted digital competence within VET (Cedefop 2020), including on computational thinking, recognising that this can raise students' employability and better prepare them for the job market (Bocconi et al., 2022). To address this issue, the European Commission has supported the development of the [Digital Competence Framework for Citizens](#) (DigComp), a tool to reach a common understanding of what digital competence is. Commercial bodies have developed their own tools for the introduction of these competences (such as Lego Mindstorms), which can be introduced in schools, provided they are coherent with national priorities.

Common challenges

A first challenge is the [difficulty of mapping the digital skills needed by the labour market](#). These skills encompass not only technical skills but also transversal skills for living and working in the 21st century, and at the same time overlap and interlock (ETF, 2022); aspects essential to one domain will support competence in another (European Council, 2017). Also, the fact that [digital teaching and assessment methods are not mainstream](#) is a challenge: the PISA data by the OECD shows that those students who use computers in their learning activities have better performance rates in comparison to those who do not (OECD, 2019d). Finally, the [lack of out-of-school support to develop digital skills](#) is a concern (Williamson et al., 2020), particularly concerning issues such as online privacy, internet safety and digital identity management.

Policy pointers and examples

P1. Include digital subjects in schools and integrate digital competences across curricula. In the past years, several countries have included digital learning outcomes and/or dedicated subjects in their general education curriculum, focusing on issues such as coding, artificial intelligence (AI) and data analytics. For example, in **Finland**, the National Core Curriculum emphasises joyful and active learning by adding digital-related activities where students work individually and collaboratively to create new knowledge using digital technologies (Eurydice, 2019). In **Estonia**, the [ProgeTiger programme](#) was adopted to improve digital literacy of students, from pre-school to vocational education, also by adding digital subjects to the curriculum (Education Estonia, 2021). Other countries, instead of introducing digital subjects, integrate digital competence learning outcomes across curricula and develop transversal skills of learners. In **France**, for example, mastering digital skills is present across all subjects. Similarly, a major component of the digital education policy in **Norway** is the integration of digital technologies into their curriculum reform: digital competences are now among the basic competences of the national curriculum, and include both the abilities to use digital tools and subject-specific tools in arts and crafts, music and science.

P2. Promote informal and non-formal learning opportunities to build digital skills. Digital skills are used and can be learnt independently outside of the school, through peer interaction and cooperation in events such as programming hackathons or bootcamps, and it is in these open contexts where learners can better gain an understanding of the digital world (European Commission, 2020). When moving to informal learning settings, it should be noted that, in general, boys more frequently use digital devices outside school than girls (OECD 2019d), so the gender balance should be taken into account. For example, in **France**, the Ministry of Education has launched [Pix](#), a gamified online platform that assesses and certifies digital competences of citizens and awards digital badges with targeted recommendations for future learning. A more grassroots approach is that of the [Informal School of IT](#), an association supported by the Ministry of Education and active in several cities in **Romania** and **Moldova**, which aims to strengthen the capacity of VET schools to use digital means to reskill workers.

P3. Promote critical digital literacy among learners. Whether within school activities or in informal learning settings, the fundamental idea is to enlarge the understanding of digital skills beyond technical skills and to include the capacity to critically and actively use digital technologies. This approach is increasingly inspiring international efforts in the field, such as the DigComp and DigCompEdu frameworks of the European Commission (Punie and Redecker, 2017). An example of in-school critical literacy development comes from the **UK**, where the Teachers' Standards specify teachers' responsibility for safeguarding students' digital wellbeing, including protecting them from potentially harmful online material (European Commission, 2019). In the field of informal learning, many creative initiatives exist, including competitions such as the 'National Award for Digital Competences' organised in **Italy** since 2021 with the support of the Ministry of Education, which focuses on digital and gender divides specifically, and awareness-raising actions such as the **EU** '[Safer Internet Day](#)'. This initiative, which started in 2004, has grown beyond the EU and is now celebrated in approximately 200 countries and worldwide, with the objective of discussing issues such as cyberbullying, social networking and digital identity.

Tools to support policy-making

- The 2022 report '[Computational Thinking in Compulsory Education](#)' by the European Commission contains a review of the latest research findings and grass-roots initiatives on the position of digital skills within Europe's education landscape. The study approaches the matter from theoretical, organisational and practical perspectives in the endeavour to spotlight new understandings, developments and emerging trends.
- The EU '[Code Week](#)' is an initiative organised each year across Europe through multiple grassroots initiatives to foster creativity, problem-solving and collaboration through programming and other tech activities. In 2021, 4 million people in more than 80 countries around the world took part in EU Code Week.
- The '[Digital Education Hackathon](#)' is a free, inclusive and open event organised with the support of the European Commission to solve pending digital education issues. Participants from all over Europe and beyond choose an open challenge, register on the portal and take part online or in-person in the event. After the event, the challenge-winning solutions are assessed and three Global Award winners are selected.

Insight: national strategies for digital skills development in the Western Balkans

In the Western Balkans region, with the support of the Regional Cooperation Council, the priority of developing basic and advanced digital skills is mirrored by a number of dedicated policies:

- In Albania, digital skills are integrated into the Strategy for Education 2021-2026.
- In Bosnia and Herzegovina, the Policy for Development of the Information Society for 2017-2021 includes a pillar dedicated to strengthening digital literacy.
- In Kosovo*, the draft Education Reform 2022-26 and the Digital Agenda for Kosovo 2030 also cover the provision of digital skills.
- In Montenegro, the Strategy on Digital Transformation and the Strategy on Digitalisation of the Education System 2022-2027 strongly focus on digital skills development.
- In North Macedonia, the Educational Strategy for 2018-2025 and the corresponding Action Plan encompass digital skills development among its priorities.
- In Serbia, the Digital Skills Development Strategy 2020-2024 includes both basic skills for all citizens and advance skills for workers in the IT sector.

To give an example, in Kosovo⁴, digital education is strongly embedded as a key component of the draft education strategy 2022-26, which includes a specific objective on the 'development of digital competence in all parties in view of the successful digital transformation of education and general social development'. The related section of the reform's work plan defines actions and allocates resources to improve the provision of digital skills and competence for learners, referring to the EU tool DigComp for the definition of standards and headings for teaching, learning and assessment. The Kosovo [Digital Agenda Observatory](#) provides an overview of non-formal upskilling and reskilling initiatives, reporting on civil society organisations' initiatives such as '[Open Data Kosovo](#)', which aim to equip youngsters with key digital skills by providing training in fields ranging from open data to institutional capacity building.

⁴ This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

3.9 Digital credentials

In recent years, 'alternative credentials' such as microcredentials and digital badges have been emerging, contributing to filling the gap between education and training provision and the skills needed by the labour market, and increasing the efficiency of skills development systems. Microcredentials are particularly relevant for the upskilling and reskilling of employees, especially in times of economic crisis (Beirne et al., 2020). At the same time, digital credentialing systems can capture, recognise and validate a broader range of learning outcomes than traditional certification schemes (UNESCO, 2022b), saving time and money for certificate issuers, retaining control over the validity of credentials and increasing visibility of skills (European Council, 2022). Also, they can contribute to the recognition of informal learning by, for example, promoting 'Open Badges' that are able to measure competency beyond what a certificate can do (Ilfenthaler and Shumacher, 2016). While promoting the use of digital credentials, governments should update teachers' training efforts and ensure the recognition of digital skills acquired by teachers/trainers through digital credentials and should make sure that the creation of digital credentialing ecosystems do not impact on the inclusiveness of education systems in terms of gender, language, or digital literacy. On the contrary, digital credentials initiatives must enable disadvantaged groups to take advantage of new digital platforms and minimize vulnerability in the workforce (Asian Development Bank, 2022).

Common challenges

Digital credentials are based on rather recent technologies, and therefore a first set of challenges relates to the [trustworthiness of data](#), [the interoperability of systems](#), and [the ubiquity of technology standards](#) (UNESCO, 2022b). In parallel, [cultural challenges](#) must be mentioned, relating to the risk that moving from traditional credentials to microcredentials will not be easily accepted by employers, especially since stacking (the combination of microcredentials) may not always lead to coherent qualifications. Notably, a recent survey commissioned by the Asian Development Bank shows that, even if 89% of respondents agreed that digital credentials will become a critical part of education, this will not diminish the market value of traditional credentials, since traditional and digital credentials will coexist and complement each other (Asian Development Bank, 2022). Indeed, progress is happening fast at global level, with efforts concentrating on developing comparing methodologies, addressing the multilingual challenges and promoting international labels (UNESCO 2022b).

Policy pointers and examples

P1. Support and promote national digital credentials platforms. In 2020, the **Australian** government announced its plans to build a national online microcredentials platform (Department of Education, 2020) as a one-stop-shop to help learners and workers identify educational opportunities: since the announcement, 54 providers have created 344 short online courses in areas of skills shortage. The online skills marketplace provides a nationally consistent platform to compare course outcomes, duration, mode of delivery and credits value. Similarly, the Association of the Registrars of the Universities and Colleges of **Canada** (ARUCC) has recently launched [MyCreds](#), a web platform which includes a credential wallet for students, allowing secure issuing, exchange and verification of official digital documents, badges, microcredentials and diplomas from Canada and around the world (ARUCC, 2020).

P2. Promote the uptake of digital microcredentials. The **European Union** is moving fast on this issue, by promoting European Digital Credentials for Learning, that are electronically sealed digital credentials in the form of tamper-proof, information-rich digital documents that use open standards and are fully aligned with EU frameworks and instruments such as the EQF, ESCO and EUROPASS (European Council, 2022). In **Finland**, with the support of the European Social Fund, Oulu University of Applied Sciences is developing a nationwide open badge constellation which enables the verification of adults' problem-solving skills in technology-rich environments by identifying and recognising competences acquired outside the formal education system.

Tools to support policy-making

- To promote digital credentials and to increase transparency of qualification in the EU, the European Commission has recently added a digital dimension to its [EUROPASS](#). The Europass Qualifications Dataset Register (QDR) underpins and feeds the Accreditation Database against which European Digital Credentials are verified, therefore providing learners, employers, education and training providers and other authorised bodies with a simple and trustworthy way of verifying the validity and authenticity of digital credentials.

Insight: the Europass Digital Credentials

European Digital Credentials for Learning include diplomas, transcripts of records and a wide variety of other types of certificates of learning achievement. They have the same legal validity as paper-based credentials and are recognised throughout the European Education Area. They are multilingual and signed with a unique electronic seal. The built-in automatic verification, run through the EUROPASS portal, checks support recognition and helps reduce administrative burdens by immediately showing if a credential has been tampered with or whether it was issued by an unauthorised organisation.

European Digital Credentials for Learning offer many benefits for citizens, employers and organisations. **Citizens** can build an online portfolio to track all of their learning, while being in full control of their data, and can present and have their credentials verified at any point in their career. **Employers** can reduce the time and cost of verifying credentials and processing job applications, better understand the credentials of candidates, and trust tamper-proof credentials. **Education and training providers** can reduce their administrative burden and the costs for issuing credentials, while also accelerating issuing procedures by going digital. They can better understand the credentials of learners, especially from other Member States, as they will be translated into their own language.

The European Commission has recently launched its [Europass Digital Credential Issuer](#), a free-of-charge web-app that allows credential-awarding bodies to prepare and issue degrees, diplomas or other learning credentials to learners in the form of European Digital Credentials for Learning.

4. CRITICAL FACTORS FOR DIGITAL EDUCATION REFORMS

Whatever focus area(s) policy-makers select for a specific digital education initiative, it is important to understand that, with regard to digital education, the choices we make in designing an initiative can have a number of unexpected short-term and long-term impacts. Because of this, this framework has identified eight transversal **critical factors for digital education reforms** that need to be taken into account and examined when designing a digital education initiative, with some corresponding thought-provoking questions.

Critical factor	Key questions
Data for policy-making	<ul style="list-style-type: none"> • Is the initiative based on actual data about digital education developments? • Does the initiative produce data that can be used as evidence to monitor progress and further develop digital education at system level? How is this data collected and stored?
Digital inclusion	<ul style="list-style-type: none"> • Does the initiative take into account the needs of digitally excluded and vulnerable groups, including the gender gap? How does it do this? • Will the initiative produce new forms of inequalities yet to be measured? Which prevention measures are being put in place?
Stakeholders engagement	<ul style="list-style-type: none"> • Is the initiative based on active involvement of relevant stakeholders, including those specifically working in the digital sphere? • Does the initiative take advantage of digital ways to continuously engage the relevant stakeholders?
Financing	<ul style="list-style-type: none"> • Does the initiative budget all the (short-term and long-term) costs of digital education? • Does the initiative engage stakeholders, including private companies, in sharing the resources to support its activities? Under what conditions?
Quality assurance	<ul style="list-style-type: none"> • Does the country education quality assurance system cover digital education? If not, what is missing? • Does the initiative include continuous quality assurance mechanisms, relating to both the digital content and the technical solutions implemented?
Environmental sustainability	<ul style="list-style-type: none"> • Does the initiative contribute to improving the environmental sustainability of the education and training system? • Does the initiative take into account the impact of digital technologies on the environment? How?
Teachers and learners wellbeing	<ul style="list-style-type: none"> • Does the initiative take into account the impact of digital technology on the wellbeing of teachers and learners? How? • Are training and support services available for learners and educators to ensure stress-free and positive learning experiences?
Foresight capacity	<ul style="list-style-type: none"> • Is the initiative based on the analysis of expected developments in digital technology and digital pedagogy? • Does the initiative include a component aimed at monitoring the digital education developments in the area of action?

Table 2 – Critical factors for digital education reforms and related questions

By reflecting on these questions, policy-makers can determine the critical factors that need to be taken into account in any of the policy areas presented in Part 3. It goes without saying that these critical factors are – or should be – common to all education policies, but with regard to digital education they bring important new challenges into the discussion, which need to be known by policy-makers. Also, **these aspects are closely interrelated**. For example, collecting reliable and appropriate data on marginalised groups can foster the evidence-based analysis and design of inclusive policies. Similarly, engaging the right stakeholders can foster successful foresight exercises and is key for the provision and sustainable use of funding to support high-quality and inclusive policies etc.

4.1 Data for policy-making

Critical questions

- Is the initiative based on actual data about digital education developments?
- Does the initiative produce data that can be used as evidence to monitor progress and further develop digital education at system level? How is this data collected and stored?

In the last two decades, a number of studies have advocated the need for data to inform the decisions of policy-makers in the field of education (Slavin, 2020), while international organisations such as the European Commission or the OECD have increasingly been encouraging countries to utilise evidence in the policy decision-making process (Pellegrini and Vivonet, 2020). With regard to digital education, it is important to understand that, apart from the data collected through traditional approaches such as questionnaires, censuses and opinion polls, the existence of learning analytics and big data coming from educational settings can help policy-makers to improve education policies (Van der Vlies, 2020). A **combined qualitative and quantitative assessment of a country or region's digital education readiness** can allow gaps and areas for improvement to be identified and help policy-makers decide where to focus, given their context. Data-gathering mechanisms should be set up through national and international cooperation platforms that can ensure exchange and better use of data, and promote a data culture (Conrads et al., 2017). Digital technology allows the collection of data about learners and their behaviours and achievements, thus improving the opportunities for **evidence-based policy monitoring**: the proper use of big data, enhanced by artificial intelligence, can represent a large improvement in statistics in education within the cycle of educational policy-making, but must be accompanied by 'policies and systems to guarantee the secure, appropriate and ethical use of the data, which should include the safeguarding of privacy and confidentiality of students' personally identifiable information' (UNESCO, 2022a, p. 18).

Countries are tackling the use of data within digital education policies in different ways. **New South Wales** (Australia) has established the Centre for Education Statistics and Evaluation to provide data analysis, information and evaluation that improve effectiveness, efficiency and accountability, collect essential education data and provide a one-stop-shop for information needs, and build capacity across the education sector so that everyone can make better use of data (Centre for Education Statistics and Evaluation 2018). **Hungary** has put emphasis on the standardisation of administration systems at central and institutional level, by creating single users' identification for students and teachers based on a common directory service

(Government of Hungary, 2016). In **Denmark**, the 'User Portal Initiative' seeks to build an infrastructure to provide data and make them accessible, including a central data warehouse that gathers data on the entire education sector (European SchoolNet, 2017). In **Japan**, the digital education strategy considers that the use of educational big data can lead to reforms for teachers and management, in particular by results processing and attendance and time management (Ministry of Education, Culture, Sports, Science and Technology of Japan, 2019). Two reports can help to understand the importance of data for digital education policy-making. The 2019 '[Index of Readiness for Digital Lifelong Learning](#)' by CEPS attempts to create a data-based ranking of EU Member States in the area of digital education, and it is useful to understand what can be measured in the field. The 2019 OECD report '[Measuring the Digital Transformation, A Roadmap for the Future](#)' maps a set of indicators across a range of areas, against current digital policy issues, and sets out a forward-looking measurement roadmap.

4.2 Digital inclusion

Critical questions

- Does the initiative take into account the needs of digitally excluded and vulnerable groups, including the gender gap? How does it do this?
- Will the initiative produce new forms of inequalities yet to be measured? Which preventing measures are being put in place?

Research demonstrates that the introduction of digital education has the potential to improve social inclusion, but also that for this to happen initiatives must be designed starting from inclusion concerns (European Commission, 2018). On the other hand, as the COVID-19 experience has shown, if this inclusive approach is not present, the introduction of digital education can increase the gaps between students of different social backgrounds, and more in general between well performing students and students with learning difficulties. When discussing digital inequalities, **researchers refer to multiple levels of exclusion** (Ragnedda, 2020). The first level focuses on inequalities with regard to access to hardware, software and internet connectivity; the second level refers to disparities in usage and has implications for socially disadvantaged individuals and groups; and the third level refers to disparities arising from algorithmic decision-making and will likely grow in importance as learning analytics and LMSs become more sophisticated and facilitate personalised learning. To mitigate this third and less known dimension, it is important to support the critical thinking and practical skills necessary for understanding how algorithms and artificial intelligence tools work, and to ensure that these technologies are transparent and do not contribute to social inequalities, including gender disparity, in participating in digital society. The digital gender divide is particularly important: in the EU, for example, there are proportionally more men than women with basic digital skills, and the difference increases with age and skills' complexity (European Commission, 2018).

'Promoting digital inclusion – namely ensuring equity, inclusion, and gender equality in access to and use of digital devices and connectivity – is the prerequisite for any national ICT in education policy and masterplan' (UNESCO 20220, p. 28). Moreover, given the expanding role of the private sector in digital education, **equity-informed design is an issue that should cut across stakeholders**, including developers, vendors and platform operators, who may be

inclined to consider time, cost and quality dimensions without necessarily attending to equity. An example of a digitally inclusive initiative has been implemented in **Greece**, where all existing secondary education textbooks are available in Braille writing code, and several schoolbooks have been adapted into accessible digital formats for deaf learners and learners with autism and intellectual disabilities (Anagnostou 2015).

4.3 Stakeholders' engagement

Critical questions

- Is the initiative based on active involvement of relevant stakeholders, including those specifically working in the digital sphere?
- Does the initiative take advantage of digital ways to continuously engage the relevant stakeholders?

As suggested by the European Commission's Digital Education Action Plan, promoting high-quality and inclusive digital education must be a common endeavour across society and must involve governments at all levels through a whole-government approach, as well as education and training institutions, the private and public sector, in an **ecosystem approach** (European Commission, 2020). Stakeholder consultations should take place in the policy design phase and should be maintained through specific governance structures in charge of monitoring and adjusting the policy implementation process, as was done in the 'Opening Up **Slovenia**' initiative and the 'Digital Schools of Distinction' project in **Ireland** (Conrads et al., 2017). Importantly, **policy-makers must engage teachers**, by drawing on their feedback, practices and beliefs: this will foster ownership and ultimately determine teachers' and school principals' willingness to assume responsibilities, risks and personal sacrifice (Pierce, Kostova and Dirks, 2003). Involvement should clearly include the opportunity for teachers to influence and shape the policy, whether through its design or implementation (Schleicher, 2020).

During the COVID-19 pandemic, **new partnerships emerged** between telecommunications operators, technology providers, VET institutions and governments, with commercial bodies providing schools with free equipment as well as free access to platforms and apps (ILO et al., 2021, EIT Digital 2022). When designing post-pandemic reforms, policy-makers should take into account that, according to some observers, the pandemic has increased the influence of the private sector on the national education systems, boosting processes of privatisation and commercialisation as a response to the necessity to come up with solutions to school closures within a very short period of time (UNESCO 2022a). Finally, **stakeholders' engagement should be continuous** and support the whole policy cycle. A good example has been implemented in **Scotland** (United Kingdom), where the ecosystem around the national 'Curriculum for Excellence' (CfE) initiative includes numerous stakeholder groups, bodies and individuals, all very engaged by the curriculum policy's evolutions (OECD, 2021a). When preparing its digital education reform, **Iceland** established a cooperation committee from throughout the school system, and holds meetings with community leaders, head teachers and principals, all member organisations of the Icelandic Teachers' Union, local educational authorities and government institutions (Gouédard, Pont and Viennet, 2020).

4.4 Financing digital education

Critical questions

- Does the initiative budget all the (short-term and long-term) costs of digital education?
- Does the initiative engage stakeholders, including private companies, in sharing the resources to support its activities? Under what conditions?

The cost estimation of digital education initiatives reforms needs to consider initial investment and maintenance costs, including those relating to the social inclusion and equity dimensions. These policies should take into account – also in financial terms – that the **requirements of digital education systems evolve over time**: governments, supported by evidence gathered as suggested in Part 4.1, need to decide when new digital tools should be introduced in education, taking into consideration the costs of the whole system (Van der Vlies, 2020) and considering that that costs for producing and delivering quality digital courses is not by definition lower than those required for face to face courses (European Commission, 2022). For example, when introducing 3D printers in schools, policy-makers should closely follow up the double trend of increasing importance and decreasing cost to decide whether and when these tools will need to become a standard element within schools. Also, cost-benefit analysis should recognise that in many cases the benefits of digital technologies go beyond the pedagogical dimension and include for example the fact that data patterns allow for better policy design and interventions that are more likely to improve equity or effectiveness (OECD, 2021b).

Different options to fund digital education initiatives exist, including government purchase, often including warranty-of-service agreement from the manufacturers or retailers for repair and/or replacement, leasing/subscription and cooperative purchase (Broadband Commission 2022). In this respect, **cooperation with business stakeholders** is crucial (OECD, 2017b): if a government does not have sufficient funds, it can be a guarantor of loans and public-private partnerships to support investment in school equipment and infrastructure, considering the potential cost-saving factor of digital education policy in the long run (OECD, 2016). In Ireland for example, at a time of funding cuts, the government has partnered with large commercial bodies to continue the existing initiatives, showing how a stable steering committee can support policy sustainability (Conrads et al., 2017). Also, it is important that the budget include at least the following **cost categories**: initial costs (hardware, software, training, setup services), ongoing costs (electricity, connectivity, insurance, hardware maintenance and renovation, etc.), staff costs (management and support staff, continuing professional development of school staff), and contracted costs, which include all the services that will be provided by third parties, such as maintenance, monitoring and evaluation.

Finally, policy-makers in low- and middle-income countries should bear in mind that **International Financing Institutions**, such as the European Bank for Reconstruction and Development or the World Bank, can play an important role in financing digital education reforms, especially the initial costs, through loans, credits and grants, both to governments and to the private sector.

4.5 Quality assurance

Critical questions

- Does the country education quality assurance system cover digital education? If not, what is missing?
- Does the initiative include continuous quality assurance mechanisms, relating to both the digital content and the technical solutions implemented?

The impact of digital education initiatives should be evaluated in the context of quality monitoring, quality assurance and quality improvement of education provision, both by the work of external bodies and through internal self-evaluation practices. Quality Assurance (QA) bodies must have the **capacity to understand and unpack the implications of digital education**, expanding their tools and frameworks to include digital systems. A possible strategy is to establish a progression scale with incremental stages in which different quality assurance standards become elements to be respected for the introduction of digital teaching and learning approaches. The importance of policy-relevant assessment of digital education programmes, aiming to ensure the integration of digital technologies leading to organisational and practice change, must be based on insights from effective innovations that need to be recorded and institutionalised: having adequate structures and systems in place to capture the relevant data is therefore crucial (European Commission, 2017). **The quality assurance of digital content** for learning is key, given the rapid influx of new content being created or adapted for digital learning environments by educators, publishers and learners. Public authorities often find themselves in the position of being curators or ‘censors’ of digital content: the exponential growth in digital content, often produced by teachers and learners, is making this challenging, with teachers and families expected to make informed judgments about quality. Online professional networks and parent associations can play a role in this regard.

The quality assurance of technical solutions deals with careful assessment of whether the digital tools chosen or developed are fit-for-purpose and actually benefit learners, as well as with issues such as cost, technical support and security. While public-private-academic partnerships are key to ensuring that the latest technologies are considered, not every technological solution can be adapted or tailored to meet educational needs: this is why it is important to involve practitioners and learners in the development and piloting of digital education tools. In the field of digital education, quality assurance should be as less normative as possible, and incorporate the need for innovation and uphold standards based on best practices. Frameworks and mechanisms should be adopted that ensure students obtain the knowledge and skills they will need in a digital age (Perris and Mohee, 2020).

4.6 Environmental sustainability

Critical questions

- Does the initiative contribute to improving the environmental sustainability of the education and training system?
- Does the initiative take into account the impact of digital technologies on the environment? How?

Digital education, as a key component of the general socioeconomic digital transition, is often related to the green transition, having the potential to contribute to fighting climate change and achieving a greener society. The green and digital transitions, that are appearing at the top of policy agendas across and around the EU, as well as globally, address very distinctive and specific priorities and at the same time are very closely connected and interdependent. The cumulative effect of implementation of digital and sustainability policy measures in a coordinated, cross-reinforcing manner deserves closer examination. If properly deployed, new, emerging digital technologies could enable the decarbonisation of the most polluting sectors, improve energy efficiency and foster the circular economy – provided that the policy demand is strongly articulated and the workforce has the necessary skills and competences.

On the other hand, the environmental impacts of digitalisation are becoming a growing policy concern: the wider use of digital technologies may increase the carbon footprint, overall energy consumption and electronic waste. This should be considered when designing a policy in the field of digital education – policy-makers must ‘balance the educational benefits with the environmental costs, taking care to minimise negative impacts’ (UNESCO, 2022a, p. 34). In particular, policy-makers should always prioritise ‘green’ technologies and make sustainable choices, giving preference to those digital solutions that: do not consume precious environmental resources such as rare earth metals; need as little power and water as possible to be developed and used; and bring a neutral carbon footprint, and can be recycled at a reasonable price. (UNESCO, 2022a).

4.7 Teachers and learners’ wellbeing

Critical questions

- Does the initiative take into account the impact of digital technology on the wellbeing of teachers and learners? How?
- Are training and support services available for learners and educators to ensure stress-free and positive learning experiences?

Despite the growing policy efforts to improve digital skills and modernise education through digital technologies, often the impact of such developments on teachers’ and learners’ (mental) wellbeing is neglected. On the other hand, the COVID-19 pandemic has highlighted how the increased isolation and transition to online work and education have contributed to mental health issues. Longitudinal studies indicate significant increases in anxiety (18%-25%) and depression (22%-32%) when comparing the pre-pandemic and mid-pandemic survey data (McLafferty et al. 2021), with young people and women affected the most. The negative impacts of digitalisation, and in particular the use of social media for education, may include cyberbullying, extensive harmful use of the internet and safety issues: nearly half of young people (47%) have received intimidating or threatening messages online resulting in depression and anxiety (Winter School Class of Future Female Leaders, 2022).

In the post-COVID era, bearing in mind hybrid teaching and learning environments, the challenge is to design digital education policies that equip citizens, and especially vulnerable

groups, with the knowledge and tools to use technology in a manner that positively impacts their wellbeing, paying special attention to adolescents and younger age groups (Winter School Class of Future Female Leaders, 2022). For this to happen, policy-makers must first support evidence-based research to understand the effects of digital technologies on mental health and wellbeing, and also think very carefully before engaging young people extensively with digital technologies over long periods. Teachers' professional development should ensure that digital technologies are used judiciously, appropriately and in a way to mitigate the potential negative impact on students' wellbeing (UNESCO, 2022a).

4.8 Foresight capacity

Critical questions

- Is the initiative based on the analysis of expected developments in digital technology and digital pedagogy?
- Does the initiative include a component aimed at monitoring the digital education developments in the area of action?

While much can be learned from the past, digital education policies also need to be open to doing things differently, since digital education is a rapidly developing area in terms of emerging technologies (such as simulations or 'metaverse' technologies) and innovative teaching and learning approaches, such as connectivism, competence-based learning and formative assessment. To do so, policy-makers in charge of digital education must leave space for emerging solutions and ideas (European Commission, 2020), together with a system for analysis of stakeholders' readiness for digital education, which should continuously inform the adaptation of policies in the field. The messages delivered by the European Commission in its report 'Digital education policies in Europe and beyond' is clear: 'policy-makers should follow a holistic approach, targeting systemic change, establish both a long-term vision and short-term achievable goals, deploy technology as a means, not an end, and embrace experimentation, risk-taking and failure' (European Commission, 2017).

Making a selection from among the many emerging digital solutions, including the applications frequently launched by the commercial sector, is a complex challenge that needs to be tackled with a *future-proof learning* perspective. As suggested by UNESCO (2022a), a mechanism for examining and validating commercial digital solutions against humanistic principles and educational needs should be adopted. This would allow policy-makers to assess the business models behind digital tools and understand what is necessary for enabling schools to take advantage of their introduction. Finally, this mechanism should allow a review of the risks around security, data privacy and wellbeing. Foresight can address the opportunities and challenges of complex policy problems, and it is a type of prospective analysis that facilitates debate and systemic thinking about multiple opportunities (OECD, 2019a). The 2021 study '[Guidelines for foresight-based policy analysis](#)' by the European Parliament aims to integrate a systemic-thinking capacity, as well as a foresight capacity, into policy-making.

5. FINAL CONSIDERATIONS

Education and training ecosystems are composed of many connected elements that make them, on the one hand, solid and resilient in the long run, and on the other resistant to change, since a change in one component has implications for all the rest. **In order to achieve sustainable change, policy-makers need to address these inter-connected elements in their complexity.** Many policies that were analysed at the time of writing this report tackle different, closely interdependent elements of digital education. However, since everything cannot be changed at once, it is important to set priorities and a sequence of actions, as well as assess the possible implications of changing certain system elements on the system as a whole. To give an example, a government's investment in producing quality digital educational resources will make an impact only if educators have the capacity to use these resources in an innovative and meaningful way and if the curriculum provides sufficient flexibility. Ignoring these interdependencies will lead to the risk of low or no impact on the key target groups, and may cause frustration of educators and learners.

While promoting effective digital education reforms, it is easy to over-sell their potential benefits. In this document, we aimed at remaining pragmatic and emphasise the importance of tailoring any reform actions to the specific country policy context. Thus, this paper concludes with a set of considerations that policy-makers and policy shapers should take into account when preparing and designing policy actions in digital education. These considerations derive from our analysis, and especially from the reviewed, most recent international policy literature.

The policy scope for digital education reforms should be linked to the country's general education policy reforms, applying a "whole government" approach. In other words, digital education policies prove to be more sustainable when embedded in an overarching national educational strategy, and if a governance structure is responsive to implementing necessary changes while at the same time ensuring policy continuity over time (Conrads et al., 2017).

The policy vision should be fully aligned with the respective policy implementation measures. Kozma (2008) identifies a variety of strategic goals that can drive digital education policies, including the support for economic growth and competition, the promotion of social development, the advancement of education reform, and the support for more efficient education management, noting that the effectiveness of policies is likely to depend on the alignment between their strategic goals and their operational components (UNESCO, 2022a).

Policy design has a key importance for effective policy implementation in practice. Key elements of policy design are: policy goals that address specific challenges; a policy scope that is clearly defined; a time horizon for the policy measures and expected results that are realistic; and policy implementation constraints that are clearly identified and addressed. It is also important to put the goals in the order of priority as this impacts the operational stage of the policy. Since education policy is usually directed towards specific target beneficiaries, it is important to clearly define the target groups of each policy component (Honig, 2006).

Open education approaches can expand and facilitate learners' access to lifelong learning opportunities. An open approach to education and training means moving from purely school-based settings to interconnected learning spaces involving both formal and informal learning, towards a 'society-wide learning grid' (UNESCO 2022a, p. 57). Digital education policies should embrace this approach, transforming existing schooling models and fostering ubiquitous access to education from schools, homes or other spaces, giving priority to the use of Open Educational Resources and open teaching practices (UNESCO 2022a).

Digital education policies should be designed to stimulate teacher demand, rather than resistance. Policies that impose tightly controlled change from the top down often induce resistance on the part of teachers and result in failure (Tyack and Cuban, 1995). This observation is particularly relevant to digital education, where the introduction of equipment into schools has often not resulted in their use by teachers. Digital education initiatives should build on existing teachers' knowledge and skills and should engage teachers in defining problems and devising solutions adapted to their own circumstances and local knowledge, thus increasing their ownership for the results of the change.

Digital education policy should rely on and contribute to research on innovative teaching and learning. Scholarly research on digital education should inform relevant policy initiatives, and at the same time, policy makers must properly fund and promote research as a critically important factor of successful reforms. Traditional topics such as digital teaching methods should be coupled with emerging ones such as the impact of artificial intelligence and immersive learning technologies in education, as well as the new trends in the development of personalised learning content or protection measures against algorithmic discrimination. To ensure that digital education builds on scientific evidence, results from publicly funded research should be made publicly available, fostering knowledge transfer between researchers, teachers, policy-makers, employers and entrepreneurs.

Overall policy monitoring and evaluation approaches must be adapted to the specifics of digital education. Monitoring and evaluation must be evidence-based and adapted to the specifics of digital education: for example, longitudinal studies should look at the policy impact of digital education over a period of years, given that uptake of digital technologies in schools is a long process. International standards, guidelines and procedures are a solid basis to compare the evolution of the implementation of initiatives, to demonstrate national trends or implement policy benchmarking, as well as to facilitate know-how exchange and learning from peers. A mix of quantitative and qualitative monitoring methods can help in drawing a reliable picture and specifically assessing the impact of digital technologies on learners, teachers and the education system as a whole in the context of other educational reform interventions.

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ANNEX 1. EXAMPLES OF DIGITAL EDUCATION INITIATIVES

Policy area	Policy pointer	Countries examples
1. Digital infrastructure	Include education and training within systemic infrastructure policies	National Broadband Network (Australia) National Digital Strategy (UK)
	Increase access to appropriate digital devices in schools and among learners	Digital Education Strategy (US) Digital Education Strategy (Hungary)
	Guarantee high-speed connectivity for schools	Zero-rating initiative (South Africa) Digital Education Strategy (US) Public-private initiative for schools connectivity (Ecuador) Digital Learning Integration (California)
2. Digital competences of educators	Define teachers' digital skills and competences.	ICT training framework for teachers (Spain) Common framework for teaching (Hong Kong) Digital Competence Framework for Teachers (Norway)
	Foster teachers' professional development in digital education.	The Good School reform (Italy) Digital Education Strategy (Québec, Canada) Strengthening Digital VET (Armenia)
	Improve teachers' training through innovative practices	Online courses for teachers and leaders (UK) Portal for digital development of teachers (Belgium) Virtual EdCamps (Ukraine)
3. Digital capacity of schools	Build digital leadership among school leaders	Looking at Our Schools 2016 (Ireland)
	Establish mechanism/profiles to support the use of ICT	Fatih Project (Turkey)
	Boost the data management capacity of schools	Roadmap on the Utilization of Data in Education (Japan) Digital records for education (Georgia)
4. Digital pedagogies and curriculum	Foster the use of innovative digital pedagogies	National portal for digital development of teachers (Belgium) Amara Berri Basque School case study (Spain) Avanguardia Educative (Italy)
	Innovate curricula for digital education	Studio Schools (England) National Project for Autonomy and Curriculum Flexibility (Portugal)
	Set up a monitoring system for digital pedagogies	Innova Schools project (Peru)
5. Digital educational resources	Produce high-quality digital education resources	Digital Education Strategy (Hungary) Digital Education Policy (Israel) Dikhsa platform (India)
	Build the capacity of teachers and learners to create and use digital resources.	Digital Skills Action Plan (Greece) Strategy for Digital Schools (Italy)
	Foster the creation and use of Open Educational Resources	Openly licensed educational resources (US) OER requiremenet for ESF (Poland) OER Strategy (Germany) Maroc Université Numerique (Morocco) IsraelX (Israel)

Policy area	Policy pointer	Countries examples
6. Digital learning environments	Develop and connect online learning environments within schools and training centres	Enlaces project (Chile) User Portal Initiative (Denmark) National Education Management System (Turkey)
	Develop national and local digital education platforms	Digital4Education Portal (Luxembourg) national digital platform on distance learning (Croatia) Masadrati platform (Saudi Arabia)
7. Digital assessment	Foster the use of digital technologies for innovative assessment	Digital Education Policy (Israel) Digital Strategy (Ireland) Digital national tests (Sweden) Technology-based assessments (US) Edo-Best platform (Nigeria)
	Review assessment criteria and approaches	Evaluation of 2015 digital assessment policy (France) Digital Assessment in Norway (Norway)
8. Digital competences of learners	Include digital subjects in schools and integrate digital competences across curricula.	National Core Curriculum (Finland) ProgeTiger programme (Estonia)
	Promote informal learning opportunities for digital skills	Pix platform (France) Informal school of IT (Romania and Moldova)
	Promote critical digital literacy among learners	Teachers Standards (UK) Premio Nazionale Competenze Digitali (Italy) EU Safer Internet Day (European Union)
8. Digital credentials	Support and promote national digital credentials platforms	National Microcredentials Framework (Australia) MyCreds (Canada)
	Promote the uptake of digital microcredentials	European Digital Credentials for Learning (European Union) Competitive Skills Initiative (Finland)