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Guidelines for ICT in education policies and masterplans

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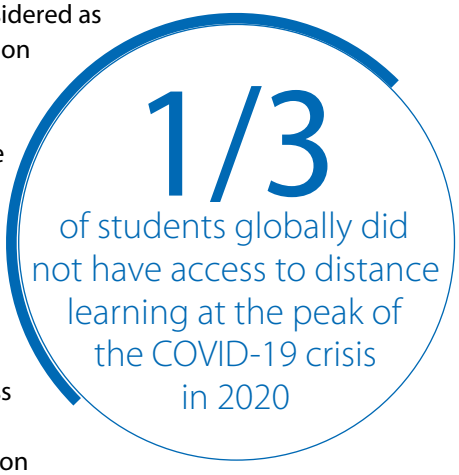
SHORT SUMMARY

Technological innovation as a common good in education

Countries across the world have been leveraging information and communication technologies (ICTs) to advance education for decades. These initiatives are driven by public institutions and involve commercial technology companies, and have resulted in paradoxes such as increasing digital inequalities and uneven access to high-quality digital learning opportunities. The COVID-19 crisis further exacerbated this trend: At least one third of students globally did not have access to distance learning during the peak of the COVID-19 crisis in 2020.

The publication aims to guide policy-makers to ensure that when adopting technology, human rights should be defended; inclusion, equity and gender equality should be at the heart of solutions; and innovations should be considered as a common good. Based on these principles, the publication presents a human-centred view on the potentials of technologies ranging from low-bandwidth technologies to emerging technologies including Artificial Intelligence and Web 3.0 or "metaverse". It advocates for national policies to protect the digital well-being of teachers and students, to reduce and neutralize the digital emission footprint, and to avoid 'techno-solutionism'.



This publication proposes policy planning frameworks and an iterative roadmap to examine the digital readiness of local education systems, assess needs of learners and teachers, and plan well-resourced national ICT in education programmes. This is followed by a deep dive into examples of national masterplans on the use of ICT in different types of education.

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"Since wars begin in the minds of men and women it is in the minds of men and women that the defences of peace must be constructed"

Guidelines for ICT in education policies and masterplans

Foreword

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Over the last 50 years, Information and Communication Technologies (ICT) have evolved from single programs locked in university laboratories to networks of tools and programs that connect across the world, and help to address many of today's challenges. As the COVID-19 pandemic made clear, ICT has become a social necessity to ensure education as a basic human right, especially in a world experiencing more frequent crises and conflicts. ICT should be leveraged as a common good to support the achievement of Sustainable Development Goal 4 – Education 2030 (SDG 4) and to build shared futures of education beyond this.

Since SDG 4 was adopted, with its vision to "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", education systems have been under mounting pressure to achieve its targets. These pressures were brought into sharp focus in 2020 with the spread of the COVID-19 pandemic. Almost all countries were forced to quickly mobilize technological solutions to support distance learning in order to ensure the continuity of education. Countries without well-planned and well-resourced ICT in education strategies prior to the pandemic were among those that had low levels of teachers' digital competences, digital content and national platforms – which left as many as one third of students around the world without access to learning during the school closures for more than a year. The education disruption caused by the pandemic clearly revealed the urgent need for policy-makers to take a critical view at how technologies and human resources can be allied to transform schooling models and to build inclusive, open and resilient learning systems.

UNESCO has stood by its role as a convener and developer of international standard instruments in the field of ICT in education. The *Qingdao Declaration*, adopted in 2015, called for a commitment to ensure that all girls and boys have access to connected digital devices and a relevant and responsive digital learning environment by 2030 – irrespective of their gender, disability, social or economic status, or geographic location. This humanistic vision was reaffirmed in the *Beijing Consensus on Artificial Intelligence in Education*, and *Artificial Intelligence and Education: Guidance for Policy-makers*. It is the fundamental guiding principle that the use of any form of technology in education must protect human rights and human dignity, promote inclusion and equity as well as gender equality, and support the sustainable development of societies.

UNESCO has also been collaborating with governmental agencies in more than 60 Member States to support the development and implementation of national ICT in education policies. This publication draws on those Member States' rich practical experience, and is intended to guide policy-makers on how best to integrate humanistic principles in national policy documents with legally binding effects. It is also designed to help policy-makers develop a holistic and needs-driven understanding of ICT in education, and provides a guiding framework to steer the use of ICT towards addressing the key challenges of achieving SDG 4.

More specifically, this publication introduces a roadmap to guide the development of ICT in education masterplans from conception to implementation. The guidelines are supported by examples of how national ICT in education policies should address key issues relating to curricula, assessment, digital learning resources, and the development of Educational Management Information Systems (EMIS).

The present publication complements two earlier ones: *Guidelines on the Development of Open Educational Resources Policies* and *AI and Education: Guidance for Policy-makers*. All three documents should be adopted as an integrated portfolio. It is my hope that the experiences shared and the ICT and education policy approach proposed will help UNESCO Member States steer the digital transformation of their education and training systems towards the enhancement of human competencies for all citizens and towards increasingly sustainable societies.

Stefania Giannini,
UNESCO Assistant Director-General for Education

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1. Introduction

1.1 Defining ICT in education as a concept and foundation for policies

1.1.1 Information and communication technology

In this publication, the term 'information and communication technology' (ICT) is used to cover any product or service that is designed to store, retrieve, manipulate, transmit, or receive information electronically in a digital form (e.g. personal computers, cloud service providers, social media, TV and radio). The singular 'ICT' is used throughout this publication when it refers to the abstract term or a single technology. 'ICTs' is only used in a few cases when several technologies need to be clearly designated.

In this publication, 'ICT in education' refers to the intersection of ICT and education that pertains to multiple perspectives including: the use of ICT as a **provision medium** by providers of educational programmes, to enable or expand access to learning opportunities; the use of ICT as **pedagogical tools** by teachers and learners to improve the relevance and quality of teaching and learning processes; and the development of **ICT competences** or digital skills needed for living, learning, and working in our increasingly technology-rich world.

While focusing on ICT in education in this publication, we begin by reaffirming that **teaching and learning should not be driven by technology**. Instead, technology should be used to facilitate education, enabling access to information and developing appropriate connections between humans, to allow teaching and learning processes to be organized most effectively. For this to happen, users of ICT in education, regardless of age or background, should be supported to gain the appropriate values, understanding, and skills that are needed to make ethical, equitable, inclusive, and effective use of ICT to support teaching and learning.

1.1.2 Defining 'ICT in education policy' and 'masterplan'

The term 'ICT in education policy' is used in this publication in a broad sense. We are referring to the multiple forms of public policies for leveraging approaches that blend human resources, hardware, software, and digital content and applications to expand access to education opportunities and enhance the relevance and quality of learning, while promoting digital skills. In fact, here we focus on public ICT in education policies that are developed by governmental or public agencies and endorsed as public instruments with a certain level of legally binding effects. These endorsements can be e.g. presidential executive orders, parliamentary rules, ministerial statutory documents, or institutional statements. The aim of the public ICT in education policies proposed in this publication is to promote the adoption or implementation of global governance effects under local contexts, to counterbalance the private governance imposed by digital platforms or applications, and to regulate stakeholder practices to protect

the human rights, data privacy, and digital security of all users of ICT in education. Further, the purpose is to leverage technological innovation to support the achievement of sectoral, intersectoral, or subsectoral strategic objectives of education systems within the framework of SDG 4 – Education 2030. This also includes the future of education beyond 2030, under both normal and crisis situations. Accordingly, this publication brings together ICT in education policies and masterplans to create an integrated portfolio of policy planning and management (in particular, see **Chapter 4**).

While around the world, researchers and policy-makers are increasingly using emerging terms such as 'digital learning',[1] 'hybrid learning',[2] and 'blended learning',[3] the term 'ICT in education' is still widely used. See, for example, the 'ICT in education policies and masterplans' of Cambodia (Ministry of Education, Youth and Sport, Cambodia, 2009), China,[4] Mozambique,[5] the Republic of Korea (UNESCO, 2019*c*), Rwanda (UNESCO, 2019*d*), and Singapore.[6] To reflect the broad scope, interdisciplinary domains, and the sector-wide or intersectoral nature of the policies needed to harness technologies in education, throughout this publication we use 'ICT in education' as a standard term (and follow the convention of leaving it unhyphenated, even where it is adjectival).

1.1.3 Alternative titles and different focuses of ICT in education policies

As illustrated in **Table 1**, there are at least two dimensions involved in defining the key focus areas or building blocks of an ICT in education policy and masterplan: varied types and levels, and key themes of education. The title 'ICT in education policy and masterplan' often presents a sector-wide scope, meaning that it covers all levels and types of education and all key themes relating to the use of ICT in education.

However, when policies only focus on particular levels and/or types of education, depending on what is included and what is left out, the policies often take alternative or customized titles. These refer to digital learning, e-learning, or e-schools (e.g. the policy of Croatia is focused on 'Digitally Mature Schools'); and digital empowerment or transformation of education (e.g. the title of Bahrain's 2014 policy is 'Digital Empowerment in Education') (UNESCO, 2016*e*). Sometimes a policy covers more than one area, depending on the duties or remits of the governmental agencies, such as Ethiopia's 2020 'National ICT Policy for Higher Education and TVET'.[7] Other examples include 'Policy on ICT in Technical and Vocational Education and Training (TVET)' and 'Policy on ICT for Non-Formal Learning'. Similarly, when the policy is centred on certain thematic areas, thematic titles are sometimes chosen such as 'Policy on Open Educational Resources' in Bahrain and Oman (Miao et al., 2016), 'Policy on Blended Learning or Hybrid Learning', 'Policy on Distance Learning', 'Policy on AI and Education', and 'Policy on Digital Skills Development'.

In practice, policy-makers usually identify focus areas of the masterplans according to the needs assessment and local readiness, and mix the two dimensions. Examples on how to develop masterplans based on focus areas are further demonstrated in **Chapter 5**. **Table 1** can also be used as a matrix to help make decisions on how different thematic ICT in education policies could be positioned and aligned in the overall policy landscape, and what types and levels of education the policies should target or might have missed.

Table 1: ICT in education policies, alternative titles, and different focuses

Key themes to be reviewed	Stand-alone policies or to integrated into sector-wide policies	Common concerns across all policies	ICT in Education Policy (covering the following sector-wide types of education)				Policy on digital transformation of education (forward-looking sector-wide policies)
			Sub-sectoral ICT in education policies focusing on				
			School Education	TVET	Higher Education	Non-formal Education	
Thematic ICT in education policies	Curriculum and assessment	ICT competences for teachers	**Alternative titles:** Policy on e-schools, policy on digital schools, policy on digital or hybrid learning	**Alternative titles:** Policy on digital or hybrid learning for TVET	**Alternative titles:** Policy on digital learning for HE, policy on distance or blended learning	**Alternative titles:** Policy on ICT for adults' literacy education, Policy on ICT for community learning centres	**Alternative titles:** Policy on digitalization of education, policy on digital and AI transformation in education, policy on digital open education
	Digital resources and Open Educational Resources (OER)		**Alternative titles:** Policy on digital resources for schools, policy on digital schools, policy on OER	**Alternative titles:** Policy on digital learning resources for TVET, policy on OER for TVET	**Alternative titles:** Policy on OER for HE, policy on OER-based universities	**Alternative titles:** Policy on Digital resources for non-formal learning centres	
	Digital competences development		**Alternative titles:** Policy on developing school students' digital skills, Policy on developing school teachers' digital skills	**Alternative titles:** Policy on developing TVET students' digital skills, Policy on developing TVET teachers' digital skills	**Alternative titles:** Policy on developing ICT talents through HE, Policy on fostering local R&D through HE institutions	**Alternative titles:** Policy on technology for re-skilling and up-skilling of adults and lifelong learners	
Thematic ICT in education policies	Education Management Information Systems	ICT competences for teachers	**Alternative titles:** Policy on EMIS for school education, policy on integrating EMIS and learning management systems	**Alternative titles:** Policy on EMIS for TVET, policy on using data to monitor needs for skills	**Alternative titles:** Policy on EMIS for HE, policy on integrating EMIS throughout basic education and HE	**Alternative titles:** Policy on building EMIS to track lifelong learning pathways and accreditation	**Alternative titles:** Policy on digitalization of education, policy on digital and AI transformation in education, policy on digital open education
	AI and education		**Alternative titles:** Policy on AI in school education	**Alternative titles:** Policy on AI in TVET	**Alternative titles:** Policy on AI in HE; policy on R&D on AI	**Alternative titles:** Policy on using AI as lifelong learning companions	

1.1.4 The role of public policies in steering the humanistic use of ICT in education

The national or state policy represents a lever of public governance within the global architecture for the use of technology across sectors including education, which is comprised of intergovernmental, state, civil society, and private governance, e.g. providers of digital platforms and applications (see more details in Section 3.2: The global governance architecture and its implication for ICT in education policies). Public policy should be fully exploited to ensure the adoption of a humanistic approach promoted by internationally recognized instruments 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.

The potential of ICT to support the achievement of SDG 4 can only be obtained through needs-driven, results-based, and well-resourced policies and concerted actions across the entire society, which stretches across the sectors of education, ICT, funding, and other stakeholders of learning communities (see **Box 1**) (UNESCO, 2015*a*; UNESCO, 2015*c*).

Box 1: Qingdao Declaration

We commit to developing well-informed long-term policies and strategies to unleash the potential of ICT to achieve greater quality in education and transform learning. We recognize that there is a need to redefine learning outcomes and the way in which we organize and assess learning if we want our education systems to prepare lifelong learners — both children and adults — to thrive in networked knowledge societies and succeed in economies that are increasingly reliant on technology.

Source: Qingdao Declaration, UNESCO, 2015*a*, Article 9

1.2 The potential of ICT for achieving SDG 4

Achieving SDG 4 by 2030 is an ambitious goal for all countries of the world. SDG 4 on education aims to 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'. Member States committed to this vision in the *Incheon Declaration*. SDG 4 promotes equitable access to education opportunities and broad inclusion. It prioritizes the importance of equity, especially between the genders, in the right to education; it affirms that increasing access must be accompanied by measures to improve the quality and relevance of learning; and it advances quality lifelong learning opportunities.

This vision, together with its profound and multifaceted targets, presents a grand challenge for all countries – particularly those that are furthest behind the 'Education for All' goals agreed in 2015. Nonetheless, it is clear that to achieve the aspirations of SDG 4 requires not only increased public spending on education but also innovative modalities to expand access to it, enhance its relevance and quality, and enable lifelong learning. This is why, among other aspects of innovation needed for achieving SDG 4, it is widely believed that ICT has an important role to play in supporting transformative reform in education (see **Box 2**) (UNESCO, 2015*b*).

Box 2: Incheon Declaration

We commit to promoting quality lifelong learning opportunities for all, in all settings and at all levels of education. This includes equitable and increased access to quality technical and vocational education and training and higher education and research, with due attention to quality assurance… Information and communication technologies (ICTs) must be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more effective provision.

Source: Incheon Declaration, UNESCO, 2015*b*, Article 10

The *Qingdao Declaration* (UNESCO, 2015*a*) outlines the potential of ICT to accelerate the achievement of SDG 4 and transform the way it can be achieved, which can be summarized as the following aspects.

1.2.1 Expanding access to educational opportunities and advancing inclusion

Access to learning opportunities for all remains a significant challenge. ICT can provide new, more flexible ways to access quality teaching, learning content and other educational resources. It can enable teaching and learning that is less dependent on the co-location and synchronicity of teachers and learners. This is particularly important for students in marginalized, deprived and less advantaged populations. So long as there is a minimum level of data infrastructure and digital devices, it is also possible to use ICT-based approaches to continue schooling and technical training in areas hit by conflicts or natural and global health emergencies that render normal educational operations near impossible. If data infrastructure or digital devices are not available, teaching and learning can be provided through radio, TV and even by community speakers.

1.2.2 Enhancing the relevance and quality of learning

High-quality learning environments are key to positive learning outcomes, which set a foundation for a better life for all members of society. ICT holds the potential to enhance the quality of learning in many ways. It can be used to support the acquisition of digital literacy competences, which are foundational to success in today's society. It can encourage active and problem-based learning, moving away from learning mere content (e.g. from a textbook). It can also extend the learning setting beyond school walls, encourage interaction with local communities, and foster collaboration with learners across the globe. For this to happen, ICT must be harnessed to help teachers learn the necessary skills and competences to adapt to a more learner-centred education system during their career. Social networks can also be used to facilitate peer learning between teachers facing common challenges. Open educational resources, open data and also open-source programming play a key role here, as they can allow teachers and learners to co-create and adapt digital tools, resources, and data sets developed by others. This opening up of learning will require a review and adjustment of quality-assurance mechanisms, to ensure that learners are receiving high-quality learning opportunities that will be recognized in the labour market and elsewhere.

1.2.3 Building ICT-enhanced lifelong learning pathways

Lifelong learning is a fundamental human right: Everyone should be able to learn what they need and want, at any time beyond the formal education system, including those who left school early and want to return, and those who need to upskill or reskill because of changes in the labour market or their own personal objectives. ICT has the potential to be used to offer more flexible learning platforms, which provide more personal learning pathways that integrate formal and non-formal learning. It can also facilitate a learning community, to enhance learners' experiences. Such approaches also require a reform of assessment and accreditation, so that learners have documentation of their successes that is useful to them throughout their lives.

1.2.4 Strengthening education and learning management systems and monitoring learning processes

ICT can provide data about learners and their behaviours and achievements. This can improve the opportunities for evidence-based policy and practice. What is known as 'big data' can be collected and used to generate feedback on what is working and what is not. It can be a huge improvement on administrative statistics in education, which is often focused on only large 'administrative events' such as the number of enrolments or education certificates awarded per annum. Naturally, in this context, governments must develop 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.

ICT tools known as education management information systems (EMIS) can provide such data quickly and within the cycle of educational policy-making. While it is important to recognize that EMIS data only offers a window into a limited range of educational activities, and so must not be assumed to give a full picture, EMIS enhanced with artificial-intelligence capabilities for the analysis of big data can provide timely, systematic, quality evidence for the monitoring and evaluation of certain aspects of learning. The *Beijing Consensus on Artificial Intelligence and Education* (UNESCO, 2019*a*) sees AI not only as a possible accelerator of change, but also as an enabler of intersectoral, whole-government approaches, as AI specifically focuses on effective and responsive data usage. However, this will only be possible with a considerate approach to AI in education, which attends to the opportunities and risks of using data algorithms and machine learning.

1.3 The COVID-19 pandemic and ICT in education: Policy planning is a long-term process

Over the past few decades, education in its various forms across the world has been under mounting pressure to adapt to rapid changes in the social, economic and technological landscape. Since the SDGs for 2030 were adopted in 2015, the accelerated climate change and natural disasters, more frequent health epidemics, and growing political extremism has further aggravated the persistent inequalities and threatened social cohesion. These pressures were brought to a sharp peak after February 2020 with the onset and spread of COVID-19. This pandemic created the most severe disruption to global education systems in history. UNESCO data shows that by the end of 2020, nearly 1.6 billion learners in more than 190 countries, 94 per cent of the world's student population, were affected by the closure of educational institutions at the peak of the crisis. UN Secretary-General António Guterres warned about a 'generational catastrophe' in August 2020 based on the unprecedented education crisis looming over millions of learners across the planet.[8]

Almost all countries combined online courses and TV or radio programmes to support the continuity of learning during school closures. However, the coverage and effects of distance-learning programmes provided a scorecard for national ICT in education policies and their implementation (UNESCO, UNICEF and the World Bank, 2020). Countries without well-planned and well-resourced ICT in education strategies prior to the pandemic are among those with lower readiness in terms of teachers' digital competences, digital learning resources, and national platforms – leaving one third of students globally without access to distance learning during the better part of a year of school closures. The long-term socio-economic implications precipitated by the pandemic are even worse: it is estimated that the number of children out of school is likely to increase by at least 24 million (UNESCO, 2020*b*). Education systems in every country should ensure that they are prepared for an increasingly crisis-prone and pandemic-prone world to unfold over the coming years. It is imperative for policy-makers to shift mindsets on schooling models and to plan visionary policies and strategies that ally technology with human resources to build more inclusive, open and resilient learning systems.

While policy-making is all too often reactive, responding to rather than preparing for unexpected events such as the COVID-19 crisis, educational challenges are usually perpetual and extend beyond the short term. They therefore require long-term policy loops – including planning and implementation, feedback, and updating. In this light, many public administrations plan policy over medium- to long-term horizons. For example, both the Republic of Korea (UNESCO, 2019*c*) and Singapore[6] have been continuously developing and updating five-year ICT in education policies and masterplans for more than 20 years.

1.4 UNESCO instruments and guidance on supporting ICT in education policies

UNESCO has been supporting the efforts of governments and educational institutions across the world to develop national and institutional ICT in education policies and set out masterplans. Until now, this support has taken a holistic approach to the development of resources and provision of technical support around its interconnected core functions:

- development of international instruments;
- production and sharing of intellectual guidance on the use of technological transformations in education; and
- technical assistance and capacity development.

The provision of resources and capacity-development support has been implemented across the following areas of action:

1.4.1 Sector-wide national ICT in education policies

- **International instruments**: the *Qingdao Declaration* was adopted and made available in six UN languages in 2015 to provide policy recommendations on leveraging ICT to achieve SDG 4 – Education 2030.
- **Intellectual guidance**: The online 'ICT in Education Policy Toolkit'[9] was launched in 2018 to provide subject-matter knowledge on the development of ICT in education policies and masterplans, and step-by-step guidance supported with tools and relevant examples. Similarly, in the same year, the *ICT Competency Framework for Teachers* (version 3) (UNESCO, 2018*c*) was published, to guide the development of thematic policies and masterplans on building teachers' capacities in making pedagogical use of ICT.
- **Workshops on developing ICT in education policies and masterplans**: UNESCO has organized more than 50 national and regional workshops, through which over 60 countries have been supported in developing national ICT in education masterplans.

1.4.2 OER as a cross-cutting policy area

- **International instruments**: *Recommendation on Open Educational Resources* (OER) (UNESCO, 2019*b*) was released and made available in six UN languages in 2019, outlining key action areas for promoting OER.
- **Intellectual guidance**: The *Guidelines on the Development of Open Educational Resources Policies* (UNESCO, 2019*e*) was published at 2019 and made available in English, French, and Spanish, to provide policy-makers with subject-matter knowledge on OER and procedural knowledge on planning OER masterplans. Through the publication *Open Educational Resources: Policy, Costs, and Transformation* (UNESCO, 2016*e*), 15 case studies were documented and analysed to guide the planning of policies on OER.
- **Workshops on developing policies on OER**: UNESCO has organized workshops since 2013 to support more than 20 countries to develop OER policies.

1.4.3 AI and education as a cross-cutting policy area

- **International instruments**: The *Beijing Consensus on Artificial Intelligence and Education* (UNESCO, 2019*a*) was adopted and made available in six UN languages in 2019 as the first international consensus on the theme. It provides recommendations on planning policies for AI and education.
- **Intellectual guidance**: *AI and education: Guidance for policy-makers* (Miao et al., 2021) was published in April 2021 to provide policy-makers with essential knowledge on AI technologies, benefit-risk dual analyses on the use of AI in education, and reviews of AI strategies and AI in education policies. It also contains comprehensive recommendations for planning policies on AI and education. In addition, a *Synthesis Report on Developing Competences for the AI Era* (UNESCO, 2021*b*) and compendiums on AI and education (UNESCO, 2019*f*; UNESCO, 2020*e*) have been published since 2019.

1.5 Purpose of these guidelines

The current publication is designed to supplement these tools, intellectual guidance, and technical support with humanistic guiding principles and essential knowledge on how to develop systematic and effective ICT in education policies. The key target audience of this publication are those who have the authority or designation to make policy decisions or to set out national or institutional strategies, and those school leaders who are directly involved in the implementation of policies. The publication also offers a guiding framework for policy-makers and institutional leaders on three sets of knowledge that are indispensable underpinning pillars of sound ICT in education policies. The specific objectives are to help policy-makers to:

- **Understand** the guiding principles and the subject-matter knowledge on the use of ICT in education, especially capacities in assessing benefit-risk dual effects relating to the use of ICT to enhance the provision and management of learning environments and to make them accessible to all in different lifelong learning settings. This set of knowledge will be guided by the core values of UNESCO on inclusion, equity, and gender equality in education as well as the humanistic approach toward leveraging ICT in education to protect human rights and dignities, sustainable societies, and ecological systems. The potential and risks of the use of ICT in education will be assessed within the context of achieving SDG 4.
- **Develop** procedural knowledge on the step-by-step planning of a sound policy with a vision of allying the use of ICT in education as public goods and directing strategic action towards common values . These guidelines provide a comprehensive framework for governments and institutions to set out their vision and the scope of their policy, then develop a policy masterplan and launch it. The understanding of core subject-matter knowledge on ICT in education will be enhanced through a learning-by-doing process.
- **Reinforce** the contextual knowledge needed to comprehend the local needs and readiness, and the gaps in policies, programmes and capacities. The guidelines inform but do not determine what governments and involved actors should do in a specific set of circumstances. They raise fundamental questions to provoke critical thinking, and provide relevant examples to elicit the collective contemplation needed to design relevant technological innovation or novel practices of using technologies in education.

1.6 Structure of these guidelines

As illustrated in **Figure 1**, the guidelines are presented in five parts: introduction; promoting digital inclusion and exploiting digital innovation; a guiding framework and guiding principles; a roadmap for participatory policy and masterplan development; and designing sector-wide masterplans.

Figure 1: Designing sector-wide masterplans

Part 1 Introduction

Through this first part, the publication clarifies the scope of ICT, defines the ICT in education policy and masterplan as a 'policy portfolio' of public governance to ensure the humanistic use of technologies in education. This section assesses the potentials of ICT in supporting the achievement of SDG 4 from access to learning opportunities and the quality of learning, to the provision of lifelong learning pathways, and management of education. It also casts a light on UNESCO's instruments and guidance that are set out to support the planning of national ICT in education policies and masterplans.

Part 2 Promoting digital inclusion and exploiting digital innovation

The second part iterates that promoting digital inclusion is the prerequisite and preconditional policy decision for any national ICT in education policy or masterplan. Part 2 recommends that to ensure digital innovation is exploited for the common good in education, policy-makers should take a critical review of digital applications based on the principles of digital inclusion, humanism, and the fundamental needs of learners and teachers. This section employs a historical view to examine digital applications and emerging technologies.

Part 3 A guiding framework and guiding principles

The publication continues with a guiding framework on the planning of ICT in education policies and masterplans. The aim is to guide a mind-set shift towards the use of ICT to build more open, inclusive, and crisis-resilient learning systems, drawing lessons from the use of technologies during the COVID-19 pandemic. It includes a set of guiding principles, associated with the guiding framework, which articulate the lessons learned from the planning and implementation of past ICT in education policies and masterplans. These guiding principles will help policy-makers to determine how best to adopt and integrate a humanistic vision into goal setting, action planning, and intersectoral coordination.

Part 4 A roadmap for participatory policy and masterplan development

The procedural knowledge for planning ICT in education policies and developing masterplans are then introduced, to ensure that the implementation of the policies is well-resourced and effectively monitored. This section starts with an introduction to guiding principles that are designed to inspire policy-makers to consider the national policy contexts as ecosystems and to plan the alignment of the ICT in education policies with other interrelated practices. A roadmap and a step-by-step guide for the development of the masterplan are then outlined, maintaining a focus on the political context and how the masterplan needs to change in response to the policies' progress. Here, the guide aims to provide structure to the processes of policy-making while reviewing each decision in the context of others.

Part 5 Designing sector-wide masterplans

Based on the system-wide enabling factors that are needed for leveraging ICT to expand access to educational opportunities and enhance the quality of learning, this section identifies the

following strategically important areas or sub-themes that should be included in national ICT in education policies and masterplans.

- **School education:** Everyone within the school system should have access to the benefits of digital devices, digital tools, learning materials and information and communication services to achieve their goals. They should use ICT to implement new pedagogies, which make school education more inclusive, and relevant to community needs, and to support pupils' learning success, laying the foundation for them to be empowered and active global citizens.
- **Higher education:** ICT should enhance the quality, efficiency and accessibility of higher education through its applications in various teaching and learning situations, and in university administration. In particular, technology-enhanced face-to-face learning, distributed learning and blended learning can improve the quality of education programmes. ICT can increase the efficiency of higher education administration by supporting managers' timely decision-making. It can widen access to higher education to non-traditional learners and underserved populations through flexible learning anytime and anywhere.
- **Technical and vocational education and training:** ICT in TVET can enable a dynamic, professional learning environment for all, with up-to-date training based on industry standards and key trends in the labour market. Through harnessing ICT and digital technologies, TVET can provide a stimulating and authentic learning experience accessible to all learners.
- **Non-formal education:** Non-formal education (NfE) provides an important avenue for continuous learning outside of, and a bridge to new learning pathways within, formal education. Digitally enabled NfE should promote quality lifelong learning opportunities for everyone, in all settings and at all levels of education. ICT should be used to diversify these pathways, and further reach vulnerable and underserved groups including rural youth and adults, women and girls, out-of-school youth, and people with disabilities. The recognition, validation and accreditation of the knowledge, skills and competences acquired through non-formal and informal education should also be pursued.
- **Curriculum and assessment:** The curriculum should be reviewed and adjusted to ensure that learners are equipped with the digital competences – the knowledge, skills, and attitudes – needed to meet the demands, and take advantage of the opportunities, emerging from the proliferation of ICT in society. Such a curriculum integrates ICTs appropriately, includes guidelines in its standards, and informs assessment accordingly, so that the learning aims across the curriculum are accomplished. It also offers professional development opportunities to new teachers so that they can integrate ICT into their professional practices.
- **Digital learning resources:** Digital learning resources consist of a wide range of online resources that should be aligned with the national curriculum. They can be single or multimodal, and static or dynamic. All students and teachers should have universal access

to quality digital learning resources, customized to users' needs, and local cultural and educational contexts. They should be easy to access, administer, share, and find, and monitored through recognized and fit-for-purpose quality-assurance mechanisms. They can be reused and regularly evaluated, updated and adapted to take advantage of new pedagogical and technological advancements.

- **Education Management Information System:** Policy and practice in education requires up-to-date information on how the education system works. Institutions should consider carefully how an EMIS or equivalent might best be used, and regularly updated, in order to unleash its potential to bring just-in-time improvements to educational provision in all sectors and for all types of education. EMIS can also facilitate the collection, aggregation, analysis and use of data and information for monitoring, forming policy, and optimizing practice. This enables continuous improvement for effective, efficient and equitable educational policies.

When countries choose to develop a sub-sectoral policy, one of these areas can possibly be covered by the stand-alone sub-sectoral masterplan such as a National Policy and Masterplan on the use of ICT in School Education, or a National Policy and Masterplan on Digital Resources Development and OER. When a sectoral approach is applied to the planning, any or all of these areas can be covered by a sector-wide policy such as a national ICT in education masterplan encompassing all levels and types of education (school, higher, and non-formal education, and TVET), as well as the integration of ICT into curricula and assessments, the development and management of digital learning resources (national content-management or online-learning platforms), and the use of ICT in education management (EMIS).

In each of the areas, a standardized structure is used for the guidelines, including:

- A text box **referring to international instrument(s)** with a focus on relevant developmental goals or statements articulated in the *Qingdao Declaration*.
- **A definition** of the theme and scope of masterplan(s).
- **Vision statements** that should be developed under the areas or themes.
- **Challenges for achieving SDG 4** and the goals of the local education systems, and an assessment of whether and how ICT can possibly help address those challenges.
- **Goals and objectives** to be defined, based on the vision, challenges, and local readiness.
- **Main lines of action** under which clear suggestions are provided for the key tasks that should be planned, specific objectives and indicators that should be established, and a pathway to execute the actions.

- **Cross-cutting issues**, including the regulatory frameworks, guiding principles, or transversal programmes that should be planned to ensure human rights protection, inclusion, equity, and gender equality. The aim is to underscore the importance of integrating and delivering these fundamental guiding principles and other key cross-cutting issues (such as the quality of learning and supporting teacher education) in all sub-sectoral masterplans.
- **Existing approaches** to implementation and proven practices on the actualization of masterplans in diverse contexts, as insightful references.

1.7 How to use these guidelines

The guidelines in this publication target policy-makers either as individuals or working groups of competent authorities who are responsible for planning the policy, and who are likely to be supported through a central coordination body. The guidelines further assume that this group of people has the authority and context-specific knowledge to prepare the policy from start to finish.

We suggest that the groups work throughout the policy planning cycle. Questions that will help policy-makers articulate key elements have been designed to provoke critical thinking or constructive design based on group discussion, or through workshops where applicable, so that they lay the foundations for the full policy and masterplan. It is recommended that the policy-makers use these guidelines together with the online ICT in Education Policy Toolkit developed by UNESCO,[10] which features online tools, a resource centre, and a step-by-step guide on how to create an ICT in education policy and masterplan that is in line with the suggested roadmap in this publication.

When this publication is used by individuals involved in developing or supporting the policy-development process, such as external consultants assisting ministries to develop policy, this support may take the form of advising the policy-making and coordination body, or it may involve evaluating the steps in policy design and implementation already taken. In the former case, the external consultant can also follow the step-by-step process by starting at the beginning of the document. In the latter case, the external consultant might want to begin with the final chapter, which looks at both launching the policy as an event and reviewing implementation for improvements, with a view to generating a more effective policy in the near future.

2. Promoting digital inclusion and exploiting digital innovation

The core value of every technological revolution in history is to help humans overcome global challenges and improve their well-being; and the success of the technological innovation can't be validated until it is adopted by the entire society, inclusively, as a public good. All countries and individuals have been facing common global challenges in recent years, from climate change to pandemics and military conflicts. As a consequence, in the education arena, setbacks are looming. The response taken by all countries during the COVID-19 disruption suggests that the right to education has become dependent on connectivity. This makes digital inclusion a societal and moral imperative, guided by the humanistic approach.

Promoting digital inclusion – namely ensuring equity, inclusion, and gender equality in the access to and use of digital devices and connectivity – is the prerequisite for any national ICT in education policy and masterplan. It must be the preconditional political commitment that will guide the planning and deployment of ICT in education. It is the social responsibility of private IT companies to make additional free and low-cost digital solutions available for digitally marginalized groups, and to create applications as a public good to address various forms of disabilities, it is state governance that should set up regulations and policies to guide the innovation towards digital inclusion, and validate the applications that are permitted to be deployed in classrooms.

ICT has been developing rapidly, and iteratively updated ICT tools have been introduced into the education sector. Many of these innovations are driven by commercial motivations, and should not be taken for granted as being designed for the common good. Policy-makers should assess the capabilities and limitations of ICT from two perspectives. First, they must take a generational view of the evolution of ICT, and conduct a robust benefit-risk review of the emerging innovations to avoid missing historical opportunities brought about by frontier technologies. Second, they need to carry out a critical review of the large range of digital applications based on the principles of inclusion, humanism, and the fundamental needs of education provision and management, as well as teachers and learners.

2.1 Promoting digital inclusion in education

2.1.1 Commitment to digital learning environments for all

Inclusive access to digital devices and internet connectivity are the preconditions for the use of ICT to help national governments address many of the world's seemingly intransigent educational problems, including the learning divide, discrimination and gender inequality. In the *Qingdao Declaration*, Member States made a commitment to guarantee that all girls and boys have access to connected digital devices and a relevant and responsive digital learning environment by 2030 (**Box 3**).

Box 3: Qingdao Declaration

Technology offers unprecedented opportunities to reduce the long-existing learning divide. The application of ICT is essential if we are to deliver on our commitment in the *Incheon Declaration* to non-discrimination in education, gender equality and women's empowerment for sustainable development. We commit to ensure that all girls and boys have access to connected digital devices and a relevant and responsive digital learning environment by 2030, irrespective of their disabilities, social or economic status, or geographic location. In striving to achieve universal access to basic education and skills development, we recommend that all education stakeholders recognize enrolment in quality-assured online courses as an alternative or complementary mode to face-to-face programmes of study.

Source: Qingdao Declaration, UNESCO, 2015*a*, Article 5

2.1.2 Barriers to digital inclusion

However, there remains a sizable gap in wired broadband or mobile connectivity around the world (ITU and UNESCO, 2020): only 37 per cent of people in rural areas, compared with 73 per cent in urban areas, have robust internet access; meanwhile, in the LDCs (least developed countries), the same figures are only 10 and 25 per cent.

Ensuring a widely available and robust digital infrastructure is the key remit of the Broadband Commission, established in 2010 by the International Telecommunication Union (ITU) and UNESCO. It calls on world leaders to prioritize universal connectivity in order to accelerate progress towards sustainable development, and acknowledges that much work remains: 'Digital inequalities and uneven access and adoption of the Internet is prevalent not only between countries, but also within countries' (ITU and UNESCO, 2020). In its 2020 Manifesto,[11] the Commission points out that 3.6 billion people remain offline, and billions of other marginalized people are struggling with poor connectivity.

The COVID-19 pandemic beginning in February 2020 further revealed the digital inequality in education systems worldwide. According to figures compiled by the Teacher Task Force, an international alliance coordinated by UNESCO,[12] up to the middle of 2021, half of the total number of learners – some 826 million – who were kept out of classrooms did not have access to a household computer. Meanwhile, 43 per cent (706 million) had no internet at home. This digital exclusion is particularly acute in low-income countries: in sub-Saharan Africa, 89 per cent of learners lack household computers and 82 per cent lack internet access. Furthermore, about 56 million learners live in locations not served by mobile networks, almost half of whom are in sub-Saharan Africa.

There are multiple reasons for these barriers to universal connectivity:

- the relative unaffordability of internet access, hardware and software in many areas;
- limited access to basic infrastructure (e.g. electricity supply) and digital devices;
- low levels of literacy in the languages used online;
- poor digital skills;
- lack of relevant content; and
- cultural beliefs and 'technophobia' in some contexts.

The Broadband Commission (2014) has presented a total of 76 recommendations to help national governments improve internet access for all citizens. These include making broadband affordable by adopting appropriate policy and regulations, fostering locally relevant content creation, and collecting and analysing reliable ICT data. It also encompasses making digital infrastructure open access, boosting affordability and usability of broadband-enabled products and services with a focus on addressing barriers faced by those at risk of being left behind, and building human capacity and skills to enable all stakeholders to make the most of digital opportunities.

Other possibilities include concentrating on low-cost connectivity technologies, e.g. more innovatively and effectively using 2G mobile systems, and establishing public/private partnerships to enable zero-rated data connectivity, especially for rural areas and internet traffic related to online education. There is also the potential for improved education to counter misinformation and misbeliefs and build individual skills; and the development of affordable, accessible and equitable content to encourage access by marginalized citizens, including women and girls, disabled people, those who are displaced or living in poverty, and those in rural areas, LDCs and similarly disadvantaged regions. In response to the education disruption caused by COVID-19, countries took urgent action to launch policies on zero-rating access to educational platforms.[13] For example, Argentina zero-rated its educational portal, Educ.ar, through the National Communications Entity (ENACOM), the country's communications and

media regulator; Jamaica zero-rated the data access to the website of its Ministry of Education, Youth and Information,[14] which houses educational content and online exam workbooks; Jordan launched the Darsak educational portal[15] on 22 March 2020, and zero rated students' browsing of the platform between 6.00 and 16.00 every day; and the Government of the Republic of Korea provided an emergency budget for zero-rating the access to all public education websites.

Box 4: Zero-rated data connectivity

In a robust definition, zero-rated data connectivity not only means that accessing, using, and downloading content from some websites will be free of charge, but also that the internet data traffic consumed by accessing these websites will be excluded from charges and monthly data caps. This requires the telecom sector and other concerned agencies to create a list of websites to be automatically exempted from billing.

Source: Zero-rating Practices in Broadband Markets, European Commission, 2017

2.1.3 Addressing ICT gender inequality

In particular, there are pronounced gender inequalities in access to digital resources and also the perpetual inequity of gender discrimination, with women and girls all too often being prevented or discouraged from using ICT in general and the internet in particular. A report published by EQUALS and UNESCO (2019) estimated that in the LDCs, only 15 per cent of women use the internet compared to 28 per cent of men. There is also a gender gap in digital skills: women and girls are 25 per cent less likely than men to know how to leverage digital technology for basic purposes, 4 times less likely to know how to program computers, and 13 times less likely to file for a technology patent. In 2021, UNESCO and its partners launched an initiative called Accelerating Girls' Digital Access, Skills and Online Learning,[16] which recommends that governments take action on: (1) equality: closing the gender gaps in girls' access to online education and digital skills; (2) empowerment: leveraging the potential of technology to advance education and gender equality, with a focus on the most marginalized; and (3) safety: ensuring safe, inclusive and gender-responsive online learning spaces.

2.1.4 Advancing digital inclusion for persons with disabilities

Persons with disabilities, who might benefit significantly from good quality internet access, are also often prevented from so doing. According to a factsheet by the World Health Organization (WHO), around 15 per cent of the world's population, or an estimated 1 billion people, live with disabilities. They are the world's largest minority (WHO, 2021). At least 93 million of these

people are children (WHO, 2011). According to UNESCO's (2020*c*) Global Education Monitoring Report, when governments employed technology-based solutions to ensure the continuity of education during COVID-19 school closures, 40 per cent of poorer countries failed to provide specific support to disadvantaged learners.

A policy brief published by UNESCO in 2021 entitled *Understanding the impact of COVID-19 on the education of persons with disabilities: Challenges and opportunities of distance education* (UNESCO, 2021*c*) identifies three levels of barriers affecting the distance education of students with disabilities, based on academic research studies and literature reviews:

- High-impact barriers:
  Poor connectivity, the divide in accessing digital devices, and the lack of training programmes for teachers on using distance learning solutions.
- Medium-impact barriers:
  Insufficient accessibility of platforms and learning materials, and the lack of competencies to conduct or facilitate distance learning among students, their parents, teachers and schools.
- Low-impact barriers:
  The dearth of one-to-one pedagogical support for students with disabilities, and the absence of technical assistance to help them and their parents implement distance-learning solutions.

UNESCO recommends that all stakeholders work towards digital inclusion for persons with disabilities. The recommendations relevant to policy-makers include:

- cooperating with organizations and associations for persons with disabilities to identify difficulties with and solutions for accessing digital learning and providing user-targeted support, paying special attention to the empowerment of women and young girls with disabilities who may face multiple forms of discrimination;
- supporting legislation or policy development to ensure that persons with disabilities are included in distance-learning programmes or ICT in education policies;
- strengthening the development and use of appropriate infrastructure needed by people with disabilities to conduct distance learning, and facilitating their access to assistive technologies;
- adopting universal design for learning (UDL) for devising and presenting curricula and instructions, and ensuring that a multitude of methods are used to support learners with disabilities;
- assessing the accessibility of online learning content based on the principle of UDL;
- implementing student-centred pedagogical methodologies to ensure better engagement of students with disabilities, promote positive learning experiences, and raise self-esteem; and
- supporting teachers and caregivers through systemic approaches.

When planning the ICT in education policy, identifying the specific needs of persons with disabilities should be a key part of the very first step, i.e. the situational analysis and needs assessment (see Section 4.2).

2.2 A humanistic and critical view on deploying ICT in education

2.2.1 A critical view on mitigating the negative impacts of ICT in education

- **Avoiding 'techno-solutionism'**

Failing to provide inclusive digital learning opportunities means that governments are in danger of discriminating against and disadvantaging certain numbers of their own citizens. Nonetheless, it cannot be assumed that the implementation of ICT in education will have the hoped-for outcomes, especially if those aspirations are not grounded in reality. Genuinely possible outcomes must be identified, recognized and targeted. In particular, it is essential that national governments avoid what is known as 'techno-solutionism', the assumption that engrained social problems, such as the shortage of qualified and experienced teachers, can be cured by technology alone – because that is almost never true. Instead, policy-makers should ensure that broader education policies, independent of ICT, are genuinely enhancing education for all, before considering how ICT can make a positive contribution.

- **Protecting the well-being of teachers and students**

The possible impact of ICT on student and teacher well-being must also be thoroughly investigated and mitigated. In short, enhancing educational outcomes at the expense of student well-being should always be avoided. During the COVID-19 pandemic, when many students worldwide were expected to engage in their learning solely using online technologies, many reported excessive tiredness, eye-strain and feelings of isolation and loneliness. In addition, in some circumstances, the use of some ICT, especially computer games, has been associated with addiction and depression. Although the role that the ICT plays and the particular mechanisms remain unclear, the 'precautionary principle' urges policy-makers to think very carefully before we ask young people to engage extensively with ICT over long periods, especially screen-based ICT. Teachers' professional development should prepare them to ensure that ICT is only used judiciously, appropriately and for minimal amounts of time. This training should equip them to understand, diagnose, and mitigate the potential negative impact of ICT on student well-being.

- **Reducing and neutralizing the digital emission footprint**

It is also important to recognize the negative impacts of ICT on the environment, in terms of its raw materials, energy requirements, and waste. All of this should be considered carefully throughout the development and implementation of ICT in education. Accordingly, any

SDG-compatible ICT in education policy must balance the educational benefits with the environmental costs, taking care to minimize negative impacts. In particular, policy-makers should always prioritize 'green' ICT: those ICT that have been designed from the ground up to require few if any precious resources such as rare earth metals; that use minimal power and water across their life cycle, including their manufacture and use; that constrain the creation of greenhouse gases and have a neutral carbon footprint; and that can easily be recycled, rather than being added to the growing mountains of 'technotrash' around the world that leach hazardous chemicals into the water table.

2.2.2 Humanistic and needs-based validation of commercial ICT applications

From the perspective of the supply of ICT solutions for education, the picture of available technologies is increasingly complex – with the commercial sector launching such applications frequently. It is essential that public governmental agencies consider very carefully the relationship between their education systems and the commercial sector, including the growing dependence of learning provision on commercial software and platforms. A mechanism for examining and validating commercial ICT solutions against key humanistic principles and educational needs should be adopted. The main purposes of the mechanism must be to protect education systems from wholesale privatization by stealth, and ensure the security and well-being of education managers, teachers, and students. It should also involve the expertise of the research community, rather than depending on the marketing advocacy of the commercial sector. The validation mechanism should examine the ICT solutions against at least five criteria:

- humanistic principles – whether the solutions will advance or do harm to inclusion, equity, and gender equality;
- affordability – relative to local incomes and government revenues;
- availability – whether the prerequisite infrastructure is in place;
- accessibility – especially for learners who have disabilities, use minority languages, or are displaced; and
- scalability – whether the functions or performance of ICT applications can be easily increased or decreased and costs adjusted accordingly, sometimes also including whether the ICT applications can be upgraded or integrated into upgraded systems.

2.3 Examining the ICT available for education based on humanistic principles

Listing the ever-growing range of ICT is beyond the scope of this publication. However, in order to develop an effective ICT in education policy, policy-makers need to have a robust and independent understanding of the increasingly broad range of ICT that is available, and how it might effectively be used to support teaching and learning. This might be addressed by commissioning research to map what ICT is available for use in education in the local region.

2.3.1 Assessing ICT in education readiness

Understanding the ICT in education readiness of the country or targeted local regions, to inform the policy as it is developed, is also essential. This involves a combined qualitative and quantitative assessment of a country or region's current situation, to identify gaps and potential areas for improvement, and help policy-makers understand what needs to be done in the current context. There are multiple ways in which the readiness might be evaluated, and they may involve any or all the following statistics, as appropriate for the local context:

- Digital devices that are already available to schools, measured by digital device/student ratios.
- Percentage of schools and households in urban versus rural areas that have robust wired and/or mobile internet access.
- Percentage of schools and households for whom internet access, devices and software are affordable.
- Percentage of schools whose learners are able to access a national or local public learning platform.
- Percentage of schools that have online courses available to complement classroom teaching.
- Proportion of the curriculum already covered by national or local public online courses.
- Amount of national funding dedicated to ICT in education as a proportion of all education funding.
- Percentage of school leaders, teachers and students who have basic digital skills.
- Percentage of schools using ICT in teaching and learning in most subjects at a certain frequency every week.
- Percentage of schools using communication technologies (e.g. social media and conferencing apps) in teaching and learning at a certain frequency every week.
- Maturity of relevant regulations and practices to ensure inclusive and equitable access, fairness of access, data privacy and security, etc.

2.3.2 Leveraging low-bandwidth applications and OER for low-resourced settings

When considering the potential implementation of ICT in education settings, it can often be too easy to focus on 'cutting-edge' ICT. However, it is also important for policy-makers to consider low-cost technologies that can be used effectively to support education, especially in low-resourced settings.

In response to the COVID-19 disruption, UNESCO curated a list of applications that might support distance learning programmes.[17] These included systems built for use on basic mobile phones ('low-bandwidth'), and systems with strong offline functionality ('no-bandwidth').

- Low-bandwidth applications only require very basic mobile access and relatively low-cost legacy hardware such as 'non-smart' phones with the ability to send and receive SMS text messages, which are widely available even in some remote rural communities. Examples include M-Shule,[18] Ubongo,[19] and Ustad Mobile.[20]
- No-bandwidth applications or platforms can provide educational resources and sometimes support adaptive learning offline. Once 'seeded' somewhere that the internet is available with the relevant information and resources, these tools can be taken into areas with no internet connection and still function effectively. Examples include iBox,[21] Kolibri,[22] Ruang Guru,[23] and School in a Bag.[24]

According to UNESCO's (2019*b*) Recommendation on Open Educational Resources, OER are 'learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, reuse, repurpose, adaptation and redistribution by others'. Because OER is affordable, accessible and usually of high quality, policy-makers, school leaders and teachers should explore its potential across all settings and levels. One type of OER that is widely available provides free reading materials: prominent examples include the Global Digital Library,[25] which makes freely available more than 5000 digital storybooks in more than 70 languages; African Storybook,[26] with illustrated storybooks in 189 African languages; and Worldreader,[27] which to date has provided more than 18 million children with free books.

Policy-makers should also consider whether academic needs can be addressed by OER resources without recourse to relatively costly print or electronic textbooks from the commercial sector, and think about what will be required for the successful use of OER, such as supportive technology or professional development for teachers.

2.3.3 Re-directing and regulating Web 2.0 tools to support online learning

Communication is fundamental to any human interaction. It is the cornerstone of teaching and learning, and of technologies that have been used to connect people for many years. The tools of Web 2.0[28] began to be widely used at the beginning of the 21st century. 'Web 2.0' refers to a growing set of tools that encourage a participatory culture, enable users to generate and share content anytime and anywhere, and support interoperability across different types of systems and devices. Web 2.0 tools that are relevant to teaching and learning include collaborative content-authoring tools, social media tools, and video-conferencing software.

- **Collaborative content-authoring tools to facilitate user-generated content**

There are multiple free-to-use collaborative authoring tools, such as the Google Drive[29] suite of Docs (for word processing), Sheets (for spreadsheets), Slides (for presentations) and Forms. Tencent Docs[30] offers a similar suite of tools. In these tools, as one person edits the document (or spreadsheet, presentation or form), all the other collaborators can see the changes and respond immediately, which facilitates in-depth collaborative authoring and joint knowledge creation. These tools are also increasingly being used in educational contexts. For example, researchers often collaborate with colleagues remotely, and primary and secondary school teachers are increasingly using these tools to cooperate on and share lesson plans.

- **Social media tools enabling content production and sharing**

Multiple popular social media platforms have increasingly become a part of the daily life of internet users, ranging from Facebook[31] and WeChat,[32] to YouTube[33] and TikTok.[34] These end-user applications installed in mobile phones enable users to produce videos or generate multimedia content anytime and anywhere and share them instantly. Social media platforms have been transforming the way content or knowledge is produced and shared. Content-sharing platforms such as YouTube and TikTok are increasingly being harnessed to support learning in formal educational settings. YouTube, for example, allows users to upload, view, rate, share, make playlists of, report, and comment on videos. While many YouTube videos designed to support learning are developed by large organizations (such as Khan Academy),[35] huge numbers are created by individuals who want to share their knowledge and skills. YouTube and other social media platforms have also started to offer dedicated education channels; for example, the WeChat platform has been proposed as a novel online learning system.[36] A similar approach is taken by TikTok, which is increasingly popular with young people around the world, as a platform where they can create short videos, often featuring background music. During the COVID-19 pandemic, teachers and students have been using it to create and share learning resources. In just a few weeks after the outbreak of the COVID-19 in March 2020 the hashtag #LearnOnTikTok received over 7 billion views for just over a million videos.

Whatever video-sharing platform learners use, it allows them to take more responsibility for their own learning by identifying their own individual goals, and selecting appropriate videos to achieve them. However, there are several issues that need to be addressed if national policies are to make use of these tools. Firstly, although videos can be informative and underpin knowledge transmission, young learners can rarely use the content to achieve in-depth understanding or apply knowledge without personal coaching. In addition, video-sharing platforms work by using algorithms to analyse user interactions to infer each student's interests and preferences in order to 'individualize' which videos will be recommended to them next. This can create 'echo chambers' in which users only see the videos that support their prior conceptions rather than content that might challenge them. In other words, this algorithmic approach might reinforce misconceptions and biases rather than leading to deep learning. It might even promote addictive behaviours. Finally, there are concerns around platform users' data privacy and the possibilities of cyber bullying.[37]

- **Video-conferencing software to enable online teaching and communication**

Video-conferencing software, such as Zoom,[38] Alibaba's DingTalk,[39] and Microsoft Teams,[40] allows users in different locations to connect with others synchronously. These software typically offer a free version for a limited number of synchronous participants or with a time limit for each conference call. **Table 2** shows some examples.

Table 2: Functionalities of live-streaming applications (free versions)

Tool	Description	Time limit of a conference call	Number of online Participants under the free version	Website link
Dingtalk	Communication platform that supports video conferencing, task and calendar management, attendance tracking and instant messaging.	No limit	300	https://www.dingtalk.com/en
Google Meet	Conference system	No limit	30	https://meet.google.com
Lark	Collaboration suite with chat, calendar, and cloud storage facilities. It provides 200GB of free storage space.	No limit	100	https://www.larksuite.com

Tool	Description	Time limit of a conference call	Number of online Participants under the free version	Website link
Teams	Chatting, meeting, calling, and collaboration features integrated with Microsoft Office software.	No limit	250	https://www.microsoft.com/en-us/education/products/teams
Zoom	Cloud platform that supports video and audio conferencing, chat and webinars. It is free for hosting up to 100 participants.	40 minutes	100	https://zoom.us

Source: Adapted from UNESCO, 2020*d*, p.31.

Due to the free version and its ease of use, which is especially important for non-technical people, many of these originally business-oriented communication platforms have been rapidly adopted by the public for daily communication and by educators to support teaching and learning. Some of these tools have developed functions to support the specific needs of teachers and students. For example, Teams is also integrated with Microsoft Classroom, which enables administrators and teachers to group individuals into classes, and distribute and grade student assignments. These standalone video-conferencing tools are also often used to supplement the online learning platforms.

Like the content sharing platforms, some of the video conferencing software was also criticized for a series of security bugs and privacy risks that both public governmental agencies and platform providers must address. Furthermore, it is essential that policy-makers properly consider the costs of the advanced versions of the applications as well as the implications of increasingly depending on commercial products to deliver basic education services.

In summary, in order to take best advantage of Web 2.0 tools to support safe and effective online learning, while properly regulating them, policy-makers should:

- explore the availability of ICT tools that can facilitate basic communication, content production and sharing, and collaboration in formal and informal learning settings;
- assess the business models behind the tools, and validate tools based on the criteria introduced in Section 2.2.2;

- provide guidance on which Web 2.0 tools are appropriate for local contexts, what is necessary to enable schools and other educational institutions to take advantage of them, and what professional development is needed to equip teachers to use them to benefit their students' learning; and
- conduct a robust review of the potential risks around security, data privacy, and the well-being of teachers and students, and develop regulation mechanisms.

2.3.4 Integrated online learning platforms

Due to the COVID-19 education disruption, policy-makers and practitioners recognized the underused capabilities of online learning platforms, especially the necessity of activating national or central public platforms to facilitate distance teaching and learning. These national or central platforms are supported by learning management systems (LMSs) but have been integrating additional functions. LMSs such as Moodle,[41] Blackboard[42] and Schoology,[43] have mostly been used to manage classroom-based teaching and learning, but were rarely integrated fully into the large-scale approaches to nationwide distance learning until the COVID-19 pandemic.

During the school closures, teachers working from home were able to develop and curate online resources, share them with their students, conduct live lessons, set assessments, monitor their students' well-being, and more. Meanwhile, students working from home were able to access the shared resources, participate in the live lessons, interact with their peers, and complete the assessments. All of this activity was supported by the platforms' inbuilt forums, blogs, wikis, messaging and other functionalities.

Some online learning platforms, such as Moodle, offer open-source technology tools for the national or institutional development teams to customize and extend functionalities in a wide range of settings. Although the basic technological architecture of open-source platforms offers access, fees are often charged for customizing the tools or adding functions. Accordingly, the policy-makers should carefully examine whether such platforms should be used widely across the education sector, and calculate the total cost of ownership (TCO – see Section 4.4.2). If wide use is warranted, they should establish appropriate guidance and professional training.

Given the heightened awareness of the importance of these platforms triggered by the pandemic, their future use is very likely to increase. However, teachers need to go beyond the basic functionalities of the platforms, so that these tools are not used simply to replicate outmoded instructional practices but instead to support effective pedagogy. This will require high-quality professional development opportunities for teachers and school leaders, which should be mandated by the ICT policy.

The ever-growing range of tools and functionalities being integrated into national or institutional online learning platforms is again beyond the capacity this publication. However, it is useful for policy-makers to develop a learner-centred taxonomy, to review the existing functionalities of the platforms and identify the gaps for further upgrading. A taxonomy was introduced in the publication *Ensuring effective distance learning during COVID-19 disruption: Guidance for teachers* (UNESCO, 2020*d*), and is amended and presented here in **Table 3** with permission. In the taxonomy, the higher the numbering, the more inclusive the platform and the more advanced support it can provide to learners.

Table 3: A learner-centred taxonomy to assess the functionalities of online platforms

Summary functionalities	Detailed functionalities
Supporting curricular courses	1. webspace presenting ad hoc content collections 2. covering all subjects 3. covering all grade levels 4. searchable by subject, topic and grade level 5. supporting different distance learning models (online, TV/ radio-based) 6. accessible for learners with visual disabilities 7. under open licence
Data management	1. protecting learners' data privacy and security 2. supporting unique user identifiers (UUID) for logins and records of learning progress 3. supporting learning analytics and periodic reporting 4. integrating with existing educational management information systems (EMIS) 5. linking and/or cross-referencing to external sources of big data
Supporting teachers' online collaboration	1. sharing resources that are dynamically updated, quality-assured and teacher-generated 2. supporting moderated online forums for educators 3. adopting certification and/or quality-assurance standards 4. providing recommendations for teachers based on learning analytics
Supporting learners' online collaboration	1. sharing resources that are dynamically updated, quality-assured and student-generated 2. supporting moderated online collaborative learning and/or project-based learning activities 3. supporting online makers' spaces

Summary functionalities	Detailed functionalities
Supporting online teaching	1. providing online classrooms to enable live-streaming lessons 2. supporting asynchronous video-based lessons (such as MOOCs) followed by two-way interactive tutorials and teacher-student discussions 3. supporting asynchronous video-based lessons followed by asynchronous coaching
Supporting formative assessment	1. providing free shared spaces to collect learners' submissions and present outputs to facilitate peer assessment and peer learning 2. supporting automated grading and reporting of assessment results 3. supporting automatic distribution and administering of tests 4. integrating AI-powered formative assessment and suggested personalized learning pathways

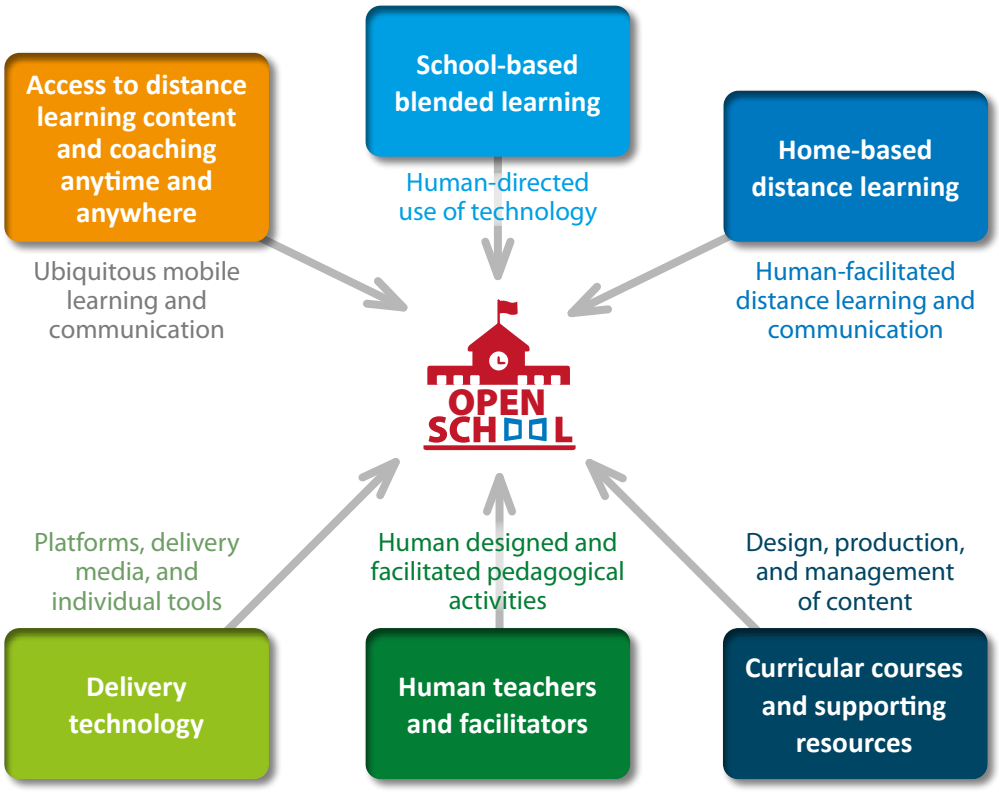
Source: Adapted from UNESCO, 2020*d*, p.22.

2.4 Integrating technology, digital content, and digital skills to build new infrastructure for learning systems

There are concerns about multiple fragmented ICT solutions existing while an increasing number of supposed innovations are emerging every month. This fragmentation has led to the isolation of digital services and wasting of end users' time. In response to this, there is a need for intersectoral and inter-ministry cooperation so that more integrated solutions can be adopted, with one single UUID and authentication for the majority of the online learning service. The most transformative approach is to integrate technology with other key underpinning pillars to build a new infrastructure of learning.

UNESCO has suggested a framework for this (**Figure 2**), which demonstrates the concept of technology-enabled open schools. This refers to an open delivery modality that mixes non-digital means with digital technologies. The aim is to enable the provision of school programmes that make curricular courses, human tutorials, coaching, and well-being accessible across multiple physical and distance learning spaces, including homes and alternative safe venues such as community learning centres, libraries, or temporary crisis shelters. The fundamental purpose is to ensure that alternative access to education can be 'switched on' or made available immediately, so that the right to learn is not disrupted during school closures precipitated by crises or emergencies.

Figure 2: Framework for planning and building an ICT-enabled open school system



Depending on the ICT in education readiness and forward-looking vision for using ICT to transform schooling, countries can choose to (i) blend ICT with TV and radio to support access to education programmes; (ii) support the online learning model as the main mode for the provision of these programmes; or (iii) integrate frontier technologies to transform pedagogy and enable open education practices. Detailed guidance is given in **Table 4**.

Table 4: Guiding framework for a technology-enabled school system

Stages	Layers	Support interconnected access	Extend learning spaces and time	Transform pedagogical practices
Policy and resource enabler	Leadership & governance	Basic open school policy	Online open school policy	Ubiquitous learning policy
	Financing and resource mobilization	Results-based financial mobilization	Recurring public budget and private contributions	Recurring public budget and society-wide resources
	Community & stakeholder engagement	School-home-community connection	School-home-community network	School-home-community partnership
Technology, content, and human infrastructure	Education delivery technologies	Inclusive TV/ radio model supplemented by online learning	Inclusive online model supplemented by TV/radio	Pervasive online-merging-offline model
	Curricular courses and supporting resources	TV/radio content covering all subjects & grade levels	Online courses and OER	System-led content and teacher-generated OER
	Human facilitation	Pre-set programme facilitators	Collaborative learning programme designers and facilitators	Technology and resource integrators and co-learners
Teaching, learning, and assessment	Social interaction and care	Technology-mediated care & support	Extended social care & support	Personalized social interaction and care
	Teaching & learning	Lecture-based continued learning	Student-centred and extended learning	Personalized learning and knowledge creation
	Assessment & credentialing of learning outcomes	Tech-assisted assessment and recording	Digitalized assessment and credentialing	Personalized learning analytics and credentialing

2.5 Exploiting emerging ICT as a common good for education

There are various emerging ICT that have the potential to transform the provision of education management, teaching, and learning. Each of these technologies have resulted from an innovative blending and reuse of existing technologies, or are themselves part of a complex

disruptive mix. As a parallel, consider the mixing of existing and novel technologies in other domains that disrupted well-established services (e.g. taxis) with a novel technology (online/mobile apps) to create a novel technology-supported approach (i.e. ride-sharing taxis). At the same time, some innovative technological solutions that emerged previously are continuing to evolve. For example, MOOCs (see **Section 5.2.6**) are developing with the aim of improving their pedagogy and motivating students to persist all the way to course completion. One of the pedagogical designs modelled on the 'conversational framework' (Laurillard, 1993) has been implemented successfully by the MOOC platform FutureLearn.[44]

The list of emerging technologies is ever growing, including robotics, edge computing and the Internet of Things.[45] This publication briefly explores the potential of three technologies that have been the subject of over-hyped claims, namely augmented and virtual reality, blockchain, and artificial intelligence (AI). It is worth reiterating that policy-makers should not allow themselves to be captured by the marketing claims of commercial players. Instead, it is important that these claims are critically assessed to identify how the technologies can genuinely make a positive and humanistic difference in classrooms.

2.5.1 Augmented and virtual reality

Augmented reality (AR) and virtual reality (VR) are two related innovations that are increasingly being applied in educational contexts.[46] VR depends on the wearing of specially designed computer-driven goggles[47] to provide an immersive experience that shuts out the physical world, enabling users to feel as if they have been transported into one of a range of real-world or imagined environments. This gives users virtual access to places that they cannot otherwise visit because they are unreachable (such as the surface of Mars or a human womb where a foetus is developing) and/or dangerous (such as the inside of a volcano or the time of the dinosaurs). Although VR can be engaging, some users find that the goggles can cause disorientation or nausea.

AR involves overlaying computer-generated images on the user's view of the real world, and does not have the same issues as VR. With some AR systems, a smartphone's camera is pointed at a QR code to reveal a quasi-3D object (for example, a human heart) that can be explored in detail. AR might also involve AI-powered image recognition and tracking. In September 2021, the combination of AR and AI enabled the creation of a virtual version of a human who is able to deliver a live-streamed speech without being recognized as 'fake'. In addition, it has been suggested that AR technologies might help realize what is known as the 'metaverse' (which is a contraction of 'meta-universe'), a future version of the internet where virtual, persistent and shared spaces are accessible in 3D.[48]

VR[49] and AR have been used in the teaching of many subjects across K-12 and beyond, including astronomy, biology and geology. To deploy VR and AR in mainstream classroom practices, policy-makers need to address some key problems, including the cost of the

equipment, the sickness that many VR goggles can induce in their wearers, and the challenge of young people careering around the same classroom while exploring their own individual VR experience. More importantly, the evidence base to support the adoption of these technologies, i.e. research into the effects of using VR and AR to improve learning outcomes and generate educational returns on investment, is still missing.

2.5.2 Blockchain

In formal education systems, national examinations are typically administered by accredited organizations, with the student receiving a paper certificate as a record of their achievements. However, a recent technology, the 'blockchain', has the potential to radically change the way in which qualifications are recorded and shared (Sharples and Domingue, 2016).

The blockchain is a chain of data that is automatically stored as identical copies on thousands of computers distributed around the world. It is a universal record that does not rely on any central authority, that can be added to and read but not edited or altered. Because it is secure, distributed, flexible, and accessible, blockchain is the technology that underpins crypto currencies such as bitcoin. However, blockchains can comprise anything that can be digitized, including text, images, sounds and videos, together with a record of every transaction, including the date on which the information was added.

Applied in education,[50] a blockchain could be used to store a variety of educational records, from attendance to competences, examination results to qualifications, student essays to e-portfolios, and course participation to degree completion. In this way, students would have a robust, accredited record of their learning experiences and achievements, potentially far more detailed than a collection of exam certificates, which they could share with university admissions teams or potential employers who could then verify the qualifications for themselves. In some universities, for example the University of Nicosia in Cyprus, blockchains are already being used to store exam certificates.[51] Similarly, Malta has been exploring the use of the blockchain technology 'Blockcerts' across its education system.[52] The European Commission are analysing the feasibility of deploying blockchain-based notarization systems in multiple settings. In 2018, European Union (EU) Member States created the European Blockchain Partnership (EBP) to collaborate on building the European Blockchain Services Infrastructure (EBSI), a joint initiative of the Commission and EBP to deliver EU-wide cross-border public services using blockchain technology.[53]

However, concerns remain about the status of blockchain as a technology that is not yet fully mature, specifically with regard to its performance and scalability, integration with legacy infrastructures, and interoperability. Since blockchain depends on the computing power of distributed high-capability computers, the substantial energy consumption and negative impact on the climate change remains an unresolved issue. Just like tried-and-tested and less complex technologies, blockchain and its management of public/private keys and protection of

personal, sensitive and/or confidential data must be evaluated. In addition, its tangible benefits need to be demonstrated, especially for countries that are still working to put in place a basic ICT infrastructure.

2.5.3 Artificial Intelligence

Within the past few years, AI has moved from the backwaters of academic research to the forefront of public discussion. In fact, AI has become pervasive in daily life — from smartphone personal assistants to self-driving cars, from recommending entertainment to predicting crime, and from face recognition to medical diagnoses. The new wave of the breakthroughs in AI has largely been based on the significantly enhanced power of cloud computing and the exponential expansion of online data, which together enable constant training and iterative upgrading of algorithms. Data, computing power, and algorithms are the foundation of machine learning, the AI technique that has made such dramatic progress in recent years. AI holds one of the strongest convergent capabilities to integrate interdisciplinary technological innovation, and has become the foundation of many other frontier technologies.

AI is also increasingly being applied in educational contexts. While there are many potential benefits, this raises profound questions about what should be taught and how, and about social and ethical implications, the evolving role of teachers, and how to make AI into a public good to enhance educational access and equity (Miao et al., 2021). In addition, at present, there is also very little robust evidence for its positive impact or effectiveness. In response to these challenges, UNESCO led the development of the *Beijing Consensus on Artificial Intelligence and Education* (UNESCO, 2019*a*), which was adopted by its Member States in 2019. It then developed and published *AI and Education: Guidance for Policy-makers* (Miao et al., 2021) to support policy-makers in planning policies and programmes to address the arrival of AI in education. Policy-makers can refer to these two documents to better understand the possibilities and implications of AI for education and learning, especially for SDG 4.

Thinking back to the three-fold potential of ICT for education outlined in Chapter 1, policy-makers also need to take a holistic approach to plan strategies on the interaction between AI and education. This includes regulating AI in education, learning *about* AI, and learning *with* AI, as discussed in the rest of this chapter.

- **Regulating the use of AI in education as a public good**

The rapid deployment of AI across sectors inevitably brings multiple risks and challenges that need to be carefully regulated (see **Box 5**). For example, the collection and manipulation of individuals' data without respecting who owns the data violates privacy, threatens human rights and increases discrimination against females and people from low-income and ethnic minority groups. By their nature, AI technologies have the capability to cross borders, meaning that providers from developed countries can easily collect and control the data of people in

developing countries, even ones that have not yet introduced AI. This will further prevent people in developing countries from accessing high-end AI technologies, and it will exacerbate rather than ameliorate existing inequalities.

- **Ethical use of AI in education:** All governments need to review the risks, and develop and implement regulatory frameworks urgently. Regulations for developers and companies must also ensure that AI serves us by contributing towards a sustainable world that is economically and socially just and inclusive. Humans should be protected from becoming victims of AI tools, and the design of AI should be based on accountability, transparency, and explainability. Algorithms that discriminate against vulnerable groups and/or promote gender bias should be prevented at the design stage. Furthermore, it is imperative that cross-border regulations are developed. The draft text of the Recommendation on the Ethics of Artificial Intelligence (UNESCO, 2021*a*) that is to be adopted by UNESCO's General Conference at its 41st session in November 2021 provides a reference document for policy-makers in this regard.
- **Inclusive and equitable use of AI:** For AI to be fully leveraged to support learning and enhance education systems, a necessary prerequisite is ICT infrastructure, especially connectivity. Governmental agencies need to mobilize all possible international cooperation to enhance infrastructure and exploit open-source AI tools and resources, to achieve equitable access.

Box 5: Beijing Consensus

Test and adopt emerging AI technologies and tools for ensuring teachers' and learners' data privacy protection and data security. Support robust and long-term study of deeper issues of ethics in AI, ensuring AI is used for good and preventing its harmful applications. Develop comprehensive data protection laws and regulatory frameworks to guarantee the ethical, non-discriminatory, equitable, transparent and auditable use and reuse of learners' data.

Affirm our commitment to developing AI applications in education that are free from gender bias and to ensuring that the data used for AI development are gender sensitive. AI applications should drive the promotion of gender equality.

Ensure that AI promotes high-quality education and learning opportunities for all, irrespective of gender, disability, social or economic status, ethnic or cultural background, or geographic location. The development and use of AI in education should not deepen the digital divide and must not display bias against any minority or vulnerable groups.

Source: Beijing Consensus, UNESCO, 2019*a*, Articles 23, 26 and 29

- **Learning about AI**

This involves how education systems can prepare for human-AI collaboration (see **Box 6**), which includes the following aspects:

- **Developing AI literacy and AI competencies for all citizens**: All of society, young and old alike, need to be better prepared for what it will mean to live in a world increasingly shaped by AI. Literacy skill sets required for living and working with AI, also called human–machine collaboration, are emerging. While we believe in the uniqueness of human intelligence, creativity and ethical reasoning, we should help people understand the theory and practice of AI. In particular, AI literacy includes understanding how AI collects and can manipulate data, and the skills to ensure the safety and protection of our personal information. It also includes algorithm literacy, which comprises knowledge of how algorithms process data and control our behaviours through personalized human-machine communication. The development of AI literacy and competencies should start from an early age and be integrated into lifelong learning programmes.
- **Mainstreaming AI literacy and AI competency development in the school curriculum**: Learning about AI should firstly be incorporated into the school curriculum to support the acquisition of values, knowledge and skills. Robust AI curriculum content must ensure balance between human-orientated and technology-mediated approaches. In addition to introducing essential knowledge and skills on AI, the curriculum needs also to facilitate students' understanding on the human abilities that AI is unlikely to be any good at for many years to come – such as creativity, collaboration, critical thinking, communication, value judgements, and social and emotional learning.
- **Fostering the development of skilful AI engineers and professionals**: The adoption of AI across sectors has been displacing increasing numbers of employees from jobs that require minimal skills, and is also creating more AI-dependent jobs. Education systems need to take broad strategic actions to develop AI engineers, AI professionals, and other human resources to fill the rapidly growing number of AI-dependent vacancies. To help prepare these high-level professionals and support local research and development in the field of AI, universities should be equipped to expand the number and quality of courses that cover the various aspects of AI, from neuroscience to mathematics, and from coding to statistics.

Box 6: Beijing Consensus

Be mindful of the systemic and long-term transformation of the labour market, including its gender dynamics, due to AI adoption. Update and develop mechanisms and tools to anticipate and identify current and future skills needs in relation to AI development, in order to ensure the relevance of curricula to changing economies, labour markets and societies. Integrate AI-related skills into the school curricula and qualifications of technical and vocational education and training (TVET) and higher education, taking into consideration the ethical aspects and interrelated humanistic disciplines.

Be cognizant of the emergence of a set of AI literacy skills required for effective human–machine collaboration, without losing sight of the need for foundational skills such as literacy and numeracy. Take institutional actions to enhance AI literacy across all layers of society.

Source: Beijing Consensus, UNESCO, 2019*a*, Articles 17 and 18

- **Learning with AI**

This involves how AI might be used within education systems in a holistic approach to support learning (see **Box 7**). Learner-centered AI tools should aim to assist the work of education management, teaching, and learning:

- **AI as a common good to promote inclusive access to learning:** Natural language processing technologies based on machine learning have been used to enable text-to-speech and speech-to-text tools. Other AI tools that have been developed for learners with hearing or visual impairments include: the Global Digital Library's use of the AI-powered Google Voice Assistant to read books aloud to children with visual impairment; and StorySign, an AI-powered mobile application created by Huawei to support deaf children in learning to read by using their sign language dialects.[54] An AI-empowered screening tool for the detection of dyslexia at an early age was developed by Change Dyslexia of Spain, a laureate of the 2019 UNESCO King Hamad Bin Isa Al-Khalifa Prize for the Use of ICT in Education.[55] ICT in education policies should firstly call for greater attention to, and significantly increased investment in, research and development to make affordable AI tools available for learners with disabilities.
- **AI-enhanced education management to monitor learning processes and outcomes:** AI designed for education management includes tools to support admissions, timetabling, learning management, attendance records and learning analytics. A systematic use of AI in education management involves integrating AI into national or institutional EMIS. AI tools are designed to analyse data on learning outcomes during courses in order to anticipate

drop-out. For example, the Open University developed OU Analyse,[56] an AI system that uses machine learning methods for the early identification of students at risk of failing, in order to improve retention. The possible risks and recommendations are made available to the course tutors and the student support teams to inform their decision-making on the appropriate assistive measures.

- **Promoting the use of AI to support teachers and learner-centred pedagogies**: The most researched and commonly available applications of AI are its uses for analysing study habits and other behavioural characteristics of learners. This includes tools such as intelligent tutoring systems, dialogue-based tutoring systems, exploratory learning environments, automatic writing evaluation, and automatic student forum monitoring. So far, the algorithms of most of these tools are based on the profiling of factual content that learners need to master, and data on learners' reactions to formative tests. It means that the current AI-based learning systems are grounded in pedagogies that are focused on teaching factual knowledge. It is therefore contestable to claim that AI tools 'teach better than teachers' (Holmes et al., 2019; Miao et al., 2021). It is recommended that the new generation of AI tools should support learners' higher-order thinking, collaborative knowledge construction, and continuous assessment, as lifelong learning companions. AI tools must be developed to support, rather than replace, teachers. At the same time, teachers will also need professional development to help them better understand AI.

Box 7: Beijing Consensus

Consider integrating or developing AI technologies and tools that are relevant for upgrading EMIS in order to enhance data collection and processing, making education management and provision more equitable, inclusive, open and personalized.

Consider applying available AI tools or developing innovative AI solutions, where the benefits of AI use clearly outweigh the risks, to facilitate well defined learning tasks in different subject areas and support the development of AI tools for interdisciplinary skills and competencies.

Apply or develop AI tools to support adaptive learning processes; to leverage the potential of data to enable the evaluation of the multiple dimensions of students' competencies; and to support large-scale and remote assessment.

Be mindful that while AI provides opportunities to support teachers in their educational and pedagogical responsibilities, human interaction and collaboration between teachers and learners must remain at the core of education. Be aware that teachers cannot be displaced by machines, and ensure that their rights and working conditions are protected.

Source: Beijing Consensus, UNESCO, 2019*a*, Articles 10, 12, 14 and 16

Example

- **UNESCO Project on Artificial Intelligence and the Futures of Learning:**[57] The project on AI and the Futures of Learning builds on the Recommendation on the Ethics of AI (UNESCO, 2021*a*) adopted at the 41st session of the UNESCO General Conference and follows up on the recommendations of the Organization's global report *Reimagining our Futures Together: A new social contract for education* (UNESCO, 2021*d*) launched in November 2021 in the context of UNESCO's Futures of Education initiative.[58] It was implemented within the framework of the *Beijing Consensus on AI and Education*. The project consists of three independent but complementary strands, and is designed to reinforce the intellectual guidance for policy-makers through producing the following outputs:
  - Report proposing recommendations on AI-enabled futures of learning
  - Guidance on ethical principles on the use of AI in education
  - Guiding framework on AI competencies for school students

3. Guiding framework and principles

This chapter presents a guiding framework and associated principles for the planning of ICT in education policies and masterplans. The political context in which policies exist can shape how they roll out, but that context will begin to change in reaction to their progress. The guiding principles and framework aim to inspire and help policy-makers to consider policies as an intersectoral ecosystem of interrelated practices. They will be useful as policy-makers draft, re-consider, and evaluate key policies related to the use of ICT in education.

3.1 The ICT in education policy and masterplan as an integrated portfolio

A **policy** is a deliberate set of statements of intent, vision, desired strategic objectives, guiding principles, and corresponding governance mechanisms with the aim of steering investment and actions towards expected outcomes. The ICT in education policies should be implemented as a set of procedures or protocols for making decisions on legislative arrangements and budget planning, and to guide concerted actions. One of the most effective and widely adopted implementation procedures is to set out mid-term (such as five-year) or long-term (such as eight- to ten-year) masterplans. It is in this context that this publication sees an ICT in education policy and masterplan as an integrated portfolio for collaboration. The portfolio planning process includes assessing the current situation, establishing developmental goals and priorities of investment, determining budget and resource allocation, designing action plans and implementation strategies, and measuring results and adjusting policies.

Meanwhile, a **masterplan** is an operational theory of change and a dynamic time-binding and result-based policy action plan that provides a conceptual layout on developmental objectives to be achieved in identified focus areas. It features mid-or long-term plans for mobilizing resources, coordinating implementing agencies, and steering concerted actions. An ICT in education masterplan should start with a review, adjustment or reform of relevant governance mechanisms and legal arrangements to ensure the protection human rights and dignities, regulation of practices, and mitigation of potential risks. A well-designed masterplan should then establish an institutional coordination architecture to direct the agencies that will implement the plan and oversee the implementation, define the results and targets for each focus area, develop detailed costing and budgeting plans to ensure sustainable

funding resources, and set out a phased implementation schedule as well as an evaluation and monitoring mechanism. Cross-cutting these vertical thematic masterplans, horizontal implementation strategies constitute another set of integrated components (Miao et al., 2019). They include strategies for the transversal sharing of funding or human resources and interoperability of technological resources across different policy areas and varied levels and types of education; intersectoral or sector-wide models for funding mobilization and partnership building; accountability and capacity development schemes to synergize and develop institutional competences and responsibilities; incentive mechanisms for institutions and individuals to promote effective implementation and innovative practices and combine top-down and bottom-up actions; and plans on advocacy for policy adoption to prepare all stakeholders, and facilitate dialogue and peer learning between stakeholders and those responsible for implementation.

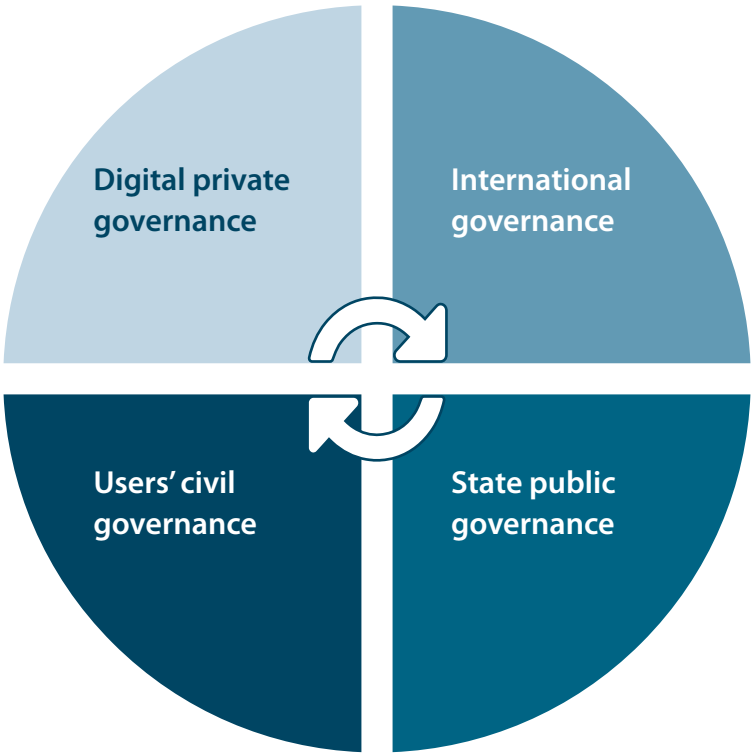
Governments of many countries have published or announced ICT in education policies without associated implementation actions. These 'shell policies' often sacrifice not only public trust in the governments but also the potential of ICT for education. A well-designed and well-resourced masterplan is one of the most important policy levers, and can play the following critical roles:

- **Strengthening integrity of public governance**: As a set of policy actions, the masterplan helps optimize the planning and execution, maximize the mobilization of public funds and implementation partners, and ensure the best possible results to avoid the loss of public trust. A participatory process of development and adoption of the Masterplan will also contribute to the transparency of the policy and therefore build or rebuild public trust.
- **Enhancing state ownership and counterbalancing external control**: The masterplan as proposed by this publication, developed and owned by public governmental agencies, is a policy lever for regulating the over-commercialization of ICT deployment driven by private companies, and helps to ensure that technological innovation is a public good in the education sector.
- **Strengthening the society-wide engagement and funding mechanism**: The development of a well-designed masterplan requires the engagement of society-wide stakeholders. Masterplans are often developed based on a gap analysis and a theory-of-change model, which can identify the possible deficiencies in public funding, and shed light on the priorities for both regular budget planning and fundraising from potential donors. It also often becomes a lever for raising external or foreign aid to fill in funding gaps.

3.2 The global governance architecture and its implication for ICT in education policies

The public ICT in education policies should be viewed in a constantly changing global governance architecture (**Figure 3**) for the digital transformation across sectors including in the education sector.

Figure 3: Governance architecture for the use of ICT across sectors



- **The rapid rise of private governance**: Behind the convenience of communication channels used by billions of people around the world, digital platforms and applications have also defined and implemented their own private normative systems (Petersen et al., 2018). Users have to accept rules that are often invisible. The algorithms – employed by AI tools to track user data, recognize behavioural patterns and rate user practices – are usually implemented without the users' explicit consent. Moreover, the commercial owners of digital platforms and applications are also taking on the roles of both implementers and regulators of the rules, and act as dispute-resolution bodies when conflicts occur among human users and between the platform providers and users. In short, the globally dominant platforms and applications are fast becoming powerful private governance systems, which are weakening public and state authorities.

- **The intergovernmental governance system is responding, but not urgently enough**: Intergovernmental agencies, through standard-setting instruments, are expected to foster international consensus and mitigate the legal and ethical risks rendered by private governance. One of the examples is the development of the *Recommendation on Ethics of AI*[59] that has been led by UNESCO. However, the development of international governance mechanisms has lagged far behind the rapid growth of digital private governance. New national legislative regulations must be reviewed while new policies, including national ICT in education policies, must be developed to ensure the adoption and implementation of the intergovernmental instruments.

- **Public governance lacks the capacity to counterbalance digital private governance strategies**: The single-blind nature of the rules of the private governance and related information asymmetry have put the human rights, data privacy, and cyber security of billions of users under threat. However, state governance systems fall short in terms of both the awareness and the capacities needed to make laws, regulations, and policies to counterbalance digital private governance. In the majority of developing countries, the protection of the users of digital tools remains an uncharted area in national ICT in education policies. A few countries or economies that are conscious of the risks and are institutionally competent have adopted regulatory frameworks or public governance mechanisms to regulate and push back on digital private governance. An example is Regulation 2016/679 of the European Parliament and Council, concerning the protection of natural persons with regard to the processing of personal data and on the free movement of such data (European Union, 2016).

- **Civil governance needs to be mobilized and empowered**: The massive body of end users constitutes a potential civil governance force capable of mobilizing society-wide monitoring and scrutiny on legal and ethical issues relating to the use of digital platforms and applications. However, faced with the rapid pace and technological complexity of the

digital transformation, the awareness and capacities of civil society needs to be enhanced. In addition, partnerships between governmental agencies and civil society must be reinforced to respond to the new challenges. Among all users, non-adult learners are the most vulnerable. Any policies on digital learning should include public regulations for protecting the human rights, cyber security, and data privacy of learners as key integral components. But national policies on digital learning rarely address how to reform public policies and develop relevant regulations to counterbalance private governance.

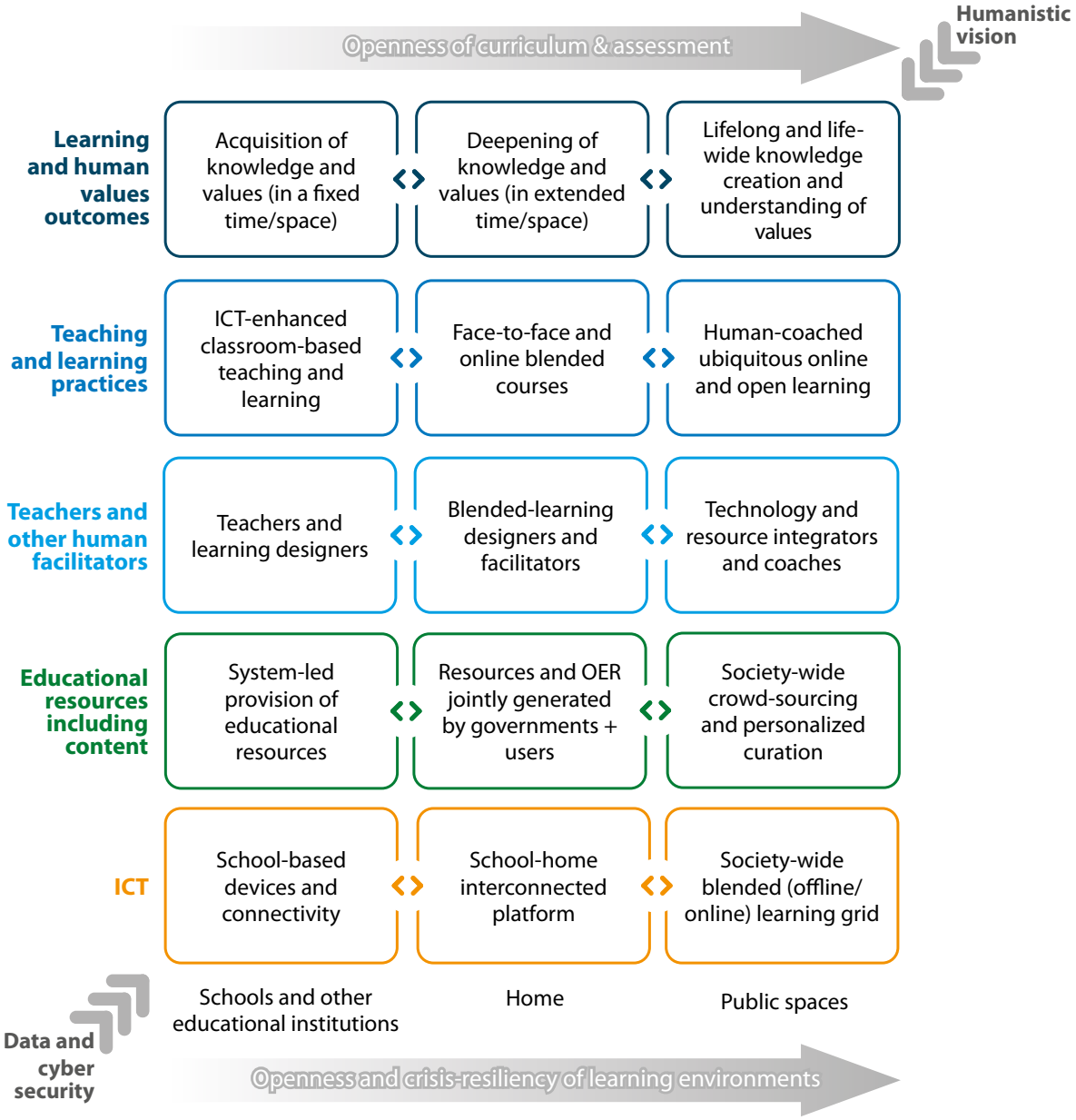
3.3 A guiding framework for planning the ICT in education policy and masterplan

- Here we propose a system-wide framework for the development of ICT in education policies and masterplans (**Figure 4**). It focuses on the main constituent components for policy planning, and does not encompass the policy and resource enablers discussed in **Chapter 4**. This framework has two explicit dimensions: one on learning spaces where ICT is used, and the other on the key elements of ICT in education policies and masterplans. The hidden dimensions include the humanistic vision; the definition of academic and human-development outcomes; the openness of the curriculum, assessment, and learning spaces; inclusion and equity in accessing technology; and evaluation of the ethical concerns and risks of using technology across spaces.

- **The learning and human development outcomes as the aim of the policy:** These outcomes represent the goals of the use of ICT in education and the starting point for the policy planning. The inclusion of human values in the outcomes reiterates the humanistic principle underpinning this planning and necessitates a result-based methodology. Well-being and social development must be included alongside the academic learning outcomes. Result-based planning of ICT in education should start from the expected learning and human development outcomes, not from the deployment of ICT for its own sake.

- **The open learning spaces as the entry point to expand access to educational opportunities**: Learning spaces represent the entry points for the use of ICT to strengthen and multiply opportunities for education. An open approach to the learning space means moving from school-based settings to interconnected learning spaces involving both home and school, and then to a society-wide learning grid. It is intended that the policy planning should move from the narrow approach that limits the use of ICT to classrooms and campuses to an approach that transforms the schooling models and enables ubiquitous access to education programmes from schools, homes, or other spaces. An ICT in education policy should mobilize and regulate society-wide resources to make digital devices and internet connectivity accessible in a range of places.

Figure 4: A guiding framework for planning ICT in education policies



- **A guiding framework for planning ICT in education policies**: The openness of national curricula and assessments represents a fundamental lever for the enabling of pedagogical innovations using ICT. Curricula and assessments should be moved from a rigid knowledge-based approach to a competency-based approach. In addition, it should provide local education districts, schools, and teachers with more flexibility to decide on the design of appropriate pedagogical methodologies, the selection of learning resources, the sequences of delivery, and the means of assessment, especially formative methods. On the other hand, the policy planning should also examine the potential for using ICT to enable assessment, credentialing, and the recording of learning outcomes across grade levels and throughout lifelong learning.
- **Interlinked constituent components as indispensable enablers for achieving outcomes**: The components should be viewed as three pillars of a technology-enabled open learning system. These should include: 1) the technology, learning resources, and human resources; 2) the pedagogical practices to be enabled, including teaching, learning, and assessment; and 3) the expected outputs, in terms of both academic outcomes and the goals of human values development. As mentioned, the planning of these constituent components should start from the desired outcomes, and then the necessary pedagogical practices in schools and beyond, and finally the defining of teachers' capacities in making effective use of ICT. In addition, policy decisions need to be made about the intended learning outcomes and the ways in which they are best achieved, which will inform what technological approaches are needed from the perspective of both the educational infrastructure and the key stakeholders, including learners and teachers. The choice at one layer will determine policy decisions on the other layers; for example, the choice of ubiquitous blended learning will require the development of digital courses covering all subjects and grade levels, in addition to the blended technology.

3.4 Guiding principles for developing the policy and masterplan

The guiding framework summarizes the following principles, which should be applied regardless of developmental level or educational context.

Implement humanistic principles and ensure inclusion, equity, and gender equality

The implementation of ICT in education must start with the adoption of humanistic principles (see **Box 8**) and should pay special attention to the challenges of inclusion, equity, and gender equality. The principles necessitate addressing two imperatives: the use of education to close the equity and gender divides in access to ICT and in digital skills; and ensuring inclusion, equity, and gender equality in all ICT in education programmes, and eliminating any gender biases – hidden or explicit – found in data sets and algorithms used to develop AI tools.

Box 8: Beijing Consensus

We reaffirm UNESCO's humanistic approach to the use of AI with a view towards protecting human rights and preparing all people with the appropriate values and skills needed for effective human–machine collaboration in life, learning and work, and for sustainable development.

We also affirm that the development of AI should be human-controlled and centred on people; that the deployment of AI should be in the service of people to enhance human capacities; that AI should be designed in an ethical, non-discriminatory, equitable, transparent and auditable manner; and that the impact of AI on people and society should be monitored and evaluated throughout the value chains.

Source: Beijing Consensus, UNESCO, 2019*a*, Articles 6 and 7

Examples

- The ITU initiative 'Digital Inclusion of All'[60] provides data and tools designed to promote digital equity and inclusion.
- The UNESCO programme on promoting technology and innovation for gender equality[61] is accumulating resources on the gender-equitable use of technology.

Evaluate trade-offs between ICT and other priorities in accordance with budget limitations

A typical mistake in planning ICT in education policies is to assume that ICT can provide a comprehensive solution. However, its deployment in the education system is costly, and allocating funds for the procurement of equipment prevents investment in other more basic priorities such as ensuring every student has a desk, a safe classroom, and adequate sanitary conditions. Applying or creating cost-value evaluations, to assess whether the educational benefits of implementing ICT in education programmes (e.g. increased effectiveness, enhanced efficiency, and expanded accessibility) outweigh the costs for other priorities, needs to happen before a major investment can be justified. Only once the use of ICT is justified should the potential of using it to support SDG 4 be contextualized and further defined – based on the challenges of inclusive and equitable access to educational opportunities, the relevance and quality of lifelong learning, and the efficacy of EMIS. Drawing on the lessons of the COVID-19 disruption, the use of technology to enhance resilience in education systems should be planned as an integral part of any new learning infrastructure. Policy-makers need to examine and assess the local ICT readiness, and only then make appropriate decisions on the most applicable technological approaches. In addition, they should use a holistic strategy to plan

where learning will occur. In the least developed countries, where schools are insufficiently safe and/or sanitary, a paramount principle is that the refurbishment of schools and classrooms should be included as a key component of ICT in education policies and masterplans.

Example

- The challenges identified by the national ICT in education policies and masterplans[62] of Bangladesh (2012/21), Cambodia (2009/13), and Nepal (2013/17) provide a reference for how developing countries have implemented ICT in the service of the local education systems.

Anticipate possible risks and emergent negative impacts and regulate accordingly

Policies must regulate and mitigate the emergent negative impacts of the use of ICT on education systems, individuals, the environment and climate change. Anticipating the hidden or uncharted risks in order to plan preventive strategies is equally important.

- **Protect data privacy and cyber security:** The most common risks are related to data privacy and cyber security. It is paramount that policies and masterplans includes the development and implementation of laws or regulatory frameworks to protect the data privacy of learners, teachers, and parents. Technological approaches and human-based measures should be planned to safeguard individual and institutional cyber security (see **Chapter 4**).
- **Promote digital well-being:** The misuse or over-use of ICT in education can be harmful to learners' – especially young students' – digital well-being. Emergent negative impacts on digital well-being include internet addiction and impaired vision caused by extended amounts of time spent using digital screens, as well as psychological problems caused by disturbing content, abusive online comments or bullying. Accordingly, particular implementation strategies should be planned to prevent or reduce these known risks and to remain alert to other problems that may be hidden.
- **Mitigate the impact on the environment:** As noted, ICT is a key source of greenhouse gases that are impacting on the climate, due to carbon-consuming electricity. ICT also produces e-waste that is polluting ecological systems, due to digital devices that are no longer in use all too often being dumped in the natural environment, rather than recycled, without proper measures for their degradation. Accordingly, policy-makers need to understand and be mindful of the carbon and e-waste footprint of ICT, ensuring that the ICT in education policy promotes carbon-neutrality or carbon-reduction principles, drives the adoption of energy-efficient approaches, and implements measures for the recycling of e-waste.

Examples

- In October 2019, China's Cyberspace Administration and Ministry of Education introduced regulations[63] designed to curb the use of AI-powered cameras, headbands, and other devices in schools.
- The effect of an internet-addiction prevention programme[64] from the Republic of Korea on adolescents' self-regulation until 2018.

Advocate a society-wide view of technology-enabled open learning systems

Following the COVID-19 pandemic, it is increasingly clear that all countries need open and crisis-resilient learning systems that can ensure the continuity and quality of learning when facing the more frequent waves of education disruptions. Crisis-resilient systems are impossible without the judicious use of technology. It is important to advocate a culture of openness in connecting and extending learning spaces, managing digital learning resources across platforms, and facilitating learning beyond the school walls. Transforming the provision of school education requires structural changes. For this to work, it is necessary for a policy to consider the links among educational sectors and sub-sectors and different areas of policy, and the need to re-design regulations and programmatic actions. Prioritizing open learning systems and outcomes also leads to requirements for OER and open practices. Policy-makers also need to take a society-wide or intersectoral view of the provision, mobilization, and integration of ICT resources for education. This can be particularly challenging in countries where connecting households and schools is the responsibility of more than one ministry, such as the Ministry of Technology and the Ministry of Finance.

Examples

- China was able to mobilize society-wide resources[65] for the provision of online courses and resources in response to COVID-19 disruption.
- UNESCO launched a project[66] on technology-enabled open schools in 2020.

Prioritize continuous support for teachers and incentivize effective implementation

Box 9: Qingdao Declaration

Successful integration of ICT into teaching and learning requires rethinking the role of teachers and reforming their preparation and professional development. It calls for promoting a culture of quality in all its aspects: staff support, student support, curricula design, course design, course provision, strategic planning and development. We will therefore ensure that teacher-training institutions are equipped and prepared to use ICT adequately to expand the benefits of training and professional development programmes to all teachers and to act as the vanguard for technology-supported innovations in education. We also commit to providing teachers with system-wide support for the pedagogical use of ICT, to incentivize teacher innovation, and to develop networks and platforms that allow teachers to share experiences and approaches that may be of use to peers and other stakeholders.

Source: Qingdao Declaration, UNESCO, 2015*a*, Article 11

As noted in the *Qingdao Declaration* in **Box 9** (UNESCO, 2015*a*), the key to the successful implementation of a policy in any social sphere is changing the behaviour of the practitioners in the system. Teachers can often be especially challenged by new configurations of teaching and learning settings, especially the need to fully integrate technology into learner-centred pedagogical practices, which is best addressed by professional development. Policy decisions for teachers' professional development should begin with a review of the following: existing programmes provided by teacher-training institutions; school-based facilitation of teachers' pedagogical use of ICT, especially for novice teachers; the provision of in-service training when a new ICT in education policy and masterplan are introduced; and the affordances and benefits of peer learning and coaching online and offline. Teachers need to be given specific support, to enable them to adapt to the changes, when the integration of ICT leads to structural changes in educational management and administration.

The behaviours of teachers and other practitioners are also often shaped by the measures and schemas used for evaluating them and their institutions, and the criteria used for assessing learning outcomes. If policies are intended to encourage the adoption of innovative practices, the evaluation schemes need to be adapted accordingly to steer the expected changes. Incentive mechanisms should be included in the implementation strategy of a policy, including the association of innovative practices with teachers' performance evaluations, and recognizing innovations through reputational or financial rewards.

Examples

- The ICT Competency Framework for Teachers, version 3 (UNESCO, 2018*c*), is designed to enhance pre-service and in-service training on the pedagogical use of ICT.
- The Republic of Korea provides training for all teachers for each of its five five-year ICT in education masterplans, and rewards 'star teachers' who have designed innovative practices (UNESCO, 2019*c*).

Monitor and evaluate the policy implementation and enhance the evidence base

A regular and transparent policy-aligned monitoring and evaluation mechanism is always an integral component of any implementation strategy. The aim is to measure and decide the extent to which the policies have actually delivered the required results. In response to the multiple areas in which ICT can be leveraged to support SDG 4, one approach to building a comprehensive and rigorous evaluation framework is proposed by this publication. As outlined in **Chapter 1**, evidence gathering should target data and feedback on ICT-supported education management and the use of ICT to expand access to educational opportunities, enhance the relevance and quality of learning, and enable lifelong learning and digital skills development. In addition to the administrative monitoring and evaluation of the policy implementation, the evidence base should be enlarged by means of independent and in-depth evaluations of the impact of the policy and masterplan, and on the long-term impact of the use of ICT in education – including both intended and unintended consequences. It is also recommended that the research evaluation programmes cover the review of emerging technologies and their implications for education, to help ensure the local education system is kept abreast of the latest trends and forthcoming opportunities.

Example

- In 2017, based on the review of the emergence of AI and its potential impacts across sectors, the Government of the People's Republic of China announced its development plan[67] for the next generation of AI.

4. Policy and masterplan development roadmap

Policy planning is a flexible concept, which in practice does not follow rigid rules. The effective implementation of a policy requires the combined actions of multiple institutions and stakeholders. For this reason, in this chapter, this planning is characterized as a participatory process in which all those affected by the policy will be involved, with a recognition of the crucial role of human agency in the development of policy. The following roadmap is both a continuous and a cooperative process in which those with similar or competing values seek to form and shape policy through an open consultation approach.

As summarized in the guidelines on the development of OER policies (Miao et al., 2019), there are three main reasons for policy failure: unrealistic objectives, lack of ownership, and misunderstanding of the aims. These are mitigated through *the participatory method* described here, involving wide-range consultations and engagement with partners for the planning. While detailed recommendations for organizing consultations based on the draft of the entire masterplan are provided in **Step 1**, joint planning with partners and other stakeholders should be exercised in every step. Consultation at an early stage helps all parties to understand whether the initial ideas for objectives and actions are feasible, and identify the possible risks. Consultation on the masterplan during this phase will help mobilize interdisciplinary knowledge and reveal possible resources and possible hazards.

UNESCO has developed an online tool and resource centre, the ICT in Education Policy Toolkit, which provides a step-by-step guide on how to create an ICT in education policy and masterplan.[68] The toolkit has two main sections: (1) Masterplan and (2) Resources. The Masterplan section is organized around toolboxes with advice on the specifics of the policy process, while the Resources section contains the reference items that were mentioned in each toolbox, together with a search tool. The step-by-step guide aims to provide structure to the processes of policy-making while reviewing each decision in the context of broad planning and in comparison with other decisions. However, it is not designed to suggest that policy planning in general is a linear, sequential, or end-to-end process. In practice, the policy and masterplan development 'steps' are interdependent, yet can be planned in parallel. Meanwhile, at each subsequent step, decisions made in previous steps need to be revisited and sometimes revised.

4.1 Step 1: Governing and steering the policy

When undertaking **Step 1**, policy-makers may refer to Toolbox 1 of the ICT in Education Policy Toolkit.[10]

4.1.1 Step 1.1 Establish the planning committee and working groups

To formalize the policy development, it is first important to establish a planning committee to govern and steer the policy's design and implementation. The committee can have different set-ups and names in different contexts. For example, it might be called a Policy Coordination Committee, Steering Committee, or High-Level Committee.

Depending on the government's political commitment to the policy, a high-level governing board or committee can be appointed by the head of state to make top-level decisions on the regulations and public budget allocation. The governing board under the planning committee should receive a clear endorsement from the highest level in the administrative hierarchy (e.g. cabinet, minister, president or head of the educational institution), granting it full and direct accountability for the planning processes of the policy. The membership should ensure that all concerned governmental agencies (including education, finance, ICT or telecom, publication, intellectual property and data security), sectors, organizations and persons are involved. The governing board should be made up of permanent members for a period that covers the duration of the design and implementation of the policy. The membership of the planning committee can be reviewed and iterated according to the scope and duration of the policy.

Alternatively, an administrative-level planning committee can be formed to steer the process and ensure the approval and launch of the masterplan. Under the administrative planning committee, sub-committees or technical working groups comprised of governmental agency officials and specialists can be established, along with a secretariat to coordinate different committees or working groups. The planning committee should be closely linked to the formal organizational structure in the education system so that governance and political considerations can be linked to the implementation of the policy.

Forming a planning committee offers an opportunity to exercise a participatory approach through involving stakeholders including representatives of development partners, donors, civil society organizations, NGOs, academia, and the private sector as well as learners, parents, school administrators, and teachers' union representatives. Their participation in the planning process will reinforce the co-ownership of the policy and masterplan and expanded the number of partners for the implementation.

4.1.2 Step 1.2 Review and reconcile intersectoral regulations and policy alignment

At the initial stage, the planning committee needs to review whether there are intersectoral overarching regulatory frameworks that govern and determine standard procedures on what technologies and data can be adopted in education, how they can be procured and deployed, and what practices are permitted. As further specified in **Step 4**, the common regulations to be considered by an ICT in education policy include data privacy, cyber security, and content licensing. The high-level committee needs to anticipate these potential issues, and review and reconcile the regulations over the entire planning process. One of the most challenging topics for the intersectoral negotiation is 'zero rating' online learning. This requires the telecom sector and other concerned agencies to create a list of online learning websites and automatically make them exempt from billing so that they can be accessed for free. The negotiation and agreement on which are included need to take place with multiple sectors and involve various legal aspects, and this can only be achieved by a high-level committee.

The ICT in education policy also needs to be aligned with other existing education policies or intersectoral development strategies, which may mean that the existing policies need to be adapted and/or reformed. An ICT policy can follow a whole-government approach to promoting universal access to and effective use of ICT in different areas of the country. In this context, a standalone ICT in education policy is produced by the education ministry, and at the same time it is integrated as a component of broader intersectoral policies on harnessing ICT for the development of the country.

4.1.3 Step 1.3 Make an initial decision on the scope, duration and possible endorsement of the policy

To begin forming the policy, the planning committee can take decisions on the following:

- **Duration of policy**: the committee should decide on a particular duration (e.g. five years) or a specific end date (e.g. 2030). If the policy is envisaged to have a long duration, the implementation plan might be broken down into three- to five-year intervals.
- **Scope of policy, thematic focus**: relating to the sub-sectoral areas detailed in **Chapter 5**, the planning committee might make an initial decision on whether a sector-wide ICT in education policy will be planned to cover all or most of the key grade levels and all types of education, or will focus on specific sub-sectors or areas (e.g. school education, TVET, HE, or non-formal or lifelong learning outside of formal educational institutions); and whether it will focus on all thematic areas or only one specific sub-theme (e.g. EMIS or digital learning resources).

- **Envisaged endorsement**: it is also the planning committee's duty to determine who will endorse the policy (e.g. the head of state, cabinet, ministers, or head of the educational institution), its legally binding effects, and the protocol for its validation and endorsement.

4.1.4 Step 1.4 Organizing consultations as a strategy to engage with partners

Consultation and engagement are critical to gain buy-in from partners and multiple stakeholders, and elicit input to finalize the policy and masterplan. A consultation process, which should begin at the start of the roadmap and continue throughout, helps achieve the following objectives:

- To elicit critical feedback on the development and draft of the policy and masterplan and constructive comments on finalizing the document.
- To enhance the understanding of partners on the desired changes and required processes of the policy and masterplan, and equip them with the right competences.
- To continue reinforcing the ownership of key partners and stakeholders, and start to involve them in the implementation of the policy.

The commonly adopted methods of the consultation include:

- **A wide public consultation** which can be conducted by means of online or paper-based surveys that anyone can fill in, or opinion-seeking meetings (face-to-face or online) with representatives of the public.
- **Focus group discussions** which can include seminars with selected representatives or experts, to seek their input on specific issues.
- **Interviews** to help collect first-hand information and direct feedback from key stakeholders.
- **Continuous knowledge sharing** which can be facilitated through newsletters, websites, or other media.
- **Regular meetings** of members of the governing board and the coordinating entities.

The process can be organized by the planning committee or external independent research institutions or consultancy organizations that are commissioned to implement the consultation tasks.

Table 5 summarizes possible stakeholder groups for consultation, which can be mobilized to play two complementary roles: to provide support, feedback, and advice on finalizing the policy and masterplan, and to be involved in implementing certain tasks detailed in the masterplan. In this context, **Table 5** also presents recommendations for relevant methods and main objectives for different groups.

Table 5: Stakeholders, relevant methods, and objectives for consultation

Group	Composition	Method of consultation	Objectives of the consultation	Possible role for implementation
Organizations with authority to establish regulations or funding incentives	Representatives of organizations responsible for: regulations, quality assurance, qualification frameworks of institutional staff, intersectoral public funds, regulating pricing of hardware, and digital services	· Focus group · Regular meetings of the governing board	· Review the feasibility of regulations, quality assurance mechanisms, qualification schemes, universal service funds, zero rating, and legal procedures for tendering	· Endorse regulations and provide capacity development
End-user groups	Representatives of learners, teaching staff, ICT support staff, leaders of educational institutions, and parents who are asked to facilitate home-based learning	· Focus group discussions · Interviews with selected groups · Continuous knowledge sharing	· Elicit feedback on the feasibility of the desired change · Gain insights into teaching and learning practices · Build awareness and capacities	· Integrate ICT into daily teaching and learning practices in the classroom · Create and share innovations
Private providers of digital learning services	Representatives of private companies that supply hardware, digital services, and content	· Focus group discussions · Interviews with selected groups	· Elicit feedback on the regulations specifically concerning the private sector · Mobilize inputs on components of the masterplan relating to technology · Advocate the humanistic principles	· Mobilize funding and resources from the private sector · Adopt regulations and promote digital innovations as public goods for education

Group	Composition	Method of consultation	Objectives of the consultation	Possible role for implementation
Research and evaluation communities	International and local experts and representatives from national educational institutions, universities, and the research community	· Focus group discussions · Interviews with selected groups · Continuous knowledge sharing	· Elicit feedback and input on the vision, objectives, indicators, and actions of the Masterplan · Mobilize inputs on the methodologies planned for monitoring and evaluation, and research	· Implement capacity-building programmes · Execute or facilitate evaluation and research
Local public community	Representatives of the local public community, especially from libraries, community service centres, and charitable foundations	· Public surveys · Focus group discussions · Continuous knowledge sharing	· Raise awareness and reach consensus · Elicit general feedback	· Help minimize any public resistance · Mobilize external funding and resources
International community	Representatives of international organizations including the UN, NGOs, and foreign aid agencies	· Focus group discussions · Interviews with selected groups · Continuous knowledge sharing	· Elicit feedback · Explore synergies with ongoing or planned programmes and with international community funding	· Plan and execute collaborative programmes · Share funds and resources · Facilitate the exchange of ideas and collective learning

4.2 Step 2: Policy review and needs assessment

When undertaking **Step 2**, policy-makers may refer to Toolbox 2.1 of the ICT in Education Policy Toolkit.[10]

It is recommended that policy-makers conduct a thorough review of previous ICT in education or other relevant policies, in order to decide on key aspects of the one that they will be developing. Policy reviews should cover at least an analysis of existing policies, a needs

assessment, and a situational analysis. The main objectives of a needs assessment are to shed light on the challenges or vision to be addressed, engage in innovative and forward thinking, and come up with initial approaches to the identified challenges. Existing policies should be assessed, and weak points should be identified, alongside the desired outcomes, and the underlying causes should be evaluated. The aim of the policy review is to identify what policy change needs to be made and why, and to provide a rationale for the public intervention and the new agenda. This is when a **theory of change** should be considered, which consists of a comprehensive description and illustration of how and why a change is expected to happen in a particular context. The theory of change should define long-term goals and then map backwards, to identify the necessary preconditions for a successful implementation.

For example, the policy review conducted by UNESCO for Malaysia in 2013[69] identified the country's key challenges when integrating ICT in education to realize the policy goal of moving toward a knowledge- and innovation-driven economy. These challenges included:

- The need for a clearly articulated roadmap with progressive goals, targets, and appropriate resourcing to guide a national developmental pathway that realizes the ultimate educational goal of nurturing first-world talent for a knowledge economy.
- The need for ICT in education to be positioned as an essential enabling factor in educational reform initiatives.
- The need for systematic supporting mechanisms to motivate and facilitate schools and teachers to undertake ICT-enabled pedagogical and assessment innovations.
- The need for consistent criteria to evaluate, support, monitor and reward innovative practices at teacher and school levels.
- The need for capacity to lead innovation and flexible implementation to achieve the policy goals for ICT and, hence, change the management strategies necessary to encourage innovations at all levels, establish mechanisms for grass-roots participation in policy and implementation decisions, and foster discursive dialogues among partners and stakeholders.
- The need to enhance the inclusiveness of the ICT in education policy and implementation, so that students who do not have a computer and internet at home can still access the learning opportunities (e.g. by means of subsidized household ownership programmes), and the need to address persistent digital and educational divides.
- The need for data management to be an integral part of a top-level coordination, in order to avoid the fragmentation of ICT-based data collection, processing and analysis.

4.3 Step 3: Defining the vision and framing the policy

When undertaking **Step 3**, policy-makers may refer to Toolbox 2.2 of the ICT in Education Policy Toolkit.[10]

4.3.1 Step 3.1 Defining the vision

A policy vision should express **a clearly articulated view of what should change and what the result should be** when the policy is successfully implemented. Such a vision should therefore be firmly placed in the present, but also focus on the anticipated future. In other words, its purpose is to reflect on unachieved previous goals, identified in the policy review, while also considering new goals and expected developments. The existing education sector plan should be used to find priority areas in order to ensure that the vision of the ICT in education policy is in line and synchronized with the broad priority areas for the development of the country. In particular, this vision should make the humanistic principles concrete by centring on the well-being and capacity development of humans. In addition, it should prioritize access to technologies and connectivity for marginalized populations, which will lead to the sustainable social and economic development of local societies and the entire country. A vision that only targets those students who already have some access to ICT while leaving marginalized groups behind must be avoided.

The vision statement should be **concise and specific** and should provide orientation for the subsequent steps. It is best to have one overarching societal vision and then link this to a vision for the educational focus of the specific policy. An example of an overarching vision can be found in the *Qingdao Declaration*: 'to unleash the potential of ICT to achieve greater quality in education and transform learning' (Article 8). In **Chapter 5**, examples of vision statements are provided for specific focal areas. The vision statement for an intersectoral policy should link these together, to provide a clear perspective of what a better teaching and learning environment for all would look like.

The vision should also be validated against a **gap analysis** of the current situation. The gap analysis will identify those programme areas that a country should implement to achieve its goals, since it provides a realistic picture of the challenges and opportunities of the current educational system (Miao et al., 2019). Based on the review of existing policies, the gap analysis will help calculate the amount of time, funds and resources needed to achieve the vision, and thus check the validity of the vision so that it can be reformulated if necessary. A gap analysis can also provide a backdrop for designing the masterplan.

4.3.2 Step 3.2 Framing the policy

By the end of **Step 3**, the duration, scope, main focus areas, and desired endorsement of the policy should have been determined, and the main body of the document should have been

drafted. While outlines and headings vary, the ICT in education policy should cover at least the following key elements:

- Preamble or introduction
- Context and situation analysis
- Rationale
- Duration, scope, and policy alignment
- Guiding principles
- Operational perspective or overall implementation strategies
- Vision statement or policy statements
- Policy framework (focus areas, each with goals or strategic objectives)

4.4 Step 4: Constructing masterplans

When undertaking **Step 4**, policy-makers may refer to Toolbox 3 of the ICT in Education Policy Toolkit.[10]

The masterplan is the **operational theory of change**, the mid- or long-term plan for guiding the sustainable development of a sector through establishing the expected results for each programme area, and then setting indicators, and defining timeframes. From there, the method is to work backwards, considering which interventions will be necessary to fill the gaps and achieve the specific goals.

A masterplan specifies what needs to be changed and can have multiple building blocks as indicated in the guiding framework: learning and human development outcomes; learning resources; expected pedagogical practices (teaching, learning, and assessment); teachers' competences of making effective pedagogical use of ICT; and appropriate technologies, including both institutional technologies to deliver education programmes and individual technologies to access digital courses. Specific action lines and the key elements of a masterplan corresponding to different areas of a policy are proposed in **Chapter 5**. Ahead of detailed masterplans on particular areas or themes, an overarching masterplan on ICT in education should first cover key transversal enablers, especially regulations or laws, budget planning, quality assurance measures, capacity building, and incentive mechanisms.

4.4.1 Step 4.1 Regulations and laws

If relevant regulatory frameworks exist before a new policy is implemented, they must be reviewed against the emergent needs of the new ICT in education policy and all key areas of the masterplan. There are three fundamental themes around which regulatory frameworks and laws must be developed and executed to ensure the legal, ethical, and safe use of ICT in education: data privacy, cyber security, and content licensing.

Data privacy

The use of technology to support learning is based on flows of data between the users and ICT system, and some of this data might be highly personal and security-sensitive. In the face of the exponential growth of data-backed ICT approaches, the most important precondition for introducing a policy and masterplan is to ensure that regulations or laws on the use of learner-created data are developed and executed. These regulations and laws on protecting data in the education sector should:

- ensure that the learner or their legal guardians remain the owner of their data at all times no matter who is collecting and processing it;
- be transparent about how data are collected, what purpose the data processing will serve, what algorithms are used to process the data, and how the results of the data processing will be explained to teachers and learners – especially when private partners are involved in the data collection and processing;
- ensure that the storage and management of personal data is secure; and
- prevent data from being used to make decisions that will harm learners' present and future education and well-being, such as overly negative evaluations, blunt judgments on learners' competences, or rigid predictions about their future development.

In the European Union, the General Data Protection Regulation (GDPR)[70] was introduced in 2018 with the aim of governing data use in all parts of society and the economy. Adherence to such procedures is vital for any ICT in education policy.

Cyber security

The number of threats in cyberspace is growing daily, and every school, educational institutions, or individual user is a potential victim. Regulations and laws on safeguarding cyber security should be integrated as one of the most important enabling factors for the ICT in education policy, which should cover at least three levels of components.

The first component applies to national or central learning management platforms. It is compulsory that all platforms engaging with learners and teachers should provide the technology and human support necessary to securely store any type of data, retain it for no longer than is necessary, and guarantee the safety and protection of online teaching, learning and communication activities. The managers of the platforms should be held accountable for giving immediate support to users who report cyber security breaches.

The second component is for schools and educational institutions to take responsibility for ensuring that the institutional online platforms, applications, and devices comply with cyber security regulations. When cloud-based platforms and applications are adopted by these

institutions, specific regulations should be designed to define and enforce the duties they share with the providers and the government agencies that are validating and monitoring the security.

The most important component of the regulations is the security of individual learners – with the most sensitive issues being related to age restrictions, especially on social media services. These services have created private spaces for individuals to engage in social interactions with unknown persons. Meanwhile, this interaction can be all too often hidden from teachers and parents. Other threats to the cyber security and well-being of learners include cyber bullying; phishing attacks to steal personal information, such as financial details and home addresses; online dating involving underage children facilitated by social media platforms; exposure to inappropriate content involving graphic violence or sexual imagery; and addiction to gaming and social media. Regulations and laws are needed to protect against these and other uncharted threats. The most common approach is to prevent social media from providing services to children until they reach a minimum age, which requires platform providers to implement content-filtering technologies to check and delete disinformation, misinformation, and inappropriate content for young learners. For example, under the Children's Online Privacy Protection Act in the United States,[71] organizations or individual social media providers are not allowed to provide services for children under the age of 13 without parental permission. And currently, TikTok, Instagram, Facebook, Snapchat, Twitter, and YouTube have adopted this restriction. The GDPR adopted by the European Union in 2018 sets 16 as the minimum age, and providers of social media including WhatsApp, LinkedIn, Flickr, and Vimeo are currently abiding by this.

A more specific regulation on ICT in education service providers is to create a scrutiny and validation framework for online courses and services, and digital applications and devices – to ensure that only trusted and accredited providers are recommended and are accessible from institutional computers. In particular, the ICT in education policy should require the development of programmes to enable individual users – especially learners – to best understand how to make ethical, legal, and safe use of ICT while protecting their personal cyber security.

Content licensing

The sharing, reuse and modification of existing learning materials can often be simplified and supported by digital formats and digital tools. However, copyright is a legal right, existing in most countries, which grants the owner the exclusive rights to control how their work is used, reproduced, and credited, as well as compensation in association with any use or reproduction of their work. By default, the owner is the author of a work unless they have transferred the copyright to someone else, such as a publisher – which must be done explicitly through a contract. This means that the infringement of intellectual property (copyright) is a risk for any ICT in education policy. OER are learning materials that have been licensed to

allow modifications and reuse without the need to contact the original author. In this way, they present an opportunity to increase access to high-quality learning materials that can be contextualized for specific regional purposes through their open licensing. It is for this reason that UNESCO recommends to all national policy-makers and stakeholders in education to move to openly licensed learning materials, and indeed to use software based on Open Source licensing (Miao et al., 2019). For this to happen, the planning committee must decide on the licences to be adopted for education resources developed under public funds, and activate a complex protocol to negotiate with the public sectors that are in charge of intellectual property and partners who will be affected by the adoption of open licences.

4.4.2 Step 4.2 Budget planning and alignment

Sufficient budgets are necessary to ensure that the digital infrastructure and devices can be procured (bought, leased or loaned) and maintained, and capacity-building initiatives are launched to support teachers and learners in the integration of ICT into high-quality teaching and learning practices. Therefore, every activity in the masterplan and all cross-cutting programmes should be accompanied by a costing exercise and a budget plan for implementation. It is worrying that some ICT in education policies are approved without determining the total costs and sources of funding. If the masterplan does not estimate the full costs and secure sufficient budget, it is likely to encounter serious problems during implementation. For example, a government may find it attractive to provide every student with an electronic tablet to use in school, and so make a heavy investment in purchasing a large number of devices. However, when the tablets are delivered to the schools, they may have no suitable content, while any content they do have may not be aligned with the curriculum. In any case, teachers will need comprehensive professional development so that they know how best to use the tablets inside the classroom effectively, which again will need to be properly budgeted for and funded. Finally, principals will need to be provided with sufficient budget to pay for the increased electricity costs and for the support and maintenance of the technology.

Estimation of total cost of ownership

To estimate the cost of different action lines or concrete programmes, it is important to adopt the approach of the 'total cost of ownership' (TCO). The initial investment paid to procure the most visible equipment is only a part of the TCO, and sometimes only amounts to less than 25 per cent of the total cost needed to make effective use of the equipment. This means more than 70 per cent of the cost, including recurrent and hidden costs, is often unanticipated. Based on the guiding framework introduced in **Chapter 3**, the costed items and distribution of costs are summarized in **Table 6**.

Table 6: A Total Cost of Ownership (TCO) model for technology-enabled open learning systems

Component	Item	Existing or baseline resources	Ongoing costs
Technology (to enable open and crisis-resilient learning systems) ~33% of total budget	Initial cost of procurement of school-based computers		Expected computer/student ratio (e.g. 1:5)
	Initial cost of school-based internet connectivity		Expected school bandwidth
	Initial cost of school-based refurbishments of classrooms and/or computer labs		Required conditions of classrooms and electricity supply
	Initial cost of school-based peripherals		Expected school-based peripherals
	Initial cost of inclusive equipment and tools for students with disabilities		Sufficient equipment and tools to support students with disabilities
	Recurrent annual cost of school-based electricity consumption, maintenance of computer and peripherals, and repair or update of broken devices		Annual cost of school-based electricity supply based on possible innovations such as the supplementary solar power
	Recurrent cost of school-based access to internet		It is recommended to consider zero/discounted rating for education data
	Recurrent cost (subsidies, loans, etc.) of household computers		Subsidies or loans needed for household ownership or access to digital devices
	Recurrent cost (subsidies, loans, etc.) of household access to internet		Subsidies or loans needed for household access to internet
	Initial cost of national or central learning-management platforms		Expected technology capabilities (accommodates synchronous visits of all teachers)
	Recurrent cost of maintaining and updating or upgrading central learning management platforms		Increased recurrent cost of maintaining and updating or upgrading central learning management platforms
	Other emergent technologies		

Component	Item	Existing or baseline resources	Ongoing costs
Learning resource development and alignment ~33% of total budget	Initial cost of digital/ distance learning courses covering all subject areas and all grade levels aligned with the national curriculum		Expected management and coverage of online courses (all grade levels, all subject areas)
	Recurrent cost of updating digital/distance learning courses		Expected functionalities to support learning, teaching, assessment, and learning management
	Other emergent items		
Teacher training and support ~33% of total budget	Cost of developing and validating teacher-training programmes (including cost of developing national ICT competency standard for teacher if applicable)		Cost of developing and validating new teacher-training programmes
	Total cost of organizing training for all in-service teachers		Cost of training all teachers
	Recurrent cost of supporting the effective use of ICT and continuous professional development for in-service teachers		Increased recurrent cost of supporting the effective use of ICT and continuous professional development for in-service teachers
	Cost of aligning pre-service teacher-training programmes		Cost of aligning training programmes and certification
	Cost of supporting parents or caregivers to facilitate home-based learning		Cost of additional support provided for parents or caregivers to facilitate home-based learning
	Other emergent items on training and supporting teachers and facilitators		

Audit of existing funds and resources

As indicated in **Table 6**, policy-makers should carry out an audit of existing funds and ICT resources at the levels of ministries, local authorities and schools. If there is an annual budget at the level of the ministry to purchase computers, buy or print books, update the curriculum, or train the teachers, the budget might need to be increased to fund similar activities in the masterplan. This might include the revision of existing budgets to respond to the structural change of items under the budget. For example, when devices with pre-loaded digital textbooks are adopted to replace some printed books, the budget previously allocated for the printing and distribution of books can be repurposed to support this. The budget and ICT resources available at schools should also be audited, and the costs incorporated in the estimation of the TCO.

Alignment of budget and funding sources

At the stage of preparing the masterplan budget, multiple sources should be aligned and coordinated to improve cost-efficiency.

- **Mobilizing intersectoral public funds for supporting universal access to broadband**: In order to extend the benefits of internet connectivity, the ITU and national policy-makers have promoted the use of intersectoral funding tools to increase the coverage of and access to broadband in underserved areas. These tools include 'universal service funds' (USFs), which levy a certain per cent of the annual revenue of the highly profitable telecommunication sector to generate public funds to be used to advance the universal access to broadband (GSMA, 2013; ITU, 2013). USFs have been established in many countries around the world. However, there are multiple examples of failed USF policies (Bleeker, 2019; GSMA, 2014), so it is recommended that policy-makers check the availability of USFs in their country and explore the possibility of mobilizing the funds.
- **Alignment with national priorities**: Aligning the objectives and targets of the ICT in education policy with the overall policy for education or even for the state will help increase the chance of raising larger amounts of public funding.
- **Seeking high-level endorsement and financial support**: Seeking endorsement from high-level governmental agencies or officials can also help increase the likelihood of more generous budget allocations (Global Partnership for Education, 2019, p. 62).
- **Outcome-based mobilization and coordinating other funding sources**: As stated in **Chapter 1**, the ICT in education masterplan is a policy lever to mobilize funding resources from international and local donor agencies, private sector companies, and NGOs. The provision of foreign aid and funding from the private companies and NGOs requires an outcome-based methodology, also called result-based funding or target-based funding. Concrete results, targets, and indicators should be defined to ensure that achievements are

properly measured, and the progress towards meeting specific targets is properly monitored. Beyond the funds' mobilization, the outcome-based method can be used to set incentives for the implementation of programmes. For example, digital devices will only be supplied to schools that can show concretely how they will integrate the tools into teaching and learning practices. This will encourage schools to develop appropriate strategies that will save disproportionate amounts of funds from being spent on institutions that are not yet ready or unwilling to operationalize digitally supported learning.

4.4.3 Step 4.3 Quality-assurance mechanisms

Digital approaches to learning provision may cause concerns regarding quality. New forms of learning provision are welcomed as they can enable more flexible learning support. However, especially in formal learning, it is important to ensure that minimum standards of learning, teaching and assessment are upheld. This calls for quality-assurance (QA) regimes that ensure transparency and trust in the quality of learning provision through setting standards and reviewing procedures of internal quality control. In line with the guiding framework on planning ICT in education polices (introduced in **Chapter 3**), the QA procedure should cover not just learning resources, but also how the interaction of all elements of the educational process is planned and carried out. Just as insufficient funding might inhibit the achievement of the policy goals, so too could an overly rigid QA regime. Therefore, a balance between QA and openness in the national curriculum and assessments, as well as the regulations on digital learning, should be pursued.

Example

- The National eLearning Center of the Kingdom of Saudi Arabia has developed a set of standards[72] for online learning in school, HE, and teacher training in 2021, which were approved and released by its board of directors.

4.4.4 Step 4.4 Supporting capacity building

Teaching staff, institutional leaders or managers, and ICT system managers and support staff are key implementers for the successful adoption and maintenance of the programmes planned by the policy. The ICT competences of these key implementers should already have been examined in the gap analysis, as this gives insights into what skills need to be further developed in order to achieve the objectives of the policy. Different implementers and key stakeholders require different skills and competences. Accordingly, a well-planned policy and masterplan should define and dynamically update the ICT competency standards for teaching and ICT staff in educational institutions. The ICT Competency Framework for Teachers (UNESCO, 2018*c*) provides a guiding framework for countries to further develop national ICT competency standards for teachers, ICT system managers and institutional leaders.

In addition to detailed recommendations for increasing the capacities of the different implementing groups detailed in **Chapter 5**, policy-makers should develop an overarching building-block approach based on the following:

- **Initial college-based training programmes**: Colleges and teacher-training institutions offer systematic foundational training to equip pre-service teachers with the values, knowledge, and skills needed to become qualified. Integrating training on the pedagogical use of ICT into initial teacher training programmes is the most important and effective method to prepare pre-service teachers, but it is often ignored in the policy planning. If national ICT competency standards or frameworks for teachers have been developed, and initial training programmes on ICT in education have been reviewed and aligned with the national standards, this will ensure that all new teachers will be well prepared to apply ICT effectively in the classroom.
- **Continuous professional training:** In many countries, systems are established to provide all teaching staff, institutional leaders, and ICT supporting staff, with regular training to keep them up-to-date with developments in the sector. Capacity-building initiatives for the ICT in education policy can be integrated into existing programmes or added as special short courses offered as modules that also make use of digital-learning formats.
- **Support professional development for staff:** Common types of activities used to support teachers' continuous professional development are online or face-to-face networking, local or regional events, and peer coaching initiatives. Other informal forms of support such as exchanging ideas and solutions, and participating in challenge-based collaboration, can provide an opportunity to create communities of practice and strengthen commitment to the use of ICT in education.

4.4.5 Step 4.5 Setting incentive mechanisms

In comparison with regulations, incentive mechanisms can enhance the intrinsic motivations of implementers. Based on the incentive measures recommended under different areas in **Chapter 5**, policy-makers should consider planning regular (e.g. annual) and long-lasting mechanisms at national, institutional, and community levels to incentivize and reward innovative practices in using ICT to provide and manage education.

At a national level, mechanisms can include: the integration of effective uses of ICT into performance evaluation standards or frameworks for institutional leaders, teaching staff, and ICT staff; an explicit policy of rewarding institutions that promote school-wide or institution-wide uses of ICT; and annual awards rewarded to institutions and individual educators for the innovative use of ICT in education. At an institutional level, the innovative use of ICT can be integrated into job descriptions and reward frameworks for different types of staff who will be involved in the implementation of the policy. At a community level, self-incentivization can be encouraged and sustained to support the sharing of innovative practices of using ICT in education and expand impacts among communities of practice.

4.5 Step 5: Planning for effective implementation

When undertaking **Step 5**, policy-makers may refer to Toolbox 5 of the ICT in Education Policy Toolkit.[10]

This is the stage where the policy is no longer seen as a plan, but rather a set of indicators of what needs to be changed over time to reach the overall policy objectives. The decisions have been made throughout the steps of constructing the masterplan, and now the policy should be executed. The implementation of the policy and masterplan is both an administrative process requiring certain orders and protocols, and a dialectic process during which the changes must be anticipated and coordinated so that all elements of the masterplan can be allied towards the successful realization of the vision(s).

This part of the planning process entails the specification of the following concrete steps which are briefly discussed below: determining the approach to implementation (4.5.1); monitoring and research for feedback and improvement (4.5.2); deciding on an organizational structure for the policy governance and coordination (4.5.3); and scheduling evidence-based iterative implementation cycles (4.5.4).

4.5.1 Step 5.1 Approach to policy implementation

In the pyramid of stakeholders, at the top are the administration and those planning the policy, while at the bottom is the massive number of practitioners who are expected to implement the new activities and ensure that the teaching and learning objectives are fulfilled. For a policy to be adopted by the target practitioners, especially when we consider the long-term influences, it is important to link planning to practice. There are three typical approaches: top-down, bottom-up, and mixed – which in practice may appear under different names according to the sector, context, and other systematic and evolutionary factors. Below is a brief review of the three options for planning and implementation, to facilitate decision-making.

- A **top-down approach** to public policy can take all the success factors necessary for good practice into account, and should provide a systemic means of implementation. It also has the advantage of being able to use standard tools of regulation, enforcement, and resource allocation, in order to push certain activities and behaviours. For this reason, it is particularly appropriate in situations where the envisaged practice is considered by many practitioners to be contentious or of little value, or where there is little direct self-directed motivation to build upon. The disadvantage of this approach is that it works on the assumption of a generalist theory of change, which may neglect important contextual factors for success. This might be particularly harmful to an ICT in education policy that has the objective of improving teaching and learning in new learning settings and with new applications of technology. The top-down approach can only support this if exploratory initiatives take place. In addition, a top-down approach may be blind to practices already occurring in the field, which means that it often cannot harness or learn from them.

- A **bottom-up approach** starts with support for practitioners in the field. The clear advantage of this approach is that it can benefit from the self-directed motivation of the initiators and their networks, and it is focused on specific contexts. This approach must then adopt activities to spread practices from this small group of active enthusiasts to the mainstream. The distinct disadvantage of this approach is that practices may be inhibited or even restricted by regulations and accepted codes or professional standards that can only be modified at the national level of the education system. Furthermore, bottom-up approaches have the disadvantage that they tend to lack a systematic view of the whole policy implementation process, being focused on their own context of practical implementation in the field, e.g. in their own institution or community.
- A **mixed approach** addresses the advantages and disadvantages of the top-down and bottom-up approaches. In this case, the policy plan contains a vision and objectives which would be transformed into the building blocks of the masterplan. At the same time, practical aspects are considered, since some of the indirect impacts of the policy will be unknown. Therefore, it is critical to ensure that the high-level committee maximizes consultations with the implementers, practitioners, and key stakeholders, to enhance their ownership of the policy and masterplan and to engage them and motivate them to act according to the changes these required. It is also important that the process of change is coordinated and closely monitored, so that all layers of decision-makers and actors can work in concert towards the shared goal of successful policy implementation.

The actual mix of the two main approaches is determined by the context: where lessons have been learned from previous policies or programmes implemented in a similar contexts and the policy need to drive system-wide multiple changes, the top-down approach will play a more important role in the launching phase. However, when there is not yet sufficient available knowledge to enable a comprehensive and large-scale high-level policy to be developed, the policy should start with a smaller-scale piloting programme harnessing bottom-up developments. Further, when policy-makers mainstream the bottom-up innovations to the national level, changes to national policy and the regulatory framework will be necessary.

4.5.2 Step 5.2 Monitoring and research for feedback and improvement

There are two key parts to this building block: administrative monitoring and evaluation, and research.

Monitoring and evaluation

Monitoring and evaluation (M&E) is an indispensable administrative protocol to ensure the timeliness and quality of the implementation of the policy and masterplan. The M&E mechanism can be merged with the quality-assurance mechanism, but it should be carried out by an independent QA agency on a regular basis and in a standardized manner. It requires

the definition of **key performance indicators** (KPIs), which can be used to compare goals with achievements. These indicators should be well-defined and based on realistic assumptions of what data and information can be collated reliably. Each KPI should have a baseline and an identified source of data. The planning committee should try to use existing data sources wherever possible and to establish proxy indicators that can be measured with existing data, as requiring new sources of data can be costly. In some cases, the cost can be contained by including the required sources in the EMIS that collect and analyse data through regular channels. KPI reports should be published regularly to show where progress is being made and where possible future policy challenges lie.

Quantitative KPIs can be defined to serve two types of objectives. The first is measuring shares or index values and informing the progress: for example, the rate of teachers with ICT skills before the intervention and each year after its implementation. The second one is indicating the status of progress towards a normative goal, which is sometimes disaggregated into segments on a spectrum. For example, if the goal is 'all primary schools provide their pupils with access to the internet at least once a week', the indicators can be grouped as e.g. less than 25 per cent of pupils, 25-50 per cent of pupils, 50-75 per cent of pupils, and nearly all pupils.

It is strongly recommended that disaggregated indicators should be defined for female learners, learners with disabilities, and other marginalized groups, in order to ensure that precise information is collected about the digital divide and advancement towards equity and gender equality.

Research

The research conducted in this step should be rigorously designed to investigate the real impact of the policy on teaching and learning, comparing the actual result against the proposed theory of change. The research under this scope is an important addition to the monitoring exercise, which contributes to the sustainability of a policy by providing in-depth evidence of impact. It does not have to be conducted frequently. Various qualitative and quantitative methods, such as combinations of administrative data, surveys, interviews and focus groups, should be used to understand how the regulations, activities and behaviours of key actors work together to produce certain impacts. The research can be carried out by independent agencies if objectivity is needed, or by the implementing agencies or individuals through action studies if the aims are to diagnose problems and adjust implementation strategies. In some cases, the policy and masterplan also include practice-oriented theoretical research on specific themes of critical importance for the policy, while there is scarce knowledge available around the themes to act as a sufficient evidence base. In addition, the development of digital competences should be synthesized and examined during **Step 2** (policy review).

4.5.3 Step 5.3 Organizational structure to govern and coordinate the implementation

As noted, the masterplan details the activities for each of the building blocks, while implementation will employ a balance of top-down and bottom-up methods which involve the key partners and stakeholders to achieve specific objectives measured through KPIs. These processes all require an organizational structure for governing concerted actions and coordinating the implementation across sectors.

As a reminder, the organizational structure should consist of:

- a central governing board with the authority to govern and oversee the policy implementation; and/or
- a dedicated national ICT in education agency delegated to coordinate the implementation and manage collaborations; and
- a task team charged with implementing the policy.

Governing board for implementation

Not all governments will establish a new governing board to coordinate the implementation of the ICT in education policy and masterplan. In some cases, the planning committee governing board can be transformed into the implementation governing board with a mandate to command, oversee and support the deployment of the policy. The membership of the board should be reviewed and revised according to the new needs. Alternatively, there could be a consultative board, comprising representatives of key stakeholders, governing authorities, implementation partners, end users of ICT, direct and indirect beneficiaries, and those who understand the context and can help advocate the adoption of the policy. In either case, the board should also include representatives who can help govern the implementation and make changes to regulations across sectors, at national or institutional levels; along with parents, teachers, legal experts on intellectual property, and representatives from ministries, independent QA agencies, national institutions, public ICT and telecom sectors, private companies, and sometimes international organizations. A set of principles on the governance of the policy should be developed and applied to guide the board's ownership and accountability.

The governing board will assume the following responsibilities:

- Lead the policy implementation by ensuring its compliance with overarching laws, standards, and procedures.
- Anticipate strategic risks and manage possible negative effects.

- Help secure public budget to provide adequate funding for the implementation and oversee the financial management at a macro level.
- Mobilize and coordinate cross-sectoral funds and resources to ensure the cost-efficiency of the implementation.
- Seek and coordinate necessary international collaboration.
- Oversee and monitor the performance of the dedicated national ICT in education agency and the task team.

The dedicated national ICT in education agency

The establishment of an agency that is tasked with implementing the policy is a major factor for its successful roll-out (UNESCO, 2011). The dedicated national agency or coordination body will either be associated with the governing board or, when there is none, can function independently. In some cases, it is this national agency that builds the governing board or consultative board. Likewise, it can be a departmental entity under a government ministry, or an independent agency, as long as it has the capability to coordinate the implementation.

This dedicated agency takes responsibility for:

- supporting and coordinating the policy implementation, by initiating and coordinating interventions or programmes appropriate to the objectives;
- implementing and sustaining some major programmes under its direct control, such as building and managing the national platforms for learning and/or content management, and/or EMIS systems;
- collaborating with partners to implement key programmes;
- managing the public budget;
- monitoring the progress and quality of implementation;
- commissioning independent evaluations and research;
- coordinating regular reporting to the higher-level administrative agencies and the public; and
- implementing international collaboration.

The task team

If a governing board is established, a task team is usually set up to assume the main duties of the dedicated national agency. In other cases, the task team may be built directly under the agency. The task team will work intensively on enforcing regulations and initiating major programmes under the masterplan.

Examples

Examples of national ICT in education agencies:

- Korea Education and Research Information Service.[73]
- The National eLearning Center,[74] established as an independent entity by the Kingdom of Saudi Arabia's Council of Ministers.

4.5.4 Step 5.4 Scheduling evidence-based iterative implementation cycles

The scheduling depends on the approach to the policy implementation. A top-down policy and masterplan move from new regulations and directives to desired practices in the field. Meanwhile, a bottom-up policy starts by piloting models, before moving on to the scaling up of initiatives that show positive impacts. The ICT in education policy and masterplan portfolio outlined in this publication suggests a combined approach to the implementation: starting on a small scale, collecting and analysing the evidence of its effectiveness, making adjustments to the policy and masterplan, and then scaling up the implementation within the duration specified by the masterplan.

Such scheduling should be based on iterative cycles informed by evidence of the impact of the practical implementation, which can be provided through the monitoring mechanisms and research. For example, if the masterplan includes a component to train all teachers in the pedagogical use of ICT as a precondition of the implementation, the scheduling might involve: a test of the training programmes for 5 per cent of the teachers in the first year, to include collecting feedback on the programmes and their methodologies as well as evidence on their impact, and improving the training accordingly; and then rolling out the training to 30-40 per cent of all teachers in the second year and finally to all teachers in the third year.

In addition, a mechanism should be planned to collect, recognize, and mainstream bottom-up innovations at the national level, which may trigger the next cycle of changes to regulations and policies. For example, in Ireland, the government's Digital Strategy for Schools 2015-2020 includes a digital learning framework and planning cycle[75] to assist schools in embedding digital technologies in learning, teaching and assessment. The planning cycle helps schools determine which overall objectives from the national digital strategy they want to focus on and monitor their own progress in implementation.

The cycle has a six-stage model:

1. **Identify focus**: The school familiarizes itself with the policy framework overall and identifies from the options the areas on which it wishes to focus.
2. **Gather evidence**: The school collects baseline data and analyses the gap between its aims and where it is now with regard to its focus areas.
3. **Analyse and make judgements**: The school determines which action lines to follow based on the benchmarks for good practice that are given in the overall government strategy.
4. **Write and share a digital learning plan**: The school formulates a plan that includes the expected results of improved digital learning in specific areas, and shares this with teachers, learners, and relevant stakeholders.
5. **Put the digital learning plan into action**: The plan is implemented through a distribution of roles and responsibilities throughout the school.
6. **Monitor actions and evaluate impact**: M&E is carried out internally and reported to internal stakeholders and to the national coordination agency.

This cycle used in Ireland emphasizes the iterative nature of the implementation as well as the adjustment of the institutional strategy for integrating digitalization into the specific teaching and learning practices. It combines the overall aims of the national strategy with the individual implementation goal of each school, and encourages an iterative development of new practices. Evidence-based practices are identified and disseminated to improve implementation at school level. The cycle also encourages innovations through the use of sound research design, reports based on high-quality data analysis, and the continuous reviewing of results.

4.6 Step 6: Endorsing and launching the policy

When undertaking **Step 6**, policy-makers may refer to Toolbox 6 of the ICT in Education Policy Toolkit.[10]

Successful policies and masterplans are those that deliver the desired outcomes to students, teachers, parents, and schools. The purposeful and multidirectional change process targeted by the policy and masterplan affect a given education system on several levels, and involve a number of iterations. Any policy should be developed in steps with iterative feedback loops, which ensure that the process and output reflect the concerns of partners and stakeholders. After a draft of the entire policy and masterplan is made available, consultations should continue to be used as a strategy to engage with partners.

4.6.1 Step 6.1 Finalizing and enduring the policy

Through previous steps, policy-makers were expected to revise and lay out the draft of the policy and masterplan and work towards a completed document. Building upon the draft created under **Step 3**, the final document should contain the following sections at a minimum:

- Preamble or introduction
- Context and situation analysis
- Rationale
- Duration, scope, and policy alignment
- Guiding principles
- Operational perspective or overall implementation strategies
- Vision statement or policy statements
- Policy framework (focus areas, each with goals or strategic objectives)
- Cross-cutting components of the masterplan (regulations or laws, budget planning, quality assurance measures, capacity building, and incentive mechanisms)
- Masterplan of key areas (each area or building block to include context or justification, specific objectives and indicators, implementation methods, budget and resources, key actions, schedule, and implementing agencies and partners)
- Launch strategy

The planning committee should conduct a final review of the document, and secure an endorsement of it by the highest possible authority relevant to the scope and scale of the policy. The endorsement should be clearly shown in the document. The planning committee should also seek a legally binding effect and budget allocation scheme for the policy and masterplan.

4.6.2 Step 6.2 Organizing launching events as key communication and partnership building strategies

This is the point at which planning gives way to the implementation phase. Accordingly, it is also the time to activate the structural organization. The committee should jointly plan and prepare the launch events with the coordinating entities for implementation or the dedicated national ICT in education agencies.

It should be made clear that the launch is not going to be the end of the policy process, but is merely the kick-off for the longer-term implementation and learning process, and constitutes only one part of the communication strategy. The following components must be integrated into the launch phase:

Release of administrative directives or orders

The formal endorsement and forthcoming launch of the policy and masterplan should be announced through administrative directives or orders distributed to key implementing agencies and through formal media channels. The endorsement can then be reiterated during the launch event itself.

Launch event for key stakeholders

The launch event provides an opportunity for the implementing agencies, key partners, and general public to be officially informed of the new policy. The event should be opened by a high-level official, such as a government minister, to underline the national commitment to the policy. While the event may be focused on the interests of institutional leadership, it should also involve representatives from the following key groups: the governing board, coordinating entities, national ICT in education agencies, end-user groups, private providers of digital learning services, research and evaluation experts, and the local community. The main objectives of the event are to ensure that those playing key roles in the implementation are sufficiently informed about the expectations of the policy, and to sensitize other authorities and partners who will be involved. In some cases, the launch event plays a critical role in informing non-governmental partners about the funding gaps, in order to seek, build or reinforce partnerships for the implementation.

Webinars and information meetings

A more in-depth webinar and/or information meeting should be organized for the representatives of the implementing agencies, to facilitate their full understanding of the key programmes, plan concerted actions, identify champion agencies or individuals, and finalize schedules. Before the webinars or meeting, briefing materials and capacity-building programmes should be developed and made available so that the key implementing agencies and individuals can interpret the policy and masterplan.

Advocacy and campaigns to raise public awareness

Raising public awareness of the relevance and potential benefits of the policy is essential to gain support for its launch and implementation. This awareness-raising should go beyond the direct stakeholders, and use tailored strategies and formats that are relevant to the interests and responsibilities of the different groups. This may include poster campaigns, television and radio programmes, news articles, seminars at educational institutions, dedicated websites, and social media initiatives with messages or videos targeting local and international professionals in the field. It is also very important to target key decision-makers in relevant organizations by means of regular e-newsletters.

5. Designing sector-wide masterplans

This chapter provides detailed guidance on how to develop masterplans around some strategically important areas or sub-themes that are widely covered by national ICT in education policies and masterplans. There are various possible scenarios for designing these masterplans. If the planning committee decide on a sector-wide scope for their policy, this means it would cover most of the strategically important areas or sub-themes such as the use of ICT in school education, TVET, higher education, and non-formal learning settings; the integration of ICT into curricula and assessments; the creation of digital learning resources; and the development of EMIS. In this context, the detailed masterplans around the identified areas need to be designed as constituent components of the actions for the sector-wide vision. When only one of these areas is chosen as a focus, a standalone sub-sectoral masterplan will be the main pillar of the policy. Inevitably, there are many transversal issues that apply in each sub-sectoral area, which means that some information is repeated in sections of this chapter.

5.1 Masterplan on ICT in school education

Box 10: Qingdao Declaration

We commit to ensuring that all girls and boys have access to connected digital devices and a relevant and responsive digital learning environment by 2030, irrespective of their disabilities, social or economic status, or geographic location. In striving to achieve universal access to basic education and skills development, we recommend that all education stakeholders recognize enrolment in quality-assured online courses as an alternative or complementary mode to face-to-face programmes of study.

Successful integration of ICT into teaching and learning requires rethinking the role of teachers and reforming their preparation and professional development. It calls for promoting a culture of quality in all its aspects: staff support, student support, curricula design, course design, course delivery, strategic planning and development.

Source: Qingdao Declaration, UNESCO, 2015*a*, Articles 5 and 11

5.1.1 Introduction

The harnessing of ICT in K-12 education has nearly half a century of history, starting with the teaching of programming and computer literacy. In those days, policy-makers were mainly concerned about school computer labs and computer literacy programmes. Later, policy-makers focused on how to equip digital learning environments for teachers and students, how to provide schools with digital resources, and how to develop teachers' ICT competences. Nowadays, the availability and use of ICT are growing rapidly around the world. Educational transformation is underway to prepare all K-12 students for life in the global digital economy. Modern schools face the challenge of not only teaching pupils to read, write and count, but also helping them gain knowledge in science and the humanities, acquire 21st-century skills, increase their personal development and learn how to live together peacefully.

ICT should be considered as an important tool to help transform K-12 education within a rapidly growing digital environment. Technology is just an enabler for change, but it is a critical one. As introduced in Section 2.4, ICT should be leveraged to transform the campus-based provision to a technology-enabled open mode of delivery, so that ubiquitous and crisis-resilient learning and human interactions can happen anytime anywhere, and be accessible for anyone.

5.1.2 Definition

Digital transformation is the use of ICT to radically improve the performance or reach of enterprises. It encompasses the profound ways in which business and organizational activities, processes, competences, and models are changed to fully leverage the opportunities of a mix of technologies and their accelerating impact across society. It should occur in a strategic and prioritized way, with present and future shifts in mind.

The digital transformation of school education includes the educational objectives, curriculum, teaching methodologies and general environment. These all undergo modification in order to prepare students to become active members of the information society and participate in the digital economy.

Harnessing ICT to enhance the provision of K-12 education is one of the necessary elements of school digital transformation. It focuses on providing all students and teachers with access to digital devices for pedagogical purposes to improve the quality of teaching, learning, and the professional development of educators. Accordingly, the design of the ICT in education policy should be considered in close connection with all other elements of the digital school transformation.

5.1.3 Vision

Students and teachers should have access to digital devices (e.g. computers, mobile devices, tablets, printers, and robots) as well as digital tools (e.g. word processors, browsers, and AI-driven tools), materials (e.g. texts, video and audio recordings, and virtual objects), and services (e.g. search engines and social networks). They should be able to use these to achieve their learning and teaching goals, including implementing new pedagogies that make schools more inclusive and relevant to community needs and empower students to become active global citizens.

5.1.4 Challenges

Policy-makers who want to deploy ICT to enhance education for specific economic and teaching/learning environments need to address the following challenges:

- The absence in the educational community of a shared vision of the use of ICT, which includes not only access to digital devices, instruments, and materials, but also changing the school culture.
- Students' and teachers' lack of access for students and teachers to proper digital devices (including mobile devices) for pedagogical purposes.
- A lack of, or limited access to, high-quality (fast and reliable) internet connectivity.
- Insufficient professional development for teachers in a rapidly changing digital environment. This is one of the biggest barriers to ICT-pedagogy integration. In fact, the huge amount of investment dedicated to providing ICT infrastructure in schools is wasted without a well-prepared workforce.
- The inability of many schools to use technology in ways that can improve learning outcomes and scale up the adoption of effective approaches to teaching.

Some policies and initiatives on ICT in school education have failed due to the dearth of clear pedagogical purposes, leading to criticism for their lack of effectiveness. As a result, the incorporation of ICT into education in some countries has lost its status as a policy priority, even though investments have not ceased. Therefore, ICT will only be able to support, enrich and transform school education if its deployment is systemic and starts with clear pedagogical needs.

5.1.5 Goals and objectives

Policies on harnessing ICT to enhance the provision of school education should take into account the following goals and objectives:

Digital infrastructure to promote learning and teaching

- Each teacher and student should have unobstructed access to digital (mobile) devices and to a high speed and reliable internet connection for teaching and learning at school and at home when they need it.
- Each school should have the required digital infrastructure (e.g. network, servers, computer labs, digital projectors, and printers) for the adoption of effective approaches to teaching and learning.

Teachers' continuous professional development of ICT competences

- A system for the continuous professional development of teachers and school leaders on the use of ICT should be in place.
- Standards (requirements) for ICT competences of teachers and other school personnel should be established and constantly updated.
- Ongoing professional development should be embedded into teaching roles and available on demand.
- Teachers should be able to use educational resources from the internet and participate in online professional networks.
- Teachers should feel prepared and motivated to use digital technology to support teaching and learning in the classroom and for their own professional development.

Wide use of ICT to improve the quality of teaching and learning in all subject areas and implement new efficient pedagogies

- The vision of harnessing ICT in education should start with pedagogical needs and expected learning outcomes.
- The provision of ICT to teachers and students should be an integral part of the overall effort to update the educational process.
- Schools should be using technology on a daily basis to improve learning outcomes in core subject areas and to develop the core subject competences.

- Schools should be using ICT for out-of-school and informal learning activities that relate to formal learning goals.
- Schools should actively involve local communities and families in the development and implementation of their digital transformation efforts.

5.1.6 Main lines of action

Provide digital infrastructure to schools

The proposed actions include:

- **Build a database and analyse the state of the digital infrastructure available for schools**

To enhance the efficiency of digital infrastructure development, quality data on the country's various projects should be gathered. Building a database ensures that there are data sets for all implementation phases – for example, from the initial project award to the completion phase – and enables effective decision-making among the different stakeholders involved. Some of the steps that may be necessary to build the database are as follows:

  - Create a detailed visual map showing the digital devices, connectivity, device access, open-licensed learning resources and their uses across the schools.
  - Identify and register in the database the devices that educators and students have access to and calculate the device-to-user ratios per school.
  - Test the connection speeds in schools and homes and record them in the database.

Building such a database will help to pinpoint inequalities and target interventions to alleviate them. The level of engagement with open-licensed learning materials can serve as an indicator of progress towards equitable access and the effective allocation of ICT resources.

- **Conduct a needs analysis of the digital infrastructure for schools**

The considerations here should encompass the ongoing and future demands of digital instruments, internet access, transmission capacity, and electronic learning resources and textbooks. The selection of appropriate digital devices depends on a number of factors: the age of the students, their individual learning needs, and whether the learning activities will happen in class, at home, or in an after-school programme.

Schools may provide students with appropriate learning devices or use BYOD (bring-your-own-device) policies that permit them to use their own mobile devices. For the latter, it may be advisable to:

- Provide students with public, fast, and reliable wireless access wherever they need it.
- Be aware that student-owned devices may not have appropriate security standards or features for storing personal data.
- Cater for and introduce a specific policy for those students and families who cannot afford their own devices.
- Consider the challenges that teachers face when managing learning activities among multiple platforms and device types in the classroom, and ensure that they know which activities are incompatible with some devices.

- **Ensure there is adequate technical support**

Technical support includes running a user help desk, troubleshooting software, maintaining and upgrading equipment, licensing digital learning resources and software, and monitoring the network. The cost for such activities will be significant and should be considered along with the budget needed for acquiring, installing and updating the equipment.

- **Determine implementation and its components**

Giving all students and teachers access to digital devices in the educational environment may be implemented in a number of different ways, such as pledging to provide one laptop per student or every five students. Plan and organize the provision of the necessary digital infrastructure components, including access to the internet. Usually, such efforts require addressing the following questions:

- What kinds of ICT infrastructure, facilities, equipment, and internet connections have to be provided and when?
- Who should be responsible for such provision?
- Should it be centralized or decentralized?
- What are the roles of the government, private sector, schools, teachers, parents, etc., in setting this up?
- How can funding for this provision be sourced?
- How can a continuous improvement cycle for the provision be established?

Importantly, access to computers for all participants in the educational process cannot be an end in itself. Such projects should be an integral part of the overall effort of updating resources and methods of teaching, which can then lead to improved learning outcomes.

- Plan iterative cycles of updating and upgrading

Since ICT is a dynamic field, with new ideas and approaches appearing every year, it is also sensible to have portfolios that include the processes, services, and business models of innovation efforts. Harnessing ICT in an iterative cycle allows the planning periods to focus on both the quality of the implementation and the openness to new ideas. Prepare a long-term plan for the development of education overall, based on the strategic vision of the country (or region, or educational institution). Break down the long-term plan into intermediate stages and aim to solve the complex pedagogical and technological problems gradually.

Develop teachers' ICT competences and support their continuous professional development

- **Streamline strategies for pre- and in-service teacher training and ongoing support**

The masterplan should include developing a framework for teachers' preparation, in-service training, and continuous professional development to build their ICT competence.

The level of ICT ability among teachers, even within the same school, can vary significantly, which can create significant difficulties when harnessing ICT in the educational process. Accordingly, a competency-based approach should be implemented, which could include short courses and masterclasses. All such programmes must be designed to support educators' identities as capable, ICT-competent professionals. The ongoing professional development should be job-embedded and available as and when needed, in view of the rapidly changing digital educational environment.

A holistic approach to this continuous development might include activities such as: regular conferences on the exchange of best practices; visits to schools where ICT is used in teaching and learning most effectively; and peer mentoring in the workplace.

School leaders should also be catered for in the planning of ongoing support and professional development, through additional courses on the leadership and management of ICT use in schools. Ongoing professional support should also be provided to ICT teachers and ICT specialists who work in education, so that they can monitor the emergence of innovations and learn about new digital resources in a timely manner.

- **Establish standards for teachers' ICT competences**

There are several approaches to developing and implementing competency-based ICT training for teachers. They include (i) integrating ICT into teachers' overall national standards and comprehensive career path (e.g. Australia); (ii) involving teachers and practitioners in the process of competency modelling (e.g. Republic of Korea); (iii) encompassing different groups of experts to review and determine a national framework (e.g. China); and (iv) initiating a partnership-driven pilot project to contextualize national ICT competence policies and standards (see UNESCO, 2016*a*).

The Australian 'Professional Standards for Teachers' make explicit reference to ICT at different career stages, while the 'SMART Education' initiative in the Republic of Korea identifies a set of ICT competences for teachers, and China has 'National ICT Competency Standards' for both primary and secondary school teachers (UNESCO, 2016*a*). Policy-makers might consider using the *UNESCO ICT Competency Framework for Teachers* (2018*c*) as one of the prototypes for the local development of standards for all school personnel who use ICT.

Box 11: UNESCO ICT Competency Framework for Teachers (Version 3)

The ICT Competency Framework for Teachers (ICT CFT) is aimed at helping countries to form comprehensive national policies on developing individual ICT skills or national ICT competency standards. In version 3, there is a matrix of three levels of learning objectives and six aspects of professional work that teachers should be able to support using ICT. The three levels are knowledge acquisition, knowledge deepening and knowledge creation, while the six aspects are understanding ICT in education policy; curriculum and assessment; pedagogy; application of digital skills; organization and administration; and teacher professional learning. The ICT CFT multiplies these six aspects with the three objectives to create 18 competencies.

The three levels refer to the aims of the use of ICT in terms of activities and expected learning outcomes. Knowledge acquisition implies that teachers should be able to design ICT-enhanced activities to support students to use ICT to be effective learners and productive members of society. The second level, knowledge deepening, encourages teachers to increase their ability to infuse ICT into pedagogical activities in order to support students to solve complex, high-priority problems encountered in real-world situations. For the third level, knowledge creation, teachers should be able to design pedagogical activities and programmes to support students throughout their school journey and beyond so that they can benefit from generating knowledge and participating in innovation and lifelong learning.

Source: UNESCO ICT Competency Framework for Teachers (version 3), UNESCO, 2018*c*

- **Support the development of professional networks and communities of practice**

Governments need to ensure that teachers have access to up-to-date online information and resources regarding best practices on using technologies for teaching, and should facilitate the best use of technologies to support professional development in online and blended spaces. Internet-based professional communities are an effective form of ongoing development. The active participation of teachers in such communities should be highly promoted, along with the traditionally organized training courses, workshops, and consultations.

- **Incentivize teachers' effective pedagogical use of ICT**

Given the investment in this continuous development and the building of professional networks, it is important to consider the ICT competences of teachers as central to their abilities to integrate ICT in their classes. This means that procedures to verify their ICT competences should be introduced, and special certificates awarded to successful teachers.

Teachers should also be enabled to look after their own training and put into practice the use of digital portfolios to self-assess their professional development. Video recordings of teachers using ICT in the classroom are simple and reliable tools enabling them to share and reflect on their own work and assess their pedagogical ICT competence.

Leveraging ICT to improve the quality of teaching and learning

- **Build the vision of harnessing ICT in education starting with the pedagogical needs**

Harnessing ICT in education is an opportunity to fundamentally reform teaching and learning. ICT should be considered as one of the tools to improve the quality of education, but not an end in itself. ICT can be used as an opportunity to re-design existing educational practices as well as to create new and much more effective pedagogies that were previously not possible. The aim is to better achieve the expected learning outcomes.

- **Leverage ICT to improve the quality of learning in core subject areas**

The use of ICT can help educators to organize learning around real-life situations, as seen in project-based learning in particular. Using a wide variety of digital learning devices and resources may contribute to the emergence of various skills as well as a better understanding of complex concepts and content. Exploiting digital laboratories can increase the interest of students in STEM and deepen their knowledge. Students should be encouraged to publish their results online and get feedback from researchers around the globe instead of writing a report that is seen only by their teacher and a small group of classmates.

ICT often moves the learning activities beyond the classroom walls to all kinds of out-of-school settings (e.g. museums, summer camps, and sports clubs). Providing learners with the opportunities to explore and do research gives them the chance to pursue their own personal interests and develop a mindset of lifelong learning.

Designing learning experiences through ICT allows students to choose from a list of learning activities such as writing essays, producing multimedia, and collaborating with experts across the globe to collect data. Teachers can also use ICT to assess the students' learning outcomes through well-recognized rubrics.

- **Leverage ICT to transform the education process and improve learning outcomes**

Harnessing ICT in education offers opportunities for school reform. Consider the ICT policies and programmes as initiatives for the digital transformation of the school. A systemic approach to the application of technology reforms the teaching process, school management, and everyday educational practices. Examples this can include the review and update of learning resources, the restructuring of the school administration forms, and changes in teaching methodologies. Transformation could, where necessary, also include changes in the physical space of the school.

Start building a robust digital infrastructure for learning by setting clear goals and desired outcomes. Pay attention to the following essential components of a digital ecosystem:

- access to devices that can serve as tools in the teaching and learning process, connect learners and teachers to the digital resources, and facilitate communication and collaboration;
- consistent access to the internet for teachers and students in and out of school; and
- digital tools and resources to design and deliver relevant learning experiences.

- **Include a pilot stage of the project to test the proposed innovations and mechanisms**

The digital transformation of school education is a relatively new phenomenon. It would be advisable for educators in each country to take stock of the prospects and complexity of this process realistically. Start with small-scale educational projects in pilot schools, before scaling up the ICT-supported innovations. Such projects can include, among other things, the development of an ICT-saturated environment and the use of an adaptive learning platform to support the transformation of teaching practices. In the course of such projects, schools should:

- engage the local communities and families in the development and implementation of the transformation activities;
- test innovative curricula and digital learning resources;
- develop and implement new routines for everyday activities;
- support out-of-school activities and connect them with goals for classroom learning;
- adopt new approaches to the use of digital tools; and
- provide professional development and ongoing support to teachers.

Keep in mind that deploying ICT involves concerted school-wide actions on a number of essential components including the development of digital infrastructure, the preparation of digital learning resources, and the professional development of teachers. The formulation of

ICT policy requires a comprehensive approach and starts with clarifying learning goals and updating pedagogies and resources in order to engage each student.

5.1.7 Cross-cutting issues

Students' cultural norms and proper behaviour in the digital environment

When exploiting ICT in school education, students should be able to follow a code for good online behaviour. If such a code is not yet written or available, it is worth emphasizing to students the online cultural norms and the effects of inappropriate behaviour.

Digitally competent persons should be able to, for example:

- Use the technologies to safely find and publish digital resources via the internet.
- Evaluate critically what they find, remembering that people and the knowledge they present – even with good intentions – can be fallible.
- Understand and follow internet etiquette.
- Consider the appropriateness, consequences, and accuracy of information before broadcasting it online.

Students, as well as their teachers, also have to distinguish between using social networks for personal connections and for academic work. They have to be aware of and follow the norms, values, and codes that might promote the safe use of digital technologies.

The prevention of cyber bullying is also a necessary part of any strategy, policy, or programme for ICT in education. Inappropriate behaviour in cyberspace can sometimes lead to tragic consequences, and it is critically important to prevent this.

If they do not already exist, the development of legal documents for children's online privacy protection should be a part of the ICT in education strategy. It will help to keep parents reassured, protect children when they are engaged in online activities, and prevent unlawful access to their personal information (see Section 4.4.1).

Gender equality

The advancement of gender equality through education and ICT is at the heart of UNESCO's mandate, which aims to equip both women and men to address the challenges of sustainable development in a fast-changing world (UNESCO, 2020*a*). The reality is that 16 million girls will never set a foot in school and two-thirds of the world's 750 million illiterate adults are women (UIS, 2017). In sub-Saharan Africa, 33.3 million girls of primary and lower secondary school age and 52.2 million girls of upper secondary age are out of school (UIS, 2018). In many countries,

there is also a failure to recognize women's needs and to support women's roles in sustainable development. The preparation of policy on the use of ICT in school education provides an opportunity to develop and implement new models and approaches to increase the gender parity in ICT access and digital competences.

There are also various opportunities for raising girls' awareness of careers in ICT. The formal curricula can be complemented with innovative out-of-school activities such as science camps, specially designated days focused on ICT, and company competitions/fellowships. Educational institutions can organize a 'Girls and ICT Day', similar to the EU's 'IT Girls' initiative. Events such as open-door activities, lectures, and shadowing of both male and female ICT workers are also valuable activities.

The ICT in education policy can also include the development of support structures (e.g. mentoring programmes, gender-sensitive counselling, career guidance, and the provision of gender-sensitive career information and materials) to encourage women and girls to go into ICT careers with the support of their families and local communities.

5.1.8 Existing approaches

There are two main approaches for projects harnessing ICT in school education: the top-down approach with government-led initiatives, and the bottom-up approach with grass-roots initiatives.[76]

The top-down approach

The top-down approach is well suited for projects aiming to solve problems common to all or most schools in the country or region. These projects are usually focused at solving tasks such as:

- the development of the policy documents on ICT in school and the digital transformation of education;
- the introduction of unified requirements for teachers' ICT competence (e.g. the ICT Competence Standard for teachers in Uzbekistan, and the digital literacy requirements for teachers in the Republic of Korea);
- connecting all schools in the country to the internet;
- providing schools with a unified set of ICT services (e.g. the Moscow Electronic School in Russia, and Education Network Services in Northern Ireland); and
- conducting teachers' ICT literacy training.

Examples

- **UNESCO 'Korea Funds-in-Trust' (KFIT) project on ICT Transforming Education in Africa:** This project is part of the global effort to implement the Education 2030 Agenda (UNESCO, 2017*a*). A three-year project launched in 2015, its goal was to develop and test models for leveraging ICT in education in Mozambique, Rwanda and Zimbabwe. The beneficiaries were teachers and students, public schools, higher education institutions, policy-makers, and educational administrators and leaders. One of the project's focus areas in Rwanda was the enhancement of teachers' capacity to integrate ICT in the classroom and use electronic assessments. Among the results in Rwanda 'A report on ICT Teacher Training Initiative Mapping', 'Certification Standards of the ICT Essentials for Teachers', and its related 'Monitoring and Evaluation Framework', and the 'Rwandan Knowledge Societies Policy Handbook'. More than 300 teachers were trained in courses under the UNESCO programmes called ICT Essentials for Teachers, Open Distance and eLearning (ODeL) Management and Design, and ODeL for Disabilities.
- **UNESCO 'Technology-Enhanced Open Schools' project**: The project is currently taking place in Egypt, Ethiopia, and Ghana.[77] The aim is to build capacity – infrastructure, technology and teaching skills – to help ensure that if schools have to shut again (as they did during the COVID-19 pandemic), the education of young people can continue.

The top-down approach does not take into account the specific features of the different schools. In addition, the impact of top-down projects on the quality of school education is difficult to assess.

The bottom-up approach

In the bottom-up approach, the school can focus on a specific local challenge and perform self-directed research through pilot studies. Schools can also carry out their own reflection on how they use ICT, e.g. through the SELFIE tool.[78] The knowledge that results from this exercise can be private or be shared within the region or beyond.

Example

- **SELFIE:** The European Commission's project SELFIE ('Self-reflection on Effective Learning by Fostering Innovation through Educational Technologies') is an easy-to-use online tool for schools in Europe. It involves the whole school in the self-reflection process, asking for the views of school leaders, teachers and students. Each school can select a set of questions and even add its own questions to the tool to suit its own objectives. Based on their responses, it provides a picture, a 'SELFIE snapshot', of a school's strengths and weaknesses in their use of digital technologies for learning. This is called the SELFIE School Report. The graphics in the output show where the school is in terms of its

progress so that participants can decide what they want to improve, and build their own strategy. There is no minimum standard in order to start improving, so SELFIE can be used by any school, not only the ones that are digital 'champions' or highly innovative. More than 67,000 students, teachers, and leaders from 650 schools in 14 countries tested SELFIE's beta version in October 2017 and overall gave very positive feedback.

A mixed approach

The digital environment development, the teachers' training, and other components of harnessing ICT in schools should be a part of a holistic digital transformation project that aims to improve the quality of teaching and learning. There are seven elements of the transformation project: vision, learning, culture, technology, professional development, funding and sustainability, and community engagement. Some ideas, stories, templates, and guides from pioneer schools can be found in UNESCO's Best Practices in Mobile Learning.[79]

The government should actively support schools in this transformation process. This support may include, among other things, allocating funds for the development of digital infrastructure, giving methodological support, and creating specialized services (see SELFIE as an example). Other projects implemented under the top-down approach can also be viewed by schools as a resource for their own digital transformation.

5.2 Masterplan on ICT in higher education

Box 12: Qingdao Declaration

While we are aware of the challenges linked to quality assurance, pedagogical effectiveness and certification (in higher education), we recognize the benefits of well-organized online learning courses for learners, institutions, systems and society at large. Online learning, including in the form of Massive Open Online Courses (MOOCs), has the potential to build new learning pathways towards tertiary education and lifelong learning. We therefore recommend that governments, institutions and other stakeholders further consider and harness the opportunities brought by online learning innovations.

Source: Qingdao Declaration, UNESCO, 2015*a*, Article 13

5.2.1 Introduction

Tertiary education includes all types of courses at the post-compulsory/post-secondary level which are provided by universities, training institutes and colleges. Higher education is a subset of tertiary education which focuses on undergraduate and postgraduate studies usually offered in universities. Higher education is often viewed as a means of social mobility, economic growth and defending democracy. Because of its importance, policy-makers are always looking for innovations that can help increase the accessibility, affordability, equity and quality of higher education.

5.2.2 Definition

The growth of ICT in recent decades has enormous implications for higher education. ICT has impacted various aspects 'from teaching and learning; institutional management, administration, and finance; to external relations; library services; research production and dissemination; and student life' (Altbach et al., 2009). However, one must be aware of the promises and pitfalls of ICT. The innovative technologies that have emerged in recent years present the higher education sector with a wide range of opportunities along with some significant challenges. The masterplan on ICT in higher education needs to leverage ICT to support the three key missions of a university: teaching, research and service.

5.2.3 Vision

ICT should enhance the quality, efficiency and accessibility of higher education through its applications in various teaching and learning situations, in university administration and in the provision of educational programmes. In particular, technology-enhanced classroom teaching, distributed learning and blended learning can improve the quality of HE programmes. ICT can improve the efficiency of HE administration by supporting managers' timely decision-making. It can also widen access for non-traditional learners and underserved populations by facilitating flexible learning anytime and anywhere.

5.2.4 Challenges

ICT in the HE sector can be deployed to address the following challenges:

Accessibility and equity:

Expand access, uphold academic standards and ensure access to higher education opportunities for all.

- Many countries experience increasing social demands for higher education due to population growth, the democratization of secondary education, and growing affluence. The challenge is how to expand HE systems rapidly without lowering academic standards.

- Responding to mass demands, policy-makers have sought different sources of funding as well as alternative modes of provision to widen access to HE.
- Policy-makers need to ensure that marginalized and under-represented groups in their countries can access quality HE.

Efficiency and productivity:

Increased complexity, due to growth and pressure for research productivity, requires a focus on efficiencies and productivity.

- As HE institutions grow, they become more complex and increasingly difficult to manage and administer.
- Under the influence of neoliberalism, the professoriate is under pressure to be accountable and is assessed based on research outputs and publications. To compete in the global university ranking, universities are also under pressure to increase and commercialize their research outputs.

Quality and transferability:

Institutions must also guarantee quality assurance, academic support and the transferability of qualifications.

- In the context of rapid expansion, quality assurance in HE is at the top of the policy agenda in many countries.
- The widening access to higher education results in an increasingly diverse student body which creates pressure for extra academic support and innovative approaches to pedagogy.
- In the era of globalization, more students are studying and more academics are working outside their home countries. With the increasing mobility of students, academic programmes and labour forces across national borders, the issue of qualification recognition and transferability is increasing in importance.

5.2.5 Goals and objectives

Goals and objectives should be defined based on a holistic examination of the roles that ICT can play in strengthening practical provision and administration as well as the three traditional missions of a university: teaching, research and service.

ICT in provision: Use of ICT to expand access to higher education

- The use of ICT provides widespread and easier access to quality HE, and helps to build an ecosystem that is flexible, integrated, efficient and affordable.

- Considering the varied needs and attributes of students, especially given that many of them are working and/or have families to care for, institutions should blend social media tools to support access to non-academic services. This includes flexible scheduling and courses they can complete at their own pace, faster or slower depending on their commitments, as well as a family-support service when needed.
- Distance education that allows learning to take place anytime and anywhere enables countries to meet excess demand for higher education. The distance-learning landscape has been transformed by ICT, allowing for real growth in the numbers and types of providers, curriculum developers, modes of provision and pedagogical innovations.

ICT in teaching: Use of ICT to improve teaching and learning

- ICT can make available digital learning that involves web-based components, enables collaboration and access to learning resources that extend beyond the classroom, and helps students to learn independently and according to their individual needs, beyond the traditional barriers of time and place.
- Technology-enabled teaching helps instructors to use the data gathered on student learning to provide targeted intervention and tailored feedback, to create active learning environments that connect students with learning resources in different ways, to provide individualized and connected experiences, and high quality resources, to all students at a low cost.

ICT in research: Use of ICT to strengthen collaboration and innovation

National and institutional ICT policies can facilitate deployment by making funds available to sustain investments in ICT infrastructure. Multiple objectives can be set up to use ICT to advance research in higher education institutions (HEIs) (Commonwealth of Learning, 2009): increases in bandwidth and computing power can enable complex calculations of large data sets; communication infrastructure can connect research teams spread across the world; and the combination of communications and digital libraries can ease and widen access to academic resources.

ICT in administration: Use of ICT for efficient administration

- The use of ICT in HE administration may increase the efficiency of academic (e.g. library) services, simplify administrative tasks (e.g. student admission and registration) and reduce paperwork and manual record keeping.
- ICT can facilitate cross-border communication among different universities, and enable services to be distributed across a country or even between countries.

ICT in service: Use of ICT for community engagement

- The use of ICT can enhance the developmental role of HEIs by addressing social issues such as poverty and gender inequality, and empowering the poor and marginalized sections of society to play a major role in the developmental process (Commonwealth of Learning, 2009).
- The use of ICT to support university-industry-government collaboration as a triple-helix model to facilitate the effective transfer of knowledge and technologies, can lead to economic growth. Strategic objectives should be set up to mobilize local HEIs to support the development of local innovators in ICT.

5.2.6 Main lines of action

ICT in provision: Develop open distance education to expand access to higher education

- **Enhance distance learning to expand access to higher education opportunities**

Distance education provides ample opportunities for the HE sector to meet increasing demands for access, in particular across the developing world. ICT has boosted the potential of distance education to reach enormous new pools of students, especially in underserved populations and regions.

Governments should deploy ICT in distance education to: increase the capacity and cost-effectiveness of HE, reach target groups with limited access to conventional education and training, support and enhance the quality and relevance of existing educational structures, and promote innovation and opportunities for lifelong learning.

- **Harness MOOCs to build new learning pathways towards higher education and lifelong learning**

Massive open online courses (MOOCs) are available for anyone to enrol. MOOCs provide an affordable (often free but increasingly charged for, at a low cost) and flexible way to deliver quality educational experiences at scale so that people can learn new skills and advance their careers.[80]

The government should stimulate and motivate the adoption of new technologies and new forms of learning (Patru and Balaji, 2016). The recognition of MOOC certification could be an important enabler. The generic model of MOOC design and provision needs to be re-engineered to take into account variations inside developing countries such as limited internet access, students' need for offline access, and lower levels of mentoring and student support. Sector-specific strategies are necessary to harness MOOCs for skill building and professional development. Governments could support the creation of regional or national centres to finance and promote MOOCs and allied activities.

- **The use of ICT to widen access to teacher education and enhance its quality**

Teacher educators have the heavy responsibility of ensuring that their graduates possess the required ICT competences for their daily practice so that they do not need to be retrained when they join the teaching force. Based on the framework for national ICT competency standards, teacher training institutions at HE level should be supported to embed ICT in pre-service preparation programmes and qualifications, and leverage distance education to provide in-service continuing professional development in particular subjects, content areas and pedagogies.

ICT in teaching: Encourage blended learning in higher education

- Encourage HEIs to use blended learning, which is a combination of multiple approaches to learning such as face-to-face, self-paced, online and collaborative.
- Support the building of a knowledge repository of multidisciplinary subjects to counter the shortage of faculty in HE.
- Encourage the establishment of online communities or collaborative networks among instructional designers, learning designers, researchers, institutional data analysts, technologists, and learners to develop online teaching experiences.
- Plan and manage the development of digital learning in HE through regulations, institutional restructuring, and the use of fiscal incentives.
- Design and develop competency-based standards for different professions. ICT can be used in various professions as a means of promoting academic standards. Understanding how to use specific tools helps learners to meet competence-based standards, such as CAD (computer-aided design) in engineering, simulations in medical fields and microteaching in education.

ICT in research: Develop and sustain research networks

- Use ICT to transform research from something undertaken by individuals or discrete teams, in particular in HEIs, to an activity involving the instant sharing and collaborative generation of new knowledge by networks of researchers located around the world. ICT can provide the tools for co-creating and sharing research that has a direct impact on society.
- Governments should build an infrastructure of networked institutions, education providers, community organizations and technology companies to create a HE ecosystem that is flexible, integrated, efficient and affordable. Policy-makers at both institutional and sectoral should seek to promote collaboration among HEIs in all ICT-related activities.

ICT in administration: Improve efficiency

- Encourage and support all HEIs to deploy ICT in administration, with systems for: student admission and records, examination results and transcripts, finance and accounting activities, human resource databases and information management. Such systems can allow efficient decisions on e.g. eligibility for benefits, accreditation of prior learning, and even graduation.
- Support all HEIs to establish various ICT systems to enhance the professional development of administrators and provide technical assistance so that they can harness ICT for planning, setting standards, enabling change, and monitoring the results of the core functions of their institution.
- Support all HEIs to invest in systems that gather continuous assessment data across courses to underpin course development and implementation. Such data can also increase retention since it may provide insights into students' learning challenges, enabling the institution to offer timely support. Furthermore, information around the students and instructors in relation to course design can offer insights into what works for whom.
- Support all HEIs to deploy a technology system that provides a seamless learning experience to cater for the different elements of student life, such as accessing online courses and resources, having a repository for their own work, collaborating with peers and lecturers, and submitting assignments. When investing in new platforms and systems, HEIs must consider interoperability elements that allow for the secure exchange of student data. Governmental agencies and HEIs should ensure the privacy and security of this data at all times.

ICT in service: Promote the use of ICT to support equitable and sustainable development

- Provide incentives and grants to encourage HEIs to develop projects and programmes using ICT for development . Such initiatives should aim to bridge the digital divide, the disparity between technological 'haves' and 'have-nots' in different geographic locations or communities, by providing access to resources or voluntary community service.
- Promote university-industry-government collaboration to support the sustainable economic and cultural development of local societies. This collaboration is particularly important in building and sustaining an ecosystem for developing and upgrading digital devices and content rooted in local communities. To make the use of ICT sustainable for SDG 4, governments and institutions should shift from relying on a device-shipment approach to fostering the evolution of local ICT solutions through giving communities agency in the process of developing technologies and digital content that meet their needs.

5.2.7 Cross-cutting issues

Connectivity as an essential component in digital learning

The effective use of ICT in higher education depends largely on connectivity and access to the internet. Not only do HEIs need connectivity, but internet access must be affordable at both the institutional and individual level. As more and more people make use of the internet, bandwidth also needs to be increased.

The government should widen access to the internet by encouraging telecommunication services through competition while at the same time implementing careful regulation to ensure internet access for all. Policy-makers in HEIs need to consider institutional networks in terms of physical infrastructure, human support for infrastructure, funding availability, and operational cost.

Professional development for harnessing the full potential of ICT

A common challenge is that many faculty members lack the competences and skills to exploit the full potential of ICT to enhance teaching and learning. More often than not, ICT is used mainly to replicate or supplement existing teaching practices rather than to transform educational processes. The same can be said of administrators who lack the skills to retrieve and process the data that are made available through ICT tools and facilities.

Accordingly, it is recommended that:

- HEIs provide continuous professional development for academic staff to support their ICT skills.
- HEIs disseminate evidence on ICT best practices to faculty members, and formulate policies that reward excellence in technology-based teaching.
- HEIs hire ICT specialists to assist with the development, maintenance, and support of online learning experiences according to the demands of faculty members and students.
- HEIs require all new students to possess certain ICT certificates. This could act as an incentive to teaching staff to develop similar competences. For example, the French national certification, C2i, aims to develop and evidence the ICT skills of students in higher education institutions.

Striking the balance between teaching and learning needs and resource availability

Finding the balance between teaching and learning needs and resource availability leads to the foundation of a robust digital system that can meet these requirements. Issues that need to be considered include: the technological infrastructure available, hardware access, software licensing, network access, and the types of software applications available.

- Important factors to consider when selecting ICT technologies are reliability, the security of student data, ease of use for both faculty and students, effectiveness, cost, and the technical know-how of staff.
- The use of open-source technologies and OERs is highly recommended. A modular approach to interoperability is also recommended, which allows features to be added as plugins.
- Digital libraries and databases can enable students to access a large number of resources anytime and anywhere. They can also help to cut down costs in terms of acquiring and storing expensive textbooks, journals, and reference materials.

Quality assurance and qualification recognition

- For public accountability, many HEIs are subject to internal and external quality assurance agencies which use digital systems to monitor and evaluate institutions, programmes and student achievements. Such accountability measures are also important for professions (e.g. nursing or law) that are regulated by professional bodies. Website portals are used to provide accurate information on recognized HEIs and accredited programmes.
- National Information Centres (e.g. APNNIC)[81] have been developed by various governments to provide official information on the comparability of overseas qualifications with domestic ones using national qualification frameworks as benchmarks. This initiative supports student and labour market mobility through qualification recognition.

5.2.8 Existing approaches

Connectivity

Governments have various options in terms of widening access to the internet, such as:

- bulk-buying services from private providers;
- building their own national educational networks;
- encouraging competition between telecommunication suppliers; and
- providing tax breaks to infrastructure suppliers or reducing taxes on the purchase of computers and internet services by end users.

Open and distance education

Open and distance education can use both print and electronic media, which can be synchronous and asynchronous. Synchronous provision involves all participants at the same time, while asynchronous provision involves the participation of the various parties at different times (UNESCO, 2010). Government-supported open universities include the Indira Gandhi

National Open University (IGNOU) in India, the Korean National University in the Republic of Korea, the Open University in the United Kingdom, the National Distance Education University (UNED) in Spain, and Anadolu University in Turkey (Commonwealth of Learning, 2005).

HEIs providing distance education can be single-mode institutions, dual-mode institutions, consortia, or non-traditional providers. Single-mode institutions focus exclusively on providing distance education, while dual-mode institutions offer a combination of distance education and more traditional face-to-face programme options. Consortia are comprised of two or more institutions working collaboratively to provide distance learning such as METEOR in Malaysia (see below). Non-traditional providers include the Virtual University for Small States of the Commonwealth and African Virtual University, both of which are supported by intergovernmental organizations.

Example

- **Open University Malaysia (OUM)[82] and its parent company Multimedia Technology Enhancement Operations Sendirian Berhad (METEOR):** METEOR is a consortium of 11 public universities in Malaysia incorporated in 1998 that provides comprehensive and enhanced approaches via technology to all industries, focusing on learning, research and consultancy. OUM was established in 2000 and has over 100,000 students in more than 50 academic programmes. It follows an open-entry admission policy for students and uses digital learning methodology and tools as well as learning centres to run face-to-face sessions.

Learning management systems and virtual learning environments

Learning and course management systems (LMS) and virtual learning environments (VLE) are useful for delivering and managing a variety of student support services and facilities such as course outlines, digitally recorded classroom material, discussion groups, laboratory manuals and lab assignments, lecture notes, live lectures for later viewing and re-viewing, links to course-specific websites, online tutorials, supplementary readings, and virtual office hours for teacher-student consultations (Commonwealth of Learning, 2009).

LMS/VLE that are popular in the higher education sector include Blackboard and Schoology,[43] and the open-source Moodle.[41] The advantages of LMS/VLE are interoperability, accessibility, reusability, durability, maintainability and adaptability – and the collection of data for use in EMIS. However, there are disadvantages as well, which include that:

- implementing LMS/VLE requires a well-built technology infrastructure, and some university departments do not have this; and
- to operate in this environment, teachers have to be willing and able to adapt part of their curricula from face-to-face lectures to online lectures, and this might be difficult for them.

Example

- **Moodle:**[41] Moodle is a free and open-source LMS. It is a learning platform designed to provide educators, administrators, and learners with a single robust, secure, and integrated system to create individualized learning environments. Moodle has been translated into 95 languages so learners can easily use their local language in their site. There are plenty of resources and tools, including an active community for technical support. Moodle provides a flexible set of tools to support both blended learning and fully online courses.

Research networks

The application of ICT in academic research varies both within and between countries and regions, depending on the vision and commitment of HEIs' leadership. It also depends on the availability of funds and people to sustain investments in ICT infrastructure. For example, collaborative strategies such as SURF[83] in the Netherlands and Jisc[84] in the United Kingdom are organizations for promoting partnerships for ICT and network services in higher education (Commonwealth of Learning, 2009), while their Croatian counterpart, CARNET,[85] dedicates many of its services to primary and secondary school education.

Example

- **National Research and Education Network (NREN):** NREN is a specialized internet service provider dedicated to supporting the needs of the research and education community within a country. NREN is now being established in different regions throughout the world, forming South African NREN (TENET/SANReN)[86] in South Africa, Kenyan Educational Network (KNET)[87] in Kenya, Education and Research Network (ERNET)[88] in India and Singapore Advanced Research and Education Network (SingAREN)[89] in Singapore. They are primarily human networks and accompanying organizational structures for producing and sharing knowledge and promoting a continuous research agenda. Tools like physical telecommunications networks are enabling the production, distribution, and management of knowledge. The human networks consist of the users and beneficiaries of the physical network (Twinomugisha, 2006). The 'Case for NRENs'[90] portal has been established in response to a request from regional networks. It provides a repository of resources to support funds, advocacy and the advancement of national and regional research and education centres.

University-community engagement

ICT can facilitate university-industry partnerships for technology transfer. ICT can also enhance the developmental role of HEIs by addressing social issues such as poverty and inequality through empowering the poor and marginalized sections of society to play a major role in

the developmental process. Examples of such projects are NetTel@Africa in Africa, Telecentre Project in South America, Telehealth in Bangladesh, and the Village Resource Centre in India (Commonwealth of Learning, 2009). NetTel@Africa is a transnational centre in Africa that focuses on the policy and regulatory reform, capacity building and knowledge exchange necessary for the use of ICT for development, especially in education. For higher education, there are undergraduate and professional digital learning courses that employ ICT-enhanced teaching methods in various fields.

5.3 Masterplan on ICT in technical and vocational education and training

Box 13: Education 2030: Qingdao Declaration

We recognize that the ability to leverage ICT for learning is no longer a specialized skill; it is foundational to success in today's societies. We therefore acknowledge the need to integrate basic ICT skills and information literacy into primary and secondary education curricula.

... We recommend that ICT be used to deliver education and training, including TVET, in both formal and non-formal settings, at all times and in all places,...

Source: Qingdao Declaration, UNESCO, 2015*a*, Articles 10 and 12

5.3.1 Introduction

What makes technical and vocational education and training (TVET) different from the formal academic path through secondary school and higher education is its greater focus on providing knowledge, competencies and skills that can be applied directly in the labour market. Moreover, TVET may be accessed by all learners at some point in their life – whether early, as a direct route into a job, or later, by following an academic pathway while working. TVET is therefore a central element in enabling the learning society, which is a basis for sustainable economies and ecologies, and better lives.

TVET has a more tightly coupled relationship to the national and global economy than other educational sectors. It is immediately influenced by changes in the economy, whether in digitalization in general or the digital economy in particular.

The *Shanghai Consensus* (UNESCO, 2012, p. 7) calls for an 'Enhancing relevance of TVET' and the '…integration of information and communication technologies (ICTs) in TVET to reflect the transformations taking place in the workplace and in society at large'.

Changes will become evident first in developed economies as they are likely to harness highly automated production processes first. This will lead to knock-on effects for parts of the production chain which have been offshored to developing countries in the past, but will now be moved back to higher-wage countries due to increased production efficiencies (inter alia automation). Equivalent processes will occur in the service sector through the impact of artificial intelligence. That puts low-skilled jobs at risk everywhere, but especially in developing countries.

However, transformation through digitalization can be achieved anywhere if the new possibilities are effectively exploited. People need to work complementarily alongside ICT-enhanced systems and offer the social, emotional, and creative skills that such systems cannot provide (Nedelkoska and Quintini, 2018).

The task for TVET is to promote and support innovation and adaptation in business practices in two ways:

- give learners the skills to review and acquire new knowledge and practices; and
- provide firms with the means to offer and support learning opportunities for their staff.

The wide reach of TVET makes it a key part of the education system for providing citizens with the skills necessary to fully benefit from the digital transformation (UNESCO and the Commonwealth of Learning, 2017; UNESCO, 2016*b*).

5.3.2 Definition

TVET covers formal, non-formal and informal learning for the world of work, usually starting after lower secondary level schooling. UNESCO defines TVET as follows (2015d, p. 9):

> Technical and vocational education and training' (TVET) is understood as comprising education, training and skills development relating to a wide range of occupational fields, production, services and livelihoods. TVET, as part of lifelong learning, can take place at secondary, post-secondary and tertiary levels and includes work-based learning and continuing training and professional development which may lead to qualifications. TVET also includes a wide range of skills development opportunities attuned to national and local contexts. Learning to learn, the development of literacy and numeracy skills, transversal skills and citizenship skills are integral components of TVET.

5.3.3 Vision

ICT in TVET should lead to a dynamic, professional learning environment with up-to-date information on industry standards based on key insights into practices in the labour market. TVET should deliver a stimulating and authentic learning experience accessible to all learners.

5.3.4 Challenges

ICT in TVET policy must overcome challenges related to equipment and infrastructure, learning resources, teacher training, and learner skill sets:

- **Infrastructure:** Harnessing the benefits of ICT for an enhanced learning environment and as an instrument for the acquisition of ICT-related skills requires a stable electricity supply, up-to-date hardware and software, and easy access to the internet.
- **Learning resources:** New teaching and learning resources are necessary to support the efforts of teachers to align the new ICT-based learning opportunities with curriculum goals. This change will require reviewing and updating the TVET curriculum.
- **Teacher training:** For teachers to be able to fully realize the benefits of an ICT-learning environment, they will require adequate training on use of the equipment, the new learning resources, and new pedagogies. Training should also facilitate authentic learning scenarios involving frequent contact between teachers and the labour market.
- **Learner skill sets:** The new learning environments will allow learners to benefit from problem-based, authentic, and self-organized learning with ICT. They will require new forms of learning support to fully benefit from these opportunities.

In addition, TVET should be reactive to changes in the economic and social environment. This results in two related challenges for any TVET policy, especially those related to ICT:

- The policy should instil a culture of dynamism into the system, so that all levels remain reactive and, more importantly, proactive in recognizing and acting on change.
- Any policy should itself ensure that it has a clear objective to review and reform its structure, goals and impacts on a regular basis.

5.3.5 Goals and objectives

To fully harness the potential of ICT in TVET, the following recommendations should be considered:

Provide more problem-focused and learner-centred arrangements for learners and teachers

ICT can be used to enhance the teaching and learning setting. Blended-learning arrangements and flexible access to materials enable a more problem-focused and learner-centred environment. Modular courses can also provide professional development opportunities for teachers.

Foster opportunities for authentic learning situations, which ensure a better link between learning and labour market needs

ICT should be blended to enhance the provision of TVET, ranging from simulating authentic scenarios in industry (e.g. in complex production processes or experimentation with expensive or risky chemicals) to simply offering video conferencing and networking opportunities for learning and exchange with industry experts.

Support the acquisition of ICT-related skills

Future jobs will require ICT literacy. Providing ICT skills should be cross-disciplinary with opportunities to acquire the skills to use software or equipment to understand how ICT processes work ('computational thinking'), which is central to TVET programmes (Bocconi et al., 2016b; ITU, 2017).

Improve access to ICT-based educational services

- Make sure that the existing infrastructure allows easy access to internet services (especially learning resources) within the course programme.
- Ensure internet services that allow collaboration and exchange through video conferencing and messaging services are available to all learners to support their cooperation with each other and experts in the labour market.

Strengthen the link between course materials and new manufacturing, production, service, and data-based services in the labour market

- Identify and fill the technical and knowledge gaps between existing curricula and labour market standards.
- Identify new materials to fill these gaps (especially using OERs, which can be adapted and updated).

Ensure all teachers working in TVET are able to use ICT as a tool for new pedagogies

- Develop new programmes focused on ICT skills and integrate ICT-related issues into all other components of further education training programmes (cross-sectional).

- Engage both new and in-service teachers.
- Scale-up learners' participation in further education programmes (including by offering shorter courses and recognizing prior learning).

5.3.6 Main lines of action

Review TVET providers' existing infrastructure and improve access to ICT-based services.

Review the current situation and discuss how to improve the infrastructure, including equipment for learning support. This should include public and, if relevant, private providers.

The proposed actions include:

- Review the existing infrastructure of providers, aiming to allow easy access to internet services (especially learning resources) for all learners within their course programme in the short term, with wide-scale improvements planned for the medium to long term.
- Review the accessibility of internet services in learning settings. Such services should allow collaboration and exchange for teachers and students through video conferencing and messaging services. They should also support cooperation among learners and experts in the labour market.
- Identify TVET providers with the weakest infrastructure and aim to prioritize investment to support them.

Ensure that TVET courses provide sufficient orientation for practical application in the workplace

The digitalization of processes and services in the workplace requires students to understand, interact with and be able to cope with these new developments. This requires a learning programme which is developed in cooperation with businesses and industries in the field.

The recommended actions are to:

- **Develop national systems to provide information on skills needed in the workplace:** Provide educational institutions with updates on the latest developments in the world of work. Carry out analyses on recruitment, including through using big data analytics, and make these data available to those responsible for curriculum development. Identify technical and knowledge gaps between existing curricula and labour market standards.
- **Use cooperative forms of developing curricula**: Establish cooperation between educational institutions, employers, and their representatives. Ensure that there is close cooperation between the labour market and TVET providers which is further supported by apprenticeship and trainee schemes. Make sure that apprentices' experiences are documented with consent in ICT systems for future reference.

- **Develop curricula to reflect competence-orientation**: This will give space in the learning processes to integrate case studies from the field, while ensuring that technical knowledge (e.g. book-keeping, social welfare, technical design) is also used to solve problems or develop new strategies. These training methods reflect the reality of the workplace more authentically.
- **Consider the use of simulations and integration of VR and AR:** Review the readiness for adopting VR and AR into learning scenarios to increase the authenticity of the environment and give more opportunities to experiment with practical applications before students apply their skills in real settings (see more information on VR and AR in Section 2.5.1).

Provide wide-scale access to learning environments to improve learners' skills and competences

Changes in the world of work lead to two concurrent requirements: learners need to frequently update their skill sets and competences for their workplace, which means that opportunities must be provided for just-in-time learning; and employees need to be furnished with reskilling and upskilling programmes.

The actions include:

- **Adopt a platform to facilitate the recognition of informal learning:** According to the Adult Education Survey covering the EU Member States, around one third of all adults undertake on-the-job learning (Cedefop, 2014). Harnessing this learning starts with recognition of these workplace activities and strategic development of learning pathways through badges and microcredits. The information learning can be recognized through skills audits and individual 'challenge exams', and the alignment of informal and non-formal learning with national qualification frameworks.
- **Provide modularized courses in TVET:** The courses should focus on new tasks in the workplace. These may be commissioned by employers who recognize the need for training, but offered by TVET providers using badges and microcredits to facilitate the recognition of learning, in other words display what a successful graduate of a module has learned. These courses should be developed on a digital platform to enable them to be updated with ease, and/or turned into OERs to facilitate their repurposing and recontextualization for specific use-cases (Ehlers et al., 2018).
- **Harness ICT to develop learning communities:** The networks should aim at spreading knowledge learned in the field to all stakeholders. Ensure that the communication channel is bi-directional; for example new agricultural research could be disseminated to local farmers and new practices developed by farmers can be shared with researchers (Deichmann et al., 2016).

Ensure that ICT-related skills are provided to all, including those who have left school

While the development of ICT skills is increasingly being considered as part of the school curriculum, it is important that TVET imparts these skills to people who left the school system early to pursue an apprenticeship or job, and people who are in the labour market but need to update their skill sets.

The proposed actions include:

- **Review the curriculum of vocational training and make sure that it includes ICT-related skills:** This may include adapting learning resources that were developed for the school system to the needs of adult learners. This adaptation will be made easier if the original learning resources are OERs.
- **Harness ICT to facilitate more flexible access to training**: This allows working adults to take part in programmes alongside their jobs. The same type of provision can be used for teacher training. This may include distance-learning programmes and online courses such as MOOCs.
- **Use ICT to offer varying levels of individualized support to learners:** This includes peer support, which may be appropriate for learners at different qualification levels and ages, with a variety of work and life experiences. This type of support is highly relevant for adult learners who have taken different routes through the education system.
- **Consider awarding learners microcredits or digital badges** to recognize the learning they have already acquired in their career and in society, e.g. through civic engagement (Hofer et al., 2018).

Review and update the training of TVET teachers

This teacher support must consist of continuous professional development to keep them up-to-date and support them in their daily work.

The proposed actions include:

- **Review frequently the level of competency that TVET teachers have acquired**. Assess their knowledge of ICT as a tool used in the labour market and as a tool for new pedagogies. Based on these results, design and implement new professional development programmes.
- **Review the level and learning resources provided in initial teacher-training courses for TVET.**
- **Review the learning resources used in TVET teacher training at further education institutions**.

- **Redesign courses, especially further education courses, so they can be offered more flexibly**. Consider awarding teachers microcredits or digital badges to recognize the knowledge and skills they have already acquired in the field.

5.3.7 Cross-cutting issues

Integrating ICT-related TVET strategies into the national agendas of the digital economy and society

TVET often continues to be considered a second-class option alongside academic training in many education systems. This is no longer appropriate and has been changing in recent years as the consequences of digitalization for the labour market and individual job profiles become clearer, since TVET is not so much an educational sector as it is a skills-focused means of learning provision.

TVET strategies are best encompassed into larger agendas, such as national skills strategies and concepts for smart cities. Examples of such schemes can be found in Bangladesh (International Labour Organization, 2016*b*); Kenya (Ministry of Information, Communications and Technology, 2014); the UNESCO learning cities (Valdes-Cotera et al., 2015); and the EU's Skills Agenda (European Commission, 2016). Furthermore, even when ICT-enhanced TVET is included in wider strategies and policies, ensure that the role which ICT plays in TVET and the labour market is clearly articulated.

Improving learning opportunities for disadvantaged groups in society

TVET is a broad sector that is central to reducing social disadvantage and improving people's lives. TVET strategy should focus on improving learning opportunities for disadvantaged groups in society. This can be achieved through recognizing prior learning where it has happened, through badges or microcredits, and helping these learners to commence new learning pathways. This is relevant to the ICT sector, where on-the-job learning occurs frequently as new technologies emerge. TVET policies should include initiatives to bridge gaps between informal, non-formal and formal learning pathways. Together these learning events are a key resource for improving the skills and capabilities available to the labour market and the wider economy.

Ensuring adequate funding for ICT-enhanced TVET

The focus of ICT-enhanced TVET on applied learning can make it more expensive to offer than academic or theoretical study programmes. A cross-cutting priority is to ensure adequate funding for TVET. Public funding is important, but other options including public/private partnerships should be pursued since employers are clear beneficiaries. The participation of

private-sector stakeholders can be considered for either direct funding of TVET or supporting policy-makers through consultations. Organizing practical periods of learning within businesses or enterprises (e.g. through apprenticeship and trainee schemes) reduces the need to have certain equipment in the training centres.

5.3.8 Existing approaches

Across the approaches to ICT in TVET that are described below, three categories of skills are relevant:

- Foundational skills, which include basic literacy, creativity, and social and emotional skills. They also include the ability to understand and exploit the benefits of digital developments (Fadel et al., 2015).
- Skills which provide students with a certain repertoire of knowledge and competences that can be applied to their future workplace ('just-in-case skills'), and assumptions and understandings of that workplace.
- Skills and knowledge required in the workplace and usually acquired through on-the-job learning ('just-in-time skills'), which may require links back to the other two types of skills to ensure that they are made transferable to new situations.

There are two basic approaches to implementing an ICT in TVET policy: (i) policies with a focus on improving initial training programmes, and (ii) policies with a focus on adult education programmes.

- Initial TVET training

Initial TVET training, often provided as post-secondary schooling and apprenticeships, offers the opportunity to integrate ICT-enhanced learning and ICT-related skills directly into the course programme. These young participants will not have much workplace experience, so what they learn will be predominantly dependent on the curriculum and the experiences provided by their teachers. A policy focused on this sector should aim at a close interaction and exchange between training providers and employers to ensure that what is learned by trainees is relevant to the modern workplace and provides them with the skills to adapt to new workplaces in the future.

Initial training is often part of the public education system, at the regional or state level and subject to the normal forms of public policy (e.g. funding and quality assurance regulations, curriculum plans, etc.). From a policy perspective, TVET training should include at least the same generic ICT infrastructure as in other parts of public education.

- Adult or further education

Adult or further education may be offered to people who are employed, taking a career break (for upskilling) or unemployed. This type of education covers far more people than other sectors, encompassing diverse age groups and a range of educational and career backgrounds. A policy focused on this sector should start by discovering and using the skills that trainees have already acquired in the workplace, in civil society activities and at home. Its goal is to connect these skills with programmes that update and expand on them to meet the requirements of the workplace, including identifying and filling in gaps in foundational skills.

Adult education may be part of the public education system, but is also likely to include many private and company-based training providers. Changing this part of the sector is more difficult, but it can be achieved through, for example, special funding schemes and accreditation or monitoring regulations, which make any differences in the quality of provision more transparent. For example, the 'Training and Adult Education Sector Plan' (TAESTP) in Singapore monitors and benchmarks training providers with the goal of increasing competition and encouraging excellence.[91]

Example

- **SkillsFuture:**[92] SkillsFuture, from Singapore, is a national initiative to offer opportunities for lifelong learning to Singaporeans no matter where they are in life. At the core of the initiative is a skills framework that is currently under development. Employers, industry associations, unions and the government are working together to create a common language around skills. This covers key information on occupation/job roles, existing and emerging skill requirements, and career pathways for more than 20 sectors in Singapore. More notably, it provides a wide array of training programmes for skills mastery and upgrading.

Policy-makers aiming to harness the benefits of ICT in TVET must review these two approaches and decide where to focus the attention of their ICT in TVET policy. While a long-term policy should impact both sectors, short- to medium-term policies might start with one and then expand to the other over time. This process should be accompanied by an evaluation and impact assessment of the implemented policy to ensure that the framework is keeping up with the dynamic developments accompanying the increasing digitalization of our societies.

5.4 Masterplan on ICT in non-formal education

Box 14: Qingdao Declaration

We reaffirm that lifelong learning is the guiding principle to enhance an individual's knowledge, skills and competences for work and life. We recommend that ICT be used to deliver education and training, including TVET, in both formal and non-formal settings, at all times and in all places, as it can improve and diversify learning pathways, improve quality, and further reach vulnerable and underserved groups including rural youth and adults, women and girls, out-of-school youth, and people with disabilities.

Source: Qingdao Declaration, UNESCO, 2015*a*, Article 12

5.4.1 Introduction

To promote inclusion and equity in education, policy-makers need to respond to two fundamental questions: How does an education system enable access to learning opportunities for those children, youth, and adults who, for various reasons, have dropped out of formal education? How can communities excluded from formal education be given an opportunity to learn and sustain their livelihood?

Non-formal education (NfE) provides an important avenue for continuous and lifelong learning outside of formal educational institutions and a bridge to new pathways in formal education. The availability of digital technologies (devices and services) in daily life opens up new possibilities for the provision and recognition of NfE. Such new environments can expand the scope, scale, quality, and variety of learning opportunities for all, provided there is appropriate, consistent, and quality access to connected digital devices for learners. But the success of digital integration in NfE depends on a range of systemic factors, and requires policy-makers to:

- develop and implement institutional policies in support of digitally enabled NfE programmes;
- develop appropriate organizational strategies and administrative systems that support the development and provision of NfE programmes for various communities such as out-of-school children and youth, refugees, and people who are keen to learn entrepreneurial skills;
- make digital resources and connected digital devices accessible to NfE learners and educators;
- provide pedagogical support to NfE educators to help them integrate digital technologies into their teaching practice in their respective courses;

- provide learning support to individuals during the period when they are participating in the NfE programme;
- guarantee ongoing improvement in the quality of NfE courses; and
- ensure the certification and recognition of NfE courses.

5.4.2 Definition

NfE refers to structured learning opportunities that are flexibly organized to suit the needs of individuals and their specific environments and contexts. It can be an intermediate, flexible concept of learning that takes place in an organized manner and follows objectives (Pantea, 2016). The learning activities are short courses which may or may not lead to formal accreditation or qualification. They may also not lead to continuous learning pathways even though they can open up opportunities for ongoing learning (Ngozwana, 2017; UNESCO Institute of Statistics, 2011).

Traditionally, 'NfE' has referred broadly to courses for out-of-school children and youth, and programmes around adult literacy and entrepreneurial, livelihood and vocational skills. Examples of structured learning situations include, conferences, seminars, so-called 'inspirational festivals', workshops with mentoring or coaching programmes, and courses organized by the third sector and for-profit training providers. They may also involve online or offline applications.

Given the rapid changes in digital technologies, there are more possibilities to expand the scope, scale, quality, and variety of educational opportunities for all, provided there is appropriate, consistent, and quality access to connected digital devices. These opportunities include:

- ICT-enabled telecentres or community learning centres where online courses and programmes are delivered;
- massive open online courses (MOOCs);
- open-schooling programmes that enable the completion of formal schooling and/or post-compulsory education; and
- flexible and blended programmes which focus on building a wide variety of skills for continuous personal and professional development and lifelong learning.

5.4.3 Vision

ICT-enabled NfE should promote quality lifelong learning opportunities for all, in all settings and at all levels of education. ICT should improve and diversify learning pathways and

outcomes; increase quality; and reach vulnerable and underserved groups including rural youth and adults, women and girls, out-of-school youth, and people with disabilities. The recognition, validation and accreditation of the knowledge, skills and competences acquired through NfE should always be possible but never mandated for the individual.

5.4.4 Challenges

ICT in NfE policy must overcome challenges related to accessibility, quality assurance standards, and the wide recognition of NfE course outcomes. Through NfE, a range of educational, social, and economic problems can be addressed under appropriate conditions. Access to learning opportunities should be guaranteed for out-of-school youth, refugees, people with disabilities, and people who lack basic skills.

Challenges that NfE is required to address

- **Exclusion from access to basic learning opportunities**

The UNESCO Institute of Statistics estimates that 263 million children and youth were out of school in 2016, of which 130 million were in sub-Saharan Africa (UIS, 2018).

Numerous institutions worldwide have made creative use of digital technologies to enable out-of-school populations living in remote areas to access non-formal learning opportunities. These point to the possibilities for improving access to education if NfE programmes appropriately integrate digital technologies.

- **Skills and employability crisis**

In 2016, the International Labour Organization estimated that there were about 71 million unemployed youth (15-to-24-year-olds) around the globe, many of them facing long-term unemployment (International Labour Organization, 2016*b*). Meanwhile, 156 million employed youth in emerging and developing countries (38 per cent) were living in extreme or moderate poverty, defined as living on less than US$3.10 per day. This demands urgent attention from policy-makers. Harnessing digital technologies to support employability and entrepreneurial skill development, including reading and financial literacy, through NfE programmes must be considered. UNESCO reports that possessing strong reading skills doubles the probability of acquiring a decent job (UNESCO, 2016*c*).

- **Low literacy rate among adults in low-income countries**

UNESCO (2016*c*) reported that in many countries only 6 per cent of adults participated in a literacy programme. Yet there are good examples of where mobile technologies have supported the development of basic adult literacy through NfE programmes (UNESCO, 2015*e*).

- **Lack of access to education for refugee communities**

UNHCR (2016) reported that there were approximately 16.1 million refugees worldwide, of whom more than half are children, and 6 million are of primary and secondary school age. NfE and digital technologies have the potential to open up education and lifelong learning opportunities for refugee communities (UNESCO, 2018*b*).

- **Lack of access to education for people with disabilities**

As stated in Section 2.1.4, around 15 per cent of the world's population, an estimated 1 billion people, live with disabilities. People with disabilities are in multiple ways worse off than other people. This includes having a poorer quality of life, and fewer economic and educational opportunities, thereby further reinforcing marginalization and exclusion. While education strategies aim to integrate people with disabilities into formal education systems, NfE can play a complementary and supportive role (Global Partnership for Education, 2018). A high priority should be given to the use of ICT to offer opportunities for the full participation and inclusion of people with disabilities.

Specific challenges in providing NfE

ICT-enabled NfE has the potential to improve the scope, scale, quality, inclusivity, and equity of education, but a wide range of challenges have been encountered in the design and implementation of these programmes worldwide.

- **Lack of access to NfE programmes:** Many NfE programmes are not accessible to their target participants, since a widely-spread perception is that learning is supposed to take place in a formal setting and that alternative learning platforms may imply a compromise in quality. Another problem is that learners are often stigmatized by failure in formal education and may be unwilling to take another chance with NfE (Dunne et al., 2014). Having digitally accessible NfE programmes combined with mentoring schemes may help educators to overcome such barriers, given that they prioritize meeting the needs of their target communities.
- **Lack of quality assurance standards:** Many NfE programmes are often comprised of small-scale, short-term, and one-off training courses that have not been quality assured. In addition, the intended learning outcomes of NfE programmes are not always aligned with labour market demands for particular skills and competences. Educators in NfE programmes can also be resistant to changing their teaching practice to embrace the different methods that digital integration requires.
- **Low recognition of learning outcomes:** Many NfE programmes are not certified or accredited, nor are they included in national qualification systems. They are not always guided by clear standards of recognition or validation.

- **Lack of capacity and limited professional development**: For NfE educators, there is no set framework of required skills, consistent professional titles, or clear development opportunities. They might be, for example, social educators, youth workers, mentors, or work supervisors. NfE educators need to collaborate with young people and employers in allowing access to education practices that are relevant to the workplace, to provide guidance to better respond to the shifts in the world of work, and to offer inspiration to young people to stay motivated and launch their careers.
- **Lack of sustainability:** Many NfE programmes are targeted at communities where people cannot often afford to pay course fees. This challenges the sustainability of the NfE programmes. Often, these programmes have limited funding available for their development, provision, and evaluation; others receive funding for development but not long-term sustainability. All of this affects their impact.

5.4.5 Goals and objectives

To fully realize the potential of ICT in NfE, the following goals should be considered:

- promote universal access to quality lifelong learning and skill-building opportunities, programmes, and outcomes for all, in support of sustainable livelihoods through the integration of ICT;
- view NfE as an integral part of lifelong learning that can develop human capabilities, improve social cohesion, and create responsible future citizens; and
- recognize that NfE can also contribute positively towards citizenship, a value-based society, and economic and social productivity as well as economic growth.

The specific policy objectives could include the following:

Access

- promote universal, quality access to internet connectivity by exploring low-cost, affordable alternatives;
- audit existing NfE programmes and explore the adoption of digital integration; and
- develop digitally enabled NfE programmes to expand access to learning opportunities for literacy and employability skills, especially for people with disabilities.

Quality

- support higher education and tertiary institutions, community colleges, NGOs and community-based organizations (CBOs) in developing programmes for NfE educators and trainers to bolster the large-scale provision of digitally enabled NfE programmes; and

- help institutions to develop, promote and encourage the use of OERs that can support specific NfE programmes.

Sustainability

- develop or enhance a system that acknowledges and recognizes the wide variety of NfE programmes which are adapted for the specific digital learning needs of cultural and linguistic minority individuals and communities;
- develop multi-stakeholder partnerships in order to generate sustainable digitally enabled NfE programmes at national and institutional levels; and
- prioritize budget allocations for NfE programmes as part of the digitalization of the national education system.

5.4.6 Main lines of action

The following principles can guide the development of a NfE policy enabled by ICT.

- All individuals have the right to access any form of learning suited to their needs.
- All individuals have the right to see the learning outcomes of their NfE programmes.
- NfE policy needs to consider a recognition, validation and accreditation process. NfE programmes should promote the equal value of learning outcomes in formal, non-formal and informal education. Competences accumulated by individuals through non-formal and informal learning should be treated equally with those that are obtained through formal learning.
- Education and training systems should consider diverse forms of learning in a range of different settings and take into account the learners' contexts, needs and experiences.
- Shared responsibility and accountability between partners and stakeholders should be established in the design, implementation and evaluation of NfE programmes and the associated recognition, validation and assessment systems (Rogers, 2016; UIL, 2012).

In line with these guiding principles, key policy considerations with reference to ICT integration in NfE are outlined in three dimensions: access, quality, and sustainability.

Access: Harness affordable ICT to increase access to NfE

- Develop a national framework for supporting the development of institutional and organizational policies and strategies that promote ICT-enabled NfE programmes.

- Build institutional and organizational capacity to deliver ICT-enabled NfE programmes.
- Introduce policy, regulatory and legal mechanisms that promote sustainable access to affordable, connected digital devices and quality, affordable access to the internet for all NfE learners and teachers.
- Make vetted OERs available for free download for specific NfE programmes.

Quality: Leverage ICT to enhance the quality of NfE

- Invest in the continuous professional development of NfE trainers and teachers, and in the integration of ICT in non-formal education in ways that align with national teacher-training systems.
- Introduce incentives and dedicated training and professional development programmes for NfE educators to integrate digital resources into their teaching practice.
- Promote institutional support mechanisms for NfE educators, such as coaching and mentorship programmes, to help them integrate digital resources into their teaching practice.
- Promote and support the creation, use and reuse of OERs and open access in NfE.
- Support global online courses and programmes and prioritize the promotion of locally developed and relevant courseware on multiple platforms via multiple entry points.
- Encourage the adoption and development of individualized e-portfolios for NfE learners and teachers, which can include planned learning pathways and objectives that can be supported by NfE organizations and institutions.
- Promote and support the establishment of makerspaces (Section 5.4.8) as non-formal learning environments among higher and tertiary education institutions, NGOs and CBOs.

Example

- **Makerspaces:** A makerspace is often a community-run collaborative workspace for members of the community who have common interests. Children, youth, and adults can come together and explore ideas, make things, and work creatively. Over the past few years, makerspaces have sprouted up across the world and provided places where computer programmers, ethical hackers and app developers can meet and design approaches together. In ICT-enabled NfE policy, higher and tertiary education institutions, CBOs, and NGOs should be encouraged to promote makerspaces as non-formal learning environments.

Sustainability: Ensure that digitally enabled NfE programmes are sustainable

- Provide mechanisms for the recognition, validation, and assessment of digitally enabled NfE programmes, including the recognition of prior learning and lifelong learning through accreditation/badging systems and inclusion in national qualifications systems. In this way, institutions and organizations offering these programmes can ensure that their learners' prior experiences and achievements are properly recognized. There are different perspectives on how recognition can be formalized, as outlined by UNESCO and its partners (Singh, 2015). One example is UNESCO's *Guidelines for the Recognition, Validation and Accreditation of the Outcomes of Non-formal and Informal Learning* (UIL, 2012).
- Establish partnerships at different levels to support the sustainability of NfE programmes. Partnerships with young people, ICT companies, chambers of commerce, NGOs and CBOs, donors, state authorities, public and private training providers, employees, philanthropic organizations, and development agencies can promote access to digital learning in NfE for all and can also help sustain the programmes.

5.4.7 Cross-cutting issues

Cross-cutting issues can be integrated into each of the policy objectives related to access, quality, recognition, and sustainability, and therefore need special attention.

Inclusive and equal participation

Addressing the challenge of learner participation in NfE means ensuring that adults from disadvantaged backgrounds as well as those needing to reskill, because their jobs are changing or disappearing, should be included. Gender imbalances in access to digital technologies and NfE programmes should also be properly addressed, ensuring that women and girls are not marginalized. One approach is to ensure that woman and girls are encouraged and supported to enlist in NfE courses in traditionally male-dominated sectors such as engineering, management, leadership, and software programming (also see Section 2.1.3).

Similarly, fostering inclusivity in all programmes is essential. This involves, for example, offering programmes that people who have a disability can access, and promoting cross-cultural integration for refugee and migrant communities, which can happen through the creative use of language mobile apps. The European Union has run dedicated programmes for youth with disabilities to learn media literacy skills, such as 'Digital and Media Literacy of Young People with Disabilities/Handicap', which was implemented in the period from January 2018 to June 2020.[93]

Partnerships

Establish workable partnership models. Governments can lead partnerships with network service providers, ICT companies, banks, and development and donor agencies to support the implementation of new ICT-enabled community learning centres or telecentres which are accessible to various communities. It would be good for such partnerships to include young people, public and private training providers, and employees to ensure that programmes are relevant to their recipients and the market's needs.

Example

- **DigiTrucks:** Huawei has been cooperating with international partners such as Vodafone and local communities in building transportable DigiTrucks[94] to provide connectivity and non-formal training on digital skills to people who are out of school. Since the launch of the project, DigiTrucks have been built in Kenya, Democratic Republic of Congo, South Africa, and United Republic of Tanzania. Up to the end of 2020, Kenya's DigiTruck alone has provided over 22,000 hours of digital training to more than 1,300 rural young people and entrepreneurs in 13 counties.

Resource mobilization

NfE offers opportunities for upskilling the working population, helping them to gain the transferrable skills needed in a fast-changing world. The participation of private-sector stakeholders can offer ample opportunities for more employee-focused provision. Apart from direct state funding, partnerships with employers can provide opportunities for funding NfE initiatives.

5.4.8 Existing approaches

The following are examples of models that can be adopted to enable universal access to digital technologies so that institutions and organizations can deliver ICT-enabled NfE programmes.

Community telecentres or resource centres

A telecentre is a public place where people can access computers, the internet and other digital technologies that enable them to gather information, create, learn, and communicate with others while they develop essential digital skills. Telecentres exist in almost every country. While each telecentre is different, their common focus is on the use of digital technologies to support community, economic, educational, and social development, reducing isolation, bridging the digital divide, promoting awareness on health issues, and creating economic opportunities.

This involves establishing dedicated spaces where individuals and communities can access digital resources in order to participate in NfE learning programmes. Ministries of education and ICT can partner with the private sector, donor agencies and NGOs to equip community centres with a suite of digital learning resources that can support the provision of online courses and NfE programmes. Examples of community centres offering NfE are 'Open Schooling – Malawi College of Distance Education' (MCDE)[95] and 'Dadaab Refugee Centre' in Kenya which have ICT centres to host a range of NfE programmes. For example, in 2017, the Dadaab Refugee Centre hosted an 'ICT Boot Camp for Girls'.[96]

Example

- **Tshimologong Precinct:**[97] The Tshimologong Precinct is a Wits University-owned Digital Hub based in the inner-city district of Braamfontein in South Africa, which aims to foster the incubation of start-ups, the commercialization of research, and the development of high-level digital skills for students, working professionals and unemployed youth. The initial concept gradually grew into a zone supported by academic institutions, governments, and private sector organizations. Its makerspace, also known as the DIZ (Digital Innovation Zone), is dedicated to the promotion of and access to innovation through collaborative making, training, upskilling and experimentation or purposeful play. At the zone, people can engage in emerging technologies such as 3D printing, Internet of Things, robotics, augmented reality, virtual reality, and design for digital fabrication.

Supporting personally-owned digital resources

More and more people in poor communities are gaining personal access to connected digital devices, particularly smartphones. In 2019, 49 per cent of the world's population had mobile internet access, with more than 7 billion people covered by a mobile network (GSMA, 2020). To encourage widespread ownership of connected digital devices, national governments can also partner with banks and network service providers to offer incentives through affordable purchasing schemes. Examples include Mobisol's affordable smartphone loan scheme in Rwanda,[98] which is offered to customers based on an alternative credit assessment model; and the Pamoja partnership between Google Android and Orange[99] that launched a digital communication package in a number of countries in the Middle East and Africa to sell high-quality smartphones at a low price (approximately US$40), bundled with data and preloaded with popular learning apps. To promote NfE, the preloaded resources could be OERs that support lifelong learning.

As introduced in Section 2.1.2, intersectoral cooperation should be mobilized so that governments can partner with network providers to zero-rate approved digital education data. The zero-rated strategy should prioritize the target learners of NfE.

Extended service of National Research and Education Networks (NRENs)

Governments can extend their NRENs, which have been established in many countries, to offer bandwidth access to higher and tertiary education institutions to support their provision of NfE programmes. NRENs are established as specialized internet service providers that are dedicated to supporting the research and learning needs of the education sector within a country. NRENs usually provide a high-speed backbone network which can offer dedicated channels for individual research projects.

These can be extended to include community centres and NfE institutions, schools, and colleges. Examples include the Malaysia Research and Education Network,[100] Sudanese Research and Education Network,[101] and GÉANT,[102] which is the European Research and Education Network.

Leveraging ICT to expand access and improve learning outcomes of adult literacy programmes

Governmental agencies and partners should leverage open, distance and flexible learning (ODFL) enabled by digital technologies to expand access and improve the learning outcomes of literacy programmes for youth and adults. Formal education institutions, NGOs and community-based organizations should all be supported to offer non-formal literacy programmes and short complementary courses for youth and adults. MOOCs are one approach to ODFL which can be used to deliver literacy programmes.

Example

- **UNESCO Strategy for Youth and Adult Literacy:** The *UNESCO Strategy for Youth and Adult Literacy (2020-2025)* (UNESCO, 2019*g*) was adopted at the Organization's 40th General Conference that took place in 2019 in Paris. This strategy has four priority areas, of which the third is leveraging digital technologies to expand access and improve learning outcomes. Under this priority, UNESCO will support Member States in leveraging digital technologies, AI and OER to expand access to literacy learning opportunities, improve their quality, and build a digital environment that will contribute to sustaining and further developing the acquired literacy skills. ICT will be used to train literacy educators and provide in-service support.

5.5 Masterplan on curriculum and assessment

Box 15: Qingdao Declaration

We recognize that there is a need to redefine learning outcomes and the way in which we organize and assess learning if we want our education systems to prepare lifelong learners — both children and adults — to thrive in networked knowledge societies and succeed in economies that are increasingly reliant on technology.

We recognize that the ability to leverage ICT for learning is no longer a specialized skill; it is the foundation of success in today's societies. We therefore acknowledge the need to integrate basic ICT skills and information literacy into primary and secondary education curricula. We support the adaptation of learning assessments in order to reflect the use of ICT and its impact on learning and on outcomes.

Source: Qingdao Declaration, UNESCO, 2015*a*, Articles 9 and 10

5.5.1 Introduction

The increased availability and use of ICT in today's world has transformed our lives and the ways we learn, work, and engage in society. In a digital society, the introduction of ICT in education should not be seen as an 'exceptional' or 'extra' activity but rather as a fundamental element that informs the activities in which teachers and student engage at and beyond school. In this context, the purposeful integration of ICT in teaching and learning activities should be guided by sound pedagogical practices aimed at achieving well-defined learning objectives. To encourage and support these practices and objectives, clear guidelines are needed to ensure that they are aligned with the national curriculum. The design of any ICT in education policy is an opportunity to reconsider the curriculum and its associated pedagogies, and strategize how ICT can amplify its impact.

5.5.2 Definition

The curriculum prescribes what, when and how students should learn during formal education. However, the constant increase in access to and use of ICT by students and teachers is challenging this traditional definition. When new tools are introduced into the curriculum, what students learn (the curriculum content) and how they learn (pedagogy), both need to be reviewed and adjusted. There is a recognized need to integrate basic ICT skills into school and reform the learning assessments in order to reflect the use of ICT and its impact on learning and on outcomes (UNESCO, 2015*a*). The implementation of the curriculum also needs to harness the opportunities offered by the availability and use of digital tools and resources.

5.5.3 Vision

A curriculum that fully reflects the impact of ICT should ensure that the young people are equipped with the digital competences (knowledge, skills, and values) needed to meet the demands of, and exploit the opportunities emerging from, the proliferation of ICT in society. Such a curriculum includes standard guidelines and pedagogies that integrate ICT, and informs assessment accordingly so that the learning aims across the curriculum are accomplished. It also offers professional development opportunities to new teachers so they can integrate ICT into their professional practices.

5.5.4 Challenges

The integration of ICT into the curriculum needs to address the *what*, *when* and *how* of students' learning:

- **What**: New competences are required to leverage ICT for learning. Policy-makers and curriculum developers need to know what digital competences should be developed in a specific subject area and how. They should also consider interdisciplinary activities that can be enabled by the use of ICT. Another remaining challenge is how to localize the global frameworks on ICT competencies to respond to the local readiness and local needs.
- **When**: If the curriculum defines the syllabus and scheduling of teaching in a rigid form and specifies strictly what can be taught and when, it will be difficult to adopt new pedagogies in order to unleash the potential of ICT to facilitate students' learning. The definition and management of curriculum and assessment need to be adjusted to provide teachers and students with flexibility in restructuring the time and sequence so as to channel more appropriate pedagogies towards achieving the curriculum objectives. The curriculum and assessments should also allow students to engage in meaningful learning activities outside the traditional classroom or school hours.
- **How**: The wide range of digital tools and resources offers many opportunities to implement student-centred pedagogies; carry out inquiry- and project-based learning, and collaborative learning; improve assessment methods including the efficiency and effectiveness of managing formative assessment; and help students with cognitive challenges and learning difficulties. Keeping a balance between the current status of teachers' ICT-based competencies and the forward-looking targets on the use of ICT in and beyond the classroom is a perpetual challenge that all policies need to dynamically address.

When defining *what* to learn, and *when* and *how* students should use ICT to support learning, it is important to ensure:

- coherence across the curriculum and consistency between the national and school or institutional ICT policies;

- the integration of ICT competences into assessing students' learning outcomes, including in the environments and tools to used for the assessment; and
- the integration of the pedagogical use of ICT into teachers' competency and appraisal frameworks.

5.5.5 Goals and objectives

Policies for the integration of ICT into the curriculum should take into account the following objectives:

All students should develop digital competences.

- There should be a clear definition of the students' digital competence standards.
- Digital competence standards should be defined for each level of the curriculum.
- Digital competences should be integrated across the curriculum.

Purposeful use of ICT in teaching and learning across all subject areas

- The use of ICT to support teaching and learning should be integrated into different subject areas and levels of the curriculum.
- Guidelines on how ICT can be harnessed to deliver the curriculum and achieve the expected learning outcomes should be incorporated into curriculum standards and teachers' handbooks.
- There should be continuous professional development opportunities for teachers to integrate ICT into their practice.

ICT should be used to assess students' learning in different subject areas

- The use of ICT to assess student learning should be integrated in different subject areas of the curriculum. Assessment can be used to measure whether students have achieved a specific competence standard (assessment *of* learning), or to diagnose the extent to which the students understood of a set of lesson units and provide advice on teaching methodologies (assessment *for* learning).
- Guidelines on how ICT can be used to assess students' learning should be incorporated into curriculum standards and teachers' handbooks.
- Professional development opportunities should be provided on how teachers can use ICT to assess learning.

5.5.6 Main lines of action

Integrate digital competences into the curriculum

- **Define the framework of digital competences for students:** In some cases, the framework can be a set of strictly defined ICT standards for students. Several options and examples of digital competences for students can be used as a starting point, including the framework of the *International Computer and Information Literacy Study* (ICILS) (Fraillon et al., 2013), and the European Digital Competence Framework (DigComp) produced by the European Commission's Joint Research Centre (Vuorikari et al., 2016). There are also definitions of broader concepts such as '21st century skills' and the targeting of specific skills such as 'computational thinking'.
- **Define the levels of the digital competences to be achieved in different grades**. Competence standards should be adjusted according to the expected learning outcomes of each grade level present in the curriculum.
- **Integrate the digital competences into the different levels (grades) of the curriculum** as an independent subject, as cross-curriculum (transversal) aims, and as part of the aims of other subjects.
- **Provide guidelines and examples to develop the different digital competences**, and concretely illustrate appropriate pedagogical methodologies that can help to develop these competences.

Guide the purposeful use of ICT to achieve curriculum objectives

- **Identify opportunities to use ICT to overcome common difficulties that students face, and achieve the minimum standard of learning outcomes**. Identify specific areas that challenge teachers and students in which ICT can make a significant contribution to teaching and learning.
- **Enrich the curriculum with innovative pedagogies, and recommend tools and resources for teachers**. Considering teachers' differing levels of needs and experience, recommend both tools and resources that can facilitate the implementation of innovative pedagogies, and low-bandwidth and/or low-cost tools and OER that can support basic-level pedagogical activities.
- **Design and develop guidelines in curriculum standards and teachers' handbooks on how ICT tools and resources can be applied.** Many teachers recognize the potential of ICT to enhance or transform ICT in teaching and learning, but only a few of them are equipped with the competences to transfer such potential to their daily practice. The guidelines should consider teachers' current levels of ICT and pedagogical knowledge, but also need to encourage student-centred learning activities and innovations. Provide concrete examples to illustrate the types of activities that teachers are expected to implement.

Guide the use of ICT to enhance the assessment of students' learning

- **Review the existing assessment mechanisms and regulations.** Cooperate with entities that are responsible for the assessment of students' learning outcomes, study the feasibility of adjusting or reforming the assessment mechanisms or regulations.
- **Assess the relevance of using ICT to support the evaluation of learning processes and learning outcomes**. Based on the feasibility study, identify and provide recommendations on the use of ICT to assess students' learning, including formative and summative assessment.
- **Implement computer-based assessment of learning outcomes**. Selected resources should be integrated into specific classroom practices, ensuring the methodological coherence between the assessment and the teaching and learning processes.
- **Design and develop guidelines in curriculum standards and teachers' handbooks on how ICT tools and resources can be used to assess students' learning**. Provide concrete examples to illustrate the types of assessments that teachers are expected to administer.
- **Design strategies to support teachers in the implementation of the guidelines**. Strategies should be designed to familiarize teachers with how to connect to the global teaching community.

5.5.7 Cross-cutting issues

Digital competences

The Joint Research Centre of the European Commission defined digital competence as a set of knowledge, skills and attitudes that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share learning resources; and build knowledge effectively and efficiently. These sets of ICT competencies are associated with digital citizenship and include areas such as data literacy, communication and collaboration, digital content creation, safety, and problem-solving.

Table 7: Areas of digital competence defined by the EU project DigComp

Competence areas Dimension 1	Competences Dimension 2
1. Information and data literacy	1.1 Browsing, searching through, and filtering data, information and digital content To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies. 1.2 Evaluating data, information and digital content To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content. To analyse, interpret and critically evaluate the data, information and digital content. 1.3 Managing data, information and digital content To organize, store and retrieve data, information and content in digital environments. To organize and process them in a structured environment.
2. Communication and collaboration	2.1 Interacting through digital technologies To interact through a variety of digital technologies and to understand the appropriate means of digital communication for a given context. 2.2 Sharing through digital technologies To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary. To know about referencing and attribution practices. 2.3 Engaging in citizenship through digital technologies To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies. 2.4 Collaborating through digital technologies To use digital tools and technologies for collaborative processes, and for the co-construction and co-creation of resources and knowledge. 2.5 Netiquette To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments. 2.6 Managing digital identity To create and manage one or multiple digital identities. To be able to protect one's own reputation. To deal with the data that one produces through several digital tools, environments and services.

Competence areas Dimension 1	Competences Dimension 2
3. Digital content creation	3.1 Developing digital content To create and edit digital content in different formats. To express oneself through digital means. 3.2 Integrating and re-elaborating digital content To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge. 3.3 Copyright and licences To understand how copyright and licences apply to data, information and digital content. 3.4 Programming To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.
4. Safety	4.1 Protecting devices To protect devices and digital content. To understand risks and threats in digital environments. To know about safety and security measures and have due regard to reliability and privacy. 4.2 Protecting personal data and privacy To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damage. To understand that digital services use a privacy policy to inform how personal data is used. 4.3 Protecting health and well-being To be able to avoid health risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies that enhance social well-being and social inclusion. 4.4 Protecting the environment To be aware of the environmental impact of digital technologies and their use.
5. Problem-solving	5.1 Solving technical problems To identify technical problems when operating devices and using digital environments, and solve them (from troubleshooting to solving more complex problems). 5.2 Identifying needs and technological responses To assess needs and identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customize digital environments to personal needs (e.g. accessibility).

Competence areas Dimension 1	Competences Dimension 2
5. Problem-solving	5.3 Creatively using digital technologies To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and challenging situations in digital environments. 5.4 Identifying digital competence gaps To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and keep up-to-date with the digital evolution.

Source: Vuorikari et al., 2016, pp. 8-9

Meanwhile, some countries have defined their own frameworks to emphasize the need to develop these skills. For example, the Chilean Ministry of Education defined digital skills as 'the capacity to solve information, communication and knowledge problems as well as legal, social and ethical dilemmas in digital contexts' (Ministry of Education, Chile, 2013, p. 17).

Another set of skills, generally known as '21st-century skills', includes additional areas such as critical thinking and creativity (see for example the Partnership for 21st Century Learning).[103]

Some countries have also incorporated computational thinking as one of the core skills students need to learn. Although the definition is still under discussion, there seems to be a consensus that it includes a set of concepts and capabilities such as abstraction, algorithmic thinking, automation, decomposition, debugging, coding, programming, and generalization (Bocconi et al., 2016*a*).

Across different subject areas, ICT is also changing the learning aims of several traditional subjects including mathematics, science, language and history. In this regard, the participation of subject-area specialists in the policy design process is of crucial importance.

Curriculum design models for the development of digital competences

The integration of digital competences in the curriculum can be implemented based on different models, including the following:

- **Define ICT as a subject area to mainstream the development of ICT or digital competencies**: the aim is to mainstream the development of ICT competencies ranging from basic to advanced ICT-related knowledge, skills and values that are age-appropriate. For example, the National Curriculum Standard for ICT (Grade 9-12) (Ministry of Education, China, 2017) covers one compulsory subject for all students: ICT fundamentals. In addition,

all students need to choose one of the five elective subjects: algorithm and programming, application of multimedia technologies, application of internet technique, technologies on data management, and fundamentals of AI. At the same time, all students in China start to learn ICT skills as a subject from grade 3, which is connected with curriculum for grades 9-12.

- **Define digital competencies as cross-curriculum aims to drive the use of ICT to support problem-solving**: the provision of all subject areas incorporates the development of digital competencies. For example, learning to 'identify, locate, retrieve, store, organize and analyse digital information' can be a transversal aim included in the implementation of a project-based activity in a history or geography class.
- **Integrate the use of ICT to support the learning of other subject areas**: students can learn how to use ICT while studying other subject areas, for example when learning how to use a word processor in a language class, a spreadsheet in math class, and simulations in science. Some countries have incorporated programming into project-based learning activities across other subject areas. These activities offer the opportunity to integrate the use of ICT to target 21st-century skills such as problem-solving, collaboration, and critical thinking.

The use of ICT to deliver current curriculum objectives and enable ubiquitous learning

For the last few decades, the use of ICT to improve students' learning outcomes has achieved conflicting results. It has been long considered to be a catalyst (Musheer, 2018) or a lever that will bring change and innovation in the classroom and thereby improve learning outcomes. However, international studies show that the use of ICT in classroom settings is still limited in frequency and variety (Fraillon et al., 2014; Law et al., 2008). Studies also show that both students and teachers use ICT much more frequently and creatively for teaching and learning purposes outside school (Hinostroza et al., 2016; Meneses et al., 2012; OECD, 2015; Wang et al., 2014).

In this context, as introduced in Section 2.4 on schooling models and Section 5.2 on higher education, policy-makers need to plan two aims for the integration of ICT into the curriculum: on the one hand, to encourage the use of ICT as a catalyst of change in the classroom to foster effective and innovative pedagogy and achieve better learning processes and outcomes; and on the other hand, to use ICT as an enabler of open learning systems that support ubiquitous, lifelong, and life-wide learning beyond the campus. For this purpose, policy-makers should review the increasing use of ICT by students and teachers outside of schools, and provide guidance on how to protect students' agency and integrate these non-formal or informal uses of ICT with more formal teaching and learning activities (Hinostroza, 2017).

ICT-based assessment for learning

The use of ICT to support assessment for learning is growing rapidly, and there are a number of approaches that aim to provide appropriate and timely feedback to students. This includes

the use of ICT-supported formative assessment. In particular, the use of e-portfolios in secondary and primary education (Beckers et al., 2016) has been expanded to cover complex problem-solving skills (Shute and Rahimi, 2017). However, for its successful implementation in classrooms, teachers and school managers need to develop appropriate competences to use and interpret the results of assessment.

One of the emerging practices is the use of AI to support adaptive assessments of students' learning that are tailored specifically to each learner based on their previous performance. Adaptive assessments are based on Item Response Theory (IRT) and have been brought about by the recent development of AI-powered LMS and big-data analytics. Combined with more sophisticated psychometric theories and algorithms, AI-based assessment tools (e.g. Kidadaptiv)[104] are able to aggregate learners' data to create psychometric profiles of each person's interactions, preferences, and achievements. For example, ViLLE[105] is an adaptive digital learning platform developed by the University of Turku of Finland, which won the 2020 edition of the UNESCO King Hamad Bin Isa Al-Khalifa Prize for the Use of ICT in Education.[106] ViLLE supports the assessment of learners' progress toward achieving curriculum objectives, recommends individualized learning routes for further study, provides analyses of study habits and diagnostic advices, and helps teachers to monitor average or individual course grades and provide early alerts when there are learning problems.

Although there are some successful experiences in this area, the use of big-data learning analytics is subject to a growing debate. There are ethical implications for collecting and managing large amounts of student data that can be used, for example, to measure and benchmark schools' performance in a high-stakes exams (Timmis et al., 2016). In this context, prior experiences in access to and engagement with ICT are associated with students' social backgrounds, which will have an effect on the results of ICT-based assessments. This contributes to inequality for the most disadvantaged students.

5.5.8 Existing approaches

Systemic approach

A systemic approach for integrating ICT into the curriculum includes incorporating recommendations on the use of ICT in teaching and learning, and on access to digital tools and resources including internet connectivity. The systemic approach also needs to ensure that all teachers have the competencies to use ICT in their professional practice and that they are able to teach their students how to use these tools effectively. For this, ICT should also be integrated into pre-service teacher training. Teachers' ICT competency standards, such as the UNESCO ICT Competency Framework for Teachers, and the incorporation of ICT competences into teachers' appraisal systems, are also part of the systemic approach.

Evolutionary approach

An evolutionary approach to ICT curriculum integration includes funding over long periods of time that recognizes the need for scaling up innovations and making them sustainable. A programme that funds ICT in education for a short period of time (e.g. one to three years) is unlikely to have the appropriate momentum to enhance learning or transform pedagogies or practices. In particular, an evolutionary approach to curriculum integration would need to support innovation beyond prototypes, and trigger educational transformations (Scanlon et al., 2013).

The integration of ICT into the curriculum needs to put in place multiple conditions and involve a large number of key stakeholders. However, the most important variables are teachers' willingness and ability to adopt and innovate with the ICT tools and resources. Accordingly, several ICT adoption models suggest considering not only teachers' competences but also their attitudes and beliefs about ICT (Ertmer et al., 2012; Kim et al., 2013; Kreijns et al., 2013; Krumsvik, 2012).

Example

The evolutionary approach to the integration of ICT into curricula and assessments can be seen in the five iterations of the ICT Masterplan of Singapore:[107]

- **ICT in Education Masterplan** (MP1: 1997-2002)
  The MP1 laid a strong foundation for schools to harness ICT. It provided basic infrastructure and equipped teachers with a basic level of digital competency, leading to technology being widely accepted for use in education. ICT tools were leveraged to help students shift from an acquisition model of learning to one that engages higher-order thinking, such as application, synthesis, and evaluation. A target was set for schools to integrate ICT into 30 per cent of curriculum time.

- **ICT in Education Masterplan 2** (MP2: 2003-2008)
  The MP2 was built on the foundation of the MP1 to strive for an effective and pervasive use of ICT in education. The key priorities were to ensure that all schools achieve a baseline level of integrating ICT use, while fully supporting schools that were ready to achieve higher levels of use. MP2 emphasized seamless integration of ICT into the curriculum and leveraging of ICT for formative assessment and summative assessment. For example, the use of graphic calculators was specified in the mathematics curriculum,

and data loggers were used for students' science assessments. Instead of distributing learning resources through CD-ROMs, the Ministry of Education (MOE) focused on the development of rich digital resources in the form of learning objects that could be accessed through online portals. To complement MOE-initiated projects, schools were encouraged to develop and share their resources.

- **ICT in Education Masterplan 3** (MP3: 2009-2014)
  The MP3 aimed to enrich and transform the learning environments of students and equip them with the critical competencies and dispositions to succeed in a knowledge economy. This masterplan focused on self-directed learning, collaborative learning competencies and the responsible use of ICT by students. MP3 aimed for the better integration of ICT into the curriculum and innovative future-looking pedagogical practices. Plans for ICT integration started from the initial design of the curriculum and assessment, so that teachers considered pedagogically applying ICT in lesson designs even before reaching their classroom. Due attention was given to developing students' awareness in cyber wellness issues.

- **ICT in Education Masterplan 4** (MP4: 2015-2020)
  The MP4 focused on quality learning, in alignment with the MOE's emphasis on student-centric and values-driven education. This included helping students gain subject mastery, acquire 21st-century competencies, and be responsible digital citizens. The MP4 directly targeted ICT in curriculum, assessment and pedagogy and sought to bring about a synergistic integration of ICT in educational outcomes across the divisions of the MOE. The curriculum determined whether students had attained the learning objectives, which in turn reflected the pedagogy of their classroom through their activities and strategies. The pedagogy then reinforced the learning objectives and prepared the students for assessment. The range of proposed strategies aimed to achieve the systematic end-to-end integration of technology into subject areas, harness technology for assessment and national examinations, and be inclusive in terms of reach and support beyond the mainstream curriculum.

- The ICT Masterplans of Singapore have now been superseded by the '**Educational Technology Plan**' (EdTech Plan), which aims to guide the development of the technological ecosystem for learning in primary schools all the way up to pre-university institutions. Building on the foundations laid by MP1-MP4, the EdTech Plan sets out a broad overall 10-year vision, from 2020 to 2030, with the aim of helping to make education more self-directed, personalized, connected, and human-centred.

5.6 Masterplan on digital learning resources

Box 16: Qingdao Declaration

OERs provide education stakeholders with opportunities to improve the quality of, and expand access to, textbooks and other forms of learning content, to catalyse the innovative use of content and foster knowledge creation. We commit to developing sector-wide strategies and capacity-building programmes to fully realize the potential of OERs to expand access to lifelong learning opportunities and achieve quality education.

Source: Qingdao Declaration, UNESCO, 2015*a*, Article 7

5.6.1 Introduction

Providing easy access to educational materials is one way to exploit the potential of ICT to support collaborative knowledge production. The provision of educational resources linked to the curriculum, although insufficient on its own, can help transform teaching and learning methods in classrooms, expand learning opportunities, and make these opportunities more equitable. Accordingly, the preparation and distribution of digital learning materials should be an important component of an ICT in education policy. In every country, it is necessary to establish policies to make these learning resources available to schools, teachers, and students, and to secure digital materials effectively with careful consideration of the local context. Based on lessons learned from the COVID-19 disruption, the provision of digital learning resources for all subject areas and grade levels has become a critical lifeline for ensuring the continuity and quality of learning in emergency circumstances.

5.6.2 Definition

Digital learning resources or content consist of a wide range of digitalized materials that are aligned with the national or institutional curriculum. These materials can be presented in any form of multimedia including graphic images or photos, audio and video clips, simulations, and animations. They can also be deployed through computer-assisted instruction (CAI) and web-based instruction (WBI) courseware including MOOCs, as well as learning objects that are self-contained, reusable, and may be portable between learning systems.[108]

It is not necessary for all learning resources within a course or lesson unit to be completely digital. To support effective learning and ensure sufficient human interaction, it is usually enough for only some parts of the course to be digital. These resources could be in single mode such as text, or in multiple modes, such as audio, video, text, and diagrams. Furthermore, these resources could be static learning objects such as e-textbooks and web pages, or dynamic knowledge objects such as animations, simulations, and games.

Digital textbooks can be seen as a special type of learning resource that has a range of digital elements such as a glossary, multimedia data, assessment items, search capabilities, hypertext links, and functions to support cross-referencing, bookmarking, highlighting and note taking. A digital textbook is not simply a traditional textbook in a digital/PDF format. A digital textbook should support interactive functions that aim to enhance the reader's experience.

The masterplan on digital learning resources should consider policy options for the process of creating, storing, and distributing digital learning materials, training teachers to use these materials, and introducing new materials such as digital textbooks which use advanced technologies.

5.6.3 Vision

All students and teachers should have universal access to quality digital learning resources. These resources should be customized to ensure accessibility according to users' needs and local cultural and educational contexts, and they should be monitored through recognized and fit-for-purpose quality-assurance mechanisms. These resources should also be easy to administer, share, and find. They can be reused and regularly evaluated, updated, and adapted to take advantage of new pedagogical and technological advancements.

5.6.4 Challenges

Securing quality digital learning resources, and adapting them to suit various teaching and learning environments, is a major challenge. Policy-makers often encounter the following issues:

- Financial resources are needed to develop and regularly update curriculum-aligned digital learning resources that cover all subject areas and all grade levels.
- There is a lack of high-quality OER that are relevant to the local curriculum.
- Localized materials with different language options are scarce.
- There are often delays in the provision of learning materials to end users.
- Accessing quality learning materials in remote regions can be difficult – for example, in schools where there are no English or science teachers.
- Teachers and students must be motivated to familiarize themselves with digital learning resources tor teaching and learning.
- There is always a need to update digital resources in order to keep pace with rapidly developing technologies and changes to the curriculum.

5.6.5 Goals and objectives

Policies for the preparation, dissemination and use of digital learning materials should take into account the following goals and objectives:

Relevant digital learning resources are available in local languages and cover all grade levels and in all subject areas.

- Materials should be searchable and accessible through various devices (i.e. computers or mobile devices) in targeted learning environments.
- Materials developed or purchased by public funds should be made available under licence to encourage teachers to use and reuse them.
- An OER policy for digital learning resources should be adopted.

Digital learning resources are securely stored and made accessible to teachers and students.

- National or local public repositories or platforms should be established and supported with technologies and human-mediated measures for cyber security.
- Universal design for learning (UDL) should be applied to ensure accessibility for learners with disabilities and learners who are from cultural and linguistic minority groups.
- Ensure the distribution of digital learning resources to remote regions and marginalized learners.

Digital learning resources are curated, quality-assured and aligned with the curriculum.

- Establish quality-assurance standards to ensure quality control of digital resources.
- Align digital resources to the curriculum and local culture.
- Ensure that there are pedagogical suggestions for group activities and peer learning.

Teachers are well-trained in finding, reusing, creating, and sharing digital resources.

- Provide teachers with regular in-service training opportunities for finding, reusing, creating, and sharing digital learning resources.
- Integrate pedagogical methodologies on the use of digital resource into teacher training programmes.
- Incorporate the knowledge and skills on finding, developing, and adapting digital learning resources into pre-service teacher-training programmes.

Integrating digital learning resources enables open access to school education and ubiquitous learning

- Integrate digital learning resources with digital devices, internet connectivity, and human-mediated facilitation and coaching to enable open access to education programmes (also see Section 2.4).
- Blend digital technologies with resources to enable ubiquitous learning[109] at any place or time.

5.6.6 Main lines of action

Develop digital learning resources for all subject areas and grade levels.

The digital learning resources should be developed based the local curriculum and in the local language, with consideration of the following suggestions:

- Carry out a needs assessment for all grade levels and school types. Possible options include asking teachers about the selection, adoption and use of the most relevant digital learning resources to suit the needs of their students.
- Select appropriate ways to secure sufficient funding resources for the production and provision of digital learning resources based on the capacity of the country. Possible options include government-led development, government procurement from the market, or a mixed approach.
- Enable the relevance of digital learning resources for learners from economic, cultural, and linguistic minority groups (such as versions supporting local or ethnic minority languages, and catering for cultural and religious sensitivities), and ensure access for learners with disabilities.
- Adjust quality-assurance mechanisms for learning content to cover digital learning resources. Institutionalize quality control of resource development and establish guidelines and standards for them.

Embed pedagogical principles in digital learning resources

- Ensure that age-appropriate pedagogical principles are applied when designing and developing digital learning resources. When forming resource development teams, include not only project managers, specialists in technological design and production, and programmers, but also specialists in quality assurance, peer reviewers, librarians, instructional designers, specialists in media accessibility, and if possible, international experts.
- Provide incentives for teachers to curate and create high-quality digital resources and support them to use communities of practice and online platforms to share resources with their peers.

- Suggest learning routes or pedagogical methodologies for teachers to apply resources to structured units of digital courses. For digital resources to be included in teaching practices, encourage teacher agency and support teachers' remixing and innovative reuse.

Establish national or institutional repositories to make digital learning resources accessible and searchable through various devices

Because of the educational disruption caused by the pandemic, all governments have realized that national or public digital or online learning platforms are no longer optional if the right to education is to be protected during crises. Sections 2.3.3 and 2.3.4 presented information on how online platforms can be made accessible through varied social media tools. After the outbreak of COVID-19 globally in March 2020, UNESCO created a list of examples of national platforms or portals that are designed to host and manage digital learning resources and support distance learning.[110] In the USA, the Washington State Board for Community and Technical Colleges established an OER repository[111] called the 'Open Washington OER Network',[112] categorized by subject area and key multimedia used in the resources. There are also institutional repositories, especially at the level of higher education, such as 'DR-NTU'[113] at Nanyang Technological University in Singapore which provides research data and supports the sharing of research papers and ideas.

Different options for policy-makers could include:

- Develop appropriate functions under the repositories or portals that allow teachers and learners to access the learning resources through various platforms or devices.
- Develop learning resource repositories or databases of digital resources that allow access through unique identification and authentication, and support searching and retrieving, and the functionality to store and modify favourite resources.
- Select a content management system (CMS) that enables users to create, retrieve and edit information and knowledge in digital format such as images, graphics, animations, audio clips, and videos, in real time and on demand.
- Review the various vendors in the market and validate them as qualified providers based on humanistic principles, inclusion and equity, and other relevant criteria (see Section 2.2.2).

Make good use of OER

Based on UNESCO's Recommendation on OER, the following actions should be considered by all governments:

- Develop supportive policies for the adoption and effective use of OER, including the governmental regulatory frameworks to support open licensing of publicly funded educational and research materials. Develop strategies to enable the use and adaptation of

OER in support of SDG 4, and build mechanisms and provide grants for relevant research on OER. Details on how to develop national policies on OER can be found in the UNESCO publication, *Guidelines on the development of OER policies* (Miao et al., 2019).

- Formulate specific mechanisms for the procurement and open licensing of digital learning resources that need to be purchased with public funds. This includes commissioning non-governmental agencies to develop of educational resources based on agreements that the intellectual property (IP) and copyright of those resources rest with the government. Grant open licences to the resources that are produced under public funds.
- Integrate capacity building on OER into training programmes for teachers, education managers and other key stakeholders. The aim is to develop the capacity of all stakeholders to create, access, reuse, repurpose, adapt, and redistribute OER. More importantly, the government should develop training programmes on how to use and apply open licences in a manner consistent with national copyright legislation and international obligations.
- Promote inclusive and equitable access to quality OER through the national or institutional repositories and personal communication tools. The national or institutional repositories should specify the policy on licensing and tag all digital learning resources with a clear copyright or open licence. They should ensure that both self-produced digital learning resources and OER are accessible in any medium are shared in open formats and standards to maximize equitable access, co-creation, curation, and searchability, including for people who have disabilities or are from vulnerable groups.
- Integrate the curation of OER into the national plan on the development of digital learning resources, and support the sustainable creation and sharing of OER at national, regional and institutional levels. This will include a mechanism to facilitate international cooperation on adopting and localizing internationally available OER to minimize unnecessary duplication in OER investments.

Train both pre- and in-service teachers on how to search, select, reuse, create and share digital resources

- Conduct training to address different needs including, searching for resources on the internet, evaluating digital resources, integrating different types of resources into different pedagogical approaches, and developing innovative resources with emerging technologies.
- Motivate teachers by providing training incentives, certification, and flexible schedules.
- Support teachers' continuous professional development through various programmes such as seminars, workshops, meetings, and online communities of practice.
- Streamline pre-service and in-service teacher training programmes on the same topics.

Leverage digital learning resources to enable u-learning

Enabling u-learning (ubiquitous learning) requires not only an infrastructure that enables access to learning resources anytime and anywhere, but also the adoption of new teaching methods that take into account the various characteristics of individual learners. Individualized learning aims to optimize the pace of and sometimes the approach to learning for each learner's specific needs. In both u-learning and individualized learning, activities should be meaningful and relevant to learners and adjustable according to their needs. Quality resources are designed to allow each learner to cater for their personal learning speed, objectives, and approach. Some tools can also be customized and optimized. The adoption of u-learning therefore require a high-level of ICT in education readiness in terms of access to digital devices and internet connectivity, digital learning content, and teachers' digital competencies and capacities in designing and facilitating online learning.

- Carry out an analysis on ICT in education readiness and an assessment of the needs of learners, especially verifying the status of their access to the learning resources, and identify the gaps in this provision for all grade levels and subject areas.
- Based on the funding resources available, choose the access solutions in terms of both the content-delivery technology and end-users' devices, to support universal access.
- Based on this feasibility analysis, make a decision on whether the initiative should be launched, and then decide on the period needed to roll out the solution.

5.6.7 Cross-cutting issues

Establish quality control and assurance mechanisms for guaranteeing high-quality learning resources.

Quality assurance (QA) is a procedure or set of procedures intended to ensure that the contents under development meet specified standards. To guarantee quality, it is necessary to establish guidelines or standards. It is recommended that a QA committee is established, comprising of representatives from schools and experts in learning resource development and curriculum development. There are bottom-up, lightweight, user-defined models such as the EdShare project at the United Kingdom's Southampton University;[114] and top-down, strictly controlled models such as the OpenLearn Initiative, also in the United Kingdom (UK).[115]

Example

- **General Criteria for Excellence in Online Learning:** The National e-Learning Center of the Kingdom of Saudi Arabia[116] has developed a document called General Criteria for Excellence in Online Learning, which provides set of reference criteria for QA covering the following categories of digital learning resources: digital courseware, MOOCs, TV-based

distance learning programmes, resources hosted by national learning platforms, and resources to support an immersive and augmented learning environment.

Sustainable mechanisms to incentivize and support teachers' creation and sharing of quality-assured OER

Digital learning resources need to be updated regularly, and governments need to build dynamic models to support teachers to create OER and conduct QA before sharing the OER through national repositories or platforms.

Box 17: Bahrain's OER Policy

1. To assure the quality of teacher-generated OER, the Digital Content Production Guide should always be referred to throughout production. Subsequently the content should be revised and assessed through the following phases:
   - Technical revision from the educational technology specialist within the school according to the Digital Content Production Guide.
   - Revision and approval by the senior teachers.
   - Revision and approval by the school principal.
   - Uploading the revised and approved content on the specified webpage.
   - Final revision by educational specialists (Curricula and Supervision Directorates).

2. Besides teachers' practices of uploading their work, senior teachers, school principals, and all educators who supervise teaching and learning processes, should periodically nominate good-quality educational content produced by teachers for the mutual benefit of teaching and learning.

3. Educators within the Ministry of Education should nominate their educational production to be published as OER after being openly licensed and approved officially by their directories.

4. The OER committee should design an official mechanism to collect useful and high-quality student assignments, projects and educational material to be potentially transformed into OER sources. This will happen in the future phase of OER policy implementation.

5. King Hamad's Schools of the Future Project manages the OER publication process of the material gathered from schools or directories within the Ministry of Education or provided from other sources on a designated webpage (certain criteria should be followed).

6. The OER committee coordinates with the concerned officials to ensure that the implementation of the OER policy is aligned with other policies, e.g. on HR and the curriculum.

Source: Miao et *al.*, 2016, p. 38

5.6.8 Existing approaches

Offline devices with pre-loaded content

In learning settings without stable internet connectivity, offline devices such as tablets or laptops with pre-loaded software applications and digital learning resources are usually adopted. The advantage of the pre-loaded content model is that pre-scheduled lessons and learning materials can be delivered easily to students without internet access. The pre-loaded software and content can then be updated periodically when internet connectivity becomes available. This model requires that tablets or laptops should be rugged and robust so that they are not easily damaged.

Example

- **One-Tablet-Per-Child (OTPC) project in Thailand:** This is an example of a pre-loaded offline device model (Viriyapong and Harfield, 2013). The Thai government offered a tablet to every Prathom 1 (primary school, grade 1) child in 2012 with the aim of bridging the digital divide and addressing inequities. They encouraged students to be self-learning by providing equal access to the materials that were pre-loaded onto the tablets. The government loaded approximately 336 learning objects (e-books, videos, and interactive content) for five subjects: mathematics, science, Thai language, social studies, and English language. They also planned to train 549 supervisors to help 54,900 Prathom 1 teachers use the tablets effectively. This ambitious project distributed 860,000 tablets in 2012, and approximately 1.2 million tablets had been distributed by June 2014. However the programme was then suspended by the new government.

Online digital textbooks

As introduced earlier, digital textbooks are well-designed learning resources that extend the learning to achieve textbook-based curriculum objectives. They cover a range of digital content and rich interactive or collaborative functions to support personalized digital learning needs.

Example

- **Digital Textbook Project of the Republic of Korea:** The government of the Republic of Korea has been working on the development of a new teaching and learning system since 2002, establishing mid-term and long-term plans for the development of electronic textbooks. They have been actively developing digital textbooks since 2013, and started to operate them in 569 pilot schools to measure their effectiveness. More than 200,000 teachers received training. After the pilot, the digital textbooks were rolled out in 2018,

and studies were conducted on their effectiveness. The evidence showed that they promote students' and teachers' competences, cognition and affect, and enable positive changes in the classroom. In addition, the studies showed that the students' creativity, innovativeness, critical thinking and information literacy improved after using digital textbooks (Korea Education and Research Information Service, 2017).

One-way provision of high-quality materials through TV and satellites to make learning resources available to learners

The most typical way of distributing learning resources to users is by using electronic devices such as radios or TV sets. In some other cases, it is possible to deliver them to remote areas through satellites. This type of provision would be a good option for countries that do not have good internet connectivity in rural areas (Bates, 2005). To use this method, it is necessary to secure broadcasting channels, design and develop programmes, prepare learning materials, and provide teachers with guidance on how to design and facilitate blended learning using broadcast or telecast learning resources (UNESCO, 2020*d*).

Live streaming of high-quality lessons.

Live streaming platforms for either audio or video output allow users to broadcast live by using a camera and an internet-connected computer. Viewers can receive the learning resources via various types of browsers and players. However, live streaming needs a high-speed internet connection. To stream an online class of any sort, the provider needs to ensure the audio/video quality is good enough for the clear transmission of lectures and reliable real-time multi-directional conversation (UNESCO, 2020*d*). In addition, the cost of the streaming service and open access to online repositories must also be addressed.[117]

Curated resources and suggested route for group learning

The curation of digital learning resources is the process of finding, selecting, sorting, and storing information from large amounts of materials found on the web, and presenting the best resources in a meaningful and organized manner for teaching purposes. The resources need to be sifted, arranged, and placed under specific themes before it is published.[118] For countries with fewer available learning resources, curated content from the internet is a good alternative. A quality-control mechanism would be needed, and teachers would need extra time to prepare their lessons for classroom teaching. Teacher-training programmes should provide opportunities for teachers to secure the best materials for their subject areas so that they are ready and equipped to create digital learning resources for their learners. They could save time by familiarizing themselves with certain useful sites and drawing from them when resources are needed.

5.7 Masterplan on educational management information systems

Box 18: Qingdao Declaration

We commit to developing comprehensive national monitoring and evaluation systems to generate sound evidence for policy formulation on the integration, use and impact of ICT in education, in order to enhance the management of education systems, ensure accountability, and understand the key roles that ICT increasingly plays in the transmission of knowledge, the acquisition of new skills and competences, and the development of values and attitudes that are relevant to the building of sustainable and peaceful societies.

Source: Qingdao Declaration, UNESCO, 2015*a*, Article 17

5.7.1 Introduction

Education systems are aligned across multiple policy spheres (management and administration, planning, policy formulation, and monitoring and evaluation) and multiple stages of the process (the collection, aggregation, analysis, and use of data and information). The data and information required by administrators, planners, policy designers and decision-makers are needed if the effectiveness, efficiency and equity of the planning, implementation, monitoring, and continuous improvement of educational policies are to be ensured. Gathering and processing the required data is the role of EMIS.

EMIS collate conventional educational data (e.g. student numbers, gender ratios, attendance, and costs) together with data automatically collected from ICT systems (e.g. LMS, VLEs, and adaptive technologies). Accordingly, they are crucial for the sound monitoring and evaluation of educational policy-making and management. EMIS have the potential to provide systematic and quality data in a well-structured enabling system and through user-friendly interfaces that facilitate the use of information to support decision-making and policy dialogues.

The successful and meaningful use of an EMIS requires a user-centred approach to its design and implementation. This should take into account multiple stakeholders like teachers, parents, school principals, planners, decision-makers, and departments and divisions of the ministries of education, as well as other government and non-government institutions, national and international organizations, donor agencies and civil society. Using complementary sources of information and engaging the relevant stakeholders is necessary to understand the complexity of educational phenomena and to better inform policy.

5.7.2 Definition

Based on a systemic approach, UNESCO defines EMIS as 'the ensemble of operational processes, increasingly supported by digital technology, that enable the collection, aggregation, analysis, and use of data and information in education, including for management and administration, planning, policy formulation, and monitoring and evaluation' (UNESCO, 2018*a*, p. 8). As systems, EMIS are sets of interdependent components, where each part contributes to the functioning of the whole. EMIS also connect and reflect the interdependence of the different levels of education systems – states, provinces, districts, and schools – in informing 'administrative, managerial, planning, and policy decisions horizontally across the entire education system, within and between subsectors and institutions' (UNESCO, 2018*a*, p. 9).

At the macro level, policy-makers benefit from the availability of nationwide indicators in order to monitor and evaluate the implementation of specific policies. Indicators that allow for international comparability are also critical at this level for benchmarking the different models being implemented. Typically, nationwide educational indicators can be derived from administrative records (including data registered by EMIS), censuses, sample surveys, assessments, and tests.

At the institutional or meso level, administrators, teachers, and civil society organizations are included. EMIS can provide relevant disaggregated information for effective and efficient education management. In addition, indicators on the provision of ICT-based applications and their uses can support the planning of ICT in education policies.

At the micro level, sound administrative data allow for decision-making by classes or teachers. At this point, EMIS can be a tool to improve the quality of education through their integration with learning platforms such as LMS and VLEs, with the potential to feed teaching and learning processes with data analytics and individual pedagogical management options.

The use of EMIS to support evidence-based policy planning involves the **collection, aggregation, analysis, and use of data.**

Regarding **data collection**, it is critical to ensure that EMIS curate the required information and that it can be used effectively in accordance with suitable parameters. When it comes to data aimed at supporting policies, it is crucial to consider the availability and readiness of information that is highly relevant to particular decision-making needs. Data production processes also need to take into account factors such as accuracy, completeness, cost, and the burden on respondents.

In terms of **data aggregation and analysis**, the development of EMIS needs to align with the vision of researchers, system designers and practitioners, and also needs to be anchored in the policy and management visions of the educational stakeholders. There are different

profiles of users including decision-makers, policy planners, researchers, students, and teachers, and their needs vary. The public need to know the status of the whole system; budget planners need detailed data to justify resource allocation or request funding for a given educational programme; managers of policies or programmes need information to monitor the implementation against objectives and communicate information on progress to other stakeholders. The analysis of data has to be tailored to the needs of the different users and their familiarity with the information.

From the perspective of **data use,** it is important to ensure that the overall management and decision-making processes in education systems are based on careful interpretation of the evidence. The purposes and uses of EMIS include: management and administration, planning, policy formulation, and monitoring and evaluation. Each of these can be associated with a set of goals and action lines.

5.7.3 Vision

ICT-enhanced EMIS should be established and continuously updated to bring just-in-time provision of data to all sectors and all types of education. The capacities of EMIS managers and policy-makers are strengthened as the system enables them to facilitate the collection, aggregation, analysis and use of data to support monitoring, form policy, and improve practice. This enables continuous increases in effectiveness, efficiency, and equity when planning and managing educational policies.

5.7.4 Challenges

Over recent decades, the rapid development and massive adoption of ICT across all areas of society, coupled with the so-called 'data revolution', has made new sources of data available for policy-making and management. However, EMIS in most countries still rely on traditional methods of data collection. Challenges involve this and the other three key aspects of EMIS: data aggregation, data analysis, and data use:

- **Data collection**: On the one hand, newer sources of data are emerging including through mining data across social media platforms and from LMS or VLE. On the other hand, in most developing countries, there is a lack of sound, systematic, up-to-date and internationally comparable data for educational policy planning. How to leverage the emerging sources of data to support data collection in developing countries remains a challenge.
- **Data aggregation**: In many educational systems, schools are the end points for data collection, which uses paper-based formats. These data are then reported to the provincial or central education authority. The extent to which this information is usable depends on whether it is effectively aggregated. Overall, countries lack capabilities to aggregate data for analysis based on indicators, and more fundamentally, lack the capacity to develop

well-defined indicators. In addition, in many countries, the efforts of implementing EMIS are limited to ICT enhancements and/or data storage and maintenance, with insufficient attention paid to building the capacity of local EMIS-supporting teams to apply the system.

- **Data analysis**: Countries also face challenges of data relevance, reliability, and accessibility. Specific challenges include the high cost of using paper-based EMIS to collect, process and report data; multiple EMIS systems being deployed separately without interoperability; and the low level of responsiveness to emergencies and crises due to fragmented EMIS and the limited capacities of EMIS-supporting teams.
- **Data use**: To achieve evidence-based policy planning, the challenge is not only data production, but also the development of a reflective process through which policy-makers use data to learn lessons through multiple perspectives. In addition, policy-makers need to be aware that the data available are always only partial – there can be many important variables that are not or cannot be included. Accordingly, the outcomes of the data have to be carefully and critically interpreted.

5.7.5 Goals and objectives

Schools and educational institutions should generate sound data to inform policy-making

- All schools and educational institutions are connected to the internet and can collect real-time data from LMS, VLE and adaptive technologies at the institutional level.
- Administrative processes are digitalized.
- Principals and teachers are trained and supported to maintain school- or institutional-level data collection.

EMIS-supporting teams should have the capacities to aggregate and analyse data, and facilitate their use

- Interoperability is enhanced among institutional and national EMIS, and multiple existing systems allow for data aggregation and analysis.
- Key indicators are well-defined and based on policy-makers' needs, to enable data aggregation.
- Alternative methods of data collection such as sample surveys and structured tests are regularly implemented to generate additional information that is not available through EMIS.

EMIS provide up-to-date data to inform the planning, implementation and evaluation of education policies

- Policy-makers have enough skills to make effective use of data provided by EMIS.

- Principals and teachers are trained on how to use EMIS and interpret the results of the data analysis at the institutional level in order to determine how to improve their daily work.
- Parents and students are engaged in the use of their personal information and are informed about the results of the data analysis that are relevant to them.
- All stakeholders, including teachers, parents, students, policy-makers, developers, and principals, are aware of privacy and ethical issues associated with the use of data and EMIS outputs.

5.7.6 Main lines of action

Optimize connectivity, processing, and human capacities to support sound data collection for EMIS

- Build and strengthen school-level EMIS-supporting teams composed of school principals, teachers or administrative officers who usually complete questionnaires or enter data in administrative databases. The school management team and upper-level education authorities should ensure that the EMIS teams are equipped with the tools and knowledge on how to operate the main functions including feeding in data, searching through the main outputs, and interpreting the results. They should be encouraged to be involved in the use of data for the improvement of their own management at the school level.
- Connect all target schools or educational institutions and ensure that institutional-level data are collected and recorded in EMIS with sound efficiency and quality.
- Exploit emerging technologies to improve the cost-effectiveness, accuracy, security, and efficiency of data collection, including: taking advantage of the spread of mobile broadband access in developing countries to record data in EMIS using mobile applications (see more information on low-bandwidth solutions in Section 2.3); and exploring the feasibility of using blockchain technology to collect and record data for EMIS (see Section 2.5).
- Streamline and optimize the information management flow so that data recording in EMIS can be engineered seamlessly at central, regional, city and school levels.
- Train principals and teachers to use EMIS and interpret their outputs.

Develop indicators and enhance data aggregation and analysis

- Build national repositories to host and manage educational data that are collected from decentralized sources. Modules for the integrated EMIS repositories should be developed and tailored according to the needs of all target audiences including teachers, parents, students, key local partners, policy-makers, education administrators at all levels, and representatives from international partners and national education leadership teams.

- Develop and keep improving the relevance of key indicators and use them to ensure data are analysable. Indicators for aggregation can be categorized by: region (rural/urban), school level (primary, secondary, etc.), disability and other vulnerabilities, gender, and the socio-economic level of the district/school. Indicators corresponding to key targets of SDG 4 should also developed to collect information on progress and setbacks. The specification of SDG 4 indicators can be found in *Education 2030: Incheon Declaration and Framework for Action* (UNESCO, 2016*d*). The UNESCO Institute for Statistics[119] provides data for 44 indicators that are defined to measure the achievement of SDG 4.

- Collect and integrate data through different sources, such as administrative data (including from EMIS), sample surveys, structured tests, and big-data sources. Triangulate sources and combine both quantitative and qualitative research methods. Adopt methodologies for increasing both the robustness and the accuracy of the outcomes.

Strengthen technological and human capacities in using data effectively for policy-making, teaching and learning

- Develop or strengthen the technological capacities of the national or local central EMIS platform to support the data analysis and visualization, report generation, and communication. A detailed introduction to the fast-developing technologies that can be used to build or enhance the central EMIS platforms is beyond the scope of this publication; however, the technological capabilities of EMIS should be guided by the following aims. Firstly, improve the user-friendliness of the interfaces (e.g. dashboards) for policy-makers, administrators, teachers, and members of the public. Second, make the EMIS tools or applications accessible through varied devices, especially through mobile phones, and if possible through all of the main local languages. Third, ensure that EMIS tools or applications are functional and accessible in varied contexts including emergencies or crises.

- Conduct a full review of the maturity of blockchain technology, including the potentials and risks of using blockchain to build a decentralized EMIS. More specifically, assess the ICT in education readiness in the country and study the feasibility based on the public funds available. Then, make a decision on whether the blockchain technology can be adopted for the upgrading of the national EMIS.

- Explore the use of emerging technologies to improve the service and data provision facilitated by EMIS tools. There are cases of using natural language processing and machine-learning-based chatbots to deliver an automated service to users. The chatbot interprets a voice message sent by the user, and responds to it by exploiting the information from the database, suggesting a predetermined or acquired action. In the education sector, chatbots such as the Genie App[120] at Deakin University in Australia are being used to provide 24/7 voice-controlled assistance with administrative tasks and information on study programmes, scheduling, and basic knowledge on thematic subject areas of study.

- Develop strategies for building capacities with an aim of creating the awareness and skills necessary for the adoption and institutionalization of EMIS at all levels. Organize training or provide guidance to strengthen the capacities of administrators, managers, and decision-makers at all levels as well as teachers and EMIS-supporting teams at the school or institutional level. Ensure that the training includes topics on using EMIS for data collection, production, and analysis, as well as evidence-based decision-making, and the safe and ethical use of personal information.
- Develop a comprehensive communication strategy on the use of EMIS data and outputs, including the validation of reporting at different levels and for different target audiences, and the main media and events to be used for sharing the reports. Information should be tailored and made relevant to needs of various target users including parents, students, and school administrators. For example, attendance rates, test results and school news should be easily available to parents and students.
- Develop professional training to enable policy-makers, principals, teachers, and parents to carefully interpret the EMIS outputs alongside other contextual information.

5.7.7 Cross-cutting issues

Privacy and the ethical use of data

While increasing the availability of data to inform the planning of educational policies, the adoption of EMIS also generates new risks in terms of protecting the security and privacy of the educational and personal data of learners and other stakeholders. Educational data, especially data relating to the performance of schools and staff, are especially sensitive because they can be used to influence future hiring decisions and have repercussions in other social spheres (UNESCO, 2018*a*). Educational and personal data of learners and parents are more susceptible to commercially driven data mining. Thus, technological solutions and human-controlled measures must be put in place to protect the security of the EMIS platforms and tools, and the privacy of individuals. This is a critical issue throughout the development and implementation of this type of digital system. Based on the general regulations introduced in Section 4.1, governmental agencies and relevant stakeholders should promote legal frameworks allowing for new forms of data governance and privacy. And more specifically, national agencies and partners need to develop specific regulatory frameworks on cyber security and data privacy for EMIS. At the same time, the ethical use of data should be integrated as a core element of capacity-building programmes for all levels of EMIS-supporting teams.

Sources of information and international comparability

Good quality indicators on the inputs, processes and products of education systems are the basis of effective data collection for EMIS. The national policy objectives are key parameters for developing the indicators for monitoring and evaluation, and they should reflect the local implementation of globally recognized goals such as SDG 4 and international standard

instruments such as the Recommendation on OER. In summary, the indicators should reflect both the local need for educational development and the government-adopted global priorities. The definition of the indicators and quality assurance procedures for the data collection must ensure the international comparability of the data used by the EMIS.

The school is the main source of data for EMIS, which requires substantial inputs in order to assess the performance of educational systems and monitoring the distribution of resources. This ranges from the deployment and attendance of teachers and students, to the roll-out of teaching and learning materials and allocation of financial resources. At the school level, the following sources of information should be integrated to serve specific aims:

- **Censuses and sample surveys**

Complementing school-level administrative data, censuses and sample surveys are relevant ways to collect quantitative data and qualitative feedback, including opinions on the planning, monitoring and evaluation of educational policies.

- **Formative assessment via LMS**

The tracking of students' formative learning outcomes in relation to school resources has great potential for both research and educational management. Some countries such as Uruguay[121] have implemented ICT-based formative assessments in public schools. Applied via an evaluation platform, the annual learning assessment can be taken on any computer that is connected to the internet. Immediately after the test is taken, teachers receive both individualized and aggregated reports that profile students´ learning outcomes including the curricular objectives they have achieved and the main challenges they are facing, and a comparison of these with their past performance.

Big-data-based learning analytics

The increased use of digital LMS, VLEs and adaptive platforms in some countries is automatically generating huge amounts of data for analysis. Learning analytics is the academic field that involves collecting, analysing, and reporting data on large numbers of learners and their contexts, with the purpose of understanding and optimizing learning itself as well as learning environments. The bulk of data that students leave behind when they interact with online platforms, known as 'digital traces', together with the responses that they explicitly provide, hold enormous potential for facilitating insight into what resources work best for specific profiles of students. However, as with any raw data, it cannot be interpreted by itself. Instead, it needs to be processed and related to meaningful concepts and theories.

As a field, learning analytics is still underdeveloped. There are at least four challenges that it needs to address (Ferguson and Buckingham Shum, 2012): (1) integrating with the learning sciences; (2) working with a wider range of datasets; (3) engaging with learner perspectives; and (4) developing ethical guidelines for managing and using students' personal information and data in education contexts.

There are also technical and practical challenges. For example, cleaning the data, defining the methodologies for the analysis, and building relevant knowledge out of it is a time consuming and complex process. Users of EMIS or learning analytics including teachers and principals need to develop skills in data interpretation in order to draw valid conclusions and make meaningful use of the results.

5.7.8 Existing approaches

EMIS systems can choose models with various degrees of centralization or decentralization, such as national centralized EMIS, local-level EMIS (provinces or municipalities), and institutional EMIS. When a country applies a local-level EMIS for each of its local entities, standards on interoperability must be developed and implemented to ensure that the exchange of information is based on nationwide management-oriented indicators.

Centralized integrated national EMIS

Countries with a centralized political or administrative system usually choose to build a centralized and integrated EMIS to collect and process data on daily school affairs and *different levels of* educational administration. This is typically based on a central platform with a network of local platforms.

Example

- **National Education Information (NEIS) of the Republic of Korea:** National Education Information System (NEIS) of the Republic of Korea: The NEIS was implemented at 2003, and has been managed by the Korea Education and Research Information Service (KERIS) since its opening. It carries out administrative tasks in about 12,000 primary and secondary schools. The NEIS initiative resulted in the integration and upgrading of the student information system and the school information management systems, which were developed in 1995 and 1997 respectively. Standalone client server systems, which had been built separately for each school, were also integrated into a common database and networked interfaces using internet capabilities (Karippacheril and Kim, 2016). The central Linux-style platform[122] contains records of teachers from all 12,000 schools and their approximately 8 million students. It can be accessed only from authorized computers.

  Since the early 2000s, the government has set up a vision to transform the NEIS into an efficient, technologically advanced and transparent system. And the NEIS has been one of the leading centralized national EMIS in terms of enhancing the efficiency of administration and improving teachers' working conditions. The framework for the three levels of NEIS and its sharing of information with national repositories can be found in a policy brief (UNESCO IITE, 2010). In 2015, the NEIS was the subject of a data privacy

struggle between the government and the public (Park, 2006). Twenty-seven categories of personal information were to be consolidated in NEIS servers maintained by local education agencies under the Education Ministry. The NEIS was supposed to include data on students' academic records, medical histories, counselling sessions, and family backgrounds. Even data on teachers' trade union activities were to be held. The National Teachers' Union of the Republic of Korea feared that their member teachers would be put under surveillance through the NEIS. The Union and other civic organizations conducted protest rallies. The National Human Rights Commission recommended that three of the 27 categories of personal data be excluded from the NEIS databases. Accordingly the Education Ministry excluded these three categories, keeping the other 24 intact.

Central coordination of decentralized multi-stakeholder data production

Countries with a federal or decentralized political or administrative system usually conduct data collection, aggregation, and analysis at the regional level, and the building and use of EMIS platforms also occurs at this level. But the central or federal consolidation and processing of nationwide educational data requires a centralized coordination mechanism.

Example

- **Brazil:** The Brazilian ecosystem of educational statistics has been developed through inter-institutional cooperation among government agencies, research institutions and civil society organizations including non-profit and private-sector organizations, as shown in **Figure 5**. Among the data producers is the Brazilian Geography and Statistics Institute (IBGE), which oversees the coordination of the national statistics. The National Institute of Educational Studies and Research Anísio Teixeira (Inep) is a federal organization linked to the Ministry of Education, whose mission is to provide evidence for the formulation of educational policies at different levels of government. Inep is responsible for the Census of Basic Education and the Census of Higher Education. With regard to statistics on ICT across sectors, most of the national representative research carried out in Brazil comes from the Regional Center for Studies on the Development of the Information Society (Cetic.br), a department of the Brazilian Network Information Center (NIC.br) that also implements the decisions of, and is funded by, the Brazilian Internet Steering Committee (CGI.br).

  These three organizations, Cetic.br, NIC.br and CGI.br, are tasked with jointly promoting research that contributes to the digital transformation of Brazil. Cetic.br´s main objective is to generate reliable indicators and conduct research about the access to and use of ICT in Brazil. The research process is structured in a multi-stakeholder approach. In 2012, the government signed a pioneering agreement with UNESCO. Through this agreement, Cetic.br became the first UNESCO Centre of Studies on the Information Society; it covers Latin America and the African Portuguese-speaking countries.

Figure 5: Coordination of multiple stakeholders for educational data production in Brazil

Source: Adapted from Cetic.br

OpenEMIS of UNESCO

OpenEMIS[123] is a customizable and open-source toolkit developed by UNESCO in 2008 in cooperation with the Community Systems Foundation (CSF). It was designed to facilitate the process of setting up reliable national or institutional EMIS systems which are adapted to the needs of the education administration and which support the formulation of evidence-based policies and plans. Since 2013, OpenEMIS has been implemented under the UNESCO-CSF OpenEMIS Framework Agreement. Between 2013 and the end of 2018, OpenEMIS was tested or implemented in 15 countries. In December 2019, UNESCO conducted an external evaluation on this initiative across four areas: relevance, effectiveness, efficiency and sustainability (UNESCO, 2020*f*). It revealed that OpenEMIS did promote the building of EMIS platforms and the evidence-based planning of education policies. However, there are substantial costs involved in the configuration and expansion of OpenEMIS platforms and tools, and they also require high technical capacity within the implementing ministries or institutions. Since 2020, OpenEMIS has been maintained and managed independently by CSF.

6. Continuous improvement and forward-looking review

6.1 Continuous learning through evaluation

Although 'Designing Sector-wide Masterplans' was presented as the last step in the roadmap, it should not be considered the end of the policy planning and implementation process. Instead, developing and implementing the policy and masterplan also involves continuous learning through evaluation. At each step of the process, it is essential that every opportunity is taken to learn from what has happened – especially the challenges, but also what has worked well – so that information can be fed back into future steps. This iterative approach is the key to policy-making, especially when this involves technology that by definition is always rapidly developing. At every step, policy-makers should learn from the previous steps, and be open to adjustments and changes that will ensure the policy generates the greatest possible impact on teaching and learning.

Implementing policy development through feedback loops, in which the masterplan and its various steps are analysed and the findings incorporated into each new iteration, is crucial. The purpose is to help ensure that targets are met according to quality-assurance benchmarks, and to adjust plans if the targets have shifted or are likely to be missed. The ongoing monitoring and research that feeds back in positive loops to the masterplan can help countries achieve or surpass their implementation goals, respond to changing circumstances (such as novel technologies or a new crisis), and make the best and most effective use of available resources (human capacities, technologies, and funding).

6.2 Summary and key factors

As has been demonstrated throughout this document, ICT has enormous potential to help countries achieve SDG 4. Nonetheless, there are many factors that policy-makers need to understand and address. Key factors include the following:

- the use of ICT in education should be guided by humanistic principles and serve humans and enhance their competencies; the potential negative impact of ICT on student well-being should be avoided; and policies must balance the educational benefits with the environmental costs;

- the priority should be expanding access to educational opportunities, advancing inclusion, and supporting lifelong learning;
- ICT on its own will not provide the solution to a country's educational problems, so challenges within the existing systems should first be addressed, with or without the help of ICT;
- teaching and learning should not be driven by technology; pedagogy that enhances the quality of learning by leveraging the affordances of ICT should be developed, while the automation of poor pedagogic practices should be avoided;
- training to enable teachers to take full but cautious advantage of ICT is essential; and
- the development of ICT in education policies is a long-term process, and the policy and masterplan should be produced as part of an integrated education portfolio.

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Acronyms and abbreviations

Concepts and technologies

AI	Artificial intelligence
AR	Augmented reality
BYOD	'Bring your own device' – students accessing learning systems using personal mobile devices such as smartphones, tablets and laptops
CAD	Computer-aided design
CAI	Computer-assisted instruction
CBO	Community-based organization
CD-ROM	Compact disc read-only memory
CMS	Content management system
DIGCOMP	Framework for Developing and Understanding Digital Competence in Europe
EMIS	Educational management information systems
GDPR	General Data Protection Regulation
HE	Higher education
HEI	Higher education institution
ICT	Information and communication technologies
ICT CFT	UNESCO ICT Competency Framework for Teachers
IP	Intellectual property
IRT	Item response theory
K-12	Kindergarten to 12th grade
KPI	Key performance indicator
LDC	Least developed countries
LMS	Learning management system
M&E	Monitoring and evaluation
Metaverse	Meta-universe, a future version of the internet where virtual, persistent and shared spaces are accessible in 3D
MOOC	Massive open online course
NEIS	National Education Information System
NfE	Non-formal education
NREN	National Research and Education Network
ODeL	Open Distance and eLearning
ODFL	Open, distance and flexible learning
OER	Open educational resources
OTPC	One tablet per child

QA	Quality assurance
SDG	UN Sustainable Development Goal
SMS	Short message service (i.e. mobile phone texts)
STEM	Science, technology, engineering and mathematics
TCO	Total cost of ownership
TVET	Technical and vocational education and training
UDL	Universal design for learning
USF	Universal service funds
UUID	Unique user identifiers
VLE	Virtual learning environment
VR	Virtual reality
WBI	Web-based instruction

Organizations

APEID	Asia-Pacific Programme of Educational Innovation for Development
APNNIC	Asia-Pacific Network of National Information Centres
CARNET	Croatian Academic and Research Network
Cetic.br	Regional Center for Studies on the Development of the Information Society of Brazil
CGI.br	Brazilian Internet Steering Committee
CSF	Community Systems Foundation
DIZ	Digital Innovation Zone
EFA	Education for All
ENACOM	National Communications Entity
ERNET	Education and Research Network
EU	European Union
IBGE	Brazilian Geography and Statistics Institute
ICILS	International Computer and Information Literacy Study
IGNOU	Indira Gandhi National Open University
Inep	National Institute of Educational Studies and Research Anísio Teixeira
ITU	International Telecommunication Union
UNESCO IITE	Institute for Information Technologies in Education
UNESCO KFIT	UNESCO-Korea Funds-in-Trust project
KNET	Kenyan Educational Network
MCDE	Malawi College of Distance Education
METEOR	Multimedia Technology Enhancement Operations Sendirian Berhad
MOE	Ministry of Education
NIC.br	Brazilian Network Information Center
OUM	Open University Malaysia

SANReN	South African National Research Network
SingAREN	Singapore Advanced Research and Education Network
TAESTP	Singapore's Training and Adult Education Sector Plan
UNED	National Distance Education University
WHO	World Health Organization

Endnotes

1 For a useful explanation of 'digital learning' see https://www.cipd.co.uk/knowledge/fundamentals/people/development/digital-learning-factsheet#gref

2 For a useful explanation of 'hybrid learning' see https://resources.owllabs.com/blog/hybrid-learning

3 For a useful explanation of 'blended learning' see https://elmlearning.com/blended-learning-everything-need-know

4 http://www.edu.cn/html/info/10plan/ghfb.shtml#fb03

5 https://www.portaldogoverno.gov.mz/por/Governo/Documentos/Estrategias/Tecnologias-e-Informacao

6 https://www.moe.gov.sg/education-in-sg/educational-technology-journey

7 https://www.universityworldnews.com/post.php?story=20200210064903949

8 UN Secretary-General warns of education catastrophe, pointing to UNESCO estimate of 24 million learners at risk of dropping out. Available at: https://en.unesco.org/news/secretary-general-warns-education-catastrophe-pointing-unesco-estimate-24-million-learners-risk

9 https://en.unesco.org/icted/home

10 https://en.unesco.org/icted

11 https://www.broadbandcommission.org/manifesto

12 https://en.unesco.org/news/startling-digital-divides-distance-learning-emerge

13 https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learning-during-the-covid-19-pandemic

14 https://moey.gov.jm

15 https://darsak.gov.jo

16 https://en.unesco.org/news/building-bandwidth-accelerating-girls-digital-access-skills-and-online-learning

17 https://en.unesco.org/covid19/educationresponse/solutions

18 https://m-shule.com

19 https://www.ubongo.org

20 https://www.ustadmobile.com/lms

21 https://www.instagram.com/iboxgh

22 https://learningequality.org/kolibri

23 https://www.ruangguru.com

24 https://smart.com.ph/About/learnsmart/programs-projects/school-in-a-bag

25 https://digitallibrary.io

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109 Ubiquitous learning, also known as u-learning is utilizing ubiquitous technology, which enables anyone to learn at anyplace at any time. The definition and characteristics of u-learning are still unclear and being debated by the research community. Researchers have different views in defining and characterizing u-learning which often leads to misconception and misunderstanding of the original idea of u-learning (Yahya, 2010).

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United Nations
Educational, Scientific
and Cultural Organization

Guidelines for ICT in education policies and masterplans

Information and communication technologies (ICT), currently aligned under digital technologies, can enhance the provision and management of teaching and learning, and make education accessible to all. However, innovations should be guided by humanistic principles to ensure that the use of technology in education protects human rights, and promotes inclusion and equity as well as gender equality. Technologies should be integrated into entire eco-systems to serve humanity and protect natural environments. It is also essential to avoid 'techno-solutionism', which assumes that perpetual problems can be cured by technology alone. Instead, policy-makers should ensure that technology-independent human interventions are examined before the use of technologies.

While learners in the least developed countries may not have access to digital devices and connectivity, we are also witnessing the advent of Web 3.0 or "metaverse". In response to the challenges, this publication aims to guide the review of the potentials of existing technologies and emerging digital innovation to: expand access to educational opportunities, enhance the relevance and quality of learning, build ICT-enhanced lifelong learning pathways, develop digital competencies, and strengthen education and learning management systems. This publication also proposes an iterative roadmap for policy planning, reviews and updates, which covers the governance, funding, result-based activities and implementation strategies.

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4 QUALITY EDUCATION

Sustainable Development Goals