

# Steering the Digital Transformation of Education: UNESCO's Human-Centered Approach

Sobhi Tawil, Fengchun Miao

Future of Learning and Innovation Division, UNESCO, Paris 75007, France

© Higher Education Press 2024

**Abstract** While digital technology holds great potential to help realize our collective educational commitments and to build the futures of education beyond 2030, it also comes with negative consequences and uncharted risks. To be effective, digital education needs to be properly steered and governed to ensure it serves public interests, happens in public spaces, and is accountable to the public. This paper first provides a comprehensive overview on UNESCO's human-centered approach to steering digital education that counter-balances dominant techno-solutionist thinking. This includes ensuring that the use of digital technology enhances human capacity, rather than undermining it, adequately addresses digital divides and digital gender inequality, and assures effective regulation to minimize the negative impact both on human well-being, and on the environment. This paper then presents recommendations to help build integrated digital education systems which prioritize support for teachers, and which address connectivity issues, not only with opportunities for the strengthening of competencies, but also with open access inclusive quality digital learning content. Finally, this paper shares a forward-looking vision for the futures of school systems, exemplified by a framework of digital open schools.

**Keywords** human-centered digital education, digital inclusion, digital gender inequality, digital well-being, techno-solutionism, digital education readiness, AI in education, digital open schools

## 1 Introduction

Over the past 50 years, information and communication technologies (ICTs) have evolved from single programs in university laboratories to universally accessible networks of digital programs to meet a range of human needs. Digital technology arguably now constitutes one

of the most important components of the social and economic infrastructure of present-day societies and shapes the way in which we live, communicate, work, and participate in civic, social and economic life. With the recent rapid developments of Artificial Intelligence (AI), it is not impossible that AI systems further evolve to co-exist with humans (Accenture, 2024). In the domain of education, digital technology is increasingly becoming an essential condition in ensuring education as a basic human right, in particular in a world confronted with growing and more frequent crises and resulting disruptions. Digital education must therefore be defined as a public good to support the achievement of global education goals and collective commitments as enshrined in the 2030 Agenda for Sustainable Development and to build effective inclusive futures of education beyond 2030 (UNESCO, 2022a). As the lead United Nations agency for the global governance of education, UNESCO has been continuously refining and advocating for a human-centered approach to digital education.

## 2 UNESCO and the Global Governance of Digital Education

### 2.1 | Setting Global Standards

Over the past years, UNESCO has been active in developing international standard-setting instruments to define and steer the governance of digital education based on a human-centered approach to the use of digital technology for education. The *Qingdao Declaration* (UNESCO, 2015), for instance, 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 human-centered vision has been reaffirmed and further refined through the organization's continuous monitoring of emergent technological transformations. The analysis of the implications of such technological disruptions has led to the setting of key standard-setting

instruments such as the *Recommendation on the Ethics of Artificial Intelligence* (UNESCO, 2022b), the *Beijing Consensus on Artificial Intelligence and Education* (UNESCO, 2019a), and the *Recommendation on Open Educational Resources* (UNESCO, 2019b).

## 2.2 | Supporting the Implementation of a Human-Centred Approach

In order to guide Member States of UNESCO in the implementation of these normative instruments in specific local contexts and to steer the use of frontier technologies in education, UNESCO has further developed and published a wide range of policy guidance relating to digital education, including: *Guidance for Generative AI in Education and Research* (UNESCO, 2023a), *Guidelines for ICT in Education Policies and Masterplans* (UNESCO, 2022a), *Education and Blockchain* (UNESCO, 2022c), *AI and Education: Guidance for Policy-Makers* (UNESCO, 2021a), and *Guidelines for the Development of Open Educational Resources Policies* (UNESCO, 2019c).

## 2.3 | Leading International Cooperation

UNESCO has also been leading international cooperation in the field of digital education. Most recently, in cooperation with United Nations International Children's Emergency Fund (UNICEF) and International Telecommunication Union (ITU), UNESCO led the thematic track on Digital Learning and Transformation within the framework of the Transforming Education Summit (TES) process convened by the Secretary-General of United Nations in 2022. One major outcome of this process has been the joint UNESCO-UNICEF Gateways to Public Digital Learning initiative to create and strengthen inclusive public digital learning platforms containing quality digital learning content (United Nations, 2022).

## 2.4 | Strengthening National Capacities

In order to strengthen national capacities in the field of digital education, UNESCO has provided technical assistance and capacity building support to more than seventy countries for the development and implementation of national policies and masterplans on digital education. In particular, UNESCO has been testing a model of digital open school.<sup>1</sup> These projects have all adopted a three-pronged approach: first, to strengthen national capacities for a whole-of-government approach for the planning and implementation of national visions and operational strategies on digital education which are aligned with broader national sector-wide development strategies; second, to strengthen the institutional capac-

ities of governmental agencies and leading local key institutes in planning mid/long-term strategies and action plans, in costing and financing these interventions, and in developing indicators to monitor and steer the human-centred digital transformation of education; third, to promote an intersectoral and multistakeholder approach to the mobilization of resources, the joint implementation of programmes, and the sharing of resources.

# 3 Human-Centered Digital Education: Multi-Layered and Multi-Faceted Implications

Steering human-centered uses of digital technology for education and humanity comprises an integral set of fundamental principles for the governance of global digital education. The human-centered principles uphold the central tenant that the use of any form of technology in education must protect human dignity and basic human rights norms. A human-centered approach seeks to address two imperatives: first, to close the equity and gender divides both in access to digital infrastructure, including to internet connectivity, to devices and digital learning content, as well as in access to digital competencies; second, to ensure inclusion, equity, and gender equality in all digital education programmes, and to eliminate any gender biases—explicit or implicit—found in data sets and algorithms used to develop AI tools. A human-centered approach to digital education has the following multi-layered and multi-faceted implications.

## 3.1 | Mandating Inclusive Access to Connectivity and Digital Content

Inclusive access to connectivity and relevant digital content are the preconditions for the effective use of digital technologies to address many of the world's seemingly intransigent social educational problems, including the learning divide, the diversity of learning needs, the challenge of meeting the growing demand for education. But connectivity gaps around the world remain significant. If 5.3 billion people were digitally connected in 2022, digital divides remain stark. While 89 percent of people in Europe were online, only 21 percent of women in low-income countries had access to the internet (ITU, 2022). The COVID-19 educational disruption laid bare the extent of digital inequality in education. In mid-2021, for instance, 50 percent of learners—or some 826 million learners—for whom in-person learning was not available did not have access to a household computer, and 43 percent (706 million) had no access to internet at home (UNESCO, 2022a). There are indeed multiple

1 <https://www.unesco.org/en/digital-education/teoss>

barriers to universal connectivity. First and more foremost among these is the relative unaffordability of internet access, hardware and software for low-income groups. The cost of a smartphone in South Asia and sub-Saharan Africa, for instance, is more than 40 percent of the average monthly income, and African users pay more than three times the global average for mobile data (ITU, 2022). It has been estimated that data-only mobile broadband (2GB) basket prices amount to 9.3 percent of gross national income per capita in the low-income countries (United Nations, 2023). This is further compounded by limited access to basic infrastructure, including electricity supply, and to digital devices. Beyond issues of access availability, cost, and affordability, barriers to connectivity are further defined by low levels of literacy in the languages that dominate online, poor digital skills, weak demand due to lack of relevant digital content, as well as social norms and cultural beliefs, at times even “technophobia.”

Recommendations for governments to improve internet access for all citizens include making digital infrastructure open access, boosting affordability and usability of broadband-enabled products and services, and building human capacity and skills to enable citizens to make the most of digital opportunities. More concretely, government should commit to make effective use of low-cost connectivity technologies, including using 2G mobile systems more innovatively, and establishing public/private partnerships to enable zero-rated data connectivity for internet traffic related to online education (European Commission, 2017).

### 3.2 | Expanding Online Learning Spaces

A report (EQUALS & UNESCO, 2019) estimated that only 15 percent of women in the Least Developed Countries (LDCs) used the internet, as compared to 28 percent of men. In terms of the gender gap in digital skills, women and girls are 25 percent less likely than men to know how to leverage digital technology for basic purposes, while men are four times more likely to know how to program computers, and thirteen times more likely to file for a technology patent. UNESCO recommends that governments take act on equality, empowerment, and safety dimensions. This includes closing the gender gaps in girls’ access to online education and digital skills, leveraging the potential of technology to advance education and gender equality, with a focus on the most marginalized, and ensuring safe, inclusive and gender-responsive online learning spaces.

### 3.3 | Advancing Digital Inclusion for Persons with Disabilities

Persons with disabilities, who might benefit significantly from assistive digital devices and needs-based

digital content (UNESCO, 2023b), are also often prevented from so doing. According to the *2020 Global Education Monitoring (GEM) Report* (UNESCO, 2020), when governments employed digital solutions to ensure the continuity of education during COVID-19 school closures, 40 percent of poorer countries failed to provide specific support to disadvantaged learners.

UNESCO recommends that policies on digital education should work toward digital inclusion for persons with disabilities (UNESCO, 2021b). This includes: (1) cooperating with organizations and experts that are specialized in supporting persons with disabilities to assess difficulties and design relevant solutions to inclusive access, provide user-targeted support, paying special attention to women and young girls with disabilities; (2) supporting legislation or policy development to ensure that persons with disabilities are included in publicly-funded digital education programmes; (3) providing grants to encourage the development and use of appropriate digital solutions for persons with disabilities and facilitating their access to assistive technologies; (4) adopting universal design for learning (UDL) for the design and provision of digital content for learners with special needs and assessing the accessibility of platforms and applications based on the principle of UDL; (5) guiding the use of student-centered pedagogical methodologies to improve engagement of students with disabilities and to raise their self-esteem.

### 3.4 | Trade-offs between Tech-Independent Education and Techno-Solutionism

Failing to provide inclusive digital learning opportunities for all implies the risk of discriminating against disadvantaged groups and citizens. Nonetheless, digital education will only serve our shared ambitions and goals for education if the trade-offs between social and human features of in-person education and digital solutions are carefully balanced. It is critical that digital learning policies avoid what is commonly known as technology solutionism—that is, the assumption that engrained social problems, such as the shortage of qualified teachers or the inadequacy of educational facilities, can only be resolved by technology alone. Rather, policy-makers should ensure that broader education policies commit to and properly finance the fundamental human and social dimension of education, before considering the ways in which digital education can make a positive contribution.

It is important to underline that building and maintaining digital education systems is costly. Allocating funds to digital education may prevent investment in other more pressing priorities such as ensuring every student has access to adequate sanitary facilities, learning resources, a desk, and a safe classroom and school environment. It has been estimated that if low-income

countries implement a basic offline scenario while low- and middle-income countries work toward a scenario of fully connected schools, these countries will need to spend 21 billion USD per year between 2024 and 2030 for the initial expenditure and 12 billion USD per year for operational expenditure (UNESCO, 2023b). The combined cost would increase their financing gap by 50 percent. Cost-value evaluations to assess whether the educational benefits of implementing digital education programmes (e.g., increased effectiveness, enhanced efficiency, and expanded accessibility) outweigh the costs of other priorities therefore need to be executed with caution before any major investment can be justified.

### 3.5 | Validating Commercial Digital Applications against Human-Centered Needs

The configuration and procurement of digital solutions for education determines what connectivity, applications and learning content teachers and students can access. It is crucial that public governmental agencies understand the implications of their relationship with the commercial sector, in particular the possible dependence of learning provision on commercial software and platforms. A mechanism for examining and validating commercial digital solutions against human-centered principles and educational needs should be adopted to protect education systems from wholesale privatization. Beyond the arguments of commercial marketing, the expertise of the independent research community should help examine digital solutions against at least the following principles. First and foremost among these is the principle of “do no harm”—that is, the extent to which the solutions will advance, and not undermine, human dignity, human agency, safety, inclusion, equity, and gender equality. Other principles include: “affordability” relative to local incomes and government revenues; “availability” to ascertain that the prerequisite infrastructure is in place; “accessibility,” in particular for learners who have disabilities, use minority languages, or are displaced; and “scalability,” to ensure that the hidden long-term costs of digital learning products and services are fully costed and planned. Indeed, it has been estimated that initial investment in education technology only represents 25 percent or less of the eventual total cost (UNESCO, 2023b). The validation mechanism needs to examine whether the functions of digital applications can be easily customized, and costs adjusted accordingly, also including whether the digital applications can be upgraded or integrated into more up-to-date systems.

### 3.6 | Anticipating Possible Risks and Protecting the Digital Well-Being of Students and Teachers

The benefits of digital education come with risks related to privacy, safety and well-being (UNESCO, 2023b). The negative impact of digital technologies on institutions, individuals, environment and on climate change is now well-established. The risks to privacy and safety in the digital world must first be thoroughly investigated and mitigated through the development and implementation of laws or regulatory frameworks to protect the data privacy of learners, teachers, and parents. Moreover, technological approaches and human-based measures should be combined to safeguard cyber security.

Even with trustable digital applications, the human-accountable misuse or over-use of digital technology in education can be harmful to learners' digital well-being, in particular for younger students. Emergent negative impacts on digital well-being include internet addiction and impaired vision caused by extended amounts of screen time, as well as psychological problems caused by disturbing content, abusive online comments or cyber bullying. Analysis of children aged 2 to 17 shows that more screen time was associated with lower well-being (UNESCO, 2023b). Accordingly, particular strategies should be enacted for suppliers of online platforms and applications, education institutions, and guardians of students to prevent or reduce these known risks and to remain alert to problems that may be emerging. Teachers should be trained and guided to ensure that digital technology is only used judiciously, in a pedagogically proper manner and for appropriate amounts of time. It is equally important to develop students' digital competencies to ensure safe and responsible online behavior and empower them to make ethically aware choices of AI services.

### 3.7 | Reducing and Neutralizing the Digital Emission Footprint

Digital technology has become one of key sources of greenhouse gases that are impacting on the climate, due to increased use of carbon-consuming electricity in training AI models and producing digital devices, as well as a surplus of e-waste caused by all too frequent iteration of digital devices. According to some estimates, extending the lifespan of all smartphones in the European Union by a year would be equivalent to taking over 1,000,000 cars off the road in terms of carbon emissions (UNESCO, 2023b). This risk has been largely overlooked in the hype around digitalization and the dominant positivist opinions on digital education. In response to this hidden risk, policy-makers need to be mindful of the carbon and e-waste footprint of digital technology and ensure that digital education promotes carbon-neutrality or

carbon-reduction principles, drives the adoption of energy-efficient approaches, and implements measures for the recycling of e-waste. Digital education programmes should also aim at the transformation toward green digital technology—technology that has been designed to require the minimal use of any precious resources such as rare earth metals and minimal consumption of power and water across their life cycle, including their training, manufacture and use; and to ensure that they can be easily recycled, rather than being added to the growing mountains of “technotrash” around the world that leach hazardous chemicals into underground water sources.

## 4 Planning Human-Centered Digital Education Systems

In order to develop effective digital education systems, policy-makers need to have a robust and independent understanding of the increasingly broad range of digital technologies, and how they might be combined to be a part of parcel of the broader education system. This might be addressed by critically reviewing “digital readiness,” the unused potentials of existing digital resources, and the genuine effects of emerging technologies on education.

### 4.1 | Assessing Digital Education Readiness

It is essential to understand the digital readiness of the education sector in targeted regions in order to properly inform policy development. This involves a combined qualitative and quantitative assessment of the current situation, to identify gaps and potential areas for improvement or feasible directions for transformation. The evaluation of the digital readiness of a particular education system may involve any or all the following statistics as appropriate:

- (1) digital devices already available to schools (and households), measured by digital device/student ratios;
- (2) percentage of schools and households in urban versus rural areas that have robust wired and/or mobile internet access;
- (3) percentage of schools and households for whom internet access, devices and software are affordable;
- (4) percentage of schools whose learners are able to access a national or public learning platform;
- (5) percentage of schools that have online courses available to complement classroom teaching;
- (6) proportion of the curriculum already covered by national or public online courses;
- (7) amount of national funding dedicated to

digital education as a proportion of all education funding;

(8) percentage of school leaders, teachers and students who have basic digital skills;

(9) percentage of schools using digital technology in teaching and learning in most subjects at a certain frequency;

(10) percentage of schools using communication technologies, such as social media and conferencing apps, in teaching and learning at a certain frequency;

(11) maturity of relevant regulations and practices to ensure inclusive and equitable access, fairness of access, data privacy and security.

### 4.2 | Leveraging Cost-Efficient Applications and Open Educational Resources (OER) for Digital Education

When considering the potential technology for digital education settings, it is often all too easy, and often erroneous, to focus on cutting-edge digital technology. It is therefore important for policy-makers to consider low-cost or cost-efficient technologies that can be used effectively to support education, especially in low-resourced settings. These can be done through the re-directing of general-purpose digital applications Web 2.0 in education, e.g., collaborative content-authoring tools, social media tools, and video-conferencing software; as well as through financing the local development and production of applications specifically designed to support educational purpose, namely practice-based educational applications.

The 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, repurposing, adaptation and redistribution by others” (UNESCO, 2019b). Based on a belief that OER might provide more affordable and accessible digital content or education programmes to support inclusive learning opportunities across all settings and levels, UNESCO has been promoting OER for more than two decades. OER that is developed based on public charitable funds can provide free learning materials. One of the prominent examples is the Global Digital Library, supported by NORAD, UNESCO, and other partners, which has made more than 10,000 digital storybooks in more than 100 languages freely available. There are also increasing number of countries aiming to reduce costs of provision of textbooks by using OER textbooks to partly replace the costly print of textbooks from the commercial sector. It is important to note, however, that in order to ensure effective use of OER or open textbooks, supportive technology and guidance for teachers need to be put in place (UNESCO, 2016).

### 4.3 | Exploiting Trustable AI to Build Convergent Foundation of Digital Education

Over the past few years, AI has become pervasive in daily life, learning, and work across sectors. The combination of significantly enhanced power of cloud computing and the exponential expansion of online data has enabled constant training and iterative upgrading of algorithms and AI model architecture. AI has demonstrated its strongest convergent capabilities in integrating various generations of digital technologies to transform the foundational level of the pervasive digital infrastructure, and AI, and generative AI systems in particular, offers foundation models for many other frontier technologies.

While AI may hold potential benefits for education, the adoption of AI in education also raises profound questions about social and ethical implications. This includes such questions as how to make AI a genuine public good to enhance educational access and equity, what AI tools should be used and how, what role of teachers in the evolving scenarios of AI-assisted learning, and what AI competencies teachers and student should develop (UNESCO, 2021a). Behind the overwhelming hype around AI's transformative powers for education is the fact that there is very little robust evidence for AI's positive impact or effectiveness in education. In response to these challenges, UNESCO led the development and adoption of the *Beijing Consensus on AI and Education*, and then published *AI and Education: Guidance for Policy-Makers* and *Guidance for Generative AI in Education and Research* to steer the ethical and effective use of AI in education. Policy-makers also need to take a “three-dimension symmetry” approach to the governance and use of AI in education, this includes prioritizing the regulation of AI in education, ensuring inclusive access, and guiding proper use. These documents represent important tools for policymakers to better understand the possibilities and implications of AI for education, especially for the achievement of global goals, commitments and targets for 2030.

To support Member States of UNESCO to define and develop the values, knowledge, and skills that the judicious use of AI in education may require, UNESCO is in the process of developing global AI competency frameworks for school teachers and students.<sup>2</sup> The two frameworks are intended to guide and foster human-centered mindsets on AI, an understanding and practicing of the ethics of AI, and the progressive mastery of AI knowledge and skills. The framework for students furthers the guidance on the learning of design thinking behind AI systems (UNESCO, 2021d), while the framework for teachers provides specific guidance on the AI-pedagogy integration and the use of AI for

teachers' professional learning.

### 4.4 | Prioritizing Continuous Support for Teachers

The key to the successful implementation of a digital education in any settings is changing the behavior of the practitioners, in particular of teachers in the system (UNESCO, 2015). Teachers can be particularly challenged by the continuously renewed digital solutions introduced in education settings, and the ways in which these technologies may be fully integrated into learner-centered pedagogical practices. To ensure that digital education practices are adopted and innovated as expected, policies should prioritize continuous support for teachers. The third iteration of ICT Competency Framework for Teachers (UNESCO, 2018) has recently been released to guide the delineation of national frameworks for teachers. Support for teachers should be streamlined through various channels: existing programmes of study on digital education provided by teacher-training institutions; school-based facilitation on the pedagogical use of digital technology especially for novice teachers; provision of in-service training when new technologies or new policies are introduced; and the affordances of peer learning and coaching online and offline.

## 5 Conclusion: Exploring the Digital Futures of School Systems

The most transformative approach to digital education is to integrate internet connectivity, digital content, and digital competencies with other key underpinning pillars to re-engineer the digital futures of education systems, most prominently, the digital futures of school systems. The report of the International Commission on the Futures of Education recognizes that while schools need to be transformed, they also be protected as physical, social and educational sites because of the inclusion, equity and individual and collective well-being they support (UNESCO, 2021c). Schools need to be reimagined so that they are not only more resilient in the face of possible disruptions of in-person learning, but are also more responsive to the rapidly-evolving needs of individuals and societies, knowledge evolution which are interacting with technological advancements, population and demographic shifts, and migration caused by more frequent conflicts or natural disasters. The digital transforming of school systems requires structural changes, and for this to work, policy-makers need to re-imagine learning and social development outcomes, the society-wide co-design and provision of curriculum, re-design of learning spaces and time to support uni-

2 <https://www.unesco.org/en/digital-education/ai-future-learning>

versal accessibility and ubiquity of learning, and wide engagement with OER and open education practices.

UNESCO has developed a framework for the exploration of possible digital open school systems. This refers to an open delivery modality that mixes non-digital means with digital technologies to ensure that school curricular courses, human tutorials, coaching, are accessible across multiple physical and distance learning spaces. The framework comprises three levels addressing policy and resource enablers, delivery infrastructure, while the third level speaks to teaching, learning and assessment strategies. The three layers enable schools to ensure the quality and continuity of learning for all linking physical and digital spaces. Depending on the level of digital readiness in education and the nature of

the forward-looking vision for using digital technology to transform schooling, countries can choose from three possible strategies. The first aims to support inclusive access by blending digital technology with TV and radio to support inclusive and uninterrupted access to education programmes. The second aims to extend learning spaces and time by blending online and offline learning to enable ubiquitous access to hybrid learning. The third aims to transform pedagogical practices by integrating frontier technologies with various digital technologies to transform pedagogy and enable open education practices. An overview of the three layers, the nine components, the three progression stages, and the twenty-seven action blocks that make up the TEOS framework is provided in Table 1.

**Table 1** Guiding Framework for Digital Open School Systems

Layers	Components	Stages of progression		
		Support inclusive access	Extend learning spaces and time	Transform pedagogical practices
Teaching, learning and assessment planning	Social interaction and care	Social and emotional development	Technology-mediated group connections	Extended social interaction and care
	Teaching and learning	Lecture-based learning	Student-centered and hybrid learning	Ubiquitous personalized and collaborative learning
	Assessment and credentialing of learning outcomes	Tech-assisted formative and summative assessment	Online personalized assessment and credentialing	Data-based assessment and credentialing of competencies
Technology, content and delivery infrastructure	Access to delivery technologies	Access to general and practice-based technologies	Extended learning platforms	AI-powered pervasive online and mobile applications
	Curricular courses and supporting resources	Curriculum goals, content, resources	Content curation and/or generation for extended learning spaces	Government-led content and teacher-generated OER
	Capacity of teachers and practitioners	Pre-set programme facilitators	Collaborative learning programme designers and facilitators	Technology and resources integrators and co-learners
Policy and resource enablers	Leadership and governance	Foundational policy development	Open school policy and strategy	Innovative and responsive monitoring, evaluation and support for open learning
	Financing and resource mobilization	Results-based mixed financing	Recurring public budget and private contribution	Recurring public budget and society-wide resources
	Community and stakeholder engagement	School-home-community connection	School-home-community network	School-home-community partnership

The potential of digital technology to help achieve educational goals and commitments can only be achieved when digital education is guided by human-centered principles, serves public interests, and enhances human capacities. The emergent negative impact on well-being and the environment must be mitigated.

If profound digital opportunities for education are to be fully unleashed, it should start from the reimagining of the digital futures of education systems that promote our collective ambitions for education and center the essential human and social dimensions of the educational process.

**Conflict of Interest** Sobhi Tawil is a member of Editorial Advisory Board and Fengchun Miao is a member of the Editorial Board of *Frontiers of Digital Education*, who were excluded from the peer-review process and all editorial decisions related to the acceptance and publication of this article. Peer-review was handled independently by the other editors to minimise bias.

## References

- Accenture. (2024). *Technology vision 2024: Human by design*.
- EQUALS, & UNESCO. (2019). *I'd blush if I could: Closing gender divides in digital skills through education*. The UNESCO Digital Library.
- European Commission. (2017). *Zero-rating practices in broadband markets*.
- ITU. (2022). *Measuring digital development: Facts and figures 2022*.
- UNESCO. (2015). *Qingdao declaration*.
- UNESCO. (2016). *Open educational resources: Policy, costs, transformation*.
- UNESCO. (2018). *UNESCO ICT competency framework for teachers*.
- UNESCO. (2019a). *Beijing consensus on artificial intelligence and education*.
- UNESCO. (2019b). *Recommendation on open educational resources*.
- UNESCO. (2019c). *Guidelines for the development of open educational resources policies*.
- UNESCO. (2020). *Global education monitoring (GEM) report 2020*.
- UNESCO. (2021a). *AI and education: Guidance for policy-makers*.
- UNESCO. (2021b). *Understanding the impact of COVID-19 on the education of persons with disabilities: Challenges and opportunities of distance education*.
- UNESCO. (2021c). *Reimagining our futures together: A new social contract for education*.
- UNESCO. (2021d). *K-12 AI curricula: A mapping of government-endorsed AI curricula*.
- UNESCO. (2022a). *Guidelines for ICT in education policies and masterplans*.
- UNESCO. (2022b). *Recommendation on the ethics of artificial intelligence*.
- UNESCO. (2022c). *Education and blockchain*.
- UNESCO. (2023a). *Guidance for generative AI in education and research*.
- UNESCO. (2023b). *Technology in education: A tool on whose terms?*
- United Nations. (2022). *Gateways to public digital learning*.
- United Nations. (2023). *A global digital compact—An open, free and secure digital future for all*.