GLOBAL EDUCATION MONITORING REPORT

2023

Technology in education:

A TOOL ON WHOSE TERMS?

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Sustainable Development Goals

Global Education Monitoring Report

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A TOOL ON WHOSE TERMS?

The Education 2030 Incheon Declaration and Framework for Action specifies that the mandate of the *Global Education Monitoring Report* is to be "the mechanism for monitoring and reporting on SDG 4 and on education in the other SDGs" with the responsibility to "report on the implementation of national and international strategies to help hold all relevant partners to account for their commitments as part of the overall SDG follow-up and review". It is prepared by an independent team hosted by UNESCO.

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Photography caption: A student at the Kanata T-Ykua school in Manaus (Brazil) completes her training with the digital content available on the ProFuturo educational platform.

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SHORT SUMMARY

Can technology solve the most important challenges in education?

The adoption of digital technology has resulted in many changes in education and learning, yet it is debatable whether technology has transformed education as many claim. The application of digital technology varies by community and socioeconomic level, by teacher willingness and preparedness, by education level and by country income. Except in the most technologically advanced countries, computers and devices are not used in classrooms on a large scale. Moreover, evidence is mixed on its impact. The short- and long-term costs of using digital technology appear to be significantly underestimated. The most disadvantaged are typically denied the opportunity to benefit.

In asking 'A tool on whose terms?', the Report shows that regulations for technology set outside of the education sector will not necessarily address education's needs. It is released along with a #TechOnOurTerms campaign, calling for decisions about technology in education to prioritize learner needs after assessment of whether its application would be appropriate, equitable, evidence-based and sustainable.

It would cost **USD 1 billion per day** to maintain connectivity for education in poor countries

It provides a compass for policy makers to use when making these decisions. Those in decision-making positions are asked to look down at where they are, to see if technology is appropriate for their context, and learning needs. They are asked to look back at those left behind, to make sure they are focusing on the marginalized. They are reminded to look up at whether they have evidence on impact and enough information on the full cost needed to make informed decisions. And, finally they are asked to look forwards, to make sure their plans fit their vision for sustainable development.

The report underscores the importance of learning to live both with and without digital technology; to take what is needed from an abundance of information but ignore what is not necessary; to let technology support, but never supplant, the human connection on which teaching and learning are based. The focus should be on learning outcomes, not digital inputs. To help improve learning, digital technology should be not a substitute for but a complement to face-to-face interaction with teachers.

Supporting the sixth *Global Education Monitoring Report* is a new series of country profiles on PEER, a policy dialogue resource describing policies and regulations related to technology in the world's education systems.

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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 defenses of peace must be constructed

Foreword

During the COVID pandemic, distance-learning tools – via the Internet but also via radio and television – showed just how useful and necessary they could be. However, they also revealed their limits.

Indeed, this period highlighted a deep-rooted tendency to see technological solutions as a universal tool, suitable for all situations, an inevitable form of progress. This confusion between the tool and the solution, between the means and the end, is what this report invites us to address, by highlighting three paradoxes – three popular misconceptions.

Firstly, there is the promise of personalized learning. Very often, this powerful hope leads us to forget the fundamental social and human dimension that lies at the heart of education. It is worth reiterating the obvious: no screen can ever replace the humanity of a teacher. As underlined in the UNESCO 'Futures of Education' report, published in 2021, the relationship between teachers and technology must be one of complementarity – never of substitutability.

While technology promises easier access to education, the reality is that digital divides still exist, to the point of actually increasing educational inequalities – which is the second paradox that this report highlights. During the pandemic, almost a third of pupils did not have effective access to distance learning – unsurprisingly, since only 40% of primary schools worldwide currently have Internet access. Even if connectivity was universal, it would still be necessary to demonstrate, from a pedagogical point of view, that digital technology offers real added value in terms of effective learning, especially at a time when we are all becoming aware of the risks of excessive screen time.

The last paradox, and by no means the least, is that, despite the desire to make education a global common good, the role of commercial and private interests in education continues to grow, with all the ambiguities that entails: to date, only one in seven countries legally guarantees the privacy of educational data.

These three pitfalls can be avoided, which is why our report makes two strong recommendations that should serve as a compass. Firstly, it recommends that the best interests of pupils should systematically take precedence over any other consideration – particularly commercial considerations. Secondly, it recommends that technology should be seen as a means, never an end.

To make these recommendations reality, UNESCO is calling on its Member States to ensure the fair, equitable and safe development of educational technologies. This means establishing appropriate normative frameworks and setting standards in terms of privacy, access to data, non-discrimination and screen time. It also means launching ambitious public action and international cooperation programmes, to support access to connectivity and open educational resources, and to train teachers on these new and constantly evolving issues.

The conclusions of this report are therefore a starting point to build on, in particular by identifying teaching methods that really work remotely and by continuing research on these subjects to inform public action. Always with the same goal in mind: ensuring that technology serves education, not the other way round.

Audrey Azoulay

Audrey Azoulay
Director-General of UNESCO

Foreword

Education and technological innovation are intrinsically interlinked. New ideas lead to digital transformation, which feeds back in turn to help us improve education systems. Together, education and technology can lead to holistic system level quality improvement and greater equity.

Before becoming Minister, my education led me to work with multiple technologies to develop prosthetic sockets for amputees, a system that enables people to walk with greater comfort; to walk to school and on through life. My role then as both Minister of Basic and Senior Secondary Education and as Chief Innovation Officer for the Government of Sierra Leone continued to draw on this link and the benefits that can come from imagining technology as an enabler.

This report highlights the extent to which the relationship between education and technology is delicate, however, in particular digital technology. Understanding when and how to use and not to use technology to serve our educational objectives is becoming a critical skill for 21st century education leaders. There are multiple benefits, for instance, that come from handling the data generated by education systems and using it to improve the effectiveness and efficiency of our education systems to cater for the education needs of all children.

In Sierra Leone, we understand this. Data brought by technology can give us a picture of the health of our education system, just as it can help us make sure that the learning journeys of each and every child is on the right path. Our push for radical inclusion is not only fuelled by, but depends upon data. We count everyone so that no-one is left out. Our EdTech strategy is firmly synchronized with our long-term vision of delivering inclusive, quality education for all learners and teachers.

When it works well, the data we generate in our education system is the best guide for the policies we need to implement to make things better. This is true for policy makers as it is for teachers, school directors, teachers, parents and communities. Our leaders in primary schools are now prepared to use tablets to collect and apply dynamic data to manage their schools; to oversee teacher registration, student enrolment and attendance.

There are benefits in speed and efficiency. Building systems based on unique student and school identifiers as we have done since 2018. Our digitized annual school census can flag up an issue far faster than many physical inspection visits could do - albeit we need both.

Problem areas such as inequality in school and inefficient resource distribution can also be prevented if we can visualize it. This report reminds us that the use of geospatial data does just that. It remains nascent in low- and lower-middle-income countries, even though it is needed there the most. In Sierra Leone, we are looking at ways of maximizing these innovations with a GIS tool that considers new school locations based on poverty, population and flood risk data. It identifies where we have blind spots; where we could improve; and where we could learn from.

Efficiency benefits can also come in some instances from technology's ability to roll out policy reforms far and fast. Increasingly, this report documents, countries are buying into the undeniable advantages that come from using technology for teacher professional development, for instance. This breaks down barriers related to location or time; it is cost-effective, fosters teacher-to-teacher collaboration and improves teaching practices. In Sierra Leone, we combine audio, visual and digital resources with printed workbooks to enhance teacher training and bring excitement around technology's potential into pedagogy from the start.

But this report also shows that seamlessly moving to a new tech-savvy system of management is not always easy or cheap. Perhaps unsurprisingly, there is a gap between the expected benefits of technology on education management and their realization. Seemingly trivial issues such as maintenance and repair of infrastructure can be ignored or underestimated. Sometimes the very objective of improving learning is forgotten when learning analytics are designed. We may forget to account for our capacity and resources.

Building systems informed by data that use dashboards, charts and tables also assumes an ability to absorb this level of change, including strong school leaders and confident teachers who are willing to innovate. It requires a broad range of people who are data literate, which is far from the case in many contexts.

The one thing around which we all unite is that there are so many tools, so many players, different operating systems and so much conflicting research on what works it can make you dizzy. I am therefore pleased to see the collaboration with partners such as the EdTech Hub in this report, bringing together strong parties whose daily work is about the importance of evidence for decision-making.

As Chair of the Advisory Board for the GEM Report, I urge all policy makers to read this report carefully and to compare your PEER country profile against others. Most of all, as the spread of technology, especially generative AI, continues to seep into our sector, I encourage everyone to apply its recommendations. There are too many risks of not doing so. For us to be tech-savvy, we must be savvy about the education systems we want to create. I support the #TechOnOurTerms campaign. Our SDG 4 terms are non-negotiable.

Dr David Moinina Sengeh
Chief Minister, Sierra Leone
Chair of the GEM Report Advisory Board

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The Global Education Monitoring Report team

Director: Manos Antoninis

Benjamin Alcott, Samaher Al Hadheri, Daniel April, Bilal Fouad Barakat, Marcela Barrios Rivera, Yekaterina Baskakova, Madeleine Barry, Yasmine Bekkouche, Daniel Caro Vasquez, Anna Cristina D'Addio, Dmitri Davydov, Francesca Endrizzi, Stephen Flynn, Lara Gil, Chandni Jain, Priyadarshani Joshi, Maria-Rafaela Kaldi, Josephine Kiyenje, Kate Linkins, Camila Lima De Moraes, Alice Lucatello, Kassiani Lythrangomitis, Anissa Mechtar, Patrick Montjouridès, Claudine Mukizwa, Yuki Murakami, Manuela Pombo Polanco, Judith Randrianatoavina, Kate Redman, Maria Rojnov, Divya Sharma, Laura Stipanovic, Dorothy Wang and Elsa Weill.

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For more information, please contact:

Global Education Monitoring Report team UNESCO, 7, place de Fontenoy 75352 Paris 07 SP, France

Email: gemreport@unesco.org

Tel.: +33 1 45 68 07 41

unesco.org/gemreport

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KEY MESSAGES

Good, impartial evidence on the impact of education technology is in short supply.

- **There is little robust evidence on digital technology's added value in education.** Technology evolves faster than it is possible to evaluate it: Education technology products change every 36 months, on average. Most evidence comes from the richest countries. In the United Kingdom, 7% of education technology companies had conducted randomized controlled trials, and 12% had used third-party certification. A survey of teachers and administrators in 17 US states showed that only 11% requested peer-reviewed evidence prior to adoption.
- **A lot of the evidence comes from those trying to sell it.** Pearson funded its own studies, contesting independent analysis that showed its products had no impact.

Technology offers an education lifeline for millions but excludes many more.

- **Accessible technology and universal design have opened up opportunities for learners with disabilities.** About 87% of visually impaired adults indicated that accessible technology devices were replacing traditional assistive tools.
- **Radio, television and mobile phones fill in for traditional education among hard-to-reach populations.** Almost 40 countries use radio instruction. In Mexico, a programme of televised lessons combined with in-class support increased secondary school enrolment by 21%.
- **Online learning stopped education from melting down during COVID-19 school closures.** Distance learning had a potential reach of over 1 billion students; but it also failed to reach at least half a billion, or 31% of students worldwide – and 72% of the poorest.
- **The right to education is increasingly synonymous with the right to meaningful connectivity, yet access is unequal.** Globally, only 40% of primary, 50% of lower secondary and 65% of upper secondary schools are connected to the internet; 85% of countries have policies to improve school or learner connectivity.

Some education technology can improve some types of learning in some contexts.

- **Digital technology has dramatically increased access to teaching and learning resources.** Examples include the National Academic Digital Library of Ethiopia and National Digital Library of India. The Teachers Portal in Bangladesh has over 600,000 users.
- **It has brought small to medium-sized positive effects to some types of learning.** A review of 23 mathematics applications used at the primary level showed that they focused on drill and practice rather than advanced skills.
- **But it should focus on learning outcomes, not on digital inputs.** In Peru, when over 1 million laptops were distributed without being incorporated into pedagogy, learning did not improve. In the United States, analysis of over 2 million students found that learning gaps widened when instruction was exclusively remote.
- **And it need not be advanced to be effective.** In China, high-quality lesson recordings delivered to 100 million rural students improved student outcomes by 32% and reduced urban–rural earning gaps by 38%.
- **Finally, it can have detrimental impact if inappropriate or excessive.** Large-scale international assessment data, such as that provided by the Programme for International Student Assessment (PISA), suggest a negative link between excessive ICT use and student performance. Mere proximity to a mobile device was found to distract students and to have a negative impact on learning in 14 countries, yet less than one in four have banned smartphone use in schools.

The fast pace of change in technology is putting strain on education systems to adapt.

- **Countries are starting to define the digital skills they want to prioritize in curricula and assessment standards.** Globally, 54% of countries have digital skill standards but often these have been defined by non-state, mostly commercial, actors.
- **Many students do not have much chance to practise with digital technology in schools.** Even in the world's richest countries, only about 10% of 15-year-old students used digital devices for more than an hour per week in mathematics and science.
- **Teachers often feel unprepared and lack confidence teaching with technology.** Only half of countries have standards for developing teacher ICT skills. While 5% of ransomware attacks target education, few teacher training programmes cover cybersecurity.
- **Various issues impede the potential of digital data in education management.** Many countries lack capacity: Just over half of countries use student identification numbers. Countries that do invest in data struggle: A recent survey among UK universities found that 43% had trouble linking data systems.

Online content has grown without enough regulation of quality control or diversity.

- **Online content is produced by dominant groups, affecting access to it.** Nearly 90% of content in higher education repositories with open education resource collections was created in Europe and Northern America; 92% of content in the OER Commons global library is in English. Massive open online courses (MOOCs) mainly benefit educated learners and those from richer countries.
- **Higher education is adopting digital technology the fastest and being transformed by it the most.** There were over 220 million students attending MOOCs in 2021. But digital platforms challenge universities' role and pose regulatory and ethical challenges, for instance related to exclusive subscription deals and to student and personnel data.

Technology is often bought to plug a gap, with no view to the long-term costs…

- **…for national budgets.** The cost of moving to basic digital learning in low-income countries and connecting all schools to the internet in lower-middle-income countries would add 50% to their current financing gap for achieving national SDG 4 targets. Money is not always well spent: Around two-thirds of education software licences were unused in the United States.
- **…for children's well-being.** Children's data are being exposed, yet only 16% of countries explicitly guarantee data privacy in education by law. One analysis found that 89% of 163 education technology products recommended during the pandemic could survey children. Further, 39 of 42 governments providing online education during the pandemic fostered uses that risked or infringed on children's rights.
- **…for the planet.** One estimate of the CO2 emissions that could be saved by extending the lifespan of all laptops in the European Union by a year found it would be equivalent to taking almost 1 million cars off the road.

Technology in education

In Uganda, Justin Biriungi (8) sits with his special education needs teacher Susan Tuhaise. Laptops are installed with Kolibri, a free and open source education technology platform that allows in- and out-of-school pupils and students to learn at their own pace.

Credit: UNICEF/UN0747881/Rutherford*

CHAPTER

1

Introduction

KEY MESSAGES

Digital technology has changed but not transformed education.

Digital technology tools have been widely adopted by learners, educators and institutions.

- The number of students in massive open online courses reached at least 220 million in 2021. The learning application Duolingo had 20 million daily active users in 2023 and Wikipedia had 244 million page views per day in 2021. Globally, the percentage of internet users rose from 16% in 2005 to 66% in 2022.

The adoption of digital technology has resulted in many changes in education and learning.

- The set of basic skills that young people are expected to learn in school has expanded to include a broad range of new ones to navigate the digital world. Higher education is the subsector with the highest rate of digital technology adoption, with online management platforms replacing some campuses. The use of data analytics has grown in education management. Technology has made a wide range of informal learning opportunities accessible.
- But in many parts of the world, education systems remain relatively untouched. Even in some of the most technologically advanced countries, computers and devices are not used in classrooms on a large scale. Technology use is not universal and will not become so any time soon.

Can technology help solve the most important challenges in education?

- Equity and inclusion: Digital technology lowers education access cost for some disadvantaged groups, but access to the internet and devices remains highly unequal.
- Quality: Digital technology encourages engagement and facilitates collaboration and connections, but an individualized approach to education reduces learners' opportunities to learn in real-life settings and has a negative impact on well-being and privacy.
- Efficiency: Digital technology reduces the time teachers and students spend on menial tasks, time that can be used in other, educationally more meaningful activities.

How do we know whether technology works in education?

- Technology is evolving too fast to permit evaluations that could inform decisions on legislation, policy and regulation. Findings that apply in some contexts are not always replicable elsewhere. Few questions are asked about who is shaping the discourse that says technology is the answer to major education challenges.
- Artificial intelligence has been applied in education for the past 40 years. More evidence is needed to understand whether its tools can change how students learn, beyond the superficial level of obtaining answers and correcting mistakes.

What do countries focus on when they invest in education technology?

- Every country has invested in the use of digital technology in education to some extent. Business rather than education arguments are more commonly deployed to justify countries' investments. Often investments are based on a belief that technology is a good in itself.

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Major advances in technology, especially digital technology, are rapidly transforming the world. Information and communication technology (ICT) has been used for 100 years in education, ever since the popularization of radio in the 1920s. But it is the use of digital technology over the past 40 years that has the most significant potential to transform education. An education technology industry has emerged and focused, in turn, on the development and distribution of education content, learning management systems, language applications, augmented and virtual reality, personalized tutoring, and testing. Most recently, breakthroughs in artificial intelligence (AI) methods have increased the power of education technology tools, leading to speculation that technology could even supplant human interaction in education (**Box 1.1**).

In the past 20 years, learners, educators and institutions have widely adopted digital technology tools. The number of students in massive open online courses reached at least 220 million in 2021 (Shah, 2021). The language learning application Duolingo had 20 million daily active users in 2023 (Statista, 2023) and Wikipedia had 244 million page views per day in 2021 (Thomas, 2022). The 2018 Programme for International Student Assessment (PISA) found that 65% of 15-year-old students in OECD countries were in schools whose principals agreed that teachers had the technical and pedagogical skills to integrate digital devices in instruction and 54% in schools where an effective online learning support platform was available (OECD, 2020, pp. 266–268); these shares are believed to have increased during the COVID-19 pandemic. Globally, the percentage of internet users rose from 16% in 2005 to 66% in 2022 (ITU, 2022). About 50% of the world's lower secondary schools were connected to the internet for pedagogical purposes in 2022 (UIS, 2023). Although digital technology has been used in poorer countries, and among some of the most marginalized people in the world, its use in education is still limited.

The adoption of digital technology has resulted in many changes in education and learning. The set of basic skills that young people are expected to learn in school, at least in richer countries, has expanded to include a broad range of new ones to navigate the digital world (Vuorikari et al., 2022). In many classrooms, paper has been replaced by screens, and pens by keyboards. COVID-19 can be seen as a natural experiment where learning switched online for entire education systems virtually overnight (**Box 1.2**). Higher education is the subsector with the highest rate of digital technology adoption, with online management platforms replacing campuses (Williamson, 2021). The use of data analytics has grown in education management (Romero and Ventura, 2020). Technology has made a wide range of informal learning opportunities accessible (Greenhow and Lewin, 2015).

> "The extent to which technology has transformed education needs to be debated"

Yet the extent to which technology has transformed education needs to be debated (Reich, 2020). Change resulting from the use of digital technology is incremental, uneven and bigger in some contexts than in others. The application of digital technology varies by community and socioeconomic level, by teacher willingness and preparedness, by education level, and by country income. Except in the most technologically advanced countries, computers and devices are not used in classrooms on a large scale. Technology use is not universal and will not become so any time soon. Moreover, evidence is mixed on its impact (Hamilton and Hattie, 2021). Some types of technology seem to be effective in improving some kinds of learning (Selwyn, 2022). The short- and long-term costs of using digital technology appear to be significantly underestimated. The most disadvantaged are typically denied the opportunity to benefit from this technology.

Too much attention on technology in education usually comes at a high cost. Resources spent on technology, rather than on classrooms, teachers and textbooks for all children in low- and lower-middle-income countries lacking access to these resources, are likely to lead to the world being further away from achieving the global education goal, SDG 4. Some of the world's richest countries ensured universal secondary schooling and minimum learning competencies before the advent of digital technology. Children can learn without it.

However, their education is unlikely to be as relevant without digital technology. The Universal Declaration of Human Rights defines the purpose of education as promoting the 'full development of the human personality', strengthening 'respect for … fundamental freedoms' and promoting 'understanding, tolerance and friendship'. This notion needs to move with the times. An expanded definition of the right to education could include effective support by technology for all learners to fulfil their potential, regardless of context or circumstance.

Clear objectives and principles are needed to ensure that technology use is of benefit and avoids harm. The negative and harmful aspects of the use of digital technology in education and society include risk of distraction and lack of human contact. Unregulated technology even poses threats to democracy and human rights, for instance through invasion of privacy and stoking of hatred. Education systems need to be better prepared to teach about and through digital technology, a tool that must serve the best interests of all learners, teachers and administrators. Impartial evidence showing that technology is being used in some places to improve education and good examples of such use need to be shared more widely so that the optimal mode of delivery can be chosen for each context.

> "While technology has tremendous potential, many tools have not been designed for application to education"

CAN TECHNOLOGY HELP SOLVE THE MOST IMPORTANT CHALLENGES IN EDUCATION?

Discussions about education technology are focused on technology rather than education. The first question should be: What are the most important challenges in education? As a basis for discussion, consider the following three challenges:

- Equity and inclusion: Is fulfilment of the right to choose the education one wants and to realize one's full potential through education compatible with the goal of equality? If not, how can education become the great equalizer?
- Quality: Do education's content and delivery support societies in achieving sustainable development objectives? If not, how can education help learners to not only acquire knowledge but also be agents of change?
- Efficiency: Does the current institutional arrangement of teaching learners in classrooms support the achievement of equity and quality? If not, how can education balance individualized instruction and socialization needs?

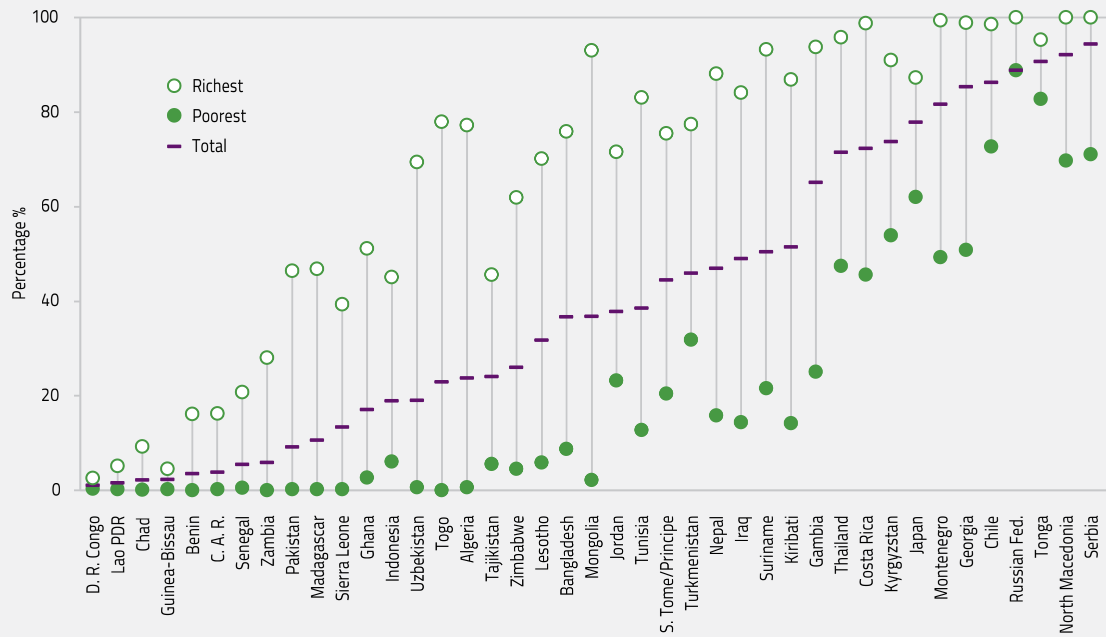
How best can digital technology be included in a strategy to tackle these challenges, and under what conditions? Digital technology packages and transmits information on an unprecedented scale at a high speed and low cost. Information storage has revolutionized the volume of accessible knowledge. Information processing enables learners to receive immediate feedback and, through interaction with machines, adapt their learning pace and trajectory: Learners can organize the sequence of what they learn to suit their background and characteristics. Information sharing lowers the cost of interaction and communication. But while such technology has tremendous potential, many tools have not been designed for application to education. Not enough attention has been paid to how they are applied in education and even less to how they should be applied in different education contexts.

On the question of **equity and inclusion**, ICT – and digital technology in particular – helps lower the education access cost for some disadvantaged groups: those who live in remote areas, are displaced, face learning difficulties, lack time or have missed out on past education opportunities. But while access to digital technology has expanded rapidly, there are deep divides in access. Disadvantaged groups own fewer devices, are less connected to the internet (**Figure 1.1**) and have fewer resources at home. The cost of much technology is falling rapidly but is still

FIGURE 1.1:

Internet connectivity is highly unequal

Percentage of 3- to 17-years-olds with internet connection at home, by wealth quintile, selected countries, 2017–19



GEM StatLink: https://bit.ly/GEM2023_fig1_1
Source: UNICEF database.

too high for some. Households that are better off can buy technology earlier, giving them more advantages and compounding disparity. Inequality in access to technology exacerbates existing inequality in access to education, a weakness exposed during the COVID-19 school closures.

Education **quality** is a multifaceted concept. It encompasses adequate inputs (e.g. availability of technology infrastructure), prepared teachers (e.g. teacher standards for technology use in classrooms), relevant content (e.g. integration of digital literacy in the curriculum) and individual learning outcomes (e.g. minimum levels of proficiency in reading and mathematics). But education quality should also encompass social outcomes. It is not enough for students to be vessels receiving knowledge; they need to be able to use it to help achieve sustainable development in social, economic and environmental terms. This report's stance is that there is no more important contemporary challenge than sustainability. Thus the definition of quality in an education system should encompass the system's ability to equip learners to act in ways that help achieve sustainable development in the social, economic and environmental senses. Yet most education systems do not fare well with respect to this challenge.

Views vary widely on the extent to which digital technology can enhance education quality. Some argue that, in principle, digital technology creates engaging learning environments, enlivens student experiences, simulates situations, facilitates collaboration and expands connections. But others say digital technology tends to support an individualized approach to education, reducing learners' opportunities to socialize and learn by observing each other in real-life settings. Moreover, just as new technology overcomes some constraints, it brings its own problems. Increased screen time has been associated with adverse effects on physical and mental health. Insufficient regulation has led to unauthorized use of personal data for commercial purposes. Digital technology has also helped spread misinformation and hate speech, including through education. Such challenges may cancel out any benefits.

Improvements to **efficiency** may be the most promising way for digital technology to make a difference in education. Technology is touted as being able to reduce the time students and teachers spend on menial tasks, time that can be used in other, educationally more meaningful, activities. However, there are conflicting views on what is meaningful. The way that education technology is used is more complex than just a substitution of resources.

Technology may be one-to-many, one-to-one or peer-to-peer. It may require students to learn alone or with others, online or offline, independently or networked. It delivers content, creates learner communities and connects teachers with students. It provides access to information. It may be used for formal or informal learning and can assess what has been learned. It is used as a tool for productivity, creativity, communication, collaboration, design and data management. It may be professionally produced or have user-generated content. It may be specific to schools and place-based or transcend time and place. As in any complex system, each technology tool involves distinct infrastructure, design, content and pedagogy, and each may promote different types of learning.

HOW DO WE KNOW WHETHER TECHNOLOGY WORKS IN EDUCATION?

In order to understand whether each form of technology addresses equity, quality and efficiency of education, three questions need to be answered. First, what is the logical mechanism that leads from the use of a piece of hardware or software to improved learning? Second, are the conditions under which a technological tool is supposed to work met in practice or is implementation failing? Third, what evidence is collected, by whom, and how in order to evaluate impact?

Technology is evolving too fast to permit evaluation that could inform decisions on legislation, policy and regulation. Research on technology in education is as complex as technology itself. Studies evaluate experiences of learners of various ages using various methodologies applied in contexts as different as self-study, classrooms and schools of diverse sizes and features, non-school settings, and at system level. Findings that apply in some contexts are not always replicable elsewhere. Some conclusions can be drawn from long-term studies as technologies mature, but there is an endless stream of new products. Meanwhile, not all impact can be easily measured, given technology’s ubiquity, complexity, utility and heterogeneity. Good research needs to balance quantitative and qualitative methods, look into evidence of both positives and negatives, and avoid cutting corners in its design, for instance with respect to focus outcomes or fieldwork locations. In brief, while there is much general research on education technology, the amount of research into specific applications and contexts is insufficient, making it difficult to prove that a particular technology enhances a particular kind of learning.

Why is there often the perception that technology can address major education challenges? To understand the discourse around education technology, it is necessary to look behind the language being used to promote it, and the interests it serves. Who frames the problems technology should address? What are the consequences of such framing for education? Who promotes education technology as a precondition for education transformation? How credible are such claims? What criteria and standards need to be set to evaluate digital technology's current and potential future contribution to education so as to separate hype from substance? Can evaluation go beyond short-term assessments of impact on learning and capture potential far-reaching consequences of the generalized use of digital technology in education?

Exaggerated claims about technology go hand in hand with exaggerated estimates of its global market size. In 2022, business intelligence providers’ estimates ranged from USD 123 billion (Grand View Research, 2023) to USD 300 billion (HolonIQ, 2022a). These accounts are almost always projected forward, predicting optimistic expansion, yet they fail to show historic trends and verify whether past projections proved true. Such reporting routinely characterizes education technology as essential and technology companies as enablers and disruptors. If optimistic projections are not fulfilled, responsibility is implicitly placed on governments as a way of maintaining indirect pressure on them to increase procurement (Mármol Queraltó, 2021).

Education is ‘often decried for being slow to change, for being stuck in the past’ (Weller, 2022, p. 33). The perspective that education ‘lags the digital leaps’ (Hirsh-Pasek et al., 2022, p. 1), that the sector ‘lagged behind’ the corporate sector in adopting technology (PwC, 2022, p. 10), and that education systems are ‘traditionally laggards when it comes to innovation’ (OECD, 2021, p. 3) is emphasized. In one such misleading presentation, education was characterized as ‘grossly under digitized’ because ‘less than 4%’ of global education expenditure by governments and households is allocated to technology (HolonIQ, 2022). But there is no basis for the suggestion that education’s success should be measured by how much spending is allocated to technology. Another presentation estimating the value of global education technology stated ‘it’s just the beginning’ as the ‘industry’s growth is undeniable’ (Yelenevych, 2022). Such coverage plays on users’ fascination with novelty but also their fear of being left behind.

BOX 1.1:

Generative artificial intelligence is the latest technology touted as having the potential to transform education

Artificial intelligence (AI) involves the application of computer science through algorithms to process large data sets to help solve problems. As algorithms and processing methods become more sophisticated in the ways they classify information and make predictions, they begin to imitate human brain functions more closely. Generative AI applies such sophisticated processing on vast data sets of natural language, code language and images to create new content in these and other data forms.

AI of one sort or another has been applied in education for at least 40 years (Aleven and Koedinger, 2002). Multiple examples are mentioned throughout this report, of which three stand out. First, intelligent tutoring systems track student progress, difficulties and errors, going through structured subject content to provide feedback and adjust the level of difficulty to create an optimal learning path. Second, AI can support writing assignments and, conversely, can be used to automatically assess writing assignments, including identifying plagiarism and other forms of cheating. Third, AI has been applied to immersive learning experiences and games (UNESCO, 2021).

Its creators expect generative AI to increase all these tools' effectiveness to such an extent that their use could become widespread, further personalizing learning and reducing the time teachers spend on tasks such as marking and lesson preparation (Google, 2022). Commonly used intelligent tutoring systems, such as Duolingo Max, which supports foreign language learning, and Khanmigo, which is used alongside Khan Academy video lessons, have collaborated with OpenAI, the developer of ChatGPT, the best-known generative AI tool, to increase their effectiveness. Increased data processing power may also generalize the collection and use of data to detect student disengagement, including during examinations taken online. AI tools have been rapidly adopted. ChatGPT had more than 1 billion monthly page visits by February 2023 (Carr, 2023). In 2022, a survey of US professionals found that 37% of those in advertising or marketing and 19% of those in teaching had used it in some way at work (Thormundsson, 2023).

The potential implications for education are numerous. If repetitive tasks are increasingly being automated and more jobs require higher-order thinking skills, the pressure on education institutions to develop such skills will increase. If written assignments no longer indicate mastery of certain skills, assessment methods will need to develop. If intelligent tutoring replaces at least some teaching tasks, teacher preparation and practices will need to shift accordingly. While many technologies previously promoted as transformative did not live up to expectations, the sheer growth in computing power behind generative AI raises the question whether this technology could be the turning point.

Some countries have been responding to the implications of AI, although so far the focus has been on education's role in supporting capacity development in AI (World Bank, 2021). France has a strategy to develop AI research capacity, including through a talent attraction and support programme (France Ministry of Higher Education and Research, 2018). India's National Strategy for AI includes education as one of five focus areas (Niti Aayog, 2018). But a review of 24 national AI strategies published between 2016 and 2020 found that one third addressed integration of AI in teaching and learning (Schiff, 2022). In Singapore, the National AI Strategy and the EdTech Plan (2020–30) highlight AI for personalizing teaching and learning through national learning platforms (Singapore Ministry of Education, 2022; Singapore Smart Nation and Digital Government Office, 2019), which all school leaders, teachers and students have access to, helping track student progress (Singapore Ministry of Education, 2022). Another global survey found that 11 out of 51 governments had developed and implemented AI curricula (UNESCO, 2022).

Yet the spread of generative AI brings risks. It makes it harder for people to trust information. As lines between reality and invention continue to be blurred, people become more susceptible to being deceived. As the content generated by AI improves, people may even become too trusting (OpenAI, 2023). Pernicious algorithms with biased design pose further risks. In the United Kingdom, algorithms applied to predict grades during the COVID-19 school closures, for instance, exacerbated inequality by socioeconomic background (Kolkman, 2020). There are risks associated with human rights (e.g. use of surveillance techniques), democracy (e.g. algorithms reproducing prejudices) and legislation (e.g. the possibility of making the use of AI compulsory in education) (Holmes et al., 2022).

Continued on next page

BOX 1.1: CONTINUED

Generative AI may not bring the kind of change in education often discussed. Whether and how AI would be used in education is an open question (Gillani et al., 2023). The appeal of learning alone with chatbots may wear off quickly. Even if perfected, such tools may be cumbersome and fail to result in any improvement. Personalization in education should vary learner paths to reach not the same learning levels but different ones that fulfil individual potential (Holmes et al., 2018). More evidence is needed to understand whether AI tools can change how students learn, beyond the superficial level of correcting mistakes. By simplifying the process of obtaining answers, such tools could decrease student motivation to perform independent research and generate solutions (Kasneci et al., 2023). Their spread could magnify risks mentioned throughout this report. For instance, if differences in student learning speeds are mismanaged, it could widen achievement gaps (United States Department of Education, 2023).

The advent of generative AI may not require major changes in education policy responses. For instance, it does not fundamentally change the set of essential digital competencies that was defined before its emergence. Teacher professional development programmes may need to be adapted somewhat to reflect new ways of assigning homework and assessing students. Supporting teachers in developing better prompts to chatbots is one of several potential areas of development (Farrokhnia et al., 2023). But, overall, general teacher proficiency remains crucial in making appropriate pedagogical choices while using this technology (Cooper, 2023).

There is a need to reflect on what it means to be well-educated in a world shaped by AI. Faced with new technology tools, the ideal response is unlikely to be further specialization in technology-related domains; rather, it is a balanced curriculum that maintains if not strengthens and improves the delivery of arts and humanities to reinforce learners' responsibility, empathy, moral compass, creativity and collaboration. The implication of intelligent tutoring systems cannot be that AI replaces teachers altogether but that teachers are entrusted with more responsibility than ever to help societies navigate this critical moment. A consensus is forming about the need to enjoy AI's benefits while eliminating risks from its unchecked use, through regulation relating to ethics, responsibility and safety.

BOX 1.2:

The switch to education technology during COVID-19 raised awareness of its limitations

Responses to the COVID-19 pandemic led to educational technology being used for learning out of school, at a pace and scale with no historical precedent. For hundreds of millions of students, formal learning became heavily dependent on technology, whether internet-connected digital devices, television or radio. A forthcoming UNESCO publication, *An Ed-Tech Tragedy? Educational Technologies and School Closures in the Time of COVID-19*, examines education during the pandemic from early 2020 through the end of 2022. It documents how technology-based solutions left a global majority of learners behind and how education was diminished even when technology was available and worked as intended.

The report documents the ambition that marked the initial transition from schools to education technology as the pandemic took hold. To better understand why and how countries turned to technology as a stopgap measure to address school closures, it examines the concept of technological solutionism – the belief that every problem, or even things not previously identified as problems, has a solution based in technology. The report traces the rise and dissemination of the idea that internet-connected technology could, and even should, replace schools as the primary means of formal education. Visions of technology-reliant and technology-guided education rest on assumptions that mainstream schooling models are outdated and no longer fit a digital age of instant information. Technology, its advocates argue, has possibilities for ubiquitous learning and would better facilitate the types of learning and skills development demanded in a connected world awash in data and content.

Continued on next page

BOX 1.2: CONTINUED

The publication also looks behind the ambitions of a shift to technology-based solutions to document what was and was not delivered in the challenging context of the pandemic. The COVID-19 school closures led to scrutiny of the ways technology can be used in education. The forthcoming report shows that the core areas in which technology failed to live up to expectations are, unsurprisingly, the same areas where it has failed to deliver in past decades, which this *Global Education Monitoring Report* (GEM Report) covers in depth. The shift to digital learning left many students behind, exacerbating inequality. Even when connected technology was available, technology-centred modes of learning tended to result in low student engagement and poor achievement. Looking beyond learning, the analysis in *An Ed-Tech Tragedy* focuses on the many ways young people's immersion in technology for education and other purposes has been unhealthy. Finally, it points out that the centrality of education technology has empowered and enriched powerful private sector actors, enabled new and invasive forms of surveillance and control, and ushered in often overlooked environmental consequences, among other harms.

Taking these risks into account, *An Ed-Tech Tragedy?* questions whether school closures and the shift to remote learning protected public health and saved lives. Did remote learning alternatives to education contribute to the prolongation of school closures? Were there alternatives to connected technology when schools were shuttered? Was COVID-19 an education crisis in addition to a health crisis? The publication challenges the assertion that education technology investment necessarily strengthens education system resilience, and hence it also questions the assertion that expenditure on education technology should necessarily be scaled up.

Echoing the findings of the 2023 GEM Report, the publication concludes that the COVID-19 education experience serves as a reminder that digital transformation should not entail replacing the deeply human enterprise of teaching and learning. It repeats the GEM Report's calls for technology design, regulation and use that put all learners back at the centre, strengthen the right to education for all, and better serve the needs and interests of those closest to education. The publication calls for continued dialogue to draw knowledge from the education technology experiences of the pandemic, making sure the integration of technology in education better aligns with the sector's humanistic aims and better ensures the progress and well-being of school leaders, teachers, students, parents and societies.

WHAT DO COUNTRIES FOCUS ON WHEN THEY INVEST IN EDUCATION TECHNOLOGY?

At the same time that the role of technology in education is being debated, every country in the world has invested in the use of digital technology in education to some extent. A review of one country from each SDG region opens a window into how they have understood the role of technology in their education system, how technology has been applied, who is involved and what challenges have been encountered. Each case study links to content covered in various chapters of the GEM Report. Their wide variation shows that the policymakers' perspective on education technology issues is often distant from the questions raised in this introduction. On the whole, it can be said that, while countries invest in digital technology for education, business rather than education arguments are more commonly deployed to justify these investments.

With some notable exceptions, countries often appear to pay little attention to whether their investment has been relevant and had an impact on learning, whether it has been equitable and inclusive, whether it is economically efficient, and whether it has longer-term negative effects on human rights and well-being. Questions are hanging over the type and quality of evidence used in making decisions. Countries tend to describe progress in terms of the technology inputs they have purchased instead of the learning improvement these inputs have achieved. While in some cases, education technology investment is aligned and integrated with related investment in the rest of government, in other cases such investment does not respond to an education system's specific problems. Instead, it appears more as a modern accessory, something that is added to the education system, possibly to imitate other education systems or in a belief that technology is a good in itself.

> There is no basis for the suggestion that education's success should be measured by how much spending is allocated to technology

BOX 1.3:

Egypt

Egypt introduced technology in education in the 1990s, initially with support from international actors that saw it as key to the problem of rote learning (Warschauer, 2003; 2004). In 2006, the Egyptian Education Initiative, a partnership between the government, the World Economic Forum and the private sector, tried to introduce coherence across multiple externally supported activities, related for instance to broadband and smart schools. By 2011, 70,000 computers had been deployed, 185,000 people had been trained and more than 2,000 schools had been involved. However, an evaluation of the partnership, which included companies such as Cisco, Intel and Microsoft, found that it had not focused sufficiently on education outcomes, had underestimated the complexity of education, and had not monitored and evaluated implementation (World Economic Forum, 2012).

In the second half of the 2010s, after having heavily prioritized the digitization of its public sector (Egypt Ministry of Communications and Information Technology, 2020), Egypt launched Education 2.0 in 2017, a major education reform placing digital technology at the heart of efforts to support skills-based learning (Kazem, 2020). The private sector has been actively involved in infrastructure, curriculum development and platforms (Oxford Business Group, 2022a).

Plans to equip schools with multimedia laboratories and digital devices were not new, but their implementation was slow (Ewiss et al., 2019). In 2019, the education technology company Promethean World was commissioned to digitize 26,000 classrooms through interactive displays (Oxford Business Group, 2020; Promethean, 2019). Its parent company, NetDragon Websoft Holdings, specialized in gaming and mobile applications, was recruited to build more than 3,000 smart modular classrooms and address the problem of overcrowded spaces (Oxford Business Group, 2022a). Tablets were provided to 25,000 public schools (Egypt Today, 2020).

Private companies have been engaged heavily in adapting the curriculum to ICT. Discovery Education, a consultancy specialized in digital curriculum, has been consulted for school programme design (Moustafa et al., 2022). National Geographic Learning, a firm specialized in English-language learning resources, has provided curriculum content and delivered print and digital materials to grades 4 to 6 (Cengage Group, 2021). The school curriculum has been updated to integrate digital learning resources, including personal devices, in-class coaching and computer-based assessments. New education programmes focus on a competency-based and multidisciplinary approach (Moustafa et al., 2022; Saavedra, 2019).

Digital learning resources have become progressively more available (Welsh, 2020). Launched in 2016, the Egyptian Knowledge Bank provides free teaching materials aligned with the reformed education programmes. Initially providing research sources to secondary and higher education, the platform was significantly expanded in the aftermath of school closures during COVID-19. It quickly became the region's largest digital learning platform, with over 20 million daily views (El Zayat, 2022; UN Transforming Education Summit, 2022; UNESCO, 2022). Related resources included learning management systems and platforms in primary and secondary education; online lessons, some for free on YouTube, some for a fee; and the now defunct Edmodo platform (UNICEF, 2021b). These efforts were documented in the Education 2.0 Research & Documentation Project at the Social Research Center of the American University of Cairo (RDP, 2021).

Education technology's impact in terms of both learning outcomes and equity has not yet been evaluated in Egypt (Helmy et al., 2020; Moustafa et al., 2022). Some questioned the reform's fit with the social and cultural context (Ramzy, 2021). A study of secondary school teachers suggested that they did not regard education technology as a top priority for education reform, even if they recognized its potential benefits (Badran et al., 2021). Monitoring was limited to access (e.g. to the Egyptian Knowledge Bank) rather than actual use (Sobhy, 2023). Three in five children reported accessing digital platforms during COVID-19 (UNICEF, 2021a).

BOX 1.4:

Estonia

Estonia made digitization across government a national priority when it became independent 30 years ago. Not only education but also taxation, voting and healthcare were progressively digitized. In 2002, each citizen was equipped with a digital identity for access to public services. Providing citizens with digital skills quickly became a necessity (Kattel and Mergel, 2019). Digital technology's integration in education began in 1996 with the Tiger Leap Initiative (Tiigrihüpe) developing school ICT infrastructure. By 2001, every classroom had access to a computer and all schools went online. Teachers and school leaders were progressively trained in the use of digital technology and its integration in teaching practices (Aru-Chabilan, 2020). School management was digitized in the 2000s and communication portals, including eKool and Stuudium, were introduced. Since 2015, textbooks and learning materials have been available via a cloud repository, the e-Schoolbag (e-koolikot) (OECD, 2020c), which consists mostly of open educational resources (Põldoja, 2020).

However, attitudes and beliefs about education technology effectiveness and benefits have not evolved as rapidly as technology itself (Haaristo et al., 2019). Some teachers have resisted the integration of digital tools (Leppik et al., 2017). Estonia was ranked first among EU countries in a readiness index for 'digital lifelong learning', but a few teachers still preferred traditional approaches (Beblavý et al., 2019). In the 2018 Teaching and Learning International Survey, only one in three lower secondary school teachers reported feeling adequately prepared to use ICT in teaching (European Commission, 2020). On the other hand, 75% had received ICT training as part of their professional development, compared with an average of 60% in OECD countries overall (OECD, 2020b). A survey of teachers found they had limited knowledge about artificial intelligence and how it could support them (Chounta et al., 2023).

From 2012, the ProgeTiger programme enhanced digital literacy in the curriculum (Aru-Chabilan, 2020). Digital competencies have been taught and tested using the European Union DigComp framework (Estonian Education and Youth Board, 2021; Mehisto and Kitsing, 2021). Yet teaching has been uneven between schools. A Tallinn University study reported that informatics was taught in less than half of schools, mostly because of shortages of qualified teachers (Põldoja, 2020). The Estonian Lifelong Learning Strategy 2020 and its successor, the strategic plan Education 2035, have focused on adult digital skills. By 2016, 10% of the country's adults had received computer training (Estonian Education and Youth Board, 2020). In 2019, 65% of the population had at least basic digital skills (European Commission, 2020). Vali-IT (Choose IT) is a short, intensive professional development course. ICT skills acquired outside formal education are formally recognized (e-Estonia, 2021; European Commission, 2022). The share of students enrolled in tertiary ICT programmes has consistently increased over time, reaching 12% in 2020, twice the OECD rate (OECD, 2020a; Viik, 2020).

Launched in 2005, the web-based Estonian Education Information System collects information on individual learning trajectories. Accessible through an individual identification number, the system tracks student personal information, including on performance and special needs, from early childhood to adulthood. Teachers are required to input data through the school management system. The interoperability platform X-Road connects the database to other national electronic registers, facilitating data exchange (OECD, 2020c). The identity-based data system was possible because of the transparency and integrity of the ICT infrastructure (Kattel and Mergel, 2019; OECD, 2020c). The Data Protection Inspectorate has clear guidelines on data use (Ruiz-Calleja et al., 2018).

Estonia's education system is considered one of the world's most digitized, a model for digital learning (Estonian Education and Youth Board, 2020). Over the years, Estonian schools have taken part in several projects and been supported by public agencies, universities and technology companies. Yet school staff believe the emphasis has been on monitoring the number of devices and the speed of connectivity instead of evaluating learning impact (Lorenz et al., 2016).

BOX 1.5:

Nepal

In Nepal, numerous strategy and policy documents have committed to strengthening ICT in education, including the 2010 and 2015 ICT policies and the 2019 Digital Nepal Framework. The framework proposed a series of ambitious initiatives, including smart classrooms, rural mobile learning centres, a rent-a-laptop programme, a biometric student and teacher attendance monitoring system, an online education management information system, and a centralized university admission system (Nepal Ministry of Communication and Information Technology, 2019). As part of the framework, the Nepal Telecommunication Authority contracted ICT laboratories in 930 community schools (Fiscal Nepal, 2020) and two years later the government announced that laboratories would be set up in 2,300 community schools by 2025 (Onlinekhabar, 2022).

Under the education ministry, four plans – the School Sector Reform Plan 2009–2015, the ICT in Education Master Plan 2013–2017, the School Sector Development Plan 2016–2023 and the School Education Sector Plan 2022/23–2031/32 – proposed ICT-related interventions. The 2016–2023 plan focused on ICT facilities in model schools (ADB, 2022). Reviewing the situation, the 2022/23–2031/32 plan reported that, among 28,000 community schools, 61% had electricity, 42% had computer facilities and 22% had internet connection but, critically, 'very few schools use them for teaching and learning' (Center for Education and Human Resource Development, 2022; Nepal Ministry of Education, 2022).

The Ministry of Education, Science and Technology provided funds for one teacher to be trained from each school where an ICT laboratory had been set up. Schools had to find a training institute, but received no guidance on the content of the training required (ADB, 2017). Opportunities for teacher education in ICT are extremely limited (Rana and Rana, 2020). A study estimated that only 12% of public schools used ICT in teaching and learning in 2019/20, and just 1% of public school teachers reported being able to integrate it in their practice (Rubin, 2021).

Prior to the COVID-19 pandemic, the Curriculum Development Centre developed digital resources for grade 6 to 8 mathematics, science and English. These and other resources were uploaded in 2020 to a new learning platform, Sikai Chautari (Bhatta and Gyawali, 2021; Centre for Education and Human Resources Development, 2023). But the resources were not easily accessible. A survey of 7,500 households during the pandemic found that 29% of children were offered distance learning opportunities but only 12% used them (UNICEF, 2020). Less than 5% of students used a dedicated YouTube channel and Sikai Chautari during school closures (Center for Education and Human Resource Development, 2022). In higher education, the potential of blended courses provided by the new Nepal Open University remains untapped (Dhakal and Bhandari, 2019; Khanal et al., 2021).

Open Learning Exchange Nepal, a non-governmental organization, has played an active role in supporting government efforts over the past 15 years (Karki, 2019). It has mainly focused on infrastructure. It distributed laptops (like those offered by the One Laptop Per Child programme), school networks (consisting of a server and a Wi-Fi router) and solar power installations. E-Paath is a collection of curriculum-based, subject-specific digital interactive learning activities in Nepali and English for grades 1 to 8, as well as in Nepali Sign Language for grades 1 to 6. E-Pustakalaya is an e-library that has made more than 12,800 textbooks and video materials available for free (OLE Nepal, 2023). Some 1,200 schools benefited from these digital resources through offline servers during the pandemic (Joshi et al., 2022).

BOX 1.6:

Rwanda

Rwanda started its multiyear national information and communications infrastructure plans in the late 1990s (Rwanda Government, 2015; World Bank, 2022). They have progressively helped digitize public services, including for paying taxes and consulting judicial proceedings and health data (Davidson et al., 2019; Rwanda Ministry of ICT and Innovation, 2019). The education system has also embraced digital transformation, with key plans drafted in the mid-2010s: the SMART Rwanda 2020 Master Plan and the 2016 ICT in Education Policy (Rwanda Ministry of Education, 2016; Wallet and Kimenyi, 2019); the latter is currently under review (Buningwire, 2022).

Rwanda started implementing the One Laptop Per Child programme in 2008 in selected primary schools; it is estimated that 275,000 laptops had been distributed by 2020 (IGIHE, 2020). However, these laptops were no longer useful, as a contract to update digital learning materials on them was incompatible with the competence-based curriculum that had come into effect in the meantime (Rwanda Office of the Auditor General, 2020). A plan to replace some of the more expensive XO computers of the One Laptop Per Child programme with locally produced devices ran into problems: ICT company Positivo BGH was commissioned in 2014 to provide 150,000 computers annually but the government reduced the target to 40,000 units in 2017 due to lack of funding. The agreement was not renewed in 2020 (Iliza, 2022). The government aims to provide every teacher with a laptop; one in eight teachers had been reached by 2021 (Ndayambaje, 2023).

Several projects have focused on improving school computer facilities. The Smart Classroom programme was launched in 2016. The Rwanda Education Board specified there should be sufficient space for 50 computers and a smart screen projector for video conferencing in each smart classroom, at a cost of about USD 45,000 each (Rwanda Ministry of Education, 2016; Sabiiti, 2019). Despite the high cost, and a massive conventional classroom construction effort taking place in parallel, significant progress was made. In 2020/21, 10% of primary and 45% of secondary schools had smart classroom settings (Rwanda Ministry of Education, 2022); the target for secondary was 88% by 2024 (Nsanzimana, 2022). Progress in rural areas may be impeded by the fact that 45% of schools in rural areas are not connected to the electricity grid (Giga, 2021).

Rwanda is one of the few African countries to provide wide 4G coverage. In total, 32% of primary schools, 53% of secondary schools, 58% of technical and vocational institutes, and all universities are connected to the internet (Rwanda Ministry of Education, 2022). Some 46% of secondary school students can get online in dedicated computer laboratories (Mugiraneza, 2021). But among schools without internet, 22% lack access because of the cost (Giga, 2021).

The African Institute for Mathematical Sciences and the College of Education collaborated to develop curriculum-aligned content (World Bank, 2022), fulfilling the aim of the Education Sector Strategic Plan 2018/19 to 2023/24 to develop digital content and integrate ICT in teaching and learning (Rwanda Ministry of Education, 2018). Digital textbooks are available through the open-access platform Shupavu, managed by the Rwanda Education Board. Learners also used Shupavu for access to educational resources during the COVID-19 school closures via YouTube and radio and TV programmes (Pankin, 2021). Of the 17 education technology companies active in Rwanda, 10 began their operations in 2020, mostly focusing on content (Laterite, 2023). A review of technology use in science and mathematics teaching in Rwandan classrooms, from simulations to videos and smart classrooms, found that it had improved teacher practices and some student abilities, but that lack of teacher confidence, pedagogical skills and internet access were limiting progress (Adegoke et al., 2023).

A child online protection policy was approved in 2019 (Davidson et al., 2019; World Bank, 2019) and a personal data and privacy protection law adopted in 2021 (Rwanda Government, 2021). The use of personal mobile phones is banned in classrooms (Niyonzima, 2018). The National Cyber Security Authority guides parents and guardians on how to manage children's online access and has issued a recommendation on screen time (Rwanda National Cyber Security Authority, 2022).

BOX 1.7:

Samoa

Education in Samoa has been repeatedly disrupted by emergencies, as has often been the case in other Pacific Island states. In 2019, schools were closed for a long period due to a severe measles outbreak that forced Samoa to prepare for potential school closures, which occurred shortly thereafter with the COVID-19 pandemic (Iosefa, 2020).

Internet connectivity is not straightforward in Samoa. The installation of undersea fibre cables in 2018 and 2019 expanded internet use in the country (Mayron, 2019). Deregulation initially brought costs down (Samoa Ministry of Commerce, Industry and Labour, 2022). But dissatisfaction with speed, reliability and affordability, including with the services connecting schools, led the government to buy back ownership of the cable (Pacific Island Times, 2022). Satellite-based internet has also been considered to overcome persistent Wi-Fi dead spots (Membrere, 2021), despite its higher cost (Sanerivi, 2022).

Just prior to the COVID-19 pandemic, only 40% of primary and 57% of secondary schools had access to a reliable internet connection (Samoa Ministry of Education, Sports and Culture, 2019a). Efforts to improve internet access for learning during the COVID-19 emergency had limited results. Mobile broadband was enhanced through agreements with the mobile service providers Digicel and Vodafone. With UNESCO support, Vodafone committed to providing free SIM cards to students for access to learning websites, along with a set amount of free data usage, and to developing and hosting a free student e-learning portal, aligned with school curricula (Fruean, 2020; UNESCO, 2020). However, the SIM cards did not reach all learners (UIS, 2020). After almost one year, less than one third of them had been distributed. Moreover, slow internet speed interfered with uploading learning material and accessibility of audios, videos and Moodle online (Samoa Ministry of Education, Sports and Culture, 2020).

School ICT infrastructure has been strengthened in Samoa in the past 20 years (Chan Mow, 2008). Primary schools are connected through the PrimaryNet project (Samoa Ministry of Education, Sports and Culture, 2019a). In 2016, the Asian Development Bank supported the SchoolNet project to also equip secondary schools with digital devices and train teachers and local communities in all districts (ADB, 2019). Results included a bank of over 28,000 digital science resources, stronger teacher capacity to use these resources for instruction, development of 120 model learning activities linking the resources with the curriculum and learning standards, and 38 school-based learning centres with access to the resources offline. While the original intention was to use open education resources, the rights to an existing international platform were bought instead to benefit from consistent user interface, design and terminology (Strigel, 2020).

Despite challenges, online distance and flexible blended learning have been embedded into education planning (Samoa Ministry of Education, Sports and Culture, 2019b). Moodle was identified as the most suitable learning platform across the education system, drawing on the experience of tertiary institutions (Samoa Ministry of Education, Sports and Culture, 2020; Samoa Observer, 2022). The National University of Samoa and the University of the South Pacific provided courses through this open-source learning platform to respond promptly to campus closures. During the COVID-19 pandemic, the University of the South Pacific made more than 250 face-to-face courses accessible via Moodle SMS. Its Centre for Flexible Learning provided technical support to both professionals and students (USP, 2020).

With only one third of Samoans estimated to use the internet on a regular basis, radio and television were identified as the main channels to reach students. Pre-recorded clips were broadcast via the national radio station for pre-primary and primary school students. Videos were made available via the national television channels for all learners. However, plans to rely on alternative television and radio channels were not implemented or were stopped because of lack of capacity (Samoa Ministry of Education, Sports and Culture, 2020). As 9 in 10 households own a cell phone compared with 1 in 10 owning a computer, online educational resources were also made available for free through mobile broadband on the ministry's website (Samoa Ministry of Education, Sports and Culture, 2020).

BOX 1.8:

Singapore

Singapore has one of the world's most digitally competitive economies (IMD, 2022), with a socioeconomic development model founded on innovation in education and training (Kwek et al., 2020; NCEE, 2021). Since 1997, it has launched four master plans on ICT in education, which laid the foundations for developing school ICT infrastructure, enhancing digital solutions, integrating ICT in curriculum and assessment, and raising technology awareness (Singapore Ministry of Education, 2022a). The ICT infrastructure was given a boost by the 2003 outbreak of severe acute respiratory syndrome, which forced education to move fully online (Watermeyer et al., 2022).

Introduced in 2017, the digital portal Student Learning Space (SLS) facilitates access to curriculum-aligned teaching and learning materials, administration of learning assessments, and monitoring of student progress (NCEE, 2021; Singapore Ministry of Education, 2022b). The 2019 Education Technology Plan promoted personalized and self-directed learning based on digital technology (Singapore Ministry of Education, 2022b). Adaptive learning systems facilitate personalization of learning in mathematics and English; in the latter case, an 'assistant' provides personalized feedback on writing. A dashboard feature in SLS helps teachers monitor student performance and plan lessons, while the SLS Community Gallery encourages teachers to share lessons with peers, including through the Singapore Learning Designers Community, which counts 20,000 teachers as members, encouraging exchange of ideas and troubleshooting (Singapore Ministry of Education, 2022d).

Just before the outbreak of COVID-19, more than two in five learners from lower-income households did not have a computer. Among those who had one, almost half shared it with other family members (Yeung, 2020). A study on information literacy showed that children and youth without internet access at home tended to be less proficient in selecting and synthesizing information (Majid et al., 2020). Some 12,500 devices were loaned out to ensure all students were connected during the school closure (Min, 2020). The COVID-19 pandemic led to the institutionalization of home-based learning (Watermeyer et al., 2022). Since 2021, lower and upper secondary school students have been able to choose to study remotely two days a month. The practice has also been piloted in selected primary schools (NCEE, 2021). As a result, all 144,000 secondary students were to be provided with a personal learning device to study from home on a regular basis (Kai, 2020; Singapore Ministry of Education, 2021a), bringing the target date to the end of 2021 instead of 2028 as originally planned (Singapore Ministry of Education, 2022d).

Primary students learn computational thinking and simple coding through the Code for Fun programme. Secondary students can expand computational thinking skills through the mathematics curriculum and develop an understanding of emerging technology, including artificial intelligence (Singapore Ministry of Education, 2020a, 2020b). The latest curriculum review gave more space to socioemotional competencies, taking into account the increased exposure to digital spaces. Starting in 2022, the time allocated to cyber wellness was doubled to four hours a week (Teng, 2020). In the character and citizenship education class, primary and secondary students learn how to identify mental health symptoms and distress caused by exposure to digital spaces, overuse of social media and access to inappropriate content. They are taught to assess coping mechanisms and support services, and are encouraged to promote a peer-support structure to better help each other (Singapore Ministry of Education, 2020b, 2021b). Students are directed to take responsibility for their online well-being and parents are advised to make screen time predictable, especially during home-based learning (Singapore Ministry of Education, 2018; 2021c).

In higher education, the campusX initiative of the Singapore University of Technology and Design experiments with sensor networks in classrooms to gather data from eye trackers and wearables to provide live feedback to teachers and students through games, robots and chatbots. In another experimental programme involving first-year students, video and voice analytics were used to analyse engagement, while virtual reality and data analytics were used to encourage and monitor engagement with peers attending the programme from China (Singapore Ministry of Education, 2022d).

BOX 1.9:

Uruguay

Uruguay began restructuring its public sector after a financial crisis in the early 2000s. Digital technology was identified as a key driver of national economic development. Education modernization was a core reform in the second half of the decade (Zucchetti et al., 2020). Plan Ceibal, the national digital education plan, was launched in 2006, with high-level political support for coupling technological innovation with social justice (Hinostroza et al., 2011; Larrouqué, 2017).

In 2007–09, Uruguay became the first country to implement the One Laptop Per Child programme nationwide and also connected all schools to the internet. Two thirds of 6- to 13-year-olds from the poorest households had a computer exclusively through the programme (Ceibal, 2022a; Plan Ceibal, 2017). Students have since progressively received better tablets and advanced digital devices (Plan Ceibal, 2017). Unlike most countries, Uruguay evaluated the impact of this investment in devices, which was found to not have improved learning in reading and mathematics (de Melo et al., 2017). Another study found that the programme increased neither education attainment nor the share of science and technology students in higher education (Yanguas, 2020).

In response to these findings, Plan Ceibal shifted its emphasis (Plan Ceibal, 2020; Severin, 2016) from inputs to pedagogy (Mateu et al., 2018). In 2010–12, it turned its attention to computer use, notably through its Crea platform and teacher support. In 2013–19, the focus shifted to transforming teaching practice through initiatives focusing on interdisciplinary projects and cross-cutting competencies, such as global citizenship. Since 2020, Plan Ceibal has further emphasized communication with teachers and coordination with the national education system while investing in infrastructure to support blended learning (Plan Ceibal, 2021). Software was made available through Crea to solve the problem of videoconferencing consuming one gigabyte per hour when mobile plans offered only three gigabytes per month; this was a key part of the response during the COVID-19 pandemic (Milder, 2022). The initiative Ceibal en casa, reached 85% of primary and 90% of secondary school students, with poorer students' internet data usage being free of charge (Ripani, 2022).

The Plan Ceibal infrastructure has also been used to address the shortage of qualified teachers in two subjects. First, Ceibal en Ingles was introduced in 2012 in response to the introduction of English as a compulsory primary school subject in 2008 (Canale, 2019). Blended remote teaching, whereby expert teachers collaborated, alternated with and mentored in-classroom teachers via videoconferencing and a learning platform, was the programme's core feature (Banegas, 2013). Practice was supported by digital tools, such as games, and standard resources, informed by feedback and improved by teacher training that focused on overcoming the diversity of language abilities in classrooms (Stanley, 2019). Participating students obtained similar results as children in the face-to-face programme (Banegas and Brovetto, 2020).

Second, in 2017, computational thinking was introduced in grades 4 to 6 (Fowler and Vegas, 2021), reaching some 50,000 students, mostly in urban areas (ANEP and Ceibal, 2022). The programme is provided by remote instructors and facilitated by in-class teachers (Fowler and Vegas, 2021; Zucchetti et al., 2020). It was also piloted through extracurricular projects in secondary education. But results from the 2018 International Computer and Information Literacy Study showed that grade 8 students performed below participating countries' average (Fraillon et al., 2019). While 56% of students from the richest quintile of the population could perform simple ICT-related activities, only 11% from the poorest quintile could do so (Ceibal and INEEd, 2022), the highest gap among participating countries.

Originally placed outside government structures (Larrouqué, 2013), Plan Ceibal was relocated under the Presidency in 2010 and ultimately under the Ministry of Education and Culture following the 2020 Law of Urgent Consideration. This institutional change is seen as a long-overdue rationalization (Uruguay Parliament, 2020), although some believe it increases exposure to private sector influence (Bordoli and Conte, 2020; Education International, 2021), a recurring theme in technology in education debates. It was rebranded as Ceibal in 2022. Fundación Ceibal, established in 2014, conducts research to guide Ceibal but also to influence the region, through the Alliance for the Digitalization of Education in Latin America (ADELA, 2022; Ripani, 2022).

Ceibal has used platforms not to reproduce traditional modes of education but to innovate in the curriculum (Reich and Ito, 2017; Rivas, 2023; Ruiz-Calleja et al., 2018). Analysis of the 2020 Aristas national assessment found that, after controlling for socioeconomic status, the use of Ceibal platforms, such as Crea, was associated with better learning outcomes (INEEd, 2021). It has been notable for its emphasis on serving the most marginalized first. However, it has not resolved education challenges in the country. The upper secondary completion rate increased from 35% in 2000 to just 42% in 2020, compared with 63% in Latin America and the Caribbean and 88% in other high-income countries. Only 21% of the poorest quintile of youth, and as little as 13% among the poorest boys, finish upper secondary school.

GUIDE TO THE REPORT

The **thematic part** of the report is split into three sections. Chapters 2-6 identify major education challenges, asking whether and how technology can help overcome them.

Chapter 2 focuses on equitable and inclusive access to education for disadvantaged groups – populations living in remote areas, affected by displacement or emergency, with a disability or constrained by time – through technology, including radio, television, mobile phones and online learning. The COVID-19 pandemic was a natural experiment that tested the capacity of distance education, especially among the disadvantaged populations for whom technology is meant to provide a solution.

Chapter 3 looks at equitable and inclusive access to content and resources – and the question of how knowledge can reach more learners in appealing and cheaper formats. The open education movement has emerged in response to the cost of content and commercialization of previously free content and platforms. Resources can be remixed, redistributed, repurposed, translated and localized. Yet despite the advantages of open resources, there are obstacles to large-scale adoption.

Chapter 4 examines how technology can improve quality in teaching and learning basic skills by offering two broad types of opportunities. First, it can improve instruction by addressing quality gaps, increasing available time and opportunities to practise, and personalizing instruction. Second, it can engage learners by varying how content is represented, stimulating interaction and prompting collaboration. However, technology can also be a source of challenges in classrooms.

Chapter 5 focuses on how technology can improve quality in delivering digital skills, which form part of a new set of basic skills, at least in richer countries: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. It is a major challenge for education systems to manage new and continuously evolving objectives related to technology, especially when many learners acquire these skills outside school settings.

Chapter 6 reviews technology's contribution to making education management more efficient and effective. Education systems continually require more data, which technology can help handle. Yet, education management information systems struggle with their capacity to integrate and analyse data, preventing their use for better education management. Computer-based assessments and computer adaptive testing also provide new opportunities, which are still not fully exploited.

After the first section has explored the potential of education technology to address major education challenges, Chapters 7-9 ask what conditions will ensure that this potential is fulfilled.

Chapter 7 asks how education systems can ensure that all learners have access to technology resources. It reviews access to electricity, hardware, software and the internet. It also explores the types of evidence that underpin government decisions on where to invest and the extent to which procurement decisions take economic, social and environmental sustainability into account.

Chapter 8 addresses how education systems can protect learners from the adverse consequences of technology use. Learners face risks related to content, contact and conduct, which spill over to education. Legislation and policies are being developed to promote standards, regulation and legal protection for privacy, security and safety, which is challenging in a context where the governance of education technology is fragmented.

Chapter 9 deals with the question of how education systems can support all teachers in using and dealing with technology effectively in their practice. Teachers face major and increasing demands to engage with technology in education and develop related competencies. Barriers to teachers' technology use relate to their access to technology, their beliefs about pedagogy and technology, and the support they receive from schools and education systems. At the same time, technology can be used to transform teacher training and teachers' opportunities to interact with peers.

Finally, **Chapter 10** addresses a subject that merits further exploration: Rather than only looking at the impact of technology on education, as the bulk of the report does, it looks at the impact of education on technology. Education is the foundation of technological development. As the science, technology, engineering and mathematics (STEM) umbrella term suggests, education systems play a major role in the transfer, absorption and development of technology in every country. The chapter reviews selected issues, such as the inclusion of technology as a subject in curricula, policies to promote STEM education and the evolving role of higher education as a pillar of national technological development.

The **monitoring part** of the report consists of **Chapters 11-22**. A short introductory chapter reviews recent developments in SDG 4 progress monitoring, including the national SDG 4 benchmarking process. The next 10 chapters provide updates on progress towards each of the SDG 4 targets, in a few cases reflecting on the interrelationship between education and technology. For example, Chapter 19 considers the application of construction, energy and transport technology in education. Each chapter pays particular attention to a midterm review, even though COVID-19 has disrupted education development and critical data are yet to emerge that could help assess this medium-term impact. The last chapter is dedicated to the evolution of education financing.

RECOMMENDATIONS

Digital technology is becoming ubiquitous in people's daily lives. It is reaching the world's most distant corners. It is even creating new worlds, where the lines between the real and the imaginary are harder to discern. Education cannot remain unaffected, although there are calls to protect it from the negative influences of digital technology. However, this is a major challenge, as technology appears in multiple forms in education. It is an input, a means of delivery, a skill and a planning tool, and provides a social and cultural context, all of which raise particular questions and issues.

- It is an input: Ensuring the provision, operation and maintenance of technology infrastructure in education, such as electricity, computers and internet connectivity, at school or at home, requires considerable capital investment, recurrent expenditure and procurement skills. There is remarkably little reliable and consistent information on these costs.
- It is a means of delivery: Teaching and learning can benefit from education technology. But the fast pace of technological change and control of evidence by technology providers makes it difficult to know which technologies work best, in what context and under what conditions.
- It is a skill: Education systems are being called upon to support learners at various levels in acquiring digital and other technology skills, raising questions on content, the best sequence of relevant courses, appropriate education levels and provider modalities.
- It is a planning tool: Governments are encouraged to use technology tools to improve the efficiency and effectiveness of education system management, for instance in collecting information on student behaviour and outcomes.
- It provides a social and cultural context: Technology affects all spheres of life, expanding opportunities for connection and access to information but also posing risks to safety, privacy, equality and social cohesion, sometimes resulting in harm from which users need protection.

This report's basic premise is that technology should serve people and that technology in education should put learners and teachers at the centre. The report tries to avoid an overly technology-centred view or the claim that technology is neutral. It also offers a reminder that, as much technology was not designed for education, its suitability and value need to be proven in relation to a human-centred vision of education. Decision makers are faced with four challenging trade-offs:

> Technology in education should put learners and teachers at the centre

- The call for personalization and adaptation clashes with the need to maintain the social dimension of education. Those urging increased individualization may be missing the point of what education is about. Technology must be designed to respect the needs of a diverse population. An assistive teaching and learning tool for some may be a burden and distraction for others.
- There is a trade-off between inclusivity and exclusivity. Technology can potentially offer an education lifeline to many. However, for many more it raises a further barrier to equal education opportunities, with new forms of digital exclusion emerging. It is not sufficient to acknowledge that every technology has early adopters and late followers; action is also needed. The principle of equity in education and learning must be adhered to.
- The commercial sphere and the commons pull in different directions. The growing influence of the education technology industry on education policy at the national and international levels is a cause for concern. A vivid example is how the promise of open education resources and of the internet as a gateway to education content is frequently compromised. A better understanding and exposure of the interests underlying the use of digital technology in education and learning are needed so as to ensure that the common good is the priority of governments and educators.

- It is generally assumed that whatever efficiency advantage education technology offers in the short term will continue in the long term. Technology is presented as a sound, potentially labour-saving investment that may even be able to replace teachers. However, its full economic and environmental costs are usually underestimated and unsustainable. The bandwidth and capacity of many to use technology in education are limited. And it is time to reckon with education technology's cost in terms of environmental sustainability and question whether such technology truly strengthens education systems' resilience.

Even more recently, a clash between machines and humans has surfaced in the context of debates over generative artificial intelligence, whose implications for education are only gradually emerging. These fault lines leave the education sector torn between hope for digital technologies' potential and the undeniable risks and harms linked to their application. 'It is at the level of trade-offs that a more complex and democratic debate ought to take place' (Morozov, 2022).

Not all change constitutes progress. Just because something can be done does not mean it should be done. Change needs to happen on learners' terms to avoid repeating a scenario like the one observed during the COVID-19 pandemic, when an explosion of distance learning left hundreds of millions behind.

Technology created for other uses cannot necessarily be expected to be appropriate in all education settings for all learners. Nor can regulations drawn up outside the education sector necessarily be expected to cover all of education's needs. What this report calls for in this debate is a clear vision – as the world considers what is best for children's learning, especially in the case of the most marginalized.

The #TechOnOurTerms campaign calls for decisions about technology in education to prioritize learner needs after an assessment of whether its application would be appropriate, equitable, evidence-based and sustainable. It is essential to learn to live both with and without digital technology; to take what is needed from an abundance of information but ignore what is not necessary; to let technology support, but never supplant, the human connection on which teaching and learning are based.

Accordingly, the following four questions have been framed for and are directed primarily at governments, whose responsibility it is to protect and fulfil the right to education. However, the questions are also meant to be used as advocacy tools by all education actors committed to supporting progress towards SDG 4 to ensure that efforts to promote technology, including artificial intelligence, take into account the need to address the main education challenges and to respect human rights.

In considering the adoption of digital technology, education systems should always ensure that learners' best interests are placed at the centre of a framework based on rights. The focus should be on learning outcomes, not digital inputs. To help improve learning, digital technology should not replace but instead complement face-to-face interaction with teachers.

Is this use of education technology appropriate for the national and local contexts? Education technology should bring added value to support the strengthening of education systems and should align with learning objectives.

Governments should therefore:

- Reform curricula to target the teaching of the basic skills that are best suited to those digital tools that have been proven to improve learning and are underpinned by a clear theory of how children learn, without assuming either that pedagogy can remain the same or that digital technology is suitable to all types of learning.
- Design, monitor and evaluate education technology policies with the participation of teachers and learners to draw on their experiences and contexts and ensure that teachers and facilitators are sufficiently trained to understand how to use digital technology for learning, not simply how to use a specific piece of technology.
- Ensure that solutions are designed to fit their context, and that resources are available in multiple national languages, are culturally acceptable and age-appropriate, and have clear entry points for learners in given education settings.

Is this use of education technology leaving learners behind? Although technology use can enable access to the curriculum for some students and accelerate some learning outcomes, digitalization of education poses a risk of benefiting already privileged learners and further marginalizing others, thus increasing learning inequality.

Governments should therefore:

- Focus on how digital technology can support the most marginalized so that all can benefit from its potential, irrespective of background, identity or ability, and ensure that digital resources and devices comply with global accessibility standards.
- Set national targets on meaningful school internet connectivity, as part of the SDG 4 benchmarking process, and target investment accordingly to allow teachers and learners to benefit from a safe and productive online experience at an affordable cost, in line with the right to free education.
- Promote digital public goods in education, including free accessible e-pub formats, adaptable open education resources, learning platforms, and teacher support applications, all designed so as not to leave anyone behind.

Is this use of education technology scalable? There is an overwhelming array of technological products and platforms in education and decisions are often made about them without sufficient evidence of their benefits or their costs.

Governments should therefore:

- Establish bodies to evaluate education technology, engaging with all actors that can carry out independent and impartial research and setting clear evaluation standards and criteria, the aim being to achieve evidence-based policy decisions on education technology.
- Undertake pilot projects in contexts that accurately reflect the total cost of ownership and implementation, taking into account the potentially higher cost of technology for marginalized learners.
- Ensure transparency on public spending and terms of agreements with private companies to strengthen accountability; evaluate performance to learn from mistakes, including on matters ranging from maintenance to subscription costs, and promote interoperability standards to increase efficiency.

Does this use of technology support sustainable education futures? Digital technology should not be seen as a short-term project. It should be leveraged to yield benefits on a sustainable basis and not be led by narrow economic concerns and vested interests.

Governments should therefore:

- Establish a curriculum and assessment framework of digital competences that is broad, not attached to specific technology, takes account of what is learned outside school and enables teachers and learners to benefit from technology's potential in education, work and citizenship.
- Adopt and implement legislation, standards and agreed good practices to protect learners' and teachers' human rights, well-being and online safety, taking into account screen and connection time, privacy, and data protection; to ensure that data generated in the course of digital learning and beyond are analysed only as a public good; to prevent student and teacher surveillance; to guard against commercial advertising in educational settings; and to regulate the ethical use of artificial intelligence in education.
- Consider the short- and long-term implications of digital technology deployment in education for the physical environment, staying clear of solutions that are unsustainable in terms of their energy and material requirements.

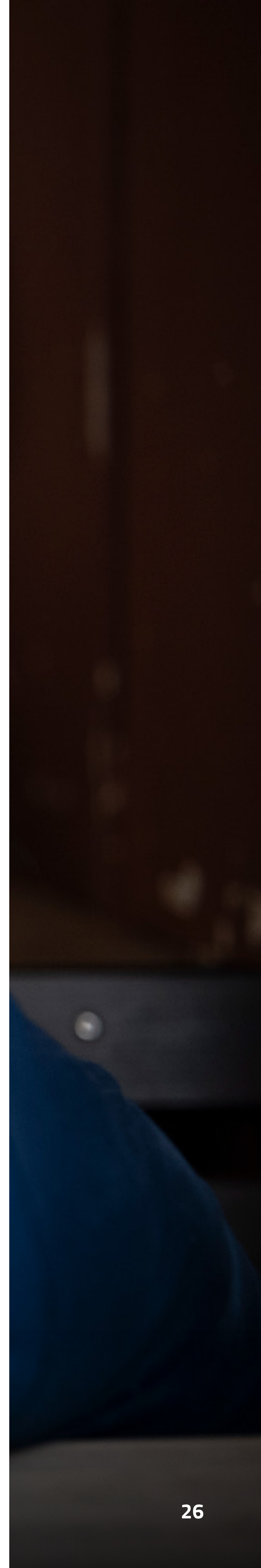
Holding a mobile phone, Samira, who has been visually disabled (blind) since birth is a high school student in Paraguay with an amazing dedication to learning. As a young child, she learned how to read and write braille. Her mother spent two years learning to do so as well in order to help Samira study and translate her coursework into Spanish.

Credit: UNICEF/UN0425712/Sokol*

CHAPTER

2

Equity and inclusion: Access for disadvantaged groups



KEY MESSAGES

Technology offers an education lifeline for millions but excludes many more.

Multiple types of technology bring education to hard-to-reach learners.

- Radio delivers education at low cost and has a strong track record. Interactive audio instruction is used in nearly 40 countries.
- Television can be effective when accompanied by in-person guidance. In Mexico, televised lessons combined with in-class support helped increase secondary school enrolment by 18% between 1970 and 2020.
- Online learning has increased participation for disadvantaged adults: 45% of students in India's National Open University are from rural areas and 18% from scheduled castes; 18% of the Open University's students in the United Kingdom have a disability.

Inclusive technology supports accessibility for students with disabilities.

- Assistive technology removes learning barriers, but challenges persist. Affordability is a major issue in poor countries. Teachers need appropriate training. In Saudi Arabia, most special education teachers had only beginner knowledge of assistive technology.
- Accessibility features being embedded in platforms and devices support inclusive, personalized learning for all students. In a study of visually impaired adults, 87% indicated that accessible technology devices were replacing traditional assistive tools. They are especially critical in low-resource settings, where assistive technology is harder to find.

Technology can support learning continuity in emergencies, but it is not integrated in plans.

- A mapping of 101 distance education projects in crisis contexts in 2020 showed that most education technology projects in such contexts were led by non-state actors, leading to sustainability concerns; only 12% were implemented by education ministries.

Technology supported learning during COVID-19, but millions were left out.

- During school closures, over 90% of education ministries carried out some form of distance learning response, with a potential reach of over 1 billion students globally. But at least half a billion students worldwide (31%) could not be reached by remote learning, most being among the poorest (72%) and those living in rural areas (70%).
- Despite 91% of countries using online learning platforms to deliver distance learning during school closures, these platforms could only reach a quarter of students globally.
- Less than half of countries have developed long-term strategies for increasing their resilience and the sustainability of interventions as part of their COVID-19 response plans; 31% have abandoned distance learning platforms developed during COVID-19, while others are repurposing platforms to reach marginalized learners. The digital platform set up in Ukraine during the pandemic was expanded once war began in 2022, allowing 85% of schools to complete the academic year.

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Access to learning remains a significant challenge for those traditionally at risk of exclusion from conventional schools and who need their specific conditions catered for. The Education 2030 Framework for Action states that 'distance learning, ICT training, access to appropriate technology and necessary infrastructure' can 'facilitate a learning environment at home and in conflict zones and remote areas, particularly for … marginalized groups' (UNESCO, 2015, sec. 57).

This chapter explores technology-supported education delivery from three main angles: it reflects on how radio, television, mobile devices and online learning have tackled the hardest to reach from a historical perspective; it discusses how technology has been harnessed to support the education of learners with disabilities; and it examines education disruptions caused by emergencies where learning continuity relied on technology to reach all learners – the COVID-19 pandemic being the prime example.

This chapter also seeks to understand whether and how technologies have helped increase participation rates for marginalized groups, while at the same time drawing attention to the fact that the application of technology during COVID disproportionately excluded those very same groups. Technology interventions need to be designed in ways that do not compromise the original objective of serving the most disadvantaged.

> Technology interventions need to be designed in ways that do not compromise the objective of serving the most disadvantaged

MULTIPLE TECHNOLOGIES BRING EDUCATION TO HARD-TO-REACH LEARNERS

Technology has historically made education available to learners facing obstacles in accessing school, good instructional content and well-trained teachers due to distant location, resource constraints and functional difficulties. Study by correspondence, for example, was an early form of distance learning used in the United States in the 19th century to educate women and others restricted from accessing formal education (Larreamendy-Joerns and Leinhardt, 2006). In the mid-20th century, correspondence education was used to educate children with long-term illnesses and former prisoners in France (Marquet and Xiao, 2008), and to deliver higher education in China (Li and Chen, 2019). Print remains a crucial distance learning medium (Mohn et al., 2022a), even as more interactive, immediate and large-scale modalities, based on radio, television and the internet, have been adopted (Sleator, 2010). For all these technologies, the key concern is how to appropriately match technology with pedagogy.

RADIO DELIVERS EDUCATION AT A LOW COST AND HAS A STRONG TRACK RECORD

Radio can be a cost-effective and sustainable education technology. Considering that any school can be equipped with radios, there are relatively low entry barriers, although access remains limited at the household level. Effective radio instruction programmes tend to be highly learner-centred, interactive and local, relying on an enabling policy environment that supports sustainability, allows decentralized broadcasting and signals government commitment (Damani and Mitchell, 2020; UNESCO, 2021c).

While traditional radio broadcasts are limited to one-way delivery and require synchronous participation, increasingly interactive approaches expect learners to engage with and respond to radio lessons through questions and exercises. Interactive instruction tends to follow the national curriculum, combines audio recordings and print materials, focuses on the active participation of children, and makes use of an adult teacher to facilitate learning. In most cases, radio remains the most cost-effective option and reaches a large number of learners (Damani and Mitchell, 2020; UNESCO, 2021c).

> There is consistent and extensive evidence that interactive radio-based instruction has helped reduce education gaps between rural and urban populations, girls and boys

Radio has a proven track record for delivering education to underserved rural learners across the globe. There is consistent and extensive evidence that interactive radio-based instruction has helped reduce education gaps between rural and urban populations, girls and boys (UNICEF, 2021a), nomadic and settled communities, and other disadvantaged children and their more privileged peers, both in terms of access to education and quality of learning (Damani and Mitchell, 2020; UNESCO, 2021c), especially in sub-Saharan Africa (**Box 2.1**). Since the 1980s, studies in at least 25 countries have documented statistically significant, consistent improvements in student achievement that is positively correlated with exposure to interactive radio instruction (Burns, 2021).

The first formal experiment with interactive radio instruction, where learners 'actively responded' to broadcasts, was carried out in Nicaragua in the 1970s for children who were unable to complete their formal schooling due to their agricultural livelihood. Participating children quickly matched and even exceeded the mathematics achievement of nearby formal school students, despite the fact that many were not even fluent in Spanish (UNESCO, 2021c). A more recent good example of interactive radio instruction for marginalised learners can be found in Cabo Verde, which has relied on educational radio to reach remote learners for decades. Evaluations have shown that children who had access to the interactive radio programme Projeto PALOP tested better in Portuguese and math compared to children who did not (Burns et al., 2019).

Interactive audio instruction is implemented in almost 40 countries globally (UNESCO, 2021c). The distribution of cassettes, CDs, MP3 files and mobile phones has allowed rewinding, replaying and recording content, countering any

BOX 2.1:

Alternative education systems in sub-Saharan Africa often use radio

Many countries in sub-Saharan Africa use interactive radio instruction as part of their alternative and distance education systems. Radio remains the most cost-effective means of reaching large numbers of out-of-school children (UNESCO, 2021c).

In northern Nigeria, where millions of nomadic school-age children face barriers to access, the National Commission for Nomadic Education designed and developed a radio distance learning strategy in 1996 based on evidence that nomadic pastoralists tend to use radio sets, which they carried with them while herding (Abdulrahman, 2016; Olaniran, 2018). Despite implementation challenges such as limited funding and untrained teachers (Habib, 2019; UNESCO, 2019), the Commission continues to improve the programme by updating the curriculum (Adéyemí, 2021) and establishing an exclusive radio station for nomadic education, with broadcasts in four languages (Gombe, 2022; Habib, 2019).

The radio strategy was designed to complement other methods, including mobile schools equipped with audiovisual materials, and increase enrolment and participation rates (Olaniran, 2018). The quality of the programme's interactivity and delivery has increased over the years through the establishment of radio listening groups, the development of teaching and learning guides, and recordings of radio episodes (Hanemann, 2017; Ugochukwu and Ezeah, 2020). Evaluations have documented its effectiveness in reaching 77% of nomadic pastoralists in North West Nigeria (Anorue et al., 2015) and increasing literacy, numeracy and life skills (Nwokedi et al., 2022; Ugochukwu and Ezeah, 2020).

In Zambia, the government first piloted an interactive radio instruction programme in community learning centres for out-of-school children and orphans who had lost their parents to AIDS. In 2004, Learning at Taonga Market was launched, an interactive audio instruction programme noted as the first to use an MP3 player. Over the next 10 years, Learning at Taonga Market programmes were delivered to 3,000 community learning centres and 1.2 million students who consistently outperformed their peers in formal government schools (UNESCO, 2021c).

Interactive radio instruction programmes were also developed in 2009 for grades 1 to 6 in French and mathematics in the Democratic Republic of the Congo as part of the Projet d'Amélioration de la Qualité de l'Éducation (Project for the Improvement of the Quality of Education). They reached 3,000 schools, with 1.2 million students outperforming their peers in control schools in reading (UNESCO, 2021c).

problems with radio reception. In Bangladesh, primary school students improved their literacy and numeracy scores through audio lessons using interactive voice response delivered through mobile phones (Wang et al., 2023). In Guyana, lessons from the government's radio programme in mathematics are sometimes pre-recorded onto CDs or in MP3 format and delivered with accompanying audio players to classrooms (Guyana Ministry of Education, 2020).

The effectiveness of radio for teaching and learning ultimately depends on available resources, the policy environment, and specific educational needs and goals. In some local contexts, interactive audio and radio instruction has suffered from issues such as equipment quality, reception, curriculum, scheduling and broadcasting costs. Radio-based instruction is only cost-effective when large numbers of students are reached; it is less efficient when the target population is smaller, for instance with learners who speak a minority language. Sustainability can be supported through strong government commitment, continuous teacher professional development, the integration of programmes into existing curricula, and effective monitoring and evaluation (Damani and Mitchell, 2020; Grant et al., 2022; UNESCO, 2021c).

TELEVISION IS EFFECTIVE WHEN ACCOMPANIED BY IN-PERSON GUIDANCE

Television has been used for delivering distance learning since the 1950s, notably in Latin America (**Box 2.2**), to help address qualified teacher shortages in rural areas and high teacher absenteeism rates (Vincent-Lancrin et al., 2022; Zacharia, 2020b). Lessons are often used to complement face-to-face instruction, with long-term studies finding significant impact on enrolment and completion rates. Success has been partially attributed to community participation and ongoing teacher training (Watson and McIntyre, 2020), while the use of in-person tutors, printed guides and videos that prompt learners to answer questions has made interventions more interactive (Mohn et al., 2022b). However, evidence on cost-effectiveness is limited and viewership in rural households is believed to be lower than in urban households (Watson and McIntyre, 2020).

Several countries have introduced interactive televised lessons to reduce gaps in access and learning for students in rural areas (Navarro-Sola, 2021). In Ethiopia, the government's educational television programme targeted at rural regions received mixed reviews on its effectiveness due to a lack of interactivity and technical support for teachers, which the Ministry of Education has been working to address (Kim, 2015; Tadesse, 2020). Evidence from China (Bianchi et al., 2022) and Ghana (Johnston and Ksoll, 2022) suggests that, when complemented by in-person support, interactive elements and adequate teacher training, television-based models can reduce learning gaps between rural and urban populations.

However, not all interactive initiatives have succeeded. Côte d'Ivoire (Wolff et al., 2002) and El Salvador (Young et al., 2010) developed secondary education programmes based on television instruction with support from international agencies. They were later abandoned due to high costs per student, teacher resistance to centralized institutions and a lack of sustainability. Both programmes ended once external financing ceased (Wolff et al., 2002).

BOX 2.2:

Latin America's long-standing televised instruction models have helped increase access to education

The Mexican government launched the Telesecundaria programme in the late 1960s to serve lower secondary school students in rural or marginalized communities who did not have access to local schools (Craig et al., 2016; USAID, 2020). Each Telesecundaria delivers lessons through television broadcasts in a classroom setting, following the national curriculum and complemented with learning guides and in-classroom work and discussions (Navarro-Sola, 2021; Rodríguez et al., 2021). The programme, which forms the basis for education in 60% of state schools (Mexico Government, 2020), has significantly expanded from serving some 3% of the total student population in 1970 to 20% in 2000, a level which has remained constant since (**Figure 2.1**).

It has been estimated that the programme increased the average enrolment rate by 21% between 1968 and 2000 (Navarro-Sola, 2021). An additional telesecundaria per 1,000 adolescents led to an average increase of 0.2 years of education for both men and women (Fabregas, 2019). However, the programme has been widely perceived as an option of lower quality, as telesecundaria students have fared below those attending traditional schools in standardized tests, although studies have not accounted for a range of unobservable socioeconomic characteristics that are likely to affect student outcomes (Fabregas, 2019; Navarro-Sola, 2021).

Continued on next page

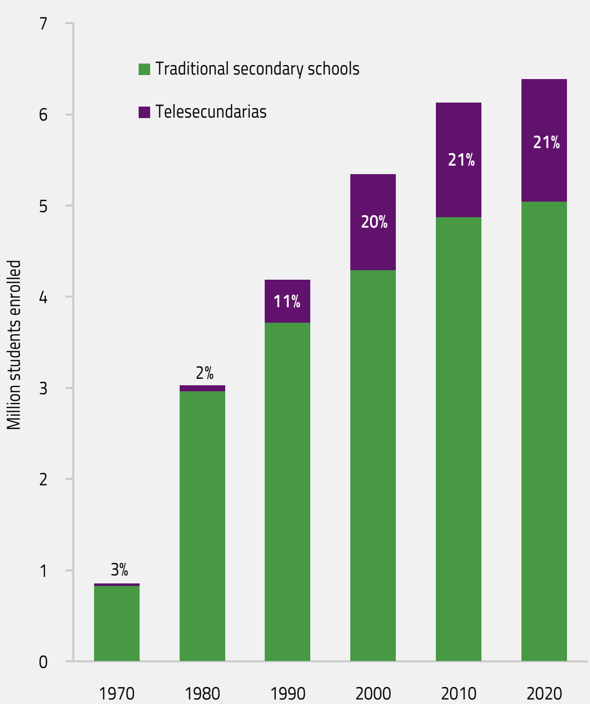
BOX 2.2 CONTINUED:

The programme's effectiveness has been attributed to the use of appropriate technology, strong involvement of local communities, domestic funding, extensive and continuous teacher training, and its blended environment, whereby televised lessons are combined with in-class support (Fabregas, 2019; Navarro-Sola, 2021; Watson and McIntyre, 2020; Wolff et al., 2002). During the COVID-19 pandemic, Mexico's Aprende en Casa (Learning at Home) programme expanded the traditional telesecundaria approach with updated features (Ripani and Zucchetti, 2020).

FIGURE 2.1:

Telesecundarias have helped increase secondary education enrolment in Mexico

Number of students enrolled in telesecundarias and traditional secondary schools, 1970–2020



Note: Traditional secondary schools include general and technical secondary education.

GEM StatLink: https://bit.ly/GEM2023_fig2_1

Sources: Mexico Secretariat of Public Education (2011, 2021); Rizo (2005).

Brazil has also been using television for educational purposes to help address the unequal distribution of educational opportunities (Filho, 2018). Launched in 1978, Telecurso was an initiative launched by two foundations associated with major television channels, one of which, TV Globo, broadcast the programmes. In 1995, a new methodology based on specific curriculum and learning materials, and continuous teacher training, monitoring and evaluation, was implemented in classrooms through partnerships with municipalities, state governments, and public and private institutions. Telecurso does not require enrolment and is freely available on television and the internet. An estimated 1.6 million students have completed primary and secondary education through the initiative (Roberto Marinho Foundation, 2023). Apart from students in remote areas, it also targets young adults who left primary or secondary school early. It provides condensed instruction through direct programmes, videotaped classroom sessions and textbooks, and involving teacher supervision and complementary written materials (Watson and McIntyre, 2020).

In the Brazilian state of Amazonas, the Amazonas State Secretariat of Education established the State On-site Technology-Mediated Instruction System in 2007, which uses satellite transmission and a communication service platform to provide secondary education on a large scale to isolated, remote communities through television. Lessons are broadcast in real time by trained teachers, with students supported by a professional, face-to-face tutor in classrooms. The programme expanded from 10,000 to over 30,000 secondary school students between 2007 and 2022. While initially broadcast on a closed television channel, the programme began broadcasting through three public channels to cover the entire state school network (Fundação Telefônica Vivo, 2022).

MOBILE LEARNING DEVICES CAN COMPLEMENT EDUCATION IN CERTAIN SETTINGS

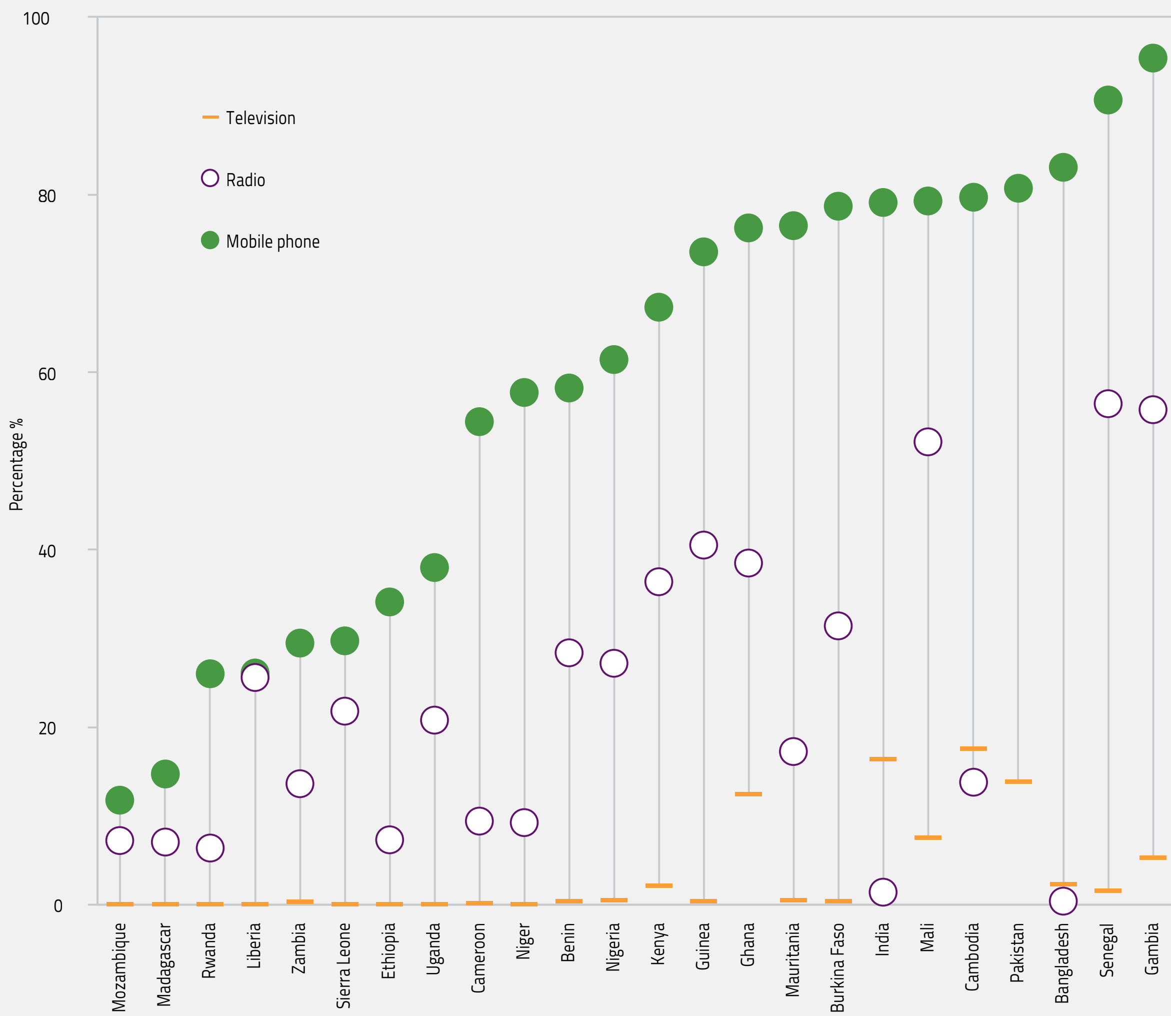
Given high levels of ownership even among the poor, the mobile phone is the device with the greatest reach that can be potentially applied to education. In 2018–21, among the poorest 20% of households in 24 low- and lower-middle-income countries, virtually none owned a television, one quarter owned a radio and two thirds owned a mobile phone (**Figure 2.2**). A distinction needs to be made between basic mobile phones that are not internet enabled, feature phones, and smartphones; studies on education impact have focused on the latter.

Mobile phones have been used for children in hard-to-reach areas and emergencies (Kan et al., 2022). In some instances, they can be an appropriate tool to connect disadvantaged children and youth to distance learning opportunities (Criollo-C et al., 2021; UNICEF,

FIGURE 2.2:

Two in three of the poorest households in low- and lower-middle-income countries own a mobile phone

Percentage of poorest 20% of households owning radios, televisions and mobile phones, 2018–21



GEM StatLink: https://bit.ly/GEM2023_fig2_2
Source: Demographic and Health Surveys StatCompiler.

2020b). Their use is usually focused on sharing educational materials; complementing in-person and remote channels; and fostering interactions between students, peers, caregivers and teachers (Jordan and Mitchell, 2020; Kan et al., 2022).

Due to high rates of ownership, low cost, flexibility, durability and portability, mobile learning devices were popular for providing access to education during the COVID pandemic. They facilitated the exchange of learning materials in low- and middle-income countries, as well as regular interaction between students, teachers and parents (Vincent-Lancrin et al., 2022). In Bhutan, 70% of students used social media applications available through phones to access lessons during the pandemic, surpassing radio, television and online education platforms (Bhutan Ministry of Education, 2021). In Indonesia, social media and communication channels were among the most widely used platforms for teaching, learning and support. More than 5 million teachers reportedly used WhatsApp groups for official information dissemination, from pre-primary to tertiary education. Many study and support groups were created among teachers, students and parents (UNHCR, 2021).

Mobile phones were also used to maintain individual support for families of children with disabilities during the pandemic. In South Africa, a national WhatsApp support line, using multiple languages, was established for those families in need. It invited parents to engage with trained facilitators to plan routines for home learning, supported learners with homework, and provided stimulating learning for preschool children (McAleavy et al., 2020).

Evidence is mixed on whether mobile applications designed to improve learning actually did so, as well as how. On the one hand, phone-based surveys have suggested a very low uptake of mobile applications: only 0.5% of students claimed to have used any during COVID in Burkina Faso (Nkengne et al., 2020) even though at least 79% of the poorest households and 94% of all households owned a mobile phone. By contrast, about 40% followed radio and television education programmes (Dang et al., 2021). On the other hand, mobile application and platform providers claim higher utilization rates. The mobile phone–based educational platform Shupavu291, which operates in Côte d'Ivoire, Ghana and Kenya, claims to have served some 5 million users (Jordan and Mitchell, 2020).

> Evidence is mixed on whether mobile applications designed to improve learning actually did so – and how

ONLINE LEARNING DELIVERS FLEXIBLE INSTRUCTION FOR HARD-TO-REACH LEARNERS

Prior to COVID, online learning had been used when face-to-face instruction was too costly or unfeasible (Burns, 2021). The considerable benefits included its flexibility and association with self-paced, self-directed and personalized learning. However, its efficacy relies on student access to devices and the internet, with more high-tech solutions like online courses not yet a practical option for many learners due to the cost and lack of access and digital skills. The biggest limitation of online learning is that two thirds of the world's children do not have an internet connection in their homes (UNICEF and ITU, 2020).

In the Republic of Korea, where there is universal internet access at home and a strong policy framework promoting digital technology, metropolitan and provincial offices of education have been operating online distance education programmes since 2012 for nearly 10,000 secondary school students who are failing to complete the curriculum due to natural disasters, illness, exclusion, relocation overseas, and work or childcare commitments (UNESCO, 2022). In Greenland (Denmark), where 40% of the population lives outside the five major towns and 54% do not progress beyond lower secondary level (Conyers, 2020), the government has introduced online distance learning, which allows students to complete their upper secondary education without having to relocate to a major town (Government of Greenland, 2022).

Sustainability and affordability concerns are raised when online learning platforms that target marginalized learners are operated by non-state actors. In Bangladesh, JAAGO Foundation's Digital Schools, which connects qualified and trained teachers in a central location to remote primary school classrooms through simple video conferencing software, has described high attendance rates and good learning outcomes for marginalized learners (Salam and Ahmed, 2015). However, concerns were reported about the project's sustainability, as it relies on corporate social responsibility funding and individual sponsors (UNESCO, 2021b).

Non-state actors have also used online learning to support the learning continuity of pregnant girls, young mothers and young brides, where early childbearing and marriage, social norms, and government policies keep them out of schools. Most successful approaches include study centres and in-person facilitation by a teacher or trained community facilitator (Naylor and Gorgen, 2020). In Afghanistan, as the Taliban regime has forbidden girls to attend secondary education, many continue learning in secret schools, of which a small number are online (Banerji et al., 2021; The New Arab, 2021). In Bangladesh, India and Pakistan, the GIRLS Inspire project uses open and distance learning to reach girls who have been prevented from attending school due to early marriage, cultural norms and distance. Evaluations have found that the project had a positive impact on access to economic opportunities and the ability to make health decisions, understand social rights and access resources (Commonwealth of Learning, 2021; Ferreira, 2017).

ONLINE LEARNING HAS INCREASED PARTICIPATION FOR DISADVANTAGED ADULTS

Adults have traditionally been the main target for online distance education (Kara et al., 2019), with learners often having competing work and family responsibilities (Waterhouse et al., 2022). According to the Programme for International Assessment of Adult Competencies, key barriers to participation in adult learning include: lack of time due to work commitments (28%), family responsibilities (15%), lack of financial resources (16%), and inconvenient times and places of training (12%) (OECD, 2020).

Roughly three quarters of countries have reported progress in recent years on improving the quality of adult learning, mainly through the use of online technology (UIL, 2022a). The flexibility of online learning allows learners to choose a time, rhythm and place compatible with their work and family responsibilities. Moreover, online learning is often cheaper than equivalent face-to-face provision (OECD, 2020) and has the potential to reach adults who missed the opportunities to acquire skills in childhood and youth. Adults with caring responsibilities, mostly women, tend to benefit from online study. In Australia, a study of adult women found that the choice to study online was largely determined by their family and caring responsibilities and the desire to improve employment opportunities (Stone and O'Shea, 2019).

In India, the Indira Gandhi National Open University, the world's largest university with over 3.3 million enrolled students, serves traditionally marginalized communities who would otherwise remain deprived of higher education. It uses a multi-instructional system that includes print and audiovisual materials, radio, television, web conferencing and instant messaging. In 2020, 45% of enrolled students were women, 12% scheduled tribes, 18% scheduled castes and 18% from other backward classes. In addition, 45% of enrolled students were from rural areas, up from 38% in 2016 (IGNOU, 2020).

The University of the South Pacific (USP) and the University of the West Indies, owned and operated by 12 and 16 countries and territories respectively, have relied on technology to deliver tertiary education since the 1970s (Bleeker, 2019; Hosman, 2019; Johnson et al., 2021). Gradually moving from print to online platforms, USP has opened up educational access to learners traditionally considered unreachable (Naidu and Roberts, 2018; Thonden, 2020). In 2021, over 30,000 students were enrolled in face-to-face (37%), blended (24%), online (22%) and print (17%) study modes (University of the South Pacific, 2021).

In the United Kingdom, the Open University (OU) was designed specifically to meet the needs of people excluded from higher education due to barriers in time, location and entry requirements. Gradually shifting from printed material to online delivery, it remains the country's largest higher education provider (Pulker and Papi, 2021), delivering education mainly through print, audiovisual and online formats (Lindeiner-Stráský et al., 2020). Since its launch in 1969, it has reached over 2.2 million people, including full-time or part-time workers (70%) and people living in the most deprived areas of the country (26%) (Open University, 2022b). The university is also the largest provider of higher education for people with disabilities in Europe (Open University, 2022a): The percentage of students with a disability increased from 3% in 2011 to 18% in 2020.

Online and distance learning can also facilitate access to education for prisoners (Msoroka, 2019). In Nigeria, a collaboration between the National Open University of Nigeria and the Nigerian Prison Service offers online distance learning programmes for prisoners, but lacks the required funding to acquire e-learning facilities and resources (Adeyeye, 2019).

Despite these advances, online distance education students continue to face difficulties in balancing work and/or family roles with studying (Kara et al., 2019). Time, or lack thereof, appears to be the predominant source of conflict between roles (Waterhouse et al., 2022). A survey of current OU students and graduates found that role conflict was significantly associated with student satisfaction, while student determination to continue with studies resulted in difficult trade-offs. The trade-off of reducing working hours to devote more time to studying, for example, can have major economic consequences (Samra et al., 2021). These challenges have so far not been addressed effectively by massive open online courses, which had originally presented much promise in the 2000s (**Chapter 3**).

INCLUSIVE TECHNOLOGIES SUPPORT ACCESSIBILITY FOR STUDENTS WITH DISABILITIES

People with disabilities face some of the most significant barriers in accessing quality education. Technology provides multiple means of representing information, expressing knowledge and engaging in learning, which can support people with disabilities, providing fair and optimized access to the curriculum, while developing their

> “The flexibility of online learning allows learners to choose a time, rhythm and place compatible with their work and family responsibilities”

independence, agency and social inclusion (UNESCO, 2020; UNICEF, 2021b). It can facilitate personalized learning (United Nations, 2022), communication and interaction with their peers and teachers, and stronger social skills and networks (Dinechin and Boutard, 2021; World Bank, 2022).

Societies should aim to ensure that products, environments, programmes and services follow universal design principles 'to be usable by all people to the greatest extent possible, without the need for adaptation or specialized design' (United Nations, 2006, p. 4). This concept was extended to curriculum design: the Universal Design for Learning is 'a set of principles for curriculum development that give all individuals equal opportunities to learn' (Association for Higher Education, Access and Disability, 2017). A mix of accessible technology and assistive devices in a classroom founded on the principles of Universal Design for Learning enhances all students' potential. Technology provides personalized options to diversify the means of engagement, representation and expression. For instance, captioned videos and touchscreen technologies, originally intended to assist autistic students, are popular with most teachers and students. Students without visual disabilities tend to prefer e-books with audio input. While Universal Design for Learning does not depend on access to technology, appropriate and sustainable educational technology can greatly support its application in education. However, in the absence of good guidance on how to operationalize it, many countries continue to rely on assistive devices where available (Banes et al., 2020; World Bank, 2022).

> People with disabilities face some of the most significant barriers in accessing quality education

A variety of technologies are available for people with disabilities who face various barriers to education and learning (Lynch et al., 2022) (**Table 2.1**). Assistive and accessible technologies should be individualized to students' specific learning needs, as not all technologies are applicable for students with the same type of disability. Technology provision without appropriate teacher training can result in ineffective use or inappropriate selection of technologies for specific children (Banes et al., 2020).

A global survey of professionals engaged with the use education of technology for disability-inclusive education found that computers, text-to-speech technologies, Braille writing equipment, and augmentative and alternative communication technologies were most commonly used. Their purpose was to help students access textbook and curriculum-related material (26%), improve communication skills (25%), improve social skills (15%), increase knowledge of sign language (10%), improve daily life skills (9%), aid mobility (4%), and help with seating and posture (4%) (World Bank, 2022).

ASSISTIVE TECHNOLOGIES REMOVE LEARNING BARRIERS BUT CHALLENGES PERSIST

While education technology supports the teaching and learning of all students, assistive technologies are those that have been modified in some way to 'assist' individuals with disabilities to perform functions that they might otherwise find difficult or impossible (Burns, 2021). They are used to 'overcome the social, infrastructural and other barriers to [learning] independence, full participation in society and carrying out [learning] activities safely and easily' (Hersh and Johnson, 2008, p. 196). They can include input technology (e.g. adapted keyboards), output technology (e.g. screen readers), alternative and augmentative communication (replacing speech) and assistive listening systems (improving sound clarity). They range from low- to high-tech devices (Lynch et al., 2022).

Assistive technologies support the social inclusion of people with disabilities as well as provide learners and educators with tools to create more inclusive learning environments by removing in- and out-of-classroom barriers to learning (Migeon et al., 2021; UNICEF, 2021b). As they are designed for specific types of impairment, they support personalized, targeted instruction that can accommodate students' sometimes conflicting needs (Hersh and Mouroutsou, 2019) and lessen learner dependence on teachers (Burns, 2021).

A study of secondary school students with disabilities in the United States found that the group reportedly using assistive technology to the greatest extent were deaf-blind students (74%) and students with visual impairments (71%). Students with disabilities who were least likely to report using assistive technology were students with speech and language impairments (15%), students with learning difficulties (19%), and students with emotional/behaviour disorders (19%) (Bouck and Long, 2021).

Assistive technologies have a positive impact on the education of learners with disabilities, including improved graduation rates, self-esteem, independence, performance and optimism (Bouck and Long, 2021; UNESCO, 2020). A systematic review of assistive technologies and devices used by students with disabilities in higher education in 10 countries, including Israel, Kenya and Türkiye, reported

TABLE 2.1:
Information and communication technologies supporting access to education, by type of impairment and challenge

Impairment	Challenge			
	Access educational tools and teaching materials	Access written and oral materials	Communication with teachers and students	Written and oral expression
Visual	Interactive screen/projector, standard projector, computer, touchscreen tablet, Braille touchscreen tablet, smartphone, magnification software, screen reader, DAISY reader and audiobooks in DAISY format	Braille transcription software, screen magnifier, optical character recognition reading machine, handheld scanner, Braille display	Computer, touchscreen tablet, Braille touchscreen tablet, smartphone, Braille notepad	Conventional keyboard, magnification software, screen reader
Hearing	Radio transmitters/receivers, speakers/loudspeakers, smartphone, sound amplifier	Speakers/loudspeakers	Radio transmitters/ receivers, sound amplifier, sign language learning material	Text-to-speech software
Communication	Computer	Text-to-speech software, screen reader	Text-to-speech software, screen reader, alternative communications software and applications	Text-to-speech software, screen reader, alternative communications software and applications
Learning	Computer, touchscreen tablet	Dyslexic fonts, magnification, large type, contrast	Speech-generating devices	Text-to-speech, alternative communications boards
Motor	Adapted trackball mouse/joysticks, eye-gaze assistive technology			Computer, alternative keyboards

Sources: AI Children Reading (2022); Banes et al. (2020); Burns (2021); Dinechin and Boutard (2021); Hsieh et al. (2022).

> “Insufficient training and external support limit the extent to which learners with disabilities can engage with assistive technology in higher education”

significant positive impacts in academic engagement, psychological well-being and social participation. However, insufficient training and external support limit the extent to which learners with disabilities can engage with assistive technology in higher education (McNicholl et al., 2021).

Students with motor disabilities receive support through adapted trackballs, adapted computer mice and joysticks, switches, and alternate keyboards (Burns, 2021). In Taiwan Province of China, the use of eye-gaze assistive technology for children aged 3 to 6 with severe motor and communication difficulties increased their participation in computer activities at home and educational environments, attaining goals related to play, communication and school learning (Hsieh et al., 2022).

For students who are blind or have visual impairments, assistive technology provides cognitive benefits and improves academic performance and learning capacity (Senjam et al., 2020). In the United Republic of Tanzania, for instance, it increased students’ self-confidence and independence (52%), enhanced interactions with lecturers and learning content (33%), and increased access to electronic materials (Kisanga and Kisanga, 2022). In Kenya, tablets with screen reader and keyboards enabled blind students to autonomously access university material and significantly improved their access to higher education (Dinechin and Boutard, 2021). Although learning to read and write in Braille is needed to understand spelling and how text is formatted, text-to-voice software and audiobooks are helpful (Banes et al., 2020).

Students who are deaf or have hearing impairments can also benefit from technology-based approaches. In the United States, deaf preschoolers who use sign language developed significant early reading skills when using shared interactive storybooks with sign language videos (Andrews et al., 2017). While subtitles and closed captions for videos can greatly help these students access auditory content, they do not replace the need to learn and communicate directly using sign languages with peers and trained professionals who are fluent in sign language (Banes et al., 2020).

Although not specifically targeted to students with learning difficulties, assistive technologies have been reported to offer benefits such as independence; selecting a preferred pace; improved quality of academic work; and greater engagement with cooperative, in-class activities (Bouck and Long, 2021). In Sweden, about half of learners with reading and writing difficulties reported that assistive technology supported reading and general schoolwork (Svensson et al., 2021).

Communication applications, speech synthesizers, augmentative and alternative communication software, sign language resources and hearing aid microphones have been used to support students with autism spectrum disorder (Hersh, 2020) who may face challenges in communicating through verbal speech (Banes et al., 2020; Lynch et al., 2022). In China, special educators reported that a tablet-compatible augmentative and alternative communication application increased the engagement of children with high-functioning autism (Hu and Han, 2019).

Assistive devices have helped students with intellectual disabilities enhance their independence and education (Boot et al., 2018). A global, systematic review for children with Down syndrome found that assistive technology can help the development of numeracy, speech, language, memory and social skills (Shahid et al., 2022).

The availability of assistive technology varies greatly both between and within countries. A study in Bangladesh, India and Nepal found that lack of accessibility, eligibility, reachability and affordability prevented access to assistive technology (Karki et al., 2021). In Australia, assistive technologies are available for English speakers but not in Aboriginal languages (Hersh and Mouroutsou, 2019). In Malawi, only 6% of the 57% of persons with disabilities who needed assistive technology were able to receive it (Eide and Munthali, 2018).

The more specialized the device, the greater the need for specialized training for teachers to use it effectively in the learning environment (Lynch et al., 2022). But teachers often lack specialized training (National Centre for Learning Disabilities, 2020). In Saudi Arabia, 54% of special education needs teachers had only basic knowledge of using assistive technologies, while 28% received no training in implementing such technologies, and 10% had no knowledge at all on using them (Aldehami, 2022).

Stigma and discrimination can also prevent the use of assistive technology. Although these devices are designed to increase human function and learning, they can make disabilities more visible and reinforce negative attitudes. Stigma can be reduced by using designs that are small, attractive and similar to general-purpose devices, which do not match the stereotypes of the appearance of assistive technology. A study of European students revealed that aesthetics greatly influences how assistive technologies and their users are perceived, while user adaptation was important for assistive technology adoption or abandonment (Santos et al., 2022).

Accessibility features are being embedded in platforms and devices

Until recently, people with disabilities relied exclusively on specialized devices to gain access to education. However, an increasing number of platforms and devices, including smartphones, computers and tablets, have been embedding accessibility and personalization features, such as built-in screen readers, voice control, immersive readers, word prediction and text-to-speech/speech-to-text tools (Dinechin and Boutard, 2021).

Accessible technologies have advantages over assistive technology, including easier availability, reduced costs, device familiarity and reduced stigma; they often allow learners with disabilities to use the same technologies as other students (Hersh, 2020). These technologies greatly support inclusive learning for all students, allowing assistive technology to play a complementary role. According to a study of visually impaired adults, 87% indicated that accessible technology devices, including smartphones and tablets, were replacing traditional assistive tools most or all of the time, stating that it was important for them to use devices that are widely adopted by the general public and address a range of user abilities and needs. Traditional devices were still preferred for certain tasks, such as those requiring extensive typing (Martiniello et al., 2022).

The use of accessible technology has been especially critical in low resource settings, which face significant challenges in providing assistive technology. In Kenya, a study on the impact of tablets found that they not only provided access to higher education for students with visual impairment comparable to that of their fully sighted peers, they also provided students with the opportunity to create a community of practice and participate in everyday life (Foley and Masingila, 2015). Another Kenyan study found that mobile phones helped 36% of people with visual impairment to access education, a figure that rose to 71% for those owning a smartphone, as it gave them access to assistive technologies essential for studying, such as screen readers (Aranda-Jan and Boutard, 2019).

TECHNOLOGY SUPPORTS LEARNING CONTINUITY AND SYSTEM RESILIENCE IN EMERGENCIES

In emergency contexts, technology can support distance learning and increase the resilience of education systems (Tauson and Stannard, 2018). In protracted displacement settings, technology is being deployed in similar ways to those education systems that are not in a state of emergency. For instance, the UN Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) began a full-scale digital transformation process in 2021, which also extended to its education programme, covering over half a million Palestine refugee students. UNRWA maintains a YouTube channel and a Digital Learning Platform from which more than 7,000 self-learning materials have been downloaded 6 million times. The materials are complemented by interactive digital teaching and learning materials. As part of the Agency's ICT for Education Strategy, the learning platform will be integrated with the education management information system, creating a fully fledged interactive learning management system (UNRWA, 2022).

In emergency remote learning settings, solutions largely rely on the current skills, knowledge and resources available to students and teachers (Crompton et al., 2021). The scalability, speed, mobility and portability of technology interventions can address disruptions affecting refugee education, such as distance, lack of resources, language barriers and exclusion from formal learning opportunities (Ashlee et al., 2020). Mobile learning technology is particularly well suited for displacement settings (Alencar, 2020; Ashlee et al., 2020). About 4 in 10 refugee households have access to mobile phones (UNESCO, 2019). A mapping of 101 distance education projects in emergency and emergency-prone contexts in 2020, prior to the outbreak of COVID, showed that 70% were using low-tech interventions (e.g. radio, TV and basic mobile phones), 62% high-tech interventions (e.g. tablets and smartphones) and 33% paper-based interventions (INEE, 2020).

> “In emergency remote learning settings, solutions largely rely on the current skills, knowledge and resources available to students and teachers”

Courses delivered via online and blended learning models have increased refugees' access to higher education. Kiron Open Higher Education is provided to refugees free of charge (Martin and Stulgaitis, 2022; UNESCO, 2021d). It is estimated that 14,000 learners have enrolled in 73,000 courses, of which over 21,000 have been completed (UIL, 2021).

Some applications and technology-assisted learning initiatives support language learning; not being able to speak the host country language is one of the main barriers which prevent forcibly displaced people from participating in host countries' formal education systems. UNICEF's Akelius Digital Language Learning Course uses mobile phones, tablets and computers to support language learning among refugees, migrants and linguistic minorities through a blended learning approach. The course was first introduced in Greece in 2017 and, as of 2022, had been implemented in 10 countries, including Bosnia and Herzegovina, Italy, Lebanon, Mauritania, and Serbia (Dreesen et al., 2021; UNICEF, 2022b). Evidence from Greece found that the course improved students' Greek writing and speaking skills and encouraged student attendance (Karamperidou et al., 2020). Still, there is limited evidence that mobile applications can effectively support refugees in acquiring proficiency in a foreign language and can only complement in-person language courses, where learners have more opportunities to engage in conversational activities (UNESCO, 2018).

In the Democratic Republic of the Congo, the interactive radio project Making Waves reached more than 2,000 out-of-school children aged 12 to 16. Making Waves combines radio lessons with teacher-facilitated instruction and group work. Students scored higher on all reading and mathematics subtasks when assessed compared to those studying traditional alternative learning programmes (INEE, 2022). In Jordan, the TIGER programme, which uses low-cost tablets, helped girls in the Za'atari refugee camp stay in secondary school and increased their desire to learn (Wagner, 2017) and managed to bring some out-of-school adolescent girls back to school (UNESCO, 2018). The Instant Network School Programme in the Dadaab refugee camp in Kenya, which uses internet-enabled tablets, increased participation rates (Vodafone Foundation, 2017).

At the height of the Boko Haram crisis in the Nigerian state of Adamawa , the Technology Enhanced Learning for All programme used mobile and radio technology to support the learning continuity of 22,000 disadvantaged children, including internally displaced children, itinerant Islamic school students and orphans aged 6 to 17. Within six months of listening to the programme, there was improvement in literacy and numeracy skills, with a sharper improvement observed among girls. The combination of mobile classroom visits with radio instruction was more effective: beneficiaries exposed to both learning modalities outperformed those exposed only to the radio programme by 25% (Jacob and Ensign, 2020).

In Chad, Jordan, Lebanon, Sudan and Uganda, with the support of teachers and facilitators, the programme, Can't Wait to Learn, used a tablet-based gaming programme integrated into the national curriculum to deliver learning to non-formal classroom settings for out-of-school, refugee and forcibly displaced children (Burns et al., 2019; Koomar et al., 2020; Topham, 2019; UNESCO, 2021a). An evaluation showed that the programme led to significantly greater learning improvements for children aged 7 to 9 in Sudan compared to state-provided education for out-of-school children (Brown et al., 2020). Children achieved nearly twice the learning gains in mathematics, and nearly three times the learning gains in reading compared to those learning through traditional approaches (Topham, 2019). The model had reached 30,000 children by the end of 2020 (UNESCO, 2021a).

However, despite some evidence of impact, there are gaps in terms of the evaluation of technology applications in education in emergencies. This may be because most interventions are being implemented as short-term crisis responses by non-state actors and donors, which also raises concerns for sustainability (Menashy and Zakharia, 2017; UNESCO, 2019). The mapping of 101 distance education projects in emergency and emergency-prone contexts found that only 12% were implemented by education ministries; more interventions were led by UN agencies (56%) and international non-governmental organizations (20%) (INEE, 2020). In many of these cases, technology was viewed as a solution for refugee education (Menashy and Zakharia, 2020) instead of as a supportive tool (UIL, 2022b).

TECHNOLOGY SUPPORTED LEARNING DURING COVID-19, BUT MILLIONS WERE LEFT OUT

During the COVID pandemic, over 90% of education ministries carried out some form of distance learning policy response. It has been estimated that these had a potential reach of over 1 billion students globally, from pre-primary to upper secondary (Avanesian et al., 2021). Most countries were able to respond quickly because they were expanding on existing infrastructure, mobilizing pre-existing knowledge and networks, or implementing ideas that had already been tested. Many of the resources used during the pandemic were first developed in response to previous emergencies or rural education, with some countries building on decades of experience with remote learning (Vincent-Lancrin et al., 2022). For instance, online learning platforms were originally used during the SARS and H1N1 outbreaks in the 2000s in countries such as the Plurinational State of Bolivia, China and Singapore (Barbour, 2021; Hallgarten et al., 2020).

Some countries relied on a combination of interventions to maintain learning continuity: 91% of countries delivered remote learning through online platforms while 85% did so through television, 82% through paper-based materials, 70% through mobile phones and 54% through radio. Radio was the most popular modality deployed in low-income countries (85%) and online platforms the most popular modality in high-income countries (World Bank et al., 2021).

Despite these measures, at least 31% of students, or almost half a billion students worldwide from pre-primary to upper secondary level, could not be reached by remote learning due to lack of access to necessary technology or targeted policies geared towards their needs. The region with the highest share of children (49%) who could not be reached during school closures was sub-Saharan Africa, which experienced full and partial school closures of about one year (Avanesian et al., 2021; Muñoz-Najar et al., 2021).

> “At least 31% of students from pre-primary to upper secondary level could not be reached by remote learning”

Location and income were the two key factors affecting the reach of remote learning policies. Globally, school-age children in rural areas and from the poorest 40% of households accounted for 70% and 72% of those who could not be reached during school closures, respectively (Avanesian et al., 2021). In Viet Nam, students from the poorest 20% and the less-educated households were 34% and 21% less likely to experience distance learning, respectively, than those from the richest 20% and from higher-educated households (Hossain, 2021).

The highest reach of distance learning was recorded in Latin America and the Caribbean (91%) (Avanesian et al., 2021). Uruguay launched Ceibal en Casa immediately after school closures were announced, drawing on the pre-existing deployment of digital resources under its National Digital Education Plan, or Plan Ceibal. Due to high levels of household internet access (88%), Ceibal en Casa relied primarily on digital media (with complementary content for students with no internet connectivity) and reached 85% of primary and 90% of secondary students (Ripani, 2020).

Despite their wide deployment during school closures, online platforms could at best reach only a quarter of children globally (Avanesian et al., 2021). Even in high-income countries, access was difficult for disadvantaged students. School leaders in England, United Kingdom, reported that 28% of their students had little to no access to technology at home for distance learning, a figure which was higher for the most deprived (43%) compared to the least deprived (18%) schools (Sharp et al., 2020). In another survey of English teachers, only 5% of government school teachers reported that all their students had access to an appropriate device for remote learning, compared to 54% of private school teachers (Montacute and Cullinane, 2021).

Radio and television proved they could be part of an active learning strategy when complemented by phone or paper-and-pencil assignments, providing students with additional (or alternative) learning opportunities (Vincent-Lancrin et al., 2022). China, which has one of the longest histories of using education television for adult learning and teacher training, launched EduTV, which reached 97% of students during the educational disruption (Zacharia, 2020b). Mexico built on its Telesecundaria programme to deploy Aprende en Casa almost immediately after the suspension of face-to-face classes, mainly drawing on audiovisual content broadcast across a network of TV stations streamed through internet platforms. Content was expanded from secondary education to all levels of education, with a special radio strategy implemented to reach indigenous students, and 300,000 printed educational materials delivered to students in rural and isolated communities with no internet access. It was reported that 82% of teachers had weekly interactions with 9 out of 10 of their students (Ripani and Zucchetti, 2022).

However, there were problems in access and engagement. Whereas television served as the main distance learning platform for 94% of students in Côte d'Ivoire, only 65% of students in rural areas had access to a television at home, compared to 90% in urban areas (Côte d'Ivoire Ministry of National Education, 2020). In the Lao People's Democratic Republic (PDR), where distance learning was mainly implemented through television (Lao PDR Ministry of Education and Sports, 2021), only 29% of households reported that their school-aged children engaged in remote learning activities during school closure, with a disparity between urban (41%) and rural (24%) households (World Bank, 2021a). The education ministry instructed teachers in remote communities to meet with small groups of children for face-to-face teaching, but there was no monitoring of how many students were reached (UNICEF and UNESCO, 2021).

Sierra Leone, which has been using educational radio since the 1960s (Zacharia, 2020a), revived the Radio Teaching Programme developed during the Ebola crisis one week after schools closed (Gutierrez and Wurie, 2021). The government made the programme more interactive and expanded its coverage to remote communities through satellite connections and solar-powered radios. Printed materials, mobile phones and television also complemented the programme (Sierra Leone Ministry of Basic and Senior Secondary Education, 2020), while a toll-free telephone line facilitated two-way interaction (Muñoz-Najar et al., 2021). However, less than half the children (41%) listened to the radio lessons during COVID school closures. Barriers included lack of motivation and competing priorities (Gutierrez and Wurie, 2021).

More generally, the pandemic has shown that many learners did not have the devices or connectivity required for low- and high-tech interventions. For these students, paper-based materials served as the primary resource for remote learning or as a supplementary resource in combination with other interventions (UNICEF, 2021a). In Bhutan, some 17,000 students in remote areas had limited or no access to broadcasting services or the internet. An initiative called Reaching the Unreached provided them with self-instructional materials. Almost all schools in the country accessed the booklets, finding them effective (80%) and user-friendly (84%), except for students in lower primary classes, for whom the materials were challenging to use without guidance (Bhutan Ministry of Education, 2021).

In Cambodia, the government provided paper-based learning materials for the most vulnerable students, and complemented these with text and Telegram messages for teacher–student follow-up (Muñoz-Najar et al., 2021). Approximately 70% of students could access some form of distance learning, although disparities in learning outcomes between rural and urban areas, and between poor and rich households, increased

> The pandemic has shown that many learners did not have the devices or connectivity required for low- and high-tech interventions

(UNICEF, 2020a). While the government in Ethiopia made provisions for distance learning through radio, television and social media, only 8% of a sample of adolescents in urban areas reported radio or television as their primary distance learning method; 58% used their own textbooks (Jones et al., 2021).

Gender barriers were observed in some contexts, regardless of the modality. In Kenya, 74% of adolescent girls – but only 46% of boys – reported that household chores distracted them from remote learning (Kenya Presidential Policy and Strategy Unit and Population Council, 2021). In Ethiopia, only 35% of girls were given a space to study, compared to 62% of boys, and only 22% of girls had their time spent on chores reduced to accommodate home study versus 57% of boys (Jones et al., 2021).

Furthermore, even when access to distance learning was possible, there was observed inequality in the resources and skills needed to use technology effectively, including parental engagement and support, which is critical in facilitating remote learning (Muñoz-Najar et al., 2021). In England, United Kingdom, the most common reason given by teachers to explain why students did not engage in online learning was limited or no parental support (60%), which affected government schools (65%) much more than private schools (25%) (Montacute and Cullinane, 2021).

Just as technology can offer learners with disabilities a lifeline, the pandemic disproportionately excluded these types of learners because remote learning modalities were not adequately prepared for sign language interpretation, closed captioning or Braille, among other issues (World Bank et al., 2021). A global online survey of parents and caregivers found that only 12% of students with visual impairments had access to Braille materials and only 10% of deaf learners had access to transcripts of audio services (World Bank, 2020). In at least half of the countries surveyed by the International Disability Alliance, governments had not adopted measures for these learners (IDA, 2021; UNESCO IITE, 2021). A global online survey showed that only 19% of teachers who had learners with a disability reported that their students continued learning during school closures, and only 16% said they had the support needed to continue helping these students (World Bank, 2021b). In Ghana, the Ministry of Education designed distance learning packages to respond to the learning needs of children with disabilities (Ghana Ministry of Education, 2020) but teachers and parents reported that radio and television content had not been adapted for children with disabilities and remained inaccessible to them (Innovations for Poverty Action, 2021).

Nevertheless, several countries did implement targeted interventions, the most effective of which prioritized communication channels that could reach a large number of families while also exploring specific solutions for learners that needed more careful interventions; for example, those in isolated regions, learners with disabilities and refugees (Vincent-Lancrin et al., 2022). France placed emphasis on the learning continuity of students with disabilities through special needs coordinators, medical professionals and social care staff, as well as the provision of adaptive and accessible learning resources. The needs of students with disabilities were also factored into the design of the national online learning platform, Ma classe à la maison (My class at home), while the teaching of students with disabilities was further supported through the Ministry of Education website Éduscol, and regional online academies for teacher professional development (Vincent-Lancrin et al., 2022).

In the Republic of Korea, all students with disabilities were individually assessed before school closures. Customized learning was provided accordingly, including online class materials with subtitles and sign language, materials in Braille, distribution of assistive devices, and home visits to check that learners were engaged and had access to the necessary adaptations. Distance learning materials were made available in three additional languages – Chinese, Russian and Vietnamese – to support students from multicultural families. Almost all students with special needs and disabilities participated in the distance learning programme during school closures, with a 99% total participation rate and 81% student satisfaction rate (McAleavy et al., 2020; UNESCO, 2022).

During school closures in South Sudan, multigrade radio programmes were designed to include refugee learners, teachers provided targeted support to learners with disabilities through home visits. Learners without access to radios were supported through the distribution of 5,000 solar-powered radios. More than 10,000 out-of-school children re-entered school through the provision of radios and the radio programme (UNHCR, 2021).

For disadvantaged students to benefit, the model of distance learning must recognize the scale of the digital divide. For instance, the school closure plan for Papua New Guinea was based on analysis which recognized the technology capacity of a large sample of schools contrasted with the lack of electricity and radios at home. On the advice of head teachers who considered writing materials and textbooks as the most helpful type of support, the government organized remote learning, mainly through printed workbooks, supplemented by educational radio (Papua New Guinea Department of Education, 2020). In Peru, where only 24% of households are connected to the internet, the government deployed a multimodal strategy that used television and radio (available to 80% of households) as well as online learning. Take-up was high, with Aprendo en Casa reaching almost 85% of students (Muñoz-Najar et al., 2021). In contrast, in the Islamic Republic of Iran, two weeks after the launch of the national e-learning platform SHAD, which required a smartphone with internet access, only 50% of teachers and 25% of students had been able to enrol, with enrolment levels even lower in the country's poorer provinces (Ershad, 2020).

The experience of COVID shows that education systems must become more resilient to cope with future crises. Two thirds of countries plan to enhance the provision of hybrid learning from primary to upper secondary levels beyond the pandemic (UIS et al., 2022). Analysis from the GEM Report team shows that, as part of their COVID response plans, 40% of countries have developed long-term, sustainable strategies to increase their resilience. Cambodia's COVID-19 Education Response Plan is underpinned by a mid- to long-term, multirisk and sustainability-oriented approach, aimed at strengthening the education ministry's preparedness, response, recovery and existing distance learning programmes (Cambodia Ministry of Education, Youth and Sport, 2020).

Not all countries have succeeded in their intentions. For instance, 32% of national digital learning platforms no longer exist, have links that do not work or have not been updated since 2020 (UNICEF, 2022b).

Programming created or enhanced during COVID can be repurposed to support distance education in other contexts. During the war in Ukraine, where millions of children were prevented from attending school and nearly 700,000 students were displaced, the Ministry of Education provided learning continuity through the expansion of the All-Ukrainian Online School digital platform that had been established during the pandemic, allowing 85% of schools to complete the 2021/22 academic year (Saavedra, 2022; UNICEF, 2022a).

CONCLUSION

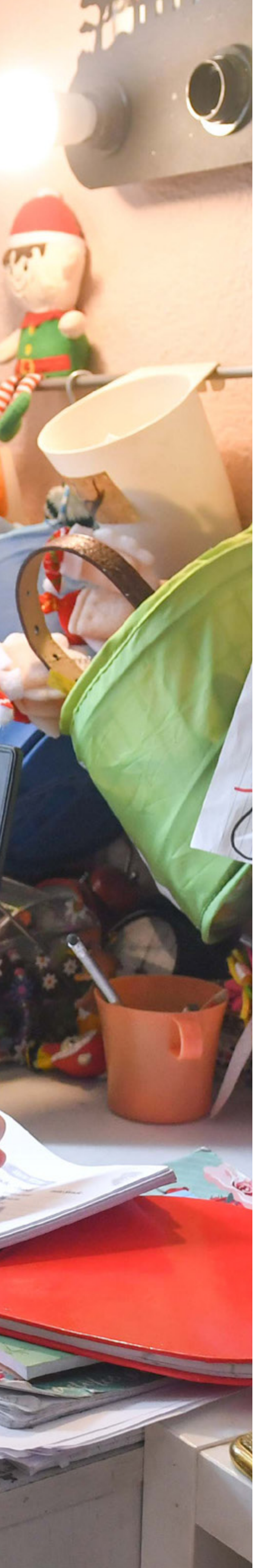
Education systems have long relied on technology to reach groups who are traditionally excluded from education, and to support learning continuity during emergencies. Technological solutions are sometimes the only option many learners have for education. Certain long-standing programmes, such as radio-based instruction for nomads or televised instruction for remote areas, have helped increase enrolment and participation for marginalized populations. Throughout the years, countries have worked on improving existing interventions, increasing the interactivity of traditionally one-way broadcasting technologies, and embedding accessibility and personalization features in platforms and devices.

> “Technology should not be viewed as the solution, but as a supportive tool in overcoming certain barriers to education access”

Technology should not be viewed as the solution, but as a supportive tool in overcoming certain barriers to education access. The most effective interventions are those that put learners' interests as the focal point and support human interaction, making use of adequate in-person support, extensive teacher training and appropriate technology for the specific context. The best learning systems never rely on technology alone.

Interventions must be backed up by strong evidence that they are the most effective tool to reach the targeted learners and respond to identified needs. In contexts of displacement, only technology's potential is seen, with less evidence and rigorous evaluation of its effectiveness in increasing access to marginalized groups; interventions remain small scale and largely non-state led. Focusing on the sustainability of interventions is key, especially as emergencies become more frequent and many children remain out of reach from conventional schooling systems. Countries can build on prior distance learning experience to quickly respond to these crises, repurpose already developed platforms, and build interventions that put the needs of the most marginalized learners at the centre. These are often the learners who stand to benefit the most from technology-supported education, while at the same time, as the COVID pandemic showed, they can be disproportionately excluded if their needs are not adequately recognized and actively prioritized.

Lea (10) gets acquainted with the newly developed e-classroom platform launched on 24 March to support distance learning for children temporarily out of school due to COVID-19. Like all children in North Macedonia she has been at home since 10 March 2020 when the government temporary closed schools due to the spread of COVID-19. Credit: UNICEF/UNI313753/Georgiev*



CHAPTER

3

Equity and inclusion: Access to content

KEY MESSAGES

Technology makes it so much easier to create and share educational content that the quality of content is increasingly hard to ensure.

Technology facilitates content creation and adaptation.

- Open educational resources facilitate affordable, efficient and more inclusive content creation. A shift to such resources resulted in over USD 1 million savings for students in the US state of North Dakota in 2018.
- Collaborative tools can improve diversity and quality in content creation. In South Africa, the Siyavula initiative supported tutors in collaborating on creating textbooks for primary and secondary education.
- Social media improves access to user-generated content and sharing. YouTube is used by about 80% of the world's top 113 universities.

Digitization simplifies content distribution channels.

- Digitizing textbooks can increase their availability and introduce new ways of learning. India uses QR codes for additional content and Sweden developed collaborative textbooks that provide a multimodal experience. Digitization also promotes inclusivity. But digital textbooks' growth has been slowed by resistance from publishers.
- Digital libraries and educational content repositories help learners and teachers discover more content. Examples include the National Academic Digital Library of Ethiopia, National Digital Library of India and Bangladesh's Teachers Portal, which has over 600,000 users.
- Learning management platforms are becoming part of contemporary learning environments. They were valued at USD 14 billion in 2021, with projected growth to USD 41 billion by 2029. Low-income countries often use social media as learning management systems.

Technology that is used to increase access to content faces challenges.

- Mass open online courses (MOOCs) reduce time, location and cost barriers to access. In Indonesia, they provide post-secondary education in rural areas.
- But expansion has happened without due diligence or planning. The quality of MOOCs is questionable, with completion rates below 5% and multiple-choice quizzes often used as assessments. Quality assurance approaches, such as the OpenupED quality label in the European Union and government oversight in China, along with micro-credentials, are among strategies to address quality concerns.
- Technology increases access mostly to those who already have it. MOOCs mainly benefit learners from richer countries due to divides in digital skills, internet access, language and course design.
- Technology can reinforce gender, language and cultural inequality in content production, with creation dominated by privileged groups. A study of higher education repositories with open educational resource collections found that nearly 90% were created in Europe or North America, and 92% of the material in the OER Commons global library is in English, which influences who can use such content.

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Access to quality educational resources remains one of the main challenges for education systems worldwide (Janssen et al., 2023). Technology has the power to improve access to educational content in at least three ways. First, it fosters content development (see **Chapter 5**) by making creation, adaptation and sharing easier – concepts strongly rooted in the open education movement. Second, it expands storage through digitization – creating digital formats of resources – and improves distribution channels with digital libraries, online repositories and learning management systems. Third, technology helps remove costs and other barriers, such as language, to accessing materials.

Nevertheless, several challenges remain before technology can achieve its full potential of increasing access to educational materials. The overwhelming quantity and decentralized production of digital content make it harder to ensure quality. And technological innovations can reinforce traditional biases associated with who produces content, and who benefits from it.

TECHNOLOGY FACILITATES CONTENT CREATION AND ADAPTATION

Content development can be divided in two phases: its original development and its subsequent adaptations, modifications and edits. Technology can help in both phases. Digital tools allow content to be produced and shared in cheaper and more efficient ways. It also allows more actors to participate in the process, going beyond traditional, institutionally-centred content production. Technology is also particularly useful in the second phase of content development, fostering co-creation and adaptation through the open education movement (**Box 3.1**).

> “Technological innovations can reinforce traditional biases associated with who produces content, and who benefits from it”

OPEN EDUCATIONAL RESOURCES FACILITATE AFFORDABLE, EFFICIENT AND MORE INCLUSIVE CONTENT CREATION

Open educational resources (OER), a term coined by UNESCO in 2002, have been defined as ‘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 licence, that permit no-cost access, reuse, re-purpose, adaptation and redistribution by others’ (UNESCO, 2019). OER are primarily associated with online and digital educational technologies but can also refer to printed materials (Butcher et al., 2023).

OER are based on five freedoms – to retain, reuse, revise, remix and redistribute resources – which can contribute to education in at least three ways (Miao et al., 2019; Wiley, 2014) (**Box 3.2**). The first is by improving the quantity of relevant learning materials in a cost-effective way. By re-using and repurposing resources, it is possible to cut development time and avoid duplication of work. The second is by improving the quality of the resources. Open sharing of resources increases peer review and fosters continuous improvement of materials. Finally, OER can improve inclusion in education. The ability to modify materials makes them more accessible to different learners (Janssen et al., 2023). A practical example is the Bloom Library, an open-source book production platform that allows users to create their own books using templates and Creative Commons images with a user-friendly tool. The platform has over 11,000 books in over 500 languages, including several minority languages, which can be downloaded and shared, even without the internet (Bloom Library, 2022).

BOX 3.1:

The open education movement: what is 'open'?

The open education movement is founded on the principle of widening participation in education, and it has gained newfound relevance and momentum thanks to the increasing availability and use of technology in education (Zawacki-Richter et al., 2020). It has numerous applications, including open-source software development, open data, open pedagogy, open access to academic literature and open educational resources (OER). This chapter focuses on access to learning materials and frames openness along two dimensions: access and adaptation rights (**Table 3.1**).

TABLE 3.1:
Dimensions of 'open' learning resources

Adaptation rights	Access			
	Free			Not free
	No restrictions	Non-financial restrictions, for everyone	Non-financial restrictions, not for everyone	
Adaptable (users have permission to adapt)	OER	OER – may need to create a free account to get access	Locally shared materials within an institution	Commercial resources, publications behind paywalls
Non-adaptable (users do not have permission to adapt)	Open access journals, blogs, websites	Massive open online courses (MOOCs)	Corporate or private online courses	

Source: GEM Report adaptation based on Janssen et al. (2023).

Access rights refer to the existence of financial or non-financial restrictions. Locally shared learning materials within an institution, for example, may allow members to freely use, adapt and share within the group, but these materials are only semi-open because access is not available for everyone. Adaptation rights are linked to open licences, which allow users to use, adapt and share content (Janssen et al., 2023).

Although this two-dimensional framework helps conceptualize the debate, it is not meant to be restrictive, nor to mean that only free and adaptable materials are valuable. The debate must encompass all attempts to increase access and participation, even if they do not achieve the highest levels of 'openness'. Moreover, other important characteristics of openness are not explored in the framework. These include, for example, technical openness – the use of open-source tools and platforms – and content requirements, including whether they are accessible to people with disabilities (Janssen et al., 2023).

The cost of learning materials is a significant barrier to accessing content. OER contribute to reduced spending on learning materials by both students and institutions. A 2018 study in the United States found that a shift to OER in the state of North Dakota required an initial investment of USD 110,000 and led to over USD 1,000,000 in savings for students (Gallion, 2018). In Malaysia, an initiative to replace textbooks and courseware with OER by the Wawasan Open University led to estimated savings in the cost of course development of MYR 1.4 million (USD 300,000) within four years (Arumugam, 2016). A study found that the production of printed versions of OER science textbooks for secondary education could cost less than half as much as traditional textbooks, even if they were updated every year. Cost savings could be much higher if they were re-used for several years, as is the case for traditional ones (Wiley et al., 2012).

“The cost of learning materials is a significant barrier to accessing content”

Lower costs do not mean lower quality. Several studies at the post-secondary level find that students using OER perform as well as, or even better than, those using their commercial equivalents (Allen et al., 2015; Fischer et al., 2015; Jhangiani et al., 2018). A recent study confirmed these findings at the primary education level.

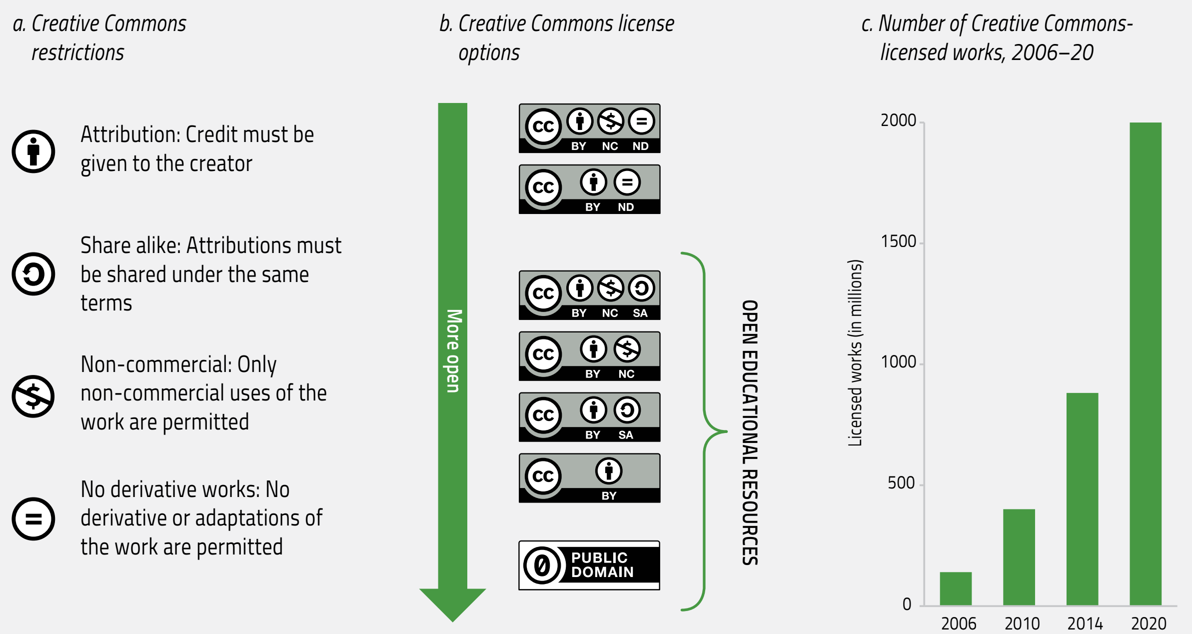
BOX 3.2:

Creative Commons licenses have set the standard for OER

Open licensing is a necessary precondition for the development of open educational resources. It offers the necessary legal backing for permissions regarding the use, reuse and sharing of the materials. Open licenses, which limit restrictions and give creators the choice of which rights they give up are often called 'copyleft', in opposition to the usual law of 'copyright' (Miao et al., 2019).

The most commonly used open licenses globally, and in particular for open educational resources, are the Creative Commons (CC) licenses, launched by a non-profit organization in 2002 (Green, 2018; Miao et al., 2019). CC licenses require that the original work be attributed to creators who retain the copyright on their work, but they simplify restrictions and use. Although it is difficult to quantify the number of works with Creative Commons licenses worldwide, it is estimated that it has grown from about 140 million in 2006 to at least 2 billion in 2020. There are four types of restrictions that combine to create six license options. The less restrictive licenses, which do not carry the 'No Derivative' restriction, allow users to adapt and modify works, one of the central tenets of OER. In addition to open licenses, there is also a public domain dedication for materials that are owned by the public and can be used by anyone without permission (Butcher et al., 2023) (**Figure 3.1**).

FIGURE 3.1:
Creative Commons licenses are increasingly used worldwide



Source: GEM Report adaptation based on Creative Commons (2017, 2019) and Miao et al. (2019).

No performance difference was found between grade 3 mathematics students in the United States who used OER curriculum materials and those using commercial ones (Hilton et al., 2019).

The potential of open resources to improve education has been increasingly recognized. What started as projects from individual institutions, such as MIT OpenCourseWare launched by the Massachussets Institute of Technology in 2001, has been mainstreamed in many educational policies and strategies worldwide. For the past two decades, UNESCO has led international efforts to drive the OER movement, which have resulted in the Paris OER Declaration in 2012, the Ljubljana OER Action Plan in 2017 and the UNESCO General Recommendation on OER in 2019 (Janssen et al., 2023). In 2022, the Transforming Education Summit, a high-level event convened by the UN Secretary-General, stressed that OER are digital public goods and a powerful solution for improving access and quality in education (UNESCO, 2022).

Globally, awareness and positive attitudes toward OER have been on the rise. Nevertheless, implementation and use have grown more slowly. Surveys of mainly tertiary-educated professionals working with teaching and research in over 35 countries found that the availability of OER policies and support for such policies increased considerably between 2016 and 2021: 86% of respondents stated that they were aware of OER 2021. But only 45% were involved in some OER activity or project (Commonwealth of Learning, 2022). This pattern of increased awareness and demand, but low adoption is confirmed by other surveys of higher education institutions in Latin America, South and South-eastern Asia and sub-Saharan Africa (Janssen et al., 2023).

The COVID pandemic has, in many instances, accelerated OER adoption. In the United States, the use of OER in higher education increased considerably and the share of professors who believe 'students learn better from printed materials' dropped from 43% in 2020 to 33% in 2022 (Janssen et al., 2023; Seaman and Seaman, 2022). OER also played an important role in pandemic responses in, for instance, Poland, Slovakia, and Shanghai, China (Janssen et al., 2023).

COLLABORATIVE TOOLS CAN IMPROVE THE DIVERSITY AND QUALITY OF CONTENT CREATION

Technology has radically increased opportunities to develop content collaboratively. In 1995, the development of wiki software, a product of the open software movement, revolutionized content creation in the digital age. The software allows documents to be directly edited by anyone while keeping retrievable records of every edit and every version (Rosenzweig, 2006). Its greatest application, Wikipedia, has become the world's largest encyclopedia with over 55 million freely accessible articles and the fourth most visited website worldwide (Statista, 2021; Wikipedia, 2022a) (**Box 3.4**). The wiki software is also often used in schools and tertiary education institutions. In Kerala state, India, for example, the SchoolWiki initiative connects 15,000 schools for collaborative content development (Telegraph, 2022).

Collaborative content creation is also strongly linked to the OER movement, which supports constant improvements to existing resources. In 2009, the government of the Netherlands created the platform Wikiwijs, a nationwide OER initiative, encouraging teachers from primary to higher education to produce and share educational resources based on open standards, so that others can build on them. The platform had over 400,000 lessons and 6 million direct visits in 2022. In South Africa, the Siyavule initative began to support communities of tutors to collaboratively develop open textbooks for primary and secondary education in science and mathematics (Janssen et al., 2023).

SOCIAL MEDIA IMPROVE ACCESS TO USER-GENERATED CONTENT AND SHARING

Social media are online-based applications that allow users to generate and share content and to engage in social networking. Their widespread adoption began in 2004, and within a few years, the number of studies analysing their role in education had skyrocketed (Barrot, 2021; Greenhow et al., 2019).

Social media can act as an important source of educational resources for both students and teachers. Teachers often consider social media a more reliable and curated source of updated practices and strategies than the internet because of their user-generated content from fellow educators (Greenhow et al., 2019; Trust et al., 2016). Social media platforms can also foster collaborative content creation by users. Academics have been engaging in new forms of informal peer review and feedback exchanges. The trend, termed 'social scholarship', has developed interdisciplinary projects and crowdsourced syllabi (Greenhow et al., 2019). Students can use social media to access content from a trusted network. At Mzuzu University in Malawi, for example, lecturers send voice notes to student WhatsApp groups with explanations on a given topic and to answer any questions or comments they may have (Childs and Valeta, 2023).

Among the most wide-reaching social media tools for educational content creation and dissemination is YouTube. Founded in 2005, it has become the largest video-sharing platform and the second most visited website in the world (Statista, 2021). Its wide reach, video format and ease of use have turned it into a major player in both formal and informal learning. According to a 2018 Google survey, 90% of Brazilian YouTube users reported using the platform to learn or study (Marinho, 2018). In 2019, Brazilian channels created by school teachers had over 5 million views per month, with some teachers earning three times the minimum statutory salary for teachers from the platform alone (Cafardo, 2019). In the United States, a survey of 14- to 23-year-olds found that nearly 60% of them ranked YouTube as their preferred learning tool – above in-person activities, learning apps/games and textbooks (Pearson, 2018). About 80% of the top 113 universities in the world, according to the Shanghai ranking, use YouTube to share their videos (Acosta et al., 2020). The COVID pandemic increased the importance of the platform. In Bangladesh, teachers uploaded videos to YouTube and Facebook during the pandemic because it was the easiest way to deliver content to students (Mulla et al., 2023).

DIGITIZATION SIMPLIFIES CONTENT DISTRIBUTION CHANNELS

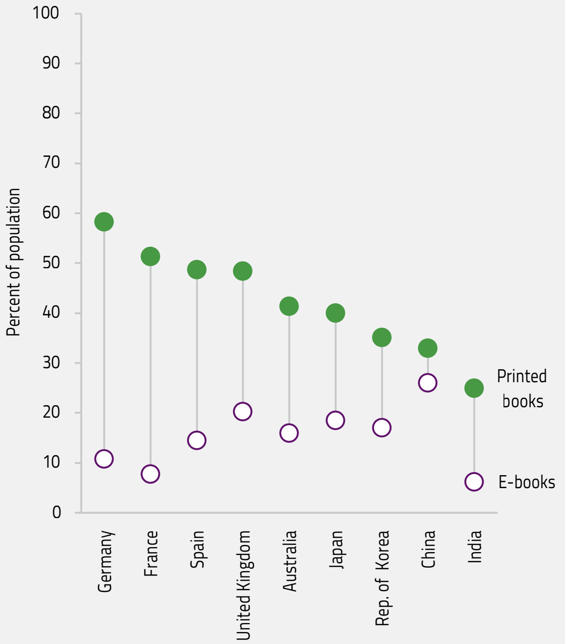
Digitization refers to the process of converting information into a digital format, such as through scanning, photographing or retyping (Hanna, 2022). Availability of digitized educational materials helps systems overcome barriers associated with distribution and storage. One of the first mass digitization projects, Project Gutenberg, was launched in 1971 as an entirely volunteer-run initiative aimed at digitizing and distributing electronic books, or e-books. Volunteers contribute digitized versions of books regardless of format, language or topic, as long as they are in the public domain or have copyright permission (Hart, 2007). The project currently hosts over 60,000 free e-books (Project Gutenberg, 2022). Another example is the Million Book Project, also known as the Universal Library Project – a collaboration between Carnegie Mellon University and government and research partners in China and India. Around the world, 50 scanning centres digitized over 1.5 million books in over 20 languages (Universal Digital Library, 2008).

> Availability of digitized educational materials helps systems overcome barriers associated with distribution and storage

Several other national and regional initiatives have encouraged digitization of content, with libraries, museums and national archives playing an important role (Collier, 2006). In 1997, the National Library of France launched its digital library Gallica, which digitizes around 100,000 items per year. Between 2010 and 2014, Gallica increased its digitized repository from 1 to 3 million documents (Gallica, 2022). Other digitization projects aim at preserving heritage. In India, the Panjab Digital Library is a non-profit organization focused on digitizing material related to the heritage, culture and language of Punjab state (Panjab Digital Library, 2022). The National Digital Library of Finland aims to preserve Finnish cultural and scientific materials (UNESCO, 2016).

Overall, electronic books reduce production and distribution costs. A survey of publishers in Ghana, Kenya and Nigeria revealed that the production cost of a book with an average print run of 500 copies is about USD 2,500. In comparison, an e-book costs about USD 40 to produce once the infrastructure is in place, and can be reproduced an unlimited number of times; the final cost represents a small fraction of the printed publication process. Most publishers indicated that digital production takes less than half the time needed for print production (Brown and Heavner, 2018).

FIGURE 3.2:
E-books still trail behind printed books
Share of population that bought e-books and printed books, 2021



GEM StatLink: https://bit.ly/GEM2023_fig3_2
Source: Statista (2022a).

Nevertheless, growth in the market share of e-books has been slower and smaller than many expected, even taking into account the relatively high price of devices needed to access digital books (Brown and Heavner, 2018; Handley, 2019). E-books have not taken off even in rich countries (Richter, 2021) (**Figure 3.2**). In the United States, it is estimated that 30% had read an e-book by 2021, still well below the 65% who have read a printed book. Those who are richer and more educated are the most likely to read an e-book rather than a printed book (Faverio and Perrin, 2022).

Governments invest in digital textbooks while publishers search for new business models

Despite significant upfront costs, including infrastructure and training, digitization of textbooks can greatly reduce the production and distribution unit cost (Brown and Heavner, 2018; Lee et al., 2013). Digital textbooks also have the advantage of increasing student access to content outside school hours (Lindqvist, 2018). Moreover, those openly licensed as OER encourage contextual adaptations that can improve inclusiveness and relevance (Janssen et al., 2023). However, this requires a reconfiguration of some of the dominant business models.

As a starting point, many governments have been digitizing content from traditional textbooks as static digital versions – that are not interactive, for example – with the objective of increasing their availability. In Bhutan, all government textbooks are downloadable from the Royal Education Council's website, although most refer to primary education. Textbooks used in secondary education are often published by non-state actors and are therefore not available digitally (Mulla et al., 2023). In Nepal, textbooks have been digitized as PDF files that are available for download (Mulla et al., 2023). The Rwanda Education Board began digitizing all textbook content and making it available on its e-learning platform (IITE and IIEP, 2021).

There are also moves away from static digital versions towards digitally enhanced contents. In Algeria, concerns over the heavy weight of textbooks led the government to develop a digital version of primary school textbooks that also contains supplementary materials such as videos, animations and interactive features (Njoya, 2022). In India, the government is embedding all textbooks with QR codes to convert them into 'energized textbooks'. When scanned, the QR codes can provide additional information, contextualize content and bridge the gap between home and instructional languages (Agha, 2018; Mulla et al., 2023). In Sweden, collaborative digital textbooks are being developed for teachers and students to engage with materials and experience a multimodal way of learning (Kempe and Grönlund, 2019).

Digitizing textbooks can make them more accessible. In India, the National Institute of Open Schooling has been developing content in Indian Sign Language and Digitally Accessible Information System-enabled talking books (Mulla et al., 2022; NIOS, 2022). In Kenya, the Ministry of Education partnered with eKitabu, a local company, to help the deaf community and local content creators produce visual storybooks and integrate sign language videos in early grade readers (All Children Reading, 2018). eKitabu is also developing 270 accessible e-books for Malawi, 220 in Tumbuka and 50 in Malawian Sign Language (All Children Reading, 2020; Buningwire, 2022). In Paraguay, the Ministry of Education and Science piloted the Accessible Digital Textbooks for All initiative in 2021, which develops digital tools and content based on Universal Design for Learning principles to make learning accessible to students both with and without disabilities (UNICEF, 2022). Over 92 countries have ratified the 2013 Marrakech Treaty, which requires parties to set exceptions to copyright rules allowing the reproduction and distribution of published works in accessible formats for people who are blind, visually impaired or otherwise print-disabled (WIPO, 2016, 2023).

Commercial publishers can be slow to adapt their business models. Printed textbooks are very profitable. For instance, e-books only represent about 10% to 13% of publishers' printed book revenue in Ghana, Kenya and Nigeria, as they face challenges adapting, maintaining and understanding new technologies. A lack of digital infrastructure in schools and of government policies to support sales of digital textbooks pose challenges for the publishers to change their production modes (Brown and Heavner, 2018). In Brazil, the 2015 National Programme for Textbooks that distributes textbooks to public primary and secondary schools allowed publishers to offer digital textbooks. However, the government stipulated that digital textbooks must have the same content as printed versions in order to preserve fair competition between publishers, many of which did not have the capacity to produce digital content (FNDE, 2023).

Governments and commercial publishers must find sustainable models for the changing textbook market. In France, a non-profit association of mathematics teachers founded Sésamath, an online platform to share educational materials, including textbooks. The association is financially supported by the government, but almost 90% of their operating costs are covered by partnerships with publishers for low-cost printed textbooks – an example of how governments, OER and commercial publishers can approach the market together (Orr et al., 2015; Sésamath, 2020).

"Governments and commercial publishers must find sustainable models for the changing textbook market"

Commercial publishers are more likely to move towards digital books at the tertiary level, where they are less dependent on government infrastructure and regulations. Digital textbooks already make up a considerable share of the higher education revenue of major publishers such as Pearson and McGraw-Hill (Bouchrika, 2022). This move requires a change in business models, however, that raises

BOX 3.3:

Digital technology is disrupting higher education in various ways

Technology has been steadily changing the way higher education operates. The transformation has only accelerated with COVID (Komljenovic, 2022). Identifying the channels through which this transformation is most likely to occur can help societies better understand the potential risks and benefits, and how governance and regulations might need to respond.

Three forms of disruptions are described. First, a digital disruption 'in' higher education refers to institutions using technology, such as digital platforms, to personalize or increase the efficiency of their services. Second, a digital disruption 'of' higher education corresponds to the expansion of services through partnerships, such as the development of university-associated MOOCs or online programmes. Third, a digital disruption 'to' higher education refers to parallel systems of teaching and learning that will challenge the role of institutions. An example is Udemy, an online platform aiming to create a learning marketplace, which connects instructors and learners: anyone can upload videos and courses for participants to follow for free or a fee (Magee, 2015).

In all three cases, the value of digital products is not based on a commodity market or the usual transfer of ownership from seller to buyer. Instead, it is based on an asset market, where resources bring future value through maintaining ownership and charging for access to the asset. This poses new regulatory, ethical and political challenges. For instance, student and personnel data create value, which is being shared between institutions and technology companies. Students and staff may be constrained in their choice of platforms and the requirement to agree or not to their terms of use. In the United States, universities have been signing subscription deals with major publishers to provide all required digital learning materials to students at a discount (Carrns, 2020). This severely restricts students' and professors' choices and may increase costs, as institutions get locked into exclusivity contracts (del Valle, 2019). These digital disruptions must be seen from the perspective of the overarching role of higher education, which goes beyond the technical process of transmitting skills.

Source: Komljenovic et al., (2023).

several regulatory and ethical concerns (**Box 3.3**). In this context, OER have been gaining ground as an accessible solution to higher education learning materials. OpenStax, a non-profit corporation, has been publishing openly licensed college textbooks online for free that are used in over 100 countries (OpenStax, 2022). Nevertheless, despite a few exceptions, including Siyavula in South Africa, open textbooks are still mostly restricted to North America, where the affordability of learning materials is high on the political agenda (del Valle, 2019; Hall, 2023; Pitt et al., 2019)

DIGITAL LIBRARIES AND EDUCATIONAL CONTENT REPOSITORIES HELP LEARNERS DISCOVER MORE CONTENT

The overwhelming amount of digital educational resources has increased the need to develop mechanisms to store but also to manage and organize resources efficiently (Koutsomitropoulos et al., 2010). This includes the development of standardized metadata that filter learning materials and portals that help users search for them (Atenas and Havemann, 2014; Currier et al., 2004). Digital repositories or libraries, which took off in the early 1990s, have considerably improved information retrieval (Collier, 2006).

The Ministry of Science and Higher Education launched the National Academic Digital Library of Ethiopia to help users find, access and download relevant learning materials (National Academic Digital Library of Ethiopia, 2020). In 2018, the National Digital Library of India was launched as a one-stop search facility for digital educational resources available in national and international repositories. It collects digital content metadata and allows users to filter their search by education level, language, difficulty level and content type (National Digital Library of India, 2022).

In Bangladesh, the government has developed the Teachers' Portal, a digital educational resources repository for teaching and learning that allows teachers to exchange their creations with over 600,000 registered users, increasing their sense of self-efficacy despite challenges faced accessing the portal (Hansson et al., 2018; Mulla et al., 2023). The government has also created a digital content repository for primary education that contains textbooks with animated pictures, videos, audio and diagrams, and an online repository of video-based tutorials called Edu Hub (Mulla et al., 2023). In Nepal, the government partnered with the Open Learning Exchange organization to launch a learning portal that provides free and open access to digital learning content for all learners (Mulla et al., 2023). It contains thousands of searchable, open-licensed books, audiobooks and videos in 10 languages (Butcher et al., 2023).

Libraries can also act as community hubs for OER repositories. The International Federation of Library

Associations and Institutions has an OER working group. European libraries have been encouraged to work together to develop their own OER policies. The African Library and Information Associations and Institutions, a non-governmental organization in Ghana, collaborates with libraries and national library associations to promote OER and knowledge production in the continent (Butcher et al., 2023; Janssen et al., 2023). In 2022, the Transforming Education Summit stressed the importance of making OER accessible in findable, accessible, interoperable and reusable OER repositories (UNESCO, 2022).

More recent initiatives have aimed at improving the searchability of material through machine learning programmes that search digital content for keywords that can be matched to curricula, although these are still mostly in the early testing stages (Groeneveld et al., 2022). The Learning Agency Lab, a non-profit organization, has launched a competition to use artificial intelligence to improve the matching of educational content to topics in primary and secondary education (Learning Agency Lab, 2023).

LEARNING MANAGEMENT PLATFORMS ARE A KEY PART OF THE CONTEMPORARY LEARNING ENVIRONMENT

A learning platform, also known as a learning management system or course management system, is an integrated set of resources, tools and online services for teachers and learners within a course structure (UNESCO, 2011). It provides access to learning content, tests, communication and collaboration tools, as well as course management and assessment tools for instructors, thus creating a virtual learning environment (Piotrowski, 2010).

“Learning management systems have become a multibillion dollar global business, valued at USD 14.4 billion in 2021 and projected to grow to USD 41 billion by 2029”

Learning management systems have become a multibillion dollar global business, valued at USD 14.4 billion in 2021 and projected to grow to USD 41 billion by 2029, as it expands into the corporate training sector. Although Northern America continues to hold the largest market share, the strongest growth is expected in countries in Asia and the Pacific, including Australia, China, India, Japan, Malaysia and Singapore (Fortune Business Insights, 2022). Nevertheless, the most widely used learning platform in the world, Moodle, is free and open source. Its use ranges from schools, universities and informal learning institutions to governments developing national public learning platforms (Theocharis and Tsihrintzis, 2023).

The Transforming Education Summit identified the use of ‘robust and open public digital learning platforms and content, and digital learning resources treated as global public and common goods’ as one of the key steps towards harnessing the digital revolution for the benefit of public education (United Nations, 2023). As a result of the summit, UNESCO and UNICEF launched Gateways, a multipartner initiative to improve access to quality digital education content for everyone. The initiative has three components: map publicly sanctioned digital learning platforms and provide detailed information on target users, quality control processes, accessibility, breadth of content and openness; identify and share best practices regarding the development of these platforms to encourage peer learning within an international community of practice; and build international consensus about norms and quality standards for such platforms (UNESCO, 2023b).

Several successful examples of digital learning platforms are already in place (UNICEF, 2023). In 2017, the Indian government launched the Digital Infrastructure for Knowledge Sharing, a national platform for school education which has become the country’s largest repository for digital educational content (Mulla et al., 2023). It hosts energized textbooks, online courses, content authoring/sourcing, interactive quizzes and question banks. Its use increased considerably during the COVID pandemic and in July 2022, it was accessed over 50 million times per day (DIKSHA, 2021; Mulla et al., 2023).

In another example, UNICEF and Microsoft have launched the Learning Passport in over 20 countries, a digital platform that can serve as a national learning management system or as a complement to existing learning platforms. The pilot programme in Sierra Leone transformed 10 years of paper examinations into digital assessments, allowing students to take practice exams and receive feedback (Carnelli et al., 2022). In Sudan, the Learning Passport was launched by the Ministry of General Education and the Ministry of Telecommunications and Digital Transformation, in collaboration with UNICEF. The platform includes material from the national curriculum for grades 1 to 8, such as digitized textbooks, interactive materials, videos and assessments (UNICEF, 2021). In 2021, UNICEF, UNESCO, the UN High Commissioner for Refugees, the Inter-agency Network for Education in Emergencies, and the EdTech Hub made recommendations for the development of a Regional Learning Hub in eastern and southern Africa, a learning platform whose content would be aligned with national curricula (Groeneveld et al., 2022).

Governments have also developed offline mobile learning platforms where access to electricity and internet is low, but use of mobile phones is high. In 2017, in Kenya, the government developed M-Shule, a mobile learning platform that uses text messaging to provide students with lesson plans, activities and learning materials. It also uses the data collected from users to adapt and send personalized content based on student needs. The platform has reached over 20,000 households and has been found to have an overall positive effect on student learning and parental engagement (Myers et al., 2023; UIL, 2022). Shupavy291, a mobile educational platform used in Côte d'Ivoire, Ghana and Kenya, provides users with curriculum-linked learning materials, sets up quizzes and allows questions to be submitted through text message (Myers et al., 2023). Finally, in Colombia, the government developed Aprender Digital Ligera, a mobile version of its learning platform, for regions with no or low internet connectivity (Colombia Ministry of National Education, 2023).

It is common for social media applications to be used as learning management systems in low-resource areas, thanks to their ubiquity, mobile accessibility and user friendliness (Cavus et al., 2021). Retrievable posts act as information repositories and teachers can easily disseminate course content to groups and conduct summative assessments through individual message exchanges (Tang and Hew, 2017). Facebook is considered both an alternative to learning management systems (Manca and Ranieri, 2016) and an effective complementary tool alongside Moodle to improve student engagement (Cavus et al., 2021). In Algeria, a survey of first-year master's students found that Facebook surpassed Moodle as the most used tool for education purposes (Ghounane, 2020). In Egypt, during the COVID pandemic, professors were encouraged to use free platforms, such as Google Classroom, Facebook, WhatsApp and YouTube, to continue learning activities. Both faculty and students preferred social media applications over education-specific platforms like Google Classroom because of their higher level of interactivity (Sobaih et al., 2020).

OPEN ACCESS RESOURCES HELP OVERCOME VARIOUS BARRIERS

Technology has been used to expand access to distance learning opportunities, notably in higher education through open universities (**Chapter 2**). The link between technology and digital course content has also led to the advent of massive open online courses (MOOCs), which are available for a large – or unlimited – number of participants and can be accessed by anyone with an internet connection (UNESCO and Commonwealth of Learning, 2016).

MOOCs took off in 2012 (Pappano, 2012). In 2020, the COVID pandemic led to a boost in enrolments. The top three global MOOC providers – Coursera, edX and FutureLearn – registered as many new users in April 2020 as they did in all of 2019 (Shah, 2020a). Smaller MOOC providers also experienced fast growth. Edraak, a non-profit Arabic MOOC platform, registered 1 million new learners in 2020. Thailand's official MOOC platform, ThaiMOOC, received 286,000 new learners in 2020, doubling its user base that year (Shah, 2020a). In 2021, MOOCs had reached over 220 million learners worldwide in over 190 countries (Coursera, 2021; Shah, 2021).

By removing most of the barriers associated with time, location and cost, MOOCs promise to increase formal, informal and lifelong learning opportunities. Although MOOCs were originally developed as non-formal learning tools, they have been increasingly used to acquire full bachelor's or master's degrees (Kato et al., 2020). In Indonesia, where low participation in tertiary education is largely attributed to geographical challenges, MOOCs can play an important role in expanding access to post-secondary learning. In 1984, the government founded the Universitas Terbuka, an open university, to provide new forms of open and online learning, which today includes MOOCs. Unlike the global trend, the majority of MOOC users in Indonesia live in rural areas and are not tertiary-educated, suggesting this mode of learning did provide access to those who might otherwise have been excluded (Belawati, 2019).

MOOCs are also viewed as beneficial to employers who may value skills and professional knowledge more than formal degrees (Gauthier, 2020). In Türkiye, the Bilgeiș project was developed by the Middle East Technical University and funded by the European Union and the Turkish government as a portal for MOOCs specifically designed to support professional development in a variety of priority fields. It became one of the country's biggest MOOC providers, reaching over 90,000 learners within a year (Cagiltay et al., 2019).

Digital educational content, including through MOOCs, tends to be offered in dominant languages (Janssen et al., 2023). Digital translation tools have been freely available since the 1990s and can be used to increase the reach of educational content (Groves and Mundt, 2021). The European Union, for example, has funded the TraMOOC project to provide machine translation solutions specifically designed for content available in MOOCs, including subtitles, slides, assignments, quizzes and forum discussions (Behnke et al., 2018). Commercial players have also been developing education-specific translation services to increase access to content. Microsoft Translator for Education, for example, supports over 100 languages and is used to translate or caption live presentations and improve the engagement of non-native speaking students (Microsoft Translator, 2021).

> By removing most of the barriers associated with time, location and cost, MOOCs promise to increase formal, informal and lifelong learning opportunities

Translation tools help connect students and teachers from various countries. A consortium of universities in Canada, Colombia, India, the Netherlands, Norway, Sudan and Thailand share core courses on global health. Classes are streamed to students from all institutions, who are expected to work together on assignments using translation tools (Hill et al., 2022). Translation also increases the accessibility of courses by helping non-native students translate their essays and assignments into the language of instruction, although this may lead to concerns over academic integrity and quality (Groves and Mundt, 2021). Other tools have also been developed to improve family engagement by translating communication between parents who do not speak the language of instruction and their child's teachers (Lash, 2022; Microsoft Translator, 2021).

TECHNOLOGY USE TO INCREASE ACCESS TO CONTENT FACES CHALLENGES

The exponential growth of digital educational content from an increasingly diverse group of providers has led to a proliferation of content aiming to fulfil very different needs. This makes it harder to ensure minimum quality standards. Policymakers and teachers who have previously played a central role in quality assurance have expressed concern that several initiatives to digitize content and develop online education repositories have been implemented without due diligence or planning, resulting in an overwhelming amount of low-quality digital content (Mulla et al., 2023).

THE QUALITY OF DIGITAL CONTENT IS DIFFICULT TO ASSESS AND TO CONTROL

The sheer quantity of digital resources poses logistical challenges to evaluation, and governments often lack the capacity to gather evidence regarding their usefulness. The government of Bangladesh, for example, has defined a lack of quality in available digital content as its motivation for developing the Blended Education Ecosystem, a new policy which tries to focus on issues of quality and equity (Mulla et al., 2023).

The quality of individual MOOCs is also particularly difficult to assess. Although they reach many learners, few engage and even fewer complete them. Several studies have estimated completion rates across a variety of different MOOCs at below 5% (Ruipérez-Valiente et al., 2019; Wenzheng et al., 2019). Completion rates, which are often seen as proxies for quality in tertiary education, are not comparable, given that not all learners have the intention to complete MOOCs (Littlejohn et al., 2016). Reasons for dropping out include lack of motivation or desire to complete the course, lack of time and insufficient prior knowledge (Itani et al., 2018; Zawacki-Richter et al., 2018). Other reasons cited by learners shed light on the institutional challenges of this mode of learning, including feelings of isolation and lack of support (Zawacki-Richter et al., 2018).

There are also concerns regarding difficulties in evaluating student work at scale. In order to accommodate the vast numbers of students, assessments tend to be multiple-choice quizzes, which target lower-level factual knowledge and provide weaker evidence of learning (Yousef and Sumner, 2021). Moreover, there are numerous concerns regarding plagiarism, cheating and verifying the identity of test takers (Kolowich, 2013; Yousef and Sumner, 2021). By charging students for certificates that have little value in terms of proving student learning, critics have accused MOOCs of being high-tech versions of diploma mills (Shea, 2015).

Another challenge to ensuring the quality of digital content stems from its decentralized structure, which makes it harder to keep checks on content producers. Concerns are also raised over the fact that anyone can contribute content to collaborative sites like Wikipedia, which has experienced several incidents of vandalism (Cunneen and O'Neil, 2022; Hern, 2021; Malone-Kircher, 2016). Still, the long-standing success of the Wikipedia project helps highlight how a decentralized structure may actually help improve the quality of the content (**Box 3.4**).

BOX 3.4:

Wikipedia has used the power of collaborative content creation

Launched in 2001, Wikipedia is a free online encyclopedia that anyone can use and, most importantly, edit. Unlike most other reference sources, its content is continuously created and updated collaboratively by largely anonymous volunteers (Rosenzweig, 2006).

Paradoxically, although Wikipedia's decentralized structure is the main source of concern regarding the reliability of its content, it is also at the heart of the project's strength. Popular articles are reviewed by thousands of people, a mass review system that can increase reliability (Cunneen and O'Neil, 2022). Because there is only one page for a given topic, broad groups of people are encouraged to transparently discuss and reach an agreement on what can or cannot be included, as opposed to other platforms where each person might upload their own version of a given event (Feldman, 2018). Moreover, Wikipedia has no leaders, which means that it is harder for individuals with power to get special treatment by appealing to a select few. The project has also developed numerous tools to prevent vandalism, including a semi-protected status for high-profile pages and IP tracking and blocking if necessary (Cohen, 2021).

Altogether, these strategies appear to work. A growing number of studies have pointed to the generally high reliability of Wikipedia articles. A study comparing Wikipedia with Encyclopædia Britannica found them to be of comparable accuracy (Giles, 2005). Other studies point to a high degree of accuracy in a variety of topics, including political science, history, pharmacology and medicine, even if concerns on readability and omissions remain (Azer et al., 2015; Kräenbring et al., 2014; Kupferberg, 2011; Rosenzweig, 2006). Wikipedia has become the main tool for fact-checking other major platforms such as YouTube and Facebook (Flynn, 2017; Glaser, 2018). In 2020, the World Health Organization partnered with the Wikimedia Foundation, the non-profit body which administers Wikipedia, to expand access to reliable and up-to-date COVID information (WHO, 2020).

Various strategies can help ensure minimum quality standards

Several strategies aimed at improving the quality of digital learning materials have been implemented. One is through the development of quality assurance frameworks. An example is the OpenupED quality label, applied to MOOCs in the European OpenupEd partnership, which was derived from the E-xcellence framework developed by Association of Distance Teaching Universities. OpenupED assesses institutional areas related to strategic management, curriculum design and staff and student support, as well as course components such as relevancy, student engagement and learning assessments (UNESCO and Commonwealth of Learning, 2016).

Other strategies opt for stronger government involvement and clearer ties with the formal education system. Several governments have been increasing their engagement with MOOCs as a way to increase access to post-secondary learning, while ensuring minimum standards (UNESCO and Commonwealth of Learning, 2016). In 2017, the Chinese government set quality criteria that allow a MOOC to be nationally recognized, as well as annual targets for the number of nationally recognized courses, reaching 3,000 by 2020 (Schaffhauser, 2019). In France, the Ministry of Higher Education launched the France Université Numérique in 2013, a MOOC platform that hosts courses from over 160 institutions, which reached over 2.5 million learners in 2021 (FUN-MOOC, 2022). The platform has strong data policy regulations, and offers verified certificates to learners who are observed through their webcams while taking exams online (Mongenet, 2016). In India, the National Education Policy 2020 allows students to take 40% of their degree online via the official MOOC platform Swayam, which was launched in 2017, up from 20%. Offering courses from over 135 Indian universities, the platform has the advantage of offering academic credit for courses and has already reached over 10 million learners (Shah, 2020b).

Another strategy is the development of alternative credentials. The European MOOC Consortium, coordinated by the European Association of Distance Teaching Universities, aims to increase the impact of MOOCs by developing a common framework for the recognition of micro-credentials in Europe (European MOOC Consortium, 2022). In 2021, over 1,600 micro-credential programmes were offered from the main global MOOC providers (Shah, 2021). Ideally, micro-credentials would ensure minimum standards have been met by both the institution and the learner, though currently the vast majority of alternative credentials still lack recognition and standardization (**Box 3.5**).

Some platforms hope to ensure minimum quality standards by recentralizing content production and increasing partnerships with well-known institutions. YouTube, for example, has been trying to control the quality

BOX 3.5:

Micro-credentials aim to recognize new forms of learning

Alternative credentials are being increasingly adopted for their flexibility in recognizing different forms of learning, and are directly associated with the digitalization of education (Chakroun and Keevy, 2018; Oliver, 2022) (**Focus 14.1**). The most common of them, the micro-credential, refers to 'a record of focused learning achievement verifying what the learner knows, understands or can do' that has 'stand-alone value and may also contribute to or complement other micro-credentials or macro-credentials, including through recognition of prior learning' (Oliver, 2022, p. 6).

Countries and regional organizations have been trying to develop frameworks and standards for micro-credentials in order to link them to minimum quality standards (Oliver, 2019). The European MOOC Consortium is working on a Common Micro-credential Framework to be used on a voluntary basis by MOOC providers, with the aim of micro-credentials becoming convertible into formal qualifications (European MOOC Consortium, 2019). Micro-credentials have also recently been included in the New Zealand Qualifications Framework (Wheelahan and Moodie, 2021). In Malaysia, the Malaysian Qualifications Agency formally implemented accreditation strategies for micro-credentials in higher education institutions in 2019 (Kumar et al., 2022). In the Netherlands and Norway, a 2021 consultation by the European Commission has led to discussions on embedding micro-credentials into formal vocational education and training (Cedefop, 2022).

Despite the potential, the impact of micro-credentials in both the labour market and higher education remains low (Cedefop, 2023). Employers are unable to understand, judge or compare the different types of micro-credentials available, and are concerned by the lack of quality assurance (Chakroun and Keevy, 2018). There is little standardization, even within the same micro-credential providers. The platform Coursera, for example, offers micro-credentials that vary from USD 27 to USD 636 in fees, from 1 to 15 months in length, and from 1 to 40 hours of reported effort a week (Pickard, 2018). There is also limited evidence of micro-credentials' ability to increase employment, advancement or earnings (Kato et al., 2020).

A specific type of digital credentials, the open badge, has been gaining ground as more learners engage with open content. The open badge contains specific metadata that allow people to verify the badge and obtain information on the skills acquired. It is distinguished by the fact that it is controlled by the badge earner instead of institutions, and that they must be issuable by, and shareable to, anyone (Clements et al., 2020). Unlike micro-credentials that aim to keep a strong link to the formal sector, the main goal of open badges is to recognize a wider range of forms of learning and give learners the possibility to customize the presentation of their skills (Blanc, 2019).

of videos by funnelling financing and resources to a few more trusted providers. In 2018, YouTube announced a new Learning Fund programme that will award USD 20 million to educational content creators with verified expertise and a minimum number of subscribers (Alexander, 2018). The company has also been increasing partnerships with well-established education institutions, such as the Lemann Foundation in Brazil, to improve quality control and therefore give advertisers safer channels for advertisements (Castillo, 2018; Ducard, 2018; Fundação Lemann, 2017).

TECHNOLOGY CAN REINFORCE GENDER, LANGUAGE AND CULTURAL INEQUALITIES IN CONTENT PRODUCTION

Although technology has decentralized content production and removed some barriers to participation, content is still mostly created by relatively privileged groups. Wikipedia allows content creation by anyone with an internet connection but has been widely criticized for a lack of diversity in its group of editors, mostly composed of white men. In 2021, only 15% of global contributors identified as women (Balch, 2019; Davis, 2021). A study of individual educational content creators with at least 1,000 subscribers on YouTube in Spain found that 76% of them were men. The gender gap is particularly pronounced in science and social science, and opposite to what is found among primary and secondary teachers in the country (OECD, 2022; Pattier, 2021). More than just reflecting existing inequality, technology may in fact exacerbate it.

In the Global South, one important challenge to the implementation of OER is the localization (or 'de-Westernization') of content (Janssen et al., 2023; Wimpenny et al., 2022). OER production and use is still largely concentrated in the Global North. A global consortium of institutions that collaborate on OER development, Open Education Global, had 236 members as of August 2022, of which 56% were from North America, 20% from Asia, 17% from Europe and only 7% from Africa, Latin America and Oceania combined (Janssen et al., 2023).

A study of higher education repositories with OER collections found that nearly 90% of them were created either in Europe or in North America (Santos-Hermosa et al., 2017). Of all the repositories in OpenDOAR, one of the main OER repositories worldwide, over 40% are from North America and Western Europe (Dawson and Yang, 2016; OpenDOAR, 2022).

In addition, despite the goal of reuse and adaptation, most of the OER works available worldwide are in English. The OER Commons is a global library of over 50,000 openly licensed resources in more than 100 languages, but 92% of the material is in English, 2.5% in Spanish and about 1.5% in French and Arabic (Janssen et al., 2023). OER remains particularly poorly developed in Arabic-speaking countries, with the exception of Bahrain and Saudi Arabia. A literature review and survey across 22 countries highlighted poor infrastructure and lack of teacher motivation and awareness of OER's potential as some of the main challenges. Another is a strong preference for Arabic resources, which are not as available (Butcher et al., 2023; Tlili et al., 2020).

> Despite the goal of reuse and adaptation, most of the OER works available worldwide are in English

Open licences and translation tools mean that content can be easily translated, but two challenges remain. First, finding relevant content is difficult when interfaces and metadata are only available in a few languages (Amiel, 2013). Second, simply translating content is not enough to make it contextually relevant (Butcher et al., 2023). The fact that OER tends to be used in its original form, as opposed to adapted and re-mixed, means that the overwhelming dominance of English materials may end up reinforcing cultural biases and the traditional philanthropic education model of donating resources produced in high-income countries. This model may hinder the creation of locally produced, contextually relevant content (Butcher et al., 2023; Hoosen and Butcher, 2019).

Still, several initiatives focus on locally producing OER. The Teacher Education in sub-Saharan Africa (TESSA) initiative, started in 2005, provides a bank of OER in English, Kiswahili, French and Arabic to support teacher education. One million pre-service or in-service teachers have used TESSA OER through partner institutions in the region, especially the Open Universities in Nigeria, South Africa and Sudan (Janssen et al., 2023). TESSA also helps develop local OER through collaborative creation in schools (TESSA, 2017). In Ghana, the Kwame Nkrumah University of Science and Technology has developed a national open access repository for health-related OER (Janssen et al., 2023).

One example of a cross-national OER initiative is the Virtual University for Small States of the Commonwealth. This initiative provides infrastructure to develop and use OER. The network of 32 countries in Africa, Asia and the Pacific, and the Caribbean engage in collaborative development and sharing of OER that is specifically focused on sustainable development. It aims to maintain the quality of resources by partnering with professionals and specialists, and by providing capacity development for OER producers (Janssen et al., 2023).

Several platforms help produce OER. An example is StoryWeaver, a non-profit initiative by Pratham Books in India that has become the largest global platform for OER multilingual stories that promotes minority languages. It has over 45,000 books in 323 languages, over 60% of which are indigenous languages and 10% are UNESCO-classified vulnerable or endangered languages. The platform also provides translation tools and the creation of bilingual storybooks in order to facilitate content creation and use in the classroom (Butcher et al., 2023).

Open access makes research free to read, but not to publish

The move towards open access to research may also reinforce biases of who gets published. There are currently two main paths towards open access: The 'green' open access when authors self-archive a copy of their article in a freely accessible repository and the 'gold' open access, which requires authors to publish their article in an open access journal (Tennant et al., 2016). Some 30% of articles registered in the Directory of Open Access Journals charge an article processing fee to authors (Directory of Open Access Journals, 2022). Fees can reach over USD 10,000 per article and are charged by major publishers such as Springer Nature, Elsevier and Taylor & Francis, restricting access from poorly funded authors or institutions (Johnson, 2019; Mehta, 2019; University of Cambridge, 2020).

In 2018, 11 European research funders, responsible for nearly USD 9 billion in scientific research grants annually, announced that any scientist they fund must make their results freely available immediately on publication (Else, 2018). The plan has been praised for its radical shift towards increasing access to scientific knowledge, but critics argue that its assumed preference for 'gold' open access, and its accompanying fee structure, effectively changes the business model from 'pay to read' to 'pay to publish', thus perpetuating inequality (Johnson, 2019). That same year, the Latin American Council of Social Sciences and Redalyc, a bibliographic database and digital library of open access journals, launched a cooperative infrastructure called AmeliCA, with UNESCO support, to fight against the 'pay to publish' model (Aguado-López and Becerril-Garcia, 2019). They advocate instead for a scholar-led, non-profit system of scholarly communication, common in Latin America.

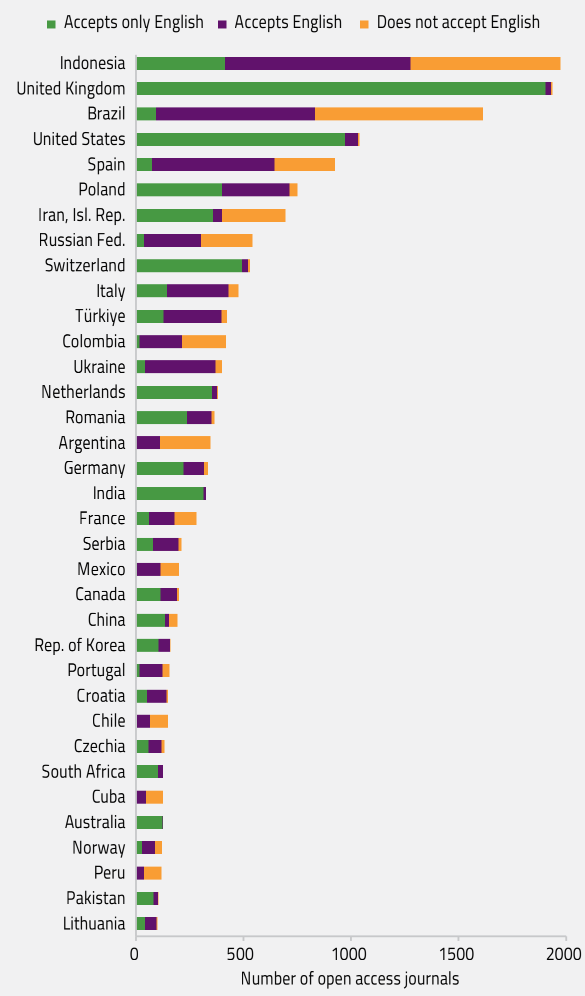
Latin America is known for the 'diamond' open access model, where open access journals do not charge any fees and are financed instead mostly by governments and academic institutions. A number of non-commercial publishing platforms have successfully emerged in the region, the first of which, Scielo, was launched in Brazil in 1997 and is considered one of the first open access collections in the world (Aguado-López and Becerril-Garcia, 2019; Tennant et al., 2016). A recent study shows that Latin America has more 'diamond' open access journals than Western Europe and Northern America combined, and that these journals make up 95% of all open access journals in this region. In comparison, 'diamond' journals make up only 55% of open access journals in Western Europe and 63% in Northern America (Bosman et al., 2021).

Research indexes can be another source of inequity in publishing. They are responsible for measuring the impact of each journal and have become gatekeepers to what is considered legitimate research. In addition to being accused of bias in favour of commercially published journals, they require journals to systematically publish English abstracts as well as a given percentage of English articles (some require that over half be in English), effectively contributing to global inequality in content production (Aguado-López and Becerril-Garcia, 2019; Bosman et al., 2021). The bias in favour of English can be observed in the number of open access journals that accept English submissions, sometimes exclusively, even in non-English speaking countries around the world (**Figure 3.3**).

FIGURE 3.3:

Most open access journals favour English submissions

Number of open access journals registered in the Directory of Open Access Journals, by country and languages accepted, 2022



GEM StatLink: https://bit.ly/GEM2023_fig3_3

Note: Data refer to countries with at least 50 journals registered in the Directory of Open Access Journals by July 2022.

Source: GEM Report analysis based on data from the Directory of Open Access Journals (2022).

TECHNOLOGY INCREASES ACCESS MOSTLY FOR THOSE WHO ALREADY HAVE IT

Access to digital content presupposes access to the internet, or at least to computers or mobile devices. However, even among those who have the infrastructure to access digital educational content, those most likely to do so continue to be the most privileged groups, reflecting existing education and skills inequalities. Users from rich countries are considerably overrepresented in the use of open access resources online. High-income countries account for about one quarter of global internet users, but nearly 70% of the traffic to Wikimedia projects (**Figure 3.4**). The Sci-Hub website, a shadow library that bypasses journal paywalls, was developed with the stated aim of helping poorer researchers from developing countries access scientific literature, yet less than 10% of downloads come from low- and lower-middle-income countries combined, even if the countries represent over 35% of global internet users (ITU, 2022; Sci-Hub, 2022).

> High-income countries account for about one quarter of global internet users, but nearly 70% of the traffic to Wikimedia projects

Data on MOOCs suggest similar findings. Learners from richer countries are not only more likely to participate but also to complete the courses and gain new competencies. A study of over 120 courses offered between 2013 and 2018 by edX, a major MOOC provider founded by Harvard and MIT, found that learners from high-income countries are more likely than their peers in low- and middle-income countries to complete the courses and to improve their competencies, as measured by course assessments (Sa'ar et al., 2021). In 2018, 56% of enrolments and 69% of certifications in the edX platform came from learners whose home country has a very high Human Development Index (Ruipérez-Valiente et al., 2019).

Even within countries, MOOCs cater to the most advantaged individuals. Numerous studies have highlighted that some 80% of learners in the major MOOC platforms already have a tertiary degree (Dillahunt et al., 2014; Meaney, 2018; Oudeweetering and Agirdag, 2018; Robinson et al., 2015). The typical MOOC learner is a professional searching for extra training who already has at least one post-secondary qualification (Oliver, 2022).

Several reasons help explain this bias in favour of learners from high socioeconomic backgrounds. Language is a major barrier to accessing MOOCs, as well as a lack of digital skills and access to the internet. English is the language of one quarter of internet users worldwide, but is the overwhelming language of instruction for MOOCs, particularly those with global or regional reach (Agudo, 2019; Belawati, 2019; Statista, 2022b). As well as difficulties following lectures, non-native English speakers may feel uncomfortable participating in discussion forums, which have been found to improve student engagement, completion and grades (Wang et al., 2015).

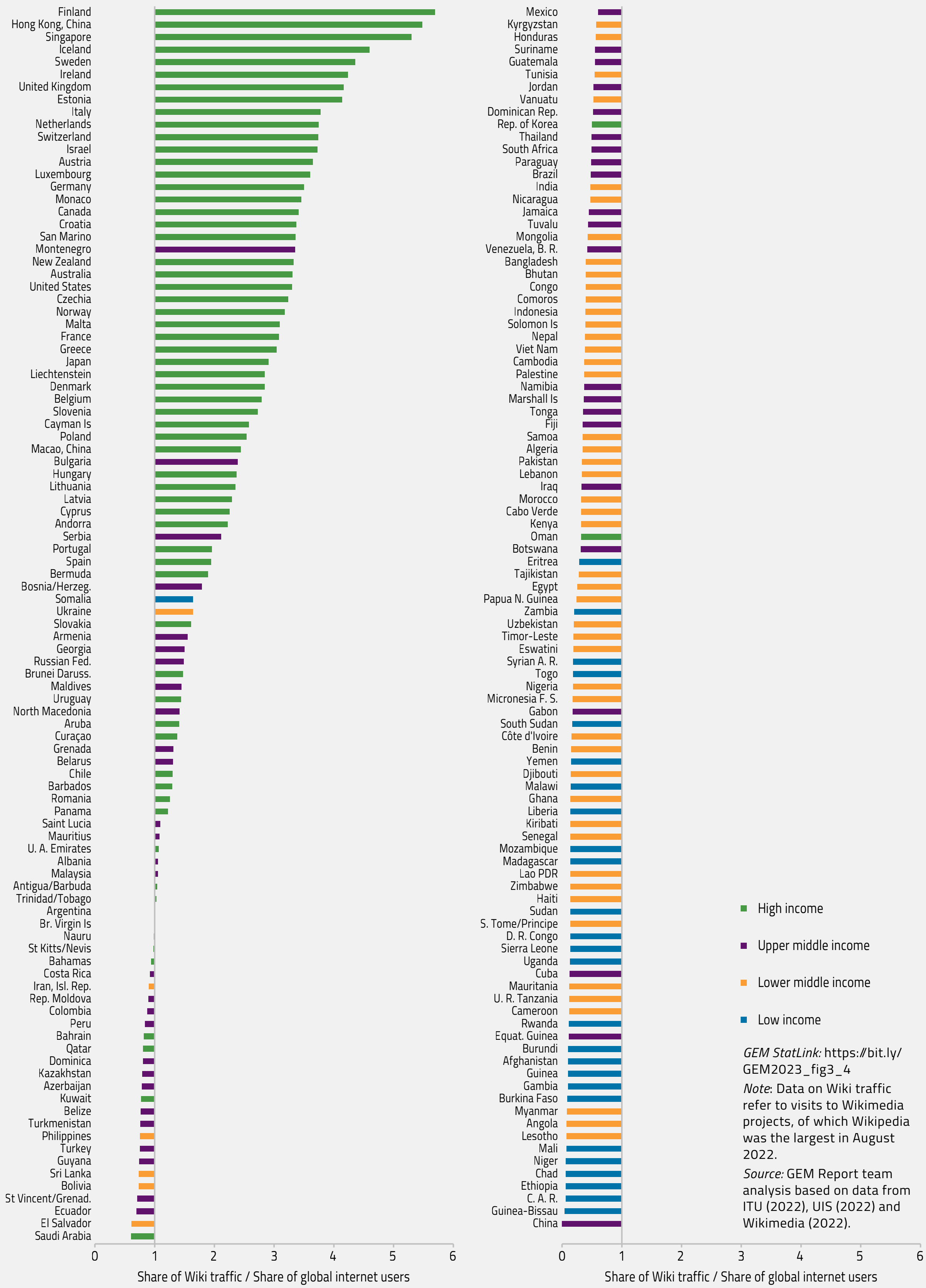
MOOCs may also exacerbate existing inequality by design. A focus on information transfer from lecturers to students and on marked assignments, for example, is likely to favour students who have experience in tertiary institutions. Moreover, because these users are highly educated, courses become increasingly designed for them (Meaney, 2018). Course design has a strong influence on the probability of learners from poorer countries completing a massive open online course (Sa'ar et al., 2021). Several universities in sub-Saharan Africa are hesitant to promote the large global MOOC providers because of incompatibilities in pedagogy and epistemology (Childs and Valeta, 2023).

National and regionally developed MOOC platforms are helping to bridge some of these gaps. Multilingual and non-English MOOCs have been successful at engaging more diverse regional learners with lower levels of education (Lambert, 2020). A study of the Arabic platform Edraak found that it is more effective at reaching Arabic-speaking, less educated and female learners compared to global MOOCs (Ruipérez-Valiente et al., 2019). A study of 15 different MOOC providers from 9 countries covering over 8 million learners found that regional providers are better at attracting a larger local population with a more inclusive profile by offering courses that are better catered to local needs, in local languages, and from institutions they already know (Ruipérez-Valiente et al., 2022). Still, critics argue that many of these local platforms continue to reproduce other inequalities, such as relying on video-centric content that requires a good internet connection, and teacher-centred learning and assessment (Bali and Aboulmagd, 2019).

FIGURE 3.4:

Internet users from rich countries are overrepresented in traffic to Wikipedia

Ratio of country share in access to Wiki pages to their share of global internet users, 2022



GEM StatLink: https://bit.ly/GEM2023_fig3_4

Note: Data on Wiki traffic refer to visits to Wikimedia projects, of which Wikipedia was the largest in August 2022.

Source: GEM Report team analysis based on data from ITU (2022), UIS (2022) and Wikimedia (2022).

CONCLUSION

Technology has the power to significantly improve access to content and, in many instances, it already has. Open educational resources help make content creation more affordable, efficient and inclusive. Collaborative tools and social media diversify production and can help with quality control. Digital libraries and repositories improve storage and distribution channels, and learning management platforms help organize the contemporary learning environment. Moreover, technology can remove many of the common barriers for accessing content, including language, cost and entry requirements.

Still, ensuring the quality and relevance of an overwhelming amount of digital educational content from decentralized producers is difficult. Governments have implemented several strategies to ensure minimum standards, including the development of quality assurance frameworks, alternative credentials, and recentralizing content production. However, they must also ensure that digital educational content strengthens national education systems, aligns with curricula and learning objectives and provides appropriate lifelong learning opportunities.

> Governments must ensure that digital educational content strengthens national education systems and aligns with curricula and learning objectives

Governments must also guarantee that technological advances do not leave learners further behind. The development of digital public goods and the use of free and open education resources are important steps in that direction. Making content production more inclusive is another. The supremacy of English and the main European languages and the need to 'de-Westernize' educational materials still pose significant barriers towards accessibility and use of digital content worldwide. Inclusive education resources should be available in different languages, adapted to different contexts and realities, and accessible by all learners.

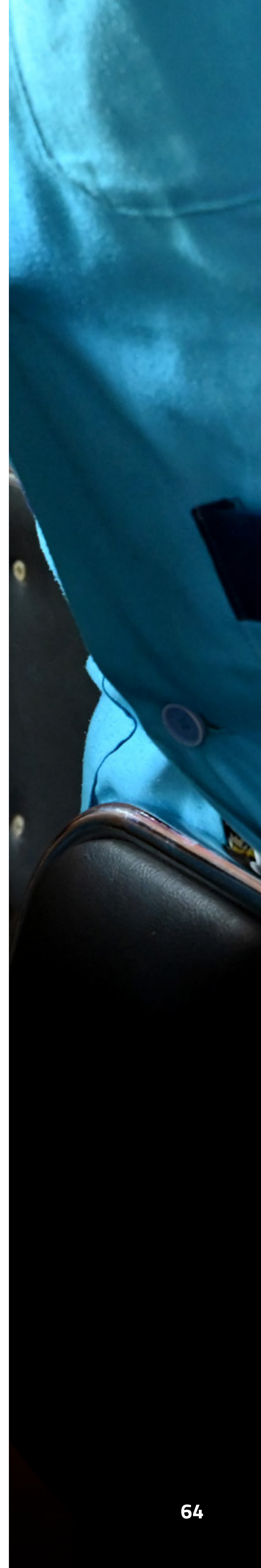
Children learn with tablets and computers in the Public Melen School of Yaoundé, the capital of Cameroon. The CONNECT MY SCHOOL initiative aims at building and expanding sustainable models for improved access to primary and secondary education through ICT.

Credit: UNICEF/UN0551722/Dejongh*

CHAPTER

4

Teaching and learning



KEY MESSAGES

Technology can facilitate teaching and learning processes but requires contextualization and integrated support.

Technology offers many potential benefits for teaching and learning but the evidence has major limitations.

- Systematic reviews of the past two decades find a small to medium positive effect of education technology on learning outcomes.
- But evaluations of what works are limited in geographical, subject and durational scope, and can often obscure the role of various pedagogical factors in influencing outcomes.
- Technology companies can have disproportionate influence. Pearson funded its own studies, contesting independent analysis showing no impact.

Technology does not need to be advanced to have an impact; it needs to be context specific.

- Pre-recorded lessons can reduce urban–rural teaching quality divides. In China, high-quality lesson recordings were delivered to 100 million rural students, improving student outcomes by 32% and reducing urban–rural earning gaps by 38%.
- Devices with pre-loaded content need contextualization and integration support. In Peru, the One Laptop Per Child programme distributed over 1 million laptops without any positive impact on learning.

Technology can improve instruction quality by adding time and personalization.

- Personalization software can monitor student progress and provide differentiated practice opportunities and feedback. Evaluations of the Ei Mindspark software in India documented learning gains in after-school settings and for low-performing students.

Digital technology improves student engagement, with appropriate pedagogical integration.

- Digital game-based applications improved cognitive and behavioural outcomes in primary and secondary mathematics in 43 studies published in 2008–19.
- Interactive whiteboards can potentially support the visual, auditory and tactile experiences of teaching and learning if well integrated. But in the United Kingdom, large-scale adoption was limited to uses such as blackboard replacement.
- Augmented and virtual reality technology can supplement practical training in science and vocational lessons.

Digital technology can facilitate regular parental communication to support children's learning.

- Sending caregivers regular nudges can positively influence learning outcomes. During COVID-19, Botswana's education ministry provided parents with over-the-phone tutoring for numeracy concepts, leading to learning outcome improvements.

ICT use carries a risk of increasing distraction and lowering student engagement.

- Technology use beyond a moderate threshold was associated with diminishing academic gains in an analysis of 2018 Programme for International Student Assessment data.
- A meta-analysis of research in 2008–17 across 14 countries found a negative effect of mobile phones on academic performance.
- COVID-19 online learning adversely affected younger learners. In Switzerland, secondary school children sustained their learning progress better than primary schoolgoers in online learning.

Technology's potential for teaching needs to be shown in practice 66
Technology is not used very extensively for teaching and learning 68
Evidence on technology's impact on learning is mixed 70
Digital technologies appear to improve student engagement 75
Intensive technology use negatively impacts student performance and increases disruption 81
Conclusion 82

Because digital technology impacts so many aspects of daily life, it is a reasonable assumption that its application in the classroom will automatically transform and improve teaching and learning. However, while students need to be taught about digital technology, as part of what is called 'digital literacy' **(Chapter 5)**, this does not necessarily mean that students need to be taught through digital technology. The value of digital technology for teaching and learning needs to be proven. The ways in which technology has been used over time to support teaching and learning continue to evolve, alongside a better understanding of how technology should be used.

This chapter focuses on how technology is being used to support teaching and learning. First, it presents the potential of and challenges posed by technology integration and describes key trends in technology use. Second, it reviews the evidence on the possible benefits of digital technologies for improving education quality, grouping them into two broad categories: those that directly focus on improving the quality of instruction, by distributing resources more equitably, personalizing and increasing practice opportunities; and those that seek to better engage learners.

> While students need to be taught about digital technology, this does not mean that students need to be taught through digital technology

TECHNOLOGY'S POTENTIAL FOR TEACHING NEEDS TO BE SHOWN IN PRACTICE

Views about how people learn have evolved considerably over the past 100 years. The earliest theories, known as behaviourism, saw learning as a process of receiving and accumulating knowledge in a programmed manner. The emphasis gradually shifted. Some theories, notably constructivism, recognized that individual learners 'construct' their knowledge through inquiry and experimentation. Others complemented this view with a sociocultural perspective, which recognizes that learning is enhanced through collaboration and support. In the digital era, a newer approach, described as connectivism, has drawn attention to the importance of learning through forming connections around information (Selwyn, 2022). Each theory helps explain the opportunities and limits of technology to mediate various kinds of learning.

There are two broad types of possibilities that technology offers for teaching and learning. First, technologies can improve the quality of instruction by redistributing resources, increasing chances to practise, supplementing instructional time and personalizing instruction (Escueta et al., 2020; Ganimian et al., 2020; Major et al., 2021). Second, technologies can engage and support learners by varying how content is represented, stimulating interaction and prompting collaboration (**Figure 4.1**).

TABLE 4.1:
Affordances of technology use in teaching and learning

Improve instructional quality	Engage and support learners
Pre-recorded or broadcast lessons Hardware preloaded with content Drill and practice software Software to supplement instructional time Personalized and adaptive software	Interactive whiteboards Digital games Simulations Collaborative digital tools ICT for communication with parents

Sources: GEM Report, adapted from Bulger (2016); Burns (2022); Escueta et al. (2020); Ganimian et al. (2020); Major and Francis (2020); Selwyn (2022); Topping et al. (2022).

Technology used in various combinations can achieve multiple objectives. Data and learning analytics can guide and customize learning experiences, whether they simply respond to learners or actively try to guide them adaptively (Bulger, 2016). Feedback can be more immediate and more accurate. Personalized tools can propose tailored content and activities (OECD, 2019). Students could spend less time in face-to-face and whole classroom instruction. Hybrid models of in-person and remote education could provide learners with materials to work from wherever they are, whenever they can. Self-paced and supplemented learning could help struggling learners (Duraiappah et al., 2021), even though information and communication technology (ICT) can distract learners and be used for leisure instead of study. Teachers can develop lessons for students to learn at their own pace through personalized and adaptive software, freeing up time for them to coach individual students or work with small groups (Bulman and Fairlie, 2016; Reich, 2020). Technology can be used to help prepare and deliver engaging lessons through such tools as interactive whiteboards in smart classrooms, simulations and collaborative learning. Cognitive load, i.e. how much information can be held in the working memory at the same time, can be reduced and student motivation increased if materials are presented using multimedia or digital games (Jamshidifarsani et al., 2019).

In high-income countries, some teachers report that technology-based tools improve learning. According to the 2018 International Computer and Information Literacy Study (ICILS), 87% of teachers in 12 participating education systems thought that ICT helped students work at a level appropriate to their learning needs and 78% that ICT enabled students to collaborate more effectively (Fraillon et al., 2019). In the United States, a 2019/20 survey found that about a third of public school representatives strongly agreed that technology use in the classroom helped students learn more in an independent and self-directed way, at their own pace, and collaboratively with peers. About half stated that teachers used technology to a moderate or large extent for classroom work that would not have been possible without it (Gray and Lewis, 2021). In Australia, a teacher survey of technology use in mathematics classrooms highlighted easier visualizations of mathematical concepts and student opportunities to work at their own pace and academic ability level (Attard and Holmes, 2022).

However, the fact that technology has the potential to support education systems does not necessarily mean that teaching processes and practices have been substantially transformed (Reich, 2020). Some who promote technology use in classrooms are accused of seeing technology as a solution to every education problem. But technology may not be the right approach to address contextual and systemic challenges that prevent learners from acquiring basic skills. Altering pedagogical practices in fundamental ways exerts pressure on teachers, staff, students, parents and caregivers who may be unprepared to deal with them or may disagree with the consequences. And far from being learner-centred, technology may promote a highly individualistic approach to gaining knowledge that undermines the collaboration and civic engagement that are needed in public institutions (Selwyn, 2022).

Embedding technology into learning processes has risks of its own. It can narrow learning priorities to those areas served best by the most marketed and accessible technological products. A large review of research focusing on the effectiveness of online and blended learning in schools found that many studies failed to report on all pedagogical elements, suggesting authors were 'digital enthusiasts who were less enthusiastic about pedagogy' (Topping et al., 2022). Moreover, the content of learning applications may not be focused on learning objectives. In the United Kingdom, a quarter of all commercial applications labelled as educational on the Google Play Store (Kanders et al., 2022) and the same share of the most popular mathematics applications in both the Apple and Google Play Stores (Outhwaite, Early, et al., 2022) did not include any explicit learning content.

Technology companies can have disproportionate influence. With tremendous incentives to show effectiveness, they may present only evidence that supports them. While independent evaluations of Successmaker, a reading and mathematics instruction tool, found negative or null effects on learning in the United States, Pearson – the company that developed the product – continues to publicize self-funded findings and conclusions of significant, positive effects (Mathewson and Butrymowicz, 2020).

> Technology companies may present only evidence that supports them

Key commercial actors act as both salespeople and advisors at the same time. Analysis of the networks and channels of influence in technology in Norway showed a direct link between industry, through the New Media Consortium, an international community of education technology actors, and the government, through the Centre for ICT in Education under the authority of the Ministry of Education and Research (Haugsbakk, 2021). In the Netherlands, international actors have become increasingly important in education technology. Google has an estimated 70% market share in primary education technology (Kerssens and Dijck, 2021). Intel is implementing artificial intelligence (AI) curricula in India for 22,000 schools with the Central Board for Secondary Education; in Poland, where the national AI curriculum is based on Intel's AI for Youth programme; and in the Republic of Korea, where the Ministry of Education has signed a memorandum of understanding to also scale AI for Youth (Intel Corporation, 2022).

TECHNOLOGY IS NOT USED VERY EXTENSIVELY FOR TEACHING AND LEARNING

Learning achievement surveys show that the prevalence of ICT usage in classrooms is not particularly high, even in the world's richest countries. According to the 2018 Programme for International Student Assessment (PISA), only about 10% of 15-year-old students in over 50 participating education systems used digital devices on average for more than one hour per week in mathematics and science lessons. Denmark was an outlier as the only country where more than half of students reported such use in both subjects. The next highest were Australia and Sweden (**Figure 4.1a**), with about one in three students in both countries reporting such use in science, but less in mathematics. The survey also collected information on the frequency with which students use digital devices at school for different purposes. For instance, just over one third of 15-year-olds reported using such devices at least once or twice per week for drills and practice.

According to the 2019 Trends in International Mathematics and Science Study (TIMSS), fewer than one in four students on average attended schools where science teachers carried out computer activities at least once or twice a week. The average prevalence did not increase between grades 4 and 8. More than two in three students were in schools that included computer activities in grade 8 science classes in Australia, New Zealand and the United States. By contrast, fewer than 5% of students attended such schools in Cyprus and France (Mullis et al., 2020) (**Figure 4.1b**).

The 2018 ICILS showed that considerable ICT resources were available in the 12 participating education systems, all but one from high-income countries. About 60% of grade 8 students – but 83% in Uruguay and over 90% in Denmark and Finland – studied in schools whose ICT coordinators reported there were practice programmes or applications. Single- or multi-user games were available to 5 in 10 and 3 in 10 students, respectively. Simulation and modelling software for classroom use were available for 42% of students, but this number ranged from 8% in Italy to 91% in Finland (Fraillon et al., 2019) (**Figure 4.2**).

Academic and market research sources provide complementary evidence on the characteristics of education technology products while not always clearly distinguishing whether they are also being used in classrooms. A global mapping of over 300 education technology products found that two thirds of them focused on student-led self-learning, lesson delivery and lesson preparation (Central Square Foundation, 2021). Analysis in Pakistan looked at 48 digital learning tools from 17 organizations, the fastest growing of which were active in profitable areas, such as examination preparation (Zubairi et al., 2022). An in-depth mapping of 50 digital learning platforms and tools in Latin America found that 14 tools used personalization to adapt to student learning levels, 12 used AI or machine learning, and 21 used gamification or play-based learning (Myers et al., 2022). Finally, a review of 40 out of over 1,000 personalized learning solutions in low- and middle-income countries categorized them by education purpose and setting. It found that almost two thirds were designed for supplemental learning only, offering multiple content, practice exercises, assessments and games, while three quarters could be used both in school and at home (UNICEF, 2022).

Some governments ambitiously aim for comprehensive integration of ICT in teaching and learning while others may prioritize, for example, personalization of learning, learning resource quality improvement and classroom infrastructure. In Estonia, the government began using ICT for school connectivity and teacher support reforms in the 1990s. Subsequently, curricula required the integration of digital technology in all subjects, signalling a move to digital culture integration in the Digital Turn Programme 2015–2018 and the Estonian Lifelong Learning Strategy 2020 (Pata et al., 2022).

A 2018 review of education policy in the United States found that 39 out of 50 states had adopted policies to deliver personalized learning opportunities, allowing preschools and schools to define what personalization means and how to implement it. Responding to the Every Student Succeeds Act, which was signed in 2015, 17 states incorporated personalized learning into their policies, while 19 states aimed to ensure all students had a personalized learning plan aligned to their academic needs, interests and goals (Zhang et al., 2020).

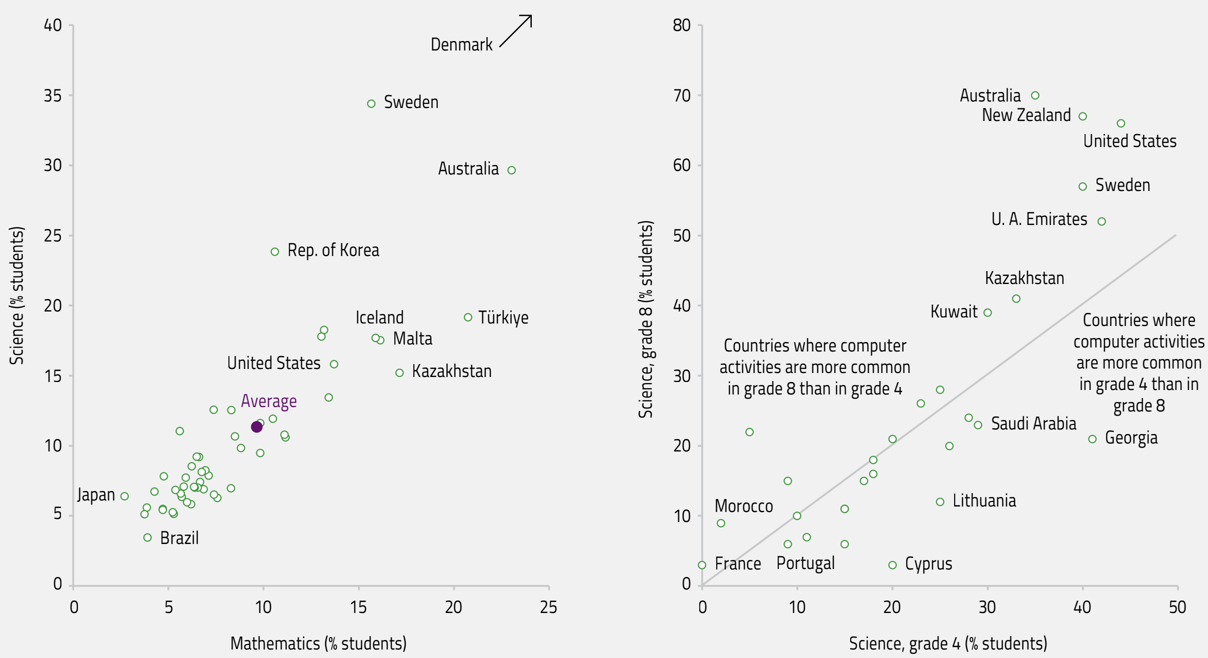
In India, the National Education Policy 2020 highlighted the need for technological interventions to improve instruction, learning and teacher professional development (India Ministry of Human Resource Development, 2020). Since the COVID-19 pandemic, in states such as Uttar Pradesh, there have been initiatives to use education technology products on a large scale to support improvements to foundational literacy and numeracy (Agrawal, 2023). Haryana became the first state to scale up personalized adaptive learning, selecting an education technology partner to provide relevant software and content on 500,000 tablets distributed to public school students (Hindustan Times, 2022).

FIGURE 4.1:

Even in upper-middle- and high-income countries, technology use in mathematics and science classrooms is not high

a. Percentage of 15-year-old students who used digital devices for at least one hour per week in mathematics or science classroom lessons, selected upper-middle and high-income countries, 2018

b. Percentage of grade 4 and 8 students in classes whose science teachers reported doing computer activities at least once or twice a week, 2019



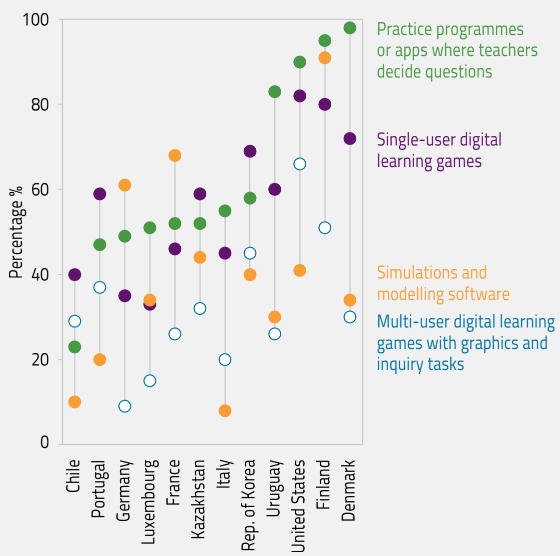
GEM StatLink: https://bit.ly/GEM2023_fig4_1a
Source: 2018 PISA database.

GEM StatLink: https://bit.ly/GEM2023_fig4_1b
Source: 2019 TIMSS database.

FIGURE 4.2:

Software resources are fairly common in schools in high-income countries

Percentage of students at schools where ICT coordinators indicated that selected software-related resources were available for teaching and learning, 2018



GEM StatLink: https://bit.ly/GEM2023_fig4_2
Source: 2018 ICILS.

Few countries are integrating AI in their education systems. Analysis of 24 national strategies launched between 2016 and 2020 found that while most discussed how to use education to develop expertise in this field, only one third highlighted integration of AI into teaching and learning. India and Kenya aspired to integrate AI to improve quality, while Malta and Spain viewed AI more as a complement to education to free up teacher time (Schiff, 2022). Another global survey found that only 11 of 51 countries had developed and implemented AI curricula (UNESCO, 2022).

> “Few countries are integrating artificial intelligence in their education systems”

Another major initiative is resourcing ‘smart’ classrooms, expanding digital infrastructure and enhancing interactivity through multimedia modes. China launched Smart Education Pilot Zones in 2019 to pursue various objectives for demonstration purposes, including using AI and big data to assess student learning and offering personalized services for teachers and students (IITE, 2022). In Guyana, the 2021 ICT in education policy and master plan aimed to provide computer labs and smart classrooms in primary and secondary schools. More resources are being allocated through the Support for Educational Recovery and Transformation Project for interactive screens and projectors in grades 2 to 6 (Guyana Ministry of Education, 2021:2022). In Rwanda, between 2016 and 2021, about half of the secondary schools were covered by the Smart Classroom initiative, equipping them with laptops connected to the internet as well as a projector (Resilient Digital Africa, 2021).

EVIDENCE ON TECHNOLOGY’S IMPACT ON LEARNING IS MIXED

Evidence on how technology interventions affect learning should inform the adoption and scaling up of technology use in education settings. Systematic, comprehensive reviews over the past two decades on the effects of the use of technology on learning generally find small to medium positive effects on learning outcomes compared to traditional instruction (Cheung and Slavin, 2013; Lewin et al., 2019; Topping et al., 2022). For instance, three recent meta-analyses, which reviewed a total of 272 studies at various education levels and in various countries, found an average positive impact of medium size (Chauhan, 2017; Hillmayr et al., 2020; Kärchner et al., 2022).

However, evaluations sometimes lack a control group. This makes it difficult to assess the impact of technology use compared to the same setting with a different medium of teaching or learning, and to attribute any positive effects to technology rather than other factors, such as added instruction, more resources or additional teacher support (Mayer et al., 2019). Moreover, research varies widely in terms of the duration of interventions, technology scope, education levels covered, contexts and samples. For instance, the duration of interventions affects the size of effects: some meta-analyses that investigated the effects of digital tools on learning have found that the longer the intervention, the smaller the impact (Hillmayr et al., 2020; Sung et al., 2016). As syntheses of existing evidence may obscure the mechanisms of impact, it is important to separately examine evaluations of individual types of technology-based learning interventions.

PRE-RECORDED OR BROADCAST LESSONS CAN SUPPORT DISADVANTAGED LEARNERS

Pre-recorded lessons are available in various formats – audio, television, tablets, desktop computers, laptops – to reduce gaps in access and learning **(Chapter 2)**. Transmitting live lectures directly to the classroom or using recordings can help teachers focus their time and efforts on integrating the lessons covered in the lectures rather than on preparing content. In India, technology-aided satellite teaching replaced one third of classroom teaching in more than 1,800 rural government secondary schools, resulting in improved mathematics and science scores (Naik et al., 2020). Introduced in 2004, the Modern Distance Education Program in Rural China policy is considered the largest education technology intervention ever implemented (**Box 4.1**). Analysis of a similar but smaller scale programme with computer-assisted teaching in China, conducted with 25 mathematics teachers and almost 2,000 students, found that it had improved lower secondary student performance. One third of the effect was attributed to improved instructional quality of local teachers who used lecture videos in lesson preparation (Li et al., 2023).

Various conditions need to be fulfilled for such interventions to succeed. It is not enough to just deliver materials without contextualizing them and providing support (**Box 4.2**). Teachers need to be integrated into these efforts. Randomized controlled trials of the e-Learn Project in Punjab province, Pakistan, evaluated two models of tablet integration. The first provided students with tablets preloaded with learning content and video explanations while the second provided teachers with the tablets to use for classroom teaching and to guide students. Compared to control groups, student achievement, as measured by mathematics and science test scores, decreased in the first model and improved in the second (Beg et al. 2019). ProFuturo, a large-scale technology-assisted learning programme implemented in Latin American, Asian and African countries, assists over 400,000 primary school teachers with tablets or computers preloaded with core educational content. An impact evaluation of the programme in Luanda, Angola, found that it had improved active teaching time and drill and practice exercises, which in turn improved student learning (Cardim et al., 2021).

Attributing effects to technology can be difficult for programmes with multiple components. For example, in Ghana, an intervention provided live, interactive satellite-transmitted lessons from Accra to 70 remote primary schools. The intervention included multiple components: a highly qualified teacher who provided the lecture over the broadcast, an additional teacher in the classroom, teacher training and sustained support, monetary incentives for teachers and for replacement teachers to tackle absenteeism, and shifting the curricular focus to basic building blocks to target teaching at the appropriate level. After two years, there was a gain in numeracy and literacy to which multiple factors beyond broadcasting contributed: local facilitators were more likely to be present, to teach in local languages and to target populations in need of remedial support (Johnston and Ksoll, 2022).

BOX 4.1:

Connecting urban with rural teachers helped improve student outcomes in China

A 2004 reform connected high-quality teachers in urban areas with more than 100 million students in rural primary and lower secondary schools in China. Over four years, the programme provided 264,000 satellite-receiving sets and 440,000 DVD player sets, while it built almost 41,000 computer rooms in rural schools. The interventions varied by school size: small primary schools received only DVD player sets, primary schools received DVD player sets and satellite sets, and lower secondary schools received all three interventions. Lectures and other study materials were then distributed to these rural schools.

The Ministry of Education selected the most accomplished teachers to record lectures and supporting materials such as interactive quizzes. Once these lectures were broadcast, local teachers helped solve technical issues and ensured that students focused on class-related activities. The objective was for the lectures to be integrated and not viewed as a separate teaching aid. Teachers delivered the lecture at a slow pace, repeating difficult content several times. The Ministry regularly reviewed and updated these lectures, using student and teacher feedback.

An impact evaluation between 7 and 10 years after the start of the intervention showed that it had increased Chinese and mathematics skills by 32% among lower secondary school students. In the longer term, students exposed to the intervention were more likely to be employed in occupations that focused on cognitive skills instead of manual skills. Exposure to the programme also led to an 18% reduction in the education attainment gap and a 38% reduction in the earning gap between urban and rural areas (Bianchi et al., 2022).

> It is not enough to just deliver materials without contextualizing them and providing support. Teachers need to be involved.

COMPUTER-ASSISTED SOFTWARE AND APPLICATIONS SUPPORT DRILL AND PRACTICE

Teachers in the United States have used drill and practice software extensively since the mid-1980s to help students master concepts. Meta-analyses showed that drill and practice applications that reinforced traditional instruction were more effective than tutorial applications that substituted for human instruction (Carnoy, 2004). Drill and practice applications include digital flashcard activities, in which students respond and receive feedback from the programme, and branching drills, where each question is determined by whether the previous one was answered correctly (Kuiper and Pater-Sneep, 2014). An in-depth review of design elements of 23 mathematics applications used by children in the first three years of school in Brazil, Canada, China, Malawi, Sweden, the United Arab Emirates, the United Kingdom and the United States showed that targeted practice was the most common objective. Most applications targeted basic number skills while more advanced mathematics skills, such as fractions, were less frequently included (Outhwaite, Ang, et al., 2022).

Practice-based educational applications have been developed by the non-profit organization onebillion to improve foundational learning in seven countries. In Malawi, an e-learning platform for government primary schools was loaded with the applications, which included over 4,000 activity units targeting specific mathematics and reading skills, enabling self-paced learning, individualized reward, and feedback upon interaction with the software. Children learned through low-cost tablets. The software recorded application use in school and fed the information back to teachers. Early primary schooling outcomes were improved and the use of these applications has been scaled up through iterative evaluations (Pitchford et al., 2018; Pitchford, 2022).

Foreign language learning typically uses drill and practice software, but few of these applications have been rigorously evaluated. Applications such as Quizlet, launched in 2007, focus on developing ready-to-use sets of online flashcards for various languages (Sippel, 2022). Analysis of lower secondary schools in the Republic of Korea found that students who had used Quizlet scored better on vocabulary tests than students receiving traditional teacher-led instruction (Cho, 2021).

Evaluations in the use of Quizlet in university settings in Japan and Saudi Arabia showed significant improvement in vocabulary learning after 10 weeks and 1 month respectively (Dizon, 2016; Sanosi, 2018). But evaluations of Duolingo, a widely used foreign language application, which includes drill-focused instructional methods and game-based components, have generally been quantitative or based on purposive samples, with limited investigation on how the learning was facilitated (Shortt et al., 2021).

BOX 4.2:

Preloaded content needs to be adapted to context and come with tailored support

In the early 2000s, there was much optimism that the One Laptop Per Child project and other free device initiatives would help educate children in low- and middle-income countries (Warschauer and Ames, 2010). The model provided low-cost, low-maintenance laptops with low connectivity requirements and loaded with open-source learning materials which had been developed for free. The laptops aimed to promote learning by doing, encouraging students to share their experiences and learn together.

Several studies have documented the failure – in particular for girls – of the One Laptop Per Child and related models focused on hardware to improve learning outcomes (Evans and Yuan, 2021; Gupta and Sarin, 2022; Jordan and Myers, 2022). Reasons for failure include overambitious costing plans, unsustainability in local contexts and inadequate integration into pedagogical processes (Ames, 2019; Souter, 2021).

Peru had the largest One Laptop Per Child programme globally, with over 900,000 laptops distributed to rural, disadvantaged students (Trucano, 2012). An evaluation of data collected after 15 months of implementation in 318 rural primary schools showed that the programme had no positive impact on mathematics and language test scores, although there was some inconclusive evidence on positive effects on general cognitive skills. Implementation challenges and a lack of integration into existing pedagogical practices prevented learning gains. While the programme's aim was for laptops to be used at home and at school, only about 40% of students were taking the laptops home. While the laptops were preloaded with age-appropriate e-books, a lack of internet access and interfaces meant that it was difficult for children to install other games or applications (Cristia et al., 2017). Teachers were trained to use the laptops and the software but less so to implement the programme in classroom work. In practice, laptops were being used to copy texts from the blackboard. Students also learned how to do creative activities, but there was little pedagogical work (Cueto, 2023).

SUPPLEMENTING INSTRUCTIONAL TIME CAN DELIVER GOOD OUTCOMES WITH TEACHER SUPPORT

Several large-scale interventions have focused on computer-assisted interventions that involve games or practice sessions. In Morazan, El Salvador, after-school, offline delivery of the Khan Academy portal in grades 3 to 6 in 300 primary schools provided two additional lessons of 90 minutes per week of additional mathematics instruction, effectively doubling it. An evaluation found that teacher-assisted Khan Academy lessons outperformed the traditional approach to teaching mathematics (Buchel et al., 2020).

Comparing in-school and after-school versions of the same intervention shows that the latter tend to deliver better outcomes. In the Indian state of Gujarat, a computer-assisted learning model was provided to a relatively well-functioning network of schools run by a non-governmental organization. The programme was not used as a substitute for the teacher-delivered curriculum. Applying the model in school was found to reduce student learning, but when implemented as a complementary after-school programme, it generated large gains, especially for weaker and older students (Linden, 2008).

Three experiments in China provide evidence on the potential of technology when used as a supplementary intervention. First, an intervention which provided two 40-minute computer-assisted sessions per subject per week in 171 primary schools and required students to practice playing games was more effective when implemented outside school (Mo et al, 2015). Second, a computer-assisted learning programme in rural public schools was more effective when implemented by a non-governmental organization than a government agency because it was less likely to have been used to substitute for regular instruction and had more direct monitoring. Benefits likely came from the extra instructional time that was facilitated rather than the computer-assisted aspect of the programme (Mo et al., 2020). Third, another experiment with more than 4,000 students in rural China similarly showed that while a computer-assisted learning programme appeared to enhance academic outcomes, it was not the technology component that made the difference (Ma et al., 2020).

Advancements in educational platforms and tools powered by AI may allow time spent on repetitive tasks, such as preparing teaching resources and assessments, to be redirected towards facilitating classroom discussion (Bhutoria, 2022). But computer software can also disrupt teaching time and demands additional teacher inputs. A programme that provided supplemental mathematics software and instruction in 52 low-performing primary schools in the US state of California found that 2 years of its use produced no effect. Only 21% of teachers were observed drawing connections between the games and what the class was learning. The ability of such games to teach skills that transfer to the mathematics classroom may have been lower than expected and the programme required classroom teachers to reinforce and create linkages (Rutherford et al., 2014).

PERSONALIZATION AND SOFTWARE ADAPTATION CAN TARGET SUPPORT TO STUDENTS

There is a general trend towards enhancing personalization features that adapt or adjust to student learning levels. Personalized adaptive software generates analytics that can help teachers track student progress, identify error patterns, provide differentiated opportunities for practice, make feedback more specific and reduce teacher workload on routine tasks (Baker, 2016).

> “Personalized adaptive software generates analytics that can help teachers carry out a variety of routine tasks”

Rigorous evaluations of commercial software mostly come from the United States. They tend to have mixed results. The mathematics homework platform ASSISTments uses formative assessment to give students immediate feedback and guide teachers to use the data. An evaluation among grade 7 students in 43 schools in the US state of Maine showed that students used the programme for less than 10 minutes per day, 3 to 4 times per week and improved mathematics scores by 0.18 standard deviations (Roschelle et al., 2016), which is considered a low impact. Students with low prior mathematics achievement benefited the most: they may have benefited from teachers targeting their homework review around common errors or deeper discussions around solutions (Murphy et al., 2020).

The Carnegie Learning MATHia software provides students with one-to-one coaching in mathematics. A study in 147 schools across 7 states showed that its implementation improved the median upper secondary school student’s performance by approximately eight percentile points (Pane et al., 2013). A 2021 study based on longitudinal data from 100,000 students in the US state of Florida found that using MATHia in lower secondary school led to better outcomes in algebra, especially for weaker students (Student Achievement Partners, 2021).

Not all widely used software interventions have strong evidence of positive effects compared to teacher-led instruction. ALEKS, an AI learning and assessment system, has been used by over 25 million students for mathematics, chemistry, statistics and accounting in the United States. A meta-analysis of 15 empirical studies between 2005 and 2015 found that it was as good as, but not better than, traditional classroom teaching (Fang et al., 2019). An updated analysis found that it was more effective when used to supplement traditional instruction (Sun et al., 2021).

A meta-analysis of 16 randomized controlled trials of digital personalized learning initiatives in low- and middle-income countries found a significant positive, if moderate, effect. Approaches which adapt to the learners' level had a significantly greater impact on learning than those that do not (Major et al., 2021).

Geekie, a Brazilian adaptive learning programme, uses machine learning to provide personalized learning. It flags specific learning difficulties encountered by students, helping teachers intervene as necessary. An analysis conducted with 400 schools, 14,000 teachers and 130,000 families found that Geekie was highly rated, but evaluations of such commercial products typically do not include impact assessments (Myers et al., 2022). Personalized adaptive learning is also spreading in India. Evaluations of one software tool documented learning gains for weak students (**Box 4.3**).

Artificial intelligence may be built into personalized adaptive technology software to help select the most appropriate content. For instance, writing tools can scaffold student writing by automating proofreading, translating and providing feedback (Yan, 2023). Secondary school students using Google Translate in Chile as part of an English as a foreign language course significantly improved their writing style and accuracy relative to those who did not use the tool (Cancino and Panes, 2021). Teachers evaluated positively writing assignments completed with Google Translate in a Hong Kong, China primary school on grammar, vocabulary and comprehensibility (Stapleton and Kin, 2019). But such positive evaluations analyse the finished products, not how students engaged and learned with these tools (Stevenson and Phakiti, 2019). Students might focus on correcting their errors and not on constructively applying the feedback to improve their writing (Koltovskaia, 2020). Similarly, overdependence on chatbots like ChatGPT may reduce students' higher order

BOX 4.3:

A commercial personalized adaptive software in India has invested in its evaluation

Mindspark, developed by Educational Initiatives, is a fee-charging software service focused on personalized learning for English, mathematics and science. The software includes an extensive item-level database of test questions and student responses to benchmark students' initial learning level and help personalize the material. Partnerships have been reached with state governments, for instance, of Rajasthan (Bhargava, 2022). During the COVID-19 pandemic, the software was made available online in 10 states across India for learners to use at home (Ei Shiksha, 2021).

The effectiveness of the software was evaluated in after-school centres and public and private schools in India. In after-school centres serving low-income neighbourhoods in Delhi, Ei Mindspark was used for 6 days of instruction per week for 90 minutes per day: 45 minutes of self-driven learning and 45 minutes of instructional support from a teaching assistant. Attending the centres for 90 days resulted in significant gains in mathematics and language, with relatively higher gains for students who performed worse at the baseline. The effect is linked to combining the computer-aided learning programme, group-based instruction and extra instructional time. The evaluation argued that the positive effect could be attributed to the programme's adaptiveness and its ability to target instructional materials at the level of the student, since a comparable after-school tutoring programme in operation at the same time had no impact on test scores (Muralidharan et al., 2019).

In less disadvantaged schools, studies showed that the software helped with remediation in mathematics. One study focused on independent practice among students in grades 4 to 7 in unaided private schools in 7 cities. After six months, additional time on practice had no effect on the average student's achievement, but students who initially had low performance slightly outperformed similar students who did not use the software (de Barros et al., 2022). Another impact analysis focused on students in grades 6 to 8 in 15 model public schools. After nine months, personalized learning had no effect on the achievement of the average student but students with low initial performance outperformed their counterparts by 0.22 standard deviations, a small effect, helping them catch up with their peers (de Barros and Ganimian, 2021).

cognitive skills, such as creativity, critical thinking, reasoning and problem-solving. By simplifying the process of obtaining information it can negatively impact student motivation to perform independent research and derive solutions (Kasneci et al., 2023).

DIGITAL TECHNOLOGIES APPEAR TO IMPROVE STUDENT ENGAGEMENT

Digital technologies – games, interactive whiteboards, simulators and collaboration tools – when effectively integrated in pedagogy by teachers and with appropriately designed features can engage students through varied representations and interaction. Some of these tools can also enhance parental and caregiver support and indirectly affect student outcomes.

DIGITAL GAMES FACILITATE KNOWLEDGE ACQUISITION IN INTERACTIVE WAYS

Educational games and the incorporation of gamification elements in digital learning can improve academic and non-academic skills through increasing learners' interaction (Schindler et al., 2017). Playing computer games has been found to support learning in science, mathematics and second languages compared to other forms of instruction. They can motivate students to initiate game play and persist in learning for longer durations (Mayer et al., 2019). A systematic review of 43 studies on digital game–based applications in mathematics education found a mostly positive impact on knowledge acquisition, cognitive skills and motivation to study mathematics (Hussein et al., 2022). In Brazil, a game-based intervention to help primary school students learn and practise four basic arithmetic operations using tablets involved playing the game for up to 20 minutes during the school day for two months. Compared to a control group, students' scores in mathematics increased, an impact that persisted a year after the evaluation (Hirata, 2022).

Game-based applications are being used more and more in low-resource settings to practise literacy and mathematics skills. In Cambodia, the Total Reading Approach for Children Plus initiative is a game-based application developed by a non-governmental organisation. It promoted early grade reading among struggling grade 1 to 3 students with a pedagogy that focused on practising the Khmer alphabet, vocabulary and phonetics, complementing the early grade reading curriculum. A study found positive perceptions of its impact on grade 2 and 3 students in reading. The interactive game-based nature, user-friendly interface and related instructional support engaged learners and educators, although the design needed further alignment to users' needs and capabilities (Oakley et al., 2022).

A systematic review of literature on mobile-learning applications targeting at refugees showed that one in three applications studied were learning approaches based on games (Drolia et al., 2022). In Jordan, using Feed the Monster, a game-based smartphone application, for 22 hours over 2 months improved foundational literacy skills among Syrian refugee children. The game also increased peer interaction and received positive feedback from parents (Koval-Saifi and Plass, 2018).

A review of empirical and theoretical studies on gamification showed that gaming strategies and features, such as multimedia, graphics, role playing, competition through leader boards and rewards with digital points and badges for completing activities, had a positive influence on students' motivation to learn, decision-making and collaboration skills (Dichev and Dicheva, 2017). Kahoot!, a game-based learning platform, was reportedly used by at least half of all students in the United States in 2022, as well as more than 24 million users and 8 million teachers globally (Kahoot!, 2023). A review of 93 studies found that Kahoot! can have a positive effect on learning compared to other tools and approaches, in various contexts and domains. Qualitative studies identified the use of leader boards, audiovisual features like high-quality animated graphics, individual feedback and increased classroom interaction as contributing to an engaging learning environment (Wang and Tahir, 2020).

Adult interaction can influence the learning impact of game-based interventions. GraphoGame is an adaptive digital game used in over 20 countries that promotes reading fluency by helping children develop sound–symbol connections. It automatizes repeated practice of word recognition and provides immediate feedback. A meta-analysis of 19 studies measuring its impact on word reading in multiple languages did not find an overall positive impact. However, while self-use was associated with no effect, adult involvement was associated with positive effects (McTigue et al., 2020). A French study of GraphoGame with a sample of grade 1 students from disadvantaged neighbourhoods found that 4 months of playing the game 4 times a week for 30 minutes had a positive impact on word-reading fluency, as teachers provided active support throughout (Lassault et al., 2022).

Augmented and virtual reality technology in games can also affect student attitudes towards certain subjects. A systematic review found that digital simulation–based games had a positive impact on learner motivation to study physics (Ullah et al., 2022). Simulations of real-world scenarios in digital games allow students to role-play, practise prosocial behaviours and learn decision-making in less intimidating virtual spaces (Rui, 2023). A game-based social and emotional learning programme for grade 3 students in the US state of California, including weekly videos with stories and narratives, a game and an assessment, improved interpersonal communications and skills, including emotional regulation and empathy, compared to a control group (Sanchez et al., 2017).

> Simulations of real-world scenarios in digital games allow students to role-play, practise prosocial behaviours and learn decision-making

INTERACTIVE WHITEBOARDS CAN ENGAGE LEARNERS TO SUPPORT LEARNING

Interactive whiteboards or smartboards can potentially support the visual, auditory and tactile experiences of teaching and learning (Abdullah et al., 2021). In European Union countries, the number of primary school students per interactive whiteboard halved from 111 in 2011/12 to 56 in 2017/18 (Deloitte and Ipsos MORI, 2019). A meta-analysis found smartboards to be more effective than traditional instruction based on lectures, due to their potential to engage learners. However, the effects may be linked less to their interactivity and more to the pedagogical approaches of the teachers using them, such as collaborative and active learning (Shi et al., 2020). Pedagogical integration of whiteboards by teachers determines whether they are used merely as projection tools or for effectively stimulating student interaction and classroom activities (De Vita et al., 2018).

Governments have significantly invested in interactive whiteboards with varied impacts. The United Kingdom was an early large-scale adopter in the 2000s. An evaluation of their pilot introduction in 200 classrooms found that teachers and 9- to 11-year-old students were overwhelmingly supportive (Thomas et al., 2010). As a result, the programme was scaled up and, by 2007, they were being used extensively in teaching (Smith et al., 2008). However, interactive whiteboards were often used simply as a replacement for blackboards and their interactive capabilities not necessarily used (DiGregorio and Sobel-Lojeski, 2010). In Türkiye, the Ministry of National Education introduced smartboards in more than 570,000 classrooms as part of a nationwide ICT reform project, starting in 2011, to integrate ICT into the education system (Esara and Sinan, 2017). A meta-analysis of 47 experimental studies on the use of smartboards in Turkish classrooms for multiple subjects found large positive effects on achievement (Akar, 2020).

When used as a teaching aid, smartboards can help explain complex concepts and save classroom time. As part of an effort to digitize primary schools in Senegal, an ICT intervention, Project Sankoré, introduced interactive whiteboards in classrooms along with pre-installed content software. An evaluation of 122 schools reported that the boards' visualization capabilities allowed teachers to not have to draw complex diagrams and use the saved time for class discussions. Student test scores improved in French, mathematics and life sciences (Lehrer et al., 2019).

The quality of teacher training is critical. In Catalonia, an autonomous community of Spain, a programme provided interactive whiteboards along with one-to-one devices to more than 600 schools. Teachers reported using interactive whiteboards mostly like a common projector to display digital textbooks and slides. But teachers who had received specialized training using examples from publishers and peers were more likely to use the boards interactively to generate content or allow students to write on them (Grimalt-Álvaro et al., 2019).

SIMULATION SUPPORTS EXPERIENTIAL TRAINING IN SCIENTIFIC AND TECHNOLOGICAL FIELDS

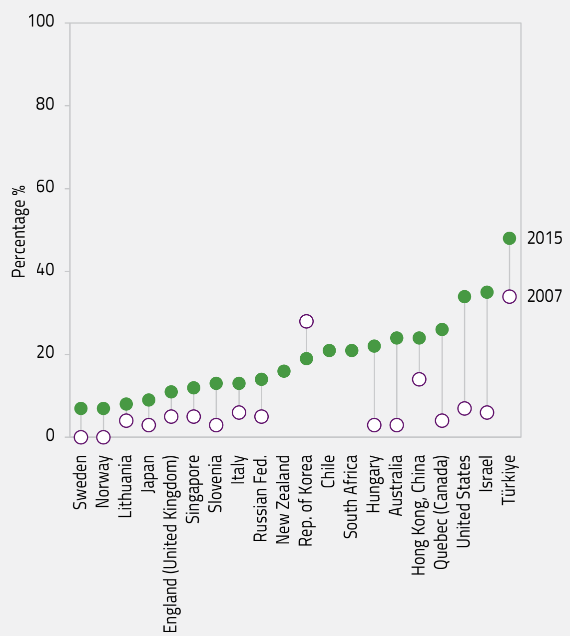
Augmented, mixed or virtual reality are being used as experiential learning tools, providing attractive visualizations, interactivity and opportunities for repeated practice in life-like conditions. Such simulations facilitate practical learning in fields such as medicine and engineering (Angel-Urdinola et al., 2021) but are also being used in secondary school science classrooms. According to teacher reported data in the TIMSS, the share of grade 8 students who experienced simulations in science classrooms increased by 12 percentage points between 2007 and 2015 but by twice as much in Israel and the United States. The highest share was observed in Türkiye, with half of students experiencing simulations (Vincent-Lancrin et al., 2019) (**Figure 4.3**).

Online science laboratories allow unlimited repetitions of experiments in a safe and cost-efficient manner; they can be software-based, virtual or remotely controlled physical laboratories (Potkonjak et al., 2016). The Global Online Science Labs for Inquiry Learning in Schools, or Go-Lab, initiative funded by the European Union provides access to 600 virtual laboratories to students and teachers of science, technology, engineering and mathematics in 50 countries in Europe and Africa, often in partnership with ministries of education (Go-Lab, 2023). The labs enable experiential, collaborative and inquiry-based learning by allowing teachers to demonstrate and students to conduct repeated and diverse scientific experiments. In Estonia, the University of Tartu Institute of Education has incorporated Go-Lab into teacher education programmes to foster a teaching culture that emphasizes inquiry and collaboration. The Ministry of Education has revised its digital science assessments, emphasizing scientific inquiry abilities drawing from Go-Lab's inquiry-based learning model (Gillet et al., 2017).

FIGURE 4.3:

More and more students are studying science with computer simulations

Percentage of grade 8 science students studying natural phenomena using computer simulations, selected countries, 2007 and 2015



GEM StatLink: https://bit.ly/GEM2023_fig4_3
Source: Adapted from Vincent-Lancrin et al, 2019)

> Training based on virtual reality may be less effective than real-life training but more effective than other digital methods such as video demonstrations

Practical training based on virtual reality may be less effective than real-life training but more effective than other digital methods such as video demonstrations. A meta-analysis of 145 empirical studies of technology effectiveness in simulation-based learning environments in tertiary education found that live simulations involving human patients in medical education had the highest positive impact on learning outcomes compared to all other digital simulations. However, compared to viewing two-dimensional computer screen simulations, virtual reality simulations were associated with larger positive effects, allowing for interaction and stimulating student sensory perceptions (Chernikova et al., 2020).

Simulated environments or digital three-dimensional models of workplaces support experiential learning that engages students, encourages inquiry and allows for repeated practice opportunities with reduced occupational risks and hazards (ILO, 2021). They can be an alternative for or supplement on-the-job training (OECD, 2021). Accordingly, augmented and virtual reality technology is being used in technical and vocational education and training (TVET) institutions. Denmark has established a Knowledge Centre to foster the use of advanced simulation technologies in TVET. In a survey of its social and healthcare programme students, almost 70% declared that virtual reality was an effective supplement to regular teaching and more than 40% reported improvements in learning outcomes (OECD, 2021).

MilleaLab, a software platform used to create virtual reality–based educational content, was developed in 2019 by a partnership between the Southeast Asian Ministers of Education Organisation Regional Open Learning Centre and the Indonesian TVET provider Shinta VR. Millealab has enabled access to virtual learning courses to 1,500 schools and has trained 5,200 teachers in the development and use of virtual reality–based learning content, even without them having coding skills knowledge (UNESCO-UNEVOC, 2021a).

Virtual reality training modules provide an interactive environment for students to train in preparation for the workplace (European Union, 2020) and some professions with high-risk work environments have adopted simulation technology in their training and assessment programmes (Morélot et al., 2021). In the Flemish Community of Belgium, teachers are developing high-quality virtual reality training modules as part of VRGhoote, a secondary TVET training initiative which allows students to safely train in a simulated high-risk work environment and practise operating machinery such as wind turbines (EU, 2020). In Ecuador, the Secretariat of Higher Education, Science, Technology and Innovation has implemented

BOX 4.4:

Flipped classrooms are changing instruction in higher education

Flipped classrooms, a type of blended pedagogical approach, are being employed in higher education, aided by the development of diverse technological tools for recording, editing and publishing videos, and online video platforms (Bredow et al., 2021; Robertson and Flowers, 2020). Students study the material before class, by watching online lectures or pre-recorded videos, at their own pace and apply the learning material during class, allowing the classroom experience to shift from being teacher-centred to learner-centred (Strelan et al., 2020).

This approach has been mainly evaluated in higher education settings (Jdaitawi, 2019) and notably in the United States and in Asian countries including China, Malaysia and the Republic of Korea (Kushairi and Ahmi, 2021). Given evidence that it improves student engagement (Lee, 2018), the Republic of Korea Ministry of Education has encouraged the use of flipped classrooms in higher education, especially for teaching science. Universities may make it mandatory for newly hired faculty to teach flipped classes across disciplines (Kim, 2021).

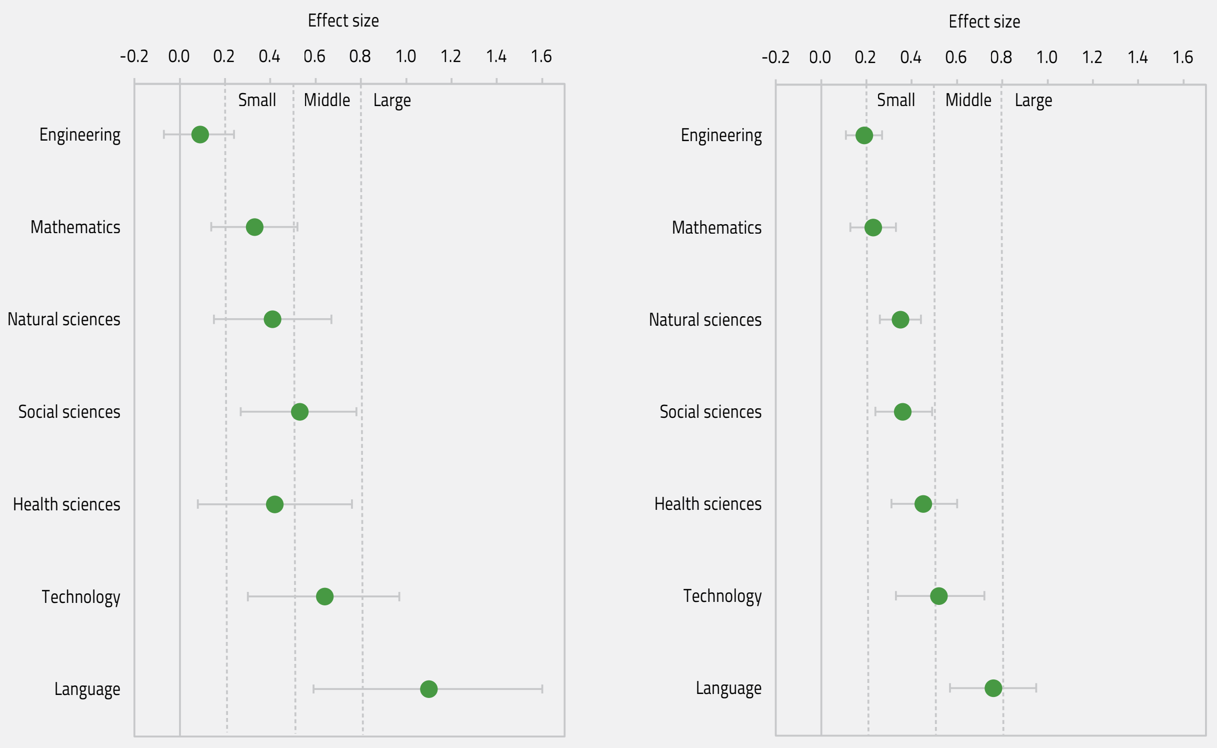
A meta-analysis of 95 studies showed that the flipped classroom model had a moderate positive effect on learning achievement and motivation compared to the traditional classroom model. In class, tools such as online discussion forums and games produced larger effect sizes than online learning platforms. Of the resources used before class, video recordings had the highest effect (Zheng et al., 2020). Effectiveness also varies by the subject taught. A review of more than 300 studies highlighted the positive effect on both academic and intra-/interpersonal outcomes of flipped classroom interventions using video support but the effect size was larger for language and technology than for engineering and mathematics (Bredow et al., 2021) (**Figure 4.4**).

FIGURE 4.4:

Flipped classrooms improve learning in a range of subjects

Average effect size of flipped classroom interventions in higher education, by subject matter, multiple studies, 2010s

a. Academic outcomes *b. Intra-/Interpersonal outcomes*



GEM StatLink: https://bit.ly/GEM2023_fig4_4
Note: Green dots show the average effect and the lines show the average variability of the estimates.
Source: Adapted from Bredow et al., (2021).

However, effective use of this pedagogical approach is contingent on students being able to self-regulate their learning and having ICT equipment at home (Lo and Hew, 2017). Teachers also need to be able to use classroom time to effectively stimulate student collaboration and need to prepare lessons before class. Adapting to two modes of instruction can increase their workload (Bülow, 2022).

ActiVaR, a national programme which integrates virtual reality technology to recreate hazardous situations, where students can gain practical experience in identifying and mitigating industrial risks. The added gamified experience allows students to practise and teachers to provide feedback in real time (Angel-Urdinola et al., 2022).

The COVID-19 crisis boosted TVET providers' use of simulation technologies as an alternative to practical on-the-job training. In Malaysia, the Tun Hussein Onn University developed the Digital TVET Learning Platform. Teachers integrated augmented and virtual reality components in their lessons to simulate real-life problems in classroom and laboratory activities (UNESCO-UNEVOC, 2021b). Yet according to a joint survey of TVET providers, policymakers and other stakeholders in 126 countries, less than 20% of upper-middle- and high-income country respondents reported using simulations, augmented and virtual reality tools (ILO et al., 2020).

COLLABORATIVE TECHNOLOGIES FOSTER COMMUNICATION AND CLASSROOM ENGAGEMENT

Digital technology can help students collaborate across boundaries, provide a visual representation of ongoing assignments, facilitate asynchronous group work and promote knowledge co-creation (Wang and Shen, 2023). In a meta-analysis of 425 empirical studies, almost all studies that explored the role of computers in fostering collaborative learning reported significant positive effects on student perceptions, group task performance and social interaction (Chen et al., 2018).

Online discussion forums and cloud-based word-processing platforms allow learners to collaborate on the same task at the same time (Wang and Shen, 2023). A review of 34 empirical studies on technology-supported collaborative writing found that wikis, Google Docs, offline word processors, Facebook, chats and forums had a positive impact on student engagement, group interaction and peer feedback (Zhang and Zou, 2021). In Bangladesh, students who used wikis for online collaborative writing had a positive perception of online word processing, such as being able to write and edit recursively (Ara, 2023). A quasi-experimental study in the Islamic Republic of Iran compared two classes of English learning and found that the use of Google Docs for peer editing improved learners' writing skills compared to traditional face-to-face settings (Ebadi and Rahimi, 2017).

Audio and video conferencing tools for synchronous and asynchronous distance learning can facilitate collaborative learning by reducing time and space barriers (Wang and Shen, 2023). Virtual learning environments encourage participation from more vulnerable and passive students by allowing them more time to think and reflect on their interventions that can be sent in writing compared to speaking up in traditional classroom settings (Chen et al., 2018). One such approach, the flipped classroom, combines face-to-face with online learning (**Box 4.4**).

However, collaborative learning pedagogies need to be integrated into the teaching process. A quantitative meta-analysis of 46 studies on augmented reality interventions indicated that the highest impact on learning outcomes was obtained when interventions employed a collaborative pedagogical approach (Garzón et al., 2020). Studies on online peer editing have emphasized that the quality of student interaction depends on the pedagogical approach employed by the teacher (Zhang et al., 2022). In Sweden, Write to Learn, a structured pedagogical approach to using ICT in early grades, emphasizes collaborative work and classroom interaction. For writing tasks, students use software to share their texts with peers and teachers continuously give and receive feedback during the process. An analysis of grade 1 and 3 students showed that 78% of students taught with this approach passed the national standard tests in literacy and mathematics, compared to 59% of those who followed the traditional method and 50% of those who used ICT without collaborative feedback (Genlott and Grönlund, 2016).

> “Short, light-touch, nudging interventions involve sending parents regular reminders to engage with their children's learning”

TECHNOLOGY HELPS PARENTS ENGAGE WITH THEIR CHILDREN'S LEARNING

Technology provides teachers with several low-cost and convenient ways to communicate up-to-date information to parents about their child's school progress (Nicolai et al., 2023). ICT can be used to improve parental knowledge and practices through training, informing and nudging them (Nicolai et al., 2023). Short, light-touch, nudging interventions involve sending parents regular reminders to engage with their children's learning using low-cost modalities, such as through text messages.

A systematic review of 29 studies found that such behavioural interventions resulted in improvements in academic outcomes (See et al., 2020), school attendance, and parental involvement in activities at home and in school (Berlinski et al., 2021). In Côte d'Ivoire, nudges were sent twice a week for a full year to caregivers in 100 public schools and were found, compared to a control group, to be associated with halving student dropout (Lichand and Wolf, 2020). In low-income neighbourhoods of Cape Town, South Africa, more than 1,000 households were sent weekly text messages to encourage children to regularly attend a government after-school programme. After 10 weeks, learners whose parents received text messages attended the sessions 6% more on average than learners who belonged to a control group (Owsley, 2017).

The Parent Engagement Project sent an average of 30 texts to each parent over an 11-month period in 36 English secondary schools. The texts included information on child performance and upcoming tests and assignments. An independent evaluation found that children whose parents received these texts improved their learning in mathematics by the equivalent of a month's worth of additional progress and reduced school absenteeism compared to children in the control group. Most parents accepted the content, frequency and timing of messages (Education Endowment Foundation, 2016).

READY4K!, a preschool literacy programme implemented in San Francisco, United States, sent parents three text messages per week over a duration of eight months on easy-to-implement home literacy activities. Children whose parents received these text messages performed higher in literacy tests, especially those who previously scored below the class median (York and Loeb, 2018). A smartphone application, EasyPeasy, sends parents of preschool age children weekly text messages with educational game ideas to implement at home. An evaluation of its implementation over 20 weeks in about 100 nurseries in the United Kingdom reported improvements in home learning activities (Robinson-Smith et al., 2019).

Moreover, learning with technology at home makes parental help particularly important so that students can apply the feedback received, as it became clear during COVID-19 (**Box 4.5**). Children sometimes struggle to use feedback received from education technology software without adult support (Vasalou et al., 2021).

BOX 4.5:

COVID-19 distance learning relied on engaging parents

During the COVID-19 school closures, governments used ICT to communicate with parents and caregivers to engage them to help their children's learning. Information campaigns using text messages and instant messaging platforms provided regular updates and shared resources for supporting home learning. After the closure for early childhood development centres, the Colombian Institute of Family Welfare launched a distance education initiative that targeted 1.7 million disadvantaged children. The programme relied on WhatsApp and other social media platforms to relay guidance to caregivers on simple pedagogical activities for children's development at home (Vincent-Lancrin et al., 2022). The Madhya Pradesh state department of education in India, under the #Ab padhai nahi rukegi (#Learning will not stop) campaign, created a WhatsApp group for each of its over 50,000 schools to share learning materials, which reached over 1.9 million parents and 200,000 teachers. A dedicated WhatsApp monitoring team was set up to oversee the content that was being circulated (Batra et al., 2022).

Schools and teachers engaged with parents using phone calls and instant messaging platforms to support them, deliver lessons and receive children's homework (Nicolai et al., 2023). In Botswana, the Ministry of Basic Education leveraged weekly text messages and phone calls from teachers to parents to continue implementing the Teaching at the Right Level programme to improve foundational literacy and numeracy. During the pandemic, parents received over-the-phone tutoring on basic numeracy concepts. An evaluation among 4,500 households found primary school children's foundational numeracy skills improving compared to a control group. Parents engaged more with their children in education activities and could correctly identify their child's learning level and needs (Angrist et al., 2022). In Mexico, teachers used WhatsApp to communicate with students and parents via text, collect pictures of student work, and answer student questions through voice or video calls (Castellanos-Reyes et al., 2022).

Despite their potential, the uptake and effectiveness of these interventions are limited by factors such as parental education levels, caregiver beliefs about education, and lack of time and material resources (Nicolai et al., 2023). A 24-week behavioural nudge via text messages to increase caregiver engagement in Ghana found that it increased at-home and in-school engagement of those who had attended school compared to their peers with no education (Aurino et al., 2022).

INTENSIVE TECHNOLOGY USE NEGATIVELY IMPACTS STUDENT PERFORMANCE AND INCREASES DISRUPTION

In contrast to digital technology's potential to improve education, there are also risks of ICT in education, which are often ignored by research and evaluations. Student use of devices beyond a moderate threshold may have a negative impact on academic performance. The use of smartphones and computers disrupts classroom and home learning activity. A meta-analysis of research on the relationship between student mobile phone use and educational outcomes covering students from pre-primary to higher education in 14 countries found a small negative effect, which was larger at the university level. The decline is mostly linked to increased distraction and time spent on non-academic activities during learning hours. Incoming notifications or the mere proximity of a mobile device can be a distraction, resulting in students losing their attention from the task at hand. The use of smartphones in classrooms leads to students engaging in non-school-related activities, which affects recall and comprehension (Kates et al., 2018). A study found that it can take students up to 20 minutes to refocus on what they were learning after engaging in a non-academic activity (Carrier et al., 2015; Dontre, 2021). Negative effects are also reported in students from the use of personal computers for non-academic activities during class, such as internet browsing, and in their peers who are in view of the screen (Hall et al., 2020).

Studies using data from large-scale international assessments, such as PISA, also indicate a negative association between excessive ICT use and student performance (Gorjón and Osés, 2022). By categorizing ICT usage at home and in school as low, medium or high, more intensive use beyond a threshold was most often found to be correlated with diminishing academic performance while moderate usage was most often associated with positive academic outcomes. Analysis of 2018 PISA data from 79 countries constructed an online activity index based on online activities such as emailing, scheduling events, web browsing and chatting. After controlling for various student-, school- and country-level factors, a positive association was found between ICT use and reading, mathematics and science scores up to a threshold of optimal use. Beyond a 'several times a week' threshold, diminishing academic gains were reported. The finding that excessive use of ICT does not provide extra returns beyond a level remained consistent across all socioeconomic categories of students (Bhutoria and Aljabri, 2022).

> “Incoming notifications or the mere proximity of a mobile device can be a distraction, leading to students losing their attention from the task at hand”

Medium levels of ICT use were consistently associated with better reading outcomes in another study that used PISA data. While the number of students classified as high ICT users rose between 2009 and 2018, significant positive impacts on academic outcomes were not observed (Borgonovi and Pokropek, 2021). After controlling for gender and socioeconomic status, analysis of 2015 PISA data from the Netherlands found that students with moderate access and use of ICT for homework, both at and outside school, had the highest reading performance (Gubbels et al., 2020).

Studies on teacher perceptions of the use of tablets and phones highlight difficulties in classroom management, when students visit websites other than those indicated by teachers or due to the increased level of noise in the classroom (Nikolopoulou, 2020). More than one in three teachers from seven countries that participated in the 2018 ICILS – and one in two teachers in Denmark – agreed that the use of ICT in classrooms distracts students from learning (Fraillon et al., 2020). The use of social media in the classroom is also disruptive, increasing academic distraction with negative effects on learning outcomes (Dontre, 2021). Analysis of PISA data between 2009 and 2018 showed a negative corelation between the use of social media in school and digital reading performance (Hu and Yu, 2021).

Online learning, such as during the COVID-19 pandemic, relies on student ability to self-regulate learning and may therefore put low-performing students further at risk of disengagement; experimental studies indicate that high-performing students find it easier to engage with technology in productive ways (Bergdahl et al., 2020). In Belgium, the Netherlands and Switzerland, not only did student performance decline, but inequality increased, likely due to factors such as a lack of family support. In the Netherlands, after eight weeks of school closure, learning losses were up to 60% greater among students whose parents were less educated (Azevedo et al., 2022). Analysis of more than 2.1 million primary and lower secondary school students in 10,000 schools in the United States found that schools in high-poverty neighbourhoods spent about 5.5 more weeks in remote instruction in 2020/21 compared to schools in low- and medium-poverty neighbourhoods and reported lower academic outcomes (Goldhaber et al., 2022).

The switch to online learning affected primary school learners more than older students, who may have been able to sustain their learning better in a remote environment. In Switzerland, in a comparison eight weeks before and during school closures, secondary school students sustained learning progress in online learning, while learning gains for primary school children slowed down. Both primary and secondary school children learned twice as fast from in-person instruction compared to remote instruction (Tomasik et al., 2021).

Apart from immediate disruptions to teaching and learning, the use of technology is associated with negative impacts on physical and mental well-being and increased susceptibility to online risks and harms, which affect academic performance in the long term. Education systems have adopted various approaches, ranging from restricting use of devices to banning them completely **(Chapter 8)**.

> “Positive impact is often dependent on strong pedagogical alignment and teacher input”

CONCLUSION

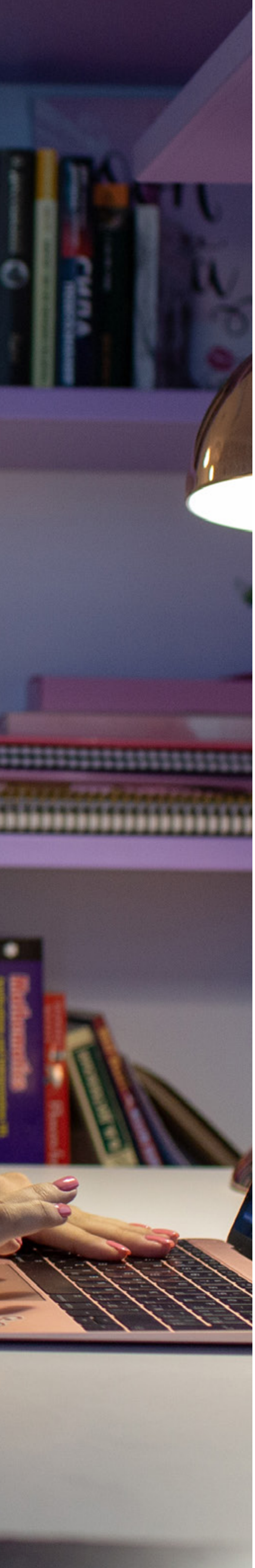
Technology has great promise for improving existing teaching and learning processes. However, evidence of success is limited and this is particularly true of large-scale research that systematically explores how technology can facilitate positive changes in a sustained way and in diverse contexts. Attributing conclusive, specific learning outcomes to hardware or software is challenging. Positive impact is often dependent on strong pedagogical alignment and teacher input.

Evidence on the use and effectiveness of technology shows that beyond affecting individual learning outcomes, it can both facilitate and disrupt teaching and learning processes. While technology offers many affordances – supplementing and personalizing instruction, offering more opportunities for practice, stimulating student engagement through audiovisual, interactive and collaborative ways – it can also increase the risk of distraction and disengagement.

Given the overwhelming number of technology products and platforms available, governments need to base their decisions on procurement and scaling up on reliable evidence that looks at the long-term effects of interventions, carefully considering all pedagogical elements involved. The design and delivery of education technology interventions need to be tailored to local contexts. Successful technology interventions rely upon the long-established building blocks of strong pedagogical integration by teachers, additional instructional time and robust facilitation.

Arai Beisenbaeva (17) is one of the online volunteers at the UNICEF campaign #ПайдасыБарКарантин#КарантинСПользой across Kazakhstan. Since the COVID-19 lockdown all her school classes and campaign participation have been conducted online.

Credit: UNICEF/UN0398146/Karimova*



CHAPTER

5

Digital skills

KEY MESSAGES

Countries are starting to define the digital skills they want to prioritize in curricula and assessment standards.

National digital skills standards are emerging.

- Digital skills' definitions constantly evolve. About 90% of countries aspire to develop digital skills, and 54% have established digital skills standards.
- The European Union's Digital Competence Framework, DigComp 2.2, is being used to develop strategies, curricula and assessment tools. But too many countries adopt digital skills frameworks developed by non-state, mostly commercial actors.

It is hard to measure digital skills.

- Commercial digital skills frameworks are narrower and usually tied to assessment tools that, for a fee, offer certification for labour market purposes. Government digital skills frameworks are broader but assessments vary by purpose, target group, uptake, item development, reliability, validity, delivery mode, cost, scalability and responsible authority.
- Assessments of digital skills need to address three issues: multidimensionality, comparability over time, and fairness.

Current measures suggest low digital skills levels and wide gaps.

- The gender gap in digital skills widens for particular skills. In 50 countries, just 3.2% of females compared to 6.5% of males can write a computer program.
- Digital skills vary by background. In Germany, 10% of adults whose parents did not attain upper secondary education achieved minimum proficiency level in problem-solving skills, compared with 53% of those with at least one parent who attained tertiary education.

Digital skills are acquired in formal education but often outside it.

- A 2011 household survey showed that most European adults gained their ICT skills informally. But a 2018 update showed that formal education could increase the probability of acquiring skills informally. Formal education systems need to accept, value and integrate the experience and knowledge students acquire outside school.

Countries have developed various ways to build digital skills.

- More than 50% of 15-year-old students in the 2018 Programme for International Student Assessment reported that they had been trained at school to recognize biased information.
- Communication and collaboration skills are promoted in schools through strategies other than in formal curricula. Argentina promotes teamwork and knowledge sharing through programming and robotics competitions.
- About 90% of 36 major universities in upper-middle- and high-income countries include intellectual property rights education in their courses.
- Prioritization of data privacy and security skills in school curricula is not yet common. Australia and New Zealand have incorporated these skills as a cross-curricular theme.
- Computer education is globally recognized for its importance in developing problem-solving skills, with mandatory computer science education in Europe and extensive computer science education pilots in Central Asia, Southeastern Asia and Latin America.

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Technology innovations – from the personal computer, the internet and search engines, to smartphones, social media and natural language models – are transforming the way people work and live, as individuals and as citizens. The pace of change is unrelenting. Boundaries between the physical world and the virtual world are becoming porous. People, businesses and machines are always 'on', hyperconnected, and the capacity to store and process data is expanding so much that analytics determine ever more aspects of everyday lives. People need new skills to navigate changing economies and societies, to make the most of opportunities as well as protect themselves from risks. They also need to know how to shield themselves and others from threats to security, freedoms and rights, and understand the import of behaving as responsibly in the digital world as they do in the physical one.

Today, two in three people in the world use the internet, ranging from 26% in low-income to 92% in high-income countries. Among young people, the ratio increases to three in four globally, ranging from 39% in low-income to 99% in high-income countries (ITU, 2022c). Additionally, people are using the internet for a wider variety of tasks. For instance, in Organisation for Economic Co-operation and Development (OECD) countries, the percentage of internet users who obtained information about goods and services on the internet increased from 40% in 2005 to 75% in 2021 (OECD, 2022).

> “People need new skills to navigate changing economies and societies”

The explosion in demand for skills to navigate the changing aspects of digital technology poses a major challenge to public education and training systems, for three reasons. First, there are multiple definitions of these skills. Some are narrowly related to job requirements, sometimes even associated with specific proprietary technologies. Education systems must clearly identify which skills are needed in order to prepare curricula. Second, it will be costly for education systems to develop the necessary conditions, including training educators, to keep up with a pace of change that well exceeds what education systems are used to: curricular reforms are estimated to take place every 10 years on average. Third, as a result of the slow pace of change in formal education and the rapid and constant generation and diffusion of technological innovation, digital skills are typically acquired out of school. In brief, public education and training systems cannot deliver all digital skills and have to prioritize an essential core set.

This chapter introduces a working definition, national frameworks and approaches to measurement of digital skills. Despite the fact that such skills are often acquired outside formal education systems, there are country efforts to develop them among children, youth and adults.

THE DEFINITION OF DIGITAL SKILLS MUST BE BROAD

The definition of digital skills has been evolving while digital technologies are evolving. Originally, they were viewed from an instrumental perspective that focused on the ability to use digital devices and online applications. The skills typically covered basic hardware and software operations, email, and search functions. While this definition is relatively easy to monitor, it is too narrow to be relevant for policy (van Dijk, 2020; Mattar et al., 2022). Skills, along with knowledge and attitudes, should not just enable people to use devices. Rather, they should empower people to use digital technologies with confidence to add value to their personal and professional lives, to treat content critically, to protect themselves from risks, and to act responsibly online so as not to harm others. The purpose of these competences is explicit in these definitions, as several organizations have tried to demonstrate (**Table 5.1**).

The definition offered by the European Commission, in particular, evolved over a decade through wide stakeholder consultation and an open validation process, including with the European Union's (EU) member states. It informs the Digital Competence Framework for Citizens (DigComp), which was also adopted as part of the Digital Literacy Global Framework (UIS, 2018) and is used as a basis for the analysis of digital skills in this chapter.

DigComp is structured along five dimensions (Vuorikari, Kluzer, et al., 2022b): 1) five competence areas (information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving); 2) twenty-one competences (**Table 5.2**); 3) eight proficiency levels (from foundational to highly specialized); underpinned by 4) multiple examples (knowledge, skills and attitudes); and 5) use cases (in employment and learning contexts) (Carretero et al., 2017).

NATIONAL DIGITAL SKILLS STANDARDS ARE EMERGING

An analysis of PEER country profiles for this report shows that 90% of countries aspire to develop digital skills. Overall, 46% of countries – ranging from 20% in sub-Saharan Africa to 80% in Europe and Northern America – appear to have identified digital skills standards for learners in a framework, policy, plan or strategy (**Figure 5.1**). More than 20 European countries have used the DigComp framework as a foundation for developing strategies, education programmes and assessment tools (Kluzer and Priego, 2018). Such standards can help guide education and training programmes. Germany's 16 federal states have developed a national competence framework and strategy to encompass various aspects of digital skills and associated teacher education, school resourcing and curriculum development (KMK, 2016). In England, United Kingdom, the Department for Education developed the Essential Digital Skills Framework through consultation with technology companies, banks, business consortia and civil society (Department of Education, 2018).

TABLE 5.1
Definitions of digital skills by four intergovernmental organizations

Body	Council of Europe	European Commission	International Telecommunication Union (ITU)	UNESCO
Term used	Digital citizenship	Digital competences	Digital skills	Digital skills
Definition	'competent and positive engagement with digital technologies (creating, working, sharing, socializing, investigating, playing, communicating and learning); participating actively and responsibly (values, attitudes, skills, knowledge) in communities … at all levels …; being involved in a double process of lifelong learning …; and'	'…confident, critical and responsible use of, and engagement with, digital technologies … information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety …, intellectual property related questions, problem solving and critical thinking'	'…ability to use ICTs in ways that help individuals'	'…a range of abilities to use digital devices, communication applications, and networks to access and manage information. They enable people to create and share digital content, communicate, collaborate, and solve problems'
Purpose	'continuously defending human dignity'	'for learning, at work, and for participation in society'	'to achieve beneficial, high-quality outcomes in everyday life for themselves and others and that reduce potential harm associated with more negative aspects of digital engagement'	'for effective and creative self-fulfilment in life, learning, work, and social activities at large'

Sources: Council of Europe (2017), European Commission (2019), ITU (2018), and UNESCO (2018).

TABLE 5.2
DigComp conceptual reference model

Competence areas	*Competences*
1. Information and data literacy	1.1 *Browsing, searching 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 appropriate digital communication means 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 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, and to deal with the data that one produces through several digital tools, environments and services.
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, and to understand risks and threats in digital environments. To know about safety and security measures and to 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 are 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 for 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 to solve them (from troubleshooting to solving more complex problems). 5.2 *Identifying needs and technological responses:* To assess needs and to 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). 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 problem 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 to keep up to date with the digital evolution.

Source: Vuorikari et al. (2022b).

Central and Southern Asia, and Eastern and South-eastern Asia, are the two other regions with the highest share of standard-setting countries. These are not limited to formal education. The Indian government adopted the Pradhan Mantri Gramin Digital Saksharta Abhiyan (Prime Minister's Rural Digital Literacy Campaign) to enable at least one member in 60 million rural households to operate digital devices, browse the internet, make digital payments and access public services. By mid-2022, 52 million had been trained and 39 million had had their training certified (India Ministry of Electronics and Information Technology, 2022, 2023).

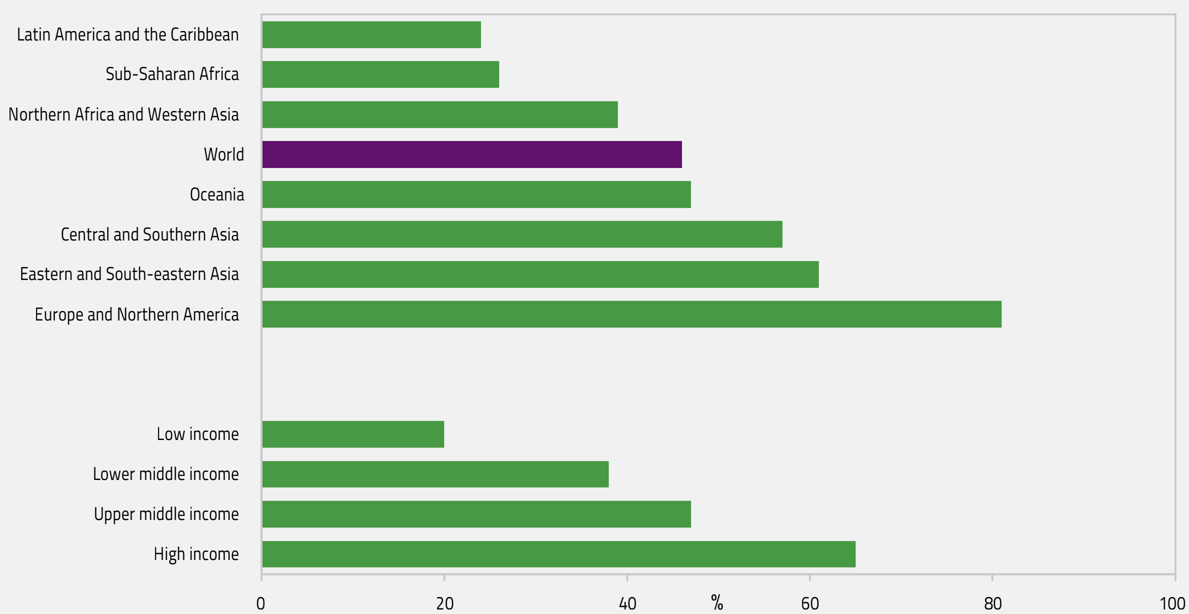
Some countries adopt digital skills frameworks developed by non-state, mostly commercial, actors. For instance, the International Computer Driving Licence (ICDL), developed by the non-profit European Computer Driving Licence (ECDL) Foundation, has been promoted as a 'digital skills standard' but is primarily associated with Microsoft applications, as is the Microsoft Digital Literacy Standard Curriculum (ICDL, 2023). The Certiport Internet and Computing Core Certification, a testing arm of the multinational publishing and education company Pearson, is presented as a 'worldwide benchmark' but is associated with selected major technology firms (Certiport, 2023). The DQ Institute, based in Singapore, has developed a digital intelligence framework, which was endorsed by the Institute of Electrical and Electronics Engineers Standards Association in 2020 (IEEE, 2020) and piloted with education ministries in Mexico, Thailand and Türkiye (Jackman et al., 2021).

A review of 47 countries at all income levels found that ICDL was adopted by two thirds of countries, while Certiport and the Microsoft Digital Literacy Standard Curriculum by about one fifth of countries (UIS, 2018). Kenya and Thailand have officially recognized and endorsed ICDL as the only digital literacy standard for use in schools, universities and training/education institutes (World Bank, 2020).

FIGURE 5.1:

More than half of countries do not have standards for digital skills

Percentage of education systems with defined digital skills standards, 2022



GEM StatLink: https://bit.ly/GEM2023_fig5_1

Source: GEM Report team analysis based on the PEER country profiles.

DIGITAL SKILLS ARE HARD TO MEASURE

Digital skills are difficult to measure. Commercial digital skills frameworks, which define skills narrowly, are usually tied to assessment tools offering certification that can be used for labour market purposes, for a fee. By contrast, government digital skills frameworks tend be broad. As a result, not all of these skills can be measured with one tool, as assessments can vary by purpose, target group, uptake, item development, reliability, validity, delivery mode, cost, scalability, and responsible authority (UNESCO, 2019).

THERE ARE CONCEPTUAL AND OPERATIONAL CHALLENGES IN MEASURING DIGITAL SKILLS

Assessments of digital skills need to address three problems (Reichert et al., 2023). The first is that digital literacy is multidimensional, and it has proven difficult to capture all dimensions in one assessment (Ihme et al., 2017). The second problem is comparability over time. Monitoring tracks specific digital skills development over time, but new technologies emerge constantly, making this difficult. Amending assessment frameworks and tools to capture these changes risks fundamentally changing the digital literacy concept being measured, and can make results non-comparable over time.

> Monitoring tracks specific digital skills development over time, but new technologies emerge constantly, making this difficult

The third problem is fairness. Valid comparisons between students by gender, socioeconomic status and country require assessment tasks and items that do not favour all groups. Biased items tend to be removed at the design stage, but meta-analyses show that some remain (Scherer and Siddiq, 2019). Access to digital devices and the internet, digital skills and school conditions are linked to socioeconomic divides (van Dijk, 2006, 2020). Also, biases can be exacerbated in cross-national assessments. However, one module related to problem-solving in technology-rich environments from the Programme for the International Assessment of Adult Competencies (PIAAC), used in 21 countries, was found to be suitable for country comparisons across gender, age groups, education levels and migration backgrounds (Gorges et al., 2017). The International Computer and Information Literacy Study (ICILS) also examines item-by-country interactions to detect culturally biased items, omitting those with large, country-specific effects (Fraillon et al., 2020). However, even in Denmark, Germany and Norway, which share cultural affinities, study participants found some ICILS tasks to have a different degree of difficulty (Bundsgaard, 2019).

There are also operational challenges. Assessments of digital skills are administered in either authentic or simulated software environments. Authentic software environments aim to ensure accuracy, yet the results may reflect familiarity with a specific software rather than general digital literacy (Reichert et al., 2020), so students more experienced in using the assessment software tend to obtain better test scores (UIS, 2018). Conversely, simulated environments simplify real-world software applications and may not fully capture student ability to handle tasks using common software applications (Reichert et al., 2020). Meanwhile, little is known about the effects of different digital devices on digital literacy performance, which may be relevant in self-administered assessments. Also, screen size, display resolution and display refresh rate can affect performance in computer-based tests (Bridgeman et al., 2003; Jensen, 2020).

CURRENT MEASURES SUGGEST LOW DIGITAL SKILL LEVELS AND WIDE GAPS

Existing assessments try to measure digital skill levels and progress, while acknowledging the challenges above. The SDG 4 monitoring framework initially tried to distinguish between a self-reported measure of 'information and communication technology (ICT) skills' (global indicator 4.4.1) based on household surveys and a directly assessed measure of 'digital literacy' (digital indicator 4.4.2). The first measure captures familiarity with selected practices, and the second measure captures some of the multiple dimensions of digital skills. However, in practice, it has not been possible to clearly separate the two concepts and their information sources.

Given the difficulty of carrying out direct assessments globally, recent efforts have focused on consolidating indicators. One example is the composite 'digital skills' indicator, developed by the European Commission (Vuorikari, Jerzak, et al., 2022a). Based on a self-reported survey in the European Union (EU) of ICT use by households and individuals, this composite indicator assesses whether individuals have performed selected activities on the internet, which have been mapped against the DigComp competence areas (**Table 5.3**). In total, 12 out of the 21 DigComp competences were captured by the survey, with ongoing efforts to adapt the tool in future iterations to meet emerging needs. One such example was the addition of a skill measure for safety in 2021.

TABLE 5.3

Questions used in the EU digital skills indicator, by DigComp competence area

Competence areas	*Questions related to:*
1. Information and data literacy	Finding information about goods or services Seeking health-related information Reading online news sites, newspapers or news magazines Activities related to fact-checking online information and its sources
2. Communication and collaboration	Sending/receiving emails Telephone/video calls over the internet Instant messaging Participating in social networks Expressing opinions on civic or political issues on websites or in social media Taking part in online consultations or voting to define civic or political issues
3. Digital content creation	Using word processing software Using spreadsheet software Editing photos, video or audio files Copying or moving files (such as documents, data, images, video) between folders, devices (via email, instant messaging, USB, cable) or on the cloud Creating files (such as documents, image, videos) incorporating several elements such as text, picture, table, chart, animation or sound Using advanced features of spreadsheet software (functions, formulas, macros and other developer functions) to organize, analyse, structure or modify data Writing code in a programming language
4. Safety	Managing access to own personal data by: … checking that the website where the respondent provided personal data was secure … reading privacy statements before providing personal data … restricting or refusing access to own geographical location … limiting access to profile or content on social networking sites or shared online storage … refusing/allowing use of personal data for advertising purposes Changing settings in own internet browser to prevent or limit cookies on any of the respondent devices
5. Problem solving	Downloading or installing software or apps Changing settings of software, app or device Online purchases (in the last 12 months) Selling online Using online learning resources Internet banking Looking for a job or sending a job application

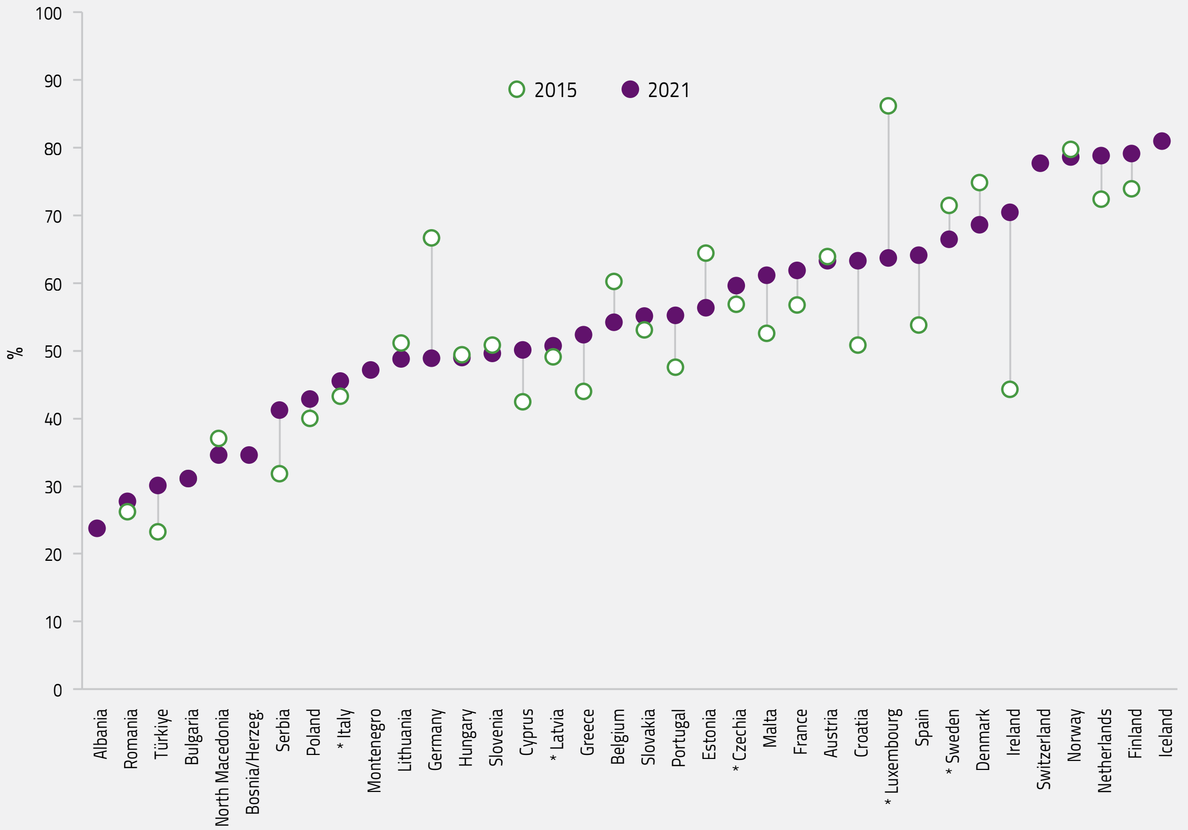
Source: Vuorikari et al. (2022a).

The digital skills indicator is being used to monitor the EU's Digital Decade target of 80% of adults in EU countries possessing at least basic digital skills by 2030. As of 2021, six levels of skill have been captured: none, limited, narrow, low, basic and above basic. Using this typology, 54% of adults in the 27 EU countries had at least basic skills in 2021; males were four percentage points higher than females. The indicator, which is also estimated for non-EU member neighbouring countries, ranged from 24% in Albania to 81% in Iceland (**Figure 5.2**).

FIGURE 5.2:

In Europe, just over one in two adults have basic digital skills

Share of 16- to 74-year-olds with at least basic digital skills, selected countries, 2015 and 2021



GEM StatLink: https://bit.ly/GEM2023_fig5_2

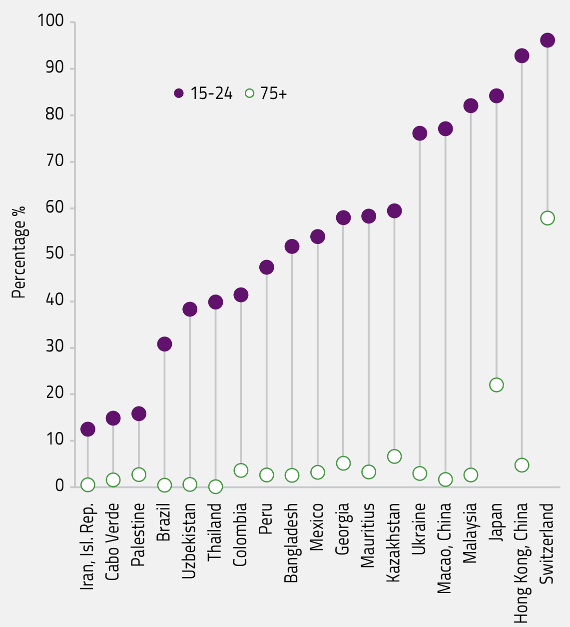
Notes: Individuals are considered to have at least basic skills if all five component indicators are at basic or above basic level. Countries with an asterisk changed the definition between 2015 and 2021.

Source: Eurostat (2023a).

The International Telecommunication Union (ITU) and the UNESCO Institute for Statistics (UIS) are co-custodian agencies of Sustainable Development Goal (SDG) global indicator 4.4.1, which measures in part the percentage of adults with ICT skills. They have recognized the need for the indicator to be founded on a robust framework. The ITU Expert Group on ICT Household Indicators has adopted the five DigComp competence areas, with a reduced set of questions relative to the EU digital skills indicator, as a future basis for indicator 4.4.1, aided by a pilot exercise in Brazil which supports a global applicability of this approach (ITU, 2022b). According to this study, 31% of Brazilian adults had at least basic skills, but with large, within-country differences: the level was twice as high in urban areas compared to rural areas, three times as high among those in the labour force as those outside it, and nine times as high among the top socioeconomic group as the two bottom groups (ITU, 2022a).

Too few countries currently report competence area data by DigComp and, even if they do, it is rarely for all five areas. For instance, 78 countries report data on problem solving while just 27 countries report data on safety (ITU, 2022c). For now, SDG global indicator 4.4.1 reporting by country is still limited to nine ICT-related activities, which, as in Brazil, reveal major differences between ages, sexes and locations, not only between but also within countries. For example, in 19 selected countries and territories, the percentage of 15- to 24-year-olds who could send e-mails with an attachment was about 40% in Colombia, Thailand and Uzbekistan but less than 5% among elderly adults over 75 years; the share of elderly adults who could do this exceeded 10% only in Japan (22%) and Switzerland (58%) (**Figure 5.3**).

FIGURE 5.3:
The digital divide in communicating by email shows a huge generational shift
Percentage of adults who can send emails with an attachment, by age, selected countries, 2019–21



GEM StatLink: https://bit.ly/GEM2023_fig5_3
Source: SDG Indicators Database.

> There is a gender gap in digital skills overall, but this gap widens conspicuously in relation to specific skills

There is a gender gap in digital skills overall, but this gap widens conspicuously in relation to specific skills. In a set of 50 countries and territories, 6.5% of males and 3.2% of females could write a computer program using a specialized programming language. The differences were particularly large in Belgium, Hungary and Switzerland, with no more than 2 women for every 10 men able to program. In contrast, Albania, Malaysia and Palestine reported 9 women for every 10 men could do so (**Figure 5.4**).

In a set of 42 countries, differences were also observed in the percentage of adults who can find, download, install and configure software between urban adults (34%) and rural adults (25%). The gap was some 15 percentage points in Bhutan, Mexico and Zimbabwe – and almost 30 in Bangladesh (**Figure 5.5**).

Significant gaps in socioeconomic status are also apparent in direct assessments that use a multidimensional framework of digital skills. Adults in selected upper-middle- and high-income countries took part in the PIAAC problem-solving in technology-rich environments module, which aims to monitor the capacity to communicate and obtain information through technology. In Germany, 10% of adults whose parents had not attained upper secondary education achieved Level 2, the minimum proficiency level, in such problem-solving skills compared to 53% of those with at least one parent who had attained tertiary education (**Figure 5.6**).

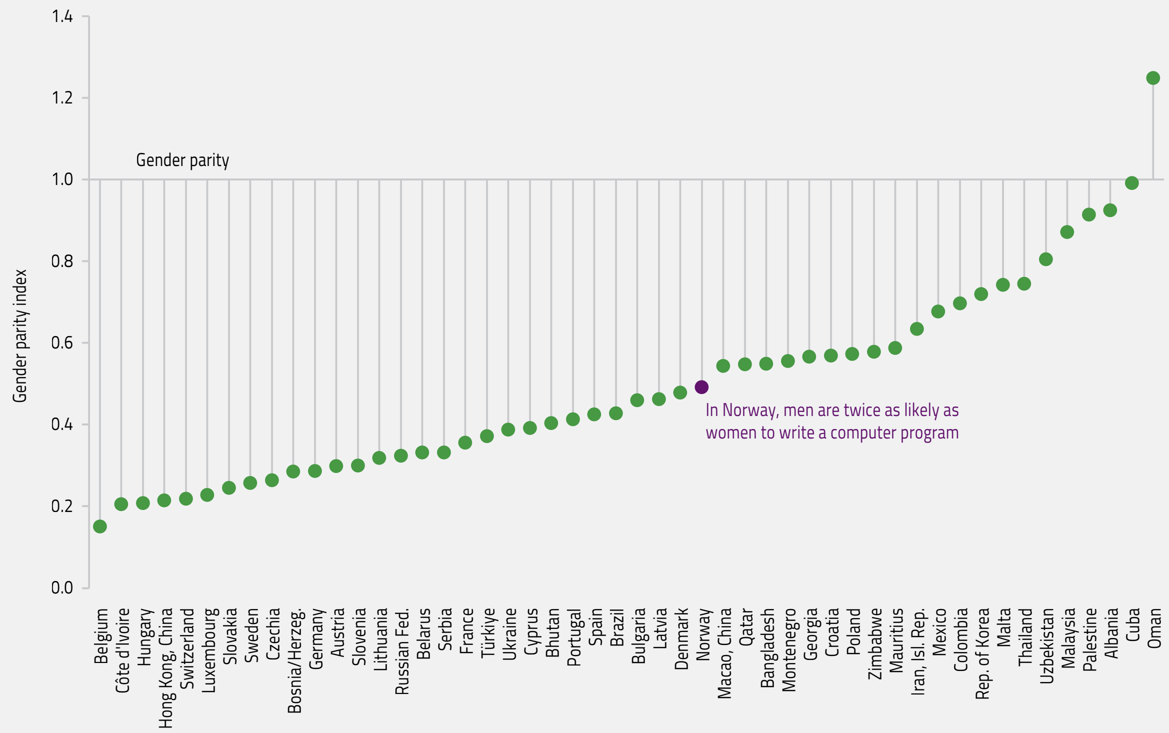
The 2018 ICILS, which was administered to grade 8 students, set a low threshold of 26 books at home to distinguish the disadvantaged from their more privileged peers. In Luxembourg and Uruguay, the average student with at least 26 books at home achieved minimum computer and information literacy, equivalent to Level 2, while those with fewer books at home scored an average of 60 points less on the ICILS scale (**Figure 5.7**).

Various surveys expose low levels of skills related to misinformation and online safety. In Singapore, a market research agency survey of adults found that although 80% of respondents expressed confidence in detecting fake news, 91% misidentified at least one fake news story as real (Huiwen, 2018). The United Kingdom's communications regulator found that 72% of 12- to 15-year-olds were aware of the concept of fake news, but only 40% said that they had ever seen something online that they thought was a fake news story (Ofcom, 2022). Learners also need skills to critically evaluate how information is generated. For example, according to the OECD's 2018 Programme for International Student Assessment (PISA), no more than 47% of 15-year-old students could distinguish facts from opinions in a text (OECD, 2021).

FIGURE 5.4:

Women are much less likely than men to know computer programming

Gender parity index in the reported ability to write a computer program using a specialized programming language, selected countries, 2019–21



GEM StatLink: https://bit.ly/GEM2023_fig5_4
Source: SDG Indicators Database.

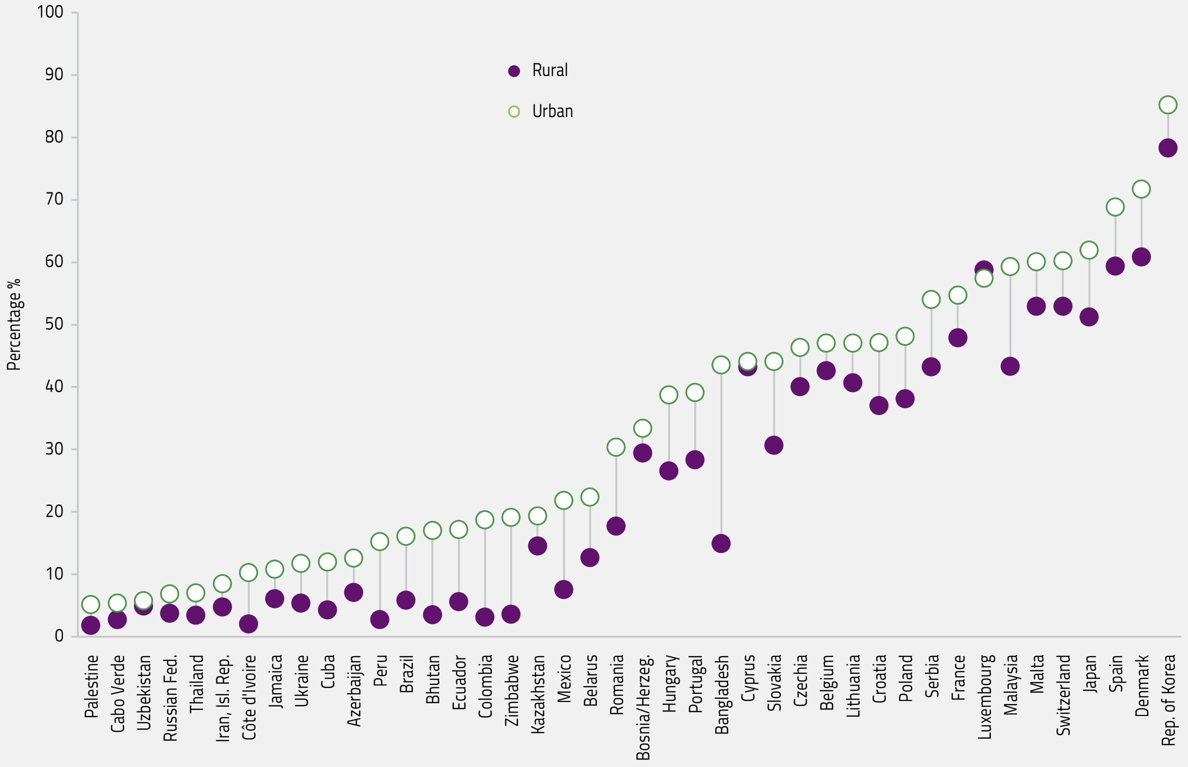
The 2018 PISA study, which also evaluated student responses to a scenario in which they received a typical phishing email – an attempt to get recipients to reveal personal information or install malicious software – suggested that 14% of 15-year-olds in participating education systems were at risk of being misled, ranging from 4% in Japan to 25% or more in Chile, Hungary and Mexico. Just 5% of those with the strongest reading skills on the PISA scale reported they would click the link, compared to 24% of those with the weakest reading skills (Jerim, 2023). This is a critical finding: basic skills such as literacy and numeracy also prepare people to better navigate a digital environment.

“Basic skills such as literacy and numeracy also prepare people to better navigate a digital environment”

FIGURE 5.5:

There is an urban-rural gap in the ability to handle software

Percentage of adults who can find, download, install and configure software, by location, selected countries, 2019–21

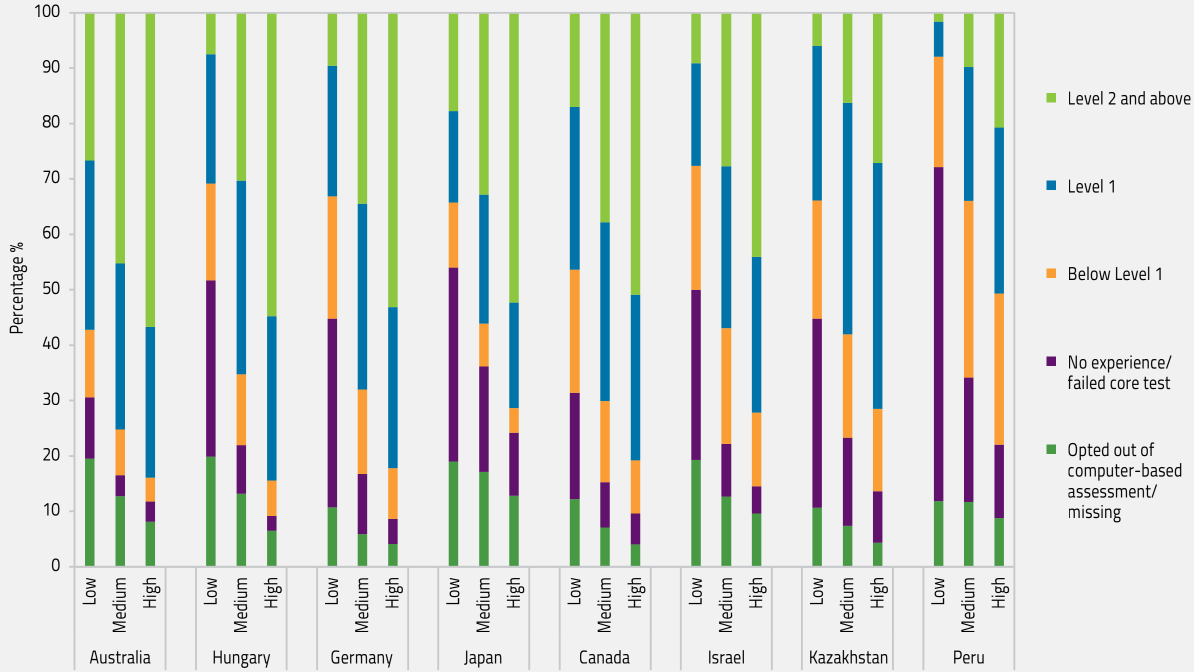


GEM StatLink: https://bit.ly/GEM2023_fig5_5
Source: SDG Indicators Database.

FIGURE 5.6:

Low parental education reduces probability of having digital skills

Percentage of adults at selected proficiency levels of problem solving in technology-rich environments, by parental educational level, selected countries, 2010s



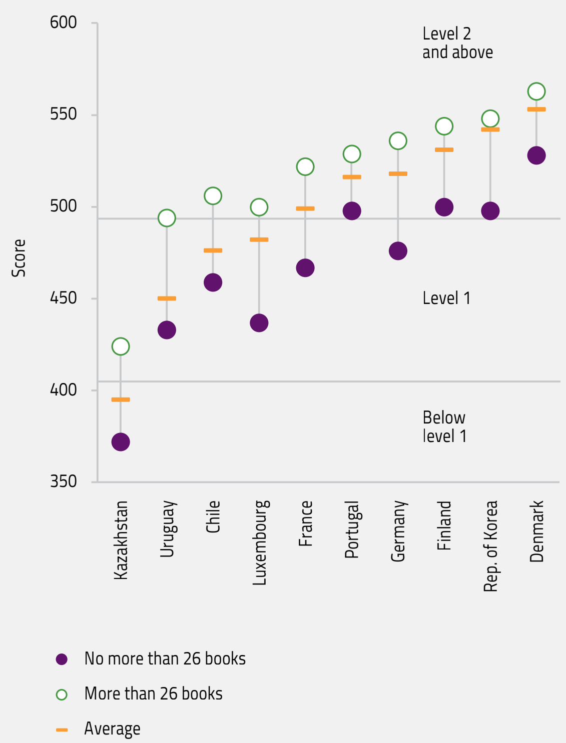
GEM StatLink: https://bit.ly/GEM2023_fig5_6

Notes:

1. Proficiency level*s:*
    - Opted out = Adults took the paper-based assessment without first taking the ICT core test, even if they reported some prior experience with computers.
    - No experience/failed core test = Adults either reported no prior computer experience and did not take part in the computer-based assessment; or had prior computer experience but failed the ICT core test, which assesses skills needed to take the computer-based assessment (e.g. ability to use a mouse or scroll through a web page).
    - Below Level 1 = Tasks are based on well-defined problems using only one function within a generic interface to meet a single explicit criterion without any categorical or inferential reasoning, or transformation of information.
    - Level 1 = Tasks require the use of widely available and familiar technology applications (e.g. email software or web browser). Little or no navigation required to access the information or commands required to solve the problem. Few steps and a minimal number of operators involved. Only simple forms of reasoning required; no need to contrast or integrate information.
2. Parental education categorie*s:* Low = neither parent attained upper secondary education. Medium = at least one parent attained upper secondary education. High = at least one parent attained tertiary education.

Source: OECD (2019b).

FIGURE 5.7:
Students from disadvantaged socioeconomic backgrounds are less likely to achieve a minimum level of digital skills
Computer and information literacy score of grade 8 students, by number of books at home, selected countries, 2018



GEM StatLink: https://bit.ly/GEM2023_fig5_7
Source: Fraillon et al. (2020).

DIGITAL SKILLS ARE ACQUIRED IN FORMAL EDUCATION AND OUTSIDE IT

Formal skills training is only one way of acquiring digital skills and may not even be the main one, as indicated by inequality in digital skills by individual characteristics, such as age, sex, socioeconomic status, education and occupation, social capital and health (Helsper and Eynon, 2013). There is remarkably little evidence on how digital skills are acquired considering there are not only multiple pathways but also multiple outcomes.

In 2011, as part of the EU ICT household survey, individuals reported the ways in which they had obtained such skills. This question has not been asked since and remains, even though out of date, a rare source of comparative information. The answers showed that about one quarter of adults in EU member states, ranging from 16% in Italy to 40% in Sweden, had acquired skills through a 'formalized educational institution (school, college, university, etc.)'. A less formal route, such as training courses and adult education centres, selected either by the person's own initiative or employer demand, was used by half as many adults. By contrast, informal learning, such as self-study, or informal assistance from colleagues, relatives and friends, was used on average by twice as many adults (**Figure 5.8**).

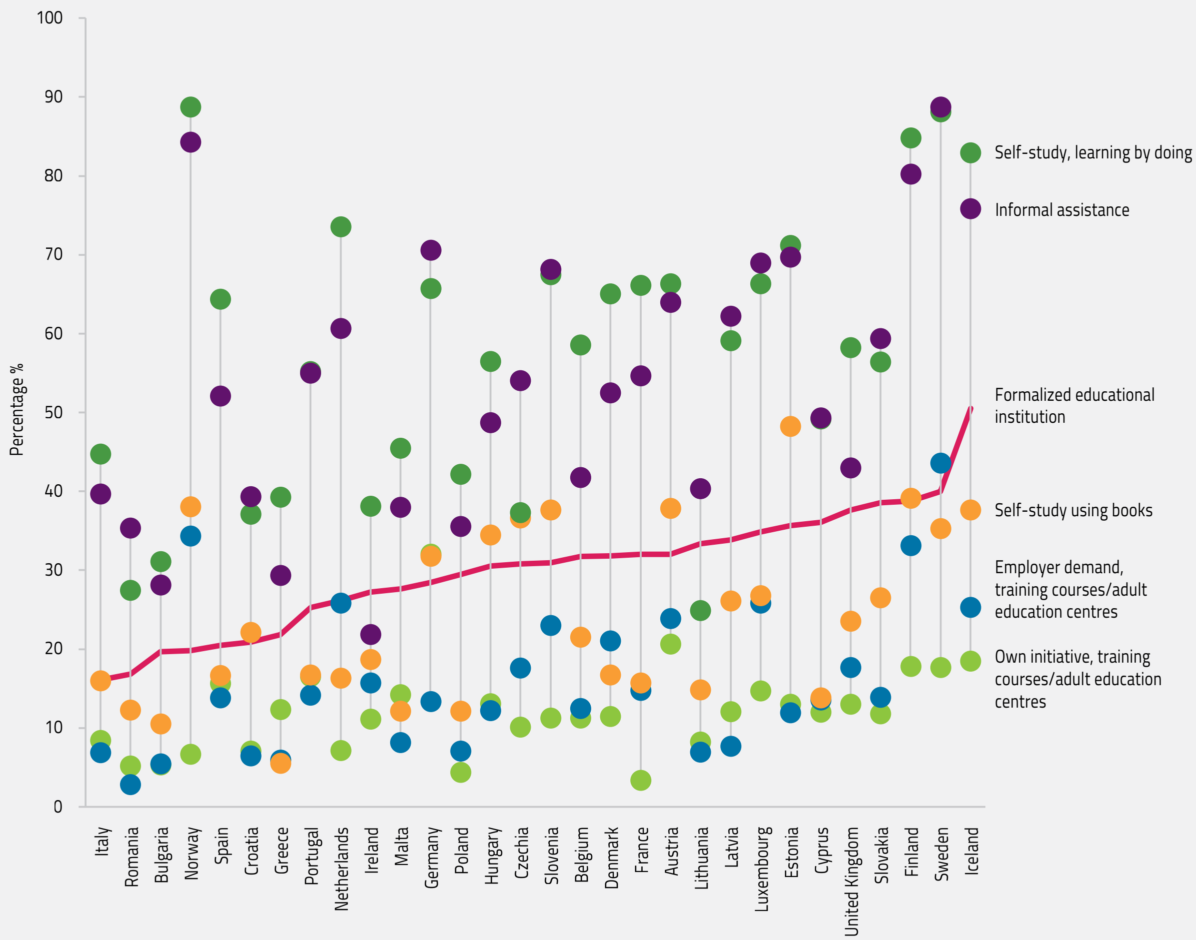
Social media platforms, whose monthly active users reached 4.7 billion in 2021 (OECD, 2022), help people communicate as well as pursue personal projects, encouraging them along the way to develop production, web hosting and social networking skills. Children develop coding and programming skills through digital games, commercially available robotic kits and puzzle-style digital applications. For instance, millions of students worldwide have established foundational programming skills, computational skills, and an interest in computer science subjects with the help of Code.org, a non-profit organization (Ali and Recep, 2021). People have developed digital literacy skills in public libraries and community centres. In Chile, between 2002 and 2017, the national digital literacy campaign was based on the programme BiblioRedes, a public library network (Chile National System of Public Libraries, 2017). In rural Sri Lanka, the e-Library Nenasala Program provided visitors to public libraries and religious community centres with access to computers and the internet (Andree, 2015).

This does not suggest that formal education is not important for obtaining digital skills. Indeed, those who have completed more formal education are better placed to continue with their education, including informally. In 2018, those with tertiary education in Europe were twice as likely (18%) as those with upper secondary education (9%) to engage in free online training or self-study to improve their computer, software or application use skills (**Figure 5.9**). Moreover, a solid mastery of literacy and numeracy skills is positively associated with mastery of at least some digital skills, for instance, media and information literacy.

FIGURE 5.8:

Most adults in Europe reported obtaining IT skills through informal learning

Individuals who obtained IT skills, by method, selected European countries, 2011



GEM StatLink: https://bit.ly/GEM2023_fig5_8
Source: Eurostat (2023b).

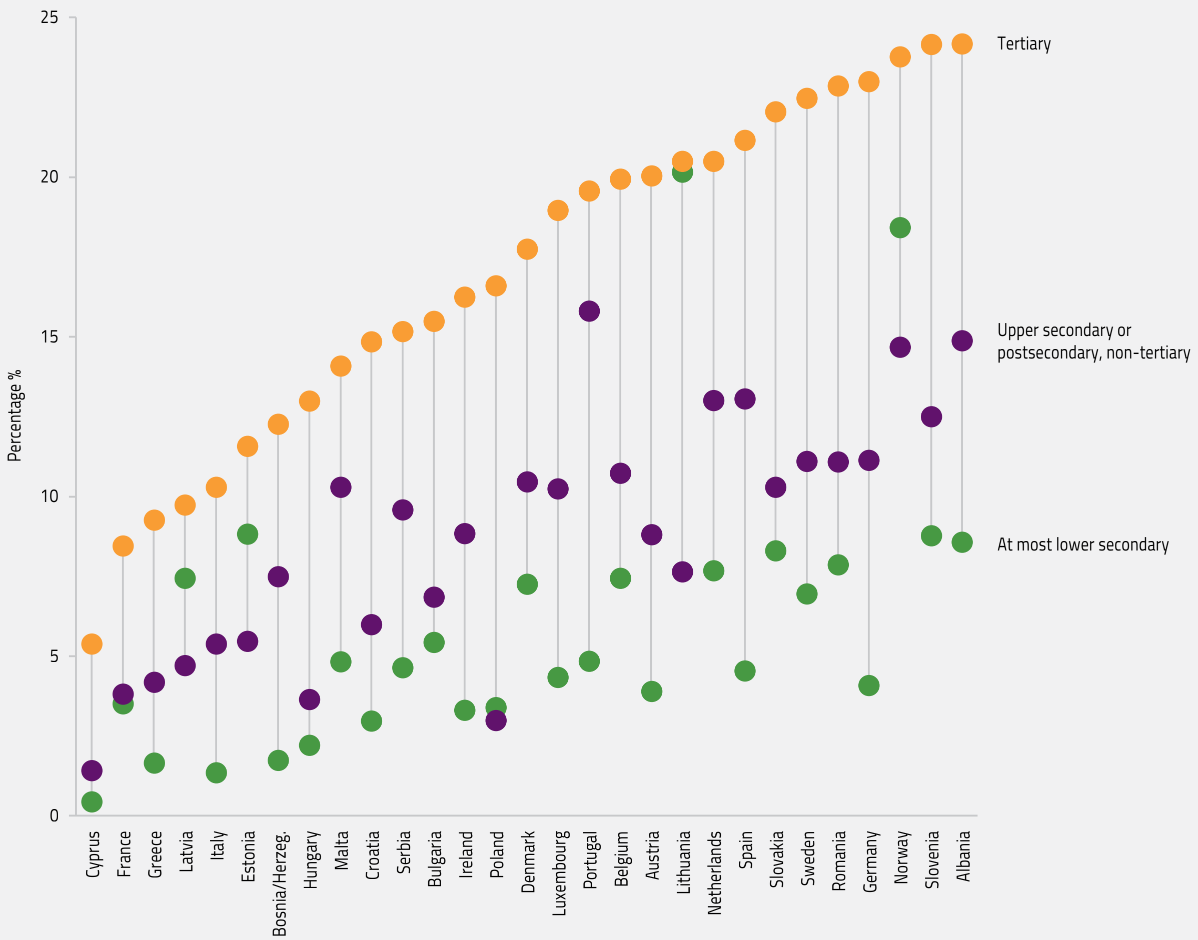
It is important to note that a preference for non-formal or informal approaches to acquiring digital skills does not ensure a higher level of competency. The easy accessibility of internet applications and resources makes self-directed learning convenient, but may mislead people to believe that learning outcomes are guaranteed. This approach has been labelled 'laborious, frustrating, inefficient, and ineffective' (van Dijk and Deursen, 2014 p. 113). While analysis of PIAAC problem-solving skills in technology-rich environments showed a positive correlation between participation in non-formal learning and ICT skills, most of this association was driven by the selection of more skilled individuals for specific training (Ehlert et al., 2021).

The challenge of non-formal learning affects both young and older people. In Spain, a survey of female university students showed they preferred self-directed (81%) and collaborative approaches to acquire digital skills (e.g. 65% talked to an expert for advice) over structured courses, which were selected by one third of respondents. But only 23% of those who relied on self-directed learning and 35% of those who relied on collaborative learning were assessed to have advanced skills, compared to 71% of those who intensively followed a structured course (Jiménez-Cortés et al., 2017). Similar conclusions were reached on the effectiveness of formal and non-formal education courses for elderly learners in Belgium: support provided by family and friends may motivate them, but often comes at the cost of constraints in terms of time, patience and expertise (Geerts et al., 2023).

FIGURE 5.9:

People who are more educated engage more with informal learning of digital skills

Individuals who carried out free online training or self-study to improve skills relating to the use of computers, software or applications, by level of education, selected European countries, 2018



GEM StatLink: https://bit.ly/GEM2023_fig5_9
Source: Eurostat (2023b).

> It is a mistake to think that people pick up digital skills effortlessly

It is a mistake to think that people pick up digital skills effortlessly. Familiarizing oneself with digital technology is essential, but regular access to technology, support networks and opportunities to apply such skills in relevant ways are just as important, especially for those from disadvantaged backgrounds (Eynon and Geniets, 2016). In India, analysis of secondary school students in the 2017/18 National Sample Survey showed that students with a computer at home were far more likely to report being able to use a computer (89%) than those without one (36%). There was some evidence that more computers at secondary schools had a mild positive effect, compensating for the absence of computers at home (Bhandari et al., 2021).

However, material resources are only part of the challenge for formal education systems. There are also questions about the kind of content, pedagogy and outcomes that best help develop digital skills, especially given the rapid evolution of technology. Formal education systems tend to focus on specialized skills; however, these may be superficial, require time for teacher training and curricula preparation, quickly become obsolete, and may ultimately be less effective in helping navigate the digital world than general skills (OECD, 2019a). In addition, formal education systems – teachers in particular – need to accept, value and integrate the experience and knowledge students have acquired outside school, 'looking in more depth at the complex and diverse reality of children's digital literacy practices to better understand the skills, knowledge and understanding they are developing' (Grant, 2010 p. 17).

COUNTRIES HAVE DEVELOPED VARIOUS WAYS TO BUILD DIGITAL SKILLS

Countries' digital skills policies, plans and strategies are developing rapidly. Some adopt a broad view of digital skills, and some focus on a narrow set of technical skills. Others take an intergenerational approach, while others still specifically target particular groups, such as children or parents (**Box 5.1**), or education levels. National examples related to five key competence areas are useful in illustrating the various ways in which countries are building digital skills.

These policies tend to be directed at primary and secondary education, although policies have also been adopted in technical and vocational education and training (TVET), and in higher education. The Ministry of Education and Higher Education of Lebanon included digital skills in the National Qualifications Framework, and in the 2018–22 National Strategic Framework for TVET (ILO, 2018; Lebanon Ministry of Education and Higher Education, 2019). In Zambia, the Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) has established a platform that offers free digital skill courses targeted at youth, women, refugees, as well as micro, small and medium enterprises. (Zambia TEVETA, 2023). Cambodia has introduced digital scholarships into the digital skills framework of its 2022 EduTech Roadmap, to help higher education students practise professionalism and solid research skills when using digital resources (Cambodia Ministry of Industry, Science, Technology and Innovation, 2022). In India, the National Education Policy 2020 envisages the mandatory curricular integration of the digital skills required for artificial intelligence and machine learning in higher education (India Ministry of Education, 2020).

BOX 5.1:

Parents need to be involved in improving children's digital skills

With technology changing so rapidly, parents may not be aware of the opportunities and risks from using technology. In South Africa, parents had higher digital skills than their children until their children reached 12 years of age. By age 15, children surpassed their parents' digital skills (Byrne et al., 2016). Parents therefore need help to guide their older children in online experiences.

Some parents feel they need to be more competent with technology to be involved in their child's technology activities (Schneider et al., 2015). Others use a variety of devices, mobile applications or parental controls (e.g. content filtering software, internet blockers, add-on monitoring software) to monitor children's whereabouts online and offline. A survey of adults in 19 countries with at least one child aged between 7 and 12 suggests that nearly half of parents use parental control applications to enforce limits on digital behaviour and 45% check their child's digital history (Kaspersky, 2021). One approach that parents use to control their child's use of devices is 'contracts' to promote shared responsibility (Zhao and Healy, 2022).

Governments try to respond to the lack of parents' digital skills, their overprotective and technologically moderated parenting, and low engagement in developing their children's digital skills. Various policy documents emphasize the role of parents and caregivers in protecting children's privacy, personal data and online reputation and the need to respect the confidentiality of their correspondence (Council of Europe, 2018).

The Digi-Matua programme, a collaboration between New Zealand's Ministry of Education and the 360 Tautua Trust, supports parents from Pacific communities to acquire the digital skills necessary to support their children's education. Parents receive a digital device equipped with 10 modules, covering various topics including essential functions such as charging devices, and more complex subjects, such as internet safety, and proficiency with Google applications (Aotearoa Education Gazette, 2022). Bhutan's 2019–2023 iSherig-2 Education ICT Master Plan aims to enhance parents' capability to guide their children in the safe and productive use of technology. Senegal's Programme for the Improvement of Quality, Equity and Transparency in Education and Training 2018–2030 aims to better involve parents in monitoring their children's digital skills through mobile phones.

INFORMATION AND DATA LITERACY

Data and information literacy skills enable people to effectively browse, search, filter, evaluate and manage data and information available in digital environments. Some frameworks focus on media as a key source of information, as its complexity has increased in the digital era alongside threats of misinformation and disinformation. UNESCO has published and updated resources on media and information literacy, including curricula and assessment frameworks (UNESCO, 2013, 2022).

The OECD Education 2030 Curriculum Content Mapping of 16 education systems showed that they have all included media and data literacy in secondary education, albeit to varying degrees. Among the systems compared, Greece and Portugal dedicated the lowest percentage of the curriculum to data and media literacy (less than 10%) while Estonia and the Republic of Korea embedded those competencies into half of their curricula (**Figure 5.10a**).

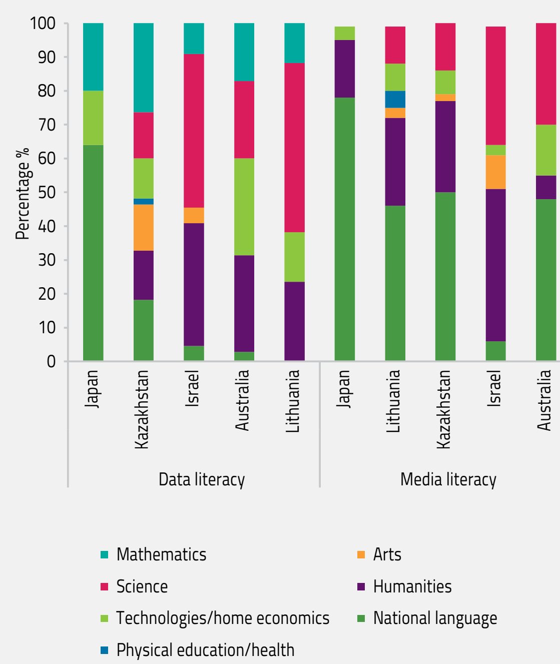
> Media literacy is embedded more in language, arts, and humanities, including civic education, while data literacy is found more in scientific subjects

Overall, media literacy is embedded more in language, arts, and humanities, including civic education, while data literacy is found more in scientific subjects. Language is the preferred medium for the development of both data and media literacy skills in Japan, where more than 60% of the curriculum covers these two competencies. By contrast, language accounts for only about 5% of the curriculum in Israel (**Figure 5.10b**).

An important question is the extent to which media literacy in curricula is explicitly connected to critical thinking in subject disciplines. In Georgia, according to the 2018–24 National Curriculum, media literacy is a cross-cutting competence, aimed at developing students' skills of filtering and critically assessing received information. The New School Model, part of a larger scale education reform introduced in 2018, aims to create a critical thinking educational environment, including through media literacy projects to develop resources, promote creativity, and use media properly. Support groups have been established to help schools develop curricula (Basilaia and Danelia, 2022).

FIGURE 5.10:
Media and data literacy are embedded in rich countries' curricula
a. Percentage of curriculum that embeds media and data literacy competencies, selected education systems, 2019

b. Distribution of content items in the curricula targeting media and data literacy as main or subtarget, by subject, selected countries, 2019



GEM StatLink: https://bit.ly/GEM2023_fig5_10
Source: OECD (2020).

Media and information literacy has become prominent in European education policy in recent years (Drotner et al., 2017; European Audiovisual Observatory, 2016). Finland's New Literacy Programme aims to strengthen media literacy skills from early childhood through to lower secondary education. Italy's National Digital School Plan integrates media literacy based on the right to access the internet. Czechia introduced it as a compulsory cross-curricular subject in the early 2000s but implementation has not been strong as the responsibility for providing training and resources was transferred to non-governmental organizations (Jirák and Zezulkova, 2019).

Despite calls by several government leaders in sub-Saharan Africa to counter the spread of false information through schools, a review of seven countries showed no follow-up in education; any actions taken were almost exclusively banning false information by law (Cunliffe-Jones et al., 2021). South Africa does include media literacy in secondary school subjects such as life orientation, English, technology and history (Wasserman and Madrid-Morales, 2022), while the Western Cape province introduced a programme focusing on misinformation in grades 8 to12 (Cunliffe-Jones et al., 2021).

Some countries take a protectionist approach to media literacy which prioritizes information control over education. As a result, media literacy is not mainstreamed in school curricula, teachers are not trained, and efforts are limited to resource development. In 2016, the Thai Digital Economy and Society Ministry commissioned Mahidol University to develop a digital literacy curriculum and lesson plans for classrooms, which includes aspects of understanding and accessing digital media (UNESCO Bangkok, 2020). In the Philippines, the Association for Media and Information Literacy advocated for the incorporation of media and information literacy in the curriculum, which has now become a core subject in grades 11 and 12 (IITE, 2023).

Media literacy receives much attention in Latin America but efforts are scattered and led by civil society, with limited streamlining of media literacy in education (Garro-Rojas, 2020). There is also a general perception that the focus on digital skills in education systems in the region is not combined with digital media literacy (Mateus et al., 2020).

More than 50% of 15-year-old students in the 2018 PISA reported that they were trained at school to recognize biased information. Australia, Canada, Denmark and the United States had the highest coverage (more than 70%) and Israel, Latvia, Slovakia, Slovenia and Switzerland the lowest (less than 45%) (OECD, 2021). Media literacy education targeting disinformation is also unevenly distributed within countries. Students from privileged socioeconomic backgrounds were more likely to be taught how to detect biased information than their peers from disadvantaged backgrounds (Suarez-Alvarez, 2021).

Evidence on the effectiveness of current programmes is mixed. The 2018 PISA found students who had received any education at all about online dangers, including a specific question about phishing emails, were no less likely to believe that clicking the link in the phishing email and providing their personal data would be an appropriate response (Jerim, 2023). In contrast, the percentage of students who could correctly distinguish facts from opinions, even after accounting for their reading performance, was higher in education systems where more students had been taught how to recognize subjective or biased information (OECD, 2021).

COMMUNICATION AND COLLABORATION

Digital skills in communication and collaboration are critical in the context of advanced digital connectivity and the increasing prevalence of hybrid learning arrangements. Such skills are instrumental in facilitating the exchange and dissemination of knowledge, fostering innovation, streamlining learning and work processes, and understanding ethical digital behaviours.

Countries adopt varied strategies to promote communication and collaboration skills in schools. Argentina promoted skills and competencies related to teamwork and knowledge sharing, as part of a digital platform to organize programming and robotics competitions for primary and secondary school students (Ripani and Vazquez-Brust, 2023). Mexico's Digital Education Agenda and National Agreement on Education promote citizen participation through digital technologies, social use of digital learning resources and communication, and research, innovation and creativity in digital education (Mexico Secretariat of Public Education, 2020). A new digital platform, the New Mexican School, offers teachers and students digital educational resources and tools for remote collaboration, peer learning and knowledge sharing (Ripani and Vazquez-Brust, 2023).

Ethical digital behaviour, also called 'netiquette', refers to the set of ethical rules, politeness, conventions and standards that should be learned, understood and practised by digital users while communicating on and using digital spaces. Factors such as anonymity, invisibility, asynchronicity and minimization of authority make it difficult for individuals to understand and experience the complexities of digital communication. University students often violate etiquette boundaries when communicating online, both with each other and with professors (Galimullina et al., 2022). In Jordan, university students share a consensus on the general rules of netiquette but have limited knowledge of the different levels of implementation and limited practice of netiquette related to critical thinking skills (Arouri and Hamaidi, 2017).

Higher education institutions are offering courses. In Scotland, United Kingdom, the University enable structured learning path to enable students to communicate effectively and ethically in digital media and spaces, participate in digital teams and working groups, and build digital networks (University of Edinburgh, 2023). In Canada, the Southern Alberta Institute of Technology offers a digital communication course for students to enhance their understanding of various digital communication and collaboration strategies, tools and formats, encouraging students to consider technology ethics, purpose and discipline in the use of collaborative technology (Southern Alberta Institute of Technology, 2022).

DIGITAL CONTENT CREATION

Competences in digital content creation include selecting appropriate delivery formats and creating copy, audio, video and visual assets; integrating digital content; and respecting copyright and licences. Young people need to be encouraged to be active participants in digital content creation, making effective use of the digital environment. From an economic perspective, the ubiquitous use of social media has elevated the value of creating content as a skill with direct application in electronic commerce (Dwivedi et al., 2021).

Countries have developed various responses to the development of content creation skills. Indonesia has updated its national primary and secondary education curricula, eliminating ICT as a stand-alone compulsory subject. The 2013 curriculum concentrates on high-order thinking skills, including analysis, evaluation and creation, through integrating ICT into other subjects (The SMERU Research Institute, 2022). As part of its National Movement for Digital Literacy, involving more than 60 national-level institutions and communities, the Siberkreasi platform counts collaborative engagement among its core activities. Intellectual property rights webinars for young content creators are one of several interventions (Siberkreasi, 2023). Indonesia Makin Cakap Digital (Raising Indonesia's Digital Capability), an initiative between Siberkreasi and the government, aims to improve digital media ethics, safety, capability and culture in content creation. The initiative involves public figures, such as artists, to inspire students and foster wider community cooperation in producing and disseminating ethical digital content to enhance the digital culture pillar of the 2020–2024 Indonesia Digital Literacy Roadmap (Literasi Digital, 2023).

In Jordan, the Youth, Technology and Jobs project of the Ministry of Digital Economy and Entrepreneurship (2020–25) provides digital skills professional programmes to 30,000 youth and women and offers to create 10,000 new jobs for youth, including women and Syrian refugees, who are active in the areas of digital freelance and content creation work (Jordan Ministry of Digital Economy and Entrepreneurship, 2023).

In Malaysia, the Ministry of Education in collaboration with public, private and academic actors launched the #mydigitalmaker movement, which encourages students to acquire digital content creation skills, focusing on programming, robotics and digital design to establish the country as a leading digital content creator and provider in the region by 2030. It has reached more than two million students nationwide (Malaysia Economic Planning Unit, 2021). Under its umbrella, the Digital Ninja programme offers bootcamps for secondary school students to gain industry and work experience alongside digital technology professionals in content creation, certifying more than 500 students (Malaysia Digital Economy Corporation, 2023).

In some upper-middle- and high-income countries, advanced content creation skills, especially related to intellectual property rights, are mainly offered in higher education. Analysis of the syllabi of bachelor's and master's courses in 36 universities in Canada, China, Germany, Ireland, Japan, New Zealand, Portugal, Singapore, Spain, Sweden, the United Kingdom and the United States found almost 90% of universities offering courses with copyright content (Fernández-Molina et al., 2022). The development of copyright education is also emerging in sub-Saharan Africa. Intellectual property rights education is scheduled in curricula in schools and universities in Namibia (Namibia Ministry of Industrialization, Trade and SME Development, 2019) and Rwanda (Rwanda Ministry of Trade and Industry, 2018). The Kenya Copyright Board, established under the Copyright Act, collaborates closely with universities to provide copyright education and conducts frequent training sessions for students, particularly in visual arts and ICT (KECOBO, 2023).

> Empowering students to stay safe, be responsible online and make smart choices are important policy priorities

SAFETY

The digital environment increases exposure to key risks: cybersecurity and violation of privacy through data misuse; the mental and physical health implications of issues including lengthy screen time and cyberbullying; and harmful content, with the potential long-term impact on addictive behaviour, violence and sexual exploitation. Empowering students to stay safe, be responsible online and make smart choices are therefore important policy priorities (**Chapter 8**).

Education systems need to strengthen preventative measures and respond to many challenges from passwords to permissions, enabling members of the education community to understand the implications of their online presence and digital footprint. Brazil's National Common Curricular Base for Basic Education recognizes schools should develop understanding and the use of digital ICT in a critical, meaningful, reflective and safe way as one of the essential skills (Brazil Ministry of Education, 2019). More than 50% of schools included elements of safe, responsible and critical internet use in the content of several subjects, although only 29% conducted debates or lectures on privacy and data protection (TIC, 2020).

In terms of cybersecurity, Ghana announced an intention to include this as part of its curricula in primary and secondary schools (FAAPA, 2019), but implementation has lagged behind; some schools run cybersecurity clubs but few young people join them (Digital Rights, 2022). As part of its 2017–2020 Education and Sports Sector Strategic Plan, Uganda incorporated systems and data security into the national ICT curriculum in lower secondary education (National Curriculum Development Centre, 2019). Qatar's National Cyber Security Agency and the Ministry of Education and Higher Education launched the Cyber Security Educational Curriculum in 2023 to enhance responsible, ethical and safe use of ICT, raise awareness of general concepts related to cybersecurity and digital safety, and foster education about the internet and data protection risks (John, 2023). In New Zealand, the Te Mana Tūhono (Power of Connectivity) programme delivers digital protection and security services to almost 2,500 state and state-integrated schools (Network for Learning, 2022).

Cyberbullying takes various forms, such as the deliberate publication of photos or videos of individuals without their consent (Myers and Cowie, 2019), exclusion from digital groups (OECD, 2017), verbal violence (Zhu et al., 2021) and insults and threats (Cebollero-Salinas et al., 2022). Many countries' policies on technology in education are responding with awareness-raising, reporting mechanisms and digital risk interventions, usually at the school level. A systematic review and meta-analysis of interventions in selected, mostly high-income countries estimated that the average programme has a 73% chance of reducing cyberbullying victimization (Polanin et al., 2022).

Access to digital technology and the internet means children can access harmful content, and school-based and other initiatives are urgently needed to protect them. In Wales, United Kingdom, the government has advised schools how to prepare for and respond to harmful viral online content and hoaxes. Guidance includes talking to learners about reporting, blocking and peer pressure, while resources aim to minimize the risk for learners of viewing offensive content (Welsh Government, 2023).

After a curriculum review in 2020/21, Australia integrated privacy and security in the updated curriculum from preschool to grade 10 in eight subjects (ACARA, 2021). The eSafety Commissioner provides information on application features that can increase exposure to content risks and equips teachers with resources to tackle the issue (Australia eSafety Commissioner, 2023). New Zealand has mandated the inclusion of critical thinking in the curriculum for grades 1 to 13 to help students understand that working with data comes with responsibility for ensuring security and privacy. Up to 80% of 15-year-old students report learning these concepts at school (New Zealand Ministry of Education, 2022).

PROBLEM-SOLVING

The definition of problem-solving skills varies widely among education systems worldwide. In its definition, the DigComp framework includes solving technical problems when operating devices and assessing needs, and when identifying, evaluating, selecting, using and adjusting digital tools. But problem-solving is usually understood more broadly, as an approach to learning which argues that understanding should be through a process of solving problems, not teaching students how to understand.

Accordingly, many countries define problem-solving in terms of coding and programming – and as part of computer science in the curriculum, which may include elements of computational thinking, the use of algorithms and automation (Passey, 2017).

A global review estimated that 43% of students in high-income, 62% in upper-middle-income, 5% in lower-middle-income countries, but no students in low-income countries take computer science as compulsory in primary and/or secondary education (Vegas et al., 2021). This translates into 20% of education systems mandating that schools offer computer science as an elective or required course; 7% offering it in some schools and subnational jurisdictions, and the rest at best only offering pilot programmes (Vegas and Fowler, 2020). Countries with mandatory computer science education are clustered in Eastern Europe and East Asia. Central Asia, South-eastern Asia and Latin America are the regions outside Europe and North America that have implemented or piloted computer education on the most extensive scale (Vegas et al., 2021) (**Box 5.2**).

In Hong Kong, China, the Education Bureau's 2020 curriculum guidance recommends 10 to 14 hours annually of problem-solving education in upper primary grades through a stand-alone class or integration into other subjects (Hong Kong Education Bureau, 2020). An evaluation of CoolThink@JC, a project launched in 2016 by a private charity in collaboration with leading universities and the Education Bureau, which has reached 87% of publicly funded schools (CoolThink@JC, 2023), showed a significant impact on students' problem-solving practices (Shear et al., 2020). In Singapore, problem-solving

BOX 5.2:

Computer science is mostly taught as a compulsory subject in Latin America

A review of seven Latin American countries for this report found that most have included or plan to include computer science as a subject in primary or secondary education and change it from an elective into a compulsory subject. The focus on computer science responds to the need to make curricula more relevant. Argentina, Brazil, Chile, Costa Rica and Uruguay are also driven by the need to increase employability and address labour market demand.

Computer science is generally treated as a stand-alone subject. Costa Rica was the first to introduce computer science in school in the late 1980s. The informatics programme was gradually scaled up and its content updated to reflect notions of computer science. Students in Chile and Cuba study computer science as part of informatics and technology courses, respectively. In 2022, a curriculum reform in Brazil introduced computer science as a compulsory and independent subject across all education levels. By contrast, in Uruguay, computer science is integrated into mathematics, language, arts and science in primary schools, and studied as an independent subject in the first year of secondary education.

Teaching and learning computer science in Latin America differs by content and by education level. With the exception of Paraguay, all seven countries reviewed teach algorithms and programming in primary and secondary schools. Argentina, Brazil and Costa Rica also include these concepts in pre-primary schools. Computer architecture and hardware are taught in most primary schools, whereas artificial intelligence is taught in secondary programmes in Argentina, Brazil and Chile. Safety is taught to primary students in Chile and Uruguay and to primary and secondary students in Brazil.

Argentina has standards at the federal level for programming skills to be integrated in compulsory education through a project-based teaching methodology. In Colombia, the 2019 National Strategy Coding for Kids has reached more than 4,000 schools and 464,000 primary and secondary students. Paraguay's 2022 STEAM National Plan incorporates video gaming competitions to increase engagement and facilitate primary and secondary students' learning of programming and coding constructs.

In most countries, non-state actors have advocated for and implemented computer science education. The Sadosky Foundation in Argentina, Korea Foundation in Chile, Omar Dengo Foundation in Costa Rica and Plan Ceibal Foundation in Uruguay have worked closely with ministries to initiate computer science education, developing teaching materials and providing in-service teacher training. The Centre for Innovation in Education in Brazil and the Brazilian Computer Association informed policy dialogue around the need to include computer science education in curriculum standards across all education levels.

Implementation challenges persist, especially in relation to ensuring the delivery of computer science in all schools in a country, except in Costa Rica. Within decentralized systems, as for example in Argentina and Brazil, the implementation of computer science programmes has varied. Gaps in the availability of teaching and learning materials, in teacher preparation and in adequate infrastructure have hampered the scaling-up of programmes. Schools serving remote, indigenous and other disadvantaged populations have usually lagged behind.

Sources: Sadosky Foundation (2023), Ripani and Vazquez-Brust (2023).

skills involve breaking down complex problems into smaller, more manageable components and designing algorithms to solve them. The 2021 secondary education computing syllabus includes a dedicated module divided into problem analysis and algorithm design (Singapore Ministry of Education, 2021). In the United Arab Emirates, problem-solving skills are defined as the ability to think logically, algorithmically and recursively and write computer code and programmes to solve problems, and are integrated into computational thinking, computer practice, and programming in its Computer Science and Technology Standards (United Arab Emirates Ministry of Education, 2015).

Kenya has become the first African country to incorporate coding as a subject in primary and secondary schools under the new competency-based curriculum (Kinyajnui, 2022). The Kenya Institute of Curriculum Development has approved a coding skills curriculum developed by Kodris Africa, a for-profit company, for children aged 7 to 16 in the Python programming language that focuses on algorithms, debugging and logical operators (Kodris, 2023).

Introducing coding for young children is considered difficult because of competition with other curricular priorities, but it can address equity issues (Trucano, 2015) and gender-based stereotypes (Sullivan, 2019) that affect the development of these skills. In Spain, the 2020 Education Law emphasizes problem-solving and computational thinking skills as a cross-curriculum topic starting from the earliest education levels (Spain Ministry of Education and Vocational Training, 2022). Problem-solving content has been integrated into primary education mathematics in the Navarra region, and in robotics and programming subjects in primary and secondary education in the Madrid and Catalonia regions (Spain Ministry of Education and Professional Development, 2018).

Non-state actors often support the inclusion in curricula of coding and programming skills, including computer science. In England, United Kingdom, Computing at School, a non-profit organization, developed a computing programme which has been helping children as young as five to learn to code (Humphreys, 2021). Following strong advocacy from Code.org, all 50 governors in the United States signed on to the Governors' Compact to expand computer science education, committing to increase the number of schools offering it, allocate more funding, create post-secondary career pathways and increase participation from traditionally underserved populations (National Governors Association, 2022). In Chile, Code.org has partnered with the government to provide educational resources in computer science and with the University of Chile to develop teaching pathways and assessment instruments (Ripani and Vazquez-Brust, 2023).

CONCLUSION

The development of digital technology has generated an urgent demand for skills to navigate its opportunities and risks. While there is consensus that digital skills have become part of a basic skills set that formal education systems should deliver, there is confusion over which basic elements a digital skills set should contain – as well as the degree to which these skills are general or specific, their purpose and the definitions of many of these skills and overlaps between them. It is also uncertain if formal education systems have the capacity to keep up with the pace of change, and which of these skills are best acquired through non-formal and informal learning.

Countries are faced with critical decisions over the range of skills to include in their curricula, how to integrate them and package them in subjects, at what level, and how to leverage the experience of learners, which often surpasses that of their teachers. Given the low levels of digital skills in the global population and the ever-increasing complexity of the digital world, countries need to urgently define digital skills and decide how best to increase them among their citizens.

Khalid Alkhawlani, one of the facilitators of the evaluation workshop.

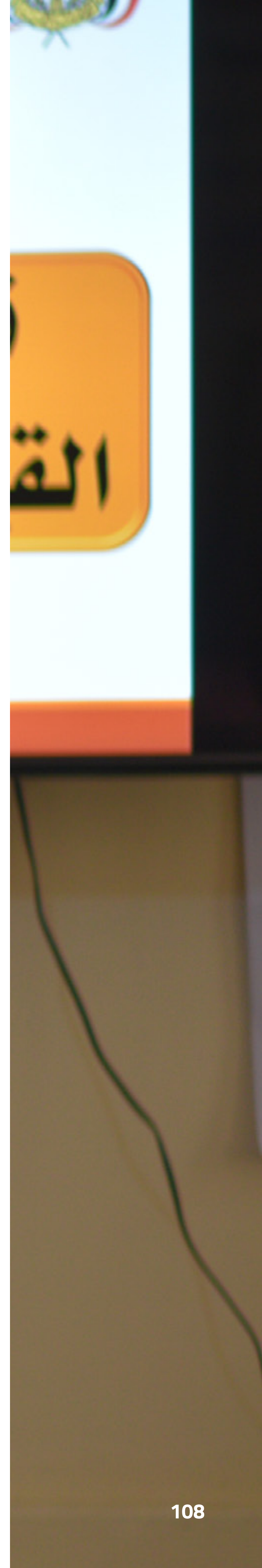
An evaluation workshop supported by UNICEF concluded the 2021 nationwide teacher training plan in Yemen. Managers, heads of training departments and decision-makers from 14 governorates attended the Annual Workshop for the Evaluation of Training, Qualification, and Planning Programmes 2022 workshop in Sana’a, in March 2022.

Credit: UNICEF/UN0674192/Marish*

CHAPTER

6

Education management



KEY MESSAGES

Various issues impede the potential of digital data in education management.

Technology supports management of large volumes of data generated by education systems.

- Since the 1990s, the number of education policies mentioning data, statistics and information has increased by 13 times in high-income, 9 times in upper-middle-income and 5 times in and low- and lower-middle-income countries.

Unique student identification is not used enough to unlock technology's potential.

- Only 54% of countries – and as low as 22% of sub-Saharan African countries – have put in place unique student identification mechanisms.

Information systems often do not communicate with each other.

- As more vendors enter the market and procurement decisions are decentralized, schools and universities often find themselves collecting data with one application but being unable, unless they spend more, to link them with other data collected with a different application.
- European countries address interoperability concerns collectively to facilitate data sharing in higher education enrolment, assessment, learning, diplomas and certification. The EMREX project is an example of good practice in development of interoperability standards.

Technology's huge potential to transform learning assessment, but the costs are unclear.

- Computer-based assessments and computer adaptive testing can make test administration more efficient, improve measurement quality and provide rapid scoring. However, among 34 papers on technology-based assessments reviewed for this report, clear and transparent data on cost were lacking.

The use of geospatial data remains nascent in low- and lower-middle-income countries.

- In India, geographical information system data has highlighted discrepancies between school catchment areas and maximum travel distances for pupils. But overall, such data are often limited to small projects led by development agencies or researchers.

Few countries have the capacity to manage the amount of data that learning analytics generate.

- In China, learning analytics have been used in primary and secondary schools to identify learner difficulties, predict learning trajectories and manage teacher resources.
- The widespread use of dashboards, charts and tables to support decision making requires minimum data literacy for increasing numbers of users, including teachers and parents. Low data literacy in European higher education institutions is a critical challenge in institutionalizing learning analytics.

Lack of confidence and capacity constrain technology use in education management.

- Too often distance exists between technology's expected benefits for education management and their realization. Seemingly trivial issues, such as infrastructure maintenance and repair, are ignored or underestimated. Learning analytics design has failed to integrate learning improvement as the core driver of its development.

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One implication of digital technology is that education systems have begun producing enormous amounts of data. This growth matches the trend in global data production, whose volume is projected to double as soon as 2025 from the estimated 97 zettabytes generated globally in 2022 (McLean, 2022), where a zettabyte is the equivalent of a trillion gigabytes. As the volume of the data produced expands, management tasks and functions accumulate. And, as systems grow in size and complexity, more demands are placed on administrators, who are expected to set and monitor a higher number of quantitative education targets. With the decentralization of education management, the number of actors involved multiplies. Each level of education management, from the ministry to the classroom, has to follow specific new data requirements, processes and uses. These uses move from individual devices to digital ecosystems, and the assumption is that by facilitating data processing and exchange, technology can improve the effectiveness and efficiency of education system management to help realize policy objectives.

Effectiveness refers to how well functions are performed, such as storage and retrieval of information, assessment of learning levels and hiring of staff. Efficiency refers to the optimization of financial, human and time resources allocated to perform tasks, to which technology can contribute substantially through automating series of commands and functions, removing the need for manual inputs. By enabling the use of information, technology can improve the quality of analytical insights that feed into decision making in education. Yet as the ability to handle and leverage these data becomes more important (Howard et al., 2022), capacity is often absent and data are not used as often, effectively or efficiently (Custer et al., 2018; Rossiter, 2020).

> As the ability to handle and leverage data becomes more important, capacity is often absent and data are not used as often, effectively or efficiently

This chapter discusses how technology supports education management while also creating new challenges, both at the system and at the school level. Technology is not a magic wand: it cannot solve problems that are not of a technological nature. Instead, it needs to be seen as playing a part in management systems alongside people, models, methods, processes, procedures, rules and regulations. For this reason, systems are often unprepared to integrate technologies.

TECHNOLOGY CAN SUPPORT THE MANAGEMENT OF LARGE VOLUMES OF EDUCATION INFORMATION

Education management information systems organize and perform 'the collection, integration, processing, maintenance and dissemination of data and information to support decision making, policy analysis and formulation, planning, monitoring and management at all levels of an education system' (Cassidy, 2006 p. 27). Critical functions include keeping track of flows and stocks of learners and their performance to ensure that commensurate and equitable resources are allocated across the system (Broadband Commission Working Group on Data for Learning, 2022; UNESCO and GPE, 2020).

Education management information systems are evolving in many countries in response to changes in public sector management that have seen a more business-oriented focus on efficiency and effectiveness. Such reforms have been characterized by increased school autonomy, target setting and results-based performance (Verger and Curran, 2014), all of which require more data. By one measure, since the 1990s, the number of policies making references to data, statistics and information has increased by 13 times in high-income, 9 times in upper-middle-income and 5 times in low- and lower-middle-income countries (Bromley et al., 2023).

The types and sources of data used by education management information systems are diversifying. Digital technology can support efforts for improving the integration, availability, sharing, frequency and granularity of data (Amuha et al., 2023). Data integration involves processes and standards to unify access to data from multiple and autonomous sources (Srivastava and Dong, 2015). In education, such integration unifies data on students (enrolment, attendance and examination results, disaggregated by individual characteristics), teachers (age, qualifications and professional development), and schools (infrastructure and resources).

In many countries, strategies to develop education management information systems focus on data integration. The Brunei Darussalam Integrated National Education Information System uses a common platform for data on admission, attendance, curriculum, results, school resources, student allowances and scholarships (Ibrahim et al., 2020). Malaysia's education information ecosystem includes about 350 systems and applications scattered across institutions. In 2017, the country introduced its Education Data Repository as part of the ICT Transformation Plan 2019–2023. By 2019, it had integrated 12 of its main data systems, aiming for full integration through a single data platform by the end of 2023 (UNICEF, 2019). In Sri Lanka, the National Policy on Preschool Education foresees the development of an integrated education management information system as a way to improve preschool registration, monitoring, analysis, planning and use of data for decision making, as well as a way to harmonize procedures, indicators and data across provinces (National Education Commission, 2019).

In Latin America, the countries of Argentina, Chile and Mexico have systems that integrate data on infrastructure, learning assessments and educational improvement. Brazil links budget and expenditure data with learning outcome data. Uruguay's platform integrates student data including variables related to disability, ethnicity, race, migration and location (UNESCO, 2021b).

Two elements are key in fostering the development of such integrated data systems for education management: unique identifiers and interoperability (Abdul-Hamid, 2017; UNESCO, 2022).

UNIQUE STUDENT IDENTIFICATION IS NOT USED ENOUGH TO UNLOCK TECHNOLOGY'S POTENTIAL

Guaranteeing that each school and student is uniquely identified within an education management information system is key to the effective and efficient use of information. It allows students to be followed in school registers, examination records and national scholarship databases throughout their education journey for administrative routine follow-up and for analytical insights into their learning trajectories. It has benefits beyond education – for example, student identification can be linked to civil registry official digital identification, which can then link to other social services.

> Student identification can be linked to civil registry official digital identification, which can then link to other social services

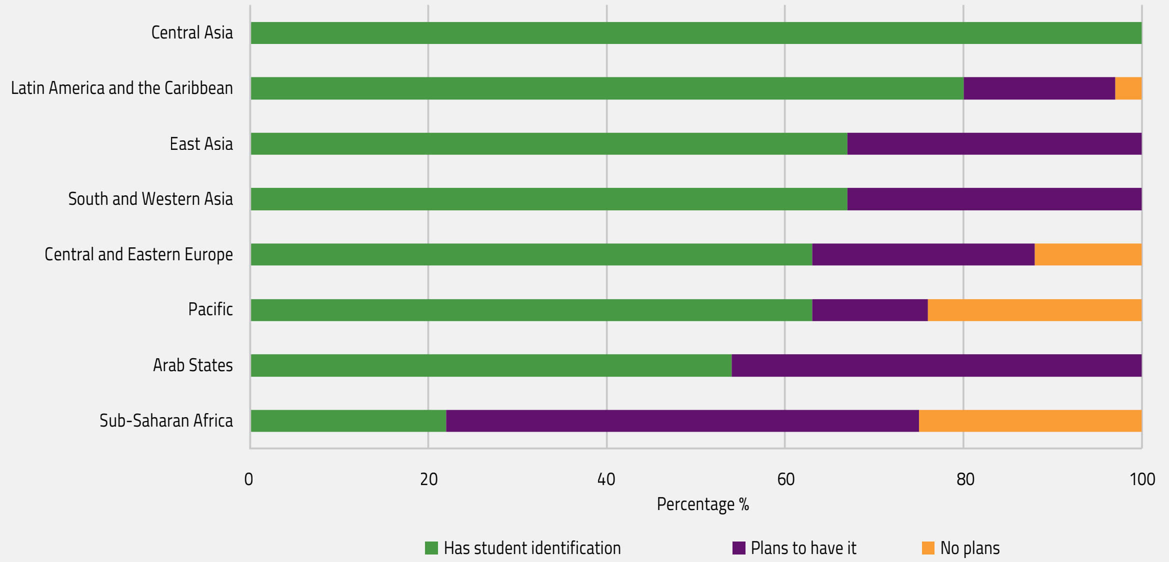
School identification is universal (e.g. 93% of countries outside Western Europe and North America have school identification numbers in secondary education) and supported by geographic information systems (**Box 6.1**), although coverage is somewhat more limited for early childhood education and for technical and vocational education centres (72% of countries each). But only 54% of countries – and as few as 22% of sub-Saharan African countries – have put in place unique student identification mechanisms. It was reported in 2020 that 34% of countries – and 53% of sub-Saharan African countries – had plans or were in the process of introducing student identification numbers (UNESCO Institute for Statistics, 2020) (**Figure 6.1**).

Even though several African countries claim to have school identification numbers, they are often not unique and can vary between databases, such as between examination result records and the school census, compromising links and preventing optimal use. With support from UNICEF, education ministries in Côte d'Ivoire, Ghana and Zambia devised an interim solution to match their school records. A text similarity algorithm (Gomaa and Fahmy, 2013) matched schools between databases using the degree of likeness between text associated with each school, such as its name or location. The process allowed 86% of schools in Côte d'Ivoire and at least 87% of schools in Zambia to be identified, helping analyse their performance between 2015 and 2020. In Ghana, some three quarters of schools had their school census and Basic Education Certification Examination records linked, enabling a detailed analysis of factors influencing student examination performance (UNICEF Innocenti – Global Office of Research and Foresight, 2023a, 2023b, 2023c).

FIGURE 6.1:

Many countries do not have student identification numbers

Percentage of countries with unique student identification numbers, by region, 2020

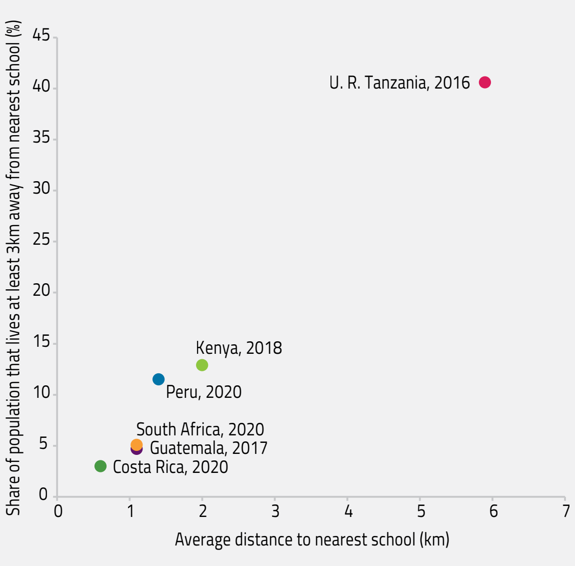


GEM StatLink: https://bit.ly/GEM2023_fig6_1
Source: UIS (2020).

FIGURE 6.2:

Geospatial data help assess travel distance to school

Average distance and percentage of population living more than 3 kilometres away from the nearest primary school, selected middle-income countries, 2016–20



GEM StatLink: https://bit.ly/GEM2023_fig6_2
Source: Rodriguez-Segura and Kim (2021).

BOX 6.1:

Geospatial data shed light on those in need of more support

Two key tools used to improve unique school identifiers are geospatial data and the use of geographic information systems (GIS). They can support decision makers as they address equity and efficiency in infrastructure and resource distribution in their education systems, including optimising teacher allocation (Beoku-Betts, 2023). School mapping can be used to foster diversity and reduce inequality of opportunity. Ireland, for instance, links three databases that use GIS coordinates, from the Central Statistical Office, the Department of Social Protection and the Department of Education and Skills, to decide in which of its 314 planning areas to build new schools (European Commission, 2022).

Travel distance to school is an important determinant of school participation (Das and Das, 2023). Countries have adopted policies stating maximum travel distance or commute time to base their school location decisions and ensure child safety and well-being. In Switzerland, children should not walk more than 1 kilometre if they are less than 5 years old and no more than 2 kilometres if they are between 6 and 8 years old (Schweizer and Regli, 2018).

Continued on next page

BOX 6.1 CONTINUED:

In England, United Kingdom, the statutory walking distances are 2 miles (3.2 kilometres) for children under age 8 and 3 miles (4.8 kilometres) for children age 8 and above. The maximum recommended commute time is 45 minutes in primary and 75 minutes in secondary education (Department for Education, 2014).

Geospatial data–based methods and tools can identify areas in which children live too far from the nearest school and estimate compliance with age-appropriate travel distances set by governments. For instance, in Guatemala despite a well-balanced allocation of schools across the country, it has been estimated that 5% of the population lived more than 3 kilometres away from a primary school in 2017. In the United Republic of Tanzania, the average distance to the closest primary school is 6 kilometres and 41% of the population are estimated to lived more than 3 kilometres away from the nearest school (Rodriguez-Segura and Kim, 2021) (**Figure 6.2**). In the Indian state of Uttar Pradesh, GIS data analysis has highlighted discrepancies between school catchment areas and maximum travel distances for pupils, as well as equity-related issues such as disparities by gender or in the pupil/teacher ratio (Agrawal and Gupta, 2016).

Equity and efficiency are often competing policy objectives. In China, school mapping was used in the early 2000s to improve efficiency in rural school distribution. Primary schools in small villages were merged or closed and replaced by boarding schools in the closest township, the next higher administrative level. The policy improved the efficiency of government spending, but is also believed to have increased the dropout rate in the short term among children from the poorest households living in the villages (Rao and Ye, 2016; Wang and Lewin, 2016).

Geospatial data also help identify schools and child populations vulnerable to specific risks (Gagnon and Vargas Mesa, 2022). In Indonesia, school mapping was used to identify schools in disaster-prone areas to prioritize risk reduction interventions and identify travel routes to and from schools (Ariyanti et al., 2018). Sierra Leone has developed a GIS tool that considers new school locations based on poverty, population and flood risk data. Geospatial data are also used to decide which schools to renovate, expand with additional classrooms, and equip with water and sanitation facilities (Vijil-Morin et al., 2023).

Despite the potential of geospatial data to lead to more equitable school and resource distribution decisions, their use remains nascent in low- and lower-middle-income countries, where they are most needed (Vijil-Morin et al., 2023). The use of geospatial data is often limited to small projects led by development agencies or researchers with the technical and financial capacity to handle such data.

For many countries, student identification is relatively recent. Albania is developing Socrates, an education management information system that will introduce unique identifiers through which students will be monitored from their entry into the formal school system until the end of upper secondary (Maghnouj et al., 2020). In Bosnia and Herzegovina, the West Herzegovina Canton is developing a new system to support planning in which student and teacher identification numbers will be introduced and linked to their respective administrative identification numbers (Guthrie et al., 2022). Serbia's 2017 Act on the Foundations of the Education System envisaged the same action (Donnelly, 2021; ITU and UNICEF, 2021).

In South Africa, the Learner Unit Record Tracking System has been in place since 2010 and covers all public schools (South Africa Department of Basic Education, 2012; van Wyk, 2015). All learners are uniquely identified with a number, and their individual data are recorded until grade 12, including when they move between schools and provinces. The number is interoperable (i.e. compatible) with the South African School Administration and Management System, which is the national school management and administration software (van Wyk, 2015). Since its introduction, the system has permitted more advanced and robust analyses of repetition and dropout patterns, learner trajectories and teacher demand and supply (van der Berg et al., 2019, 2021, 2022). However, the system still appears to sometimes assign a second identification number to students who transfer to a new school (van der Berg et al., 2021). UNICEF has been implementing the Learner Unit Record Tracking System in four northern Nigerian states (UNICEF, 2022).

Digital identification projects face various challenges. In Ethiopia, the implementation of a digital identification system for five million secondary school students is based on blockchain technology. The system is a pilot for Ethiopia to build a national digital identification system. It uses Cardano, a public blockchain platform, as the foundation, but the platform is vulnerable to major risks, from network failures to privacy breaches (Renieris, 2021).

> Student identification systems should be developed carefully to avoid exclusion

Student identification systems should be developed carefully to avoid exclusion. Digital national identification systems are key for accelerating progress to universal legal identification by 2030: currently, it is estimated that 850 million, mostly marginalized, people do not have legal proof of identification (World Bank, 2023). Access to education, healthcare or social welfare may be conditional on having national identification (Maikem, 2022; Mutung'u, 2021). Yet digital identification processes have been shown to exclude populations from access to such services (Center for Human Rights and Global Justice et al., 2021; Privacy International, 2021). In India, the Supreme Court ruled in 2018 that Aadhaar, the successful national digital identity card, could not be made mandatory: not only should alternative means of identity verification be made available but children should be exempt. However, Aadhaar continues to be routinely demanded from children for enrolling in anganwadis (a type of rural childcare centre), and schools, that may lead to their exclusion (Drèze and Khera, 2022).

Refugee populations can be made vulnerable because of digital identification. In Kenya, members of the Somali minority have faced vetting and delays while applying for identification. In some cases, this is because individuals have previously registered with the UN High Commission for Refugees (UNHCR) to access services, including education, that were available to refugees at the time. However, they were later barred from obtaining digital identification cards when the government cross-checked their applications against UNHCR data (Mutung'u, 2021; Weitzberg, 2020; Yousif, 2018). The UNCHR has also shared biometric, personal information data of Rohingya refugees in Bangladesh with the Bangladeshi government, which were then shared with the Myanmar government. To protect marginalized communities, the collection of biometric and other personal data needs to be accompanied by informed consent on their use (Human Rights Watch, 2021).

Social safety net programmes are also vulnerable to weaknesses in identification systems. In Kenya, cash transfer programmes started using electronic payment mechanisms in 2013 based on two-factor identification: a personal identification number and a national identification card and/or a biometric fingerprint. This posed a problem for households headed by children, whose identity cards are only issued when they reach 18 (Mwasiaji, 2016). In Uganda, the Senior Citizens' Grant is an unconditional cash transfer to all Ugandans over 65. The grant has had an impact on child education attainment, as 14% of beneficiaries spent part or all of their cash on their grandchildren's education (Kidd, 2017). However, its effectiveness was impacted with the switch to Ndaga Muntu, the Ugandan digital identification system, which has been shown to exclude some populations. Indeed, the poorest elderly are usually outside the formal identification system as they cannot travel long distances to fulfil the administrative requirements to obtain their digital identification. Some were victims of system errors in recording their age properly (Center for Human Rights and Global Justice et al., 2021).

INFORMATION SYSTEMS OFTEN DO NOT COMMUNICATE WITH EACH OTHER

Interoperability, which includes the ability of databases to communicate and work with one another, is becoming a necessary condition to unlock the full potential of education data for effective management (UNESCO, 2021a). Applications and software have multiplied to respond to the increasing role played by education data in management at all levels. As more vendors enter the market, and as many procurement decisions become decentralized, schools and universities often find themselves collecting data in one area with one software but being unable, unless they spend more, to link them with data collected in another area with a different software. Education is not the only sector facing this problem: the lack of interoperability was recognized 20 years ago as a major challenge in the healthcare sector (Walker et al., 2005).

> Applications and software have multiplied to respond to the increasing role played by education data in management at all levels

In education, the Groningen Declaration, initially signed by China, India, the Netherlands, Norway, the Russian Federation, South Africa, the United Kingdom, the United States and several European higher education institutions (Groningen Declaration, 2012) now has more than 110 signatories who have committed to foster and improve digital student data to ensure the free movement of students. A recent survey among universities in the United Kingdom indicated that 43% of respondents identified interoperability issues as highly problematic for managing learning assessment data (Knight and Ferrell, 2022).

Australia, Canada, New Zealand, the United Kingdom and the United States have developed systems interoperability frameworks: each country has a defined infrastructure, and specifications are made freely available to all stakeholders and developers (Access 4 Learning Community, 2022). In 2010, Australia introduced the National Schools Interoperability Program to develop common technical standards and projects that improve the interoperability of information systems used by education institutions (Education Services Australia, 2023a). A toolkit helps test how administration authorities interact with the National Assessment Platform, facilitates marking of examinations, and supports institutions to process results and produce learning assessment reports in compliance with the requirements of each authority (Education Services Australia, 2023b).

Particularly in these four countries, but also in a few other high-income countries, demand for data has been fuelled by sector performance monitoring, often within the framework of accountability policies. Unprecedented volumes of data are needed, not only for monitoring whether schools meet standards but also to ascertain whether student performance is improving over time. In the mid-2010s, New Zealand recognized that schools had been procuring student management systems and related software independently, and that the lack of interoperability between them, as well as with other central databases, was preventing authorities from tracking student progress (Hernandez, 2019; New Zealand Ministry of Education, 2016). In 2019, the government assigned the company CoreFour to deploy its learning management system, Edsby, to develop the Te Rito National Learner Repository and Data Exchange. The project also intended to reduce the administrative burden on teachers and improve the quality and timeliness of data provided to the government. The data were to be hosted in Microsoft-operated, Ministry-approved cloud data centres (Edsby, 2019). However, deployment was paused in 2021 due to cybersecurity concerns (New Zealand Ministry of Education, 2022) and is to restart in mid-2023 (New Zealand Ministry of Education, 2023).

European countries have been addressing interoperability concerns collectively to facilitate data sharing between countries and across multiple applications used in the management of higher education enrolment, assessment, learning, diplomas and certification. The EMREX project, which emerged from an initial collaboration between Denmark, Finland, Norway and Sweden, has fostered student data portability as part of the Erasmus+ programme. It has supported degree and credit mobility and the recognition of previous studies. The system uses a set of common standards, including a data model that describes assessments, diplomas, transcripts and records for higher education institutions (EMREX, 2022; EMREX and ERASMUS+, 2015). EMREX has set good practice in the development of interoperability standards based on openness and inclusion. Its code is open source and standards development is governed by a user group where all actors interested in improving student data portability are represented and can vote (EMREX, 2022a). The standard is subject to public scrutiny as it is neither privately developed nor imposed through commercial dissemination (Bollinger, 2000). EMREX is currently used by higher education institutions in 10 European countries. Still, it coexists with other standards, including Erasmus Without Paper and Europass, which at times do not communicate with each other (Fridell et al., 2022).

TECHNOLOGY'S HUGE POTENTIAL TO TRANSFORM LEARNING ASSESSMENT IS UNDERUTILIZED

Learning assessments used to be exclusively paper-based and manually corrected, but are now increasingly administered using technology, with substantial gains in measurement precision, ease of administration and sharing of results with learners and parents (Office of Education Technology, 2015). Computer-based assessments and computer adaptive testing have been replacing many paper-based assessments (Dandan, 2023).

Computer-based assessments are administered with the use of a computer or a digital device (Wise, 2018). They reduce test administration costs, improve measurement quality and provide rapid scoring. It is also claimed that by providing immediate feedback, they help teachers individualize feedback and teaching (McClelland and Cuevas, 2020; Moncaleano and Russell, 2018; Wise, 2018). However, the evidence on this is weak and, at least in the United Kingdom, an impact on improving teaching and learning has not been confirmed beyond early grade reading and mathematics (See et al., 2022). Other benefits of computer-based assessments include the potential to support teachers to communicate with parents about their children's progress (Shute and Rahimi, 2017) and to reduce opportunities for cheating by easily generating multiple test versions, as is done in Indonesia (Dwiyono et al., 2021).

Computer-based approaches open vast opportunities for both formative and summative assessment. They expand the range of skills assessed – for example, collaboration and creativity (OECD, 2017). They can go beyond a simple analysis of correct answers to explain how students respond to questions. For instance, they can identify factors explaining learner performance, such as confidence, enjoyment and cognitive engagement with reading tasks (Usher et al., 2019). In Finland, the use of log files from computer-based assessment enabled researchers to disentangle the effects of student motivation when performing reading tasks. Students who enjoyed reading were found to be more likely to spend more time on a task and to engage with cognitive strategies to solve particular reading challenges (Ronimus et al., 2022). Technology also facilitates universal design for the assessment of learners with disabilities or learning difficulties (Almond et al., 2010). In France, a computer-based reading assessment tool helped group grade 2 to 9 readers by type of reading difficulty. The tool distinguished children with hyperlexia and children with low decoding skills, for which different remediation strategies are needed (Auphan et al., 2019).

Computer adaptive testing is administered with a computer or digital device but also uses algorithms that select test items sequentially to match the level of the test taker's proficiency. Computer adaptive testing uses variable test forms, as opposed to the fixed forms of traditional pen-and-paper tests (Luecht, 2018; Moncaleano and Russell, 2018). It has been found to increase measurement precision in China, Cyprus, Germany, India, Malaysia and Türkiye (Dandan, 2023). In Indonesia, a programme assessing critical thinking in physics was determined to measure higher-order learning skills with more precision (Abidin et al., 2019).

Some of the most advanced uses of technology in learning assessments are observed in fields like medical and military training where learners are assessed in virtual simulation environments (Ahir et al., 2019; Liu et al., 2018; McGrath et al., 2018). The combination of higher computational power, advances in natural language processing, improvement in three-dimensional representations and connected wearable devices makes it possible to assess learners in virtual scenarios that would be difficult or impossible in real life (McGrath et al., 2018). Formative assessments using virtual reality have been used to train and assess construction workers as a safe and cost-effective method to prepare them for hazardous tasks without exposing them to safety risks (Adami et al., 2021).

To be effectively implemented, technology-based assessment must strike a good balance between quality, cost and time. However, quality problems in the administration of technology-based assessments are not uncommon (Hillier et al., 2020). For instance, universities are introducing protocols and policies to deal with problems such as power, hardware, browser and internet connectivity failures in online examinations (e.g. University College London, 2020). As more examinations shifted online as a result of COVID (Deneen, 2022), the need for online cheating detection and proctoring tools also increased. These tools record student computer activity through webcam video and audio to detect potential fraud during examinations (Andreou et al., 2021; Harwell, 2022; Kharbat and Abu Daabes, 2021). While they can reduce cheating (Milone et al., 2017), their effectiveness should be weighed against fairness and psychological effects (Lee and Fanguy, 2022). A high degree of scrutiny and intrusiveness, and lack of transparency about how they are being followed, may make students afraid to click too frequently or even rest their eyes for fear of being signalled as cheating (Harwell, 2022). As the use of proctored online assessment tools will continue to increase, the intersection of artificial intelligence use and ethics will become an important consideration (Coghlan et al., 2021).

Moreover, while evidence on the quality and usefulness of technology-based assessments has started to emerge, much less is known about its cost efficiency. Among the 34 papers on technology-based assessments reviewed for this report, clear and transparent data on cost were lacking (Dandan, 2023). Cost effectiveness needs to take into account development, manufacturing, maintenance and operating costs. It also requires an understanding of the expected number of learners, the number and type of courses, adaptations for meeting different learners' needs, as well as a usage rate (Dandan, 2023; Grunwald, 2009). The little research available acknowledges potential material-saving (e.g. paper printing and distribution or administrative costs) and time-saving features but ignores the costs associated with the development, operation and waste disposal of technology-based assessments (Dandan, 2023).

Artificial intelligence opens further opportunities for reducing costs through automated assessment development, writing analytics or continuous assessments through electronic platforms (Swiecki et al., 2022). Cheating and plagiarism prevention tools have been used in higher education and research for some time (Foltỳnek et al., 2019). In Germany, the crowdsourced plagiarism detection project, VroniPlag, has reviewed more than 200 dissertations and theses since 2011 in Austrian, Czech and German universities. In at least 40 of these, more than two thirds of pages were found to contain plagiarism (VroniPlag, 2023). However, traditional plagiarism detection tools that do not use artificial intelligence have been found to be insufficient. In 2019, a study of 15 web-based plagiarism detection tools in 8 languages highlighted that they could not detect all text similarities, especially when students used synonym replacement, paraphrases or translation. The tools worked better in some languages than others but also sometimes identified original materials as false positives (Foltýnek et al., 2020).

Generative artificial intelligence-based (AI) tools that can detect texts produced by generative AI, including GPTZero (Rogers, 2023), DetectGPT (Mitchell et al., 2023), AI Text Classifier (OpenAI, 2023) and Writer AI Content Detector (Writer, 2023) have been developed recently.

Overall, advances in digital technology will continue improving how assessments are designed, administered and scored. But important issues need to be addressed to ensure that these approaches remain fair and secure (International Test Commission and Association of Test Publishers, 2022).

LEARNING ANALYTICS CAN SUPPORT MANAGEMENT BUT BRINGS NEW CHALLENGES

The interaction of learners with education hardware and software generates massive volumes of data that, when curated and analysed appropriately, can help teachers understand their students' progress and school leaders and system administrators make better management decisions (Dillenbourg, 2021; Ifenthaler, 2021). Learning analytics can provide formative feedback, empower students to take decisions pertaining to their development path, support academic planning, strengthen early detection systems, and improve curriculum and assessment alignment (Macfadyen, 2022).

Three approaches of learning analytics have been followed (Buckingham Shum, 2012). First, at a descriptive level, schools in richer countries have become familiar with the dashboards, visualizations and customized reports that learning management systems have copied from business intelligence software (Șahin and Ifenthaler, 2021).

Second, at a more advanced level, data on student characteristics can be combined with their learning management system use patterns to predict student trajectories and design supporting interventions (Ifenthaler, 2021). In Germany, such data have been used to detect students at risk of failing their studies, looking at more than 200 individual risk characteristics. Combined with data on grades, enrolment and study progression, insights by lecture, course and student cohort support evidence-based discussions on student management (Hinkelmann and Jordine, 2019). The use of learning analytics has been shown to benefit the governance and the management of institutions (Ifenthaler et al., 2019).

Third, an even more data-intensive approach is based on computer adaptive software, such as those used for assessment. Such data help unpack how students learn concepts, playing an effective formative role. In Viet Nam, learning analytics and visual data mining obtained with a computer adaptive testing tool effectively supported teachers to monitor the growth of students' reading skills in English as a second language and develop teaching strategies (Aristizábal, 2018). Such data can also help improve curriculum design. Analytics methods have been used in digital textbooks, where textbook usage metrics can be used to predict course grades (Junco and Clem, 2015).

In classrooms, data from sensors have been used to analyse interactions and student attention to detect struggling students (Dillenbourg, 2021). Commercial and open-source tools have also been used to record student attendance during online education sessions, albeit at the cost of raising privacy concerns. For instance, Google Meet Attendance enables teachers and managers to record and report on attendance during online sessions but also to share data with the central level for general reporting purposes (Smith, 2022). Similar plug-ins exist for Canvas, Moodle, Teams and Zoom. Recent technological developments – including the use of AI – have even tracked students' attention during online classes. For instance, facial recognition is being used to record attention levels during lectures through physical cues such as blink rate, eye gaze and posture (Rahul et al., 2021)

While learning analytics is becoming part of the education landscape, few systems can deal with the vast amounts of data generated. In China, learning analytics has been used in primary and secondary education to identify learner difficulties, predict learning trajectories, and manage teacher resources and professional training. Commercial applications, such as Homework Gang and Yuanfudao (Ape Tutor), use optical character recognition and natural language processing to analyse student test responses, while Liulishuo uses automatic speech recognition in oral language evaluations. In Uruguay, Plan Ceibal, the government agency responsible for the integration of ICT in education, launched a laboratory in 2022 whose mission is to improve learning through the combination of user-centred data analytics and behavioural science principles (Aguerrebere et al., 2022).

In higher education, learning analytics has been used more extensively (Lang et al., 2022). In Europe and Northern America, several universities have developed early warning systems. Course Signals, a predictive learning analytics system created in Purdue University, is used to flag whether a student has a low likelihood to pass a course in order for educators to target additional support (Tsai and Martinez-Maldonado, 2022). In Belgium, the LASSI dashboard helps students regulate their learning by providing them with data displays that signal how they compare with their cohort in terms of stress, time management and examination strategies (Broos et al., 2020).

In Finland, the Digivision 2030 programme aims to optimize the use of learner data to provide a tailored and individualized student experience (Digivisio2030, 2023). The Finnish National Agency for Education has focused on two projects: KOSKI is an integrated data warehouse that connects to other major data systems, such as social insurance and national statistics; and mPassId is the national unique identification system that allows learners to access web services such as the student registry and learning management systems (Aguerrebere et al., 2022).

“Just because data are available does not mean they should be used”

Despite the opportunities it is creating, learning analytics also raises important concerns. First, there are ethical issues. Just because data are available does not mean they should be used. It is a highly sensitive process to decide what data can be analysed, what other data they are to be combined with, and who can have access to the results (Slade and Prinsloo, 2013). Second, learning analytics need to be a valid and reliable representation of student progress and potential. In practice, they often focuses on a narrow set of learning outcomes, capturing some but missing other aspects of student potential, which may form an unsuitable basis upon which to design support interventions. Third, the capacity of users to interpret learning analytics as well as to translate the diagnosis into appropriate pedagogical interventions tends to be underestimated (Gasevic et al., 2016).

For learning analytics to be effective, challenges that need to be overcome include improving data literacy among all system actors (Macfadyen, 2022) and understanding algorithmic fairness (Kizilcec and Lee, 2022; Loukina et al., 2019; Wang et al., 2022). Algorithms used in decision-making processes are subject to bias that may render their decisions unfair in many ways. They may, for instance, single out groups that make sense algorithmically but not from the perspective of social policy (Perrotta and Williamson, 2018). Machine learning algorithms can define high levels of performance in a way that is disadvantageous for minority groups. Algorithms can be discriminatory if they learn stereotypical patterns from observed data and replicate these patterns in predictions (Wang et al., 2022). While these issues have been acknowledged in other fields, they remain relatively neglected in education. It has been argued that perceiving learners as data constructs by learning analytics can be misleading and, rather than improving the educational experience of learners, it may narrow their educational opportunities (Perrotta and Williamson, 2018).

Another challenge is for learning analytics to be understood by those concerned (Mandinach and Abrams, 2022). The widespread use of dashboards, charts and tables to support decision-making requires a minimum level of data literacy from a broader range of users, including teachers, students and parents (Jarke and Breiter, 2019; Lang et al., 2022). Both teacher- and student-facing learning analytics applications have been shown that to be used effectively, they need to address variation in data literacy skill levels (Leeuwen et al., 2022). Low levels of data literacy in European higher education institutions constitute a critical challenge to institutionalizing learning analytics (Macfadyen, 2022). Simplifying complex learning analytics into accessible data displays, such as traffic light systems, removes nuances and can distort the meaning behind the data that educators are meant to interpret in relation to learning processes (Mandinach and Abrams, 2022).

Multiple data sources, data types, analytical outputs, users and institutions form a complex set of data and users that can only yield results if data governance, policies and processes are in place and supported by new models of education leadership (Macfadyen, 2022). A survey of senior managers in Australian universities pointed at leadership as a critical bottleneck in integrating learning analytics and other complex technological innovations into management (Dawson et al., 2018).

LACK OF CONFIDENCE AND CAPACITY CONSTRAIN TECHNOLOGY USE IN EDUCATION MANAGEMENT

By one estimate, businesses see only 30% of their digital transformation projects achieve their objectives. Clear strategy, leadership commitment, relevant skills, agility, effective monitoring, and technology resources are preconditions of success (Forth et al., 2020). If these factors are difficult to secure in competitive business environments, it is clear that few education systems and actors are ready to undergo digital transformation, despite the presence of good tools to improve education management (McCarthy et al., 2023). Indeed, technology infrastructure is often simply not available. As well, administrators and teachers have beliefs and attitudes towards technology, which may not facilitate technology adoption. Finally, education institutions vary in their capacity to absorb technological change and use it for its intended purposes.

Administrators and teachers are the main users of education technology for management purposes. It is through their effective use of applications and devices that data are generated and used for decision making. However, a recurrent finding is that education technology projects have not necessarily addressed the issue of how technology is managed. Self-efficacy, or confidence in performing management tasks that require the integration of technology (Šabić et al., 2022), is strongly associated with prior successful use. In Kenya and the Philippines, positive administrator attitudes are a strong predictor of adoption and use of technology in school management and, eventually, of school management improvements (Kirui et al., 2022; Vida Villa and Natividad Eder, 2019). In Nigeria, a lack of required skills and competencies explained most of the variability in education management information system use in universities (Akinwole et al., 2019). In North Macedonia, increased technological knowledge and information and communication technology support were the two factors that directly influenced usage of education management information systems (Stamenkov and Zhaku-Hani, 2021).

Technology design plays an important part in driving attitudes and fostering adoption. Badly designed user interfaces or frequent bugs which hinder ease of use compound negative attitudes and the low self-efficacy of intended users. In Malaysia, the use of an online education management information system by secondary school teachers responsible for data entry was positively influenced by its perceived ease of use (Saad and Daud, 2020). In Jordan, administrative staff perceptions of an education management information system software's ease of use was found to influence its usage within the education ministry (Alhanatleh, 2020). Perceived ease of use was also a determinant of staff intention to use technology in British higher education institutions; together with perceived usefulness, institutional support and innovativeness of individuals, it contributes to explain more than half of the variance in intentions to use an education management information system (Zhao et al., 2020).

Whether education institutions are ready to adopt technology for management depends on their resources and their ability to integrate technology in daily practices. The concept of absorptive capacity refers to the ability of schools, as learning organizations, to acquire and apply new knowledge through innovation (Da'as et al., 2020; Lenart-Gansiniec et al., 2022; Zuckerman et al., 2018). In settings where technological change is required, absorptive capacity is an advantage but also a key source of inequality. Recently, the COVID pandemic highlighted the value of school absorptive capacity for rapid adjustment to new modes of education delivery. Combined with effective leadership, absorptive capacity means that new knowledge can be used and can lead to school improvement.

However, absorptive capacity varies substantially between and within countries. Successful education systems are typically equipped with absorptive capacity resources, including strong school leaders and confident teachers willing to innovate (Schleicher, 2015). Rural schools tend to have fewer financial and human resources than urban schools, and lag behind in the development and implementation of technology-related innovation (Zuckerman et al., 2018). Four conditions determine school absorptive capacity: prior knowledge; staff skills acquired from experience and professional development; engagement with innovative education projects where teachers and staff have collaborated; and exposure to external knowledge which provides institutions with more options to approach problems from different perspectives (Lenart-Gansiniec et al., 2022). These conditions also overlap to some extent with the determinants of technology self-efficacy and attitudes towards technology integration.

There are few examples of effective institutional implementation of learning analytics. Many challenges remain to achieve systemic change (Macfadyen, 2022). The pace at which learning analytics is making its way into institutionalized practices is slow, with most higher education institutions still at the earliest stage: extraction and reporting of education data (Macfadyen, 2022). Issues remain even in countries where learning analytics is becoming a priority. In Finland, the Digivision 2030 programme continues to struggle with data sharing, as many systems still store and maintain their data separately (Aguerrebere et al., 2022).

Institutional culture is a particularly important factor in the adoption and use of learning analytics. A survey of senior leaders from 32 universities in Australia showed that top-down approaches that neglect learners and academic staff result in poor buy-in (Colvin et al., 2016). Research covering senior managers from 83 higher education institutions in 24 European countries found that the involvement of students as key stakeholders in the design and implementation of learning analytics is necessary for learning analytics to be used effectively (Tsai et al., 2020).

Too often, there is a gap between the expected benefits of technology on education and the realization of these benefits. This may be because seemingly trivial issues such as maintenance and repair of infrastructure are ignored or underestimated (Pangrazio et al., 2022), because there might be a local reluctance to use big, automated data (Selwyn, 2020) or because the development and design of learning analytics has failed to integrate the very objective of education systems – improving learning – as the core driver of their development (Lang et al., 2022).

CONCLUSION

Technology offers various opportunities to improve education system management. It provides the possibility of expanding the range of data collected on schools and students and linking them to generate fine-grained analyses of learning trajectories and the factors that determine them. Such data can be used to personalize learning, track marginalized children and prevent disengagement and early school leaving. Technology also has the strong potential to support continuous assessment for learning as well as to expand the range of skills and outcomes assessed.

“Understanding all aspects of a digital ecosystem is critical for countries that want to leverage technology to improve the effectiveness and efficiency of their education system management”

However, with that potential comes challenges. Some question whether the amount of data generated can be used effectively, not just to monitor but to improve individual and institutional performance. Policymakers and school leaders are overwhelmed with the amount of information and with the range of purported solutions to combine data, which often do not speak to each other. The rollout of many technology projects is fraught with high costs, privacy and security concerns, implementation challenges and weak capacity. Understanding all aspects of a digital ecosystem is critical for countries that want to leverage technology to improve the effectiveness and efficiency of their education system management. Users need to be put at the centre, improving their attitudes towards the technology they are expected to adopt, and strengthening their capacity to use it.

In the field trip to Bat Xat secondary and high school in the Lao Cai province of Viet Nam, UNICEF staff had a chance to visit the household of Nong Van Duong (15) and Nong Van Thanh (13). Both of them were great students in Bat Xat school. Duong and Thanh had faced many difficulties due to the COVID-19 pandemic time, while other students used a smartphone or laptop to attend class. Duong and Thanh shared that they tried to copy the recording from the online class and play it on the old red radio. However, Duong and Thanh worked hard and received many certifications from Bat Xat School.

Credit: UNICEF/UN0610392/Le Vu*

CHAPTER

7

Access to technology: Equity, efficiency and sustainability

KEY MESSAGES

Investments to improve access to technology often neglect sustainability.

Access to technology is unequal at home and in schools.

- One in four of the world's primary schools lack electricity; 40% of primary, 50% of lower secondary and 65% of upper secondary schools are connected to the internet.
- Globally, 46% of households had a computer at home in 2020, ranging from 7% in low-income to 80% in high-income countries. The share of schools with computers was 47% among primary, 62% among lower secondary and 76% among upper secondary schools.
- Mobile phone ownership is also unequal, reaching 73% of those aged 10 and above worldwide but only 49% in low-income countries.

Countries use various policies to improve access to technology.

- Globally, 85% of countries have legislation or policies in place to improve school or learner connectivity and 52% to enhance school electrification.
- Globally, 30% of countries had policies to provide each student with a laptop or tablet. The share was as high as 61% in Latin America and the Caribbean but has since fallen to 15%.
- About one in five countries have policies granting subsidies or deductions for students to buy devices. Such approaches can reduce schools' financial burden but may widen divides for low-income families. Only 19% of countries have regulations addressing that risk.

Evidence needs to drive equitable, efficient and sustainable technology solutions.

- Several education technology products are underused, if they are used at all. Two studies in the United States estimated that 67% of education software licences were unused.
- A review in the United Kingdom found that only 7% of education technology companies had conducted randomized controlled trials to evaluate effectiveness.
- Investment decisions need to assess whether a technology application has an impact on teaching and learning. Ghana suspended its One Laptop Per Child programme after three years because sustainability and feasibility conditions were not fulfilled.

Procurement decisions need to take sustainability into account.

- The lifespan and hidden long-term costs of products and services are critical. It has been estimated that initial investment in education technology represents 25% or less of the eventual total cost.
- Devices lead to a surplus of e-waste. 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.

Regulation needs to address risk in education technology procurement.

- Even the most conservative estimate of corruption put it at equivalent to 8% of procurement contracts worldwide in 2019. In Brazil, the Comptroller General of the Union found irregularities in the electronic bidding process for the purchase of 1.3 million computers, laptops and notebooks for state and municipal public schools in 2019.

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Access to digital technology is now considered a part of the right to education. The Special Rapporteur on the right to education recently argued that 'the implementation of the right to education must respond to the needs of all persons to access, master and use technology as an empowering tool for being active members of society' (United Nations Human Rights Council, 2022). The issue of equitable access has therefore become key.

Schools, teachers and students need context-appropriate devices of good quality, relevant software aligned with national curricula and accessible platforms. Governments need to pay affordable prices and ensure proper maintenance of technology. Systems need to be interoperable and sustainable. Electricity and telecommunications infrastructure, especially to ensure internet connectivity, needs to be installed. Yet, many of these conditions are not met.

The cost of much of that investment is high and beyond the budget of many countries (**Chapter 22**). It needs to compete with other education priorities. Access to technology ends up being unequally distributed, both between and within countries. Evidence on the impact of products and services on learning is limited. Providers are a step ahead of government officials. Some engage in misleading marketing practices. Waste and obsolescence are high, adding to a growing environmental cost of digitalization.

This chapter describes the distribution of technology resources; efforts to ensure that access to infrastructure, hardware and software is equitable and affordable; and initiatives to support evidence-based public procurement of education technology that leads to equitable, efficient and sustainable solutions.

ACCESS TO TECHNOLOGY IS UNEQUAL

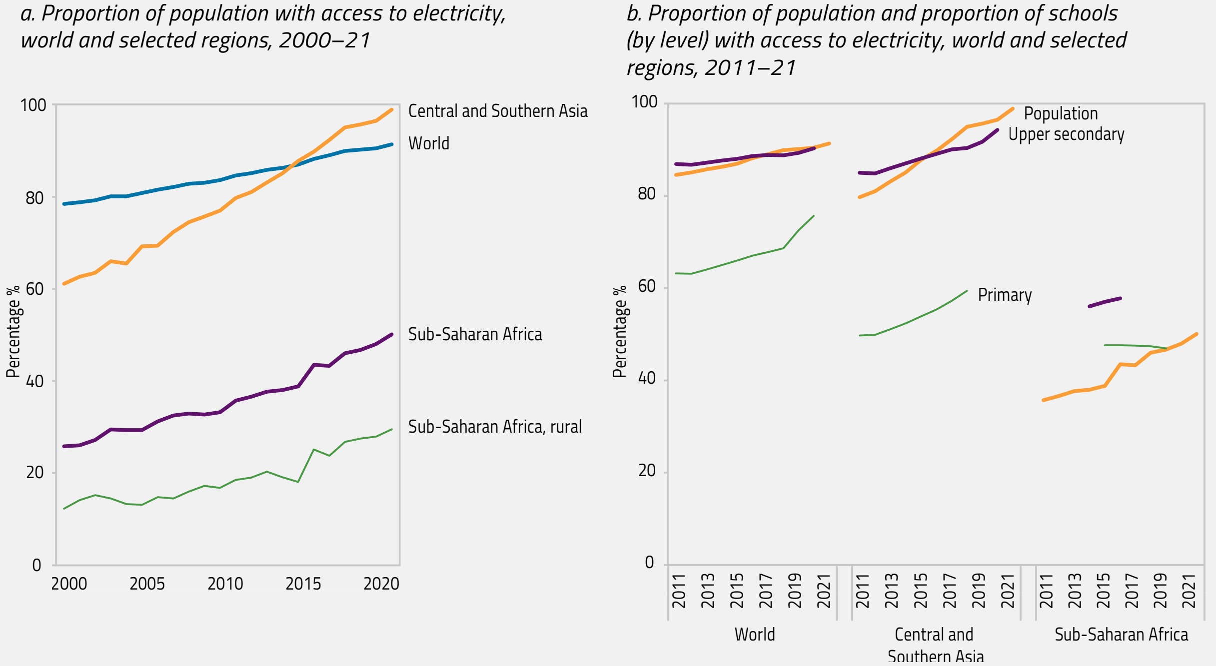
Access to electricity, devices and the internet is highly unequal between and within countries, including between schools. In 2021, 770 million people, or almost 9% of the global population, did not have access to electricity. That year, access to electricity in sub-Saharan Africa exceeded 50% for the first time, although it was still below 30% for those living in rural areas. In Rwanda, for instance, 18% of rural households have access to electricity, with 12% accessing the grid and 6% off-grid solar devices (World Bank, 2022). Over a period of two decades, access to electricity increased by 38 percentage points in Central and Southern Asia – becoming almost universal – and by 24 points in sub-Saharan Africa, and 17 points in rural sub-Saharan Africa (**Figure 7.1a**). It has been estimated that universal access to electricity by 2030 will require USD 413 billion per year (SEforAll, 2020).

The proportion of upper secondary schools with access to electricity follows the share of the population with access to electricity. By contrast, the proportion of primary schools with access to electricity lags behind access in the general population – by 15 percentage points globally and 35 percentage points in Central and Southern Asia (**Figure 7.1b**). Globally, one in four primary schools does not have electricity, a prerequisite to benefiting from technology.

> Globally, one in four primary schools does not have electricity, a prerequisite to benefiting from technology

FIGURE 7.1:

Only 3 in 10 rural Africans have access to electricity



GEM StatLink: https://bit.ly/GEM2023_fig7_1
Source: SDG database.

The 2018 Multi-Tier Framework survey found that 60% of public schools in Cambodia, Ethiopia, Kenya, Myanmar, Nepal and Niger had no access to electricity, 31% were on grid and 9% off grid (IEA et al., 2020). But access to electricity varies widely between these countries. The national grid provides energy to 22% of Ethiopian and 49% of Nepalese schools. In Niger, 5% of schools are electrified through the grid and 3% through solar energy sources. Solar power is a backup solution for 15% of Kenyan and 86% of Cambodian schools. Power interruptions are costly. On average, only 16% of schools in the six countries enjoyed uninterrupted supply. Voltage fluctuations damage devices: 28% of schools experienced equipment damage because of frequent power surges and outages (IEA et al., 2020). In South Africa, where a long-standing energy crisis means many schools cannot operate during load shedding, the High Court ruled that public schools should be protected from power cuts (Vollgraaff and Sguazzin, 2023).

Globally, 46% of households had a computer at home in 2020, with the percentage ranging from 7% in low-income to 80% in high-income countries – and 83% in North America (Broadband Commission, 2022). But even in the United States, in 2020, up to 16 million public school students and 400,000 teachers, or 10% of all those teaching in public schools, lived in households without adequate digital resources. Closing the digital gap would have cost between USD 6 and USD 11 billion in 2020 and from USD 4 to USD 8 billion per year afterwards (Ali et al., 2021).

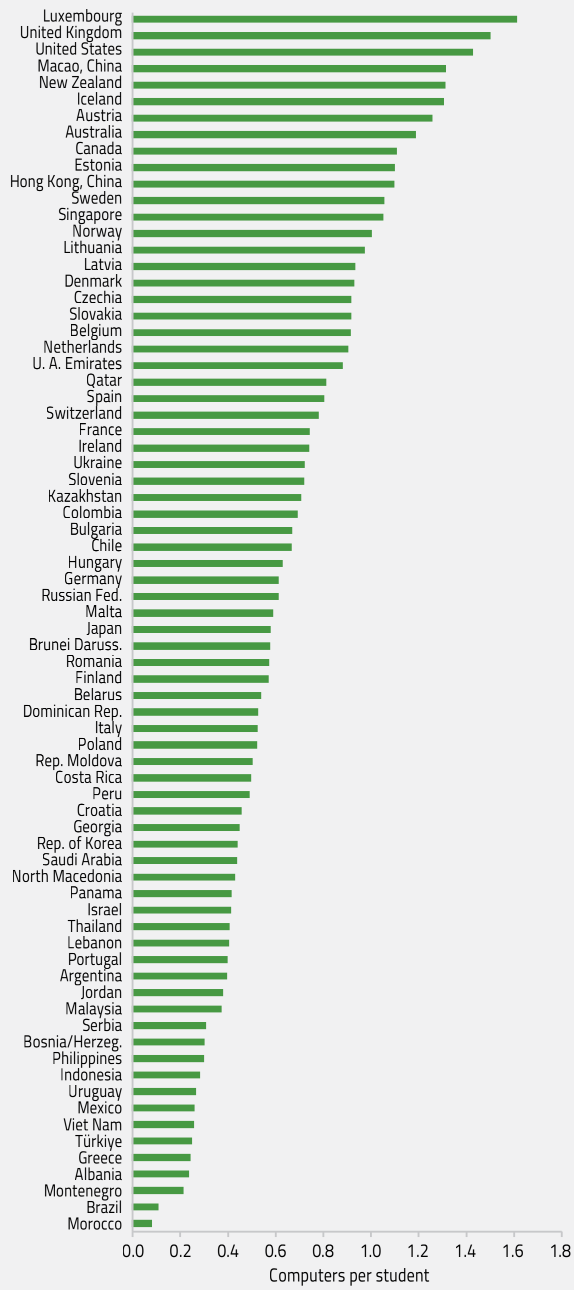
Globally, the shares of schools with computers for pedagogical purposes was 47% among primary, 62% among lower secondary and 76% among upper secondary schools in 2020. But these averages mask considerable inequality. No primary schools in Chad, and less than 5% in Niger, Sierra Leone and Togo, had access to computers in 2021. In Chad and Sierra Leone, less than 10% of secondary schools had access to computers, according to the UNESCO Institute for Statistics. The 2018 Programme for International Student Assessment (PISA) estimated that almost each 15-year-old student in a large sample of middle- and high-income countries had access to a computer for educational activities in school. But access ranged from at most 10 computers per 100 students in Brazil and Morocco to 160 computers per 100 students in Luxembourg (**Figure 7.2**) (OECD, 2020).

In European Union member states, 35% of primary, 52% of lower secondary and 72% of upper secondary schools were fully digitally equipped in 2017/18 based on a composite index that included the number of desktop computers,

FIGURE 7.2:

Many students do not have a computer available at school for education activities

Computers per student, 15-year-old students, selected middle- and high-income countries, 2018



GEM StatLink: https://bit.ly/GEM2023_fig7_2
Source: OECD (2020).

laptops or notebooks, interactive whiteboards and digital cameras per 100 students; the proportion of fully operational equipment; internet speed at school and type of internet access; and a range of indicators on access to digital content, including a virtual learning environment (European Commission et al., 2019). Attempts to define a 'highly equipped and connected classroom' have since been updated (European Commission, 2022).

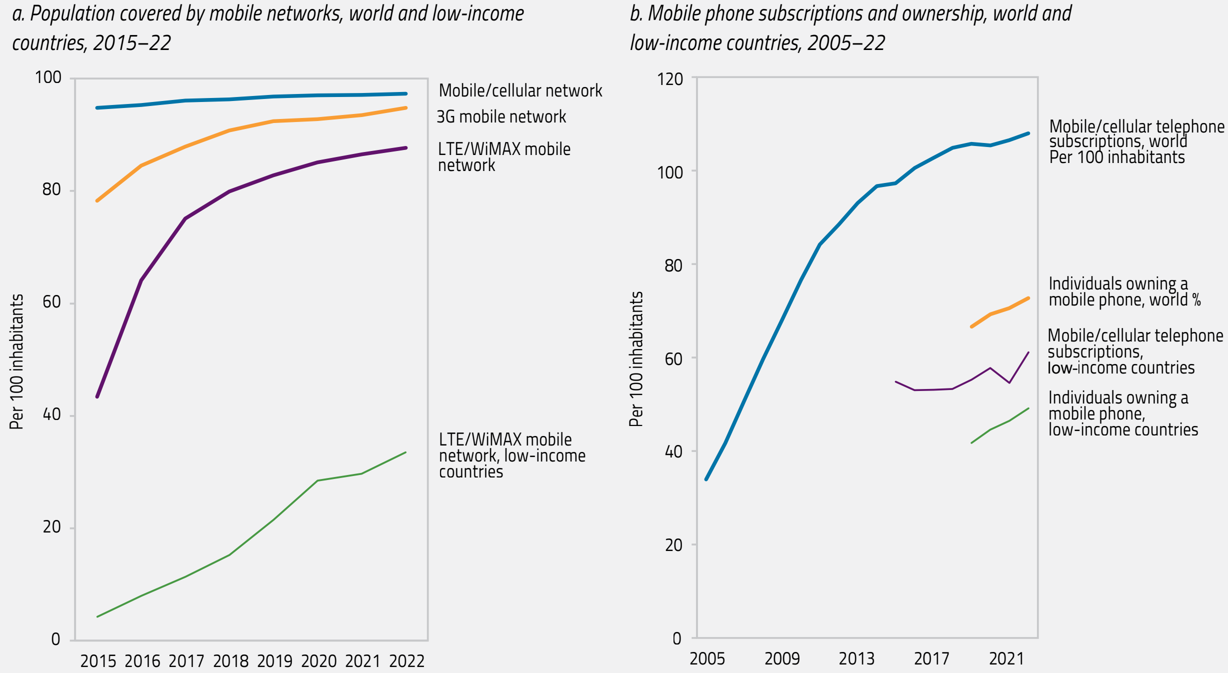
Coverage of mobile telecommunications technology continues to expand. In 2022, 95% of the global population was covered by 3G wireless networks and 88% by 4G technologies such as LTE and WIMAX, although 4G only reached one third of people in low-income countries (**Figure 7.3a**). Mobile phone subscriptions reached 108 per 100 people in 2022; however, they have stagnated at about 60 per 100 inhabitants in low-income countries since 2015. Globally, mobile phone ownership reached 73% of those age 10 and above, and 49% in low-income countries (**Figure 7.3b**). By 2021, the share of connections with 3G, 4G or 5G smartphones was higher than with basic phones, except in sub-Saharan Africa, where basic phone connections are still the majority (GSMA, 2022b).

Access to the internet is a vital enabler of economic, social and cultural rights. Universal and meaningful connectivity can provide the opportunity for users to have a 'safe, satisfying, enriching, and productive online experience at an affordable cost and with a sufficiently large data allowance' (ITU, 2022c). In 2016, Article 19 of the Universal Declaration of Human Rights was amended to include a call to all countries to 'facilitate access to information on the Internet, which can be an important tool in facilitating the promotion of the right to education' (United Nations Human Rights Council, 2016). The drive for improved connectivity is captured in Sustainable Development Goal (SDG) target 9.c that called on countries to 'strive to provide universal and affordable access to internet in least developed countries by 2020'. One of the Broadband Advocacy Targets to be achieved by 2025 is for user penetration to reach 75% worldwide, 65% in low- and middle-income countries, and 35% in least developed countries (Broadband Commission, 2022).

In 2022, two in three people in the world used the internet (ITU, 2022b) (**Figure 7.4**), ranging from only 26% in low-income to 93% in high-income countries. The share of internet users in urban areas was nearly twice as high as in rural areas (82% and 46%, respectively) (ITU, 2023) – and the same gap was nearly three times wider in Africa (63% vs 23%). High-income countries also have access problems. The Australian Education Union estimated that 125,000 public school students lived in dwellings without internet access. One third of those living in remote areas faced the same challenge (Barbara Preston Research, 2020).

FIGURE 7.3:

Only one in two people in low-income countries owns a mobile phone



GEM StatLink: https://bit.ly/GEM2023_fig7_3
Source: ITU database.

There are gender gaps associated with access to technology. It has been estimated that 9% fewer women than men own a mobile phone and 16% fewer use mobile internet in low- and middle-income countries (Broadband Commission, 2022). The largest gap in mobile ownership is reported in Pakistan (52 percentage points) but large gaps are also observed in Benin, Burundi, Mali, Nigeria and Sierra Leone (MacQuarrie et al., 2022). The largest gender gaps in internet usage were found in Nepal (20 percentage points) followed by Pakistan. In some cultures, access and use of technology are contingent on socio-cultural gender norms (Myers et al., 2023), where ownership and use of technology are framed as masculine (Zelezny-Green, 2011), perpetuating unequal access to technology, including in education (Webb et al., 2020).

Fixed broadband subscriptions, including digital subscriber line (DSL), satellite, cable and fibre, averaged 18 per 100 people globally, ranging from less than 1 in Africa to 35 in Europe (ITU, 2022a). Mobile broadband gives more flexibility and is increasingly used to access the internet; it remains the only option to connect in some contexts, such as displacement (Culbertson et al., 2019). In late 2021, there were 87 mobile broadband subscriptions per 100 people, which corresponded to 55% of the global population accessing mobile broadband, up 20 percentage points since 2014 (GSMA, 2022b).

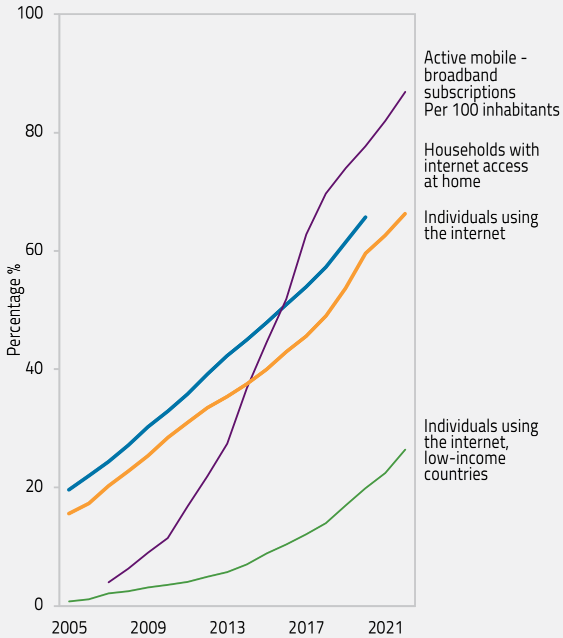
Exclusion remains an issue in mobile broadband coverage and, especially, usage. An estimated 400 million people are not covered by mobile broadband, while 3.2 billion do not use mobile internet services, despite being covered by a mobile broadband network (GSMA, 2022b). The Groupe Speciale Mobile Association (GSMA), which represents the interests of the global mobile industry and mobile operators in particular, has developed a Mobile Connectivity Index. The Index assesses enablers of mobile internet adoption (infrastructure, affordability, consumer readiness, and content and services) in 170 countries. It ranges from less than 20 in South Sudan and Chad to more than 90 in Australia, Finland and Singapore (GSMA, 2022a).

Even if people theoretically have internet access, the connection may not be affordable or of good quality. In 44% of low- and middle-income countries with pricing data, the median cost of 1 gigabyte (GB) of data exceeded 2% of gross domestic product (GDP) per capita. Large differences exist between regions: the median cost was 0.5% of GDP per capita in South Asia and 3.4% in sub-Saharan Africa (GSMA, 2022b). Globally, those in the bottom income quintile would need to spend more than 65% of their average monthly income for an entry-level internet-enabled handset, and the number would exceed 100% for these users in sub-Saharan Africa

FIGURE 7.4:

One in three people do not use the internet

Selected indicators of internet usage, world and low-income countries, 2005–22



GEM StatLink: https://bit.ly/GEM2023_fig7_4
Source: ITU database.

(GSMA, 2021; 2022b). In Brazil, one in four people must disconnect for at least one week per month; 45% of the poorest users run out of data on their mobile phone plan before the end of the month (Telecompaper, 2021). Access is costlier in remote areas, where digital networks are more expensive to establish. Even if they existed, accessing them would cost families two to three times more than in urban areas (GOLA, 2022).

Internet bandwidth (how much information is received per second) and speed (how fast that information is received) are two key measures of connection quality. Applications necessary for education, such as videoconferencing and streaming, require high bandwidth. International bandwidth usage per internet user is estimated to have increased from 52 to 233 kilobits per second (kbps) between 2015 and 2022, ranging from 40 kbps in low-income to 680 kbps in high-income countries, according to the International Telecommunication Union (ITU) database. The COVID-19 pandemic spurred an increase in the share of people who had used mobile internet to support their own, their children's or their relatives' education at least once a week, from 27% in 2019 to 38% in 2021 (GSMA, 2022b).

School connectivity to the internet remains limited. Globally, 40% of primary, 50% of lower secondary and 65% of upper secondary schools are connected to the internet, according to the UNESCO Institute for Statistics. The ITU has proposed as targets for universal and meaningful school connectivity a minimum download speed of 20 megabits per second (mbps) per school and 50 kbps per student, as well as a minimum data allowance of 200 GB (ITU and United Nations Office of the Secretary-General's Envoy of Technology, 2022). The Giga project, which mapped 328,000 schools in 49 countries, found that 53% were connected to the internet (UNICEF and ITU, 2023). In 2020, in Sierra Leone, less than 1% of primary, 5% of lower secondary and 8% of upper secondary schools were connected to the internet (Mullan and Taddese, 2020).

> "Globally, 40% of primary, 50% of lower secondary and 65% of upper secondary schools are connected to the internet"

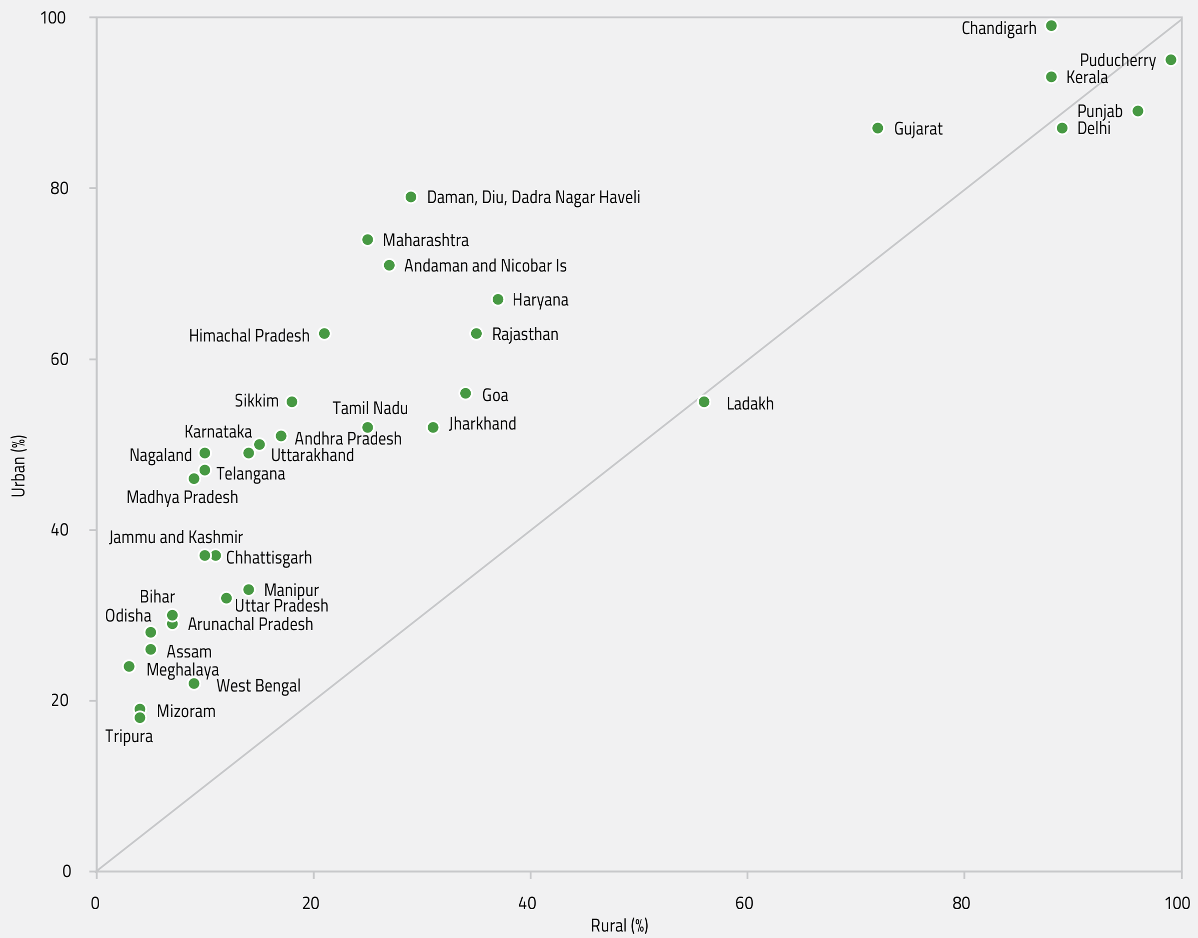
In India in 2020/21, about 50% of urban schools but less than 20% of rural schools were connected to the internet (**Figure 7.5**). The divide was largely determined by the fact that 53% of private unaided and 44% of private aided schools, but only 14% of government schools, were connected (Bhattacharya et al., 2023). The European Union has set a far more ambitious broadband target, whereby all schools would have access to 1,000 mbps internet connection by 2025; yet, in 2019, fewer than 1 in 5 students attended schools with high-speed internet above 100 mbps (European Commission et al., 2019).

COUNTRIES FOLLOW VARIOUS POLICIES TO IMPROVE ACCESS TO TECHNOLOGY

Countries use various policies to improve access to technology. As access to technology will not be equitable until at least electricity supply and internet connectivity are universal, many countries concentrate their actions on strengthening infrastructure: 85% of countries have legislation or policies for improving school or learner connectivity. Meanwhile, 38% of countries have a law on universal internet provision and 27% on universal access to electricity. About one in five countries has a policy granting subsidies or deductions to buy devices (**Figure 7.6**).

Low- and lower-middle-income countries, whose education systems are impacted more by lack of power, are more likely to have provisions for universal access to electricity. While 52% of countries have policies to enhance school electrification, 83% of sub-Saharan

FIGURE 7.5:
There is a large rural–urban divide in internet connectivity in India
Percentage of schools connected to the internet, by state/union territory and location, India, 2020/21



GEM StatLink: https://bit.ly/GEM2023_fig7_5
Source: Bhattacharya et al. (2023) based on UDISE+ data.

African countries do. The 2017–2030 Education and Training Sector Plan of Burkina Faso provides for school electrification to support the development of evening classes and non-formal education (Burkina Faso Ministry of Higher Education, Scientific Research and Innovation et al., 2017). A policy aims to provide learners with lighting kits to increase individual learning time. In Kenya, as part of the 2018 National Electrification Strategy (Kenya Government, 2018), the Rural Electrification Authority is leading efforts to provide all primary schools with power (African Development Bank, 2021). The 2017 National Electrification Program and Implementation Roadmap of Ethiopia aims to achieve universal electricity access by 2025, of which 65% would be on grid and 35% off grid (Ethiopia Government, 2019). In Rwanda, the ICT and infrastructure ministries aim to improve school electricity supply through the national grid, generators, and solar and wind power.

> “38% of countries have a law on universal internet provision and 27% on universal access to electricity”

In Bhutan, where all private but only 8% of public schools had electricity in 2021 (Bhutan Ministry of Education, 2021), the 2020 School Design Guidelines mandate all schools to have a power supply agreement with the Electricity Authority (Bhutan Ministry of Education, 2020).

FIGURE 7.6:
Countries pursue a variety of education technology laws and policies
Percentage of education systems with specific education technology–related policies

GEM StatLink: https://bit.ly/GEM2023_fig7_6
Source: GEM Report team analysis of PEER country profiles.

COUNTRIES ARE SHIFTING THEIR POLICIES ON DEVICES

One-to-one technology models have long been used to provide each student with one laptop or tablet. Such approaches are costlier than most interventions and their effectiveness has been questioned (Hennessy et al., 2021; GEEAP, 2023). The One Laptop Per Child initiative is probably the most famous intervention (**Chapter 4**). Since its launch in 2005, more than 3 million Linux-based educational computers at USD 100 each have been distributed (OLPC, 2023).

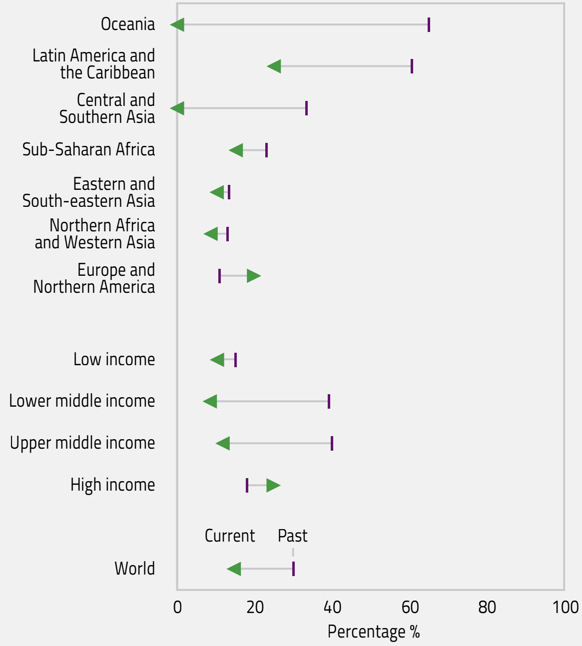
Analysis for this report shows that one-to-one technology programmes were at one time established in 30% of countries. However, currently only 15% of countries pursue such programmes. In some cases, this pursuit has been fuelled by the pandemic. The shift away from them has been particularly strong in Latin America and the Caribbean, where 61% of countries had previously implemented them. By contrast, there has been a small increase in Europe and Northern America (**Figure 7.7**). Argentina reintroduced the Conectar Igualdad programme in 2022 with the aim of promoting education technology in public secondary schools and developing strategies for its integration into teaching and learning processes (Then24.com, 2022). Devices are distributed according to criteria such as regular attendance and socioeconomic status (Argentina Ministry of Education, 2022).

Analysis for this report also suggests that one in five countries globally, and mainly high-income countries, has a policy, plan or strategy to provide subsidies, deductions or cash transfers to parents and/or students to purchase laptops or tablets. In France, the Digital Education Territories programme provides basic digital equipment for 2,700 classrooms and foresees lending equipment to 15,000 disadvantaged students (France Ministry of National Education and Youth, 2023).

FIGURE 7.7:

Countries have moved away from one-to-one provision of hardware

Countries with a policy of providing a device for every student/family, by region and country income group, past and current



GEM StatLink: https://bit.ly/GEM2023_fig7_7
Source: GEM Report team analysis of PEER country profiles.

> One in five countries globally has a policy, plan or strategy to provide subsidies, deductions or cash transfers to purchase laptops or tablets

A number of upper-middle- and high-income countries are shifting from providing devices to allowing students to use their own devices in school (Roberts, 2020). In Australia, a Bring Your Own Device policy replaced the government's Digital Education Revolution scheme in 2013 (Australia Department of Education, 2013). Generally, schools set their own approach, including establishing codes of conduct and identifying the groups of learners to exclude from the use of their own devices at schools, such as those in primary schools. In South Australia, the Department of Education stated that each school should have a policy in place detailing expectations by 2021. Schools were encouraged to consult with their community to complete and review their own policies (South Australia Department of Education, 2021). Jamaica adopted a Bring Your Own Device policy framework in 2020 for reasons of sustainability (Jamaica Ministry of Education, Youth and Information, 2020). The Hong Kong Education Bureau allows schools to adopt various approaches for the devices students can bring to school, but notes that many schools have already made specifications for these devices (Hong Kong Education Bureau, 2022).

While Bring Your Own Device approaches can reduce the financial burden for schools and governments, they bring about other challenges. First, they risk widening divides, as the students who can access good digital learning resources are likely to be wealthier. But governments can try to counter that challenge. In New Zealand, where the cost of devices varied between USD 200 and USD 1,250, hardship assistance payments worth USD 3.3 million were made to almost 25,000 students in the first 3 months of 2019 (Stock, 2019). Second, teachers may not have the skills or find it very difficult to organize and manage learning and teaching activities in a classroom with different devices and platforms (Ginley, 2021). Moreover, the management of licences and proprietary rights can be more complex with personal devices used in schools. Third, there are privacy and security concerns (Regan and Bailey, 2019). Student-owned devices may not have appropriate safeguards for storing personal and school data. There can also be major concerns for theft, cybersafety, virus protection and the costs of working with multiple operating systems (Poggi, 2021).

Despite the risks associated with Bring Your Own Device policies, only 19% of countries have regulations to address them. Jamaica's policy set requirements for approved devices at school along with guidelines for acceptable use. But without privacy controls, students' use of educational platforms from their own devices is open to confidentiality breaches or worse, cyberattacks (Jamaica Ministry of Education, Youth and Information, 2020). In Wales, United Kingdom, the government has issued Bring Your Own Device guidelines, which refer to health and safety considerations, such as display screen equipment, excessive screen time and device accessibility. They also highlight that attention should be devoted to the impact on socioeconomic differences and to how schools will manage and deliver licences for essential applications (Wales Department of Education, 2019).

SOME COUNTRIES CHAMPION FREE AND OPEN SERVICE SOFTWARE

In a context where most basic operating systems and software used in education institutions are proprietary, some governments support the use of free and open source software, which can be adapted and improved to meet specific needs (Nagle, 2022). The content can be customized for teaching and learning at a low cost. Such software includes that used in wikis, GitHub, discussion forums and member portals, tutorials, textbooks, professional training and online learning. Open source software supports education systems by facilitating the sharing of data and libraries. It is growing: a review of more than 1,700 code databases found that most of them contained open source software and that open source codes in education technology grew by 163% between 2018 and 2022 (Synopsis, 2023).

Education institutions with complex IT infrastructure such as universities can benefit from open source software and its flexibility to add new solutions or functionalities. By contrast, proprietary software does not permit sharing. Proprietary file formats carry vendor locks that hinder interoperability, exchange and updates. Awareness about free and open source software is still low and the required skills to use it are not widely available. Moreover, there are costs to deploy and maintain it.

Yet some countries are turning to open sources for public services, including education. X-Road is the open source data exchange used as the backbone of government e-services in Estonia, including for the collection and management of education information (Nordic Institute for Interoperability Solutions, 2023a). It has been exported and is being implemented in Faroe Islands, Finland, Iceland, Japan, Kyrgyzstan and Mexico (Nordic Institute for Interoperability Solutions, 2023b). Similar technology based on the Estonian interoperability experience has also been implemented in Namibia and Ukraine (e-Governance Academy Foundation, 2017). In North Macedonia, while education moved to Zoom and Google during the COVID-19 pandemic, the government searched for a sustainable solution. Along with university and other partners, the Ministry of Education and Science set up a platform combining Moodle, a free and open-source tool, with Microsoft Teams, to enable video classes and communication, connecting 27,000 students across the country and supporting them to continue learning online at zero cost (Mrmov, 2020).

In India, the National e-Governance Plan, launched in 2015, makes it mandatory for all software applications and services used in government to be built on open source software to achieve efficiency, transparency, reliability and affordability. The government of India is accordingly encouraging the use of GNU/Linux (Thankachan and Moore, 2017). The National Resource Centre for Free and Open Source Software supports development, awareness and adoption, notably through the free Bharat Operating System Solutions certified by Linux and supported in 18 Indian languages (India Ministry of Electronics and Information Technology, 2021). Its educational variant, EduBOSS, is a free operating system for schools (CDAC, 2023). The Digital Infrastructure for Knowledge Sharing, or DIKSHA, is a portal and mobile application launched in 2017 as a repository for e-books, e-content and assessments published by states and national organizations for grades 1 to 12 (India Government, 2021). The free software policy in the state of Kerala, for instance, means that more than 2 million computers used in schools carry the latest version of free and open source software (Financial Express, 2019).

COUNTRIES ARE COMMITTED TO UNIVERSAL INTERNET PROVISION AT HOME AND IN SCHOOL

Commitments to universal internet provision are a foundation for equitable access. But while 155 countries emphasize broadband in their national digital plans or strategies (Broadband Commission, 2022), analysis of the Profiles Enhancing Education Reviews (PEER) country profiles suggests that only 78 countries have universal service provision for connectivity. In Benin, the 2016–2019 National Programme for Universal Electronic Communication and Postal Services targeted populations that were poorly served due to location, inability to pay or inability to use ICT. The Benin Digital Code (2018) highlights the non-discriminatory, fair and transparent nature of affordable universal service. Public infrastructure, including community digital points, offer Wi-Fi at no cost in youth centres and municipal libraries. These measures have helped Benin's internet penetration (34%) to catch up with the regional average (36%), although other western African countries, such as Ghana (68%), Mauritania (59%) and Senegal (58%), and other sub-Saharan African countries, such as Botswana (74%) and Cabo Verde (70%), have done much better.

Measures targeting school connectivity are essential. One estimate suggests that a 10% increase in school connectivity could contribute to increases of 1.1% to GDP per capita and 0.6% to effective years of schooling (The Economist Intelligence Unit, 2021). An analysis of the PEER country profiles shows that 77% of low-income countries address school connectivity in plans and policies.

The Bangladesh 2020–25 Eighth Five-Year Plan aims to connect all secondary schools to electricity and the internet by 2025. The Digital India programme includes the Technology for Education – e-Education Plan, which aims to connect all schools to broadband and provide free Wi-Fi to all 250,000 secondary and higher secondary schools. In Nepal, within the 2019 Digital Nepal framework, a Rural Telecommunication Fund aims to enhance community school connectivity in hard-to-reach areas.

In Brazil, the Connected Innovation Education Policy established by law in 2021 supports the universalization of high-speed internet access to promote the pedagogical use of digital technology in basic education (Brazil Presidency of the Republic, 2021). In Oman, the government has connected 141 rural schools to high-speed internet via satellite, as part of efforts to achieve universal school connectivity (Oman Daily Observer, 2020). In Uganda, the 2021, Digital Education Standards and Guidelines aim to provide minimum internet bandwidth connectivity of 512 kilobits per student in all schools (Uganda Ministry of Education and Sports, 2021). The multicountry Giga initiative has been working in partnership with ministries of education and other stakeholders to expand school connectivity (**Box 7.1**).

Governments and providers lower internet connection costs in various ways

The Affordability Drivers Index is a composite score calculated by the Alliance for Affordable Internet, which assesses the extent to which the policy, regulatory and supply-side environment helps lower cost and improve broadband affordability. It suggests that progress in 72 low- and middle-income countries has been slow: in 2021, 53 countries had a national broadband plan but investment per user varied widely between countries and remained low in many (Alliance for Affordable Internet, 2021; Giga et al., 2023). Governments can affect affordability through direct public investment (Roddis et al., 2021a) but also with taxes, subsidies and loans for families, and through licensing and authorization frameworks for providers (World Bank, 2023b). Another channel that governments can use to increase affordability is universal service funds (**Box 7.2**).

Taxes on digital services can help regulate the sector but can also increase the cost for end users and negatively affect affordability. For instance, in the Democratic Republic of the Congo, the introduction of a Central Equipment Identity Register tax, i.e. a yearly payment of USD 7 for 3G and 4G handsets, increased the cost of 1 GB of data by almost 10% (GSMA, 2021). By contrast, removing a 4.2% excise duty on mobile services in Argentina could increase the number of unique subscribers by 2.1% (Working Group Report on Smartphone Access et al., 2022).

Grants, subsidies and loans to poor families and schools are another way to reduce connectivity costs. In Costa Rica, the Hogares Conectados (Connected Households) programme provides access to subsidized devices and a subsidy to the poorest 60% of households with school-age children to cover part of the internet cost, helping reduce the share of unconnected households from 41% in 2016 to 13% in 2019 (Foditsch and Alliance for Affordable Internet, 2023). In 2021, the government of Nepal introduced free internet access to all community schools, aiming to equip 60% of them with free broadband by the end of 2022 (Regmi, 2021). In South Africa, the Telecommunications Act provides at

BOX 7.1:

The Giga initiative supports school connectivity leveraging multiple stakeholders

The UNICEF Office of Innovation and the International Telecommunication Union launched the Giga initiative in 2019 with the ambitious aim to connect every school to the internet by 2030. The initiative has been referenced in the UN Secretary-General's Digital Cooperation Roadmap and *Our Common Agenda* (United Nations, 2020; 2021). Giga works in partnership with governments to map connectivity demands; plan interventions to connect schools; and provide countries with safe, secure, reliable, fit-for-purpose infrastructure to support digital development needs (Giga et al., 2023). Across Latin America and the Caribbean, over 540,000 schools were mapped and over 1,000 connected (Giga et al., 2022). In Colombia, artificial intelligence was used to map schools from satellite imagery (UNICEF Office for Innovation, 2021).

In Kazakhstan, Giga is supporting the government to bridge the urban–rural school digital divide (ITU and UNICEF, 2020). The digital development ministry aims to make the public education system 'digital by default', improving broadband connectivity, strengthening digital skills and making the online environment safer (UNICEF and ITU, 2023). In Kyrgyzstan, school mapping allowed the government to renegotiate contracts to generate savings totalling 40% of its education connectivity budget. Prices were cut nearly by half and speed was almost doubled, from 2 to 4 mbps. Nearly all public schools are currently connected to the internet (UNICEF and ITU, 2023; UNICEF Office for Innovation, 2021).

In Kenya, Giga connected 110 schools, and plans to connect 1,050 more, out of a total of 23,000 schools (Giga et al., 2022). In Niger, where just 80 of more than 19,000 schools are currently connected, Giga and the government are using mapping, monitoring technologies and innovative financing to implement cost-effective connectivity. In Rwanda, investment by Giga mobilized private funds to reach remote schools with high-speed internet. The connectivity demand of 63 schools in the Eastern Province was aggregated and a common bid helped reduce the average price schools paid by between 30% and 55%. Fixed wireless boosted connectivity speed for schools by 400% (UNICEF Office for Innovation, 2021).

BOX 7.2:

Universal service funds could help equitable access but few succeed

Universal service funds aim to address gaps between governments' goals to provide universal ICT service on the one hand, and access, price and quality of ICT services and products on the other (Trucano, 2015). They can be used to fund infrastructure deployment, public access to ICT, content and government digital capabilities (Alliance for Affordable Internet and Internet Society, 2021; UN ESCAP, 2017). However, high levels of undisbursed funds; the rigid and inappropriate legal frameworks within which they operate; lack of reporting, transparency and institutional capacity; and frequent lack of a gender-specific focus have raised concerns on their use and effectiveness (Bleeker, 2019; ITU et al., 2018), including in Asia and the Pacific and in some Caribbean countries (Roddis et al., 2021b; UN ESCAP, 2020).

In 2018, universal funds existed in 37 African countries and were active in 23, which had disbursed funds in the previous 2 years. Unspent funds were estimated at some USD 180 million. The disbursement rate ranged between 47% in 2012 and 54% in 2016 (ITU et al., 2018). Among 24 Latin American and Caribbean countries, 18 had active and 4 had inactive funds, while only Haiti and Uruguay didn't have any (Alliance for Affordable Internet and Internet Society, 2021). Brazil had a dormant fund, but a 2021 law allocated over USD 650 million to guarantee connectivity for public school students and teachers, partially funded by the universal access fund (Brazil Presidency, 2021). The primary targets are students belonging to families enrolled in the Single Registry for Social Programmes of the Federal Government (CadÚnico) and those enrolled in schools of indigenous and quilombola communities (Alliance for Affordable Internet, 2023; Brazil Presidency, 2021).

A review of 72 low- and middle-income countries found that 29 countries performed well in terms of using funds to prioritize investments to reduce costs and enhance access for underserved groups (A4AI, 2022). In Pakistan, which ranked first, the first set of interventions financed by the universal service fund were used to boost ICT for girls, providing devices and trained teachers to 226 schools in Islamabad serving 110,000 students (Pakistan Universal Service Fund, 2022). Thailand, Türkiye, Vanuatu and Viet Nam have also used their respective universal service and access funds to provide internet access to education institutions and establish internet access centres for underserved populations and areas (UN ESCAP, 2017).

least a 50% discount for internet services to education institutions (South Africa Republic, 2016). In Singapore, the DigitalAccess@Home programme subsidizes broadband, as well as laptops or tablets, for poor families (Singapore Infocomm Media Development Authority, 2023). In the United States, the Affordable Connectivity Program, launched in 2022, targets households with income below 200% of the Federal Poverty Guidelines or who receive free or reduced-price school meals, offering a discount for internet services (United States Federal Communication Commission, 2022; United States Universal Service Administrative Company, 2022).

Zero-rating is the practice of providing free internet access under certain conditions. For instance, some mobile network operators offer not charging for data used for educational purposes (Bayat et al., 2022; Eisenach, 2015), a practice which received attention during the COVID-19 pandemic. However, such practices are challenging in terms of competition because they violate the net neutrality principle, which states that internet service providers should treat all internet traffic equally, not necessarily in processing data but indirectly in pricing such traffic (European Commission, 2017). In the European Union, zero-rating is neither allowed nor forbidden. In the United States, rules do not ban zero-rating practices (Olukotun, 2015; Rodríguez Prieto, 2017; Vogelsang, 2019). The concern has been that poor users come to equate the internet with zero-rated content provided by companies, such as Facebook, and do not get to benefit from the rest of the internet content, which comes at a cost (Leidel, 2015).

In 2020, the zero-rating portal Colombia Aprende (Colombia Learns) was introduced to support learning continuity during the pandemic (Colombia Presidency, 2020). The portal was optimized for mobile devices through the Colombia Aprende Móvil application. An agreement between the government and mobile operators opened up opportunities for free teaching and learning to students, teachers and school administrators, accessible from their mobile phones. Yet challenges emerged during implementation. It was difficult to ensure equal and equitable access to online resources, as the existing infrastructure could not support the new mode of mobile learning and facilitate access to the ministry's online portal which hosted the educational resources. There were also difficulties in cataloguing and curating digital content (Razquin et al., 2023). Still, the online portal received nearly 283,000 visits by about 66,000 users in the first 4 weeks (Sanchez Ciarrusta, 2020).

EVIDENCE NEEDS TO DRIVE EQUITABLE, EFFICIENT AND SUSTAINABLE TECHNOLOGY SOLUTIONS

Achieving universal provision of electricity, internet, and hardware and software for schools, teachers and students involves substantial amounts of money and requires good investment decisions supported by effective procurement processes. Evidence is critical to determine good investments (Hennessy et al., 2021), especially when the resources and infrastructure to support technology are limited. Value for money should be a key decision criterion, as several education technology products are underused, if they are used at all. The quality and reliability of vendors also needs to be assessed alongside the relevance of the solution.

> "Value for money should be a key decision criterion, as several education technology products are underused, if they are used at all"

Most evidence on these issues comes from the United States. Two studies by data analytics providers estimated that an average of 67% of education software licences were unused (Davis, 2019) and 98% were not used intensively (Baker and Gowda, 2018). Another study based on the EdTech Genome Project, coordinated by the Jefferson Education Exchange, estimated that 85% of some 7,000 pedagogical tools on which USD 13 billion had been spent were 'either a poor fit or implemented incorrectly' (Foresman, 2019). The National Edtech Equity Dashboard, which assesses student and teacher engagement with 11,000 education technology products, has shown that disadvantaged students' engagement is worse (LearnPlatform, 2022). Less than one in five of the top 100 education technology tools used in classrooms met the requirements of the Every Student Succeeds Act (ESSA); only 39% had published research and 26% had research aligned with the Act (LearnPlatform, 2023).

RIGOROUS EVIDENCE IS RARELY USED TO MAKE DECISIONS ON TECHNOLOGY

Evidence is needed for making decisions on technology in education. Teachers, schools and administrators need to know the product features best suited to their education priorities. Technology may not even be the best or only solution to consider: people are often attracted by new education technology (UNESCO, 2022a), and purchasing for the sake of technology rather than for pedagogical reasons is a common mistake.

Research cannot keep up with the speed at which new education technologies emerge (Burns, 2022). Rigorous evaluation is often missing even for high-profile programmes (Hennessy et al., 2021), and national policies and programmes are rarely informed by evidence (Jameson, 2019; Slavin, 2020). A review in the United Kingdom by EdTech Impact, a company that collects independent, verified reviews of education technology products to help improve trust with prospective teacher and school customers, found that 7% of education technology companies had conducted randomized controlled trials, 12% had used third-party certification and 18% had engaged in academic studies (Sandhu, 2021). This is not to suggest that only these types of evidence should be used. Rather, an evidence portfolio can help answer different questions (Kucirkova, 2023) and account for diverse real-world settings (Joyce and Cartwright, 2020). However, accessing impartial advice can be challenging.

At least two different assessments are needed. First, a technology needs to prove it has an impact on teaching and learning. When evidence of effectiveness is unavailable, decisions tend to rely on referrals and anecdotal knowledge (Morrison et al., 2019). A 2021 survey of 1,500 teachers and administrators by a portal software company in the United States found that about half of teachers identified new digital tools through other teachers in their district (Clever, 2022). Another online survey of teachers and administrators in 17 states showed that only 11% requested peer-reviewed evidence prior to technology adoption (United States Office of Education Technology, 2018). Recommendations from others in-person or electronically influence purchase decisions on education technology products. Yet reviews from education technology suppliers tend to omit issues such as security and quality standards. Moreover, ratings can be manipulated based on fake reviews and disseminated through the social media (He et al., 2022).

Second, evidence is needed on the implementation of education technologies that may have proven their potential in principle. In Rwanda, as part of the One Laptop Per Child programme, computers were reportedly stolen or, when damaged, left unrepaired (IGIHE, 2020). Even when thefts and damages were reported, the issues were not resolved. The Auditor General considered that the programme did not attain the intended objective, and the investment was a loss of public resources with no value for money (Rwanda Office of the Auditor General, 2021). Ghana suspended its programme after three years of implementation because basic sustainability and feasibility conditions, such as power supply, laptop durability, and costs of connectivity and maintenance, were not fulfilled (Steeves and Kwami, 2017).

Various responses have been organized to systematize the collection of information on technology effectiveness. In the United States, both government and academic efforts try to fill the evidence gap. The United States Department of Education established the What Works Clearinghouse in 2002 to provide a trusted source of evidence on education interventions, including those related to technology. Its team contracts private research entities to review research and summarizes the findings, including whether studies meet quality standards (United States Institute of Education Sciences, 2023). However, its reporting quality has been questioned in academic circles (Reeves and Lin, 2020) and in media reports. An incisive summary of the evidence contained in the Clearinghouse pointed out that only 188 of 10,654 studies showed that products had 'strong or moderate evidence of effectiveness' (Garcia Mathewson and Butrymowicz, 2020).

The government of the United States has described three levels of evidence – strong, moderate and promising – to differentiate products that can be funded under ESSA. However, the demand has grown for independent reviews. Universities have championed alternative efforts to produce and summarize evidence. The Center for Research and Reform in Education at Johns Hopkins University launched Evidence for ESSA in 2016 to help schools decide how to invest federal resources for which they are eligible (Evidence for ESSA, 2023). The EdTech Evidence Exchange, originally based out of the University of Virginia, developed a platform where registered teachers can access evidence on technology interventions ranked on the basis of Edtech Genome Project measurement instruments (EdTech Evidence Exchange, 2021). Ten factors are proposed to make purchase decisions, which span from teacher beliefs to professional development and implementation (EdTech Evidence Exchange, 2023). A related initiative, Edtech Tulna, was established in India in 2020 (**Box 7.3**).

Multiple actors can help make better informed choices on procuring education technology. The European Commission has funded a team of experts from schools, education ministries and research institutes to develop Self-reflection on Effective Learning by Fostering the use of Innovative Educational technologies (SELFIE), a free tool to help schools embed digital technologies into teaching, learning and assessment. Each school that completes SELFIE receives a report containing data and insights on the weaknesses and strengths of the technology applied (European Commission, 2023).

The International Society for Technology in Education, a non-profit organization, ISTE is involved in issues ranging from digital citizenship to artificial intelligence and computational thinking (ISTE, 2023b). It issued standards for effective use of technology in schools (ISTE, 2023a), identifying five pillars of selection (privacy, alignment with standards, research and evidence, implementation, and the role of teachers) and publishing a practical guide for educators (ISTE and Project Unicorn, 2023). Arguably, some of these initiatives have close links with the education technology industry, which may ultimately be serving market expansion objectives.

International partnerships have also funded resources to support decision making. The United Kingdom Foreign and Commonwealth Office, the World Bank, and the Bill & Melinda Gates Foundation (which has funded several of the initiatives identified earlier in the United States) have helped establish the EdTech Hub, a partnership that supports low- and middle-income countries to make informed decisions about technology in education through research (EdTech Hub, 2022) . In Malawi, for instance, it tested different approaches for personalized learning tablets for both classroom and home use. In the United Republic of Tanzania, it supports the design of a technology-enabled, school-based teacher professional development programme (EdTech Hub, 2022). A rapid response service provides evidence-based advice on demand to inform how education technology is used in education policies and programmes; to date, it has been used by 54 countries (R4D, 2022). Meanwhile, the World Bank has developed 16 knowledge packs, covering teacher development related to learner-centred technology, to explain the context in which it is relevant to use education technologies and insights for successful implementation (Barron et al., 2022).

PROCUREMENT DECISIONS NEED TO TAKE SUSTAINABILITY INTO ACCOUNT

One of the most important issues in education technology procurement decisions is sustainability. These decisions have economic, social and environmental impacts that need to be considered (Selwyn, 2021; 2023).

With respect to economic considerations, the lifespan of products and service is critical. The so-called total cost of ownership should incorporate both the initial investment and the operational and support cost for the entire lifespan (Chuang et al., 2021; Morrison et al., 2019). As well as the initial cost, there are other recurrent and hidden costs, such as compatibility and interoperability with the existing information technology environment, depreciation, replacement needs, and even training (Mitchell and D'Rozario, 2022; UNCTAD, 2012). Buying devices for schools implies additional electricity needs, replacement of equipment when it is broken or outdated, purchases of

BOX 7.3:

In India, a public–private partnership tries to promote better evidence on education technology

India has been a global champion of information technology for a very long time, but it has recently witnessed the expansion of an unregulated education technology market, which has grown in response to strong household aspirations for education, especially during the COVID-19 pandemic. However, households make choices on education applications without research evidence on their learning impact. Moreover, the business models employed by education technology firms offering free content options can be misleading. Byju's, the leading education technology company in the country, has received criticism for its aggressive sales strategy, where parents are contacted to convert to paid subscriptions after a trial period (UNESCO, 2022). The government was prompted to alert the public to be on guard when signing up for free online content or services (India Ministry of Education, 2021). But companies such as Byju's have also been working with state governments. Its not-for-profit arm made an agreement with the government of Andhra Pradesh to provide free digital content to almost half a million grade 8 students (The Economic Times, 2022).

A systematic evaluation framework of the product quality of education technology is therefore needed. EdTech Tulna (EdTech Comparison) is a partnership between Central Square Foundation, a private think tank, and a public university, the Indian Institute of Technology Mumbai. EdTech Tulna offers three resources: domain-specific quality standards, which outline the features of an effective education technology product to contribute towards a shared understanding of quality; an evaluation toolkit consisting of reviewer guidelines and scoring sheets; and publicly available expert reviews of various products (EdTech Tulna, 2023). Each product is assessed in terms of its content quality, its alignment with the national educational requirements and its integration of appropriate pedagogy. For each dimension, the product is rated on a three-point scale.

Two states in India have already adopted the EdTech Tulna framework for software procurement and its toolkits in evaluation products for tender processes. The government of Haryana has used the resources when procuring personalized adaptive learning solutions in upper secondary education. The EdTech Tulna evaluation framework was adjusted to create Haryana Tulna to respond to the specific context and needs. The government of Madhya Pradesh also used the standards to procure personalized adaptive learning solutions for some 1,000 schools (Anand and Dhanani, 2021).

cables and printers, security, user training and support, and maintenance. Manufacturers tend to base warranties for devices on an average of a three- to five- year lifespan. But this lifespan is likely to be shorter for educational institutions, as products are exposed to more intensive use. Shorter lifespan, tighter budgets and the ongoing semiconductor shortage which has impacted supply chains are increasing the risk of education technology disruption.

> Initial investment in education technology has been estimated at up to only 25% of the total cost

Initial investment in education technology has been estimated at up to only 25% of the total cost (UNESCO, 2022b). A computer-assisted learning programme in China installed computers in all rural primary schools. While computers were donated for free, the programme cost was USD 7.60 per student for intensive teacher training, maintenance costs, compensation for teacher instructors and depreciation of laptop computers (Lai et al., 2016; Mo et al., 2015; Rodriguez-Segura, 2020). Ghana implemented a pilot programme to reach rural primary schools by satellite. Fixed costs accounted for 43% of the total programme cost, while the remaining 57% was used for maintenance, teacher and facilitator salaries, and other administrative costs (Johnston and Ksoll, 2017). India's One Laptop Per Child programme cost USD 229 per computer but the overall implementation cost was USD 461, including maintenance (10% per year), training, servers and back-office support (Bando et al., 2016).

Another potential hidden cost with both economic and broader consequences is privacy. In 2022, the Special Rapporteur on the right to education called for procurement regulations to ensure due diligence for protecting children's privacy and personal data in relation to online learning, as well as to guide education institutions to put data privacy clauses in contracts signed with private providers (United Nations Human Rights Council, 2022) (**Chapter 8**). In the United States, some states require companies to sign agreements with schools and universities to protect student data, while others have established data privacy regulations with which companies must comply. In the state of California, vendors are required to sign a Standard Student Data Privacy Agreement, which provides comprehensive protection (Education Technology Joint Powers Authority, 2023).

The biggest economic concern related to sustainability is how giant technology firms, despite significant efforts to regulate their activities, use their dominant position to enter education and further strengthen their near monopoly on the market. Google Workspace for Education and Google Classroom, which play the role of a learning management system, are being used to extract student personal data for advertising purposes (Krutka et al., 2021). Amazon Web Services is increasingly influencing education through cloud computing, data storage and platform technology services, taking advantage of the increasing use of data in system management. It hosts several education technology providers, helping them scale up their platforms on its cloud, offering data centre, network, security, content delivery and machine learning services (Williamson et al., 2022).

With respect to social considerations, procurement processes need to address equity, accessibility, local ownership and appropriation. Accessibility should be addressed from the start (Federico et al., 2020). Assistive technology can be expensive, particularly in low resource contexts (Alasuutari et al., 2022; UNICEF and WHO, 2022). The Global Initiative for Inclusive ICT has developed a roadmap to help education systems integrate accessibility in their policies and procurement practices (Global Initiative for Inclusive Education, 2021; 2022). In the United States, the Voluntary Product Accessibility Template explains the extent to which ICT products conform to IT accessibility standards and helps public officials to procure those products (United States General Services Administration, 2022). Accessibility can be assessed using the Perceivable, Operable, Understandable and Robust model, which is the foundation of the Web Content Accessibility Guidelines (CAST, 2023; W3C WAI, 2023).

Local ownership and appropriation are key for sustainable investments in technology (Fundacion Telefonica and Fundacion La Caixa, 2022). In France, the first edition of the Territoires Numériques Educatifs (Digital Educational Territories) initiative was criticized because some of the subsidized equipment did not respond to local needs (Foin, 2021), while regional and local governments were left out of the decisions of which equipment to purchase (Rabiller, 2018). Following the evaluation of the first stage of the programme, local authorities are now invited to participate in the design and financing of the intervention. Regional councils may be required to consult municipalities on their needs (Lesay, 2021).

In the bidding process, local firms, especially small and medium-sized enterprises, can be at a competitive disadvantage to the international firms dominating the market. In Chile, the 15% decrease in the budget of the Becas TIC programme, part of the Seamos Comunidad (Let's Be a Community) plan launched in 2022 was primarily due to fluctuations in the exchange rate and price increases (Chile Ministry of Education, 2022). The reliance on imported, instead of locally produced, devices highlights the need for better planning and management to ensure all students' needs are met (Foditsch and Alliance for Affordable Internet, 2023).

There are various dimensions with respect to environmental considerations. Water, energy and natural materials consumed to create education technology contributes considerably to environmental damage and the climate crisis. Distributing devices to each student rather than having students share a device leads to a surplus of e-waste when outdated products are discarded (Selwyn, 2021; 2023). This issue is particularly pertinent in low-income contexts that lack infrastructure to properly manage waste and have lower rates of formal e-waste collection.

It has been estimated that the reduction in carbon dioxide emissions achieved by extending the lifespan of all laptops and smartphones in the European Union by a year would be the equivalent of taking 870,000 cars and over 1 million cars off the road, respectively (European Environmental Bureau, 2019). A movement calling for improvements in the repairability and reliability of tablets and phones has emerged. In the United States, the Right to Repair Act was signed in December 2022 but will only apply to products made after 1 July 2023 and excludes from its reach any 'product sold under a specific business-to-government or business-to-business contract … not otherwise offered for sale directly by a retail seller' (Ganapini, 2023). The right to repair does not yet exist in the European Union (Ganapini, 2022), although a draft EU regulation published in late 2022 sets some obligations for manufacturers (Vallauri, 2022).

A submission to the Advisory Committee of the Human Rights Council emphasized that 'the drive toward universal internet connectivity is rarely considered in relation to energy usage and climate change … [even though] reliable and sustainable energy is a precondition for internet access' especially for the unconnected, often 'predominantly rural, located in the Global South, and economically disadvantaged' (Allmann and Hazas, 2019). Yet energy-efficient solutions for education technology are not widespread. Schools represent a large share of the public building stock (Lara et al., 2015). Already 10 years ago in the United States, computing consumed 18% of electricity usage in schools and 19% in colleges and universities (Friendly Power, 2020b; 2020a).

REGULATION NEEDS TO ADDRESS RISKS IN EDUCATION TECHNOLOGY PROCUREMENT

Public procurement is vulnerable to collusion (Baranek et al., 2021; Kawai and Nakabayashi, 2022) and corruption (Decarolis and Giorgiantonio, 2022a; Titl et al., 2021; Titl and Geys, 2019). In the European Union, one estimate suggested 10 years ago that losses from corrupt or questionable procurement cases added up to 18% of budgets (PwC and Ecorys, 2013). Globally, even the most conservative estimate raises the cost of corruption to 8% of the value of procurement contracts, or approximately USD 880 billion in 2019 (Bosio, 2021).

Education technology procurement is not immune to these risks. In Brazil, the Comptroller General of the Union found irregularities in the electronic bidding process for the purchase of 1.3 million computers, laptops and notebooks for state and municipal public schools in 2019 (Flores, 2019). Indeed, the report showed that some schools received two or three laptops per student (Valor Economico, 2022). In 2021, the legal dispute over the rules of the bidding process for the largest purchase of computers in Costa Rica's history (Foditsch and Alliance for Affordable Internet, 2023) was adjudicated by the Comptroller General: while the competitive process was not cancelled, the conditions under which the procurement was made were required to be reassessed (El Financiero, 2021).

Decentralizing public procurement to local governments is one proposal to balance some of those risks. Some countries have used technology to support procurement processes at the school level, such as Indonesia with its SIPLah e-commerce platform (Indonesia Ministry of Communication and Informatics Office, 2023). However, this has been found to add other risks related to weak governance mechanisms and organizational capacity. A review of 30 European countries' procurement between 1996 and 2015 found that the decentralization of procurement did not promote good governance, even if decentralization of services such as education had been beneficial overall (Kyriacou and Roca-Sagalés, 2020). A survey of administrators in 54 school districts in the United States found that they had rarely carried out needs assessments (Morrison et al., 2019).

Procurement laws, rules and regulations are needed. The Agreement on Government Procurement requires that domestic public procurement procedures be based on principles of transparency, non-discrimination and procedural fairness (World Trade Organization, 2023). The European Commission issued specific guidelines for procuring information technology in 2015, highlighting interoperability, sharing and reuse strategies, and open ICT systems to avoid vendor lock-in effects (Bargiotti and Dewyngaert, 2015). In Ireland, the government published procurement guidance and a toolkit for schools (Ireland Department of Education and Skills, 2016). Uganda, has published guidelines on procurement, providing information on eligible ICT expenditure at district and school level (Uganda Ministry of Education and Sports, 2021).

> Less than one third of countries have a sustainability clause in their procurement law

Sustainability clauses are emerging, albeit slowly. Analysis of the World Bank Global Public Procurement Database for this report found that less than one third of countries have a sustainability clause in their procurement law. Countries show more interest in domestic preference clauses (46%) and small and medium-sized enterprises clauses (just over 50%). Crown Commercial Service, a procurement agency in the United Kingdom, launched an ICT procurement contract designed with the Department of Education to increase the participation of small and medium-sized enterprises (which made up more than three quarters of suppliers) (Mari, 2019) and simplify the process of purchasing technology products and services for education organizations (Rogers, 2019). In Türkiye, as part of the Fatih project on information technology in education, the government requires that equipment from winning bidders be made at least partly in the country (Razquin et al., 2023).

Civil society organizations have set up mechanisms to monitor public spending to increase the transparency and accountability of public procurement. Poder Ciudadano (Citizen Power) in Argentina and Fundación Ciudadanía y Desarrollo (Citizenship and Development Foundation) in Ecuador introduced procurement observatories that reviewed emergency public procurement contracts during COVID-19, among which education technology figured prominently (FCD, 2023; Poder Ciudadano, 2023).

CONCLUSION

Access to and use of education technology is characterized by inequality, a phenomenon that received greater attention during the COVID-19 pandemic. The costs of electricity, internet connection, and hardware and software are high and often underestimated. Sustainability concerns go beyond social dimensions and extend to economic and environmental aspects. As technology is constantly changing, making decisions that promote equity and quality requires expert guidance from trusted sources. However, the very sources of such expertise inherently have financial interests, which could be seen to compromise their independence. Regulatory enforcement of equitable policies and practices can be difficult to implement if governments are unable to invest sufficiently in the technical expertise which it requires.

Sound, rigorous and impartial evidence is needed more than ever. Procurement regulations and standards need to embed sustainability as a criterion for adopting interventions that are economically, socially and environmentally effective and efficient and can be scaled up for the good of all.

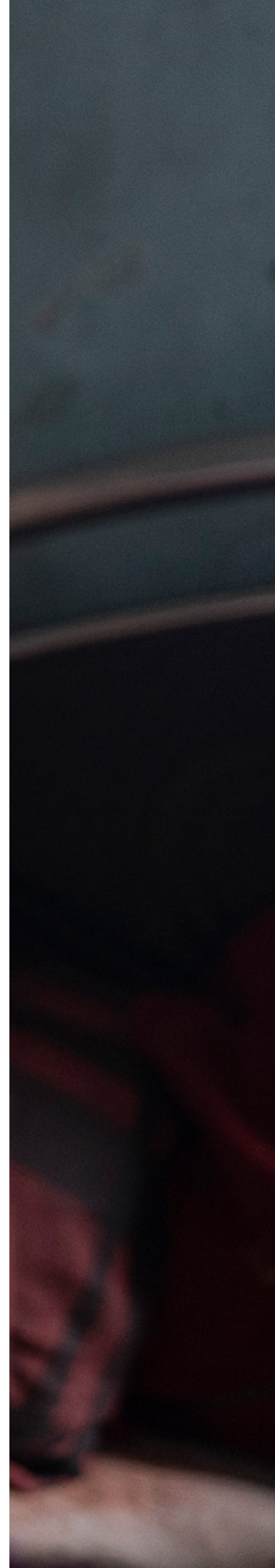
Jhorna Akhter, a 16-year-old adolescent who receives services from one of the Adolescent Friendly Health Services supported by UNICEF, is playing online games with her friends from home in Mirpur, Dhaka, Bangladesh on July 14 2020. During the lockdown, Jhorna spent most of her time reading, helping her family members, listening to news on TV, attending online classes on her cell phone and visiting satellite health camps where adolescents can come and share their health problems and receive free counselling and medication.

Credit: UNICEF/UN0506086/Paul*

CHAPTER

8

Governance and regulation



KEY MESSAGES

Children's privacy, safety and well-being are at risk due to lack of oversight of the education technology industry.

Governing education technology is a challenge for governments.

- In 82% of countries, there is a government department or agency in charge of education technology. In 48% of countries, this function is led by the education ministry, in 29% by the education ministry and another ministry, and in 5% by another ministry altogether.

Public authorities struggle to govern private actors.

- Concerns have been raised about lack of oversight of private actors. In India, a government advisory in 2021 cautioned citizens considering education technology purchases not to be misled by deceptive marketing tactics.

Privacy, safety and well-being risks need to be regulated.

- Analysis of 163 education technology products recommended for children during the COVID-19 pandemic found that 89% could or did collect information on children in educational settings or outside school hours.

Data protection legislation is only nascent.

- Only 16% of countries guarantee data privacy in education with a law; further analysis of 10 countries found that, despite this legislation, children's rights were still not protected.
- Schools collect a wealth of data on children and teachers, yet regulations on the use of the data are rare. In the European Union, public schools are covered by the General Data Protection Regulation and must appoint data protection officers.
- Artificial intelligence algorithms applied in education can reproduce or deepen inequality. In the United States, an evaluation of 99 developers found the highest rate of false positives in relation to indigenous groups.

Safety risks cannot be dismissed.

- Education is increasingly targeted by cyberattacks. In the United States, the number of schools hit by cyberattacks in 45 districts nearly doubled between 2021 and 2022.
- Globally, 16% of countries have adopted legislation to prevent and act on cyberbullying with a focus on education; of those, 38% have done so since the COVID-19 pandemic.

Exposure to screens and technology affects children's well-being.

- Analysis of children aged 2 to 17 showed that more screen time was associated with lower well-being. In the United States, 11- to 14-year-olds were estimated to be spending 9 hours a day on a screen. The levels increased during COVID-19.
- Few regulations and guidelines exist for screen time. In China, the Ministry of Education limited time spent with digital devices as teaching tools to 30% of overall teaching time.

Several countries are banning the use of mobile telephones or other technology in schools.

- Globally, less than a quarter of countries have laws or policies banning the use of telephones in school.
- Some ban the use of specific applications because of privacy concerns. Some states in Germany have banned Microsoft products that do not comply with the General Data Protection Regulation.

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Digital technology provides the infrastructure for modern societies and economies. Its development, diffusion and maintenance need to be coordinated across multiple government departments. Involving the information and communication technology (ICT) industry needs to be clearly spelled out in concrete terms through transparent processes. Governance issues become even more complex in relation to integrating digital technology in education. Governments need to make decisions on infrastructure decisions and carefully consider pedagogy. Education agencies need to consult with learners and teachers in order to take decisions in their best interests.

Governments' goals for education equity, inclusion, quality and efficiency are not necessarily aligned with those of the education technology industry. Industry's profit orientation leads to practices that can be inappropriate, inequitable, inefficient and unsustainable – which reduce well-being, breach security, abuse personal information and even violate human rights, negating any benefits of applying technology to education. The increased presence of technology in daily lives, especially artificial intelligence, (AI) demands attention to both the right to education and the right to non-discrimination in and out of school (Holmes et al., 2022). According to the Special Rapporteur on the right to privacy, educational processes 'need not and should not undermine the enjoyment of privacy and other rights, wherever or however education occurs' (United Nations Human Rights Council, 2021).

> The goals of governments are not necessarily aligned with those of the education technology industry

Preventing such collateral damage is a major new challenge for regulators all over the world, as digitalization makes education structures, forms and modes of delivery ever more complex. Effective protection and promotion of democracy, human rights and the rule of law needs collaboration, partnerships and establishing common goals between many stakeholders at national and international levels. This chapter focuses on governance and regulation to ensure users, especially children, are protected when they use education technology.

GOVERNMENTS FIND IT CHALLENGING TO GOVERN EDUCATION TECHNOLOGY

Education ministries need to collaborate with economic development, infrastructure, energy and telecommunications departments in the governance of education technology use. The respective departments might have different visions, goals and objectives on issues such as innovation, digital transformation, and the storage and use of data. In addition to government actors, the role of private actors, notably through public–private partnerships, needs to be clear; this requires transparency and accountability mechanisms (Hillman, 2022a; Lingard and Sellar, 2013).

MINISTRIES OF EDUCATION DO NOT ALWAYS LEAD ON EDUCATION TECHNOLOGY

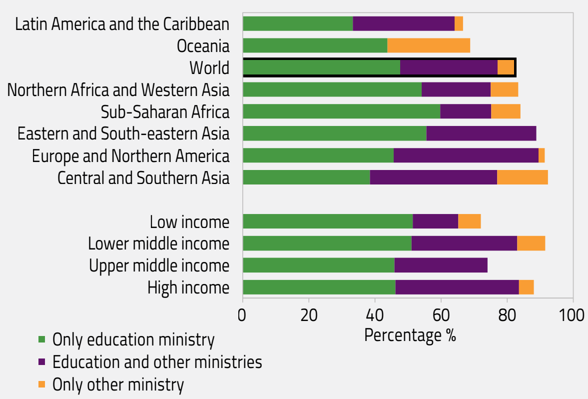
When considering integrating technology in education, it is important to make clear which body steers the process. Ministries of education need to lead such decisions and pedagogical decisions need to take precedence over commercial considerations. Learners' best interests may be at risk where education technology companies do not come under the jurisdiction of education legislation and are seen purely through commercial law.

Analysis for this report shows that in 82% of countries, a government department or agency is in charge of ICT or education technology: in 48% of countries the education ministry takes the lead, in 29% the education ministry and another ministry does so, and in 5% another ministry is the leader (**Figure 8.1**). In Armenia, the 2009 general education law places the responsibility for the introduction and development of technology in education under the Ministry of Education, Science, Culture and Sports. The National Centre for Educational Technologies under the same ministry has various responsibilities in the field of ICT deployment, teacher training, ICT integration in education and data collection.

FIGURE 8.1:

Ministries of education lead government education technology agencies in 6 out of 10 countries

Percentage of countries with a government department or agency in charge of education technology, by leading ministry, 2022



GEM StatLink: https://bit.ly/GEM2023_fig8_1
Source: Profiles Enhancing Education Reviews (PEER).

In other countries, other ministries have a stronger role. In Bangladesh, the two ministries responsible for primary and post-primary education, respectively, share responsibility for coordinating and implementing ICT in education, including on curriculum, infrastructure and remote learning (Bangladesh Ministry of Education, 2013). But the government also has an ICT Division with a State Minister and an ICT Adviser to the Prime Minister with responsibility for national ICT strategy and policy development and the integration of ICT in various sectors, including education (Bangladesh ICT Division, 2023). The ICT Division also leads on cybersecurity laws and policies, ensuring their implementation alongside the Digital Security Agency (Bangladesh Digital Security Agency, 2023). Finally, the Ministry of Science and Technology also supports education institutions in its field (Bangladesh Ministry of Science and Technology, 2019).

In Kenya in 2019, the Ministry of Information, Communications and Technology issued the National Information, Communications and Technology Policy aiming to integrate ICT at all levels of education, including through the facilitation of public–private partnerships to mobilize resources for e-learning initiatives. The Ministry of Education contributed to the Digital Economy Blueprint in the same year. In Niger, the governance of education technology is shared between the Ministry of Post and New Information Technologies and the Ministry of Education. Within the latter, the Division for Information Technology Promotion is responsible for hardware selection, information system security, data collection for strategic decision making and ICT integration in education. Since 2017, the National Agency for the Information Society has also been involved in the implementation of ICT programmes, for instance on school mapping. In Palestine, two ministries share responsibility for the integration of ICT in education: the Ministry of Telecommunications and Information Technology and the Ministry of Education and Higher Education. However, neither has a dedicated ICT department.

Expert task forces or steering committees support the quality and coherence of ICT strategy priorities and coordinate their implementation (Chuang et al., 2022). The Bhutan Education Blueprint 2014–2024 highlighted the need for a dedicated governance structure to drive the implementation of ICT projects. The iSherig-2 Masterplan 2019–2023 recommended establishing a division to oversee all matters related to ICT in education and a steering committee comprising representatives from the education, information and communication, and finance ministries, as well as project leads from implementing agencies. In Nepal, two committees were established under the ICT in Education Master Plan 2013–2017: a Steering Committee responsible for policy decisions and a Coordination Committee responsible for overall planning and intersectoral and inter-agency coordination of the Master Plan.

In high-income countries, mechanisms have emerged to strengthen the governance of digital education and the representation of various stakeholders in policy design, implementation and monitoring. In Australia, extensive public consultations have informed the development of the Digital Strategy (Australian Human Rights Commission, 2021). In Europe, the Digital Education Stakeholder Forum, organized by the European Commission, has promoted the engagement of the digital education community in the implementation of the Digital Education Action Plan

(European Commission, 2022). In the United States, the State Educational Technology Directors Association, a non-profit association, provides a forum for advocacy on equity in digital learning. The 2016 National Education Technology Plan resulted from collaboration between educators, innovators and researchers who provided feedback and identified 235 exemplary programmes and initiatives, 53 of which were included. The Plan's principles and examples align with the Activities to Support the Effective Use of Technology of the Every Student Succeeds Act (United States Office of Educational Technology, 2016). However, in 2022, only 41% of education sector leaders agreed that they were regularly included in planning and strategic conversations about technology (SETDA, 2022).

> Expert task forces or steering committees support the quality and coherence of ICT strategy priorities

PUBLIC AUTHORITIES STRUGGLE TO GOVERN PARTNERSHIPS WITH PRIVATE ACTORS

Quite apart from the challenge of inter-agency coordination, governments face major new challenges in establishing governance mechanisms to manage their relationships with private suppliers. Connectivity, devices, software and content are expensive to acquire and maintain. Governments that want to expand their supply often seek private companies' assistance. Partnerships cover such inputs as technical expertise, leasing and contracting services, training, and in-kind contributions of equipment and software licences (Pillay and Hearn, 2011).

In Argentina, Educ.ar, a public company launched to help teachers develop an ICT curriculum and materials, was established with a private donation in 2000. After 2010, it started overseeing school infrastructure readiness for the programme Conectar Igualdad (Connecting Equality) (Roddis et al., 2021). In France, education technology companies provided resources to schools under the Territoires numériques éducatifs (Digital Education Territories), including computers, interactive screens, whiteboards, speakers, Wi-Fi hotspots and secure networks (Razquin et al., 2023). In Indonesia, education technology companies offer services to students, often under a licence agreement with the government that allows them to become accredited education providers, whereby users pay a fee for accessing the platforms (Razquin et al., 2023). In Saudi Arabia, Aanaab, an education technology company providing teacher professional development online and in education institutions, has started collaborating with the Ministry of Education to train over 1,000 teachers. Teachers can enrol for free, although they must pay a fee to receive a training certificate (Razquin et al., 2023).

There have been some attempts to streamline the participation of non-state actors in major decisions. The European EdTech Alliance brings together more than 2,600 education technology organizations working 'to support the domestic and international growth of education technology' through policy and support to start-ups. It has developed a vision for sustainable public–private partnerships and calls for 'clearly defined framework architectures determining the scope and boundaries for co-operations at all levels of the digital education ecosystem' (European EdTech Alliance, 2022). On the whole, however, partnerships between public authorities and large technology companies are often controversial, as they can give unfair advantage to the companies, eventually undermining oversight.

Three types of concerns have been raised about such partnerships. The first is about violation of privacy and safety through the use of generated data. Some technology companies have a stranglehold on data, which raises concerns over the abuse of data use. In Brazil, large private education technology vendors, including Amazon, Google, Huawei, Microsoft and Oracle, have tried to establish close partnership agreements with the Ministry of Education, offering free access to their software. But such agreements may also force students and teachers to use a particular software, as it might not be easy to integrate the use of products from different vendors (Foditsch, 2023). Apple, Google and Microsoft run educational platforms tied to hardware (e.g. Chromebook, iPad, Surface) and operating systems (ChromeOS, iOS/MacOS, Windows), through which they collect information on users, giving these actors a constant data pipeline.

Governance can be extremely difficult with complex data pipelines (Chitkara, 2022). The US state of California approved its Cradle-to-Career Data System Act in 2019 'to link existing education, workforce, financial aid, and social service information to better equip policymakers, educators, and the public to address disparities in opportunities and improve outcomes for all students throughout the state' (California Data System, 2019). The Act requires the integration of data from various partners, some of which are commercial (DXtera, 2023; Ed 3.0 Network, 2020; T3 Innovation Network, 2023). However, the implications of this on governance are under scrutiny, while it is being asked how to ensure the data system is managed in an equitable and non-discriminatory way (EdTrust-West, 2019; Moore, 2020).

The second concern is about the impact of the use of platforms on essential pedagogical functions. Such platforms can reduce teacher autonomy by forcing teachers to use them instead of choosing the tools they want to use. They can alter student assessment in ways that suit the interests of profit-seeking technology providers. They can also define education in ways that fit big data analyses, shaping content, intended learning outcomes and their measurement. Gradually, the control of fundamental pedagogical decisions, which have long been entrusted to teachers, has moved from the public to the private domain, without the scrutiny and debate that has characterized decisions on curriculum and textbooks (Zeide, 2017).

Consultation is necessary for solutions to also be pedagogically appropriate. In Germany, the not-for profit Bündnis für Bildung (Alliance for Education) brings together education authorities at the federal, regional and municipal levels with the education industry to develop joint solutions to digital education challenges. Working groups are active on issues such as content, privacy, school transformation and teacher training (Bündnis für Bildung, 2022).

“The business model used by many education technology companies, which offers free content, may be a deceptive marketing tactic”

The third concern is that consumers could be misled, and so more traditional market governance is required. But governments find it challenging to accredit and quality assure education technology companies. Leaving aside education technology product purchases by government, the absence of adequate quality measures, standards and evaluations is also problematic for the sale of education technology products to individual consumers (Patel et al., 2021). The business model used by many education technology companies, which offers free content, may be a deceptive marketing tactic, requiring the payment of a subscription fee. In India, the Department of School Education and Literacy issued an advisory in 2021 urging citizens to exercise caution before purchasing education technology products (India Ministry of Education, 2021).

One response of the education technology industry was self-regulation. It established the Indian EdTech Consortium, under the Internet and Mobile Association of India, an industry body. However, self-regulation can only succeed with clear long-term objectives (Thathoo, 2022). In 2022, the Consumer Affairs Secretary proposed to the Consortium the creation of a joint working group to create advertising guidelines ‘to keep unethical practices in communication and advertisement at bay’ (Press Trust of India, 2022).

DIGITAL PRIVACY, SAFETY AND WELL-BEING NEED TO BE REGULATED

While digital technology offers excellent opportunities for teaching and learning, it also comes with risks related to privacy, safety and well-being – even with copyright (**Box 8.1**). The internet – including its use as part of education – exposes users to misuse of their personal data, invasion of privacy, abuse, identity theft, offensive messages and images, cyberbullying, scams, and fake news and misinformation (Smahel et al., 2020). Concerns are higher for children exposed to these risks in terms of their vulnerability and the potential damage caused. Meanwhile, the excessive use of digital devices has potential harmful effects on physical and mental health.

PRIVACY IS ROUTINELY VIOLATED FOR PRIVATE BENEFIT

Digital technology providers, including those producing education technology products, collect and store data on their users, including information that is sensitive (Hillman, 2022). Integrating technology in teaching and learning could therefore compromise students’ privacy. Student data should not be used either by education technology or advertising technology companies for marketing purposes (United Nations Human Rights Council, 2022).

Yet, analysis of 163 education technology products recommended for children’s learning during the COVID-19 pandemic found that 89% could or did follow children in educational settings or outside of school hours. Tracking technologies installed on learning platforms collected and sent data on children to third-party companies, usually advertising technology companies, that targeted the children with behavioural advertisements. In most cases, the surveillance took place without opportunities to opt out and without consent from children or their parents. Out of 42 governments that provided online education to children during the pandemic, 39 used digital technology in ways that ‘risked or infringed’ children's rights. Among these countries, only Morocco did not endorse any education technology product that could potentially undermine children’s rights (Human Rights Watch, 2022).

The right to privacy, generally framed as protection by the law from arbitrary or unlawful interference with privacy, family, home or correspondence, and from unlawful attacks on honour and reputation, is recognized and protected as a human right through international legal

BOX 8.1:

Intellectual property right issues must be addressed

The initial expectations that digital technology would expand access to content have been dampened **(Chapter 3)**. Yet, as schools and teachers typically use and create intellectual property, questions arise over ownership and restrictions on the reuse and sharing of student and teacher work. A study in 15 European countries showed that these issues are often unclear or unaddressed. The copyright status of education materials varies according to the type of work. Although resources freely available online can, in principle, be used in the classroom, there may be limits (Nobre, 2017). In the European Union, the right to communicate copyrighted works to the public is in principle harmonized (Nobre, 2017; Torres and Xalabarder, 2020); four criteria by the Court of Justice of the European Union can be used to establish the public, non-profit-making character of a communication and its use for education purposes (EUIPO, 2022).

A review of legislation in 18 countries that mentions education in relation to intellectual property and intellectual property rights suggests it is primarily related to copyright and often targeted at higher education institutions (WIPO, 2022). Yet, clearer regulations are needed for a broader range of issues, especially while the use of digital teaching and learning tools is increasing. They could cover, for example, ownership of intellectual property in relation to content produced by teachers and students and the legal standing of sharing content for educational purposes via email, the cloud and chatrooms. In the Australian state of Victoria, intellectual property policy provides the framework for the ownership, management and use of intellectual property. The Department of Education manages and uses intellectual property in accordance with state policy and legislation (Victoria Department of Education, 2021a). The Department guides schools and teachers on using and sharing copyrighted material. For instance, teachers can use copyrighted material owned by the education or other government departments and covered under a Creative Commons licence (Victoria Department of Education, 2021b).

In Bangladesh, the Post COVID-19 National ICT Roadmap supported the updating of the intellectual property rights policy to ensure appropriate encryption and protect the providers of online education. In Singapore, the Ministry of Education eMedia channel for educators provides a space for teachers to share video projects and lessons that they and their pupils have created. Access is limited to educators with the appropriate login information.

A survey of European ministries of education in 2015 showed that training on intellectual property was not a priority of national education plans in 15 countries and not a part of teacher training in 6 countries (Office for Harmonization in the Internal Market, 2015). An expert network of representatives from education ministries and intellectual property offices was formed to develop a common approach to intellectual property in education so that creativity, innovation, entrepreneurship and the ethical use of protected materials can influence knowledge and behaviour. The network works with schools and teacher training colleges to raise awareness on intellectual property issues in education (EUIPO, 2022b). The Ideas Powered@Schools initiative produces and disseminates education materials aiming to raise the awareness of students on the value of intellectual property and the importance of respecting it (EUIPO, 2022a).

instruments (Right to Education Initiative, 2023). But the threat to privacy from digital technology is a new territory for legal experts. The harm from such a privacy violation is harder to define. It extends into the future. Its negative consequences are spread across many people, even if they may be minimal for a single individual. They may cause only an inconvenience for an individual but bring large benefits to companies. All of these factors challenge courts' traditional understandings of harm; legal experts are just beginning to come to terms with the new terrain (Citron and Solove, 2022).

Students' privacy must be protected while they are using technology, while allowing the appropriate use of data to personalize learning, advance research and visualize student progress. Schools should be aware of who can access student data and disclose to families the type of data that is collected when students use technology at schools. Schools need to ensure that both parents and students are aware of and understand their rights and responsibilities concerning data collection and use (UNESCO, 2022).

In 2021, a report of the UN Special Rapporteur on the right to privacy highlighted the lack of protection for children's right to privacy in national legal frameworks, the lack of parents' and children's capacity to challenge vendors' privacy arrangements or refuse to provide data, and the fact that schools are not addressing privacy concerns in relation to their education technology choices. It noted that companies 'routinely control children's digital educational records' with such data – extending to thinking characteristics, learning trajectory, engagement, response times, pages read, videos viewed, device identification and location – being shared with third parties, such as advertising partners. It called for appropriate legal frameworks for online education (United Nations Human Rights Council, 2021).

In 2022, a report of the UN Special Rapporteur on the right to education highlighted that digitalization of education should not 'lead to violations of other human rights within education, in particular the right to privacy'. It raised concerns about 'massive imbalance in power, awareness and knowledge between those who decide on the technologies and the users'. It also drew attention to the lack of transparency related to data collection and use, unclear lines of accountability for data-based decision-making, an inability to challenge privacy arrangements in the face of legitimate concerns, and the potential for student digital records to adversely impact their employment options. The report called on countries to adopt and implement child-specific privacy and data protection laws that protect the best interests of children in complex online environments; to protect adults in any educational setting with privacy and data protection laws; and to define categories of sensitive personal data that should never be collected in educational settings, in particular from children (United Nations Human Rights Council, 2022). Some of these concerns are heightened by AI (**Box 8.2**).

In 2021, the Council of Europe issued guidelines for children's data protection in an educational setting, based on four criteria: the best interest of the children, their evolving capacities, the right to be heard and the right not to be discriminated against (Council of Europe, 2021).

Data protection legislation is only nascent

Despite the urgent need for it, national legislation has barely addressed data privacy and security in using technology in education. With few exceptions, data protection standards, consumer protection laws and privacy regulations are still fragmented and opaque, hampering the coherence or privacy policies for students and teachers (Right to Education Initiative, 2023). Analysis of PEER country profiles for this report shows that only 16% of countries guarantee data privacy in education with a law and 29% with a policy (the countries are mainly in Europe and Northern America); in 41% of countries, these policies have been adopted since the COVID-19 pandemic (**Figure 8.2**). A further analysis of 10 countries for this report suggests that even when there are legislative provisions protecting data privacy and safety, international human rights law on children's rights to data privacy and security has not been fully implemented at the national level (Right to Education Initiative, 2023).

> "Analysis of PEER country profiles for this report shows that only 16% of countries guarantee data privacy in education with a law and 29% with a policy"

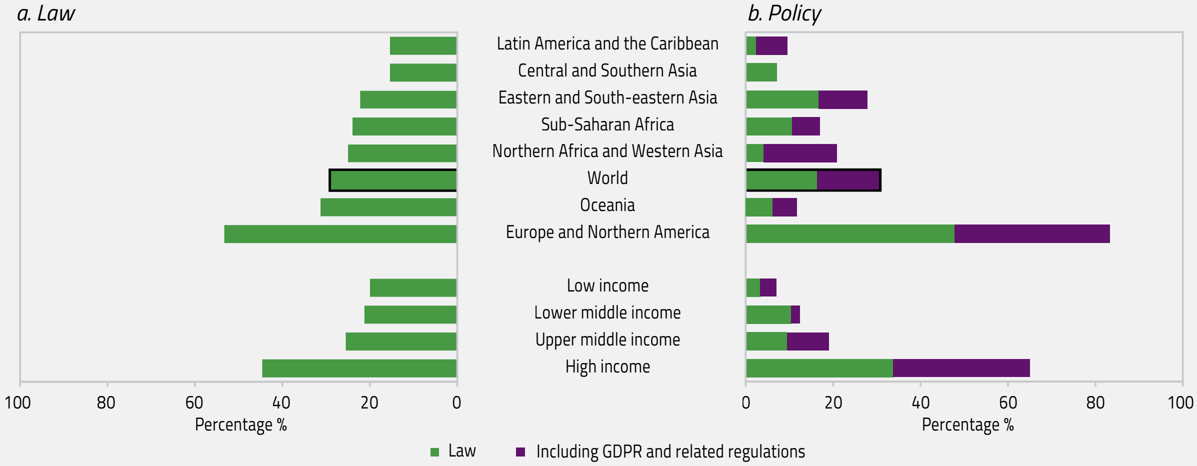
In the European Union, the General Data Protection Regulation (GDPR), issued in 2016 and which entered into force in 2018, has changed the legal landscape for child protection. Article 8 specifies that the processing of a child's personal data 'shall be lawful where the child is at least 16 years old'. For children under 16, consent is lawful only if given by the 'holder of the parental responsibility'. Lower ages can be proposed by Member States, but this should not be below 13 years of age (European Parliament and Council of the European Union, 2016). In France, parental right holders must give their consent jointly with that of their child up to age 15, according to Article 45 of the Data Protection Act (France Parliament, 2018). Adding countries that have ratified the GDPR or laws that are compliant to that regulation outside Europe increases the share of countries that guarantee data protection, at least in public schools, from 16% to 31%. In Ireland, which passed a Data Protection Act in 2018 to enforce the GDPR, the Data Protection Commission outlined 14 core principles for child data processing (Ireland Data Protection Commission, 2021).

Other countries that ensure an adequate level of data protection include Argentina, China, Israel, Japan, New Zealand, the Republic of Korea, the United Kingdom and Uruguay. China's legal framework offers strong protection to children's privacy regarding the sharing of their personal information, including in an educational environment. Two laws, on the protection of minors and on the protection of children's personal information, are dedicated to children's digital rights (China Cyberspace Administration, 2021). In 2021, the Provisions on the Protection of Minors by Schools regulated child protection in the use of digital devices in education, also enshrining principles of equity, inclusion, respect for dignity and the right to education (China Ministry of Education, 2021). In Japan, the Act on Establishment of Enhanced Environment for Youth's Safe and Secure Internet Use aims to promote internet literacy and the use of internet filtering software on computers and smartphones (Japan Government, 2008). In Latin America, most constitutions recognize personal data protection rights. However, individual regulation to protect these rights is lacking. The GDPR has triggered some initiatives; Colombia and Mexico are developing new legislation.

FIGURE 8.2:

Most countries do not guarantee data privacy in education in their legislation

Percentage of countries guaranteeing data protection in education, by tool, 2022



GEM StatLink: https://bit.ly/GEM2023_fig8_2

Source: Profiles Enhancing Education Reviews (PEER).

In the United States, there is an independent data authority and a data protection law. Data collection for children under 13 is governed by the Children's Online Privacy Protection Act, while the Children's Internet Protection Act aims to protect children from obscene or harmful content on the internet in schools and libraries. Parents, students and school staff have to sign written agreements, responsible use policies, which describe consequences for misuse. The Children's Internet Protection Act also covers academic integrity standards and resources that students can or cannot access when using school-provided devices or the school network (United States Department of Education, 2017). Yet, despite all those measures, it does not ensure adequate data protection (Right to Education Initiative, 2023).

In India, out of some 5,500 complaints received in 2021 by the Advertising Standards Council of India, one third concerned the education sector (Financial Express, 2022). Discrepancies between advertisements and actual products amount to false advertising (Varshney, 2018). The Department of Consumer Affairs took note of the alleged fraudulent selling of courses by some companies (ET Online, 2022). It advised Byju's, one of the largest education technology start-ups, to work with the Council to redress claims it makes in its advertisements. Concerns have arisen about complex pricing and financial agreements, and aggressive marketing and sales strategies (Inamdar, 2021).

In Oman, the 2022 Personal Data Protection Law determines that personal data should only be processed with the express written consent of the data owner. The 2022 Reference Framework for the Use of Educational Devices in Schools dedicated a section for security regulations for protecting data privacy in relation to the use of devices in schools (Oman Ministry of Education, 2022). In Africa in 2020, 24 of 53 countries had adopted laws and regulations to protect personal data (PrivacyInternational.org, 2020).

Schools collect a lot of data on students, families and teachers, some of which are sensitive, including student biometric and health data, and dietary requirements that can be used to make assumptions about religion. In Europe, public schools are covered as 'public authorities' by the GDPR. They must appoint data protection officers, who are more accountable for the data they collect. When data are handled by third parties, schools should ensure that these are GDPR-compliant and that transactions occur within a legally binding contract. Data breaches that negatively impact data subjects need to be reported to the data protection authority within 72 hours. The GDPR also determines how and when such data can be lawfully processed; for example, there is a lawful basis for schools to process data and this task is in the public interest. But even so, the data cannot be recycled for another task. If schools want to share student data, they need to seek parental or student consent.

“If schools want to share student data, they need to seek parental or student consent”

BOX 8.2:

Artificial intelligence presents additional risks for privacy

The use of artificial intelligence (AI) in education is expanding at an exponential rate, spanning from the automation of administrative processes and tasks to curriculum and content development, teaching, and learning. But a section dedicated to education and research in the 2021 UNESCO Recommendation on the Ethics of Artificial Intelligence, the first with a global reach, describes tangible and intangible risks and calls for a robust policy and legislative framework along with ethical oversight (UNESCO, 2021).

AI is largely based on machine learning algorithms, which are used to make decisions that can have a major impact on people's lives. Far from being fair and objective, algorithms carry the biases of their developers and can reproduce or deepen inequality, especially in terms of discrimination (European Union Agency for Fundamental Rights, 2022). The issue of fairness has been a challenge in assessment for a long time (Hutchinson and Mitchell, 2019) and is included among international organizations' core principles for trustworthy AI (European Commission, 2019; OECD, 2019).

Applied in different domains, including health, justice and the labour market, algorithms are also applied in education, for instance to admit students (Engler, 2021) and predict dropout probabilities (Sybol et al., 2023) and grades (Yağcı, 2022). When examinations had to be suspended in the United Kingdom due to COVID-19, algorithms were used to predict scores, which had grave consequences. Public school students received grades lower than what they expected and lower than those in smaller private schools, leading to major questions about accountability and the ethics of such predictive systems (Kolkman, 2020). AI does not consider student's real experiences and contexts, exhibiting gender, racial and other biases (Baker and Hawn, 2022; Borgesius, 2018; Buolamwini and Gebru, 2018).

Facial recognition systems can also be biased against specific races (Garvie and Frankle, 2016). An evaluation in the United States of 189 software algorithms from 99 developers yielded higher rates of false positives for Asian and African Americans relative to images of Caucasians by 'a factor of 10 to 100 times, depending on the individual algorithm'. The highest rates of false positives were found in relation to indigenous peoples (NIST, 2019). In Brazil, facial recognition has been used to monitor access to public services, including schools, with the aim to monitor student attendance. However, the programmes collect other information and can monitor and record information on excluded and marginalized groups at the expense of privacy. As a recently approved law for data protection does not cover data processing for public security purposes, these systems could be used to profile and punish already vulnerable groups (Canto, 2021). In the US state of Texas, at least eight school districts use facial recognition that is also used for law enforcement purposes (Simonite and Barber, 2019). They justify the use of facial recognition systems in schools that could identify every student entering and leaving the classroom by arguing that the systems can also 'recognize students' behaviours such as [being in a] daze, dozing, and playing with mobile phones' (Jin, 2019). China's Cyberspace Administration and the Ministry of Education introduced regulations in 2019 requiring parental consent before cameras and headbands powered by AI are used with students and requiring data to be encrypted (UNESCO, 2021).

In many countries, there are no specific regulations yet on how and when the sharing of children's personal information is lawful. Consent for data processing may not be valid even when it is requested, as children or parents may not be able to refuse it when it is necessary for education or when they do not understand the basis for consent (European Data Protection Board, 2020). There may be confusion on whether existing standards of consent apply to schools. In the United Kingdom, the Information Commissioner's Office has issued the age-appropriate design code, which applies to online services likely to be accessed by children. The code contains 15 standards to be followed by online services (United Kingdom Information Commissioner's Service, 2021). However, these are not applied to services for children carried out by education technology providers through schools (Digital Futures Commission, 2022).

In South Africa, the Guidelines on e-Safety in Schools include a provision on monitoring software, stating that learners and teachers must be informed at the outset that their online activity is being monitored. The purpose is to provide a safe online environment which educates users on how to manage their access and online behaviour and ensures the behaviour does not overstep the bounds of reasonable respect for privacy. Schools' acceptable use policy specifies that learners need to be informed about what data are captured by the monitoring software, how long the data are kept, who has access to the data, how the data will be kept safe so that unauthorized users cannot access it, what mechanisms exist to ensure the data are accurate, and how the data can be used (South Africa Department of Basic Education, 2017).

Recent investigations have generated government responses, such as the removal of advertising tracking from learning platforms (France, Indonesia, the state of Minas Gerais in Brazil) and opening investigations into learning platforms (the Australian states of New South Wales and Victoria, Ecuador and Spain's autonomous community of Catalonia) (Human Rights Watch, 2023).

While the provisions described here are a step forward in protecting children from risks associated with the online processing of their personal information, they are grounded in an approach based on risks rather than rights. Moreover, they do not provide the same assurances as human rights or child rights due diligence processes. Supervision and oversight must ensure that education technology companies adhere to standards and do not extend their power without limits. Complaint mechanisms and administrative or judicial remedies tend not to be tailored for children. Australia, Brazil, France, Ireland, Singapore, South Africa and the United Kingdom have entrusted a regulatory authority with the power to bring administrative actions against parties who have committed a breach of data laws. But the extent to which they can investigate, impose civil liability and issue fines varies by country. Article 69 of the Chinese Personal Information Protection Law puts the burden of proof on the handlers of personal information, making them liable to the extent that they cannot prove they are not at fault. However, the mechanism is complex and it may still be difficult to make such actors accountable (Right to Education Initiative, 2023).

In cases of infringements of privacy and data protection, administrative fines must be effective, proportional and dissuasive. In Iceland, the Supervisory Authority ruled that a US cloud-based education company breached the GDPR by not obtaining parental consent for processing student data from one of Reykjavík's primary schools and issued an ISK 5 million (USD 38,000) fine (European Data Protection Board, 2022). A fine was imposed by the Norwegian Data Protection Authority on the Municipality of Oslo for poor security in a mobile app used for communication between school employees, parents and pupils (European Data Protection Board, 2019). The Swedish Data Protection Authority, reviewing the platform of the Stockholm school administration, found that the level of security was insufficient, affected 'several hundred thousand' data subjects – including children and pupils – and did not adequately handle sensitive and special categories of personal data. The authority issued a fine of SEK 4 million (USD 390,000) to the Stockholm Board of Education (Stockholm Board of Education, 2020).

Education technology companies can play an important role in privacy and data protection by applying sound privacy and data protection to their products, service and systems. In some cases, this amounts to setting the privacy by default in applications and devices, and not requiring manual input from the user (UNESCO, 2022). Users need instead to opt in to being tracked by third-party applications, as is the case with Apple's operating system iOS 14.5. In a survey in the United States, only 13% of users had granted permission for tracking by any apps and 4% had set themselves so they cannot be asked to opt-in (Laziuk, 2021). Alternatively, companies can ensure privacy by design. The GDPR establishes 'data protection by design' as a legal requirement to be fulfilled. Article 83 considers non-compliance with this obligation as a punishable offence and its correct application is one of the criteria for measuring the gravity of an infringement.

Education technology services and products need to make the privacy and human rights implications deriving from their use fully understandable. Yet providers seek exemptions. In the Netherlands, Google proposed changing the contractual privacy commitments for service data after the government carried out a data protection impact assessment of Google Workspace for Education (Bonamigo, 2021). However, the ban was not lifted (Rao, 2022). Even where online child protection exists, it is sometimes discontinuous across settings. Protection offered on services or applications used in schools does not necessarily continue when children are at home doing their homework, resulting in their data being captured by other providers and vendors and used afterwards for behavioural profiling and social scoring (Digital Futures Commission, 2022).

SAFETY RISKS CANNOT BE DISMISSED

Education, like all sectors, is increasingly targeted by cyberattacks. Schools possess confidential data about students and parents ranging from socio-demographic to health records and financial information; all need to be protected. More attacks on education systems and users mean more exposure to theft of identity and other personal data. In the United States, the number of schools impacted by cyberattacks in 45 districts nearly doubled between 2021 and 2022 (Emsisoft, 2023). Globally, in 2022, the education sector accounted for 5% of all ransomware attacks (APWG, 2022) and more than 30% of security breaches (Verizon, 2022).

> The global cost of cybercrime was estimated at USD 7 trillion in 2022

The global cost of cybercrime was estimated at USD 7 trillion in 2022 (Morgan, 2022). The costs and risks of poor cybersecurity in schools are large even though ransoms are often not paid. Besides loss of data and work, these costs include increased student and teacher data exposure, and the downtime and restoration of key systems and resources. In the United States, in 2022, the cost to schools and colleges of downtime was estimated at USD 9.5 billion (Bischoff, 2023) and the average data breach cost in education at USD 3.9 million in 2022 (IBM, 2022). The average cost of a ransom attack in 2,700 universities across 43 countries was estimated at around USD 447,000 (Bluevoyant, 2021) and the average cost to educational institutions to re-establish the conditions pre-attack was an average of USD 2.7 million in 2021 in the United States, much higher than in other sectors (Shier, 2021). A 2021 survey of 5,400 information technology decision makers in 30 countries, including 500 from the education sector, showed that 44% of organizations were hit by ransomware in 2020, with 58% of those suffering from data encryption. More than one third of those that experienced data encryption paid an average ransom of USD 112,000. Even paying the ransom helped recover only 68% of data (Sophos, 2021).

Governments need to develop appropriate legal and policy frameworks to protect and safeguard digital infrastructure and data from cyberattacks. They can adopt strong acceptable use policies that clearly define appropriate and inappropriate uses of technology and consequences for violating them. Increasing exposure to cybersecurity risks also calls for raising awareness and informing teachers, students and families. Establishing a collective defence model, based on a community of defenders and collaboration between multiple stakeholders to protect education systems from threats, was a critical component of the 2021 K-12 Cybersecurity Act in the United States.

Cyberbullying is a growing concern for safety and well-being

Cyberbullying is a new form of bullying behaviour, which is fuelled by access to smartphones and other devices. Globally, 16% of countries have adopted legislation to prevent and act on it with a focus on education; of those, 38% have done so since the COVID-19 pandemic. About 40% of countries have a policy, strategy or plan in this area. Europe and Northern America is the region with the highest share of countries – 61% – with such a policy (**Figure 8.3**).

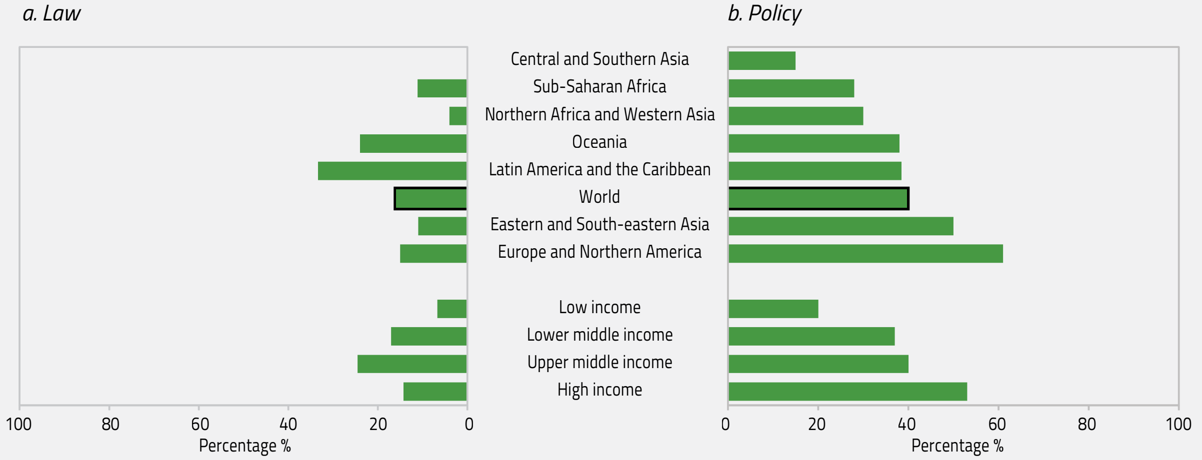
Most countries do not explicitly define cyberbullying and online abuse as a distinct offence, as those behaviours may fall under other laws (Right to Education Initiative, 2023). In Australia, various legislative tools at central, state and territory levels criminalize stalking, intimidating or threatening conduct, encouraging suicide, defamation, and accessing online accounts without authorization. The 2021 Online Safety Act defines cyberbullying material as something that can seriously humiliate, harass, intimidate or threaten a child and grants the Office of the eSafety Commissioner the power to require online service providers to remove the material and manage complaints for Australians under 18 who experience cyberbullying. The 2022 Personal Data Protection Act is the first comprehensive data protection law in Indonesia. It calls upon public or private entities that handle personal data to ensure data protection, with sanctions applied for mishandling. Protection against cyberbullying is indirectly provided under the Act. However, Article 45B of the amended 2008 Electronic Information and Transactions Law considers cyberbullying a form of harassment.

In Japan, the Act for the Promotion of Measures to Prevent Bullying, which does not separate online and offline bullying, stipulates the obligations of national and local governments, schools, teachers, and parents regarding the prevention and early detection of and responses to bullying. China has specific provisions regarding cyberbullying. Articles 77 and 80 of the 2020 Law on the Protection of Minors provide that 'no organization or individual should insult, slander, or threaten minors, maliciously damage the image of minors, or conduct other cyberbullying acts against minors through the internet in the form of text, picture, audio and video'. They also establish the obligation of network service providers to act in a timely manner after receiving notification from the cyberbullying victim to stop these acts and prevent the spread of information, including by deleting, blocking and disconnecting links, as well as to keep relevant records and report the cyberbullying to the relevant authorities (Right to Education Initiative, 2023).

FIGURE 8.3:

Fewer than 1 in 5 countries have legislation to prevent and act on cyberbullying

Percentage of countries taking measures to prevent cyberbullying in education, by tool, 2022



GEM StatLink: https://bit.ly/GEM2023_fig8_3

Source: Profiles Enhancing Education Reviews (PEER).

In Bangladesh, cyberbullying is punishable under the 2006 ICT Act, amended in 2013, but there is no explicit link with education or schools. The 2012–21 Master Plan for ICT in Education supports special measures to protect the confidentiality of students, teachers and administrators who use technology. The draft 2022 Data Protection Act is the first legislation in the country focused on data privacy and protection. The draft Act does not mention education but refers to child online protection in general. In India, the Information Technology Act can be considered a legal basis for dealing with cyberbullying. It prescribes punishment for sending annoying, offensive and insulting communication through digital and information communication technology. Cyberbullying could also fall under the Penal Code if it involves offences such as defamation, blackmail, sexual harassment, stalking or words, gestures and acts intended to 'insult the modesty of a woman'. However, no special protection is granted to children under those laws.

EXCESSIVE TECHNOLOGY USE PUTS PHYSICAL AND MENTAL WELL-BEING AT RISK

The use of technology involves prolonged periods of time spent handling devices and facing screens. Education is particularly vulnerable to excesses in both respects, which exacerbates the risks to health and general well-being; governments are only now beginning to consider how to respond to these risks.

Exposure to screens affects children's well-being

The amount of time children spend on screens is a growing concern for parents as well as for education and health practitioners. In the United States, the Center for Disease Control and Prevention estimated daily screen time at 6 hours for 8- to 10-year-olds, 9 hours for 11- to 14-year-olds (of which 5 were watching television) and 7.5 hours for 15- to 18-year-olds (CDC, 2018). These levels increased during the COVID-19 pandemic. A survey of screen time before and after the pandemic of 2,500 parents with 3- to 8-year-old children in Australia, China, Italy, Sweden, the United Kingdom and the United States found that children's screen exposure increased by 50 minutes as a result of both education and leisure. A lower socio-economic status was associated with greater increases (Ribner et al., 2021).

There were differences between countries. In 19 European countries, children aged between 9 and 16 years spent 2 hours and 47 minutes online on average in 2020, from a low of 2 hours and 14 minutes in Switzerland to a high of 3 hours and 39 minutes in Norway. Compared with data collected in 2010, this time has doubled in countries including France, Italy and Spain. Children aged 15 to 16 years spend nearly 2 hours and 30 minutes daily online, compared with nearly 2 hours for those aged 9 to 11 years and 3 hours and 12 minutes for those aged 12 to 14 (Smahel et al., 2020). In France, even children under 2 spent 3 hours and 11 minutes daily in front of screens in 2022 (Le Point, 2023).

Concerns about screen time were discussed well before the advent of computers and screen-based digital devices. But earlier studies' results were often inconclusive because of the self-reporting of screen time, which can be affected by recall errors and bias (Wong et al., 2021). More recent studies tend to report negative impacts in various domains. A review of 89 studies on screen time in various countries and regions suggests that while all age groups recorded increases in screen time, primary school children had the biggest daily increase (by 1 hour and 23 minutes), followed by adults (58 minutes), adolescents (55 minutes) and children under 5 (35 minutes). The increases negatively affected diet (e.g. eating self-regulation), sleep, mental health and eye health (Trott et al., 2022).

In the United Kingdom, some estimates suggest that 40% of 11- to 16-year-olds had experienced back or neck pain and 15% of parents said this likely resulted from the use of laptops, tablets or computers (Sayer Clinics, 2014). A report based on the findings of 12 systematic reviews found an association between more screen time and a less healthy diet, a higher energy intake and more pronounced indicators of obesity. More than 2 hours a day of screen time is associated with more depressive symptoms, poorer educational outcomes, loss of sleep and fitness. Children and youth between the ages of 11 and 24 were spending approximately 2.5 hours on the computer, 3 hours on their phone and 2 hours on the television per day (Viner et al., 2019).

Analysis of a large sample of young people aged between 2 and 17 in the United States showed that higher screen time was associated with poorer well-being; less curiosity, self-control and emotional stability; higher anxiety; and depression diagnoses. Some of these associations were larger for adolescents than young children (Twenge and Campbell, 2018). A study of early childhood development among 2,441 mothers and children in the Canadian province of Alberta found that higher levels of screen time in children aged 24 and 36 months were associated with worse development outcomes at 36 and 60 months, respectively (Madigan et al., 2019). A similar result was reported in a study of 52 children aged 3 to 5, which used brain scans to analyse brain structure according to each child's digital media use. It found that higher media use was associated with lower cortical thickness and sulcal depth. These two characteristics are linked to language development, reading skills and social skills, such as complex memory encoding, empathy, and understanding facial and emotional expression (Hutton et al., 2022).

Experts are increasingly calling for public interventions and limits to screen time (Nagata et al., 2022). A meta-analysis covering 12 cohort studies and 15 cross-sectional studies on a sample of 25,000 children aged between 6 and 18 years argued for public interventions to promote outdoor activities to reduce the risk of myopia (Duraipandy et al., 2021). An experimental study on two sets of grade 6 students from a school in the US state of California found that those who went on a trip to a nature camp and were not allowed to use any type of digital device did substantially better at interpreting human emotions than those who continued spending time on digital devices (Uhls et al., 2014) .

> “Experts are increasingly calling for public interventions and limits to screen time”

Despite the risks of screen time, there are few strict regulations. In China, the Ministry of Education placed a limit of 30% of overall teaching time spent with digital devices as teaching tools and at most 20 minutes per day spent on electronic homework. Guidelines also suggest students should rest their eyes for 10 minutes after 30 to 40 minutes of educational screen time (Wong et al., 2021). The government has set strict limitations on gaming too, at three hours maximum per week, placing some responsibility on gaming companies (Soo, 2021). Games require all users to register using their real names (Feiner and Kharpal, 2021) and government-issued identification documents (Zhang, 2021).

In the Republic of Korea, until recently, children up to age 15 were forbidden to play video games during the night, a provision enshrined in the 2011 Youth Protection Revision Act, which was abolished in 2021. The Department of Education of the US state of Minnesota passed a law in 2022 stating that public preschool and kindergarten students cannot use screens alone without teacher engagement (Minnesota Department of Education, 2021).

Guidelines or recommended screen time limits exist, most often under the purview of health authorities, but it is up to the parents to follow them. The World Health Organization guidelines on physical activity, sedentary behaviours and sleep recommends less than an hour of sedentary screen time for children aged between 1 and 5 years (WHO, 2019). In Australia, the 24-Hour Movement Guidelines for Children recommend: no screen time for children under 2 years; no more than one hour per day for 2- to 5-year-olds; and no more than two hours of sedentary recreational screen time per day for 5- to 17-year-olds (not including schoolwork). But only 17% to 23% of preschoolers and 15% of 5- to 12-year-olds met these guidelines (Joshi and Hinkley, 2021).

Some countries are recommending negotiation rather than imposing strict limits. In Canada, guidelines by the Canadian Paediatric Society highlight four principles – minimizing, mitigating, mindful usage and modelling healthy use of screens – to move away from screen time limits, which can be a major source of stress for parents and children (Ponti, 2022). A similar approach is found in the United Kingdom, where the Royal College of Paediatrics and Child Health has published guidelines to help parents manage children's screen time through dialogue (Viner et al., 2019). In 2020, the Ministry of National Education, Children and Youth of Luxembourg and the BEE SECURE initiative set up the campaign, Screens in the Family, to promote parental awareness of reasonable screen use (Luxembourg Ministry of National Education, Childhood and Youth, 2020; Luxembourg Ministry of National Education Childhood and Youth and BEESECURE, 2022).

Several countries are banning telephones or other technology from schools

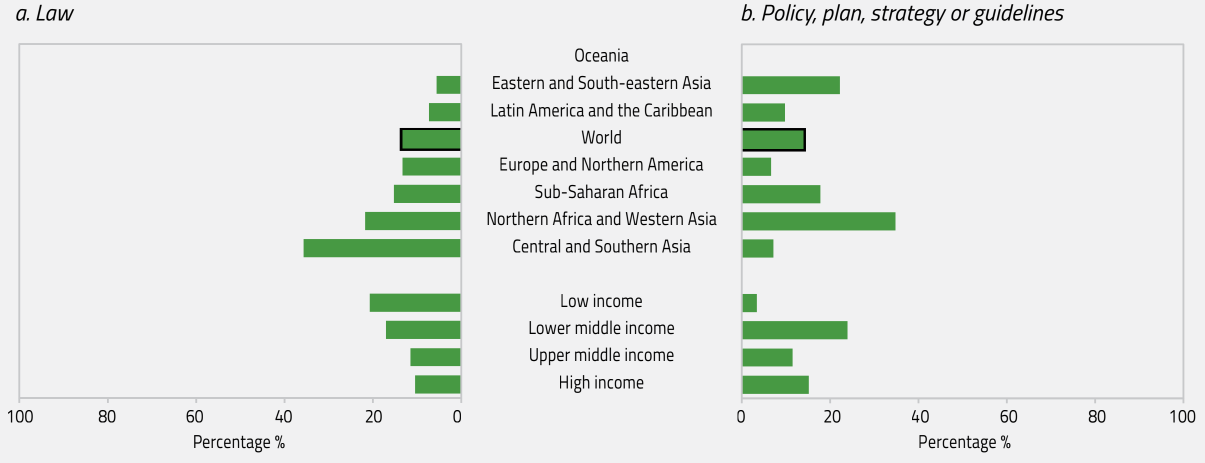
Concerns over data privacy, safety and well-being also underpin debates about the use of some technology in schools, especially by students at young ages. The use of smartphones in schools is contentious. Studies from Belgium (Baert et al., 2020), Spain (Beneito and Vicente-Chirivella, 2020) and the United Kingdom (Beland and Murphy, 2016) show that banning mobile phones from schools improves academic performance, especially for low-performing students.

Analysis for this report shows that, globally, almost one in four countries has introduced such bans in laws or policies. In particular, 13% of countries have laws and 14% have policies that ban mobile phones. Bans are more common in Central and Southern Asia (**Figure 8.4**). In 2011, Bangladesh imposed a ban on the use of mobile phones by teachers in classrooms (Samad, 2011). In 2017, both students and teachers in schools and colleges were banned from bringing mobile phones into classrooms (bdnews24, 2017). Article 25 of the education law in Tajikistan states that the use of mobile phones by students is prohibited in primary, vocational and secondary schools. In Uzbekistan, the law calls for switching off all devices when entering schools.

FIGURE 8.4:

One in seven countries ban the use of mobile phones in schools by law

Percentage of countries taking measures to ban mobile phones in schools, by tool, 2022



GEM StatLink: https://bit.ly/GEM2023_fig8_4
Source: Profiles Enhancing Education Reviews (PEER).

The Department of Education in the Australian state of New South Wales implemented a restriction on mobile devices in public primary schools in 2018 (New South Wales Government, 2020), while mobile phones are prohibited for all public school students in Tasmania (Tasmania Government Ministry of Education and Training, 2019) and Victoria (Gullaci, 2019). Yet a poll of 1,070 people in Australia found that 2 in 3 respondents strongly or somewhat supported implementing digital safety programmes to educate students on how to safely use mobile phones rather than banning all students from using mobile phones in schools. More than half supported or somewhat supported a ban for all students, while 37% supported or somewhat supported only grade 11 and 12 students using mobile phones in school (Essential Research, 2022).

France has a ban but makes exceptions for certain groups of students (e.g. with disabilities) or when smartphones are used for 'pedagogical' purposes (France Ministry of National Education, 2018). Full or partial bans have been imposed in Latvia, Mexico, Portugal, Spain, Switzerland and the United States, as well as in Ontario (Canada) and Scotland (United Kingdom). But in the Republic of Korea, a watchdog argued that a complete ban would infringe on students' basic rights, such as freedom of communication (Hyo-jyn, 2021).

> Working with technology in schools, and the accompanying risks, may require something more than banning

In Burkina Faso, a 2018 order prohibits the use of mobile phones and accessories within secondary schools under penalty of confiscation, with equipment held and not returned to the student until the end of the school year. The use of devices other than those authorized for the course or assessment is prohibited and the student will be temporarily or permanently excluded in the event of a repeat offence. In Côte d'Ivoire, a ministerial decree prohibits the use of mobile phones in schools, while a 2018 order prohibits digital communication media during examinations. In Guinea, a 2021 decision bans the use of smartphones and any other internet-connected devices in schools.

Countries have banned the use of specific applications from education settings because of the privacy concerns they raise when they collect user data unnecessary for the applications to work. In Denmark, a data protection impact assessment conducted by the Helsingør municipality in relation to Google Workspace for Education and Chromebooks led to banning their use in schools (Schmiedt, 2022). France's Ministry of Education and Youth has banned free versions of Microsoft Office 365 and Google Workspace in schools (UC Today, 2022). In Germany, Microsoft products have been banned in the states of Baden-Württemberg and Hessen because they do not comply with the GDPR (Schneider, 2022). The Dutch Data Protection Authority proposed to ban Chromebooks and Google Workspace for Education from schools until August 2023 because of non-compliance with children's data protection and privacy regulations (Toulas, 2022).

Several schools and universities in the United States have also started banning TikTok and other platforms (Ksetri, 2023). An executive order published in March 2023 highlights the importance of technology to the nation's 'security, economy, and democracy' while also ensuring that 'technology is developed, deployed, and governed in accordance with universal human rights; the rule of law; and appropriate legal authorization, safeguards, and oversight' (United States Presidency, 2023).

Banning technology from schools can be legitimate if technology integration does not improve learning or if it worsens student well-being. Yet, working with technology in schools, and the accompanying risks, may require something more than banning. First, policies should be clear on what is and is not permitted in schools. Students cannot be punished if there is no clarity or transparency on their required behaviour. Decisions in these areas need conversations supported by sound evidence and involve all those with a stake in students' learning. Second, there should be clarity on the role these new technologies play in learning and on their responsible use by and within schools. Third, students need to learn the risks and opportunities that come with technology, develop critical skills, and understand to live with and without technology. Shielding students from new and innovative technology can put them at a disadvantage. It is important to look at these issues with an eye on the future and be ready to adjust and adapt as the world changes.

CONCLUSION

Technology has fundamentally changed the way in which children exercise and realize their rights, including their rights to both education and privacy. While under certain conditions the use of technology in education can enhance children's opportunity to learn, it can also put their physical and mental integrity, privacy, and dignity at risk. Issues related to intellectual property, data privacy and online safety are critical challenges that countries need to address.

In addition to digital education strategies, many countries, primarily high-income ones, have issued data protection laws or regulations following the GDPR. Yet they do not often distinguish between adults and children with respect to the treatment of personal data. As children deserve special protection, child data protection laws and standards, and accountability mechanisms tailored to children, are increasingly needed. Policymakers should listen to the voices of children so that their rights are protected and safeguarded during their online activities. Sound education technology and data governance are essential to make technology benefits more equitable and of quality while ensuring that schools are a safe place for children to learn, play, develop and thrive. Achieving that aim implies setting clear frameworks, effective regulations, oversight and dispute resolution mechanisms. The right to education and the right to privacy need to be monitored and protected in a world where billions of people are connected and exchange data and information as they are learning.

November 9 2022, Berdychiv, Ukraine. Tetiana, computer science teacher, with her notebook, provided by UNICEF.

Tetiana says it was not just the shelling and air raids that made teaching difficult in 2022 – it was also the school computers, which did not even have webcams.

Credit: UNICEF/UN0832329/Filippov*

CHAPTER

9

Teachers

KEY MESSAGES

Any potential that technology has will not be realized unless teachers are prepared to use it.

Technology-based practices and resources are changing the teaching profession.

- Options for working with multiple teaching and assessment resources and for interacting with students accelerated during COVID-19. A survey of teachers in 165 countries found that 27% used technology daily to assess students during the pandemic.

Various barriers prevent teachers from making the most of what technology has to offer.

- Teachers often do not take part in decisions on technology: 45% of teachers in 94 countries reported not being consulted about new technology they had to work with.
- Age is believed to negatively affect teachers' technology skills but research with teachers in 17 countries showed that resistance to technology was related more to preparation than to age.
- Some teachers are hesitant or lack confidence in using technology. Lower secondary school teachers who took part in the 2018 Teaching and Learning International Survey reported that ICT was their second highest training priority. Even after training, only 43% felt prepared to use technology for teaching.
- Many teachers are critical of technology. Among grade 8 teachers surveyed in the 2018 International Computer and Information Literacy Study, 37% felt that technology distracted students from learning.

Education systems are taking steps to define development needs.

- Self-assessment tools support teachers in identifying their development needs.
- Around half of countries have ICT standards for teachers and about one fifth of those countries have specified or readjusted them since the COVID-19 pandemic.
- New ICT training topics are being introduced, including how to respond to plagiarism and how to safely share students' work online.

Technology is changing teacher training.

- Technology can make training opportunities more accessible, overcoming location and time barriers. Distance education programmes have been found to promote teacher learning in mathematics in South Africa and even to equal the impact of in-person training in Ghana.
- Teachers can use technology to learn from each other. About 80% of more than 1,500 teachers surveyed in the Caribbean belong to professional WhatsApp groups and 44% use WhatsApp and similar messaging applications to collaborate at least once a week.
- Technology can facilitate coach and mentor involvement. In Senegal, face-to-face coaching improved teaching practices more, but online coaching cost 83% less and still improved the way teachers guided their students' reading practice.

Many education actors support teacher professional development in ICT.

- Head teachers are generally responsible for setting conditions for ICT integration into schools. But according to the 2018 International Computer and Information Literacy Study, only some 40% of students attended schools whose head teachers considered it a priority to encourage teachers to integrate ICT into their teaching.

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Teachers are increasingly expected to integrate technology into various aspects of their professional practice, including their pedagogy, student assessment, interactions with students and parents, and professional development. Effective integration means enabling teachers to make their teaching practices more learner-centred; creating engaging and relevant learning environments; and preparing students with technological knowledge and skills. However, despite these expectations, teachers receive varying levels of support to improve their skills in information and communication technology (ICT), and use them to teach. Many teachers remain hesitant or lack confidence in using technology. The COVID disruption increased the working hours and learning needs of teachers who worked remotely, as well as the expectations on them, but training responses have been uneven.

> "Many teachers remain hesitant or lack confidence in using technology"

Taking these challenges as a starting point, this chapter describes education system responses to help teachers use technology in various areas of their practice, with a focus on effective professional development which integrates technology. The chapter is based on the premise that technology cannot replace teachers in the classroom. Teachers not only impart knowledge and instruction, but also socialize students and act as motivational role models, which technology alone cannot do. They also encourage critical thinking and autonomy in students. Teacher development in and through technology should recognize and enable teachers to act as creators, designers and facilitators, particularly in relation to the appropriate choice of technology to respond to the diversity of learners' needs and contexts.

TECHNOLOGY-BASED PRACTICES AND RESOURCES ARE CHANGING THE TEACHING PROFESSION

As new applications and technologies make their way into classrooms around the world (**Chapter 4**), the teaching profession is adapting to and changing with the education landscape. More opportunities arise for student-centred learning, access to multiple curriculum and assessment resources, and frequent interactions with students and parents. The COVID pandemic accelerated some of these trends, requiring teachers to adjust the curriculum, prioritize learning that can be done online, and rethink their assessment methods accordingly.

Effective use of education technology by teachers can strengthen the extent to which they can facilitate student-centred learning, including through project-based activities. Platforms using algorithms and adaptive learning technologies can provide personalized learning experiences for students. Although a precise definition of personalized learning remains elusive, the main idea is that such approaches provide teachers with data-driven insights about students' strengths and weaknesses, offering them a range of new tools to support their teaching, and helps them identify areas where students need additional support and adjusted teaching strategies. Such approaches also allow teachers to adopt more flexible teaching schedules and to provide students with more opportunities for self-directed learning (Walkington and Bernacki, 2020). For instance, Khan Academy interactive exercises and video lessons use adaptive learning technology to provide students with customized learning paths that have been found to promote personalization (Vidergor and Ben-Amram, 2020).

Virtual and augmented reality technologies can help teachers find new ways to explain concepts and provide students with more engaging ways to delve into subject matter through game-based learning and simulated real-world scenarios, such as virtual field trips (Lan et al., 2018; Lu and Liu, 2015; Pellas et al., 2019; Tobar-Muñoz et al., 2017).

> Teachers are more and more supported through technology to select, adapt and produce teaching resources

Teachers are more and more supported through technology to select, adapt and produce teaching resources. In France, the government facilitated access to 17 online teaching resource banks mapped against the national curriculum in all disciplines and grades. They also offered teachers the possibility of adapting these resources according to student profiles and needs. Within two weeks of the start of the pandemic, the government disabled all authentication requirements and the collection of personal data through its platforms, making it easier for teachers, as well as for students and their families, to access the resources (Thillay and Vidal, 2022). In the Republic of Korea, nearly 60% of the resources found on the School-On website exchange platform are created by teachers. During the pandemic, the Ministry of Culture, Sports and Tourism also temporarily relaxed copyright rules to allow teachers to produce online course content using existing resources (Vincent-Lancrin et al., 2022).

France Education International, under the supervision of the French Ministry of National Education, developed the Imagin'Ecole platform during the COVID pandemic. With support from UNESCO and the Global Partnership for Education, this platform brings together several digital resources, enabling teachers to produce, modify or share teaching scenarios and to disseminate them at the local or regional level. The resources submitted are then integrated into teaching sessions and learning paths adapted to national programmes and country needs (France Education International, 2022).

The CL4STEM project aims to assist newly qualified science, technology and mathematics teachers in Bhutan, Nigeria and the United Republic of Tanzania to select, integrate and adapt the resources of the Connected Learning Initiative, or CLIx, an open educational platform from India, and other open educational resources into their national curricula to ensure inclusive technology education (Connected Learning Initiative, 2023).

Education systems are providing access to assessment tools, which can help teachers save time, provide immediate feedback to students, and gain new insights into their students' learning. Key initiatives support teachers in their use of online quizzes and tests, learning management systems, video recording tools, digital portfolios, automated assessment tools that use artificial intelligence to automatically mark students' work, and collaborative tools to facilitate group work and peer assessment.

During the COVID pandemic, many teachers had to adapt assessment to what technology could – or could not – do. According to T4, an online survey of more than 20,000 teachers in 165 countries, 27% of teachers used technology to assess students during the pandemic on a daily basis, 29% did so weekly, and 20% once or twice a month (Koomar et al., 2022; Pota et al., 2021). Over 60% of teachers responding to the Responses to Educational Disruption (REDS) International Survey reported they had to adapt assessment practices commonly used before the disruption, particularly for students with special needs and in more practical subjects, to fit the new mode of delivery (Meinck et al., 2022). In some countries, teachers were given autonomy to assess students in the ways they felt most appropriate. In Slovenia, two fifths of primary and one third of secondary teachers adjusted their assessment methods, with many reporting a greater use of quizzes (Slovenia National Education Institute, 2020). In Israel, teachers in the Kibbutzim College of Education introduced new forms of assessments, based on student blogs, interactive digital posters, digital portfolios, mind maps, online presentations and videos (Donitsa-Schmidt and Ramot, 2020).

Technology provides teachers with a variety of tools and platforms to boost interaction with students and parents. These include online communication tools such as email, messaging applications and discussion forums (e.g. for quick messages, questions and answers) as well as online platforms such as forums, chat rooms and video conferencing tools (e.g. to manage and distribute course materials online). Some teachers also use social media platforms, often on a voluntary basis, to share updates and information with students and parents. Teacher–student interactions using messaging applications were encouraged during COVID (International Task Force on Teachers for Education 2030, 2020).

In Costa Rica, the Ministry of Public Education, the Directorate of Technological Resources for Education and the Directorate of Management Information Systems have implemented a secure collaboration platform between teachers and students. This platform provides access to a helpdesk for information requests and integrated email accounts that allow teachers and students to create work teams, participate in virtual sessions, share teaching materials, and evaluate and create e-portfolios. In August 2020, there were 665,000 active users, and almost three quarters of them were still active when in-person courses resumed in October 2021 (Ripani, 2022).

Teachers use technology to communicate with parents and the community. The REDS International Survey found that during the COVID pandemic, among teachers engaging in remote teaching, more than two thirds of those in India, the Russian Federation, Slovenia, the United Arab Emirates and Uzbekistan, and more than half of those in Burkina Faso, Denmark and Ethiopia, had spent more time communicating with parents than before the pandemic (Meinck et al., 2022). Overall, more interactions with students and parents can help strengthen relationships and improve learning outcomes. But teachers need to learn how to use these tools appropriately and be aware of privacy and security issues when sharing information online.

Overall, evidence on the impact of teacher practices integrating technology on student learning is relatively limited (Allier-Gagneur et al., 2020). Among the 170 studies on technology-based teacher professional development programmes in low- and middle-income countries reviewed for this report, only 5% tried to measure training impact on student knowledge and skills (Hennessy et al., 2023), leaving a gap in the knowledge of how to design such programmes well.

VARIOUS BARRIERS PREVENT TEACHERS FROM MAKING THE MOST OF WHAT TECHNOLOGY CAN OFFER

Teachers face various obstacles when trying to integrate these technology practices and resources into their professional practice. Lack of access to infrastructure is one of them. In 2018, teachers in schools with a lack of digital infrastructure in Organisation for Economic Co-operation and Development (OECD) countries were seven percentage points less likely to feel that they could support student learning through the use of digital technology 'quite a bit' or 'a lot' than their peers in better equipped schools (OECD, 2022a) (**Figure 9.1**). More than half of teachers reported in the T4 survey that inadequate online access had hampered schools' ability to provide quality education. Two in five teachers said they needed to bring their own digital devices to school to compensate for the lack of classroom resources. Almost a third of teachers reported their school only had one computer, laptop or tablet for educational use (Pota et al., 2021).

Teachers in low- and middle-income countries have lower levels of access to devices and software. In Punjab, India, nearly 8 out of 10 teachers reported outdated computers in ICT laboratories and poor internet connections in schools (Singh et al., 2020). The same percentage of secondary school teachers in Isfahan, Islamic Republic of Iran, lacked easy access to software related to their subject. As well, most software on the market is designed in English only and is not adapted to the local culture, which affects how effectively teachers can integrate technology, particularly in literature and the humanities (Esfijani and Zamani, 2020). Teachers with disabilities face higher barriers. In Ethiopia for instance, the absence of assistive technologies, such as screen readers or magnifiers, e-books or word prediction programmes, prevents the full engagement of visually impaired teachers; in fact, there are teachers who may not even be aware of some assistive technologies (Alala, 2022).

Teachers are also often left out of decisions to select new digital technology: 45% of teachers from 94 countries participating in Education International's Teaching with Tech study reported that their unions had not been consulted at all regarding the introduction of new digital technologies, while 29% had been consulted on 'only a few aspects'. At the same time, 57% of respondents indicated that their unions had not been consulted on the digital technology they wanted (Colclough, 2020). When schools and teachers are provided with equipment, teachers should also be supported to use them effectively (Zacarias, 2023): in the United States, schools often purchase expensive software licences but do not invest in teacher training programmes due to budgetary constraints (Kologrivaya and Shleifer, 2022).

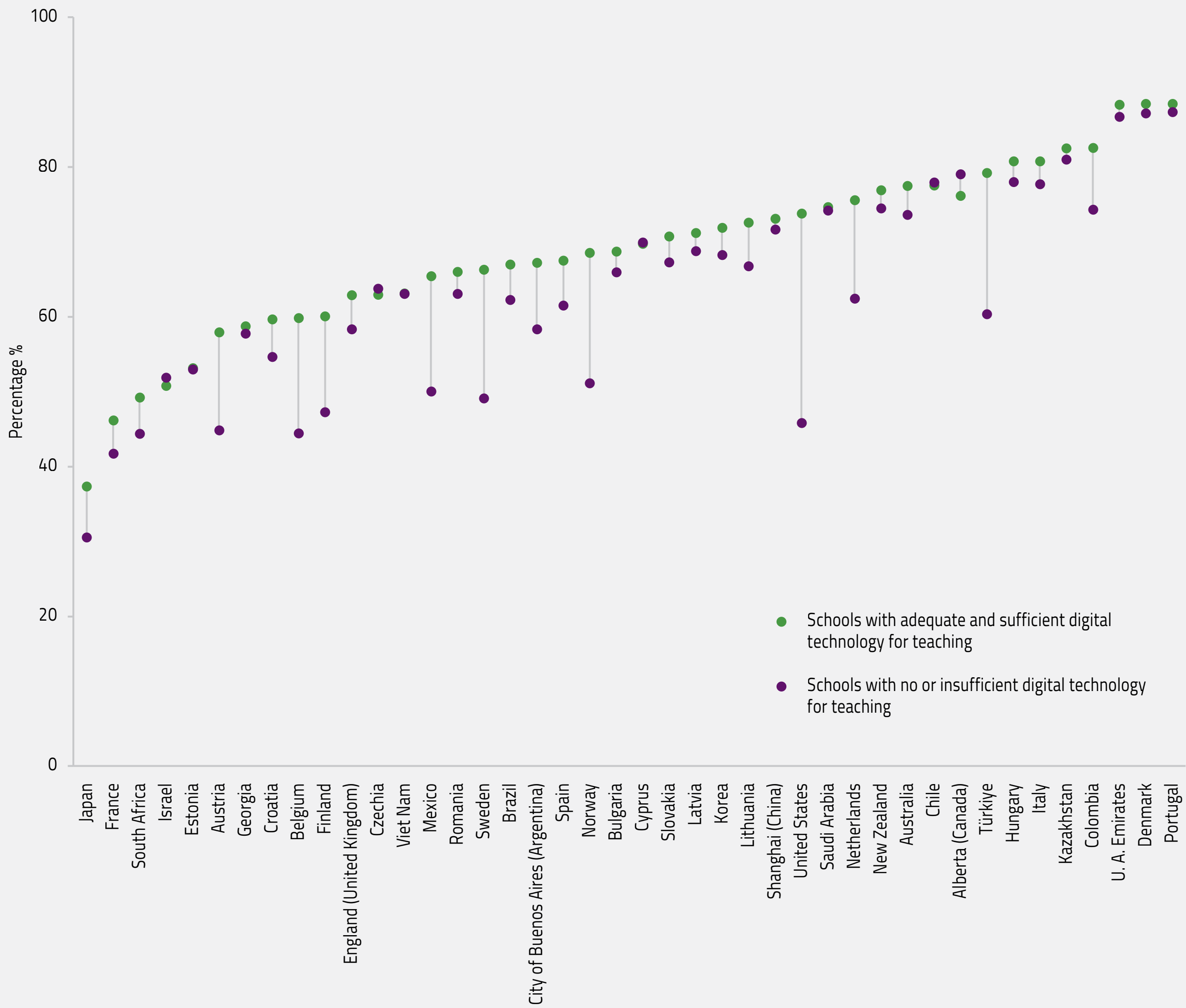
AGE CAN IMPACT TEACHERS' TECHNOLOGY SKILLS AND PRACTICES

It is generally assumed that older teachers possess fewer skills and are less prepared to use technology in teaching. According to the 2018 Teaching and Learning International Survey (TALIS), older teachers in the 48 participating education systems were more likely to have weaker skills and lower self-efficacy in using ICT. This relationship holds true even after accounting for characteristics such as years of experience, contract type, teacher training in ICT use and classroom composition (OECD, 2018). The European Commission's SELFIE tool showed significant age-related differences in the use of digital tools in teaching between younger and older upper secondary technical and vocational education and training (TVET) teachers (OECD, 2021a). In Indonesia, older teachers in Islamic religious schools found it more difficult to keep up with the rapid pace of ICT change, hampering their ability to use different

FIGURE 9.1:

Teachers feel that their teaching is hampered by the lack of digital technology

Percentage of teachers who feel they can support student learning through the use of digital technology 'quite a bit' or 'a lot', by availability of digital technology for instruction, selected education systems, 2018



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Source: OECD (2018).

tools (Miskiah, Suryono, and Sudrajat, 2019). In Sudan, a study of 200 TVET teachers found that older teachers had lower ICT skills in word processing, spreadsheets and databases (Ramadan et al., 2018).

In practice, teachers often rely on their creativity to make up for lack of skills. According to the T4 survey, during the COVID disruption, more experienced teachers deployed more creative strategies than younger teachers, such as integrating video and audio recordings in their teaching. They were also more likely to be the first to adapt and encourage change among their peers (Pota et al., 2021). In India, as part of the Connected Learning Initiative, the most experienced secondary school teachers placed less emphasis on the challenges of technology integration (Connected Learning Initiative, 2020). Background research for this report conducted with 70 teachers from 17 countries showed that teacher resistance to technology was related to preparation, not age. While novice and younger teachers generally know how to use technology, they often have difficulties in integrating it thoughtfully into their teaching practice (Burns, 2023).

Along with age, gender is also sometimes believed to have an impact on ICT skills, as there is the stereotype that female teachers may be less comfortable using technology.

Some gender differences may appear in teacher confidence in using ICT and in their attitudes towards the pedagogical use of ICT, but these are generally neither significant nor consistent across different contexts, at least in upper-middle and high-income countries (Punter et al., 2017).

> Gender is also sometimes believed to have an impact on ICT skills, as there is the stereotype that female teachers may be less comfortable using technology

SOME TEACHERS ARE HESITANT OR LACK CONFIDENCE IN USING TECHNOLOGY

Many teachers recognize the importance of digital technologies in education, regardless of their background, age or skills. Analysis of TALIS and the Programme for the International Assessment of Adult Competencies data from 11 European countries showed a larger variation in teacher technology skills than in their attitudes (Hämäläinen et al., 2021). The REDS International Survey also indicated that most teachers believed that new pedagogical approaches integrating technology would remain in place after the pandemic (Meinck et al., 2022).

However, some teachers are more critical of the use of technology in the classroom. Among grade 8 teachers surveyed in the 2018 International Computer and Information Literacy Study (ICILS), 37% agreed that the use of technology distracted students from learning and 46% that it limited personal communication between students (Fraillon et al., 2020). In Europe, while three out of four lower secondary teachers who took part in a self-assessment of their competencies in technology-enhanced teaching believed that ICT enables students to communicate more effectively with others, develop a greater interest in learning and work at a level that corresponds to their learning abilities, just over half of them thought that ICT improves students' academic performance (Abbiati et al., 2023).

Even when they recognize its value overall, teachers may consider the use of technology to be less suitable for certain subjects or levels of education. In the Netherlands, a study highlighted pre-service teachers' doubts about the use of technology in kindergartens, especially to promote early literacy, as they felt that teaching young children should be based on concrete, not virtual, experiences (Voogt and McKenney, 2017). Negative attitudes may in some cases be related to safety. In India, teachers reported virus attacks, leaks of student data and privacy problems in online teaching (Joshi et al., 2020). In Indonesia, teachers were concerned about using free public Wi-Fi, which compromises data security (Purwanto et al., 2020).

Teachers may lack confidence in using technology to teach. Only 43% of teachers in OECD countries felt well- or very well-prepared for using technology for teaching after their initial education or training (OECD, 2020). Teachers who felt they could support student learning through the use of digital technology 'quite a bit' or 'a lot' were more likely to teach in private than in public schools (OECD, 2022b). According to the 2018 TALIS, the more effective lower secondary school teachers felt in their own use of ICT, the more likely they were to let their students use technology for projects or class work (OECD, 2018). The 2018 ICILS found that 84% of teachers in the 13 participating education systems knew how to prepare lessons that involved the use of ICT by students, while just under 60% knew how to contribute to online discussions, collaborate with others on platforms (such as wikis or blogs) or through shared resources (such as Google Docs), and use a learning management system (such as Moodle, Blackboard or Edmodo) (Fraillon et al., 2020). A knowledge gap with students may also lead teachers to limit their use of ICT in teaching (Spiteri and Chang Rundgren, 2020).

Lack of training is one significant reason that explains this knowledge gap. The 2018 TALIS indicated that one in five lower secondary school teachers in OECD countries expressed a high need for professional development in ICT skills for teaching, making it the second most important area of training after support to learners with special needs (OECD, 2019). This need was confirmed by grade 4 mathematics and science teachers in the 2019 Trends in International Mathematics and Science Study: only 35% and 32%, respectively, reported participating in professional development in this area, the least common of all areas inquired. About half of grade 8 mathematics and science teachers received such training (Mullis et al., 2020). As part of the European Commission's SELFIE tool, less than half of TVET teachers reported that head teachers had discussed with them their professional development needs for teaching with digital technologies (OECD, 2021a).

Access to training is not enough. First, training must be continuously evaluated and responsive to teacher needs. Analysis of countries' policies, plans, strategies and laws on teacher education, as reflected in the Profiles Enhancing Education Reviews (PEER) profiles, shows that key areas are sometimes overlooked: for example, only 21% of countries mention online safety as part of training in these documents. Second, training must be sustainable, a difficult task given the rapid changes that make programmes obsolete. Donor-funded projects do not operate for more than 36 months on average (von Lautz-Cauzanet, 2022). A review of 170 studies on technology-based teacher professional development programmes in low- and middle-income countries showed that one fifth of them focus on time constraints as a challenge to sustainability (Hennessy et al., 2023).

EDUCATION SYSTEMS ARE TAKING STEPS TO HELP TEACHERS DEVELOP THEIR CAPACITY

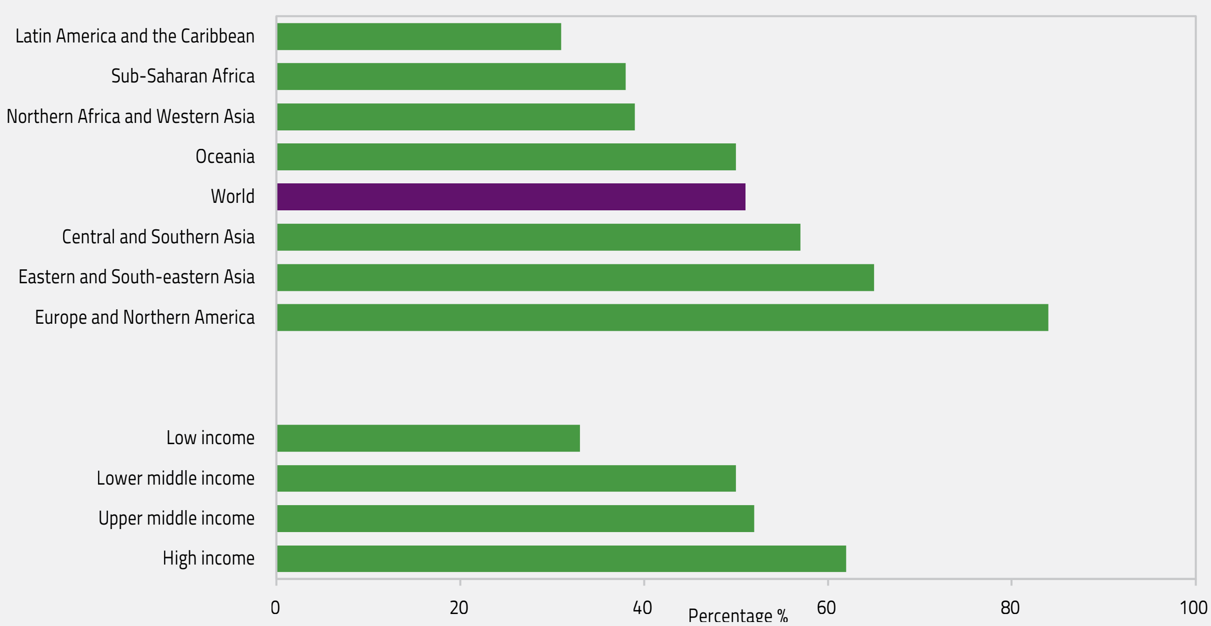
Education systems are responding to help teachers develop professional competence in technology, first and foremost by setting standards. They complement those standards with instruments, such as self-assessment tools (**Box 9.1**), and teacher training programmes. Since the outbreak of COVID, these training efforts have become more organized and structured. More generally, many teacher capacity development programmes are introducing digital elements, which can improve flexibility, collaboration, coaching effectiveness, reflection and subject knowledge. These efforts require multiple actors to be engaged, including head teachers, school ICT coordinators and teacher unions.

ICT STANDARDS FOR TEACHERS AIM TO DEFINE DEVELOPMENT NEEDS

Governments and regional and international organizations have been developing teacher standards and competency frameworks to guide teacher development through training and coaching. According to the GEM Report's PEER for 211 education systems, 51% have set ICT standards for teachers in a competency framework, teacher training framework, development plan or strategy (**Figure 9.2**). European and Northern American countries have been the most proactive. The introduction of ICT standards for teachers began in Europe in the 1970s (Bucherberger et al., 2000) and Latin America in the 2000s (Zacarias, 2023). It is estimated that 19% of countries with ICT standards have specified or readjusted the ICT skills expected of teachers since 2020 to reflect changes brought about by the COVID disruption.

In the Canadian province of Quebec, the 2021 Reference Framework for Professional Competencies for Teachers

FIGURE 9.2:
About half of countries have identified ICT standards for teachers
Percentage of countries with ICT standards for teachers, by region and income level, 2022



GEM StatLink: https://bit.ly/GEM2023_fig9_2
Source: GEM Report team based on PEER.

envisages the use of digital technologies across teacher practices. The 2019 Digital Competency Framework is complementary and conceives digital education as a form of literacy and social practice for which teachers are responsible (Quebec Ministry of Education, 2019). To operationalize these two frameworks, the Ministry of Education has been organizing annual digital education days for teachers since 2019. It has also launched the CompetenceNumerique.ca platform, which allows teachers to develop their digital skills in engaging ways, including through games (Quebec Government, 2020). Since 2021, a digital pedagogy management and leadership training programme, also offered by the Ministry of Education, supports school administrators through school-level digital action plans, to develop their skills to implement measures identified in the frameworks and to improve teacher competencies.

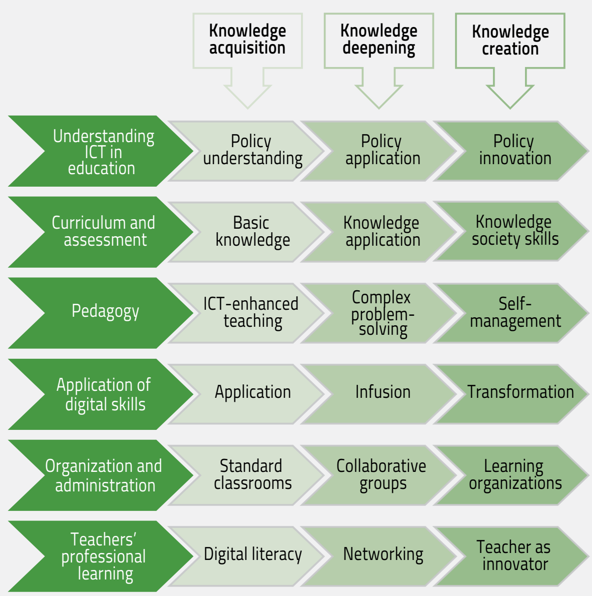
In Spain, the National Institute of Educational Technologies and Teacher Training regulates the digital competence of teachers through the Common Digital Competence Framework for Teachers, adopted in 2017. Building on this framework, the Institute offers a wide range of face-to-face and online training courses and collaborative school projects. It also promotes open educational resources and other support materials for teachers, including applications, platforms, networks and communities of practice that facilitate the exchange of experience and resources between teachers. These initiatives are subject to an annual monitoring report, which lists all the latest training resources published by the Institute as well as the number of certified training activities implemented and teachers trained (INTEF, 2021).

Organizations that have developed ICT frameworks for teachers include the CARICOM Secretariat (Standards for the Teaching Profession), the European Commission (DigCompEdu), UNESCO (ICT Competency Framework for Teachers, ICT-CFT) (**Figure 9.3**) and the World Bank (Teachers' Skills and Skills Frameworks for Remote and Blended Learning Knowledge Pack). Non-governmental organizations have also been active in developing frameworks, including the International Society for Technology in Education (National Educational Technology Standards for Teachers, NETS-T), the Education and Training Foundation (Digital Teaching Professional Framework) and ProFuturo (Global Framework of Competence for Education in the Digital Age – Teacher) (Trujillo Sáez et al., 2020).

Some countries have adopted ICT teacher competency frameworks developed by researchers: for instance, the Technological Pedagogical Content Knowledge (TPACK) (Mishra and Koehler, 2006; Miskiah et al., 2019), the DigiLit Leicester framework (by the Leicester City Council in the United Kingdom and De Montfort University Leicester) and the Competency Profile for the Digital Teacher (Ally, 2019). Background research for this report, which compared DigCompEdu, UNESCO ICT-CFT, NETS-T, Digit Leicester and TPACK, found that the two areas included in all frameworks were professional development and subject teaching and learning. Within these, assessment only appeared twice. This analysis demonstrated the difficulty of creating a set of shared indicators across all contexts (Queen Rania Teacher Academy, 2023).

> Some countries have adopted ICT teacher competency frameworks developed by researchers

FIGURE 9.3:
Teacher training for technology should touch upon various practices in increasing order of complexity
UNESCO ICT Competency Framework for Teachers, 2018



Source: UNESCO (2018).

BOX 9.1:

Self-assessment tools support teachers to identify their development needs

Teachers want to know their strengths and weaknesses in terms of technology applications, and what resources and support they can access that will cater to their individual needs (Burns, 2023). Ideally, measures of teacher skills should be based on external observation, but such instruments are complex and expensive (Tomczyk and Fedeli, 2021). Therefore, these tools are mainly based on teachers' self-assessments or reported practices.

The Centre for Innovation in Brazilian Education (CIEB), a non-profit association aiming to promote a culture of innovation in public education, launched a digital skills self-assessment tool for basic education teachers in 2019. This instrument provides diagnosis in three areas: pedagogy, such as practice, personalization, evaluation and creation; digital citizenship, with a focus on responsible, critical and safe use and inclusion; and professional development, with a focus on self-development, self-evaluation, sharing and communication skills. Guidelines for professional development activities, including those offered by the CIEB, are also proposed to ensure that training is tailored to the profile of teachers (Centre for Innovation in Brazilian Education, 2022).

The Australian Institute for Teaching and School Leadership has developed a self-assessment tool for teachers to evaluate their skills in using technology in teaching. This research-based tool is aligned with national teacher standards. After completing the self-assessment, teachers receive feedback on their strengths and areas for improvement, which can help them identify areas where they may need additional professional development or training. A validation process involved almost 6,000 teachers (AITSL, 2023).

In South-eastern Europe, the Digital Needs Analysis for Teachers Tool, which is based on the European Commission's Digital Competence Framework for Educators (DigCompEdu), has engaged teachers in Albania, Montenegro, Northern Macedonia, the Republic of Moldova and Serbia to self-assess their digital skills. The tool provides a representative picture of teachers' needs by country and by school type. Teachers also reflected on how to integrate the tool into their professional development. Its use has helped policymakers better understand teacher needs, analyse training supply and reflect on the role of data in policymaking, especially on teacher education (European Training Foundation, 2022).

TRAINING EFFORTS HAVE BECOME MORE SYSTEMATIC AFTER COVID

Analysis of PEER profiles shows that only one quarter of education systems have legislation to ensure teacher training in technology, through initial or in-service training. Of these, some make such training mandatory in their legislation, or even define it as a teacher right. In the French-speaking community of Belgium, a 2020 decree stipulates that initial teacher education must prepare teachers to develop a digital culture and to use computer science for educational, pedagogical and didactic purposes (Parliament of the Wallonia-Brussels Federation, 2020). In Croatia, the 2020 Act on Education in Primary and Secondary Schools affirms the right and obligation for teachers to receive professional training in ICT through programmes approved by the Ministry of Education (Croatia Government, 2020). In Romania, the 2022 draft Law on Pre-University Education states that initial and in-service teacher training should focus on the development of digital skills. In-service training should help teachers acquire digital skills and teach with digital tools, new technologies and open educational resources (Romania Government, 2022).

> Only one quarter of education systems have legislation to ensure teacher training in technology

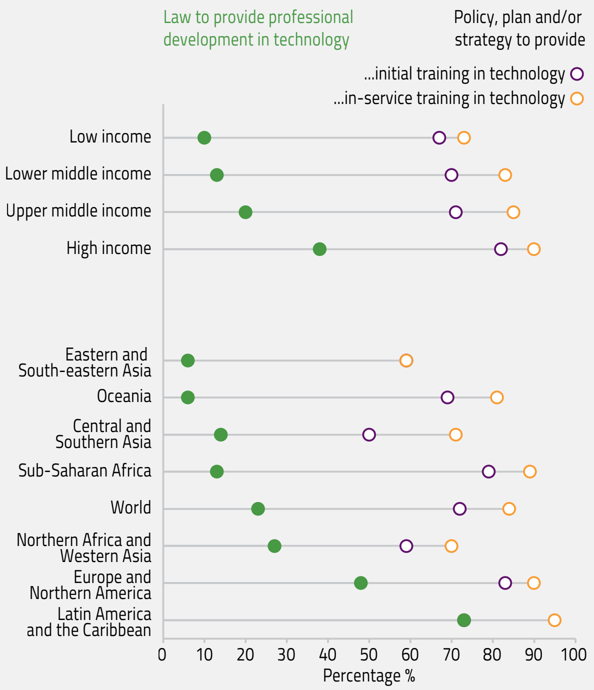
In Chile, the 2016 law on the teacher professional development system mandates teacher pedagogical standards based on the 2003 Good Teaching Framework, which identifies teaching strategies to integrate digital technologies and ensure their safe, ethical and legal use (Chile Government, 2016). In Rwanda, a 2020 Presidential Order, which establishes special teacher governing statutes from pre-primary to vocational education, stipulates that teachers have the right and the duty to take part in capacity-development programmes to improve their expertise and knowledge, including the integration of ICT in teaching and learning.

Globally, 72% of education systems have a policy, plan or strategy for pre-service teacher education in technology, while 84% have one for in-service teacher professional development (**Figure 9.4**).

FIGURE 9.4:

One in four countries has a law and three in four countries have a policy, plan or strategy on teacher training in technology

Percentage of countries that have laws and policies, plans or strategies to provide teacher education in technology, by region, and income level, 2022



GEM StatLink: https://bit.ly/GEM2023_fig9_4
Source: GEM Report team based on PEER.

According to the 2018 TALIS, 56% of lower secondary school teachers in the 48 participating education systems had received training in the use of ICT as part of their formal education or training, ranging from 37% in Sweden to 97% in Viet Nam (OECD, 2020). Meanwhile, 60% of teachers had received training in the use of ICT as part of their in-service training in the 12 months prior to the survey, ranging from 40% in Belgium to 93% in Viet Nam (OECD, 2021b). Apart from Viet Nam, more than three quarters of teachers had received in-service ICT training in Chile, Kazakhstan, Mexico, Singapore, the United Arab Emirates and Shanghai (China) (OECD, 2022a) (**Figure 9.5**). In the European Union, less than half of teachers reported that ICT was included in their initial education or training before the pandemic (European Commission, 2020).

School closures during the COVID pandemic, and the ensuing switch to online learning for many education systems, accelerated efforts to prepare teachers for using ICT. In 2021, 89% of countries reported having provided training on online course delivery through distance learning, the most common teacher support measure, ahead of pedagogical content adapted to distance learning (80%), professional, psychosocial and emotional support (78%) and free connectivity (59%) (UNESCO et al., 2021). By 2022, more than 80% of low- and middle-income countries reported having implemented professional development activities for teachers in digital skills from primary to upper secondary education. The share of countries that had implemented such activities among pre-primary teachers, although lower than for other education levels, rose from 48% in 2020/21 to 62% in 2021/22 (UNESCO et al., 2022). The sample report of the REDS International survey found that most schools in upper-middle- and high-income countries reported having increased teacher professional development on distance education. But fewer schools did so in low-income countries, ranging from 4% in Burkina Faso to 50% in Rwanda (Meinck et al., 2022) (**Figure 9.6**).

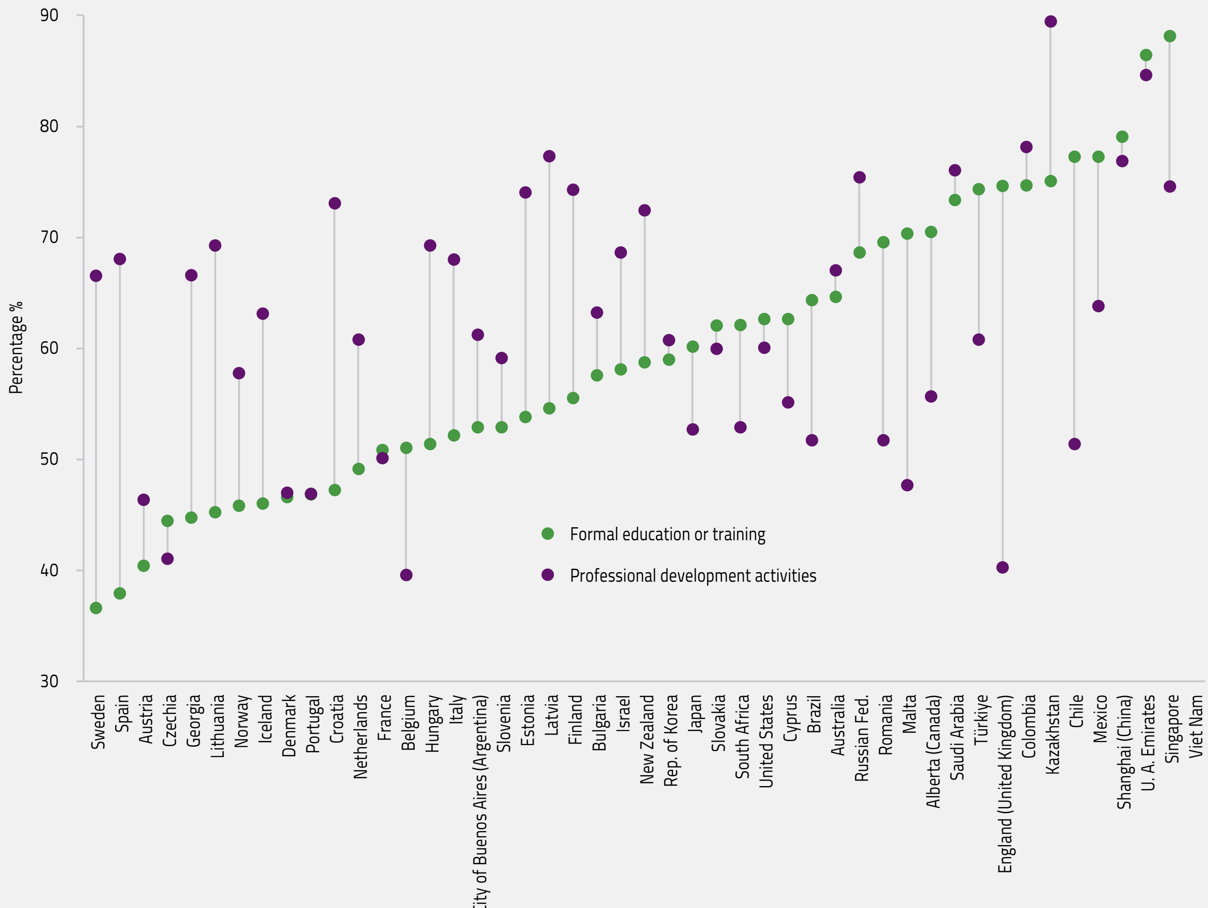
In Indonesia, 44% of primary and lower secondary teachers surveyed by the World Bank had received online training during the pandemic, three quarters of whom had never participated in online training before (Yarrow et al., 2022). According to the T4 education survey, 42% of teachers worldwide spent more than 10 days on professional development in 2020, above the OECD average of 62 hours per year (Pota et al., 2021). About 80% of countries worldwide have reported plans to maintain or expand in-service training in digital skills for primary and secondary teachers, while around 70% of countries reported such plans for initial training as well (UNESCO et al., 2022).

Other ICT-related areas of training may be needed. For example, countries are recognizing the prevalence of electronic cheating in student assessments. Montenegro enacted a law on academic integrity in 2019, while in Ukraine, the 2017 education law provides a clear list of expectations regarding academic integrity (EdEra, 2022). However, it is important to accompany legislation with training in identifying and addressing electronic cheating. A review of available tools suggests that teachers need to exercise critical judgement in using plagiarism detection software, making comparisons and analysing the number of similarities reported, as these programmes do not unambiguously identify cases of plagiarism. Teachers also need to be trained not to violate non-disclosure agreements by uploading students' work to text-matching software (Foltýnek et al., 2020).

FIGURE 9.5:

Teacher training in the use of ICT varies greatly from country to country

Percentage of lower secondary school teachers for whom the use of ICT for teaching was included in their (a) formal education or training (b) professional development in the 12 months prior to the survey, selected education systems, 2018



GEM StatLink: https://bit.ly/GEM2023_fig9_5
Source: OECD (2018).

TECHNOLOGY IS CHANGING TEACHER TRAINING

In addition to training teachers to use technology, the use of technology as a means of teacher training is also increasing in countries, transforming the way teachers can learn. A synthesis of 170 studies for this report showed that the use of technology can make a major contribution to teacher professional development in low- and middle-income countries (Hennessy et al., 2023).

...creating flexible learning environments

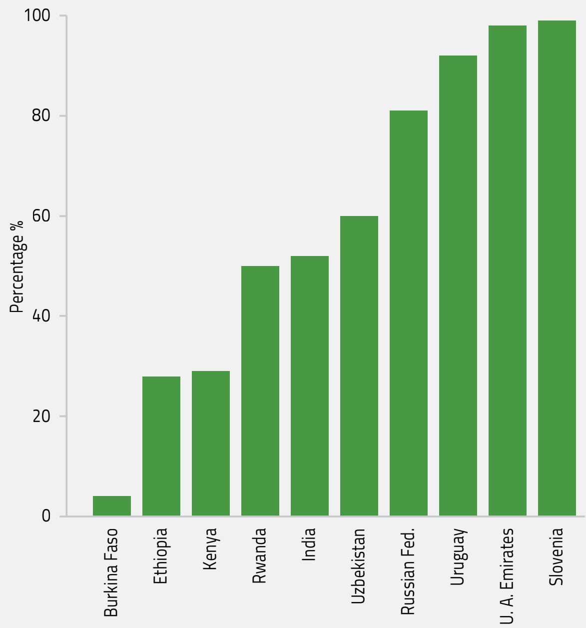
Technology can be a tool to make training opportunities more accessible, helping overcome location and time barriers. Such flexibility also helps teachers choose the pace, location and modality of their learning and, in some cases, even the content and pedagogical approach.

Distance learning, including massive open online courses (MOOCs), and self-study models improve teacher self-efficacy in remote and rural areas, as well as in emergency settings (INEE, 2021). The Distance Learning and Teacher Training Strategies in the Caribbean Small Island Development States project was piloted in 2020 and scaled up in 2021. It is a four-week hybrid training that addressed concerns related to the pandemic, such as engaging and interacting for learning online, converting content into appropriate online learning formats, handling school management issues, and working with students with diverse educational needs (Conover, 2022; UNESCO, 2020). Participating teachers appreciated the use of self-study reading materials that offered opportunities for further self-reflection (Teacher Task Force and UNESCO, 2022). Distance education programmes have been found

FIGURE 9.6:

Almost all schools in richer countries but few in poorer countries increased teacher professional development during the pandemic

Percentage of schools that increased their teacher professional development activities focused on delivering remote teaching, by country, selected countries, 2021



GEM StatLink: https://bit.ly/GEM2023_fig9_6
Source: Meinck et al. (2022).

to promote teacher learning in mathematics in South Africa (Amevor et al., 2021) and even to equal the impact of in-person training in Ghana (Henaku and Pobbi, 2017). But as with other MOOCs, more privileged learners access them (Castillo et al., 2015) and the materials are often developed outside the specific context of the learner.

Blended learning models, involving classroom applications coupled with virtual peer reflection, have also shown to improve teaching practices, for instance in India (Wolfenden et al., 2017). In Kenya, the JiFUNzeni approach encouraged rural teachers to use solar-powered tablets and open source educational resources and software to collaborate in creating context-relevant multimedia learning resources. Teachers were trained to use the tablets and could reach their trainers at any time via mobile phones. Bimonthly face-to-face follow-up meetings provided spaces for teachers to share their experience of using the resources developed in the classroom. Trainers created new ways to support teachers through blended approaches and teachers were still using the strategies they developed a year after the intervention (Onguko, 2014).

...helping teachers engage in collaborative online learning

Whether training is about or through technology, teachers value hands-on, personalized and collaborative training. They want to use technology tools, experiment with different software and devices, and learn about the practical applications of technology in classrooms and its benefits for students. While teachers report that the use of technology in pre-service programmes is often too theoretical (Burns, 2021), they can use technology to learn from each other, share best practices and work together on projects (Burns, 2023).

> “Virtual communities of practice are one promising model for peer learning and resource sharing”

Virtual communities of practice are one promising model for peer learning and resource sharing, especially in the absence of face-to-face communication or subject specialists. In the Flemish Community of Belgium, the KlasCement network, created in 1998, was designed as a ‘community for and by teachers’. It expanded access to digital educational content during the COVID pandemic and provided teachers with a space to discuss best practices for implementing distance education. At the start of the pandemic, more than 22,000 teachers joined this platform, with 500 learning resources shared and more than 50 discussions initiated weekly. This bottom-up initiative was initially conceived and managed by a non-profit organization but is now coordinated by the Ministry of Education (Minea-Pic, 2022).

Virtual communities have emerged, primarily through social networks, for communication (via social networks like WhatsApp) and resource sharing (via video conferencing software like Zoom). About 80% of more than 1,500 teachers surveyed in the Caribbean belong to professional WhatsApp groups and 44% use such instant messaging to collaborate at least once a week. In the United Republic of Tanzania, active teacher collaboration in Telegram-supported teacher groups emerged before the pandemic but strengthened during school closures, as membership expanded to 17,000 teachers. This virtual support mechanism reinforced in-person teacher collaboration and is embedded in teachers’ lives (von Lautz-Cauzanet and Buchstab, 2023). A review of practitioners in emergency settings found that virtual communities of practice were seen as a form of continuous professional development: more than half believed their participation had fostered a sense of community and improved their confidence and well-being (El-Serafy et al., 2023).

In Botswana, 71% of all TVET teachers in the country were trained with the Future Teacher Kit, a tool developed by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and UNESCO. In collaboration with the Botswana Ministry of Education and Skills Development, the programme trained teachers individually via WhatsApp, as well as interactive voice response accompanied by Messenger groups, to exchange information on the training content. All TVET institutions had a focal point to help teachers progress through the training. One outcome is that teachers set up learning circles to continue engaging with each other on the content. It is envisaged that the approach will extend to secondary school teachers (von Lautz-Cauzanet and Buchstab, 2023).

...supporting coaching and mentoring

Experienced teachers play a key role in professional development as coaches and mentors. Technology can facilitate their involvement in providing feedback, observing classes and encouraging younger teachers to follow certain practices. As part of the Estonian mentoring programme, for instance, online mentor seminars, held two to three times a year for those trained in mentorship, management, or intern supervision, also provide counselling and discussions for future plans (Burns, 2023). Coaching software has been used to provide structured observation tools to improve the quality of support. The Tangerine:Coach software provided guided observation protocols to coaches in Kenya and Uganda, automatically generating feedback that coaches can share with teachers. Tablets and software simplified coaches' work and increased their commitment to improve their work (Pouezevara et al., 2019).

Conversely, technology can help teachers access a wider range of expertise and experience than they might find locally. The Inspiring Teachers' Peer Coaching Platform connects volunteer teachers based in the United Kingdom and the United States with teachers in low- and middle-income countries. Workshops are held to share teaching techniques, while practice sessions provide an opportunity for teachers to apply them while facilitating peer observation and feedback. Inspiring Teachers partners with local organizations across 11 countries, reaching more than 5,000 teachers in South Asia and sub-Saharan Africa (Inspiring Teachers, 2022). In Kenya, the Teachers for Teachers initiative in Kakuma refugee camp is led by Teachers College Columbia University. The initiative uses real-time reporting through text messages and email, classroom observations and summaries to organize training and mentoring for teachers. For two to six months, teachers are matched with an experienced global mentor who provides ongoing support (Teachers College, 2022).

Virtual coaching appears to have the same impact on teachers as in-person coaching (Evans, 2021). In the United States, online coaching of teachers has produced similar results to face-to-face coaching (Kraft et al., 2018). In South Africa, face-to-face coaching appears to be equally effective in the short term, although it produces better results in the long term (Kotze et al., 2019), which suggests virtual coaching needs to overcome the challenge of maintaining trusting relationships over time (Cilliers et al., 2022).

Yet virtual coaching often has huge cost advantages. In Senegal, the Reading for All programme reached more than 14,000 teachers in 2020/21 using an ongoing professional development model that included in-person workshops and in-person and online coaching. Teachers receiving any type of coaching were 23% more likely to give constructive feedback, and students had better learning outcomes in reading when their teachers were being coached. While face-to-face coaching improved teaching practices and was considered more useful by teachers, online coaching was still 83% less costly than face-to-face coaching, although it still achieved a small but significant improvement in the way teachers guided their students' reading practice (Bagby et al., 2022; Hennessy et al., 2023).

...increasing reflective practice

Critical self-reflection helps teachers analyse the impact of, and ultimately improve, their instructional strategies. Some technology resources can develop teachers' reflective practices, especially videos but also digital storytelling, e-portfolios and blogging. Videos allow teachers to observe exemplary teachers, to whom they often lack access, or to watch themselves or their peers teach.

The OER4Schools programme in Zambia has integrated video lessons into a multimodal and blended approach to support teachers with an emphasis on inclusion. Learning was guided by built-in prompts for both teachers and facilitators, while materials linked theory to practice. Teachers were able to work together to try new pedagogical strategies. A professional learning resource was developed, consisting of 25 two-hour sessions organized into five units and covering interactive teaching principles, group work, questioning, dialogue, formative assessment and inquiry-based student learning. An evaluation found that teachers who completed the sessions became more responsive to disadvantaged students' needs (Hennessy et al., 2015; Hennessy et al., 2016).

...improving teacher subject and pedagogical knowledge

Technology can be put to service for teachers who need to improve their knowledge of the language of instruction or a second language they teach. Multilingual skills are critical for teachers working in contexts where the language of instruction is not their first language (Zhao et al., 2022). Improving subject and pedagogical knowledge is particularly important for teachers from remote areas who may have more limited access to quality training opportunities. Technology support includes specialist language learning applications, audiovisual materials, lesson plans on preloaded devices, virtual coaching and other tools.

In South Africa, under an intervention of the non-profit organization Funda Wande, teachers received a preloaded USB stick containing lesson plans, classroom videos and teaching materials. This initiative has increased literacy in isiXhosa, led to changes in teacher pedagogical practices and had a significant impact on the reading proficiency of all learners regardless of their initial skill level, in particular grade 1 students (Ardington and Meiring, 2020).

Software applications are commonly used to improve teachers' pedagogical content knowledge, especially in mathematics and science. For instance, used with certain pedagogies and support structures, Geogebra, an interactive application for teaching mathematics, has improved teacher and teacher educator understanding of a range of mathematical concepts (Golding and Batiibwe, 2020). But as with much of this research, studies that control for other determinants of learning are rare and the positive impact may therefore not extend to changing teacher practices.

MANY ACTORS SUPPORT TEACHER PROFESSIONAL DEVELOPMENT IN ICT

With such a broad scope of teacher professional development opportunities in ICT, the ongoing support of several stakeholders is needed (Burns, 2023). This includes head teachers, ICT coordinators, universities, unions, non-governmental organizations and multilateral organizations.

Head teachers play a key role in setting the conditions for the integration of technology in schools. First, they support digital implementation following the expectations set in national plans. In Singapore, the Educational Technology Plan 2020–30 calls on head teachers to adopt a data-driven and learner-centred approach and to develop an environment that supports lifelong learning by integrating ICT at school and at home (Singapore Ministry of Education, 2022). In South Africa, the 2018 Professional Development Framework for Digital Learning requires head teachers to empower the school team in planning and implementing digital learning and to initiate collaborative teacher learning (South Africa Department of Basic Education, 2018). Second, head teachers manage the digital infrastructure. Depending on their degree of autonomy, they may be responsible for purchasing, maintaining and renewing equipment licences. Third, they can create a culture of sharing and experimentation, for example supporting teachers, promoting good practice in the use of digital technology, and recognizing the time spent on digital integration (Gravelle et al., 2020; Gravelle et al., 2021).

> "Head teachers play a key role in setting the conditions for the integration of technology in schools"

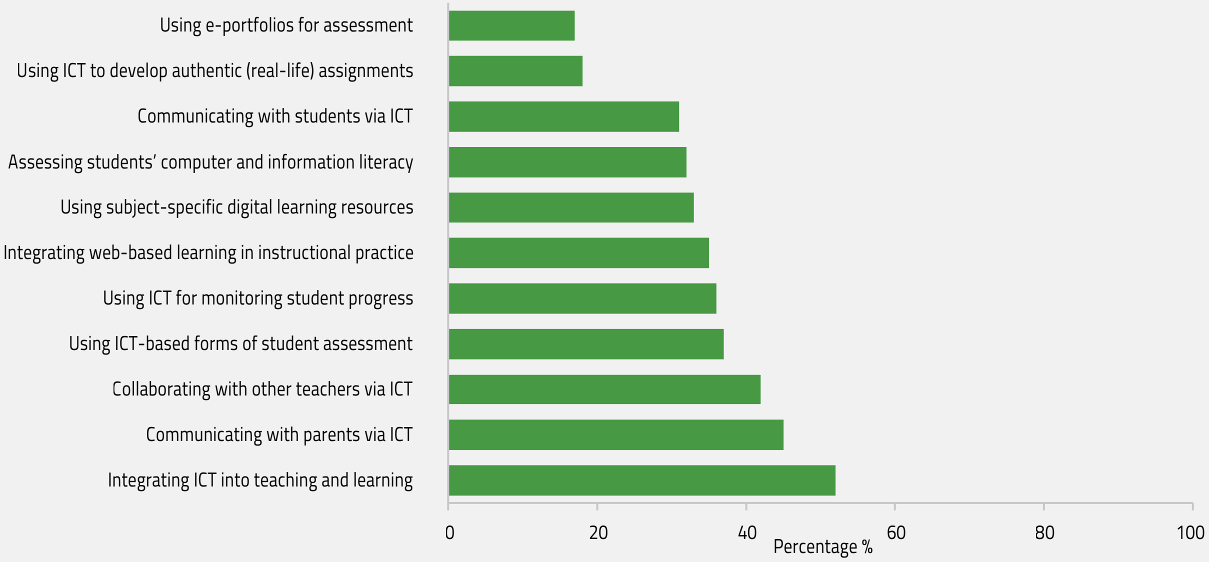
In practice, the level of support which head teachers provide is hard to gauge and varies widely. According to the 2018 ICILS, prior to the pandemic, less than 25% of students attended schools whose head teachers considered it a priority to give teachers time to prepare lessons in which ICT is used, and some 40% of students attended schools whose head teachers considered it a priority to encourage teachers to integrate the use of ICT into their teaching. Head teachers' expectations of teachers in relation to the integration of ICT also vary widely. Almost 45% of students who participated in the 2018 ICILS were in schools whose head teachers expected teachers to communicate with parents through ICT and 31% were in schools with a head teacher who expected teachers to communicate with their students through ICT (**Figure 9.7**) (Fraillon et al., 2020).

A sense of urgency appears to have grown during the pandemic, at least in countries that relied on digital learning. According to the European Commission's SELFIE tool, just over half of upper secondary TVET teachers received support from their school leaders to try out new ways of teaching with digital technologies and to share their experiences with their colleagues during the COVID pandemic (OECD, 2021a). In Malta, a study of the transition to distance education during the COVID disruption showed that head teachers were available and supportive, encouraging staff to work and learn as a team and to communicate with each other. Teachers in schools that received such support from their head teacher were able to build collegiality and effectiveness (Busuttil and Farrugia, 2020).

FIGURE 9.7:

Head teachers have varying expectations of the knowledge expected and required of teachers in relation to ICT-based activities

Students attending schools where head teachers expected and required teacher knowledge regarding ICT-based activities, 13 education systems, 2018



GEM StatLink: https://bit.ly/GEM2023_fig9_7

Note: The participating education systems were Chile, Denmark, Finland, France, Germany, Italy, Kazakhstan, Republic of Korea, Luxembourg, Portugal, Moscow (Russian Federation), United States and Uruguay.

Source: Fraillon et al. (2020).

ICT coordinators provide technical support and professional development, although the scope of their functions varies greatly between schools (León-Jariego et al., 2020). In Spain, ICT coordinators act as internal advisers to facilitate change and as mediators between ICT policy requirements and the school. They help teachers solve problems related to ICT use and encourage the pedagogical use of ICT by teachers and students. A survey of more than 5,000 teachers showed that 77% received support to develop ICT teaching, 58% benefited from ICT training in school and 43% had experienced ICT innovation projects, all organized by ICT coordinators (Moreira et al., 2019). In the United Kingdom, ICT support technicians are responsible for school networks, installing, monitoring and maintaining software and hardware, and providing technical support and professional development to teachers and students. They are also involved in the handling of confidential information, such as health data on teachers and students and confidential information from or for senior management, including budget plans. In addition, they protect the school by maintaining internet filtering (UNISON, 2022).

Some countries set criteria for the selection and professional development of ICT coordinators. In Israel, the Ministry of Education requires them to be teachers with at least four years' teaching experience, to have attended professional development courses in the field of ICT over the past five years, to have a thorough knowledge of the processes of teaching, learning and assessment in an online environment, and to be familiar with the entire curriculum. Furthermore, ICT coordinators are required to follow a 60-hour training programme covering the Technological Pedagogical Content Knowledge framework and change leadership (Avidov-Ungar and Hanin-Itzak, 2019).

Universities, teacher training institutions and research institutes offer specialized training, encourage research and innovation, and partner with schools to support teacher professional development in ICT. In Rwanda, the 2016 ICT in Education Policy envisaged collaboration between universities and teacher training schools to make teaching practices learner-centred. One such collaboration, between the University of Rwanda, teachers and the government, resulted in the development of an ICT course for teachers (Moore et al., 2018).

Teacher unions focus on protecting teachers' rights with regards to technology, advocating for policies that support teachers who face challenges related to technology use.

In 2020, the Confederation of Education Workers of the Argentine Republic reached a collective agreement with the government in response to the work overload created by school closures. The agreement established education workers' right to disconnect and required the Ministry of Education to invest in the provision of technological resources for distance learning (Education International, 2022). In Peru in May 2020, the Ministry of Education issued additional accountability requirements, requiring teachers to submit monthly reports with evidence of their online and distance work. This was questioned by the National Union of Teachers of Peru, leading the government to adjust its guidelines to reduce the administrative workload of teachers (Munoz-Najar, 2022).

Civil society organizations often fill gaps in government provision, in poor and rich countries alike. In Chad, Kenya, Lebanon and Niger, the Carey Institute for Global Good, a non-profit organization, supports refugee teachers in creating open educational resources and online courses (Carey Institute for Global Good, 2021). The Estonian Information Technology Foundation for Education established an information line to answer teachers' technology questions during the COVID pandemic (Barron at al., 2021). In Sierra Leone, Plan International implemented the Girls' Access to Education project between 2013 and 2021, funded by the United Kingdom. The project supported more than 700 young women from rural communities to become primary school teachers through a distance education programme, while also supporting them on days requiring face-to-face training (Saidu et al., 2021). In Ukraine, the Academic Integrity and Quality Initiative offers a free online course for teachers, on academic integrity in assessment and methodological advice on avoiding plagiarism (EdEra, 2022).

Multilateral organizations provide resources, support research, facilitate collaboration and networking, advocate for policies and funding, and provide technical assistance for teacher professional development in ICT. The World Bank's Technology for Teaching programme has developed guides for the implementation of technology-based teacher education programmes directed at policymakers and practitioners (World Bank, 2022a, 2022b). UNESCO has produced a learner-centred taxonomy for teachers to assess the functionality of online platforms with respect to curriculum support, data management, online collaboration between teachers and learners, online teaching, and formative assessment to identify gaps and plan educational strategies (UNESCO, 2020). The UNESCO Institute for Information Technologies in Education develops country-specific materials for trainers to support the integration of ICT into pedagogy, with a particular focus on higher education and TVET (IITE, 2023).

CONCLUSION

Technology is slowly but surely changing the teaching profession. In those education systems where technology is widely available, teachers need to adapt their pedagogy, use multiple resources related to the curriculum and assessment, and interact more frequently with students and parents. COVID accelerated this transformation. Yet, many teachers still lack access to appropriate technology and the necessary infrastructure. Moreover, they have varying attitudes towards the usefulness of technology and varying beliefs about their ability to integrate technology to improve student achievement. Many teachers receive sufficient, appropriate and sustainable teacher professional development. But their participation in decisions that affect them in the planning, implementation, regulation and evaluation of technology in education is generally lacking. Many education systems develop competence frameworks and complementary tools to guide their investments in teacher professional development. The supportive work of many actors who can complement government efforts is a precondition for success in this area.

Working with a wide range of educational practitioners, including teachers, is key to developing education technology policies. Involving teachers and reflecting their experiences at an early stage of policy development will increase teachers' acceptance of technologies and will help make these policies more effective. Ongoing, school-based teacher professional development is critical to build their skills and confidence in using digital technologies. Ideally, such programmes should provide hands-on experience and opportunities for teachers to share experiences and best practices with peers.

Sixteen students from the third cohort at the African Drone and Data Academy (ADDA) in Malawi graduate on Friday 16 July after a five-week online module and another five week in-person module on campus.

Credit: UNICEF/UN0488681/Mvula*

CHAPTER

10

Education and technology development

KEY MESSAGES

Science, technology, engineering and mathematics (STEM) skills are the bedrock of future technology development, but opportunities are unequally distributed.

Technology features in most secondary education programmes in the world.

- Learning about technology can vary in nature and the topics it covers. In Eastern Europe and in Eastern and South-eastern Asia, technology tends to be taught as a specialist, compulsory subject.
- But many education systems have integrated technology across disciplines and also promote it through workshops, projects and other extracurricular approaches.

STEM quality determines student aspirations and achievement.

- A group of upper-middle- and high-income countries allocated 26% of grade 8 instructional time to science and mathematics but increasing that time had no impact on learning. The 2019 Trends in International Mathematics and Science Study (TIMSS) showed that grade 8 students who had access to science laboratories in schools tended to perform better.
- A combination of teacher-directed and inquiry-based approaches led to higher achievement in science. Grade 8 students who reported that instruction was clear also performed better in mathematics and science.

Gender and social identities shape STEM aspirations.

- Women in STEM accounted for just one third of global tertiary graduates in 2016–18. Gender is one of the strongest determinants of the likelihood of pursuing education and careers in STEM. Grade 8 boys were more willing to pursue a mathematics-related occupation than their female schoolmates in 87% of the education systems participating in the 2019 TIMSS.
- Early STEM learning may prevent negative beliefs about mathematics and science from building up. In Colombia, the Pequeñas Aventureras project promotes STEM interest in pre-schools.

Higher education institutions are key to national technological development.

- Higher education institutions support national technological development by preparing researchers through teaching and learning, and by generating knowledge through their own or collaborative research. This role is mediated through their engagement with governments, businesses and society, and their organization and management.
- The most innovative economies tend to have high scores in the university–industry collaboration indicator. Businesses and universities in Israel, Switzerland and the United States exhibited the highest degree of collaboration.
- Performance-based funding to universities aims to stimulate competition, but competitive funding also has downsides. In Japan, it reduced the originality of filed patents.
- Enterprises contribute about 60% of research expenditure, but there are risks that such funding may influence the choice of experimental design, framing questions and analyses, leading to bias.
- Countries compete to attract students into STEM fields through scholarships. Since 2006, STEM education has accounted for almost 30% of global scholarship recipients.

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This report focuses on the impact that technology has on education. Yet, the reverse also merits investigation: the impact that education has on technology. How does education impact the process of developing, transferring and adopting technology, especially as related to science, technology, engineering and mathematics (STEM) disciplines? While the past and future impact of technology on education is still being debated, there is no doubt that there is no technological development without the sharing of knowledge over generations, the individual pursuit of advanced education opportunities, and organized research in higher education institutions leading to technological innovation.

This chapter presents selected aspects of education's contribution to technology. First, the chapter examines the provision of STEM education in secondary school curricula. In particular, it looks at how it is delivered and whether it is associated with students' interests and eventual outcomes, reflecting on opportunities to promote equity in STEM aspiration and choices. Second, it looks at how post-secondary education institutions contribute to technological development through teaching and research, evolving their strategies to remain relevant and well resourced.

TECHNOLOGY FEATURES IN MOST SECONDARY EDUCATION PROGRAMMES

Learning about technology has been gradually introduced into general school curricula (de Vries, 2018b), and is being taught in most educational systems in the world (Keirl, 2018). However, there is great variation across countries in what methods are used to teach technology, and how important its role is. Technology education can be taught as a stand-alone subject, or integrated across disciplines (Keirl, 2015, 2018). It can be compulsory or elective, and be taught in various grades.

TECHNOLOGY CAN BE TAUGHT AS A STAND-ALONE SUBJECT

As a stand-alone subject, technology has been conceived as skills and craft education, industrial arts, or as vocational training. Its content remains highly contextualized, responding to various national strategies and cultural contexts (Buntting and Jones, 2015; de Vries, 2018b).

In some cases, teaching technology covers design thinking, generally conceived as a problem-solving approach that focuses on collaboration between designers and users. For example, Botswana's senior secondary curriculum includes a design and technology subject whose content ranges from health and safety to design tools and processes. It was reformed in the early 2000s to also include graphics, information technology and electronics (Ruele, 2019). In the United Kingdom, the 2013 National Curriculum for England introduced design and technology studies targeting 5- to 14-year-olds. The subject drew on mathematics, science, engineering, computing and art, and even included a module on cooking and nutrition (McLain et al., 2019; Department for Education, 2013).

Technology education can be closely tied to vocational studies. In Scandinavia, the acquisition of skills to use manual tools and machines has historically found its expression in slöjd (craft) education (de Vries, 2018b). Technology education was eventually added to the general education track, despite maintaining a strong vocational orientation. Sweden's 2011 compulsory curriculum emphasizes the handcraft nature of technology education as a form of design and cultural expression (Hallström, 2018).

> Globally, with the growing relevance of digital technology, computer science education has been introduced as a specialist subject in many compulsory education curricula

The subject also varies in whether it is compulsory or optional. Globally, with the growing relevance of digital technology, computer science education has been introduced as a specialist subject in many compulsory education curricula (**Chapter 5**). Eastern European and Eastern and South-eastern Asian countries tend to require all students to follow a specialist technology subject such as computer science education (Vegas et al., 2021). All primary and secondary school students in Poland have been taking informatics as a compulsory subject since 2015 (Webb et al., 2017). In the same year, the Republic of Korea also made informatics a compulsory course in lower secondary school to provide all students with a basic understanding of computational thinking (Fraillon et al., 2020). In Viet Nam, the 2018 reform of the national curriculum introduced information and communication technology (ICT) as a compulsory subject for grade 3 to 9 students, who are taught foundations of digital technology and computer science (Le Anh et al., 2023).

In Germany, technology education and foreign languages are alternative options in Realschule, a type of lower secondary school which typically leads to vocational education. Since having a command of another language is a requirement to access upper secondary education, languages are preferred over technology by students who want to pursue higher education. Technology education tends to be selected by those who intend to pursue a vocational track (Mammes et al., 2016).

TECHNOLOGY CAN BE INTEGRATED ACROSS DISCIPLINES AND TAUGHT OUTISDE THE CURRICULUM

Technology studies are sometimes integrated into the disciplines of science, engineering and mathematics (Buntting and Jones, 2015; Keirl, 2018). The United States followed an interdisciplinary approach towards technology education. Drawing on the tradition of industrial arts, the study of technology was universalized through the Technology for All Americans project, which was sponsored by the National Science Foundation and the National Aeronautics and Space Administration in the 1990s, and informed the development of comprehensive standards for student technological literacy, assessments and teacher professional development (Reed, 2018).

An integrated approach to STEM studies is now endorsed by many education systems (Freeman et al., 2019; Teo et al., 2021). Malaysia has a STEM framework that covers all levels, from pre-primary to tertiary and adult education. A project- and inquiry-based approach informed the revised school curriculum, and advocacy campaigns were organized to encourage youth to enter STEM studies in tertiary education (Chong, 2019; Malaysia Ministry of Education, 2013).

However, the interdisciplinary nature of STEM may challenge pedagogies based on single disciplines. Mathematics and science are usually taught as separate subjects at primary and secondary level; technology is traditionally a priority in vocational education; and engineering is largely provided in higher education (Holmlund et al., 2018). An analysis of Australia, England (United Kingdom), Estonia, Hong Kong (China), South Africa, Türkiye and the United States introducing engineering into primary and secondary science standards shows differences in how disciplines are understood and taught. The United States, and to some extent Türkiye, explicitly include engineering through primary and secondary education science standards (Ekiz-Kiran and Aydin-Gunbatar, 2021).

In addition to including STEM subjects in the curriculum, they can also be promoted through workshops, projects and other extracurricular approaches. Activities outside school provide more contextual and flexible learning experiences than those defined by the curriculum. Visions of Science Network for Learning, a non-profit organization, organizes weekly community science clubs in the Greater Toronto Area, Canada, offering experiential learning to 8- to 14-year-olds through workshops, field excursions and real-world applications (Duodu et al., 2017). The South Dakota State University's Civil and Environmental Engineering Department promotes culturally responsive activities to attract Native American girls to their study programmes. The project combines indigenous arts and crafts with STEM content. Results show that role models and a clearer link with the community's traditions led to a positive association with STEM studies (Kant et al., 2018).

STEM QUALITY DETERMINES STUDENT ASPIRATIONS AND ACHIEVEMENT

Countries strive to expand and improve school curricula to attract more students to STEM subjects and provide them with relevant knowledge and understanding. However, low aspirations to STEM studies and careers do not only reflect a genuine lack of interest in those subjects (Archer et al., 2020). Aspirations can be shaped by prior academic achievement, gender and social identities, and socioeconomic inequalities, which often intersect (Holmes et al., 2018).

INSTRUCTION TIME IS NOT ALL THAT MATTERS

Countries differ in the emphasis they place on STEM subjects. The 2019 Trends in International Mathematics and Science Study (TIMSS) showed that participating education systems, mostly from upper-middle-income and high-income countries, allocated an average of 26% of total grade 8 instructional time to science and mathematics. The number of hours for mathematics ranged from 102 in Cyprus to 200 in Chile, while science, when taught as a separate subject, ranged from 73 hours in Italy to 243 in Lebanon. Time allocation varies across education levels. With grade advancement, time tends to decrease in mathematics and increase in science (Mullis et al., 2020a).

Mathematics can be considered particularly difficult. In France, 40% of grade 11 students abandoned mathematics while transitioning to grade 12, following a 2018 reform that allowed them to choose specialization subjects (France Ministry of National Education and Youth, 2021; Lecherbonnier, 2022; Morin, 2020). The government reintroduced 1.5 hours of mathematics per week for all students without mathematics as a core subject in grade 11, concerned that inequality in achievement would be exacerbated without mathematics instruction (France Ministry of National Education and Youth, 2022).

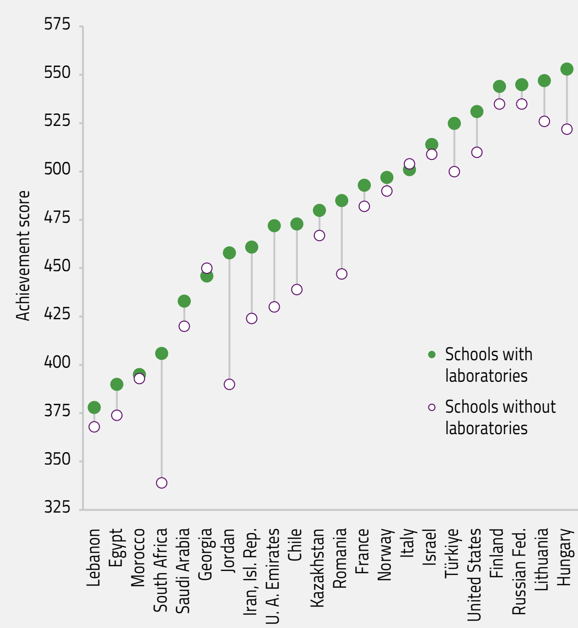
In principle, more instructional time dedicated to mathematics and science should lead to more knowledge and a better understanding of STEM fields. However, in practice, the relationship between time invested and learning achievement is not clear. Among education systems that took part in the 2018 Programme for International Student Assessment (PISA), 15-year-olds in Finland, who are taught science for about 2 hours and 45 minutes per week, reported similar scores as their peers in Canada, who are taught for more than twice that time. Among countries of the Organisation for Economic Co-operation and Development (OECD), Chilean students received the most instruction time in science, but perform below the OECD average. Most of the top performing education systems in mathematics tend to offer fewer than four hours per week (OECD, 2020a).

For more instruction time to lead to better results, it is critical that time be used efficiently and concepts taught effectively (Lopez-Agudo and Marcenaro-Gutierrez, 2022). Poor mathematics and science results in the Programme for International Student Assessment (PISA) led Portugal to allocate more teaching hours to Portuguese, mathematics and science as well as to increase school autonomy and strengthen initial teacher training. Implemented since 2013/14, these reforms have been associated with improved student performance in the two more recent PISA rounds (Maróco, 2021).

FIGURE 10.1:

Access to a laboratory is associated with higher student achievement in science

Grade 8 student achievement in science, by school laboratory availability, selected countries, 2019



GEM StatLink: https://bit.ly/GEM2023_fig10_1

Note: In the selected countries, up to 97% of schools have science laboratories. Data for South Africa and Norway refer to grade 9 instead of 8.

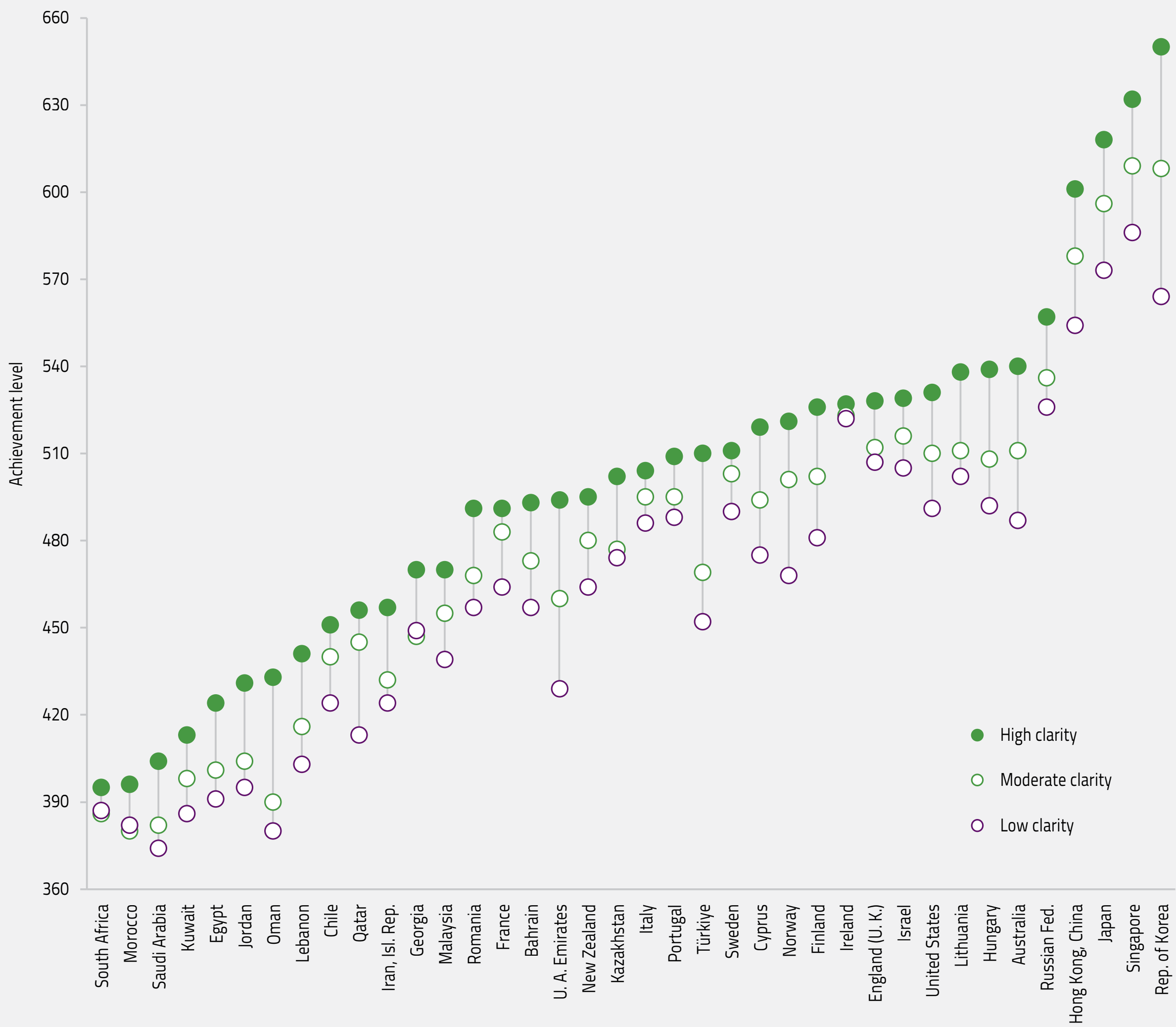
Source: 2019 TIMSS.

FIGURE 10.2:

Students perform better if mathematics and science are taught clearly

Grade 8 student achievement, by self-reported clarity of teaching, selected countries, 2019

a. Mathematics



GEM StatLink: https://bit.ly/GEM2023_fig10_2
Note: Data for South Africa and Norway refer to grade 9 instead of 8.
Source: 2019 TIMSS.

A combination of teacher-directed and inquiry-based approaches in science practices lead to higher science achievement (Mourshed et al., 2017). According to the 2019 TIMSS, grade 8 students in schools with science laboratories tend to perform better than their peers in schools without them (**Figure 10.1**). One of the largest gaps in science performance is observed in South Africa, where more than half of students are in schools without laboratories (Mullis et al., 2020a). Adequate laboratories have high costs for their establishment and maintenance that many countries cannot bear (Ofori Antipem, 2019).

TEACHER PREPARATION AND PRACTICE AFFECT STEM ACHIEVEMENT AND ATTITUDES

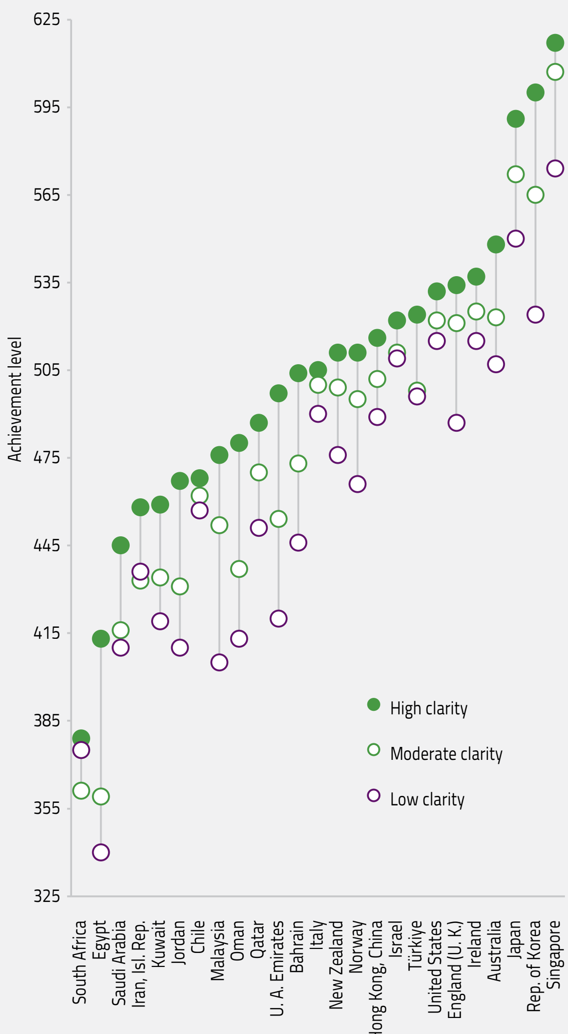
Introducing technology into the curriculum should be accompanied by adequate teacher training and professional practice. Recruiting and retaining qualified teachers in technology-related subjects remains challenging. In New Zealand, technology is one of the disciplines with the largest shortage of qualified teachers (Reinsfield and Lee, 2021). To attract more students, the University of Waikato reconceptualized pre-service training for secondary technology teaching and also

FIGURE 10.2 CONTINUED:

Students perform better if mathematics and science are taught clearly

Grade 8 student achievement, by self-reported clarity of teaching, selected countries, 2019

b. General and integrated science



GEM StatLink: https://bit.ly/GEM2023_fig10_2

Note: Data for South Africa and Norway refer to grade 9 instead of 8.

Source: 2019 TIMSS.

extended admission to students with a vocational background. In 2021, applications increased compared with previous years (Reinsfield and Lee, 2022).

Education systems in high-income countries report qualified teacher shortages in STEM disciplines (European Union, 2018; Sims and Jerrim, 2020). There is often a high demand for professionals with such expertise in other sectors, which offer better remuneration packages and working conditions than teaching (OECD, 2018c). Teacher shortages lead countries to consider employing personnel with qualifications and preparation not specifically related to STEM (UNESCO, 2021a), and out-of-field teaching is a worldwide practice. In at least 40 countries, over 10% of lower secondary science teachers did not receive any formal education or training in the subject (OECD, 2018e). In 27 education systems, an average of nearly half of grade 8 students were taught mathematics by teachers without a major in the subject (Mullis et al., 2020b).

The teaching experience of science professionals may be relevant, as the ability to teach complex content with clarity and the use of appropriate instructional materials and pedagogical approaches impacts student performance (Taylor et al., 2020). In the 2019 TIMSS, when asked how easy it was to understand teachers, and whether teachers were available to explain and support their learning, less than half of grade 8 students evaluated the instructional clarity of their mathematics and science classes as highly satisfactory. Those most satisfied with instructional clarity performed better than students reporting moderate or low instructional clarity in both mathematics and science (Mullis et al., 2020a) (**Figure 10.2**).

Another study using 2015 TIMSS data assessed the impact of subject-specific teacher qualifications on student achievement using the variation in student test scores across four science subjects (biology, chemistry, physics and earth science). Teachers having subject-specific qualifications was associated with a positive impact on test scores, and was even higher for disadvantaged students and female students, in the latter case compounded if the teacher was female. It was found that a fifth of the effect was the result of teacher confidence (Sancassani, 2023).

Out-of-field teaching may influence student engagement and disposition. In Australia, where one in three secondary mathematics classes are delivered by non-specialist teachers, there has been a negative impact on student choices to engage in post-secondary STEM studies. Enrolments in advanced mathematics courses have steadily worsened with the ongoing employment of non-specialists (Prince and O'Connor, 2018). In the United States, an evaluation of projects funded by the National Science Foundation's Discovery Research

> “Education systems in high-income countries report qualified teacher shortages in STEM disciplines”

BOX 10.1:

Career counselling and guidance can raise student STEM aspirations

Providing young people with relevant information about education and job opportunities can help challenge existing career stereotypes. Research on the impact of career counselling has found that receiving guidance is also associated with positive academic achievement (Hughes et al., 2016).

Some countries have made considerable efforts to raise STEM career awareness. Since 2019, Canada has invested about USD 11 million to support the activities of the non-profit Let's Talk Science, which promotes STEM educational and occupational opportunities to teachers and students up to grade 12 through STEM career profiles and models (Let's Talk Science, 2022). In Kenya, Safaricom, a telecommunications company, launched a digital mentorship programme for secondary school students in partnership with UNESCO and the Eneza Foundation. Students receive information on STEM studies and career pathways from mentors and role models through local television and radio channels, and text messages (Safaricom, 2020).

Counselling and guidance services expose youth to pathways they would have not otherwise considered (Musset and Kureková, 2018). Role models and mentors have proved to increase girls' confidence in STEM and to influence their career aspirations (Hencke et al., 2022). Since 1995, Botswana has encouraged young women to pursue a career in science and technology fields through a job-shadowing career programme in collaboration with employers' organizations. This approach may have contributed to the significant increase in the female enrolment rate in STEM higher education of the past decades (Mokgolodi, 2020).

Not all career counselling has a positive influence on reversing students' traditional choices. In the Netherlands, teaching staff and school career advisers tend to persuade more boys to choose STEM careers than girls, who sometimes even receive recommendations against doing so (UNESCO and UNESCO-UNEVOC, 2020).

PreK–12 programme also found that teachers with limited preparation and command of science content are less likely to support children's interest in the discipline (Ferguson et al., 2022; Mader, 2022).

MULTIPLE OBSTACLES NEED TO BE OVERCOME TO IMPROVE STEM ASPIRATIONS

Children and youth often develop negative attitudes towards mathematics and science during their school years (Tytler et al., 2019). Encouraging student interest is critical for future education and career choices. In almost all countries participating in the 2015 PISA, students were more likely to opt for a science-related career and enrol in a post-secondary STEM programme if they achieved a higher science score and if they perceived learning science as useful. While more time in science subjects is not necessarily associated with higher achievement, it is nevertheless linked with higher student interest in jobs in science and engineering. On average, less than one in four 15-year-old students from OECD countries expected a career in STEM (OECD, 2016a). Career counselling and guidance can help raise students' aspirations to continue study and search for work in STEM fields (**Box 10.1**).

Gender and social identities shape STEM aspirations

Gender is one of the strongest determinants of the probability to pursue STEM studies and careers, and this gender divide manifests at a young age. Grade 8 boys were more willing to pursue a mathematics-related occupation than their female schoolmates in 87% of the education systems participating in the 2019 TIMSS. Girls do not opt for STEM careers even when they are among the top performers in mathematics (Hencke et al., 2022). These gaps become entrenched in post-secondary education (**Box 10.2**).

> "Girls do not opt for STEM careers even when they are among the top performers in mathematics"

Beliefs and dispositions towards mathematics and science limit girls' and women's STEM aspirations, much more than their performance (DeWitt et al., 2013). It is important to note that girls achieve the same learning results before they develop the idea that they are not good enough in mathematics. They start to show less motivation towards STEM subjects, particularly in lower secondary education. This gap is subsequently widened, and results in girls feeling less confident in their capacities – which widens the gap between them and their male peers even more (Kuhl et al., 2019). In all participating education systems in the 2019 TIMSS, boys reported being significantly more confident in mathematics than girls, with the exception of Bahrain and Egypt (Hencke et al., 2022).

Schools perpetuate gender stereotypes. In Latin America, between 8% and 20% of mathematics grade 6 teachers reported believing that their subject is easier for boys (Treviño et al., 2016). In Greece and Italy, teachers holding strong implicit gender stereotypes negatively affect girls' scores in tests, challenging students' self-confidence and impacting their future academic choices (Carlana, 2019; Lavy and Megalokonomou, 2019).

Girls' motivation and confidence in STEM fields are also influenced by their peers' expectations, especially during adolescence. Attitudes of other girls are significant predictors of interest and confidence in both mathematics and science (Dasgupta and Stout, 2014; Robnett, 2013). Young women may be discouraged from taking STEM subjects if their peers view these subjects as inappropriate for girls (Robnett and Leaper, 2013). In Denmark, a study on the gender composition of secondary school peers in the mathematics track showed that having a mother who is STEM-educated helped mitigate potential negative peer effects (Brenøe and Zölitz, 2020).

Students from socioeconomically disadvantaged backgrounds also tend to be less willing to pursue educational and professional careers in science and mathematics, even if they achieve good learning outcomes. High achievers from socioeconomically disadvantaged households in OECD countries are nearly four times more likely to aspire for jobs that do not rely on technology and are at risk of automation (Mann et al., 2020). A survey in England, United Kingdom, conducted between 2009 and 2018 showed that 17- to 18-year-old students from the least privileged households were 2.5 times more likely not to study physics, chemistry and biology than their most socioeconomically privileged peers (Archer et al., 2020).

BOX 10.2:

Women are underrepresented in STEM fields in post-secondary education

The various influences that put girls off STEM subjects in compulsory education are crystallized in the education pathways they pursue once their compulsory education is complete. In 2016–18, women in STEM accounted for only 35% of tertiary education graduates globally (**Figure 10.3**). In 15 out of 94 countries, at most one in four graduates were female, including in high-income countries – for example Chile, the Republic of Korea and Switzerland. By contrast, women constituted more than half of total graduates in six countries, including Algeria, Oman and Tunisia. The perpetuation of social gender biases and stereotypes is a global phenomenon (Hammond et al., 2020), but the high share of women choosing STEM in some countries may be explained by the fact that women, despite risks, may have a greater incentive to take up STEM careers where there are fewer economic opportunities (McNally, 2020).

Within STEM fields, however, there are clear distinctions. Women represented an average of 28% of engineering, manufacturing and construction tertiary graduates and 30% of ICT tertiary graduates, but 57% of natural sciences, mathematics and statistics graduates – and more than 80% in Bahrain, Maldives and the United Arab Emirates.

Female students who choose to study in a male-dominated STEM field often experience discrimination and stereotypes, which may precipitate dropout. In Cabo Verde, Congo, Kyrgyzstan and Malaysia, women are more likely to drop out of STEM faculties. In Kyrgyzstan, the share of females enrolled in engineering, manufacturing and construction was 34% in 2018, but only 18% completed the programme.

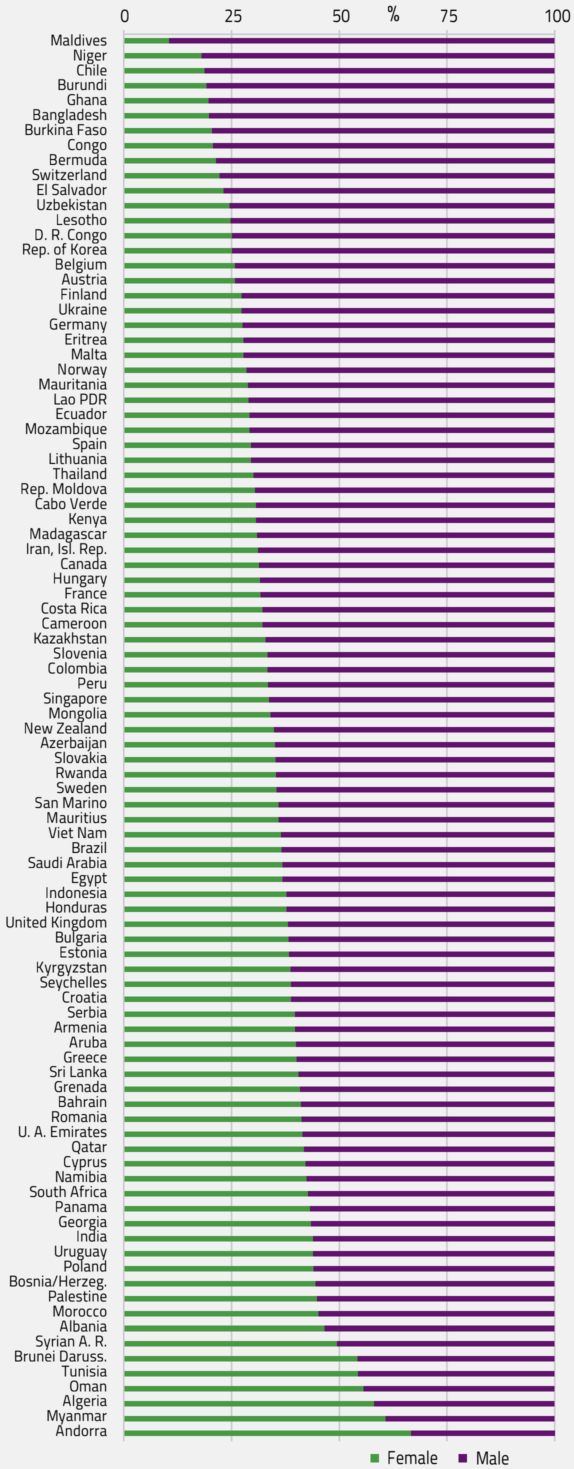
Even with equivalent qualifications, women are less likely to find relevant technology-related jobs. In OECD countries, fewer than one in three fully employed STEM researchers are women (OECD, 2019d). In the 20 leading economies, women represent 26% of employees in data and artificial intelligence, 15% in engineering, and 12% in cloud computing (WEF, 2020). In the European Union, one in four women with a degree in information technology work in digital occupations, compared with more than one in two men. In India, no more than 30% of women work in computer science despite a tertiary enrolment rate in technology studies of 45% (UNESCO and EQUALS Skills Coalition, 2019).

Women are also less likely to be involved in collaborations that lead to innovation, and female researchers are less likely to register patents: in 2020, only 16.5% of patent applications were filed by women globally (Kersten and Athanasia, 2022).

FIGURE 10.3:

Just one third of tertiary STEM graduates are women

Females as a share of all tertiary STEM graduates, selected countries, 2016–18



GEM StatLink: https://bit.ly/GEM2023_fig10_3

Source: UIS database.

Belonging to ethnic and linguistic minorities can also affect STEM achievement and aspirations. In the United States, Black and Hispanic students tend to underperform in mathematics and science compared with White and Asian students. This increases the probability that they choose less academic education tracks and opt out of STEM courses in secondary school (Alvarado and Muniz, 2018). Analysis of the nationally representative High School Longitudinal Study has shown that ethnicity is a significant determinant of developing and maintaining STEM aspirations, especially when combined with gender and socioeconomic factors. All girls, and Black and Hispanic boys from a poor socioeconomic background are the least likely to show an interest in STEM education and occupations (Saw et al., 2018).

Early exposure to STEM has a positive impact on student attitudes

Beliefs about, and a disposition towards, STEM subjects are established in early childhood. They tend to remain stable throughout adolescence, which is the time by which STEM programmes are generally integrated into the education system (Archer et al., 2020). Some countries have integrated STEM studies at lower education levels to leverage children's natural predisposition to exploration and experimentation, which can strengthen student confidence in learning (Campbell et al., 2018).

> Some countries have integrated STEM studies at lower education levels to leverage children's natural predisposition to exploration and experimentation

Drawing on the well-established Haus der kleinen Forscher (Little Scientist's House) programme in Germany, Australia introduced the Little Scientists project in the state of New South Wales in 2013 to promote STEM learning among 3- to 6-year-olds. Educators were trained to teach STEM through play-based experiences, and to stimulate children's self-directed exploration and positive disposition towards scientific subjects (MacDonald et al., 2020; MacDonald et al., 2019). The Little Scientists project has also been implemented in Thailand since 2010, in collaboration with the Princess Maha Chakri Sirindhorn Foundation, where children are engaged in hands-on science activities using cheap and easy-to-find materials. As of 2020, the project had reached over 29,000 schools and 232 networks (East-Asia Association for Science Education, 2021; Promboon et al., 2018).

Children who familiarize themselves with analogue and digital tools learn progressively how to use various instruments, apply them in exploring their environment, and find their own methods and instructions (Early Childhood STEM Working Group, 2017). Sweden's preschool curriculum (Läroplan för Förskolan), revised in 2018, aims to develop children's ability to identify and explore technology and to create using different techniques and tools by drawing on children's curiosity and interest (MacDonald and Huser, 2020; Swedish National Agency for Education, 2018).

Early STEM learning is also found to help overcome student gender stereotypes and biases towards mathematics and science. In 2019, the Colombian Institute for Family Wellness launched the Pequeñas Aventureras (Little Adventurers) programme in collaboration with the Sesame Workshop and the support of Dubai Cares and the Interamerican Development Bank. Targeting 4- to 5-year-olds, the project draws on the principle that boys and girls have the same potential in STEM if they are not exposed to gender stereotypes. Implemented in 661 community-based preschool programmes, mothers are trained on the use of a digital toolkit, including teaching guides, tutorials, computer games and interactive posters, to teach their children STEM-related concepts. Preliminary evaluation results showed that the initiative reduced gender as well as race stereotypes among instructors and contributed to raising children's interest in STEM (Inter-American Development Bank, 2022; Naslund-Hadley and Hernández-Agramonte, 2020).

HIGHER EDUCATION INSTITUTIONS ARE KEY TO NATIONAL TECHNOLOGICAL DEVELOPMENT

In the triple helix theory of innovation (Etzkowitz and Leydesdorff, 1995), universities, governments and businesses take part in research, development, financing, application and the commercial use of ideas (Ivanova et al., 2018; Piqué et al., 2018). Higher education institutions play two key roles supporting national technological development (UNESCO-IESALC, 2023). First, they prepare and develop professional researchers through their teaching and learning activities (Boulton and Lucas, 2011; Maes, 2010). Second, they generate knowledge, which forms the basis for developing technology and innovation, through their own research activities or in partnership with other actors (Geschwind et al., 2019; Matherly and Tillman, 2015). Research production has continued to grow (**Box 10.3**). The role of higher education institutions in the promotion of national technological development is mediated through two functions: their engagement with governments, businesses and society; and their organization and management (UNESCO-IESALC, 2023).

Higher education institutions around the world are increasingly making more decisions on study programmes and research portfolios, implementation of quality standards (Mittelstrass, 2020), recruitment, promotion and remuneration of researchers, and the establishment of legal entities and external partnerships (Cervantes, 2018; OECD, 2019e). In many, though mainly high-income countries, their governance has been changing in recent years, gradually leading to more independence. In the context of national and cross-national competition for funding and talent, higher education and research institutions have strengthened their executive leadership and management structure. They have adopted a more entrepreneurial approach, developing strategic objectives and embracing performance-based management (Benneworth, 2019). They are building their brands and reputation to gain resources and status (Huisman and Stensaker, 2022), formally measured through quantitative indicators and standardized processes that compare teaching and research activities across institutions (Musselin, 2018).

Higher education institutions increasingly cooperate with companies in knowledge creation and technology development (Ivanova et al., 2018). They engage in basic research to expand the stock of knowledge but need partners to apply their research and leverage technological progress. They are therefore seeking new funding mechanisms more and more (Fan et al., 2021). Globally, in 2018, private enterprises accounted for an estimated 60% of gross domestic expenditure on research and development (GERD) (UIS, 2018).

Close collaboration between universities and industry arguably erodes the boundaries between basic and applied research, and between the public and private sectors (Ulrichsen and Kelleher, 2021). The flow of researchers from higher education institutions to the private sector is estimated to have grown between 2000 and 2020. Those individuals most likely to move are high-performing professionals, as measured by the number of citations (Jurowetzki et al., 2021). In addition to better compensation and generous benefits, researchers are attracted by the opportunity to study large data sets that they cannot access in universities. New industry–university collaboration opportunities may therefore be putting higher education institutions at a disadvantage, with companies stealing academic brain power while gaining capacity and influence to define the technology research agenda (Woolston, 2022).

BOX 10.3:

Research activity leading to technological development and innovation is growing

In 2018, there were more than 8.8 million full-time equivalent researchers in the world, compared with 7.8 million in 2014 (UNESCO, 2021). It is estimated that most researchers work in STEM fields. In 2018, more than 80% of full-time professional researchers in OECD countries were engaged in the field of natural sciences and engineering (OECD, 2018d).

Publications and patents suggest the volume of research production and their focus (Inglesi-Lotz et al., 2018). According to Scopus, an academic publication database, more than 2.5 million publications were published in 2019, up by 21% compared to 2015. Health accounted for 34% of total output in 2019. Cross-cutting 'strategic' technologies, a catch-all term capturing a broad field from artificial intelligence to energy and from materials science to biotechnology, accounted for 18%, up by one third relative to 2015 (UNESCO, 2021).

Patents are a form of intellectual property representing a product or process that grants a new technical solution (WIPO, 2022c). Patent applications have shifted towards digital technology. Between 2010 and 2020, over 10% of filed patents in the world were in computer technologies (WIPO, 2022d). In OECD countries, the largest number of filed patents in 2018, about one third of the total, were in information and communications technology, followed by climate change mitigation (13%) and medical technology (9%) (OECD, 2018b).

Publications and patents also provide a rough estimate of a country's propensity and capacity to create knowledge (Hall and Jaffe, 2018). Their concentration among richer countries signals inequalities in innovation capacity. G20 countries contribute 91% of scientific publications. China and the United States lead the group, producing one fourth and one fifth of global publications, respectively, and holding the highest share of patents. In 2019, data from the five biggest patent offices showed that China produced 29% and the United States 20% of total global patents (UNESCO, 2021).

Influence flows in both directions. Universities seek external, non-academic members for their governance. A survey in 34 OECD countries showed that more than 80% of higher education governing bodies include representatives of the private sector, civil society and professionals. Industries, including small and medium enterprises, participate in university governance in about three quarters of the participating countries. As a result, private actors may contribute to defining institutions' research agenda (OECD, 2019e), and to reviewing and defining the content of higher education programmes (Ankrah and Omar, 2015).

University–industry collaboration is associated with national innovation capacity. According to the World Intellectual Property Organization's Global Innovation Index 2022, which measures the innovation ecosystem performance of 132 participating economies, the most innovative economies tend to have high scores in the university–industry collaboration indicator. The indicator was based on an opinion survey conducted by the World Economic Forum in 2021, which found that businesses and universities in Israel, Switzerland and the United States exhibited the highest degree of collaboration (WIPO, 2022a, 2022b).

GOVERNMENTS USE VARIOUS FUNDING MECHANISMS TO INFLUENCE RESEARCH PRIORITIES

A country's innovation capacity is also linked to the financial resources dedicated to research and development (Afzal et al., 2020). Globally, GERD as a share of gross domestic product (GDP) by governments, higher education institutions, the private sector and non-profit organizations increased from 1.5% in 2000 to 1.9% in 2020. The growth has been fastest in Eastern and South-eastern Asia (from 1.5% to 2.3%), which has the second largest share after Europe and Northern America (2.6%). By contrast, sub-Saharan Africa (0.3%), Central and Southern Asia (0.6%) and Latin America and the Caribbean (0.6%) have seen no change in 20 years. Globally, engineering and technology are the fields receiving the largest share of funding, about 30% of the total GERD (UIS, 2018).

Governments are the main funders of research and development, accounting for 54% of the total, and the main support for higher education institutions research activities (UIS, 2018). Through funding allocations, governments set national priorities that higher education and research institutions are called to follow in their research activities (OECD, 2021a). In some richer countries, public higher education and research institutions have seen a shift from block funding to competitive funding allocation with increasing attention to cost efficiency (Broström et al., 2021; Lewis, 2015). This is partly a consequence of increased autonomy for universities that receive public funds, which has come with more regulation and quality assurance mechanisms. These have transformed government–university relationships. As states maintain an interest in particular areas, they bind higher education institutions and research institutes to deliver specific outcomes in exchange for resources (Scott, 2020). Contrary to institutional block funding, project-based funding has defined timelines and targets (Borowiecki and Paunov, 2018). Targets may be related to revenues from research transfer (e.g. in Austria), research quality and productivity (e.g. in the United Kingdom) and the number of awarded grants (e.g. in Ireland; Tennessee, United States). They may also impose education objectives on institutions, such as a requirement for a certain number of students obtaining doctoral degrees (e.g. in the Netherlands) (Jongbloed et al., 2018).

Performance-based funding departs from one-size-fits-all formulas and focuses on predefined and quantifiable indicators that assign a particular value to scientific research. Greater emphasis is placed on the need to reward research excellence (Jongbloed et al., 2018; Sørensen et al., 2016). Introduced in 2005, the Exzellenzinitiative in Germany provides additional funding to universities whose research projects comply with criteria of excellence. Among them, Future Concepts (Zukunftskonzepte) are the most prestigious. With a budget of USD 4.7 billion, or 4% of all research funds to universities, the initiative supports higher education research activities to boost the international standing of universities and to stimulate competition between them (Buenstorf and Koenig, 2020; Mergele and Winkelmayer, 2021).

Yet, competitive funding also has its downsides. Studies on the effects of competitive funding in Japan show that performance-based funding may have reduced the originality of filed patents. In Japan, institutional funding coexists with a more market-oriented incentive system, introduced in the early 2000s. The increased push for competitive project grants may have led higher education institutions to perform incremental, low-risk research. Past successful applications with high academic status also resulted favorably compared with junior and female colleagues, suggesting that the system is less receptive to novel ideas (Wang et al., 2018).

In Africa, centres of excellence have been established in various countries since the mid-2000s to promote scientific and technological research. Research projects are sponsored through research excellence grants which, however, often do not define clear criteria of excellence (Tijssen and Kraemer-Mbula, 2018). Awards are based on visibility and reputation over their actual capacity and potential for developing local technology (Tijssen and Winnink, 2022).

Governments in high-income countries have been diversifying their financial support for research and development to cover not only universities but also private companies (Hutschenreiter et al., 2019), notably through tax incentives (OECD, 2021a). This is because the knowledge produced by enterprises contributes to economic growth and competitiveness and the benefits are estimated to have large social returns (Lach et al., 2021). Governments also try to encourage small and medium enterprises and start-ups to engage in research and promote experimental development for market applications (OECD, 2020b). Tax exemptions apply on both research outputs, such as generated income, and on inputs, such as equipment (Hall, 2022).

Specific interests may influence publicly sponsored research

Leading countries which produce research report a large share of business contributions to domestic research funding. In 2017, private companies financed more than three quarters of national research and development activities in China, Japan and the Republic of Korea and more than two thirds in Germany and Switzerland (UIS, 2018).

Private funding of academic research is not without controversy, as it is likely to be biased towards areas that bring higher financial returns. For example, the private sector is the primary source of global health research and development. Private companies are found to invest more in research on diseases with greater incidence in developed countries that bring larger returns. By contrast, public and philanthropic sectors are more likely to allocate funding to neglected diseases (85%), which are a greater burden in terms of the size of populations affected (Anderson et al., 2017).

“There are risks that the processes and outcomes of research may be distorted to favour those who pay for it”

There are risks that the processes and outcomes of research may be distorted to favour those who pay for it. Private interests can influence the choice of experimental design, framing questions and analyses. Often sponsored by pharmaceutical companies, clinical research can lead to biases (Lundh et al., 2018). For example, trials conducted on the effects of the use of Bisphenol A, a synthetic chemical, in food and beverage cans led to different results depending on the sponsor. About 90% of publicly funded research has shown that even low-dose exposure to Bisphenol A could be dangerous to human health. By contrast, industry-funded studies reported no effects. These conclusions may have been manipulated through research design (Reutlinger, 2020). In 2008, striking findings from the Centers for Disease Control and Prevention, the United States federal public health agency, led industries to reduce the use of the substance. It is only recently that scientists and regulators worldwide have been discussing the harmfulness of even minimal levels of exposure to Bisphenol A (Henderson, 2022).

Public research and development may also be vulnerable to specific interests. Unlike health, most global agricultural research is publicly funded. Private research and development, including in Asia and Latin America, focus on market-oriented crops, such as corn and wheat, that are more likely to be consumed in high-income countries and present higher net returns. But public sources also tend to support research in crops with high production value. Many publicly funded researchers in South and South-eastern Asia study market-oriented crops, which raises the question whether such research could not have been funded by private industry (Anderson et al., 2017).

UNIVERSITIES RECEIVE SUPPORT TO TURN KNOWLEDGE INTO INNOVATION

National technological development requires the results of research to be diffused into the economy. This process often starts with training researchers to pursue such opportunities. Some higher education programmes integrate content focusing on science commercialization and technology transfer processes (Bolzani et al., 2021; Spiel et al., 2018). Science departments are more likely to promote an entrepreneurship culture (Kaloudis et al., 2019). Innovation and entrepreneurship courses have been rapidly growing in medical education in the United States. Most teach innovation concepts, notions of leadership and information about healthcare systems and the business of medicine (Niccum et al., 2017). Universities in Zambia promote digital marketing and business training through the Zambia AgriBusiness BootCamp programme, implemented by BongoHive, an innovation and technology hub active in different sectors. Started in 2018, and supported by the World Bank, it provides entrepreneurial training to agro-processing companies (FAO and ITU, 2022; UNCTAD, 2019).

A survey of 166 universities, carried out by the European University Association, found that relatively few students had received entrepreneurship training and, if so, mostly through extracurricular activities. Limited exposure during compulsory schooling further contributes to low awareness and interest (Kozirog et al., 2022). A survey by the University Commercialisation and Innovation Policy Evidence Unit of the National Centre for Universities and Business in the United Kingdom found that universities have a growing interest in collaborating with external partners for prototyping, demonstrating and testing of technological products (Coates Ulrichsen, 2021).

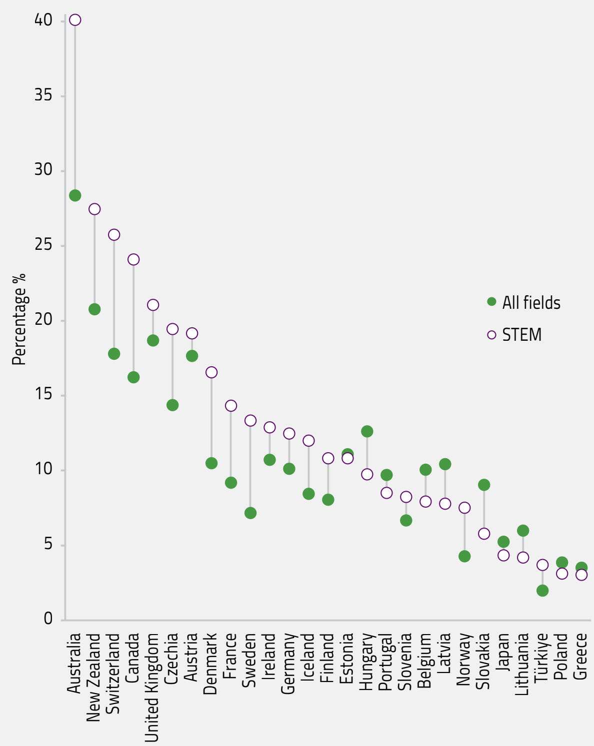
Higher education institutions have developed multiple mechanisms to apply technology innovations to industry (Knudsen et al., 2021). Technology transfer offices are intermediary organizations in the knowledge transfer process, helping to map existing inventions, maintain relationships with private companies and support scientists in the patent application process (Holgersson and Aaboen, 2019).

Since 2013, Colombia has strengthened six regional technology transfer offices, as part of a series of policies aimed at promoting technology transfer between universities and businesses. Established through a public call launched by the Science, Technology and Innovation Administrative Agency, technology transfer offices were identified as a key instrument for enhancing innovation by the National Development Plans 2010–14 and 2014–18. A National Network of Regional Technology Transfer Offices has aimed to strengthen their capacity and encourage resource sharing. External reviews have shown that technology transfer offices have supported specific technology transfer projects in the field of water management, pharmaceutical treatments and paediatric care (OECD, 2019e; Pontón et al., 2019).

Science and technology parks are another example of joint efforts of universities, industry and government to create and transfer knowledge. They promote networks within which technology-oriented companies, their research departments, and academics interact and collaborate, encouraged by close proximity and a favourable regulatory framework. The objective is to draw on existing knowledge-based institutions to promote a culture of innovation and promote local and regional social and economic development (Löfsten et al., 2020). Science and technology parks have spread worldwide, starting from the Silicon Valley example in the 1950s, initiated by Stanford University. They may also be promoted by industries, as in the case of Ideon Science Park, in Lund, Sweden or by governments through incentives to firms, such as the Beijing Zhongguancun Science Park in China (Etzkowitz and Zhou, 2018).

By contrast, the sustainability of digital hubs in Africa has been challenged by the lack of strong knowledge-based institutions. Several national and international initiatives have promoted digital-oriented economic development in the continent, including through the establishment of technology parks, such as Konza City in Kenya, CcHub in

FIGURE 10.4:
Students in STEM fields are more likely to study abroad
International students as a share of all tertiary education students, by host country and field of study, OECD countries, 2019



GEM StatLink: https://bit.ly/GEM2023_fig10_4
Source: OECD (2019a).

Lagos, Nigeria, MEST in Accra, Ghana, and kLab in Kigali, Rwanda. However, the lower capacity of higher education institutions to support entrepreneurs means there are fewer opportunities for technology diversification and specialization (Friederici et al., 2020).

UNIVERSITIES AND EDUCATION SYSTEMS COMPETE FOR TALENT WORLDWIDE

Globalization and the internationalization of higher education have intensified competition for talented students, especially in the STEM fields. Although the number of students spending a period of study abroad represents only 2.7% of students in tertiary education in 2020, this share has tripled in the last decades and is expected to represent 8 million students by 2025 (UIS, 2019; UNESCO, 2022b). International students in most host countries are more likely to study in STEM fields (**Figure 10.4**). According to the Atlas Project, 46% of international students in selected advanced economies were enrolled in a STEM field of study (Institute of International Education, 2023).

While most students finance themselves, scholarships support students to enter STEM fields (Marsh and Oyelere, 2018). STEM students have received increasing financial support over the years (Baxter, 2018; Campbell, 2021). Since 2006, it is estimated that beneficiaries of grants related to STEM fields of study in higher and graduate education have accounted for 31% of global recipients (Foundation Maps: Scholarships for Change, 2022).

> While most students finance themselves, scholarships support students to enter STEM fields

In middle-income countries, scholarships promote study experiences abroad (Kent, 2018; University of Oxford, 2017). Launched in 2011, the Brazilian Scientific Mobility Programme Ciência sem Fronteiras (Science without borders) was one of the largest government-sponsored scholarship programmes for national students in STEM. From 2012 to 2015, Brazilian undergraduates and graduate students benefited from 101,000 fully funded scholarships to conduct research or complete their studies abroad, mostly in Europe and the United States (Brazil Ministry of Education and Brazil Ministry of Science, 2013). Of those, 45% were engaged in engineering and technology fields, followed by biology, biomedical sciences and health (18%) and the creative industries (9%). In 2015, the results of a survey conducted by the Brazilian Senate's Office of Transparency reported that 28% of the participants enrolled in master of science (M.Sc.) and doctorate (Ph.D.) programmes, compared with 7% of undergraduates without international study experience (Menino, 2017; Zahler and Menino, 2018). Launched in 2005, the King Abdullah Scholarship Programme in Saudi Arabia is another ambitious initiative (Pavan, 2020). Renewed in 2019 for five additional years, it supports some 130,000 Saudi undergraduate students per year in STEM studies (Saudi Arabian Cultural Mission, 2023).

High-income countries tend to attract STEM students from other countries to study in their higher education institutions (Kent, 2018). Across OECD countries, 8% of international students were in STEM studies compared with 5% of national students (OECD, 2021c). In the United States, international students accounted for 4% of tertiary students in 2021. Of those, 54% were enrolled in STEM programmes (Institute of International Education, 2021; Marsh and Oyelere, 2018).

Existing mobility flows have created great imbalances between receiving and sending countries (Marinoni and de Wit, 2019). Countries with a high level of outbound mobility flows see their best students leaving and, with them, human capital for future innovation and development (Baxter, 2018). In the past 15 years, new destinations have challenged the traditional mobility flows of skilled students (Marsh and Oyelere, 2018). The United Arab Emirates reports the highest increase in the proportion of tertiary students coming from abroad, from 43% in 2011 to 73% in 2020 (UIS, 2019). This trend is the result of targeted policies aiming to make the country a regional higher-education hub through a general expansion of provision and the establishment of private institutions and international campuses (Ahmad and Hussain, 2015). With 30 international campuses, the United Arab Emirates is the second largest host country per number of international campuses after China (Cross-Border Education Research Team, 2022).

“Countries have implemented policies to encourage professionals educated in strategic fields abroad to return”

As a countermeasure, countries have implemented policies to encourage professionals educated in strategic fields abroad to return. After a significant brain drain in the 1990s, China has become one of the most active countries in reattracting talent. In 2008, the Hundred Talents Programme aimed to attract 2,000 professionals and scholars with key knowledge and skills in emerging technological fields through social and financial measures, including salary compensations, education and housing subsidies and allowances, and research grants (Campbell and Neff, 2020; Zha and Wang, 2018). By 2015, the programme recruited more than 3,000 top-tier professionals. In 2011, the Thousand Youth Talents Programme was designed to attract long-term returnees up to 40 years old who obtained a doctoral degree in STEM in a foreign university (Li et al., 2018).

As a common instruction language, English has ensured the circulation and the exchange of professionals and of scientific and technological knowledge (Schofer et al., 2021). Worldwide, English-taught programmes outside native-speaking countries, such as Australia, Canada, the United States and the United Kingdom, increased by 77% between 2017 and 2021. Among them, STEM programmes, including engineering and technology, computer science and information technology, are the most represented, accounting for about one fifth of the portfolio of English degrees in non-native English-speaking countries. The largest increase was registered in China and in sub-Saharan Africa (British Council, 2021).

CONCLUSION

Learning about technology is critical for supporting national technological development. As a stand-alone subject or integrated into other disciplines, STEM has been included in most secondary education systems in the world. However, the quality of provision makes a difference in student performance and aspirations to continue studying and working in these fields.

> "The quality of provision makes a difference in student performance and aspirations to continue studying and working in these fields"

In addition to teaching and learning, higher education institutions are responsible for knowledge creation through research activity. With more institutional autonomy and new forms of government funding and support, universities continue to play a key role in leading technological development. The capacity to innovate is associated with resources, and, increasingly, with their collaboration with industry.

Monitoring education in the Sustainable Development Goals

Preschool-aged children attend early childhood education classes at Arabistan School, a UNICEF-rehabilitated education facility in Aleppo city, Syria, on 14 December 2022. Years of conflict in Syria have taken a heavy toll on children's education, leaving 2.4 million children out of school and a further 1.6 million at risk of dropping out.

Credit: UNICEF/UN0804872/Nader*

CHAPTER

11

Introduction

KEY MESSAGES

By June 2022, three in four countries had committed to national targets on seven SDG 4 benchmark indicators to be achieved by 2025 and 2030.

In January 2023, the UIS and the GEM Report published the first annual snapshot of country progress towards these national targets, *SDG 4 Scorecard: Progress Report on National Benchmarks*.

Among countries with benchmarks and data, the share of those on course to achieve their 2025 benchmark with high probability was 29% for the upper secondary completion rate and 43% for the early childhood education participation rate.

Poorer countries set overambitious targets on learning, a sign of lack of data and awareness in this area, while richer countries set underambitious targets, reflecting falling achievement levels. By contrast, the targets countries set on completion reflect past trends.

The national benchmarking process is meant not only to serve accountability purposes but also to be formative. *SDG 4 Scorecard* discussed country progress in early childhood education participation with reference to three policies: free and compulsory pre-primary education legislation, financing, and private provider regulation.

The 2022 Transforming Education Summit was part of the UN Secretary-General's vision for the future of international cooperation and a step towards the 2024 Summit of the Future. It was the most important event in the global education calendar since 2015.

The national SDG 4 benchmarks, already embedded in the 2015 Framework for Action, were recognized in the UN Secretary-General's vision statement on the 2022 Transforming Education Summit as a mechanism to monitor its high-level outcomes.

The SDG 4 High-level Steering Committee's Call to Action invited Member States to identify a benchmark indicator for three of the 2022 summit's global initiatives and set national targets:

- On greening education, the proposed measure focuses on the extent to which curriculum frameworks and primary and secondary education syllabuses prioritize climate change.
- On digital transformation, school internet connectivity, an existing global SDG 4 indicator, is the proposed measure.
- On youth participation, an indicator will need to confirm that governments invite youth to participate in education policy development, and that youth organizations are consulted.

As 2023 marks the midpoint in the implementation of the 2030 Agenda for Sustainable Development, the primary focus of the monitoring part of this year's *Global Education Monitoring Report* is key trends by each SDG 4 target. While it is always difficult to provide the up-to-date situation – as education data inevitably lag considerably – some methodological developments, to which this report has contributed, facilitate the ability to 'nowcast', i.e. make reasonably reliable short-term projections for some flagship indicators.

But even these tools have been put to the test as a result of the disruption to education data collection processes caused by the COVID-19 pandemic. The ultimate effects of school closures on education systems remain unknown and will unfold over the coming years. This is particularly the case for learning, where no shock at such a large scale had ever been experienced, from which potential consequences could be assessed. The first evidence from the world's richer countries documented a negative effect but less dramatic than feared. However, evidence from the world's poorer countries, some of which experienced an unfortunate combination of long school closures and limited distance education opportunities, is yet to emerge. In any case, the gap in data on learning outcomes remains a cause for concern and an area where global action remains elusive.

This introductory chapter to the monitoring part of the report presents four issues. First, it gives an update on the national SDG 4 benchmarking process, arguably the most important development for framing the monitoring of the global education agenda, with potential lessons for other sectors. Second, it describes the 2022 Transforming Education Summit, the most important event in the global education calendar since 2015, which facilitated reflection on new education challenges as well as on monitoring, building on the benchmarking process. Third, it presents some of the key features of the monitoring part of the report and its links with this year's theme: technology. Finally, it gives an overview of the GEM Report's outputs since 2015 to orient readers to the multiple resources at their disposal in interpreting progress towards the 2030 goal.

THE NATIONAL SDG 4 BENCHMARKING PROCESS HAS REACHED A MILESTONE

Inspired by the United Nations (UN) Secretary-General's 2014 call for countries to embrace 'a culture of shared responsibility' based on 'benchmarking for progress', paragraph 28 of the Education 2030 Framework for Action had called on countries to establish 'appropriate intermediate benchmarks … for addressing the accountability deficit associated with longer-term targets'. The GEM Report and the UNESCO Institute for Statistics (UIS) began working in 2018 to make this commitment a reality.

There have been three important markers of progress in this process. First, in August 2019, seven SDG 4 indicators were selected for benchmarking: early childhood education attendance; out-of-school rates; completion rates; gender gaps in completion rates; minimum proficiency rates in reading and mathematics; trained teachers; and public education expenditure. This development was captured in the *SDG 4 Data Digest 2021 report* (UIS and GEM Report, 2021).

Second, in two stages, by October 2021 and June 2022, three in four countries committed to national targets on these indicators to be achieved by 2025 and 2030. These benchmark values define countries' nationally determined contributions to the common education goal, using a concept embraced by the climate change sector. They enable the monitoring of progress to be context-specific, recognizing countries' starting points and education sector plans, helping link their national education agendas with regional and global agendas. These developments were described in the *Setting Commitments* report, which was presented at the High-level Political Forum and the Transforming Education Summit in 2022 (UIS and GEM Report, 2022).

Third, in January 2023, a milestone was reached: the first annual snapshot of country progress towards national targets was published. Entitled *SDG 4 Scorecard: Progress Report on National Benchmarks*, this first report of what is intended to be an annual series to mark the International Day of Education makes four contributions (UIS and GEM Report, 2023).

First, it analyses historical progress rates between 2000 and 2015: how the change in benchmark indicator values has varied according to the starting point. This analysis provided a measure of what countries will achieve if they accelerate progress, move at a 'business as usual' pace or perform under par.

Second, the *Scorecard* describes the steps the UIS took to set up the benchmark database, which highlighted the strong political will to support the benchmarking process and the rich information in national education sector plans, but also continuing challenges of communication on indicator definitions and data sources.

Third, it classifies countries' progress in terms of the probability they will achieve their national targets by 2025. For instance, among countries with benchmarks and data, 29% in the upper secondary completion rate and 43% in the participation rate in organized learning one year before primary were on course to achieve their 2025 benchmark with high probability. The report also shows how a country's progress in 2015–20 compares with the historical progress rates in 2000–15 of the average country that had started from a similar point.

Fourth, the *Scorecard* makes a clear statement that reporting on benchmarks must not be the end but the beginning of a process to engage countries to learn from one another.

> Benchmark values define countries' nationally determined contributions to the common education goal, using a concept embraced by the climate change sector

The benchmarking process is designed to allow countries to achieve two objectives critical for their education development. The first is to help countries reflect on the quality of their national targets and improve them to serve their policy and planning. As part of the process, every country was provided with indicative 'feasible' benchmark values by the UIS and the GEM Report, which show where countries could be by 2025 and 2030 if they grew at the historic rate of the fastest 25% of countries.

A review of how benchmark values set by countries compare with indicative feasible benchmark values is instructive of the challenges countries face in setting benchmarks. The wide discrepancy between benchmarks and feasible benchmarks is found in minimum proficiency levels, for instance in reading at the end of primary education (**Figure 11.1a**). On average, countries with low starting values are far more ambitious than indicated by feasible benchmark values, while countries with high starting values are less ambitious. This may be because this indicator was only added to the education monitoring framework in 2015: poorer countries lack data and are less familiar with progress in this area. By contrast, richer countries have been taking part in cross-national assessments for the past 20 years and are more familiar with the indicator and progress on it. In fact, indicator levels in richer countries with high initial learning levels (more than 70% of students achieving minimum proficiency) fell on average between 2000 and 2015 (**Chapter 12**), which may explain why these countries have been more cautious in setting their national targets.

By contrast, the discrepancy in completion rate – an indicator with a trajectory far more familiar to countries – is considerably smaller (**Figure 11.1b**). Again, a few countries with low starting values have been too ambitious. This may be explained by their inexperience or a lack of precedent in national target setting. However, fewer countries have been as ambitious in this indicator as they were for learning.

The second objective is to link indicator levels and progress with the policies countries need to implement. Each edition of the *SDG 4 Scorecard* focuses on one benchmark indicator; the first looks at the participation rate in organized learning one year before primary. It discusses country progress with reference to three policies: free and compulsory pre-primary education legislation, public education financing, and private provider regulation. The introduction of three years of free education in Armenia, four years in Uzbekistan and three – and later five – years in Azerbaijan is associated with a large increase in participation rates (**Chapter 13**). Doubling spending from 0.25% to 0.50% of GDP is associated with a tripling of the participation rate in public institutions from 20% to 60% on average. And the early childhood education participation rate is 7 percentage points higher in countries with private preschool fee-setting regulations (UIS and GEM Report, 2023).

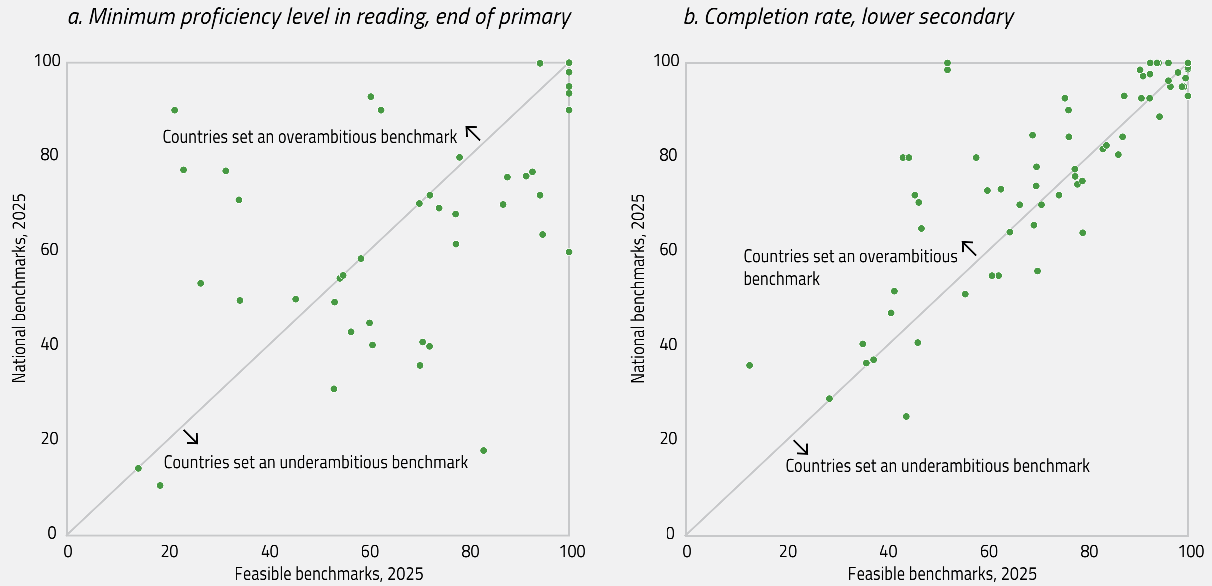
Various challenges will need to be tackled in the coming years. Countries need help to set missing education targets and address a lack of alignment between national and global indicators. A process of dialogue and capacity development is recommended. Finally, countries will need to incorporate the potential effects of COVID-19 in their national benchmarks.

In summary, the GEM Report is providing a global update on progress towards the targets of universal access to education, the provision of key minimum inputs and the achievement of relevant learning outcomes, as agreed in 2015. The partnership with the UIS through the national SDG 4 benchmarking process offers a new perspective on how progress can be monitored and assessed in a way that is closely linked to national starting points and plans; is fair for every country; and helps bridge the gap between national, regional and global commitments.

FIGURE 11.1:

Countries set realistic benchmarks for the completion rate but less so for learning

Comparison between actual and feasible benchmarks for 2025



GEM StatLink: https://bit.ly/GEM2023_fig11_1

Note: Actual benchmarks are those set by countries for 2025. Feasible benchmarks estimate where countries are expected to be if they improve at the rate of the historic rate of the fastest 25% of countries observed in 2000–15.

Source: UIS and GEM Report (2023) based on the SDG 4 benchmark database.

FOLLOWING UP ON THE TRANSFORMING EDUCATION SUMMIT COMMITMENTS

When the UN Member States adopted a declaration on the commemoration of the 75th anniversary of the United Nations (the 'UN75 Declaration'), the UN Secretary-General was asked to outline a vision for the future of international cooperation. His report, *Our Common Agenda*, was conceived as the first step towards a Summit of the Future in 2024 in which 'to forge a new global consensus on what our future should look like, and what we can do today to secure it' (United Nations, 2021). While the 2030 Agenda for Sustainable Development captures the scope of international ambition and provides a framework and a mechanism for its fulfilment, *Our Common Agenda* aimed to address the obstacles to realizing this agenda. With education high on the UN Secretary-General's priorities, a key step in the process towards the Summit of the Future was the Transforming Education Summit (the 'Summit'), which took place in September 2022 'in response to a global crisis in education – one of equity and inclusion, quality and relevance'.

The Summit aimed to elevate education to the top of the global political agenda and to galvanize action, ambition, solidarity and solutions to achieve two objectives: recover from the learning losses brought about by COVID-19 and sow the seeds to transform education in a rapidly changing world. As part of its preparation, more than 150 education ministers gathered in Paris in June 2022 at the Pre-Summit, where discussions were organized along five thematic action tracks: inclusive, equitable, safe and healthy schools; learning and skills for life, work and sustainable development; teachers, teaching and the teaching profession; digital learning and transformation; and education financing. At the Summit itself, the key outcome was seven global initiatives related to: education in emergencies; foundational learning; gender equality; greening education; digital transformation; education financing; and youth participation.

From a monitoring perspective, the Summit presented the challenge of how to match the SDG 4 targets and monitoring framework with the priorities expressed in the global initiatives and then to report on achievements to inform policy dialogue.

Two steps were taken. First, in his Vision Statement at the Transforming Education Summit, the UN Secretary-General called for 'ways to strengthen political accountability for transforming and financing education, taking current arrangements for monitoring

SDG 4 implementation, including the Global Education Meetings and the national SDG 4 benchmarking process, to the next level' (United Nations, 2022). The national SDG 4 benchmarks, which are embedded in the 2015 Framework for Action, were therefore also recognized as a cornerstone of monitoring the high-level outcomes of the 2022 Transforming Education Summit.

Second, a call to action was issued by the SDG 4 High-level Steering Committee (High-level Steering Committee, 2022). The call recognized that selected SDG 4 benchmark indicators were appropriate for monitoring four of the seven global initiatives proposed during the Summit: education in emergencies, foundational learning, gender equality and education financing. It further urged countries to build on the national SDG 4 benchmarking process by:

- Agreeing to set an indicator for each of the three other global initiatives (greening education, digital transformation and youth participation) that would be added to the list of seven SDG 4 benchmark indicators.
- Setting national targets for these indicators for 2025 and 2030, which would represent the countries' intended outcomes from the Transforming Education Summit.

At its meeting in December 2022, the High-level Steering Committee decided to add indicators for greening education, digital transformation, and youth and student engagement to the existing SDG 4 benchmark indicator framework (**Figure 11.2**). Preliminary ideas on benchmark indicators for these three global initiatives were proposed to the Technical Cooperation Group on SDG 4 Indicators.

Relating to greening education, an initiative which consists of four dimensions (schools, learning, teachers and communities), the main indicator proposal is a measure of national intentions to cover climate change based on an analysis of relevant policy documents; this indicator has already been estimated based on keyword searches of more than 170 national curriculum frameworks for 133 countries. Further information will be added from science and social science syllabi in primary and secondary education.

In terms of digital transformation, the global initiative consists of three dimensions: content, capacity and connectivity. While no indicator can cover all aspects comprehensively, school internet connectivity has the advantage that it is an existing global SDG 4 indicator (4.a.1) and is therefore being monitored by countries and reported at the international level. In the coming years, improvements can be made in how the indicator is sourced, such as adding information from internet service providers.

A potential indicator on the youth participation global initiative will involve, first, governments reporting whether they have an education policy development council or related body that includes youth representatives; and second, youth organizations reporting whether they are active members of such a council or body and have been consulted in education policy development.

FIGURE 11.2:

Transforming Education Summit priorities have been integrated into the SDG 4 monitoring and benchmark indicator framework

Alignment of Transforming Education Summit global initiatives with SDG 4 targets and benchmark indicators

	SDG 4 monitoring framework		
	SDG 4 target	Benchmark indicators	Global initiatives
4.1	Basic education	1. Out of school rate [4.1.4]	Education in emergencies
		2. Completion rate [4.1.2]	Foundational learning
		3. Learning proficiency [4.1.1]	
4.2	Early childhood	4. Pre-primary participation [4.2.2]	
4.3	TVET/higher/adult education		
4.4	Skills for work		
4.5	Equity	5. Gender gap in completion [4.5.1]	Gender equality
4.6	Adult literacy		
4.7	Sustainable development	to add	Greening education
4.a	Learning environment	to add	Digital transformation
4.b	Scholarships		
4.c	Teachers	6. Trained teachers [4.c.1]	
FFA	Finance	7. Public education spending as (i) % of total spending (ii) % of GDP [FFA1/2]	Education financing
		to add	Youth participation

Note: Indicators in **bold** are the 7 **benchmark indicators**. FFA: Framework for Action. TVET: technical and vocational education and training.
Source: UIS and GEM Report (2023).

HIGHLIGHTS OF THE 2023 GEM REPORT MONITORING PART

As described previously, the first objective of the monitoring part of the 2023 GEM Report is to provide a concise measurement of progress towards the 2030 targets. A box in each chapter provides a snapshot of such progress for at least one global indicator. The remainder of the main text analyses developments in other global and thematic indicators.

A second objective of the monitoring part of the 2023 GEM Report is to identify one or more issues per target that connect with the thematic part. These focus sections make various links with the theme of technology in education.

Some focus sections examine aspects of digital technology. For instance, they look at issues such as how technology affects definitions of writing skills (**Focus 12.1**), active play outdoors in early childhood education as an alternative to screen time (**Focus 13.1**), micro-credentials facilitated by online technology as an alternative to traditional higher education (**Focus 14.1**), the potential effect of artificial intelligence technology on skill demand and supply (**Focus 15.1**), the elevated attention assigned to social and emotional learning and how theories about it inform education technology (**Focus 18.1**), and the role of big data in identifying education trends with an application on the use of online searches to understand interest in international scholarships (**Focus 20.1**).

An extensive analysis shows the financing gap that the GEM Report team has estimated will need to be filled for low- and lower-middle-income countries to achieve their national SDG 4 benchmarks, with new evidence on how the gap would increase if countries were to cover the cost of digital transformation in education under three scenarios of increasing ambition (**Chapter 22**).

One focus is related to how education can influence technology adoption, adjustment and development instead of how technology influences education – and examines shortages in science, technology, engineering and mathematics teachers (**Focus 21.1**).

Four focus sections look at technologies other than information and communication: construction and school buildings (**Focus 19.1**), energy and closing the school electrification gap through solar panels (**Focus 19.2**), transport and the impact of commuting to school (**Focus 19.3**), and agriculture linked to improving school meals (**Focus 12.2**).

Finally, other focus sections look at selected issues of interest unrelated to technology: inequality based on parental education with an emphasis on first-generation students (**Focus 16.1**), the significance of reading speed for literacy (**Focus 17.1**), and the concern about the potential impact of an impending debt crisis in low and lower-middle-income countries (**Chapter 22**).

THE GEM REPORT IS MORE THAN JUST A REPORT

The world is very different today than in 2001 when the decision was taken to establish the Education for All Global Monitoring Report as an editorially independent report hosted and published by UNESCO. It has even changed considerably since 2015, when the decision was taken to give the *Global Education Monitoring Report* the mandate to monitor progress in education in the 2030 Agenda for Sustainable Development. The changes are not just related to the political, social, economic and environmental challenges, which provide the framework in which the report operates. They are also related to the much larger volumes of information that are available to report on education, the many more channels through which audiences are now used to receiving such information, and the pluralism in voices that these channels help bring.

For a report designed from the outset to combine the twin functions of research and advocacy, there are also changing expectations of what should be delivered. The GEM Report could not stay the same as its mandate expanded to cover a universal education agenda for all countries and all levels of education. It developed a strategy for 2019–24 on the focus and form of its outputs within a constant resource envelope. The strategy set two priorities: fulfil its expanded mandate to be a truly global education reporting mechanism while tailoring its outputs and communication channels to increase opportunities to influence policy change.

Today, the GEM Report is more than just a report. It offers a range of resources: global and regional, in a few targeted cases, also national; monitoring and quantitative but also thematic and qualitative; indicators on outputs and outcomes but also on laws and policies; in print and online; static and interactive; organized by different themes; presented in numerous settings; and communicated through various channels. The outputs feed into and inform each other (**Figure 11.3**). This expansion has been possible through this synergy and coherence but also thanks to invaluable partnerships with a committed group of organizations around the world

FIGURE 11.3:

The GEM Report is more than just a report

Global Education Monitoring Report outputs by issue, focus and channel

Issues	Thematic		Regional
SDG 4 coordination			
Finance			
Access			
	Country profiles of laws and policies		**Regional reports**
Equity and inclusion	PEER www.education-profiles.org		**2019 Arab States report**
		Equity in financing	**2020 Latin America and the Caribbean report** with SUMMA and UNESCO Santiago **2021 Central and Eastern Europe, Caucasus and Central Asia report** with EASNIE and NEPC
Learning			**2022–25 Africa Spotlight series on foundational learning** with the African Union and ADEA
Quality	**Sexuality education** with UNESCO	**Technology**	**2023 South-east Asia report** with SEAMEO **2024 Pacific report** with Commonwealth of Learning
		School leaders	**2025 Latin America report** with OEI
Sustainable development	**Climate change education** with the MECCE project		
Governance			
		Private actor regulation	**2022 South Asia report** with CPR, CSF, BRAC, IIDS, ITA and IPS

Notes: The pink frame indicates the Global Education Monitoring Report. The blue frame indicates the GEM Report's online resources. The black frame indicates other GEM Report publications.
Source: GEM Report.

Global

SDG 4 SCORECARD
National SDG 4 benchmarks with UIS

Global Education Monitoring Report
Monitoring part
A chapter per SDG 4 target
Statistical tables

Finance chapter
Aid tables

Thematic part
Background papers

2019 Migration and displacement

2020 Inclusion

2023 Technology

2024/5 Leadership

2016 People and planet

2017/8 Accountability

2021/2 Non-state actors

Youth edition

Gender edition

Policy papers

Monitoring

RESULTS REPORT
Chapter 1 of the **GPE Results Report** with UIS

SCOPE
SCOPE finance
www.education-progress.org

SCOPE access

SCOPE equity

SCOPE learning

SCOPE quality

Interactive SDG 4 monitoring

GEM Report co-chairs the data and monitoring functional area of the SDG 4 High-level Steering Committee with UIS

EFW
Education Finance Watch
with the World Bank and UIS

VIEW
www.education-estimates.org
Completion rate
Out-of-school rate, with UIS

Two key indicators estimated using multiple data sources

High-level Political Forum reports
Meeting Commitments,
Beyond Commitments,
Setting Commitments

SDG 4 costing model

WIDE
www.education-inequalities.org
with UIS
Access indicators

Learning indicators

Database of inequality in education

Communications and advocacy

World Education Blog

Launch events and presentations

Videos, animations, infographics

Print, electronic and social media

Notes: ADEA: Association for the Development of Education in Africa; CPR: Centre for Policy Research (India); CSF: Central Square Foundation (India); EASNIE: European Agency for Special Needs and Inclusive Education; IIDS: Institute of Integrated Development Studies (Nepal); ITA: Idara-e-Taleem-o-Aagahi (Pakistan); IPS: Institute of Policy Studies (Sri Lanka); MECCE: Monitoring and Evaluating Climate Communication and Education; NEPC: Network of Education Policy Centers; OEI: Organization of Ibero-American States; SEAMEO: Southeast Asian Ministers of Education Organization; SUMMA: Laboratory of Education Research and Innovation for Latin America and the Caribbean; UIS: UNESCO Institute for Statistics.

12

At Weyra Lalo Primary School in the SNNP region, Ethiopia, 5- and 6-year-old children learn by having fun. Recreational activities help them to develop a taste for learning from an early age.

Credit:UNICEF/UN0837179/Pouget*

KEY MESSAGES

A new methodology combining multiple data sources indicated that some 244 million children and youth were out of school in 2021, 9 million less than in 2015. During this period, the out-of-school population in sub-Saharan Africa grew by 12 million.

Completion rates have improved faster than out-of-school rates. Globally, the completion rate increased between 2015 and 2021 from 85% to 87% in primary education, from 74% to 77% in lower secondary education and from 54% to 59% in upper secondary education. Many children in low-income countries complete primary school late, which impedes their progression.

Since 2011, the share of students with at least minimum proficiency in reading at the end of primary education has increased faster in low- and lower-middle-income countries, albeit from low starting points, than in upper-middle- and high-income countries.

In 21 of 32 mostly upper-middle- and high-income countries, grade 4 students performed worse in reading in 2021 than in 2016, although the average decline was only one fifth of what children learn in a school year. Low- and middle-income countries appear to have suffered a stronger impact, with some findings suggesting children lost at least one year of learning, but comparable evidence post-COVID is not yet available.

Writing is a technology. Although it is rarely included in standardized learning assessments, research suggests that improving writing proficiency is more strongly associated with the frequency of writing tasks than with how it is done (handwriting, typing or a combination of both).

CHAPTER 12

TARGET 4.1
Primary and secondary education

By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes

GLOBAL INDICATORS

4.1.1 – *Proportion of children and young people (a) in Grade 2 or 3; (b) at the end of primary education; and (c) at the end of lower secondary education achieving at least a minimum proficiency level in (i) reading; and (ii) mathematics, by sex*

4.1.2 – *Completion rate (primary education, lower secondary education, upper secondary education)*

THEMATIC INDICATORS

4.1.3 – *Gross intake ratio to the last grade (primary education, lower secondary education)*

4.1.4 – *Out-of-school rate (primary education, lower secondary education, upper secondary education)*

4.1.5 – *Percentage of children over-age for grade (primary education, lower secondary education)*

4.1.6 – *Administration of a nationally representative learning assessment (a) in Grade 2 or 3; (b) at the end of primary education; and (c) at the end of lower secondary education*

4.1.7 – *Number of years of (a) free; and (b) compulsory primary and secondary*

ACCESS AND COMPLETION

The number of out-of-school children of primary school age was the flagship indicator of the international education agenda from 2000 until 2015. It was easy to communicate and powerful in presentation. It also seemed to be straightforward to calculate, based on a headcount of children in school, although a reliable population measure was often not available. It was selected even though it did not capture the second Education for All goal ('all children … have access to, and complete, free and compulsory primary education') nor the second Millennium Development Goal ('children everywhere … complete a full course of primary schooling'). In fact, the out-of-school indicator showed exaggerated progress, as access to school does not mean progression and completion, as the international community came to realize over time through better statistics. Moreover, the indicator encouraged countries to bring and keep children in school – but made them less accountable for ensuring that children finished each education level or that children learned what was expected.

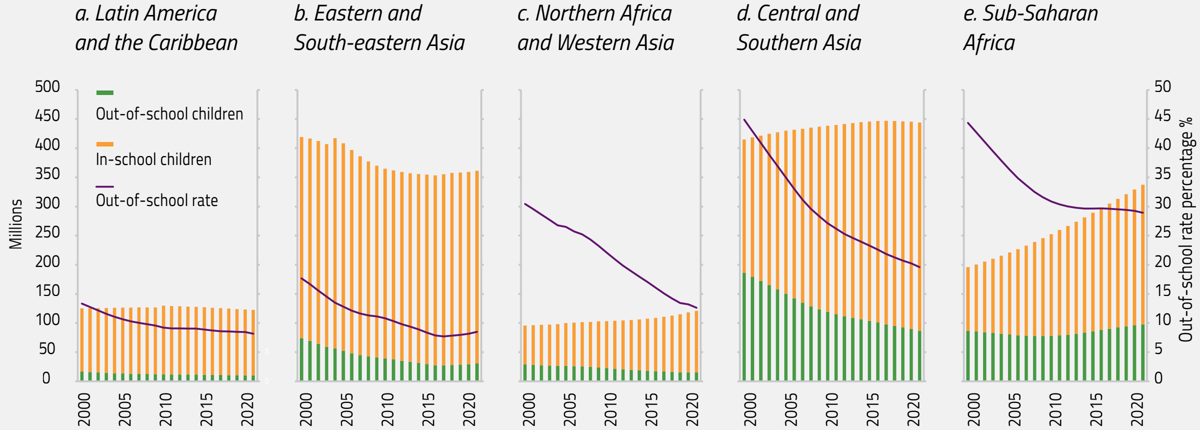
It was recognized in the early 2000s that the traditional way of estimating out-of-school rates and numbers was falling short of the requirements. Many countries, especially some of those with the largest out-of-school challenges, did not have robust administrative data systems. Education data reporting has been incomplete or inaccurate, while in some country-year combinations, there has been no reporting at all. As well, given the two-source nature of the administrative estimates, there are often inconsistencies between enrolment counts and

“It was recognized in the early 2000s that the traditional way of estimating out-of-school rates and numbers was falling short of the requirements”

population estimates. Data from household surveys offer crucial complementary insights, especially in countries with weak administrative data systems, yet there was no framework to incorporate them into national, regional and global estimates. At the same time, survey-based data are incomplete, as they tend to be infrequent and subject to survey bias and sampling and non-sampling errors. Still, the two sources can complement each other. A 2005 report recognized that 'some sort of composite approach may be needed for estimating time series and producing estimates for the most recent year' (UIS and UNICEF, 2005).

It took another 15 years before this methodological challenge was addressed. In 2022, the UNESCO Institute for Statistics (UIS) and the Global Education Monitoring (GEM) Report developed a new cohort-based model that estimates out-of-school rates and numbers for all countries with available data, combining multiple data sources (UIS and GEM Report, 2022). The model mirrors the natural progression of students through a school cycle. Data from administrative and survey-based sources are reconciled, recognizing the fundamental differences in how the respective data are generated, while sharing information about bias and variance across

FIGURE 12.1:
The out-of-school population in sub-Saharan Africa increased by 12 million over 2015–21
Out-of-school rate, out-of-school children and enrolled children (primary and secondary education)



GEM StatLink: https://bit.ly/GEM2023_fig12_1
Source: VIEW website.

countries. Similar approaches have been used by the global health and demographic community to estimate under-5 mortality (Alkema and New, 2014), maternal mortality (Alkema et al., 2016) and sex-ratios at birth (Chao et al., 2021). The model results are published on the Visualizing Indicators of Education for the World (VIEW) website (**Box 12.1**).

Using the new model, the global out-of-school population of primary and secondary school age was estimated at 244 million in 2021, only 9 million less than in 2015. This change corresponds to a slow decline of the out-of-school rate from 17.3% in 2015 to 15.9% in 2021, or just over 0.2 percentage points per year. By education level, out-of-school rates in 2021 stood at 9% for primary

BOX 12.1:

The VIEW website presents new estimates for out-of-school and completion rates

The Visualizing Indicators of Education for the World (VIEW) website is accessible at: https://education-estimates.org/. It was launched in December 2021 to present the results of the completion rate estimation model (**Box 12.2**). It was expanded in September 2022 with the results of the out-of-school rate model produced by the UNESCO Institute for Statistics (UIS) and the *Global Education Monitoring* (GEM) *Report*. Its objective is to showcase the rationale for an estimation model for these two flagship indicators and help countries reflect on the quality of their data.

Individual pages present specific results by education level, country, region and income group for each of the two indicators. The website also allows users to explore details of the out-of-school rate model by plotting age-specific estimates (**Figure 12.2**). The left panel plots the observed data series, with each age assigned a unique colour and each data source a unique marker. The right panel plots the estimated age-specific out-of-school rate series. Further options from a drop-down menu allow users to look at the results by age, year and cohort (e.g. the out-of-school path of those who were of school entry age in 2000).

FIGURE 12.2:

The out-of-school estimation model makes full use of data from multiple sources

Out-of-school rate by year, age and data source, observed data and estimated values, Burkina Faso, 2000–20

GEM StatLink: https://bit.ly/GEM2023_fig12_2
Note: DHS: Demographic and Health Surveys. MICS: Multiple Indicator Cluster Surveys.
Source: VIEW website.

The UIS still reports official completion and out-of-school rates by country. But the Technical Cooperation Group on Sustainable Development Goal (SDG) 4 indicators has approved the use of the model's results on two occasions: first, to report country income group, regional and global averages; second, to report national values of out-of-school rates for countries that have not reported administrative data during the last five years (UIS, 2022c).

school age children, 14% for lower secondary school age adolescents and 30% for upper secondary school age youth.

Out-of-school rates have stagnated in Eastern and South-eastern Asia, Latin America and the Caribbean, and sub-Saharan Africa but have declined in Central and Southern Asia (from 23% to 20%) and in Northern Africa and Western Asia (from 17% to 13%). Sub-Saharan Africa is a unique case because the decrease in its out-of-school rate has occurred while the absolute number of out-of-school children has increased. Since 2015, the region's out-of-school rate has declined by just 0.1 percentage points per year while its out-of-school population grew by 12 million. Consequently, sub-Saharan Africa's out-of-school rate (29%) remains 10 percentage points greater than in any other region. This is the result of rapid demographic growth, which saw the school-age population grow by 50 million in the 6 years between 2015 and 2021.

The cohort structure of the model is well-designed to capture long-term stable trends. It estimates out-of-school rates for 187 countries and territories, with only a handful not being covered, such as Eritrea and Somalia (**Box 12.3**), although the margin of error is large in many countries for which only survey data are available, such as Angola or the Democratic Republic of the Congo.

> Not only were education systems damaged by school closures, their monitoring mechanisms were, too

However, the model is less well-suited to capture sudden departures from such trends. Events of this kind are relatively rare in education systems, but the COVID-19 pandemic presented just such a case. Therefore, to understand whether school closures had a negative impact on enrolment, it is necessary to analyse short-term changes in administrative data. Unfortunately, not only were education systems damaged by school closures, their monitoring mechanisms were, too. By the time of the most recent UIS release in March 2023, just 27% of countries had reported enrolment data in primary and secondary education in 2019 and 2021. Even where data exist, they can sometimes be difficult to interpret. It is unclear whether an increase in the number of out-of-school children is genuine or affected by particular disruptions during the time of data collection.

One plausible assumption is that, if there is an impact on enrolment, this is likely to have affected older students more, especially the most disadvantaged, as their attachment to school is more tenuous. In the face of continuing uncertainty and with financial pressures adding up, those students with the potential to earn income and support their families would have been more likely to leave school early. By contrast, the pandemic should have had a lesser impact on younger children. In some countries, there is evidence that dropout was higher at higher levels of education, including in the Dominican Republic, the Lao People's Democratic Republic and Zimbabwe. But other countries, like Jordan and the Philippines, followed the opposite pattern.

Drawing a general conclusion is difficult. The Philippines, which had the longest school closure in this sample, has reported a large increase in the primary out-of-school rate (six percentage points) but a large decrease in the upper secondary out-of-school rate (four percentage points) between 2019 and 2021. India, which had an average full school closure duration but one of the longest partial school closure durations reported a large decrease in the primary out-of-school rate (seven percentage points); no data are reported for secondary out-of-school rates. Excluding India and the Philippines, the out-of-school population among the some 50 countries appears to have remained constant among primary school age children, to have declined among lower secondary school age adolescents (by 3.3%) and to have increased among upper secondary school age youth (by 3.9% or just over half a million). On average, the longer the duration of school closures, the higher the increase in primary out-of-school rates: an increase of 1 percentage point for every 22 weeks of full school closure. But this is a weak association and does not hold for secondary out-of-school rates (**Figure 12.3**).

FIGURE 12.3:

The longer the duration of school closures, the higher the increase in out-of-school rates

Change in out-of-school rates (2019–21) and number of weeks schools were fully closed, primary school (2020–22), by education level

GEM StatLink: https://bit.ly/GEM2023_fig12_3

Source: GEM Report team analysis of household survey data.

BOX 12.2:

Progress since 2015: SDG indicator 4.1.2

SDG global indicator 4.1.2, the completion rate, has improved faster than the out-of-school rate (-1.4 percentage points across all school age groups), according to the estimation model, which follows a similar methodology (Dharamshi et al., 2022) but draws exclusively on household surveys and censuses. Globally, the completion rate increased between 2015 and 2021, from 85% to 87% in primary education (2.1 percentage points), 74% to 77% in lower secondary education (2.8 percentage points) and 54% to 59% in upper secondary education (4.9 percentage points). Sub-Saharan Africa remains well below the global average by more than 20 percentage points in primary education (64%) and by almost 30 points in lower secondary (45%) and upper secondary education (27%).

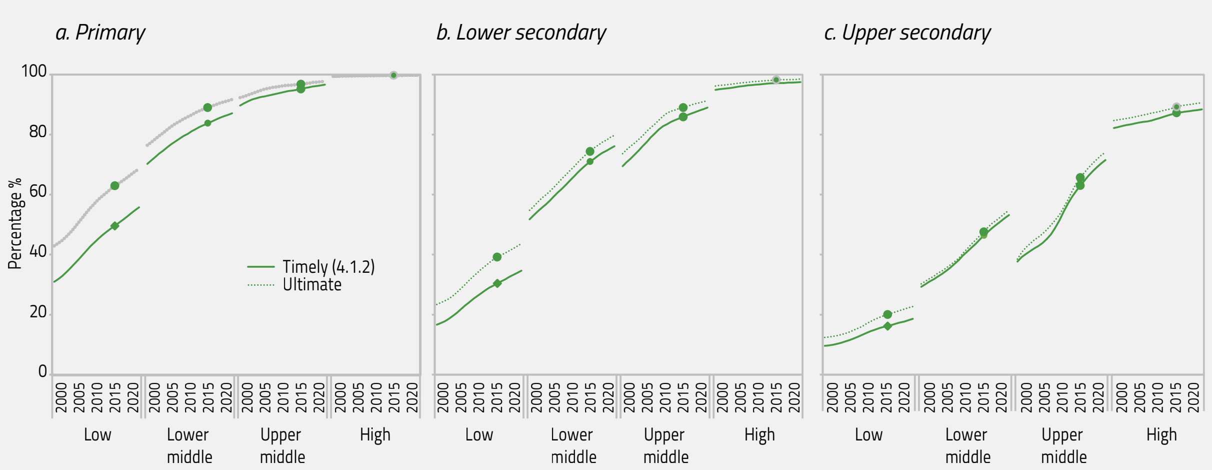
This faster growth of completion relative to enrolment rates suggests that education development must not only be expanded, but also be made more efficient through more timely enrolment and less repetition that enables more students to reach the end of each cycle. While the SDG completion rate indicator is officially defined among those three to five years above graduation age (e.g. the primary completion rate is calculated for 14- to 16-year-olds in education systems where primary school should officially be completed by age 11), even this 'timely' completion rate may miss children and young people who reach the end of each cycle even later through a combination of late enrolment and repetition. This is particularly the case in poorer countries. For instance, in low-income countries, the timely completion rate was 56% in 2021 but the 'ultimate' completion rate was 69%, i.e. 13 percentage points higher (**Figure 12.4**). Globally, this gap between timely and ultimate completion has fallen from 5.1 to 4.6 percentage points since 2015.

The gap between timely and ultimate completion declines in lower secondary (4.4 percentage points) and upper secondary education (3.3 percentage points) as adolescents and youth are drawn into the labour market or, in the case of girls, pushed into marriage and childbearing. But overall, it means that, globally, 92% ultimately complete primary, 81% lower secondary and 62% upper secondary education.

FIGURE 12.4:

Too many children complete primary school late in low-income countries

Completion rates, by country income group and education level, 2000–21



GEM StatLink: https://bit.ly/GEM2023_fig12_4
Source: VIEW website.

In brief, high enrolment rates do not guarantee high completion rates. In Madagascar, the total net enrolment rate (i.e. 100% minus the primary out-of-school rate) was 92% in 2014. But six years later, only 50% were completing primary school on time and 64% were expected to eventually complete (**Figure 12.5**). The primary reason for this gap is high repetition: in Madagascar, 22% of primary school students were repeating a grade. This is verified in all countries with a large gap between enrolment and completion that also have data on repetition during this period, including Benin, Burundi, Chad and Uganda. Improving completion rates by 2030 requires overcoming the twin challenge of late entry to school and repetition.

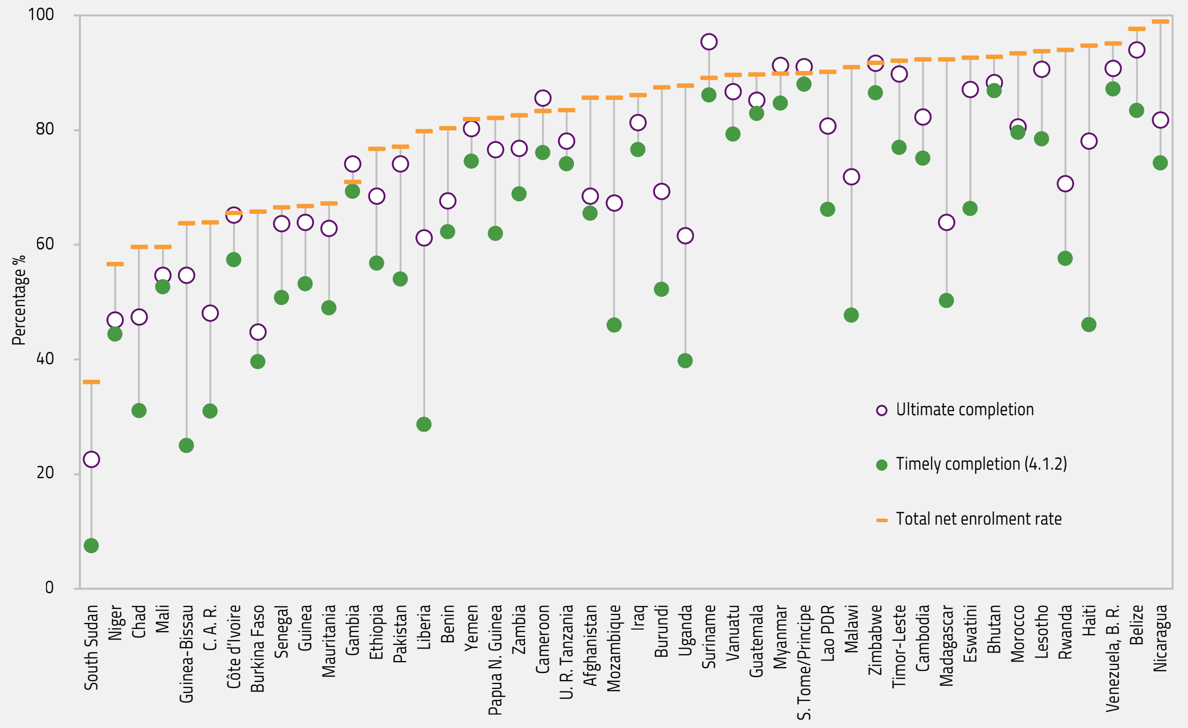
Continued on next page

BOX 12.2: CONTINUED

FIGURE 12.5:

In many countries with relatively high enrolment rates, a large share of students do not complete primary school

Estimated primary total net enrolment (2014) and (timely and ultimate) primary completion rates (2020), selected low- and lower-middle-income countries



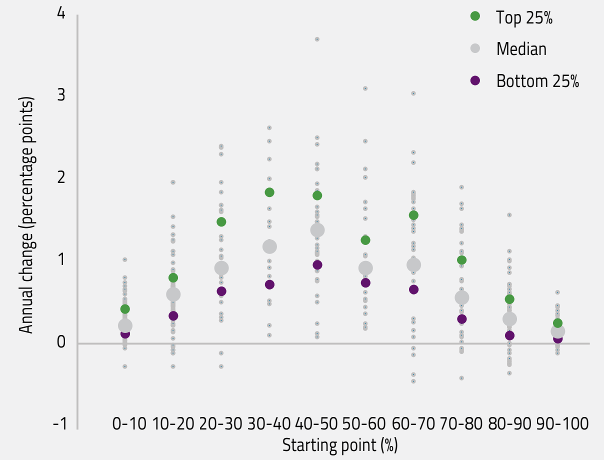
GEM StatLink: https://bit.ly/GEM2023_fig12_5
Source: VIEW website.

Historical data are needed to forecast the speed at which countries will progress in the coming years. As part of the first report on countries' progress towards their national benchmarks, countries' progress given their starting points was analysed as a basis for evaluating whether their recently observed progress meets expectations (UIS and GEM Report, 2023). Progress tends to be greater among countries whose existing completion rate was around 50% and slower among those starting from a lower or higher point. In the case of the upper secondary completion rate, among countries that start with a completion rate value between 60% and 70%, the average country in 2000–15 had an annual increase of just under 1 percentage point. But the slowest 25% of countries improved by less than 0.7 percentage points per year, while the fastest 25% of countries improved by almost 1.6 percentage points per year (**Figure 12.6**). As of 2023, the upper secondary completion rate is projected to have reached 60% globally. If progress is at average past rates, then it will reach 66% by 2030; if it is at the level of the historically 25% fastest country, then it will exceed 70%.

FIGURE 12.6:

Countries' progress rates increase as they move closer to a 50% starting point and gradually decrease from that point onwards

Annual percentage point change in the upper secondary completion rate, by starting point and quartile, 2000–15



GEM StatLink: https://bit.ly/GEM2023_fig12_6
Source: GEM Report team analysis based on the VIEW database.

BOX 12.3:

In Somalia, fewer than one in five children complete primary school

Somalia has suffered from three decades of state dissolution, conflict and instability, which has been compounded intermittently – but also most recently – by drought and famine episodes. Its public education system has likewise suffered a meltdown. In 2020, among primary schools, just 3% were public and 39% were private but publicly supported; among secondary schools, 5% were public and 22% were private but publicly supported (Somalia Federal Government, 2022).

As the education system disintegrated, efforts to monitor education development in the country have struggled. To date, Somalia is the only African country since records began in 1970 without any data point on thematic SDG indicator 4.1.3, the gross intake rate to the last grade of primary education (which is a proxy of the primary completion rate).

The lack of a population census, from which to sample a representative set of households, challenges attempts to generalize findings from household surveys, especially in the context of the most extreme mix of demographic conditions: nomadic populations, rapid urbanization and some 1.1 million internally displaced people (World Bank, 2019) out of an estimated population of 17 million. Extreme levels of insecurity make field research a high-risk activity and have resulted in some of the most vulnerable districts being excluded from many surveys. Education questions have also been asked in inconsistent ways, which has prevented comparisons.

Nevertheless, data from various household surveys from the last 20 years can be pieced together to draw tentative conclusions. The 2006 Multiple Indicator Cluster Survey, which was the second and last nationally representative of this family of surveys, provides a baseline. It estimated the primary net attendance rate at 23%, ranging from less than 5% among the poorest fifth and 53% among the richest fifth of households (and from 12% in rural to 41% in urban areas). The secondary net attendance rate was 7%, ranging from less than 1% among the poorest three fifths to 22% for the richest fifth of households (and from 1% in rural areas to 14% in urban areas) (UNICEF Somalia, 2006). Based on these data, the GEM Report team estimated that the primary completion rate was 24% (18% for girls) and the upper secondary completion rate was 6% (1.5% for girls) in 2006.

Two surveys, close to nationally representative, have been carried out in recent years with the somewhat improved security situation. But they provide contradictory estimates. In 2017, the second wave of the Somali High Frequency Survey in 2017 suggested that the primary net attendance rate may have increased to 33%. It also estimated that the rate was lower for internally displaced people (25%) and for nomads (10%) (World Bank, 2019). But the 2018–19 Somali Health and Demographic Survey provided a more pessimistic account, suggesting that the primary net attendance rate was only 18% (20% for boys and 17% for girls). It also estimated an upper bound of the primary completion rate for girls aged 15 to 19, when it suggested that 19% had 'some levels of primary education', which suggests that there has been no education progress in the past 20 years (Somalia Directorate of National Statistics, 2020).

The latter account is also consistent with administrative data, which indicate that the net primary enrolment rate was 16% in 2020/21 (Somalia Ministry of Education Culture and Higher Education, 2021). It can therefore be concluded that education development has regressed since the 2006 baseline, with an estimated 13% to 17% of children reaching grades 6 to 8. It is estimated that 45% of children aged 6 to 13 have never been to school (Somalia Federal Government, 2022). On the basis of this indicator, Somalia is one of the three educationally least developed countries in the world, alongside Chad and South Sudan.

A particular difficulty in assessing the education situation is that a sizeable share of children in school attend Qur'anic schools. In 2018–19, among the two in five children aged 9 in school, half were in secular and half in Qur'anic schools (Somalia Federal Government, 2022), with many children attending both systems. Despite rudimentary conditions, these Islamic schools have offered a fallback when formal schools collapsed in periods of crisis, due in part to their community ownership (Mohamed-Abdi, 2003; Moyi, 2012; Somalia Federal Government, 2018). Nevertheless, they pose a challenge as they are not under the supervision of the education ministry (Somalia Ministry of Education Culture and Higher Education, 2017).

LEARNING

Compared to access and completion statistics, analysis of learning faces distinctive challenges. First, data on learning outcomes are far less readily available. For instance, four in five countries do not have any data for learning in grades 2/3; roughly one in two countries do not have any data for learning at the end of primary and lower secondary education. Trend data are even more scarce: at most, 13 of the 82 low- and lower-middle-income countries have 2 observations for reading at the end of primary education since 2013, while other combinations of level and subject have even fewer trend data points. Second, even when trend data exist, the quality is insufficient to allow robust assessments of change over time, despite significant efforts by the UIS to align multiple assessments for comparable measures of minimum proficiency (UIS, 2023a). These measures include only some basic skills: writing is not one of them, despite its importance. It is also a skill that is potentially being affected by technology (**Focus 12.1**).

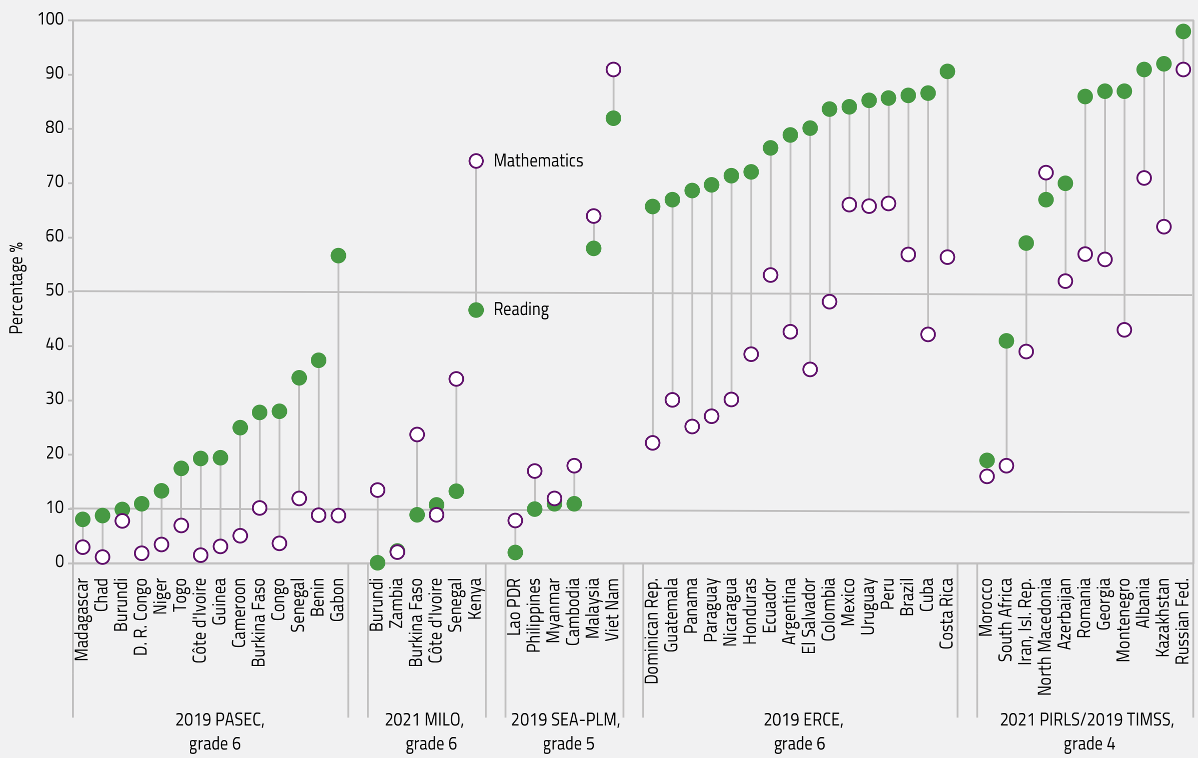
> "Roughly one in two countries do not have any data for learning at the end of primary and lower secondary education"

The data available show that low- and middle-income countries are far from reaching universal minimum proficiency. Of the 31 low- and lower-middle-income countries for which there are data since 2019, only Viet Nam has a majority of children achieving minimum proficiency in both reading and mathematics at the end of primary school. By contrast, in 18 of these countries, fewer than 10% of children are reaching minimum proficiency in reading and/or mathematics (**Figure 12.7**).

FIGURE 12.7:

Most low- and middle-income countries are far from reaching universal minimum proficiency

Percentage of students at or above minimum proficiency level at the end of primary school, reading and mathematics, selected low- and middle-income countries, 2019–21



GEM StatLink: https://bit.ly/GEM2023_fig12_7

Note: Results for the 2019 ERCE are adjusted by the results of the Rosetta Stone project that equated its results with those of PIRLS and TIMMS (UIS, 2022b). ERCE: Regional Comparative and Explanatory Study. MILO: Monitoring the Impacts on Learning Outcomes (project). PASEC: Programme d'Analyse des Systèmes Éducatifs de la CONFEMEN. PIRLS: Progress in International Reading Literacy Study. SEA-PLM: Southeast Asia Primary Learning Metrics. TIMMS: Trends in International Mathematics and Science Study.

Source: UIS database.

Combining the two SDG target 4.1 global indicators on completion (4.1.2) and learning (4.1.1) into a single measure is a succinct way to capture progress. It has been recognized by the Inter-agency and Expert Group on SDG Indicators as a form of disaggregation of global indicator 4.1.1. The UIS and the GEM Report consider this indicator as describing the percentage of children who are 'prepared for the future' and the UIS lists it as indicator 4.1.0. The indicator draws the attention of policymakers, public opinion and the international community to the percentage of an entire cohort in the population reaching an education level (grade 3, end of primary and end of lower secondary) and who are proficient in a given subject (reading or mathematics), according to the global minimum proficiency level. For instance, in Benin, 45% of children achieved minimum proficiency in reading at the end of primary school; but considering that one in three children did not reach the end of primary school, only 30% of children in the primary school age cohort achieved minimum proficiency in reading.

An extension of this analysis shows the extent to which children achieve proficiency in one or both subjects. For example, only one in five children who achieved minimum proficiency in at least one of the two subjects achieved minimum proficiency in Chad and Congo, but three in five did in Kenya and Madagascar. Overall, even among the one in five children who reach the end of primary in sub-Saharan Africa and achieve minimum proficiency in reading or mathematics, only one in three appear to achieve minimum proficiency in reading and mathematics (**Figure 12.8**).

> For every child to achieve minimum learning proficiency by 2030, average annual progress must be at least 2.7 percentage points

In order to predict progress in learning, past trends must be considered. For every child to achieve minimum learning proficiency by 2030, average annual progress must be at least 2.7 percentage points. Piecing together the sparse trend data, the average progress observed in reading at the end of primary education in 2000–19 was just 0.4 percentage points (UIS, 2023b).

Disaggregated by country income group, low- and lower-middle-income countries have improved (by 0.71 percentage points per year), while upper-middle- and high-income countries have deteriorated (by 0.06 percentage points per year). One factor supporting the faster increase in learning outcomes in poorer countries is improved nutrition conditions, including through school meals (**Focus 12.2**). These estimates are important to inform discussions on the learning crisis but must be used with extreme caution: 52% of children live in countries where there are not enough data points to estimate learning trends.

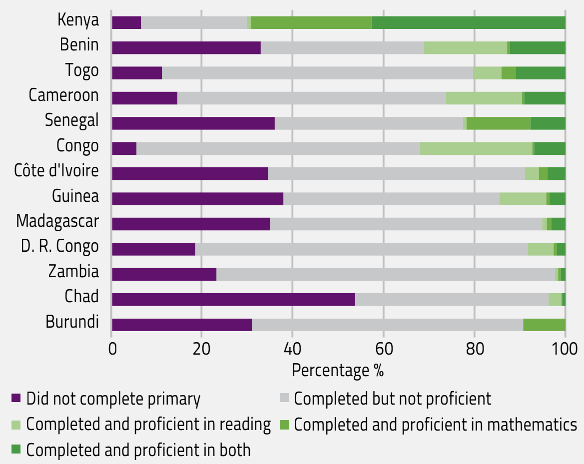
Another way to look at trends is to analyse the annual change in the minimum proficiency level relative to the countries' starting points, as presented above for the completion rate. Since 2011, the share of students at the end of primary education with minimum proficiency in reading has increased faster in poorer countries, which began from a low starting point (**Figure 12.9**).

A similar distribution of progress characterizes proficiency in mathematics at the end of primary education. Armenia progressed well above the average – by 2.4 percentage points per year – among the group of countries that started with a share of students achieving minimum proficiency between 50% and 75%. Türkiye progressed above the average by even more – 3.3 percentage points per year. In Türkiye, improvements in learning outcomes

FIGURE 12.8:

Among the few African children who reach minimum proficiency in reading or mathematics, only one in three achieve proficiency in both

Distribution of primary school age population by primary school completion status and minimum learning proficiency status at the end of primary education, selected sub-Saharan African countries, 2019–21



GEM StatLink: https://bit.ly/GEM2023_fig12_8
Note: Ultimate completion rates (i.e. completion within up to eight years of the expected age of completion) were used.
Source: GEM Report team analysis of international learning assessments and household survey data.

FIGURE 12.9:

Poorer countries improved reading proficiency levels faster than richer countries

Average annual change in percentage points in the share of students who achieved a minimum level of proficiency in reading at the end of primary education, by starting point and country income group, 2011–21

GEM StatLink: https://bit.ly/GEM2023_fig12_9

Source: GEM Report team analysis using cross-national assessment data.

have been associated with an increase in public education expenditure, from 3.8% of GDP in 2010 to 4.4% in 2019, alongside an increasing prioritization of learning outcomes (Kitchen et al., 2019).

Estimates of slow growth in learning outcomes do not even take into account COVID-19, which dealt a heavy blow to education systems. Major questions remain about the impact of COVID-19 on learning outcomes, not only its size and unequal distribution but also whether it is short-term, one-off or prolonged and will affect student learning trajectories for years to come.

The first robust piece of cross-national evidence on the impact of COVID-19 is the 2021 Progress in International Reading Literacy Study (PIRLS) on grade 4 students, whose results were released in May 2023. Students from 57 mostly upper-middle- and high-income countries participated. Progress relative to 2016 could be assessed for 32 of these countries. In one sense, the 2021 PIRLS confirms that COVID-19 had a negative impact on learning: 21 of 32 countries performed worse in 2021 than in 2016, while 8 retained the same levels and 3 improved. But the results could also be interpreted as not as bad as expected. In 10 of the 21 countries whose achievement scores fell between 2016 and 2021, the score had also decreased between 2011 and 2016. Moreover, in absolute terms, the average decline in the PIRLS score between 2016 and 2021 was eight points, which is about one fifth of what children learn in a school year, a small impact given the magnitude of the disruption. Still, it is a significant consideration that these were wealthier countries with many opportunities to maintain learning continuity for most of their students.

Aside from PIRLS, and while anticipating the release of other cross-national assessment data, several country-specific studies have been published in the last two years. However, they are not anchored to the SDG 4 global proficiency level and comparability is further hampered by these studies being carried out at different times, levels and subjects. Nonetheless, these studies suggest that COVID-19 took a toll on education systems. This appears to be particularly true for poorer countries, where schools were closed for longer periods, and distance learning solutions were few and less effective than in richer countries. As most studies come from high-income countries (Hammerstein et al., 2021a; Moscoviz and Evans, 2022; Patrinos et al., 2022), there is a concern that they underestimate the impact in lower-income countries.

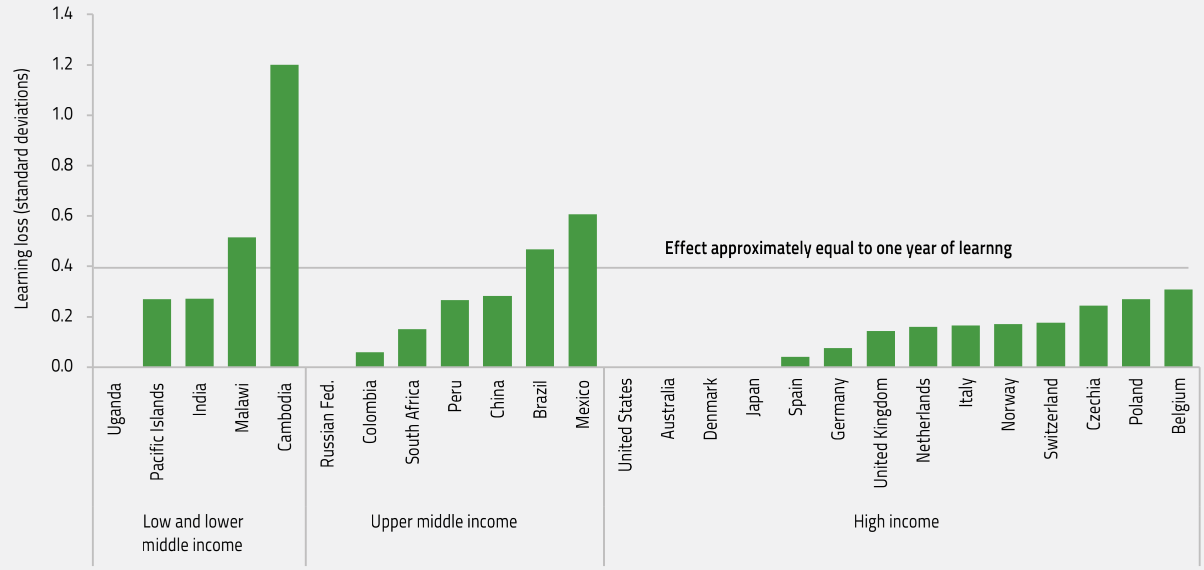
Country-specific studies measure learning loss using different outcomes. Expressing the impact on the standard deviations of learning outcomes (a measure of dispersion) can offer a common scale and basis for comparison to facilitate cross-country comparisons. These studies also differ in their design. For example, observed learning outcomes after students returned to school are compared with expected outcomes based on past trends in some studies but with actual observed outcomes before COVID-19 in gross domestic product. There is evidence that learning loss was greater in primary than in secondary school, possibly due to younger children's weaker self-regulation skills (Hammerstein et al., 2021). Thus, countries with primary school evidence will likely yield higher learning loss compared with country studies conducted in secondary schools.

The data reveal significant variations in the size of learning losses across countries and distance learning modalities, with smaller effects in high-income countries (**Figure 12.10**). The largest losses are observed in Brazil and Mexico, where they exceeded 40% of a standard deviation in learning outcomes, which is usually equated with one year of education. There were also high impacts measured in Cambodia and Malawi. However, the more robust Monitoring Impacts on Learning Outcomes study in six sub-Saharan African countries did not suggest any major impact (UIS, 2022a), although caution is needed in the interpretation: if learning levels in sub-Saharan Africa were growing prior to the pandemic, then lack of progress is a negative development.

FIGURE 12.10:

Learning loss due to COVID-19 appeared stronger in poorer countries

Standardized measure of learning loss, selected countries



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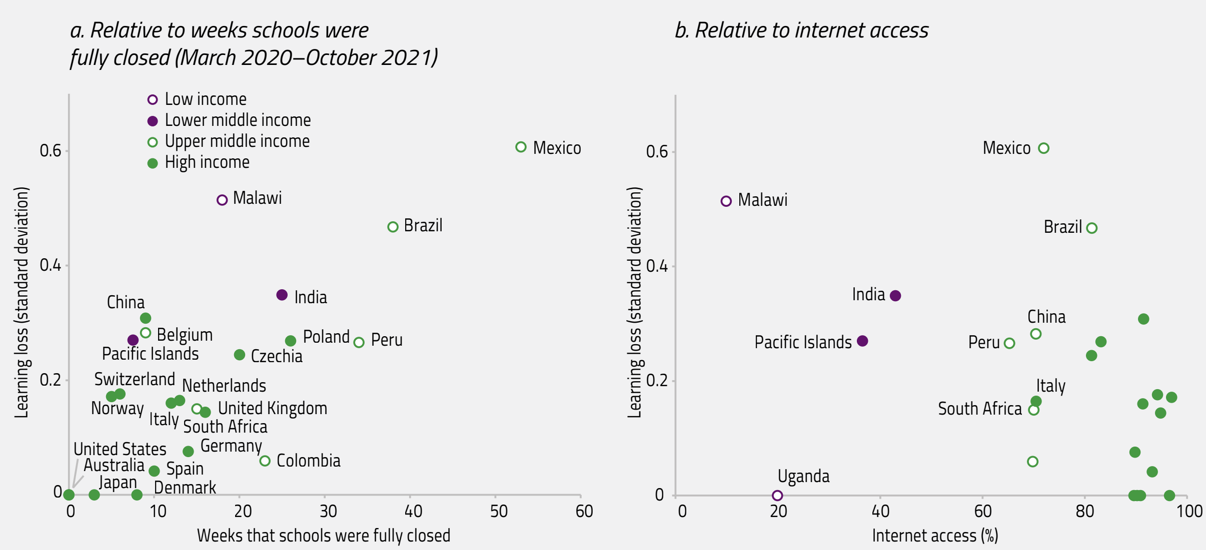
Note: The standardized measure on the vertical axis represents the loss in learning outcomes due to school closures divided by the standard deviation of the corresponding outcome. The measures of learning loss and its standard deviation are extracted from 31 studies containing post-COVID data, i.e. studies with achievement data obtained after students returned to school. Simulation studies were discarded. The methods (e.g. differences-in-differences), education levels (e.g. primary, secondary), subject areas and target populations (e.g. regions from the same country) varied between and within countries across the studies. In cases where multiple estimates were available per country, the average was computed. Data from the Pacific Islands are aggregate, reported for reading and mathematics in the Pacific Islands Literacy and Numeracy Assessment study.

Source: GEM Report team learning loss estimates based on country studies.

FIGURE 12.11:

The size of learning loss is proportional to the duration of school closures and internet access

Standardized measure of learning loss, before and after COVID-19



GEM StatLink: https://bit.ly/GEM2023_fig12_11

Source: GEM Report team learning loss estimates and analysis of UIS data.

As could be expected, learning losses have been greater in countries with longer school disruptions, usually lower-income countries (**Figure 12.11a**). The correlation between learning loss and the number of weeks schools were closed was −0.72 across countries. For example, the size of the learning loss in Mexico was 61% of the standard deviation during the 53 weeks schools were closed, whereas students in Colombia experienced losses of 6% during the 23 weeks schools were closed.

Learning losses were greater in countries where students did not have access to the internet (**Figure 12.11b**). The correlation between learning loss and internet access was 0.48 across countries. In Malawi (but not in Uganda), where at most 20% of the population has access to the internet, the decline in learning was equivalent to at least one year of schooling (>40%). In contrast, learning losses were small or negligible in Australia, Denmark, Japan and Spain, where 90% or more of the population has internet access.

FOCUS 12.1: (HOW) DO WRITING TOOLS AND TECHNIQUES MATTER?

Despite being part of the 'three Rs' of basic skills taught in schools, writing – unlike reading and mathematics – is rarely included in standardized learning assessments. The 2019 Regional Comparative and Explanatory Study assessment in Latin America, known by its Spanish acronym, ERCE, included a module for assessing writing skills, but the results, which showed that struggles with writing are at least as widespread as with those reading, were not widely disseminated. In the United States, the National Assessment of Educational Progress (NAEP) included a writing module in 2007, 2011 and 2017. The results from 2011 show a stark gender gap, with 37% of girls performing at a proficient or advanced level compared to 18% of boys. The 2017 results have not been made available because preliminary analyses revealed confounding factors affecting them: in particular, the writing task used to be a pen and paper task, but was moved to laptops for the 2011 assessment and then to tablets in 2017.

The challenges presented by the choice of writing technology is a clear reminder that writing has a material dimension that cannot be separated from technology, whether it is writing on a slate with chalk or writing on a tablet with a stylus. Writing is, in and of itself, technology (Haas, 2013). Creating a visual mark for others to read has a history spanning millennia, starting with drawing in the sand with toes, fingers or a stick. Other writing surfaces and instruments have included papyrus, clay, ink applied with quills and mechanical typewriters.

“Writing has a material dimension that cannot be separated from technology”

Technology also has a role to play in writing, from the banal, such as automatic spell-checking, to the less tangible, such as enabling online collaborative critique. Assistive technologies are also key for writing, even if they tend to blur the line between writing and speaking: cheek-controlled virtual keyboards (Lange, 2011) may count as writing but are a stepping stone for text-to-speech synthesis. Conversely, even the relatively well-established technology of speech-to-text conversion has so far not diminished the continuing reliance on mechanical writing in classrooms, although this may change in the future. In a survey in Sweden, more than a third of teachers reported using speech-to-text technology to help writing instruction with all their students, not just the ones needing assistance, 'once or several times' per week (Fälth and Selenius, 2022).

But technology also has a role to play in the physical act of writing. Two technologies predominate: pens, pencils and paper on the one hand and screens and keyboards on the other. Less clear is how each shapes language performance and learning. A variety of studies shows that each technology may have learning benefits.

Multisensory learning (Shams and Seitz, 2008) might be one of the reasons explaining experimental research showing higher learning gains in handwriting (Vasylets and Marín, 2022) or the retention of notes taken (Mueller and Oppenheimer, 2014). Stimulation in the reading brain circuitry of 5-year-olds was found when they were handwriting but not when they were typing (Lee et al., 2022). A recent review documents evidence (partly from neuroimaging) on the benefits of handwriting, notably including with digital pens, in terms of writing letters and words as well as reading (Vasylets and Marín, 2022). One hypothesis is that the variability in handwriting provides a stimulus beneficial for learning.

By contrast, the greater amount of movement involved in typing, in turn, offers kinaesthetic learning benefits of its own (Askvik et al., 2020). However, differences in alphabet matter. In Chinese language learning, for instance, handwriting benefited learners' orthography and orthography-semantic mapping, while typing showed an advantage in phonography recognition and phonology-orthographic mapping (Lyu et al., 2021).

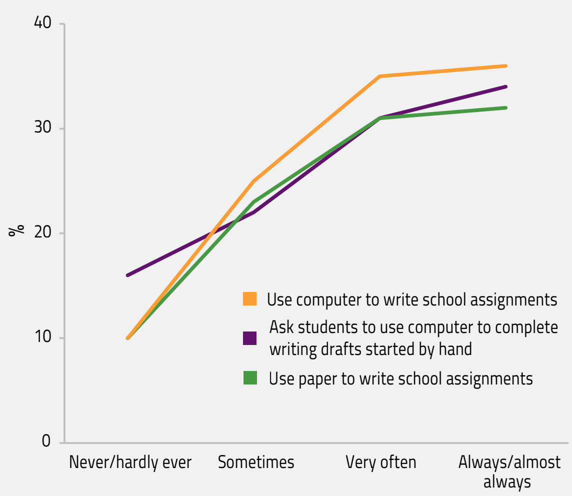
> Recent writing research has provided evidence that typing might favour writing processes and performance

Another question is whether the choice of writing technology impacts the style and literary quality of the writing. As linear finger movements are less demanding of motor skills, learners can reach an 'automatic' level faster when typing, leaving more time to think about higher-level features of what they want to write (Trubek, 2016). While some true- and quasi-experimental evidence does point in the direction of handwriting making better writers (Santangelo and Graham, 2016), recent writing research has provided evidence that typing might favour writing processes and performance (Vasylets and Marín, 2022). A meta-analysis found that handwriting and keyboarding fluency were significantly related, and both make for better writers (Feng et al., 2019). A study of Norwegian grade 1 students found no difference between texts written with pen on paper or touch-typed on a tablet (Spilling et al., 2021). A small-scale qualitative study suggested that students, especially reluctant writers, were more motivated to write longer texts when typing (Rønningsbakk, 2022). Indeed, offering typing as an alternative is a well-established accommodation in response to certain learning or functional difficulties (Freeman et al., 2005).

FIGURE 12.12:

Strong writers can be found both among those writing by hand and those typing

Grade 8 students scoring at a 'proficient' or 'advanced' level in writing, by student self-reported usage of using pen and paper or a computer to write for school assignments and by teacher-reported frequency of requesting mixed use, United States, 2011



GEM StatLink: https://bit.ly/GEM2023_fig12_12
Source: 2011 NAEP.

Ultimately, in their daily lives outside of school, young people tend to use different writing technologies depending on their subjective advantages and disadvantages in a given context (Farinosi et al., 2016). More important than the choice between them may be the proficiency in the chosen technique. When handwriting is used, *better* handwriting is associated with higher text quality (Limpo et al., 2017; Skar et al., 2021) and academic success (McCarroll and Fletcher, 2017). Similarly, without the ability to touch-type, in other words, type without looking at the keys, typing is not necessarily faster than handwriting (Weigelt-Marom and Weintraub, 2018) and the quality of texts written on a computer suffers (Weerdenburg et al., 2019). Students in grade 8 at schools that required better keyboarding skills scored higher in the NAEP writing task.

Detailed data from the NAEP on the writing habits and performance of grade 8 students in the United States show that both students who report writing their school assignments by hand more frequently and those who use a computer more frequently score higher writing scores (**Figure 12.12**). The same is true of students whose teachers encourage them to use a mixed approach of editing and finishing handwritten early drafts on a computer.

Whether typing, handwriting or using a combination of the two, students always had higher proficiency levels when carrying out writing assignments more often. What seems to matter most is simply performing writing assignments frequently, by any means. It seems then that, as handwriting and typing are not mutually exclusive in real life, both have a place in the classroom.

FOCUS 12.2: HEALTHY SCHOOL MEALS ARE KEY TO UNIVERSAL EDUCATION AND LEARNING

Hungry children learn poorly. School feeding can play a key role in supporting cognitive performance. Evidence of the positive effects of school feeding on the health and physical development of children, as well as their schooling, is confirmed by systematic reviews (Destaw et al., 2022; Kristjansson et al., 2007; D. Wang et al., 2021). This includes the benefits that India's midday meal scheme – the world's largest programme – brings to learning (Chakraborty and Jayaraman, 2019), especially for the most disadvantaged (Kaur, 2021). In a cost–benefit analysis across 14 low- and middle-income countries, the education returns alone amounted to the equivalent of USD 156 billion, a tenfold return on its cost of USD 11 billion (Verguet et al., 2020).

Feeding children at school, especially without charging families (**Chapter 22**), serves as a significant attendance incentive for disadvantaged households. If designed well, large-scale school feeding programmes can also provide local employment opportunities, including to farmers. Strong efforts were made to continue operating school feeding programmes even while schools themselves were closed during the early stages of the COVID-19 pandemic (Borkowski et al., 2021), highlighting the importance of school feeding in emergencies.

Even countries that have low capacity or struggle to implement teacher management or pedagogical reforms have successfully implemented large-scale school feeding programmes (Beeharry, 2021); their positive effects are relatively robust even for programmes with weak implementation. Unlike many interventions that require highly skilled technical staff or make large demands on teachers, school feeding tends to remain effective when scaled up (Crawfurd et al., 2022).

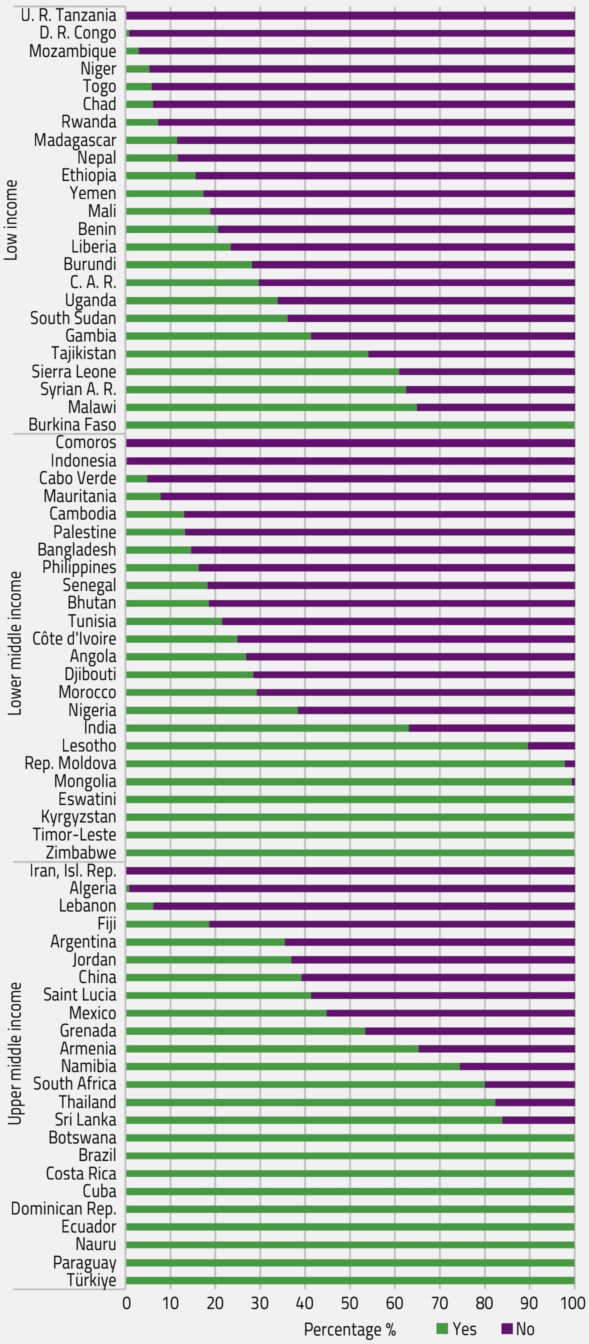
There is a pressing need for further improvement: an estimated one in three children lacks access to healthy food (Cupertino et al., 2022). Some 73 million children in low- and middle-income countries live in extreme poverty with significant nutrition deficits (Drake et al., 2020). In sub-Saharan Africa, 32% of children, or almost one in three, are affected by stunting. In Central and Southern Asia, 14% of children are affected by wasting (DESA, 2022). At the same time, low- and middle-income countries are home to about 40 million overweight young children under 5 and 120 million children and adolescents who are obese. Hunger, malnutrition and obesity add up to a triple burden, and providing balanced meals at schools is an important part of relieving it.

Almost every country implements some kind of school feeding programme (Chakrabarti et al., 2021). In 2020, school feeding programmes reached 388 million, or about one in two schoolchildren (WFP, 2020). Unfortunately, the coverage is lowest in low-income countries (**Figure 12.13**). Whereas most programmes in upper-middle-income countries reach the majority of children, more narrowly targeted programmes are more commonplace in low- and lower-middle-income countries, those countries with the greatest need.

FIGURE 12.13:

School feeding tends to be most limited where it is needed the most

Coverage of national school feeding programmes, by country income group, selected countries, 2020



GEM StatLink: https://bit.ly/GEM2023_fig12_13
Source: WFP (2020).

School feeding programmes face many challenges. When poorly designed, they can exacerbate poor children's experience of exclusion (O'Connell et al., 2022). School meals have only a limited effect on malnutrition if they are not sufficiently nutritious (H. Wang et al., 2020). Not all foodstuffs are equally nutritious, nor are all combinations of nutrients equally valuable for growing children. At the same time, food ingredients differ in their seasonal availability, nutrient density and price. With poor regulation and cost cutting, many countries' programmes are using more ultra-processed foods. In the United Kingdom, secondary school children get almost 80% of their lunch calories from them. The share of such food is far too high in school meals, although packed lunches children bring from home tend to be even worse in terms of nutrition (Parnham et al., 2022).

> “With poor regulation and cost cutting, many countries' programmes are using more ultra-processed foods”

Modern nutrition science provides guidance on combining foods in meals that offer variety and a cost-efficient way to growing children's calorie and nutritional needs. The most promising approach is to fortify staples that are routinely consumed by most people. Nutritional considerations are a critical part of the school feeding process, but 23 low- and middle-income countries have not published official nutrition guidelines for school meals (Aliyar et al., 2015; FAO, 2019).

The Home Grown School Feeding initiative aims to integrate school feeding with agricultural development and poverty reduction. Home-grown school feeding aims to connect local smallholder or family farmers to schools and school communities. Farmers benefit from a predictable buyer and the opportunity for greater investment, and food gets transported over shorter distances, resulting in multiple sustainable development gains. Home-grown school feeding is currently supported in 46 countries by the World Food Programme with technical support and a resource framework (WFP, 2023), while other countries have similar multisectoral schemes under national ownership.

The integration of smallholders and schools into local food supply chains can be facilitated by the judicious use of technology, such as in transportation, tagging and monitoring logistics, and increasing transparency. For example, artificial intelligence-based routing and scheduling was used to optimize the delivery of school meals using school buses during COVID-19 school closures in the United States (Smith et al., 2020).

Logistics are also important for hygiene. Almost a third of the global population is affected annually by foodborne illnesses (Cupertino et al., 2022). The lack of cold-chain technology limits the use of fish in several countries, including Angola, Honduras, Peru and even in island states such as Sao Tome and Principe (Ahern et al., 2021). Where home-grown school food programmes use produce from non-commercial family farms, they must be monitored for compliance with hygiene practices, as contamination of meat and fish is not uncommon, as documented, for instance, in Brazil (Rosso et al., 2021).

Many schools lack basic infrastructure, including for cooking. Across school feeding programmes in low- and middle-income countries, only some 40% of schools hosting the programmes have kitchens. A lack of suitable infrastructure at schools can be overcome either by centralized preparation of meals that are then distributed to schools or by providing dry snacks such as biscuits. Nutritious meals made from locally sourced, fresh ingredients can be prepared in large central kitchens implementing recognized food safety standards. A centralized model has been successfully applied by the award-winning initiative Food4Education in Kenya (Food4Education, 2023), which has four kitchens and the capacity to cater to up to 30,000 children every day. At the schools, the subsidized price for a meal is charged to a tap-to-pay wristband that families can recharge using mobile payment systems.

Food is directly or indirectly responsible for a substantial part of global carbon emissions, both food eaten and food wasted. School food that goes to waste is both an unnecessary environmental burden and missed nutrition (Liu et al., 2016). Especially for children, food must be made palatable. A study in Ghana showed that disadvantaged children with no other options might choose to go hungry if they dislike the school food being served (Mohammed, 2021). Aligning with the local food culture is also important to encourage children to develop cooking skills at school (Cupertino et al., 2022). Eating food, even good food, does not necessarily educate learners about food the way food preparation might (Andersen et al., 2017). Since at least 2006, the World Health Organization framework for addressing nutrition-related health problems in the school environment has adopted a holistic view beyond school feeding itself to include nutrition policy, awareness-raising and training, and a curriculum and school environment supportive of good nutrition (Cupertino et al., 2022).

First day back to school, students of Maramarua Primary School (Fiji) pose as they enjoy their lunch break playing in front of their newly set up UNICEF-supplied temporary classroom.

Credit: UNICEF/UN0410110/Stephen/Infinity Images.*

KEY MESSAGES

The world early childhood education participation rate remained stable at about 75% between 2015 and 2020. The largest increases, of about four percentage points each, took place in sub-Saharan Africa and Northern Africa and Western Asia, the two regions that had the lowest baseline values.

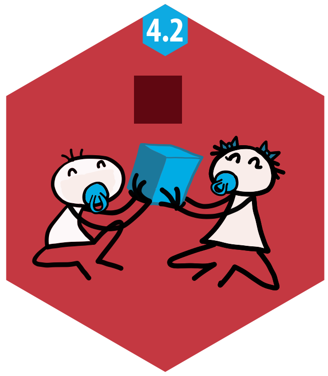
The COVID-19 pandemic set progress back in some countries. Participation rates dropped by about 20 percentage points in selected lower-middle- (Nepal and Philippines), upper-middle- (Albania and Dominican Republic) and high-income countries (Oman and Uruguay).

The average enrolment rate in countries that do not offer any free pre-primary education is 68%, compared with 78% among those that guarantee one and 83% among those that guarantee at least two years of free pre-primary education.

Countries where households have at least three books at home tend to have higher shares of children experiencing positive and stimulating home environments. In nearly 40 countries, many of which are in sub-Saharan Africa, over 90% of children have fewer than three books at home.

Active play outdoors is an essential element of early childhood education, but a study of 28 countries showed that too few children reached high levels of physical activity. The lack of such activity may be a bigger concern in richer and urban contexts, but the rapid advent of technology and long times spent watching screens are turning it into a global policy concern.

CHAPTER 13



TARGET 4.2

Early childhood education

By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education

GLOBAL INDICATORS

4.2.1 – *Proportion of children aged 24–59 months who are developmentally on track in health, learning and psychosocial well-being, by sex*

4.2.2 – *Participation rate in organized learning (one year before the official primary entry age), by sex*

THEMATIC INDICATORS

4.2.3 – *Percentage of children under 5 years of age experiencing positive and stimulating home learning environments*

4.2.4 – *Gross early childhood education enrolment ratio in (a) pre-primary education and (b) early childhood educational development*

4.2.5 – *Number of years of (i) free and (ii) compulsory pre-primary education guaranteed in legal frameworks*

Sustainable Development Goal (SDG) target 4.2 emphasizes the importance of early childhood development. It focuses on monitoring regulations, home environments and early childhood care and education (ECCE) participation, even though several other factors play an important role, including the type and quality of ECCE provision (**Focus 13.1**).

Thematic indicator 4.2.5 measures the number of years of free and compulsory pre-primary education guaranteed in legal frameworks. About half of countries do not offer free provision of pre-primary education, and three quarters of countries do not make it compulsory (**Figure 13.1**). In 2022, 88 out of 186 countries with available data still did not have any legislation committing to either free or compulsory pre-primary education.

Progress has been slow and has slowed down even further since 2015. Between 2010 and 2015, 10 countries increased the number of years of free, and 18 countries of compulsory, pre-primary education. Since 2015, when countries committed to make at least one year of pre-primary education free and compulsory, another 13 countries increased the number of years of free and 5 countries of compulsory pre-primary education. Azerbaijan moved from zero to five years of free pre-primary education between 2015 and 2018 and Latvia now guarantees six years of free and two years of compulsory pre-primary education.

Countries that guarantee free and compulsory pre-primary education tend to have considerably higher enrolment rates. The average enrolment rate for children one year younger than the official primary school entry age in countries that do not offer any free pre-primary education is 68%, compared to 78% among those that guarantee one year free and 83% among those that guarantee at least two years (**Figure 13.2**). Making pre-primary education compulsory has an even stronger association with education participation. The average enrolment increases from 69% in countries where it is not compulsory to 89% in countries where one year is compulsory and 92% in countries where at least two years are compulsory.

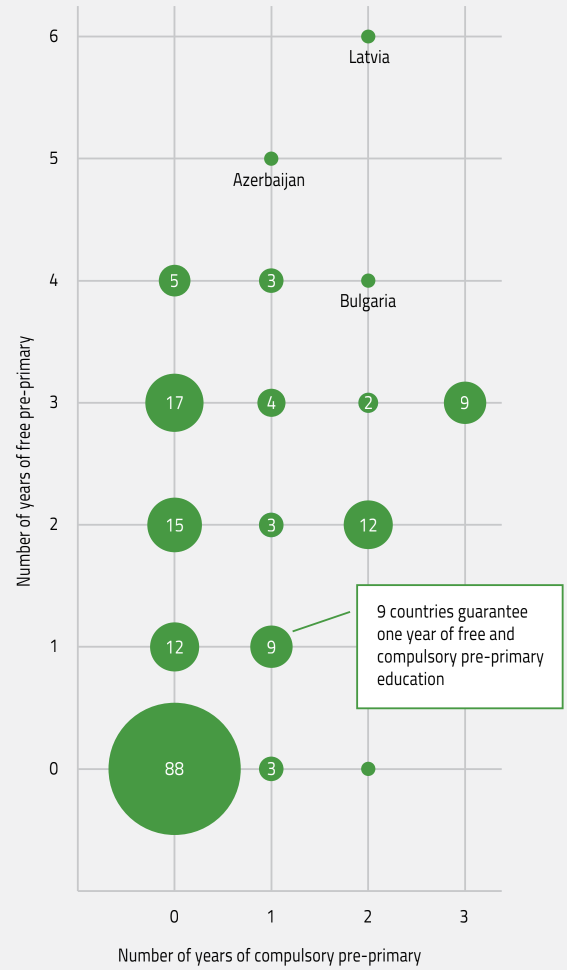
> "Making pre-primary education compulsory has an even stronger association with education participation"

Individual countries' trajectories help confirm the positive effect that legal frameworks can have on pre-primary education. In Azerbaijan, for example, the implementation of compulsory and then free pre-primary education was associated with significant increases in enrolment rates for children one year younger than the official primary entry age (**Figure 13.3a**). In Uzbekistan, the introduction of two years of free and compulsory pre-primary education in 2017 led to the enrolment rate doubling in the following five years. The strength of impact, however, always depends on how countries implement and enforce legislation: in some countries, including for example Kenya and Nigeria, parents are asked to pay hidden fees for uniforms, examinations and textbooks, or administrative costs despite legal guarantees of free education (Cinnamon, 2022; Malala Fund, 2021).

FIGURE 13.1:

Many countries guarantee at least one year of free pre-primary education, but only about one quarter make it compulsory

Number of countries that guarantee free and compulsory pre-primary education in legal frameworks



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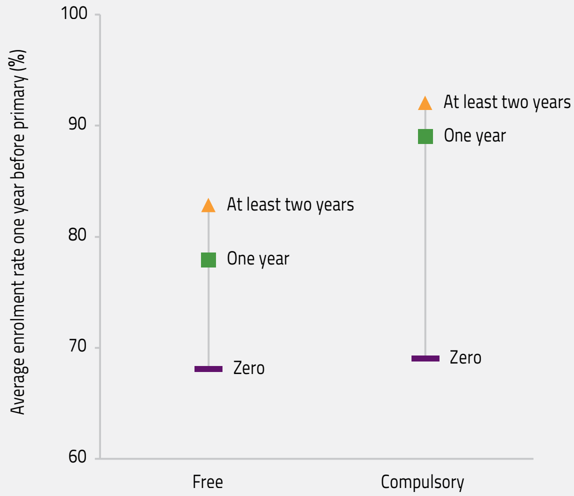
Source: UIS database.

FIGURE 13.2:
Countries that guarantee at least one year of free or compulsory pre-primary education have higher participation rates
Average participation rate in organized learning (one year before the official primary entry age) by number of years of free and compulsory pre-primary education guaranteed in legal frameworks, latest year

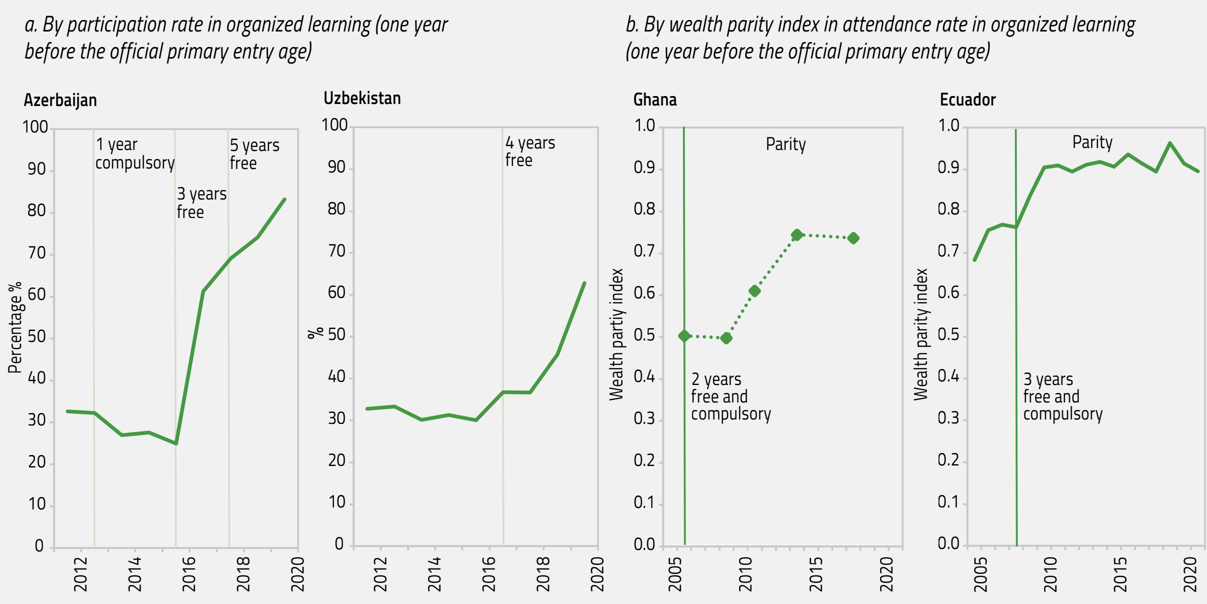


GEM StatLink: https://bit.ly/GEM2023_fig13_2
Source: UIS database.

Legal guarantees can also help improve equity in access to pre-primary education. In Ecuador, where enrolment rates have been relatively high for the past 15 years, a 2008 constitutional reform that increased free and compulsory pre-primary education from 1 to 3 years is associated with an improvement in the wealth parity index – a measure of the gap in attendance between the richest and the poorest children (Ecuador Republic, 2008). Before 2008, the richest children were about 25% more likely to attend pre-primary education than the poorest children, a gap which has more than halved since 2010 (**Figure 13.3b**).

In 2007, Ghana introduced a series of early childhood education policies, including guaranteeing two years of free and compulsory pre-primary education. Given the prevalence of non-state providers, the government also introduced a limit to the level of tuition and other fees charged by private institutions (Pesando et al., 2020). Since then, the net attendance rate for children one year younger than the official primary entry age has been steadily increasing, and the wealth parity index has improved considerably for every 100 of the richest children enrolled, from 50 of the poorest children enrolled in 2006 to 74 enrolled in 2018 (**Figure 13.3b**).

FIGURE 13.3:
Guaranteeing free and compulsory pre-primary education is associated with higher and more equitable participation



GEM StatLink: https://bit.ly/GEM2023_fig13_3
Note: The dotted line indicates that the trend has been interpolated.
Source: UIS database.

Consequently, the lack of free and compulsory pre-primary education legislation risks undermining countries' SDG 4 benchmarks for 2025 and 2030. In total, 117 countries, mostly in Africa and Asia, have set a target for increasing early childhood education participation but without having legislation to make pre-primary education compulsory. For example, Kenya has set a target of over 80% enrolment for children one year younger than the official primary entry age by 2025, and Pakistan a target of 95%, even though neither of these countries offer free or compulsory pre-primary education (UNESCO, 2023).

> At the height of preschool and kindergarten closures in early April 2020, more than 180 million children had their pre-primary schooling disrupted

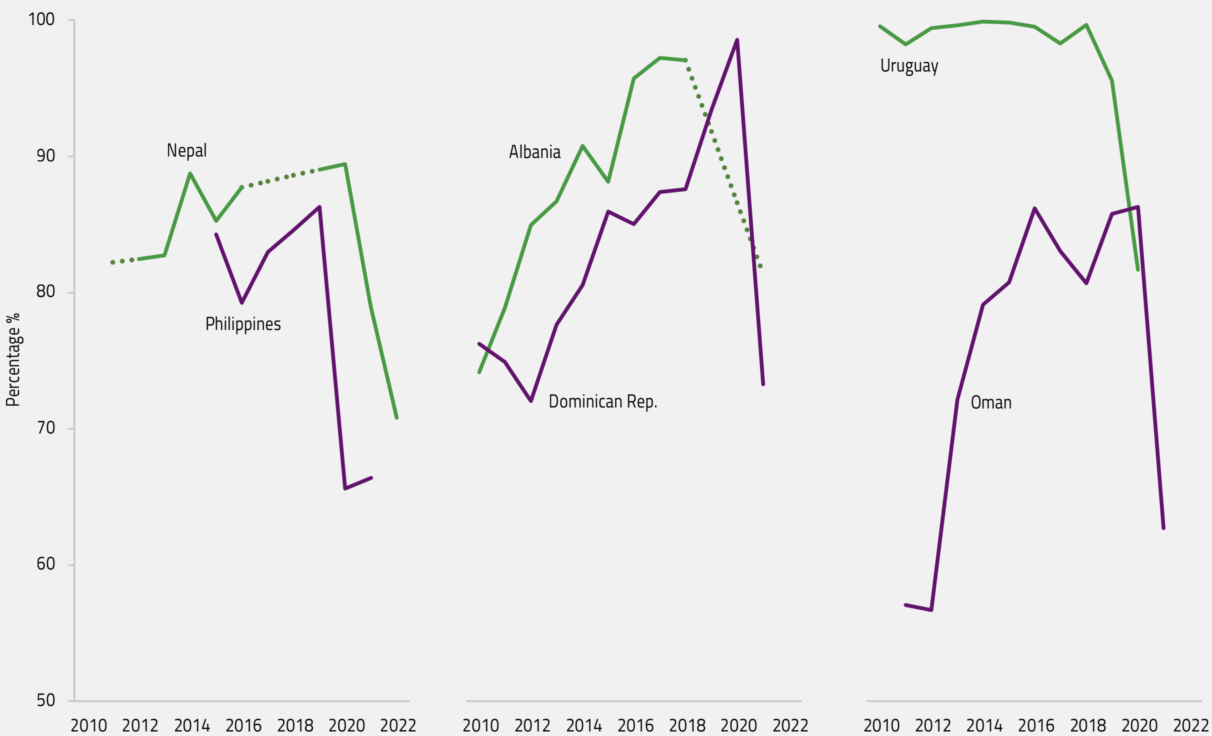
The COVID-19 pandemic may have set progress back in some countries, at least in the short term. At the height of preschool and kindergarten closures in early April 2020, more than 180 million children had their pre-primary schooling disrupted (Nugroho et al., 2021). On average, preschools were closed for 78 days in 2020, ranging from 46 days in high-income countries to 122 days in lower-middle-income countries (UNESCO et al., 2021). Younger children lost more instruction days than primary and secondary students, and they were also less likely to have access to remote learning opportunities (Nugroho et al., 2021).

This disruption caused sharp declines in pre-primary participation in many countries (**Figure 13.4**). In some, the impact was already notable in 2020 and in others in 2021. This was likely because of when student counts were conducted (before or after the peak COVID closures) and the duration of school closures. In the Philippines, for example, enrolment dropped considerably between 2019 and 2020 – from 86% to 66% – and remained equally low in 2021. In Oman, enrolment remained stable in 2020 but dropped by 27% between 2020 and 2021.

FIGURE 13.4:

In some countries, early childhood education participation rates dropped drastically during the COVID-19 pandemic

Participation rate in organized learning one year before the official primary entry age, selected countries, 2010–22



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Note: The dotted segments indicate that the trend has been interpolated.
Source: UIS database.

This fall in participation is likely to exacerbate inequality between and within countries. Low- and lower-middle-income countries kept institutions closed for longer, and disadvantaged children were more likely not to be sent to preschool as families experiencing income losses during the pandemic are believed to have prioritized the education of older children (Al-Samarrai et al., 2020). Absence from preschool comes with a significant impact on children's learning, social and cognitive stimulation (Yoshikawa et al., 2020): one study estimated that the closures between March 2020 and February 2021 alone would result in 11 million more children being developmentally off track (McCoy et al., 2021).

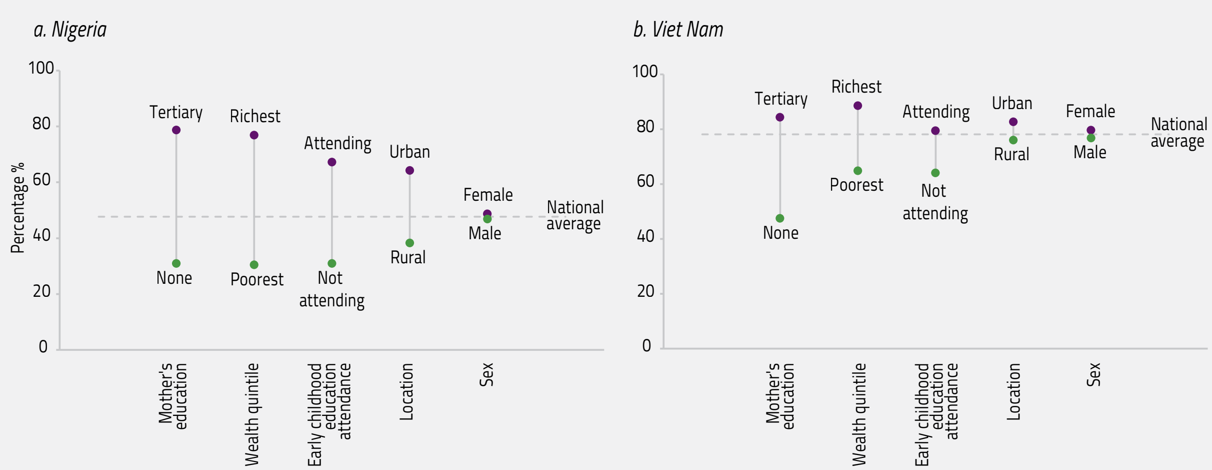
The importance of children's overall development is reflected in global indicator 4.2.1, i.e. the proportion of children under 5 years of age who are developmentally on track in health, learning and psychosocial well-being. Various steps have been taken to improve how this indicator is monitored. Since 2015, UNICEF has systematically reviewed available tools; identified items that measure child development; carried out cognitive tests; and piloted draft questions and administrative procedures. The new monitoring tool, the Early Childhood Development Index 2030 (ECDI2030), has broader and more comprehensive content coverage than the original Early Childhood Development Index (ECDI). It contains 20 questions in 3 interrelated domains: learning, psychosocial well-being and health (UNICEF, 2022). In March 2020, the United Nations Statistical Commission approved the ECDI2030 to be implemented in future rounds of UNICEF's Multiple Indicator Cluster Surveys (MICS) and it has also been included in the Demographic and Health Surveys and in national data collections (Petrowski et al., 2022).

So far, the results from using the ECDI2030 are only available for a few countries. Data from Nigeria and Viet Nam serve as an example of the difference between the old and the new ECDI measures. In both countries, fewer children are considered to be developmentally on track using the ECDI2030 than with the previous ECDI measure. In Nigeria, the share of children developmentally on track using the previous ECDI measure in 2016/17 was 14 percentage points higher than the measure using the ECDI2030 in 2021. In Viet Nam, it was 11 percentage points higher. These results are to be expected given the larger number of developmental subdomains covered in the new module. Nevertheless, as was the case with previous ECDI results (UNESCO, 2021), the new ECDI2030 continues to highlight significant inequality in development across children of different backgrounds. In Nigeria, while 79% of children who have a mother with tertiary education were developmentally on track, the same was true for only 31% of those whose mother has not completed primary education (**Figure 13.5**).

FIGURE 13.5:

The new Early Childhood Development Index highlights inequality

Share of children developmentally on track, Early Childhood Development Index 2030, by characteristic, 2021



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Note: Children aged 2 are excluded from the measure of early childhood education attendance as these data are only collected for ages 3 and 4.

Source: MICS reports.

Target 4.2 also recognizes that much of children's development happens at home, where children first learn to socialize, manipulate objects and materials, develop language, and explore the world around them. Hence, thematic indicator 4.2.3 examines whether children experience a positive and stimulating home environment in the form of adults' engagement in a range of activities: reading or looking at picture books; telling stories; singing songs; taking children outside the home; playing; and naming, counting and/or drawing. Such parenting practices are all associated with better developmental outcomes (Fletcher and Reese, 2005; UNESCO, 2021).

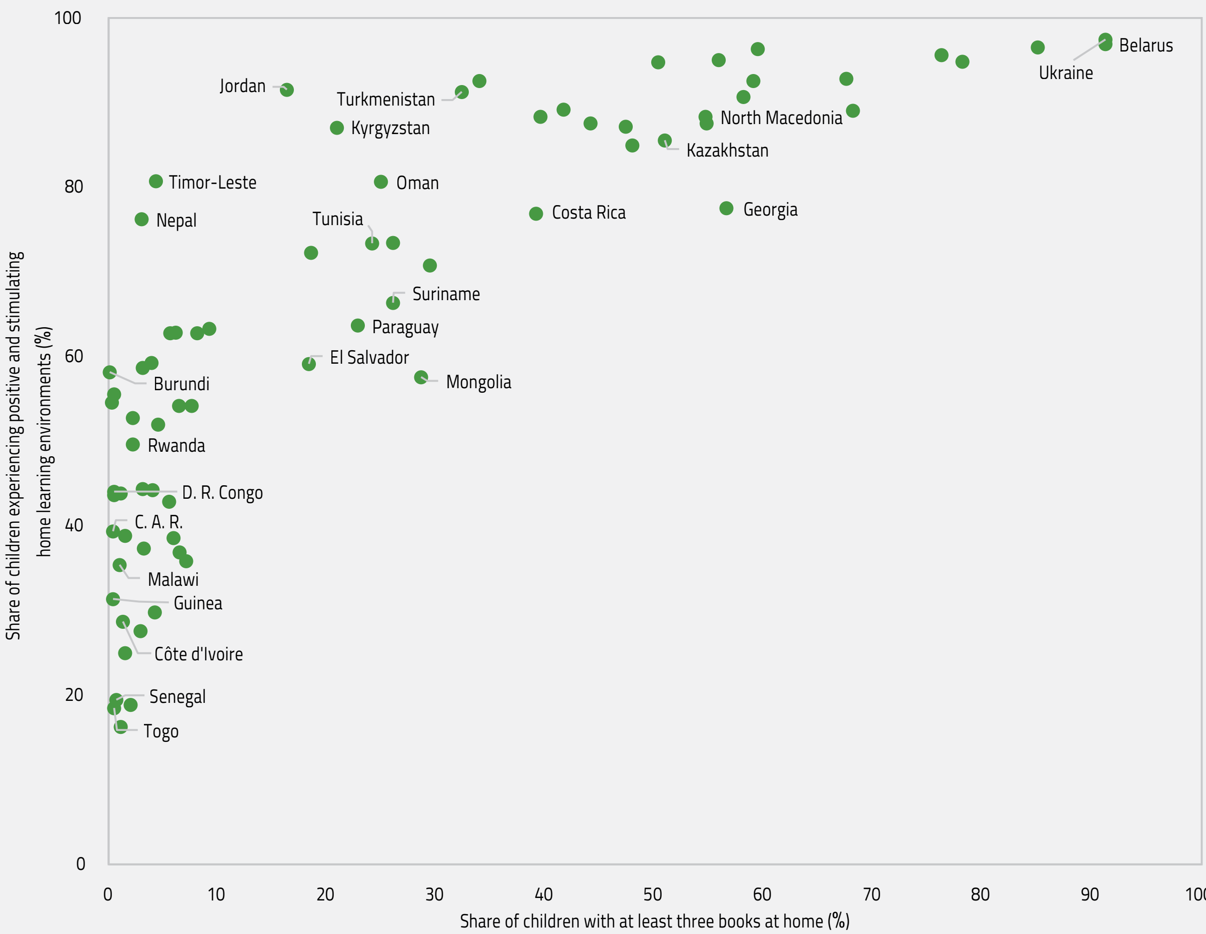
Children from poorer households are consistently less likely to experience positive adult engagement at home. One reason for this pattern is that poverty increases parents' stress and constrains their time, which is instead spent on labour and livelihood challenges (UNESCO, 2020; Verdisco et al., 2016). Another reason may be a lack of materials, such as children's books and toys. Countries where children are more likely to have at least three children's books at home also tend to have higher shares of children experiencing positive and stimulating home environments (**Figure 13.6**). In nearly 40 countries, many of which are in sub-Saharan Africa, over 90% of children have fewer than three children's books at home (UNICEF, 2021).

> "Children from poorer households are consistently less likely to experience positive adult engagement at home"

FIGURE 13.6:

Having books at home is associated with positive and stimulating home environments

Share of children with at least three children's books at home and share of children experiencing positive and stimulating home learning environments, 2010–19



GEM StatLink: https://bit.ly/GEM2023_fig13_6
Source: UIS and UNICEF databases.

BOX 13.1:

Progress since 2015: SDG indicator 4.2.2

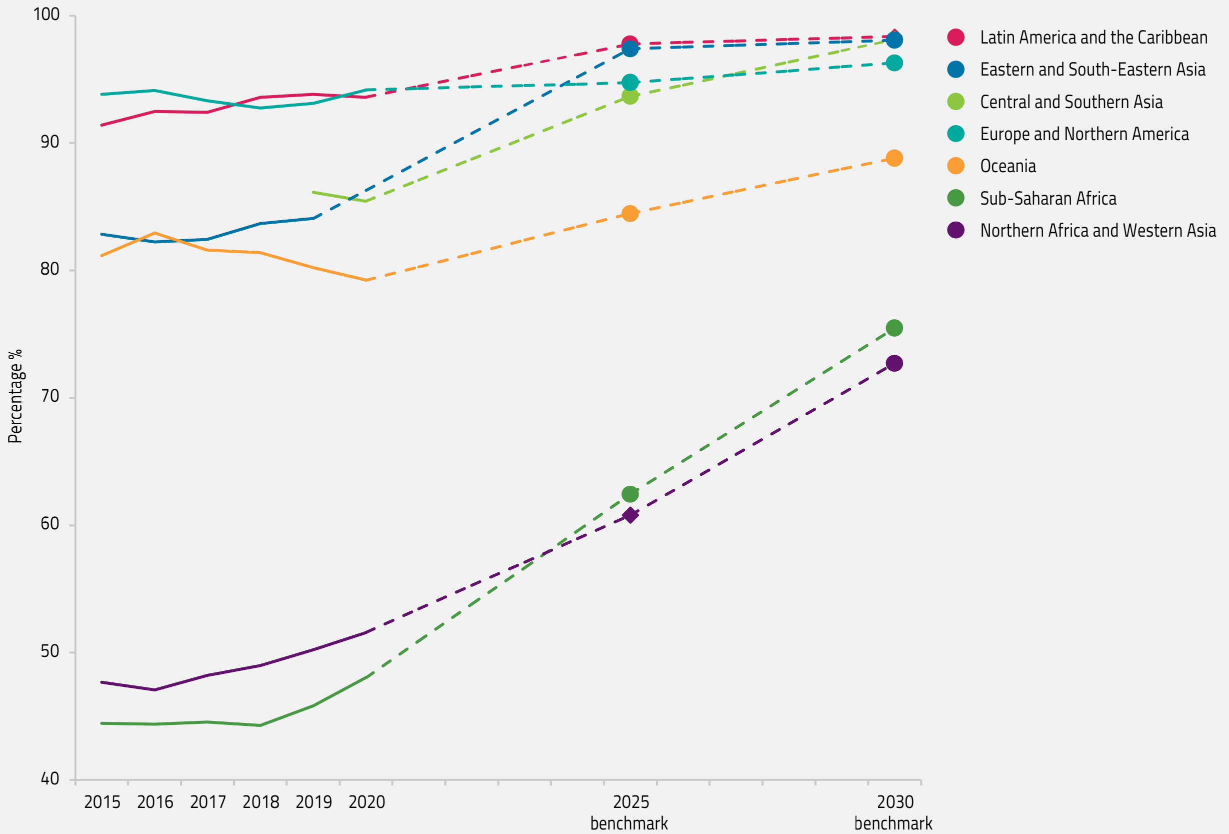
Trends for the global indicator 4.2.2, the percentage of children one year younger than the official primary entry age who participate in organized learning programmes, highlight very slow progress since 2015. Globally, the participation rate has remained stable at about 75% between 2015 and 2020. The largest increases, of about four percentage points each, have taken place in sub-Saharan Africa and Northern Africa and Western Asia, the two regions with the lowest baseline values (**Figure 13.7**). But progress must accelerate considerably if countries are to reach the targets set for 2025 and 2030, as expressed in the national SDG 4 benchmarking process (UNESCO, 2023). In sub-Saharan Africa, participation increased by an average of 0.7 percentage points per year between 2015 and 2020; however, the rates must grow four times faster, or by 2.8 percentage points per year, to reach the region's 2025 benchmark – or even faster if COVID-19 is found to have had a long-term impact.

The 2023 SDG 4 Scorecard monitored individual countries' progress towards achieving their national benchmarks, taking into account their starting points and the progress made between 2000 and 2015. Overall, high-income countries are more likely to be classified as either having achieved, or having a very high probability (over 75%) of achieving their 2025 national benchmark. Nevertheless, there are 15 low- and lower-middle-income countries that are on track to achieve their benchmarks: Burkina Faso, Burundi, Bhutan, Cambodia, Côte d'Ivoire, Ghana, Guinea, India, Kyrgyzstan, Mongolia, Republic of Moldova, Rwanda, Sierra Leone, Vanuatu and Viet Nam (UNESCO, 2023).

FIGURE 13.7:

Regions must progress faster in order to reach their pre-primary participation targets for 2025 and 2030

Participation rate in organized learning (one year before the official primary entry age) and regional benchmark values for 2025 and 2030



GEM StatLink: https://bit.ly/GEM2023_fig13_7
Note: Dotted segments indicate that the trend has been interpolated.
Source: UIS and UNICEF databases.

FOCUS 13.1: ACTIVE PLAY OUTDOORS IS MISSING FROM EARLY CHILDHOOD EDUCATION

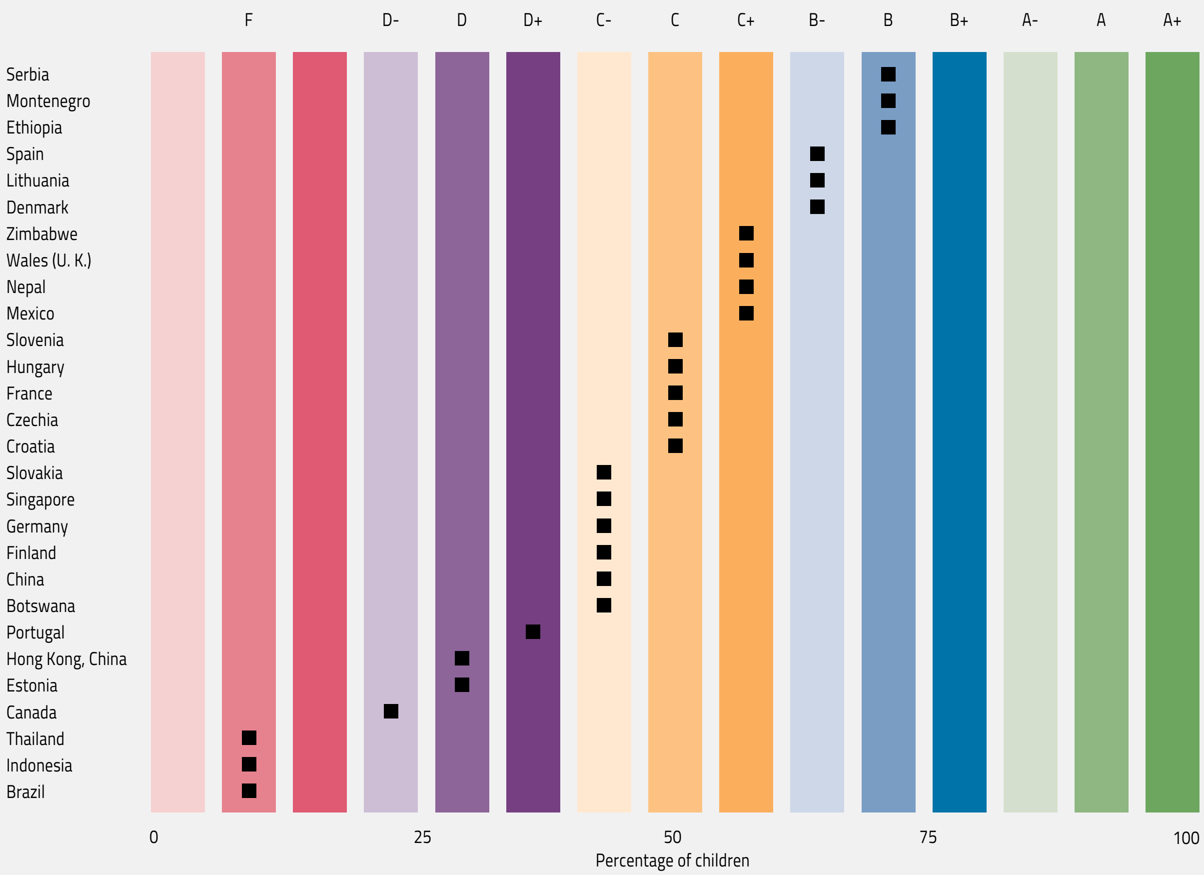
The Education 2030 Framework for Action does not reference play as an essential element of SDG 4. It recognizes that young children 'engage in intensive meaning-making of the self and surrounding world' but makes no reference to their interaction with the natural world. But while active play outdoors is an essential element of early childhood education, a global study of unstructured play and/or time outdoors showed that children and adolescents did not reach high levels of physical activity in any country (**Figure 13.8**). The lack of such activity may be a bigger concern in richer and urban contexts, but the rapid advent of technology and lengthy screen time is turning it into a global policy concern.

Nature-based education amplifies both the benefits and the risks of outdoor play. It can provide opportunities for honing scientific skills, including observation, classification and prediction (Yanagihara, 2019), as well as general skills, including problem-solving, critical thinking, leadership, teamwork and communication (Kuo et al., 2019). Even coding can be introduced in this setting, without reference to or handling of electronic devices (Bell and Vahrenhold, 2018; McLennan, 2020; Polat and Yilmaz, 2022; Saxena et al., 2020; Singhal, 2022). A systematic review similarly concluded that nature experiences show promise for increasing content knowledge and insights into scientific methodologies (Schilhab, 2021). Forest kindergartens, for instance, are daily outdoor educational programmes with limited or no indoor facilities. Children spend most of their time outside and the curriculum is based on their outdoor activities (Larimore, 2016).

FIGURE 13.8:

Too few children spend enough time in active play

Index of physical activity for children and adolescents, selected countries, 2022



GEM StatLink: https://bit.ly/GEM2023_fig13_8

Notes: The Physical Activity Report Card levels are based on national expert teams who assessed (a) the approximate percentage of children and adolescents who engaged in unstructured/unorganized active play at any intensity for more than 2 hours per day or (b) the percentage of children and adolescents who reported being outdoors for more than 2 hours per day, or a combination of both.

Source: Aubert et al. (2022).

> Nature-based education amplifies both the benefits and the risks of outdoor play

Some studies suggest that the calmness of outdoor activity is beneficial, specifically for disadvantaged children (Kim et al., 2012; Kuo and Taylor, 2004; Yıldırım and Akamca, 2017). Recognizing unconventional forms of early childhood education may reduce barriers to indigenous communities' participation. In New Zealand, the bicultural Te Whāriki curriculum, introduced in 1996 and updated in 2017, has required teachers to incorporate Māori ways of appreciating and connecting with the natural environment into their teaching, well before the model of forest kindergartens arrived in the country (Masters and Grogan, 2018). Moreover, alternative home-grown initiatives, also reflecting Māori thinking, have achieved considerable scale – the Enviroschools, for instance, of which there are 1,000 at school level and 200 at early childhood level (Alcock and Ritchie, 2018). In New Zealand and elsewhere, it has long been recommended to recognize traditional teaching of plant lore and outdoor survival skills, such as by the San in Namibia, as a form of early childhood education (Haraseb, 2011).

The role that nature-based early childhood education might play in low- and middle-income countries is ambiguous. By making use of what is found in the environment, it costs less than modern preschools with rent and equipment costs. However, it requires an outdoor space that must be both accessible and reasonably safe, which is a luxury in many contexts.

Risks to safety may come from exposure to inclement weather, wild animals or toxic plants. However, a study of the frequency, types and causes of injuries in forest and conventional kindergartens in Japan found injuries were not appreciably higher in forest settings than in school settings (Imanishi et al., 2018), even though some types – such as burns and tick bites – were specific to them. Similar findings were reported in Czechia (Michek et al., 2015).

Nature-based early childhood education is more often an elite experience for already privileged families (Perlman et al., 2020). In the United States, for example, African-American children, Hispanic children, children with special needs and children living in households where English is not the primary language are all underrepresented in these programmes (Natural Start Alliance, 2017).

No authoritative data exist on nature-based early childhood education programmes as they are a niche service. However, studies in selected high-income countries suggest that their numbers are increasing. In Norway, there are 356 nature kindergartens (Alme, 2021), making up some 6% of the 5,788 kindergartens in the country. There are more than 500 in Denmark, where the wave of nature kindergartens originated in the late 20th century (Riis, 2023). There were 120 such organizations in Czechia by 2014, about 2,000 in Germany (Bundesverband der Natur- und Waldkindergärten, 2023), up from 'over 300' reported in 2004 (Kiener, 2004), and 180 in Sweden (Michek et al., 2015). The North American Association for Environmental Education estimates at least 585 nature-based preschools in the United States, up from fewer than 25 in 2010 (Natural Start Alliance, 2020). And, in Japan, there were reportedly more than 100 forest kindergartens as of 2014 (Imamura, 2014).

Regulatory frameworks do not fit easily with this growing trend. Some countries, including Czechia and Germany, have adopted specific regulations to define and recognize forest kindergartens (Klauer, 2016). In Scotland, United Kingdom, the government adopted a Play Strategy and changed the role of regulators to help providers improve children's experiences of outdoor play (Mathias, 2018). But mainstream regulations mostly presume an indoor facility, for instance, including a minimum surface area per child or a minimum number of toilets. By definition, forest kindergartens, especially in their purest form, cannot meet such requirements. In Australia, nature-based early childhood education is limited to four hours per day because the regulatory requirements for full-time centres cannot be met (Christiansen et al., 2018). An alternative solution has been to run programmes part-time and under other frameworks than early childhood education. In the Republic of Korea, many centres are operated by the Korea Forest Service for instance, rather than education authorities, as 'infant forest experience centres', thereby avoiding regulatory constraints on licensed kindergartens (Jeon et al., 2020).

14

Student Mohamed fixes the electricity circuit that he trained on in the vocational training supported by UNICEF and implemented by Al Zahra Foundation in Sa'ada, Yemen.

Credit: UNICEF/UN0804476/UNICEF/YPN*

KEY MESSAGES

For adults aged 25 to 54, the median participation rate in formal and non-formal education and training across 115 countries with recent data is 3%, ranging from 2% in low- and lower-middle-income countries to 7% in high-income countries.

In 57 mostly high-income countries with data for both 2015 and either 2020 or 2021, the median participation rate declined by 10%, mostly as a result of COVID-19. For example, between 2019 and 2020, the rate fell from 23% to 15% in France and from 15% to 6% in the United Kingdom.

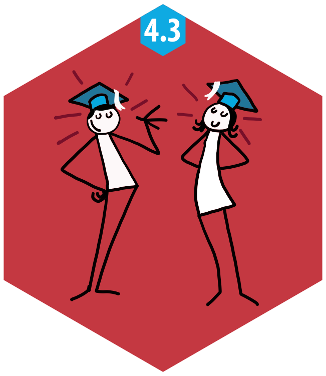
Global enrolment in tertiary education grew over the previous decade, but at a slower pace after 2015: the gross enrolment ratio increased from 29% in 2010 to 37% in 2015 and 40% in 2020.

In 2020, the tertiary gross enrolment ratio for women was 43% and that for men was 37%. Of the 146 countries with data, 106 had a gap in favour of females and 30 a gap in favour of males. Among the latter, 22 are in sub-Saharan Africa.

In contrast to tertiary education, the gender gap in technical-vocational education was smaller and tended to favour males. Of the 146 countries with data, 40 had a sizeable gap in favour of males and just 3 in favour of females.

Micro-credentials' flexibility and relatively low cost offer the potential to promote equity. However, this potential is limited by the fact that they are generally not rewarded in the labour market as much as traditional degrees.

CHAPTER 14



TARGET 4.3

Technical, vocational, tertiary and adult education

By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university

GLOBAL INDICATOR

4.3.1 – *Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex*

THEMATIC INDICATORS

4.3.2 – *Gross enrolment ratio for tertiary education by sex*

4.3.3 – *Participation rate in technical-vocational programmes (15- to 24-year-olds) by sex*

No indicator could ever capture global progress on the very wide range of post-compulsory education opportunities covered in Sustainable Development Goal (SDG) target 4.3. Global indicator 4.3.1 focuses on just one angle: the participation rate of youth and adults in formal and non-formal education and training in the previous 12 months. As with all indicators under target 4.3, the focus is on access rather than affordability, quality and equity (except gender inequality).

While participation in formal education and training can be measured by asking both providers and beneficiaries, non-formal education and training opportunities can only be estimated systematically by asking those who benefit from them. The data that inform this indicator, therefore, primarily come from labour force surveys compiled by the International Labour Organization and analysed by the UNESCO Institute for Statistics (UIS).

For adults aged 25–54, the median participation rate in formal and non-formal education and training across 115 countries with recent data is 3% (**Figure 14.1**), ranging from 2% in low- and lower-middle-income countries to 3% in upper-middle-income countries and 7% in high-income countries.

In Europe, the median is 8%; all countries with participation rates above 10% are in the region. This is despite the fact that the reference period for education and training questions in the European labour force surveys is the last 4 weeks before the survey instead of the 12 months originally intended by the indicator. Another specialized survey, the Adult Education Survey, which is carried out about every 5 years and has a 12-month reference period, yields much higher participation rates. Overall, caution is needed when comparing data for this indicator given the different reference periods across surveys.

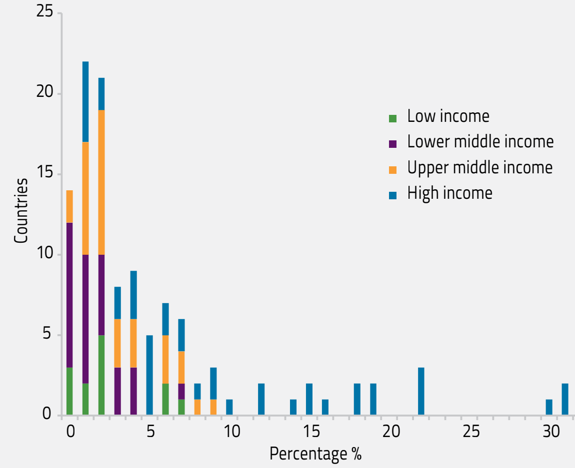
The data also show that, globally, there is gender parity in participation rates, with males at 3.1% and females at 3%. Of the 113 countries with data by sex, only six have a gender gap of more than five percentage points, and in all cases, it is in favour of females. All but one of these are located in northern Europe (Denmark, Estonia, Finland, Iceland and Sweden, which has the largest gap, 14 percentage points); the other country is the Dominican Republic.

Education and training is meant not only to improve a population's skills for work, but also the value they can derive from their employment. Cross-national data that help assess the extent to which education and training improve well-being come from the Comparative Panel File, which compiles household surveys from seven countries:

FIGURE 14.1:

The median adult participation rate in formal and non-formal education and training is 3%

Participation rate of adults (ages 25–54) in formal and non-formal education and training in the previous 12 months, by country income group, 2018–21



GEM StatLink: https://bit.ly/GEM2023_fig14_1
Source: SDG database.

Australia, Germany, the Republic of Korea, the Russian Federation, Switzerland, the United Kingdom and the United States. On average, workers who have undertaken training are no more likely to express satisfaction with their work or a sense of job security in six of the seven countries. Only in the Republic of Korea were those with training 18 percentage points more likely to express high job satisfaction (50% vs 32%) and 7 percentage points more likely to express a sense of job security (91% vs 84%).

Indicator 4.3.2 is the gross enrolment ratio for tertiary education. It divides the number of people enrolled in tertiary education regardless of age by the number of people within five years of the standard age for upper-secondary completion (usually 19 to 23 years old). However, the indicator does not account for differences in the duration of programmes between countries (for example, whether a bachelor's degree typically takes three or five years). Moreover, the indicator does not distinguish between different levels of tertiary education. For example, two countries with similar enrolment ratios might have quite different profiles, with one having far more people studying in short-cycle or long-cycle programmes or even in postgraduate degrees (**Box 14.2**).

Global enrolment in tertiary education grew over the previous decade, but at a slower pace after 2015: the gross enrolment ratio increased from 29% in 2010 to 37% in

BOX 14.1:

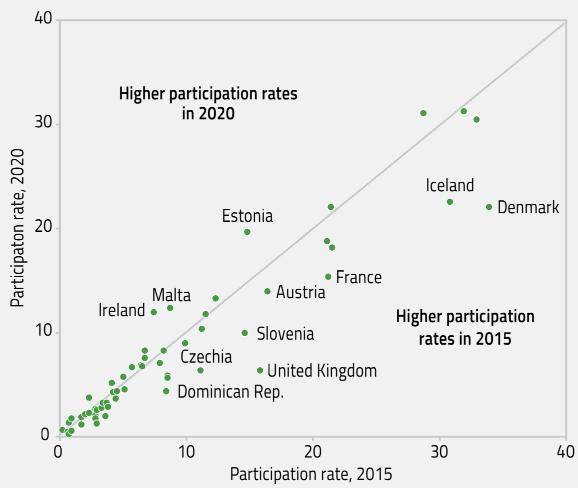
Progress since 2015: SDG indicator 4.3.1

There are 57 countries for which there are data on indicator 4.3.1 in both 2015 and either 2020 or 2021. Compared to the general analysis, an even higher share of countries are high-income (60% vs 35%), which means results need to be interpreted with caution. Overall, the median participation rate declined from 6.4% to 5.8%, or by 10% in this five-year period (**Figure 14.2**). It appears that adult education and training levels, at least in countries that experienced the largest decline in relative terms, was negatively affected by COVID-19, as the sharpest fall is observed in 2019–20. For example, in just one year, the rate fell from 23% to 15% in France and from 15% to 6% in the United Kingdom. The only country where participation rates fell continuously and appear unrelated to COVID is Iceland (from 31% to 23%). Even countries where participation rates rose in the five-year period suffered a decline in 2019–20: in Ireland from 14% to 12% and in Estonia from 23% to 20%.

FIGURE 14.2:

Adult education participation rates fell between 2015 and 2020

Change in rate of adult participation in formal and non-formal education and training, 2015–20



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Source: UIS database.

> Global enrolment in tertiary education grew over the previous decade, but at a slower pace after 2015

2015, but only to 40% five years later. Gross enrolment ratios range from below 1% in South Sudan to over 150% in Greece, where many are still enrolled to maintain certain social benefits even though they are not actually attending. At the lower end, 16 countries have a female gross enrolment ratio below 10%, all of which are in sub-Saharan Africa except Afghanistan, even before the Taliban government banned tertiary education for women.

In most countries, females are more likely than males to be enrolled in tertiary education. In 2020, the gross enrolment ratio for women was 43% compared to 37% for men. Of the 146 countries with data, 106 have a gap in favour of females and 30 – 22 of which are in sub-Saharan Africa – have a gap in favour of males. The higher the rate of tertiary enrolment, the more likely there is to be a gap in favour of females. Of the 50 countries with the highest enrolment ratios, only the Republic of Korea has a sizeable gap in favour of males, compared to 47 countries with a sizeable gap in favour of females (**Figure 14.3**).

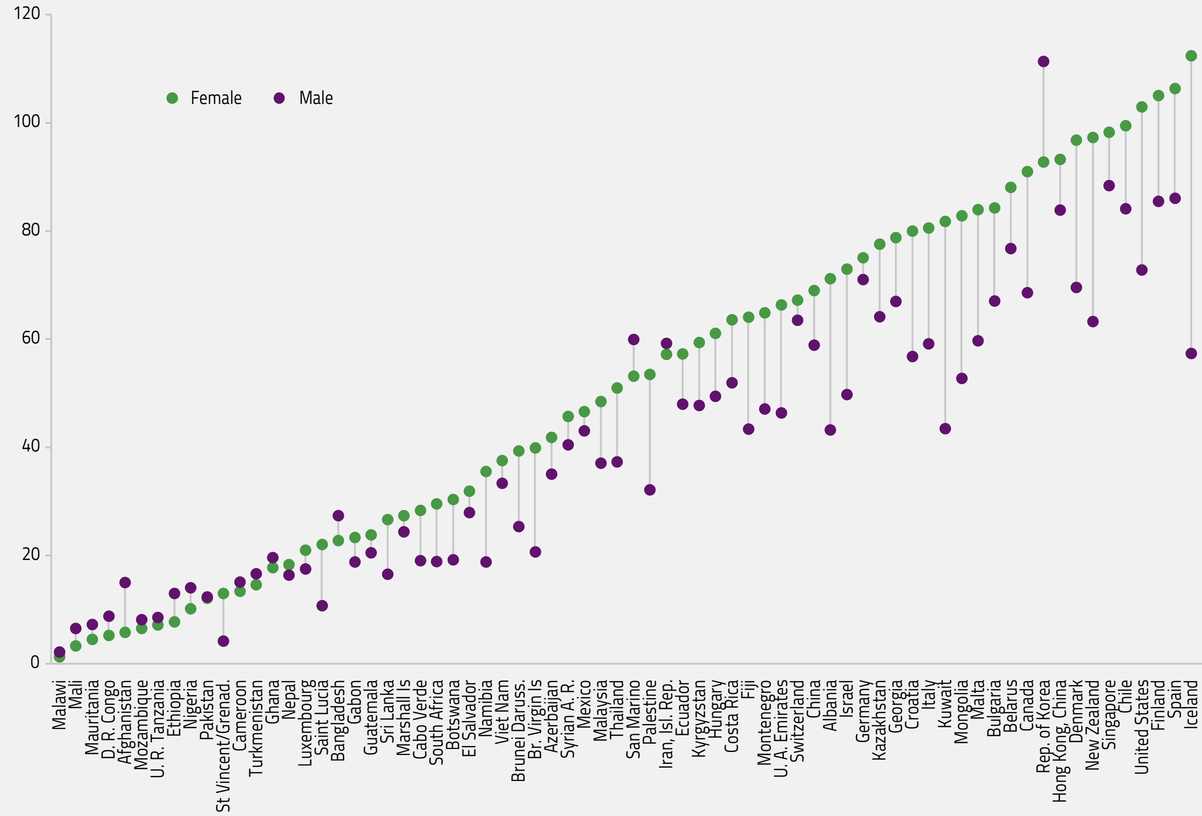
Indicator 4.3.3, which measures the participation rate in technical-vocational education among 15- to 24-year-olds, regardless of whether they are at the secondary, post-secondary non-tertiary or tertiary levels, shows a contrasting situation. Unlike indicator 4.3.2, which counts participation regardless of age, this indicator only counts participation among youths in this particular age range. In contrast to tertiary education, the gender gap in technical-vocational education is smaller and tends to favour males. Of the 146 countries with data, 40 have a sizeable gap in favour of males (in excess of 3 percentage points) in contrast to just 3 (Curaçao, Israel and Seychelles) in favour of females. Across countries, participation in technical-vocational programmes ranges from 0% to 36%. The lowest participation rates (less than 10%) are found primarily in the Caribbean, the Pacific and sub-Saharan Africa. The highest rates (more than 25%) are found almost exclusively in Europe, the exceptions being the Plurinational State of Bolivia, Seychelles, Singapore and Uzbekistan.

COVID-19 may have posed even greater challenges to technical-vocational education than to other types of formal learning because its applied nature is, in many contexts, difficult to emulate with the technology available. For example, safety measures in Malaysia limited the handling of tools and in-person practical assessments, requiring educators to rely more on theoretical coursework (Masrom et al., 2022). Colleges in the Philippines faced such great challenges switching to large online classes that the Commission on Higher Education suspended online learning after three days of teaching (Toquero, 2020). Studies of colleges in Kenya and South Africa report the

FIGURE 14.3:

There is a large gender gap in tertiary education participation

Gross enrolment ratio for tertiary education, by sex, 2018–22



GEM StatLink: https://bit.ly/GEM2023_fig14_3

Source: UIS database.

exacerbating impact of connectivity issues and a lack of training and support in how to teach online, especially in rural areas (Aina and Ogegbo, 2022; Karani and Waiganjo, 2022). In contrast, some systems successfully used their existing technological capacity to shift online; for example, Mexico's Capacítate Para El Empleo (Train for Work) online portal made hundreds of technical courses freely available (Hoftijzer et al., 2020).

FOCUS 14.1: WILL MICRO-CREDENTIALS CHALLENGE TRADITIONAL HIGHER EDUCATION DEGREES?

Opportunities for skills development, including sophisticated skills for highly paid technical positions, are increasingly sought outside of traditional higher education. Multiyear degrees are less attractive to those who lack time, money or the inclination. Mutually reinforcing trends in education and in employment, such as fully online instruction, open-access learning materials and skills-based hiring, have coalesced around the concept of micro-credentials. Micro-credentials are the 'digital certification of assessed knowledge, skills and competencies which is additional, alternate or complementary to or a component of formal qualifications' (Oliver, 2019). Micro-credentials can be issued by various providers who may or may not be registered as tertiary education institutions in a given country or may not even be in the same country as the student. They are not taken into account in international tertiary education statistics.

Micro-credentials are only 'micro' relative to traditional degrees and not necessarily as short as the name may suggest. A 2018 review of 450 micro-credentials offered by some of the major online providers found the average time to complete a course was 3 to 12 months, although some courses took over 50 months to complete. Minimum completion time ranged from 1 to 15 months. While some courses only require a few hours per week and can easily be completed alongside other commitments, others call

BOX 14.2:

Postgraduate education participation has been growing more slowly than overall tertiary education

Tertiary education encompasses multiple levels. Countries vary greatly in the distribution between short-cycle (ISCED 5) and long-cycle (ISCED 6) programmes. Less attention has been paid to postgraduate education programmes, i.e. master's (ISCED 7) and doctoral (ISCED 8) programmes. The UNESCO Institute for Statistics (UIS) does not report separate enrolment rates for each level. However, a look at the distribution of the student population between each level is indicative of whether the balance between different levels has changed.

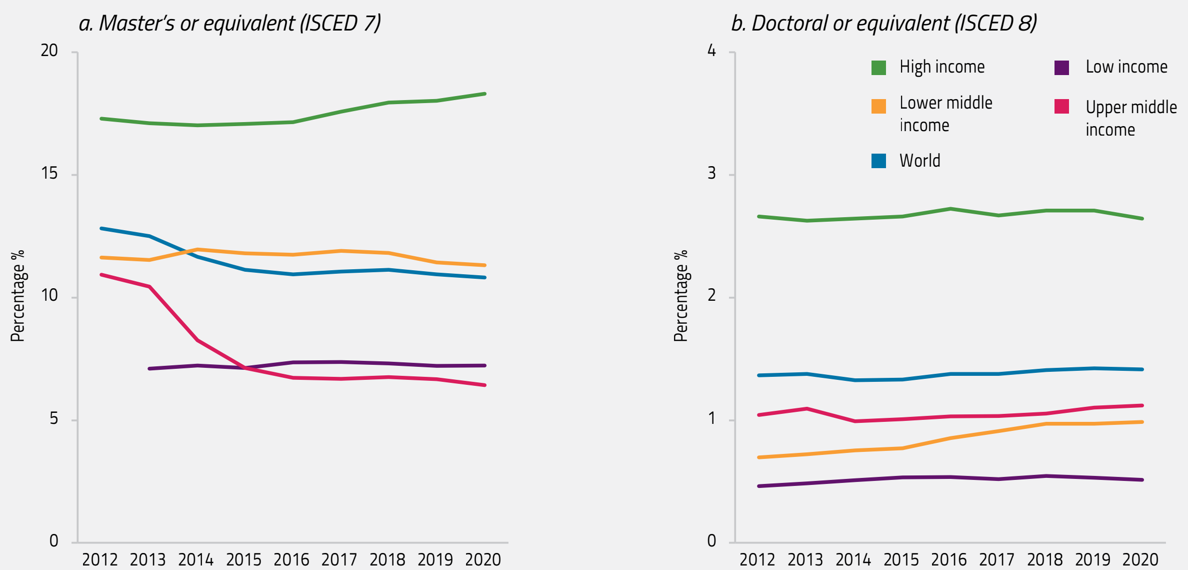
Among those in tertiary education, in the past decade there has been a slight decline in the proportion studying advanced degrees. Overall, around 12% of students enrolled in tertiary education were pursuing master's or doctoral-level degrees in 2020, down from 14% in 2012. The share ranges from 24% in Europe and Northern America to about 6% in Latin America and the Caribbean and in Eastern and South-Eastern Asia. One partial explanation may be that higher-level or specialized skills are increasingly sought outside traditional higher education, as evidenced by the growing popularity of micro-credentials (**Focus 14.1**).

The drop appears concentrated in upper-middle-income countries at the master's level. Between 2012 and 2020, enrolment in master's courses as a proportion of all tertiary study almost halved, from 11% to 6%. By contrast, the proportion of tertiary students in those countries who were at the doctoral level remained constant, at 1%, meaning that the shift in these countries was due to a greater proportion of students pursuing bachelor's degrees (**Figure 14.4**). Meanwhile, other parts of the world experienced very little change over the same period. The two major features that continued to prevail during the 2010s are that advanced degrees took a greater share of tertiary education students in high-income countries and that master's students outnumbered doctoral students globally by a ratio of about 8:1.

FIGURE 14.4:

The share of students in master's programmes has halved in upper-middle-income countries

Share of tertiary education students in postgraduate education, by country income group, 2012–20



GEM StatLink: https://bit.ly/GEM2023_fig14_4

Source: UIS database.

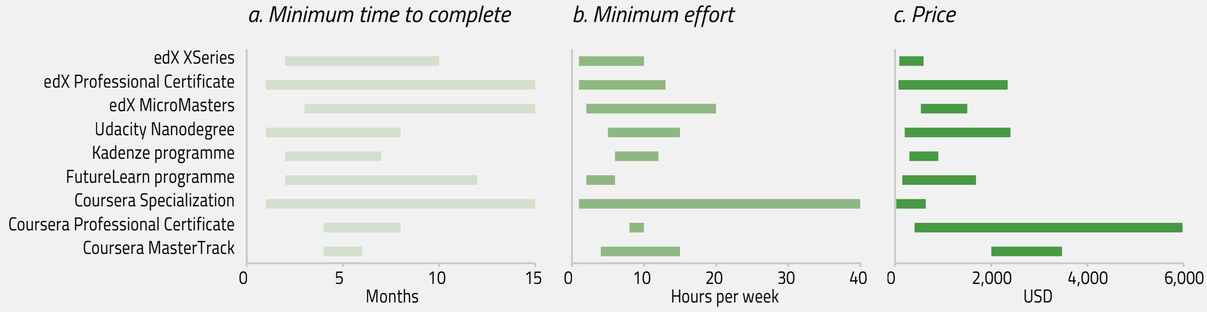
for 10, 20 or even up to 40 hours per week, essentially the equivalent of a part-time or even full-time job. Costs similarly varied by orders of magnitude, from almost or actually free to thousands of US dollars (**Figure 14.5**).

> Micro-credentials allow specific skills to be acquired on demand at any time and in any place

FIGURE 14.5:

Micro-credentials offerings vary tremendously in duration and cost

Minimum duration, minimum effort and cost, selected micro-credentials, 2018



GEM StatLink: https://bit.ly/GEM2023_fig14_5

Source: Pickard et al. (2018).

Micro-credentials allow specific skills to be acquired on demand at any time and in any place. This meets the needs of learners for flexibility and personalization of learning opportunities that, ideally, can add up to a higher-value qualification over time (Resei et al., 2019). Students can learn vertically (i.e. a sequence of increasingly advanced courses that build on each other), horizontally (e.g. combinations that broaden information and communication technology [ICT] professionals' skills in a set of different programming tools) or in other domains (e.g. engineers or other professionals acquiring project management skills) (Cedefop, 2023). For instance, while there is significant demand for job-specific science, technology, engineering and mathematics (STEM) skills in non-STEM occupations (Grinis, 2019), these skills often do not require a full STEM degree and could be more efficiently acquired by teaching them to those who already possess the required non-STEM skills for the job.

The relatively low cost and short course duration lower entry barriers. Flexibility of timing and sequencing is also an advantage: it is possible to leave arbitrarily long gaps between individual credentials, unlike traditional degrees, where interruptions are typically subject to strict rules. In the best case, micro-credentials support self-regulated learning, whereby learners are active agents who set their own goals and monitor and regulate their progress. Working towards micro-credentials can remind them of their progress to date and what gaps remain (Gish-Lieberman et al., 2021). New technological skills can be incorporated and certified long before they are included in traditional degree curricula. Micro-credentials therefore potentially serve not only credentialing but also motivational and pedagogical functions (Richard et al., 2020).

But critics say that micro-credentials may be harmful or go against the very idea of university education. Some are concerned by the fragmentation of knowledge (Chakroun and Keevy, 2018). Short courses leading to a narrow prespecified skill reduces the scope of curriculum by packaging knowledge in small pieces (Cliff et al., 2022). Further, micro-credentials may be only serving professionals to receive visible certification for skills they already have rather than to actually aid in their acquisition (Kässi and Lehdonvirta, 2018).

The benefits of micro-credentials as part of the overall tertiary education system are yet to be proven outside of specific niches (Oliver, 2021). Large gaps remain in academic research; most publications on the topic are white papers and reports (Selvaratnam and Sankey, 2021). While there was tremendous growth in enrolment in online massive open online courses in 2020, many of which led to micro-credentials, their sustainability remains unclear (Cowie and Sakui, 2022).

Greater confidence and trust in micro-credentials are undermined by the lack of common definitions, standards and regulations. University and industry stakeholders consider this the biggest barrier to the greater adoption of micro-credentials (HolonIQ, 2021). Part of the problem is that employers can struggle to assess the credibility of credentials due to a lack of structured information. The non-profit Credential Engine identified 1,076,000 unique credentials in the United States alone, of which there were some 430,000 digital badges (Credential Engine, 2022).

This situation is beginning to change, with major governance stakeholders adopting explicit frameworks for the integration of micro-credentials into national and international education, qualifications and training frameworks. Australia has already incorporated micro-credentials into its national qualifications framework, paving the way for their official recognition (Pollard and Vincent, 2022). Following a consultation process, the Malaysian Qualifications Authority in 2020 released a good practice guide for micro-credential providers. Adherence to its quality, design and delivery principles is meant to result in accredited and portable courses that align with other qualifications in the national framework (Brown et al., 2021; Cowie and Sakui, 2022).

Some researchers have argued that micro-credentials can promote equity. They encourage access and participation because they have low stakes. This makes the risk of non-completion less daunting, perhaps especially for those who feel out of place in a traditional university environment. A recent summary of policy advice on flexible learning pathways lists micro-credentials as an opportunity to overcome persistent inequality in adult education (Hijden and Martin, 2023). The European Consortium of Innovative Universities expects micro-credentials to make education more accessible (ECIU, 2020). In 2022, the Council of the European Union adopted a Recommendation, which identifies micro-credentials as a means to cater to the needs of learners from disadvantaged groups (Council of the European Union, 2022). In the United States, micro-credentials can signal extracurricular achievements that are prized in college admissions that disadvantaged youth are less likely to demonstrate (Gutierrez and Martin, 2021).

However, a recent systematic literature review showed that, whether from the perspective of learners, higher education institutions or governments, the majority of studies are sceptical about the ability of micro-credentials to make such a contribution (Varadarajan et al., 2023). The promise of micro-credentials contributing to education equity is also undermined by their concentration in STEM disciplines. As socially disadvantaged groups are heavily underrepresented in these subjects, they are less likely to benefit from such micro-credentials. In practice, micro-credentials tend to serve as a convenient opportunity for lifelong learning for those already active in these fields, who are disproportionately already privileged, rather than as entry ramps for those who are not.

It has also been shown that even for those who obtain micro-credentials, the potential benefits may be outweighed by lower returns. Micro-credentials have not yet conferred the same prestige as traditional degrees. They are also not generally rewarded in the labour market in the same way. Employers see micro-credentials as complementary to, rather than substitutes for, formal degrees (Kato et al., 2020). However, while degree requirements have measurably declined in job advertisements for middle- and high-skill positions, this trend has not been clearly replaced by a demand for micro-credentials. Moreover, many technology companies continue requiring degrees despite their public pronouncements of moving to skills-based hiring (Fuller et al., 2022).

Ironically, one bottleneck to the greater recognition of micro-credentials is that most digital recruitment and human resource management technology does not accept and process non-degree credentials (Gallagher et al., 2023). There is a risk, therefore, that even if micro-credentials were to be taken up by disadvantaged groups, they would not be recognized, reinforcing educational stratification. In the worst case, those unprepared to navigate the maze of offered credentials may end up with an incoherent, fragmented education based on micro-credentials, which are poorly recognized by employers and where it is uncertain what credit value they receive for formal education (Kift, 2021).

15

Cooking class: Robin (15, left) and Bredley, Vanautu. They both started three months ago and they want to learn "different styles" of cooking as it would be a good thing and allow them to get a job in the future. The centre, financially supported by UNICEF, is a meeting point for children and youth and offers vocational training, art workshops, HIV/AIDS prevention and more. The centre is run by a local NGO called Wan Smolbog Theatre.

CREDIT: UNICEF/UNI97361/Pirozzi*

KEY MESSAGES

ICT skills are unevenly distributed. The proportion of youth and adults who had sent emails with an attachment ranged from 65% in high- and 34% in upper-middle-income countries to 20% in lower-middle- and 3% in low-income countries.

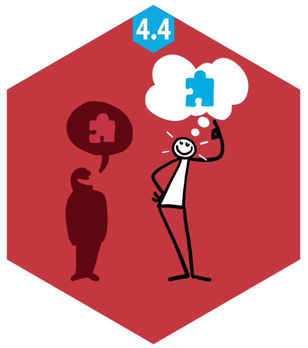
There has been progress in ICT skills. Of the 32 mostly rich countries with data on software management skills, 24 improved by at least five percentage points between 2015 and 2019.

There is clear gender disparity at women's expense at low ICT skills levels: Only 8 women in Pakistan's Balochistan province can use a basic arithmetic formula in a spreadsheet for every 100 men who can. But at higher skill levels, parity is achieved or the order of disparity is reversed: In Tonga, women are twice as likely as men to have this skill.

The gap by wealth is the widest. In Mongolia, 39% of adults from the richest quintile but just 1% from the poorest quintile have spreadsheet skills.

Artificial intelligence is putting jobs at risk. In 2018, it was estimated that 54% of employees would require significant reskilling to meet the demands of new tasks associated with their jobs. However, there may not be enough workers who can train others. The relative supply of graduates in ICT, science and mathematics has remained remarkably stable in recent decades.

CHAPTER 15



TARGET 4.4

Skills for work

By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship

GLOBAL INDICATOR

4.4.1 – *Percentage of youth/adults with information and communications technology (ICT) skills, by type of skill*

THEMATIC INDICATORS

4.4.2 – *Percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills*

4.4.3 – *Youth/adult educational attainment rates by age group and level of education*

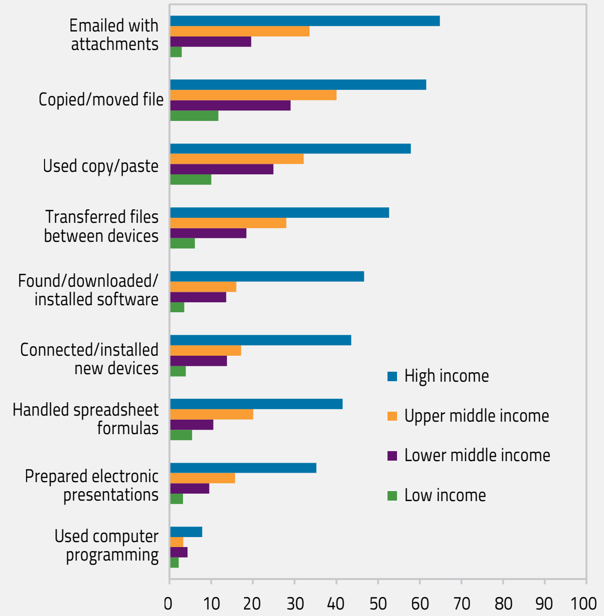
> Two of the three SDG target 4.4 indicators relate to the digital transformation of economies in the belief that more and more jobs will require them

SDG target 4.4 covers skills for work, a concept that is crucial but hard to measure, context-specific and too broad. The indicators that have been selected to monitor it reflect the difficulties in identifying parameters for progress for such a hard-to-define and moving target. Required skills differ by labour market and change over time. Each job requires a mix of skills and skills at different levels of proficiency. Having a higher level of proficiency in one skill may be an advantage for one job but irrelevant or even a disadvantage for another. For this reason, two of the three SDG target 4.4 indicators relate to the digital transformation of economies in the belief that more and more jobs will require such skills.

The first indicator is a self-reported measure of the use of information and communication technology (ICT) (global indicator 4.4.1). The second is intended to be a directly assessed measure of digital literacy (thematic indicator 4.4.2). Given the high cost of directly assessing digital literacy skills, there is an ongoing attempt to merge the two indicators by maintaining the less costly indirect approach to assessment through household surveys while expanding the set of ICT tasks that adults are being asked to confirm they are familiar with. These developments are discussed in the thematic part of the report and in particular in the chapter dedicated to digital skills (**Chapter 5**).

In 2015, nine tasks were specified to be part of the global indicator. As these were meant to be carried out on a computer or a tablet, there were demands to amend the list of tasks assessed, for instance, to also capture activities that can be performed with smartphones or to drop activities that are becoming obsolete. The International Telecommunication Union (ITU) has responded to these demands with a number of actions, including adding measures on safety, such as the use of passwords, privacy settings and verifying the reliability of information found online. Recommendations were also made to streamline data collection and analysis. Skills are no longer grouped as basic, intermediate or advanced, given their propensity to change as software and apps advance. Another change has been to review existing responses to eliminate redundant specificity, for example, to simplify from 'using [a] basic arithmetic formula in a spreadsheet' to 'using spreadsheet software' and to expand from 'creating electronic presentations' to 'creating something that combines different digital media' in order to accommodate the use of mobile phones.

FIGURE 15.1:
ICT skills are not evenly distributed
Percentage of youth and adults with ICT skills, by country-income group, 2014–19



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Source: UIS database.

However, as these changes have only been introduced recently, this chapter reports on progress based on the original nine tasks. The data, which come mainly from richer countries and are therefore not globally representative, show that 24% of adults can use a basic arithmetic formula in a spreadsheet and 4% can write a computer program using specialized programming language. Of the 90 countries with data, most adults had copied or moved a file or folder in 43 of them and had used tools to copy and paste text in 36 countries. In contrast, a majority of adults had created an electronic presentation in only 2 of the 90 countries (Iceland and Luxembourg).

For each of the nine tasks, respondents in richer countries report markedly higher rates of carrying out these computer-related activities than in poorer countries. For example, the proportion of youth and adults who had sent emails with an attachment ranges from 65% in high-income countries and 34% in upper-middle-income countries to 20% in lower-middle-income countries and 3% in low-income countries.

Digital natives – those familiar with computers from an early age – are not necessarily digital experts. While they use technology more frequently than older generations, ICT skills remain sparse in many countries' youth and adult populations. With the exception of high-income countries, it is rare for more than a fifth of respondents to show that they possess any of the ICT skills.

ICT skills are more unequally distributed in the population than basic literacy and numeracy skills are. Not only do ICT skills require a minimum level of literacy and numeracy skills but they are also used in mostly urban, formal sector jobs that are scarce in poorer countries. Evidence from UNICEF Multiple Indicator Cluster Surveys (MICS) data sets in 2017–22 on the ability to use a basic arithmetic formula in a spreadsheet shows a diversity of inequality patterns by sex, location and wealth.

There is clear gender disparity at the expense of women at low levels of ICT skills. But at higher skill levels, this trend stops and either parity is achieved or women are more likely to have this skill. At the opposite extremes, only 8 women in the Balochistan province of Pakistan have this skill for every 100 young men who do, while women are twice as likely as men to have this skill in Tonga (**Figure 15.4a**).

“There is clear gender disparity at the expense of women at low levels of ICT skills”

BOX 15.1:

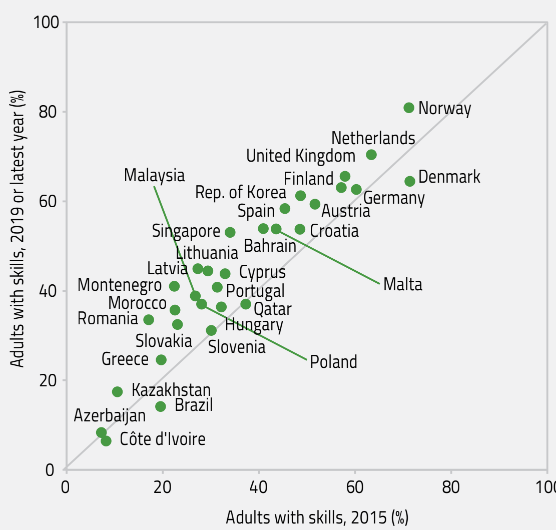
Progress since 2015: SDG indicator 4.4.1

Digital skills are increasingly incorporated into national curricula. At the same time, opportunities have grown to develop these skills outside of formal education. This raises the question of the extent to which ICT skills have improved since the Sustainable Development Goals (SDGs) were set in 2015. There is a clear pattern of improvement across the mostly richer countries with data. Of the 32 countries with available data on managing software, 24 show an improvement of at least five percentage points between 2015 and 2019 (**Figure 15.2**). However, the sample does not contain any low-income countries.

FIGURE 15.2:

ICT skill levels are increasing in most countries

Adults who reported having found, downloaded, installed and configured software, selected middle- and high-income countries, 2015 and 2019 or latest year available



GEM StatLink: https://bit.ly/GEM2023_fig15.2
Source: UIS database.

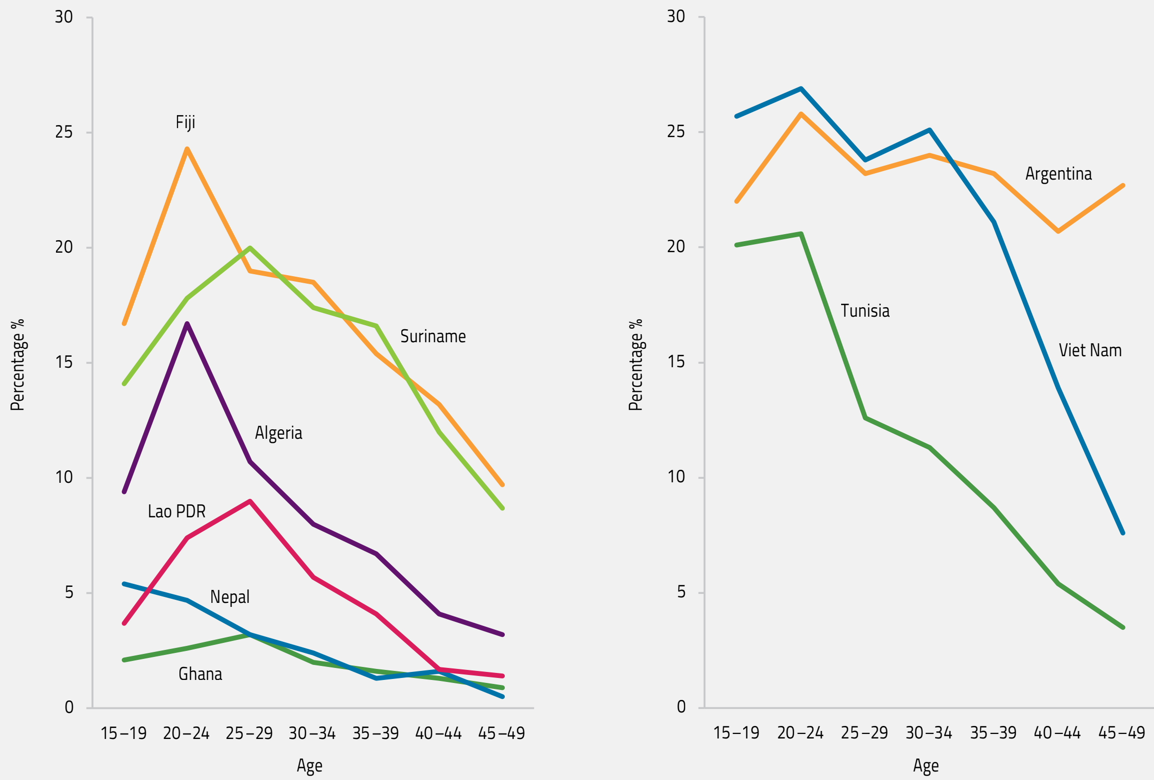
Another way to understand progress is by looking at differences in the ICT skill levels of various population groups. Since the sixth round began in 2017, the UNICEF Multiple Indicator Cluster Surveys (MICS) have been used to ask respondents whether they have carried out these nine computer-related activities. In a sample of 36 low- and middle-income countries, 20- to 24-year-old women are twice as likely to be able to use a basic arithmetic formula in a spreadsheet than their 40- to 44-year-old peers. There are considerable differences in the pace of change between countries. In Argentina, there is practically no difference between these two cohorts, while in Tunisia, the younger cohort is almost four times as likely as the older cohort to have this skill. There are also differences in the peak age of skill prevalence, which is observed among 25- to 29-year-olds in Suriname, 20- to 24-year-olds in Algeria and 15- to 19-year-olds in Nepal (**Figure 15.3**).

BOX 15.1 CONTINUED:

FIGURE 15.3:

Younger women acquire ICT skills in far greater numbers

Women who reported using a basic arithmetic formula in a spreadsheet, selected low- and middle-income countries, by age group, 2017–21



GEM StatLink: https://bit.ly/GEM2023_fig15.3
Source: MICS Survey Findings reports.

The urban–rural gap is very wide. In the low-income countries in this sample, almost no women living in rural areas have this skill. In the Lao People's Democratic Republic, 12.5% of urban women and 1.3% of rural women can carry out this computer-related activity. The gap is 17 percentage points in Samoa and 23 points in Viet Nam (**Figure 15.4b**).

The gap by wealth is the widest. In the low-income countries, nearly no adults in the poorest 60% of households have this skill when the national average is below 10%. In Mongolia, 39% of adults from the richest quintile but just 1% of their peers from the poorest quintile have this skill. In Zimbabwe, none of the poorest but more than 25% of the richest have this skill (**Figure 15.4b**).

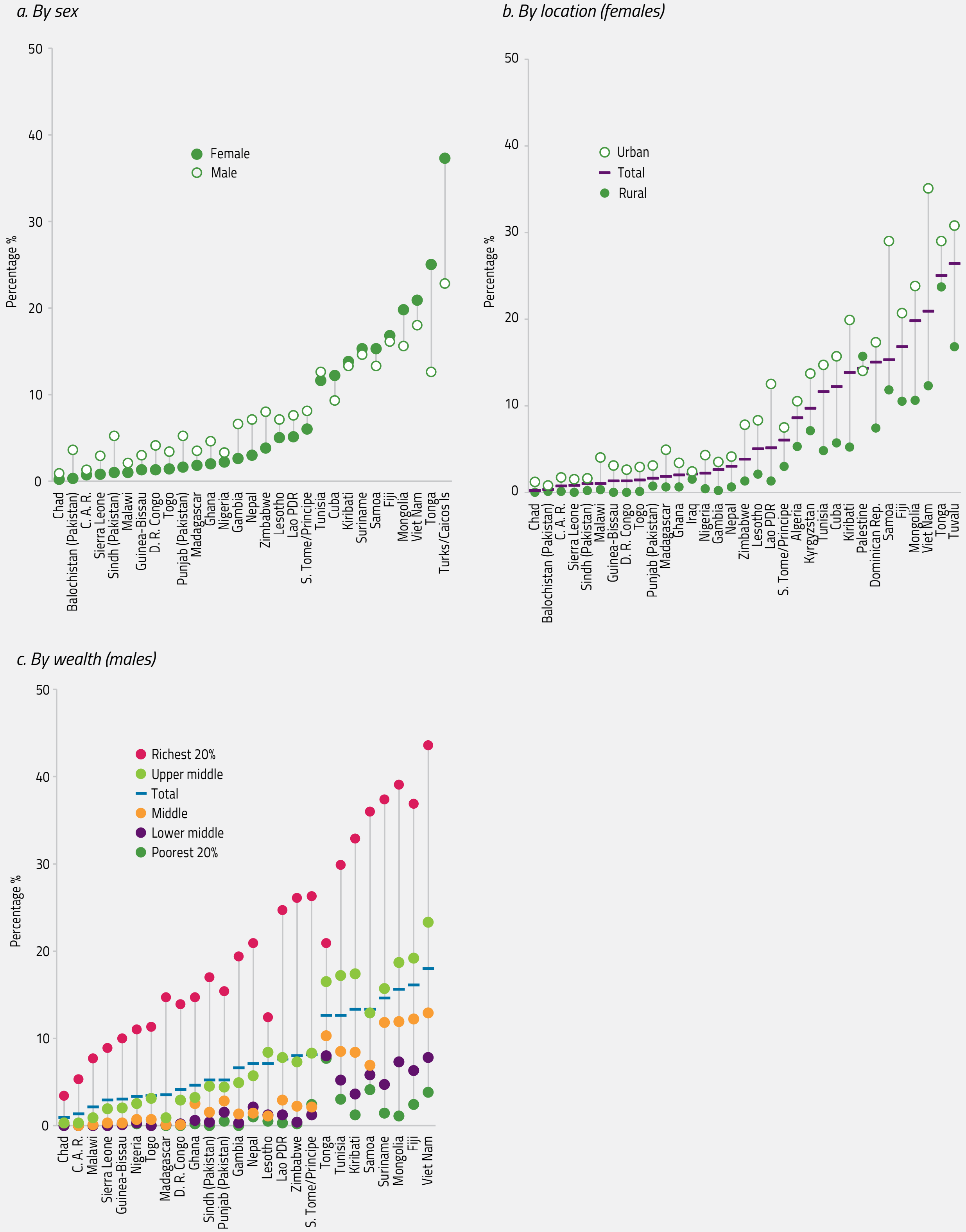
Indicator 4.4.2 focuses on the percentage of youth and adults who have achieved at least a minimum level of proficiency in digital literacy skills, defined as the confident and critical use of digital technologies for information, communication and basic problem-solving. It covers the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the internet.

The Programme for the International Assessment of Adult Competencies (PIAAC) makes assessments in this area. It has notably assessed respondents' ability to use technology to solve problems and accomplish complex tasks. Among the 28 countries, most of which are high-income, that took part in three waves of the survey in the 2010s, those with tertiary education were almost twice as likely to have basic proficiency in technology as those without it.

FIGURE 15.4:

ICT skills are very unequally distributed in the population

Adults who reported using a basic arithmetic formula in a spreadsheet, selected low- and middle-income countries, 2017–21



GEM StatLink: https://bit.ly/GEM2023_fig15.4

Source: MICS Survey Findings reports.

The last indicator of this target, thematic indicator 4.4.3, focuses on a proxy of actual skills for work: the educational attainment rates of those aged 25 years and above. Given the wide age range, differences in the distribution of attainment reflect the different pace at which education systems have expanded historically. Among 91 countries with data, the percentage of those with at least upper secondary education ranges from near zero (in Burundi and Mali) to almost 100% (in Kazakhstan and Uzbekistan) (**Figure 15.5**).

FOCUS 15.1: ARTIFICIAL INTELLIGENCE TECHNOLOGY IS EXPECTED TO SHIFT SKILL DEMAND AND SUPPLY

While the mission of education cannot be reduced to preparing learners for future jobs, people do choose education with the expectations of being able to secure better work. The match between the skills students acquire in education and those required and rewarded in the labour market is, therefore, constantly being questioned (Figueiredo et al., 2017). Such questions have multiplied with rapid technological change. In recent years, concerns have grown that advances in artificial intelligence (AI) technology will have a more fundamental impact on jobs than other technologies (Gaynor, 2020), not least with the advent of large language models, such as ChatGPT.

The previous prediction that the robotics and automation revolution would lead to the replacement of human workers has not been realized. The demand for supposedly obsolete manual human labour has not collapsed. Labour markets have adapted, as efficiency gains from automation have allowed labour to expand in other areas. In the United States, the rise of automated teller machines (ATM) for cash handling resulted in an increase in the full-time equivalent number of human bank tellers because, as ATMs made branch offices cheaper to operate, more branches opened, leading to an increase in employment (Haynes and Thompson, 2000).

Still, technology has had a massive, disruptive impact on jobs, their skill content, remuneration and geographical distribution worldwide. In many high-income countries, a phenomenon of polarization has been documented, whereby employment levels have increased for high- and low-skill occupations, squeezing out middle-level skill occupations that have proven to be more vulnerable to automation. While low-skill jobs have become more poorly paid, relative pay for high-skill jobs has been improving. Many low-skill jobs moved from high-income countries to low- and middle-income countries, a shift aided by changes in trade policies (Acemoglu and Autor, 2011).

“Technology has had a massive, disruptive impact on jobs, their skill content, remuneration and geographical distribution worldwide”

Numerous studies predict the effect of automation on jobs. Based on a survey of adult workers in Europe, an estimate from the European Centre for the Development of Vocational Training (Cedefop) puts the share of jobs at risk of automation at 14% across the European Union (Jaures, 2021). Limiting consideration to ‘proven technologies’, one study identified only 5% of all jobs in the United States as fully automatable (Manyika et al., 2017). Defining automatable jobs as those where more than 70% of the associated tasks are automatable leads to an estimate of 9% of jobs at risk across the Organisation for Economic Co-operation and Development (OECD) (Arntz et al., 2016). Highlighting the impact of specific assumptions and methodological choices, the 2019 World Development Report on the future of work estimated that the percentage of jobs at risk of automation varied widely between studies, from a low of 5% to highs of 40% in Ukraine, 56% in Lithuania and even 61% in Cyprus (World Bank, 2018).

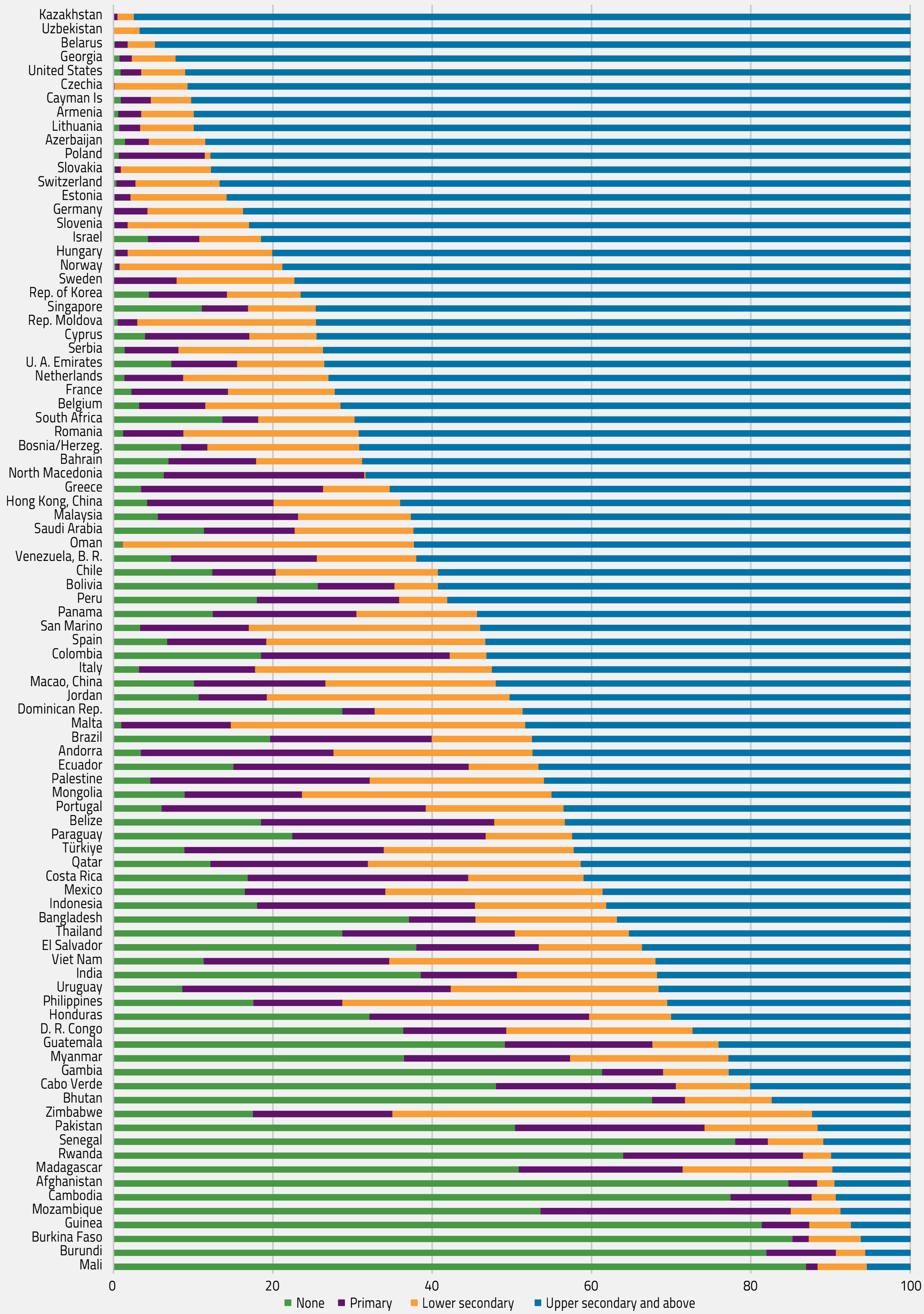
Analysis of technology effects on labour markets in Association of Southeast Asian Nations (ASEAN) countries concluded that occupations at all levels of the skills spectrum would lose some jobs and gain others, with a net loss largely limited to the agricultural sector (Oxford Economics Systems and Cisco, 2018). A study of 10 middle- and high-income countries based on LinkedIn data documented shifting demand for different occupations triggered by advances in digital technology but also pointing out that the way skill profiles overlap between different occupations differs significantly between countries (Amaral et al., 2018). Workers access different opportunities for moving out of declining occupations in different countries.

To date, most of the AI technology that is causing concern about AI taking over jobs is not yet market-ready, so it is difficult to predict the impacts on jobs (Bessen, 2018). A study of AI adoption in China showed that, as with other technologies, it lowered demand for low skills but increased demand for high skills (Xie et al., 2021). Likewise, a study of online vacancies in the United States from 2010 onwards detected no association between AI exposure and the labour market at the level of whole occupations or industries (Acemoglu et al., 2020),

FIGURE 15.5:

The share of adults with at least upper secondary attainment varies from zero to almost universal

Distribution of adult population by educational attainment, 2015–21



GEM StatLink: https://bit.ly/GEM2023_fig15.5

Source: UIS database.

suggesting that AI can only replace humans in specific tasks and has not yet delivered significant productivity gains.

Even jobs at a high risk of displacement from automation and AI consist of a mixture of tasks, some of which are more automatable than others. Estimating the future labour market impact of AI should therefore not look at entire occupations that might be replaced but instead at tasks required in various professions. For instance, only 2 out of 29 tasks associated with the occupational profile of radiologists concern image recognition, a task where machine algorithms are expected to outperform humans or already do so. By potentially freeing radiologists to spend more time on expanding their role in diagnostic and treatment teams with other physicians, their number could increase (Agrawal et al., 2019).

One study went a step further and matched AI research progress and labour-related tasks from European labour markets to 14 cognitive abilities (such as sensorimotor interaction or metacognition and confidence assessment) to assess the extent to which AI is progressing to meet the cognitive demands of various jobs. It was found that much of AI research activity and progress is in cognitive areas that are not essential to many jobs. Conversely, many crucial skills for real-life tasks do not see much AI research activity (Martínez-Plumed et al., 2020). Moreover, what all these estimates have in common is that they strictly assess which tasks are technically feasible to automate, without regard to non-technological factors and constraints (Poba-Nzaou et al., 2021).

Currently, people lack the skills for working with AI or such skills are not in demand. It is still rare to have skills such as being able to match the right AI tool to various tasks, setting parameters, crafting the right prompts, and understanding the strengths and weaknesses of AI to critically interpret the response (Maskey, 2019). Explicit demand for such skills is also rare, with less than 1% of online job advertisements being AI-related (Samek et al., 2021). However, there has been a clear upward trend, in contrast to demand for general computer and software skills (Alekseeva et al., 2021). Vacancies asking for AI skills are mostly for professionals, but AI skill requirements have started appearing in advertisements for machine operators, craft workers and other occupations, and agricultural and other industries. Still, even for the legal services sector, where experts see much potential for AI, the share of job advertisements featuring keywords related to legal technology, AI, data science or automation in Singapore, the United Kingdom and the United States was less than 1% (Qian et al., 2020).

Despite the rapid evolution of AI technology, the skills expected of AI-related workers have changed little over the past decade. The ability to work with AI includes significant demand for socioemotional skills, such as communication, creativity and teamwork, alongside cognitive ones (Samek et al., 2021). The socioemotional aspects of jobs become more prominent because these skills are less likely to be automatized and because the right questions must be asked for AI to answer. This was already true for information technology (IT) specialists who were called upon to ensure that IT solutions actually solved the right problems. Human involvement and intelligence is required to do this adjudication (Burbekova, 2021).

Rather than worrying whether AI will make workers obsolete, attention should focus on training needs, both in terms of training graduates with skills complementary to digital transformation and the ability to train others. One estimate was that 54% of employees will require significant reskilling to meet the demands of the new tasks associated with their jobs, with almost one in five requiring at least six months of additional training (WEF, 2018).

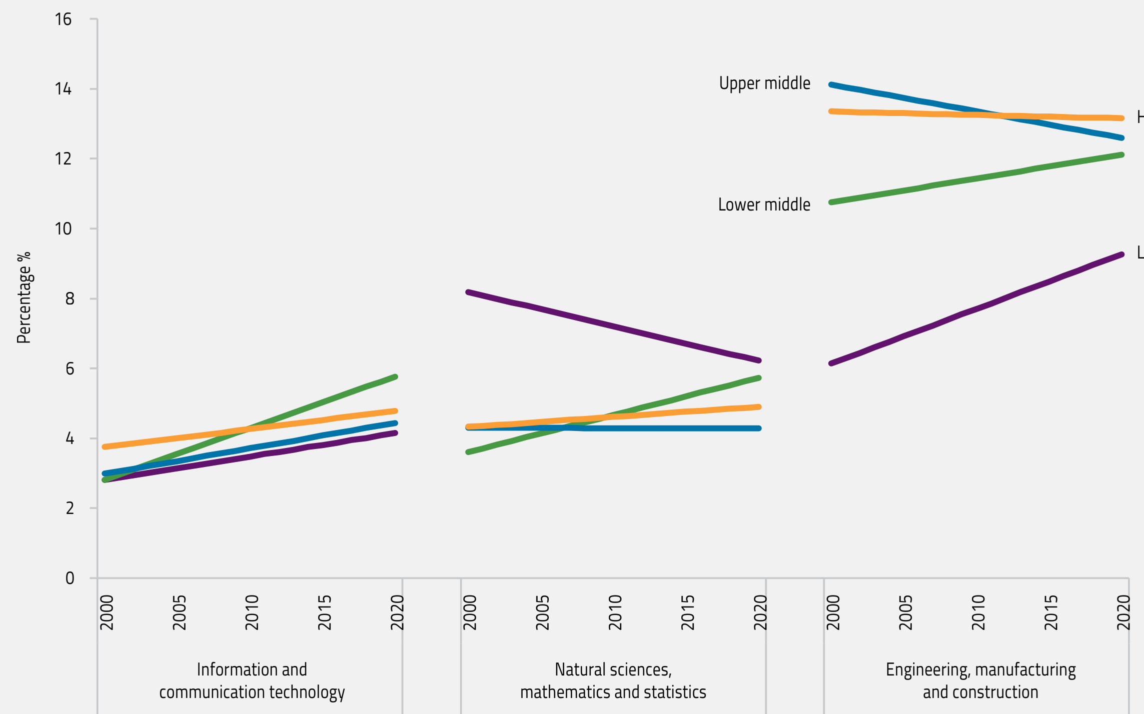
“One estimate was that 54% of employees will require significant reskilling to meet the demands of the new tasks associated with their jobs”

However, there may not be enough workers who can train others. The supply of science, technology, engineering and mathematics (STEM) graduates has remained remarkably stable (**Figure 15.6**). The share of graduates in digital technology subjects has grown, at most, very slowly, as have the shares for both more scientific and more applied STEM subjects. Digital technology graduates make up some 5% of the total of STEM graduates, scientists and mathematicians about 5%, and engineers from 9% to 13%. Similar to the changing nature of jobs, this stability may hide the fact that both science and engineering, as well as non-STEM subjects, have increasingly incorporated digital technologies and skills within their subject boundaries. In the United Kingdom, for instance, fewer than half of STEM graduates work in occupations that are nominally STEM-related (Grinis, 2019). While this may be misinterpreted as a waste of their STEM training, it actually reflects the fact that non-STEM occupations account for more than a third of the jobs requiring STEM skills.

FIGURE 15.6:

The share of STEM graduates has remained remarkably stable over the past two decades

Percentage of graduates from tertiary education programmes, by subject, 2000–20



GEM StatLink: https://bit.ly/GEM2023_fig15.6

Note: Trends are calculated by unweighted, unbalanced linear least-squares regression.

Source: GEM Report team analysis based on the UIS database.

National skills strategies can provide a holistic approach. These aim to bring together representatives from all stakeholder groups to encourage a consensus on developing the desired skills needed to work with AI and technology, through awareness campaigns, incentives, educational programmes and other voluntary measures. In 2013, over 60 parties from central and regional government, education institutions, regions, industry, employer associations, and labour unions in the Netherlands signed onto a technology 'pact' (Techniekpact) (EU STEM Coalition, 2023). The aim was to improve the alignment between the job market and the education sector, taking a centrally supported but regional approach to increase entry into technology-related subjects and progress into and retention in technology-related jobs, with annual impact monitoring and reporting (Cedefop, 2016).

In 2017, Portugal established a national strategy for using AI in the economy and society as part of the national digital competences initiative, Portugal INCoDe.2030 (Bação, 2022). Annual forums convene public and private sector institutions for sharing promising practices. Activities are organized under five action lines (Portugal INCoDe 2030, 2023): education and training, (re-) qualification, inclusion, advanced training, and research. Activities have included the creation of industry network academies to support companies to develop qualification plans for their employees; integration of computing in school curricula; scholarships, including to overcome gender barriers; coordination of research and development under a National Artificial Intelligence Strategy; and a national Coalition for Digital Employability. The goals include doubling the share of ICT specialists among employed persons to 7% and increasing the share of ICT graduates from 2.2% in 2018 to 8% by 2030. The initiative also conducted a study on employability in the future to understand ICT skills development needs in other professions (Portugal INCoDe 2030, 2023).

16

Children in pre-primary class at Tahouak Primary School, Ta Oi District in Saravane Province, Lao PDR, eat nutritious food during their lunch break.
A healthy diet helps fight against malnutrition and ensure children grow up healthy.

Credit: UNICEF/UN0311097/Verweij*

KEY MESSAGES

The world overall achieved gender parity in primary and secondary education enrolment before 2015. But in sub-Saharan Africa, parity is yet to be achieved. As of 2020, for every 100 males, there were 96 females enrolled in primary, 91 in lower secondary, 87 in upper secondary and 80 in tertiary education.

Three aspects of gender parity trends need examination. First, girls in poor countries are worse off in secondary completion than in secondary enrolment. Second, not all countries follow the global trend. Third, parity indices measure average disparity; poor and rural girls in low- and lower-middle-income countries fare worse than average.

Gender gaps in learning outcomes are of an entirely different kind. Globally, in reading, for every 100 proficient boys there are 115 proficient girls at the end of lower secondary education. But boys tend to have a considerable advantage over girls in science and mathematics at the higher end of performance.

Children with at least one sensory, physical or intellectual difficulty were 7 percentage points less likely than the average child to complete primary school; the gap was 10 percentage points in Zimbabwe and 14 points in Iraq. These gaps may be underestimated, as poorer families are less likely to report that they have a child with disability.

First-generation students have it hard everywhere. For first-generation schoolgoers in low- and lower-middle-income countries, the median gap with other students in lower secondary completion is 34 percentage points.

CHAPTER 16

TARGET 4.5

Equity

By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations

GLOBAL INDICATOR

4.5.1 – *Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous peoples and conflict-affected, as data become available) for all education indicators on this list that can be disaggregated*

THEMATIC INDICATORS

4.5.2 – *Percentage of students in primary education whose first or home language is the language of instruction*

4.5.3 – *Extent to which explicit formula-based policies reallocate education resources to disadvantaged populations*

4.5.4 – *Education expenditure per student by level of education and source of funding*

4.5.5 – *Percentage of total aid to education allocated to least developed countries*

One of the most notable successes in the implementation of the international education agenda over the past 30 years has been the move towards gender parity in education. The world achieved gender parity in primary and lower secondary education in 2009 and in upper secondary education in 2013. Tertiary education progress has been different. Parity was achieved a decade earlier, in 1998, but by 2004, there was already disparity at the expense of men, which has continued to increase: by 2020, there were 114 women enrolled for every 100 men at this level of education.

> The world achieved gender parity in primary and lower secondary education in 2009 and in upper secondary education in 2013

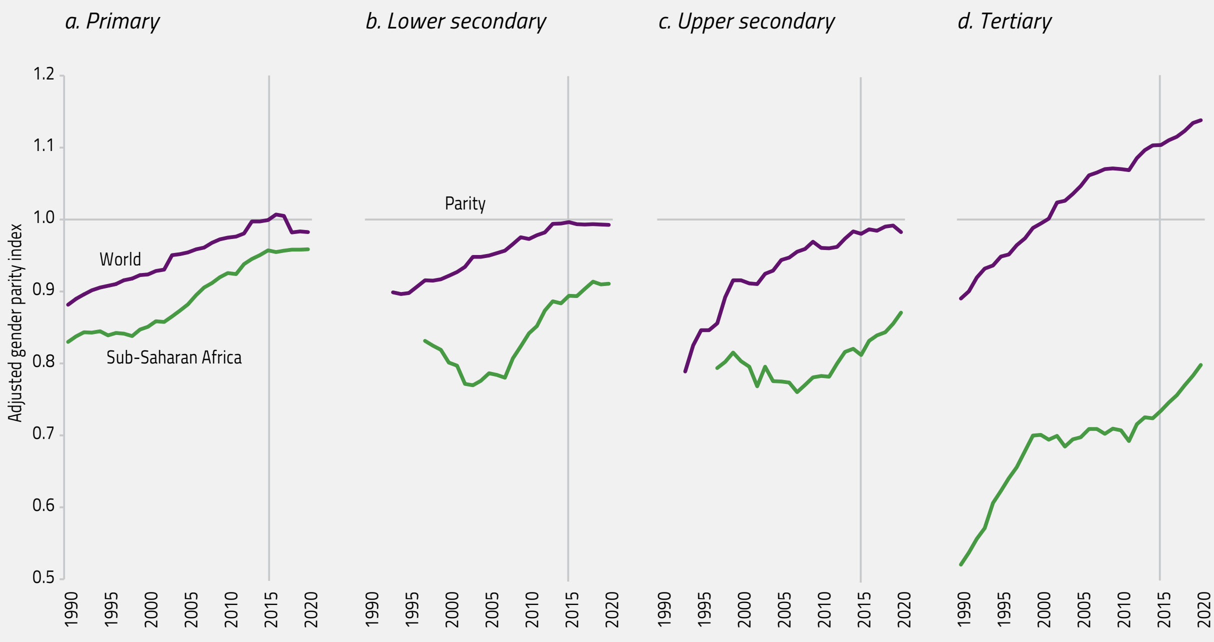
The one exception to this success has been sub-Saharan Africa, where parity has not been achieved at any level of education. As of 2020, for every 100 males, there were 96 females enrolled in primary, 91 in lower secondary, 87 in upper secondary and 80 in tertiary education. Conditions for girls and young women worsened during the period of structural adjustment in the 1990s and disparity increased in secondary education. The 1997 level of the gender parity index in lower secondary enrolment did not recover until 2010. The 1999 level of the gender parity index in upper secondary enrolment did not recover until 2013. But between 2015 and 2020, the gender parity index in upper secondary enrolment improved at the fastest rate ever observed, by 0.012 points per year. Similar levels of progress have been achieved in tertiary education (**Figure 16.1**).

Three aspects of these trends need examination. First, enrolment is only a stepping stone towards completion. The most disadvantaged group tends to fare relatively worse in terms of completion rates than in enrolment rates (**Box 16.1**).

FIGURE 16.1:

Sub-Saharan Africa has not achieved gender parity in enrolment at any education level

Adjusted gender parity index of the gross enrolment ratio by education level, world and sub-Saharan Africa, 1990–2020



GEM StatLink: https://bit.ly/GEM2023_fig16_1
Source: UIS database.

BOX 16.1:

Progress since 2015: SDG indicator 4.5.1

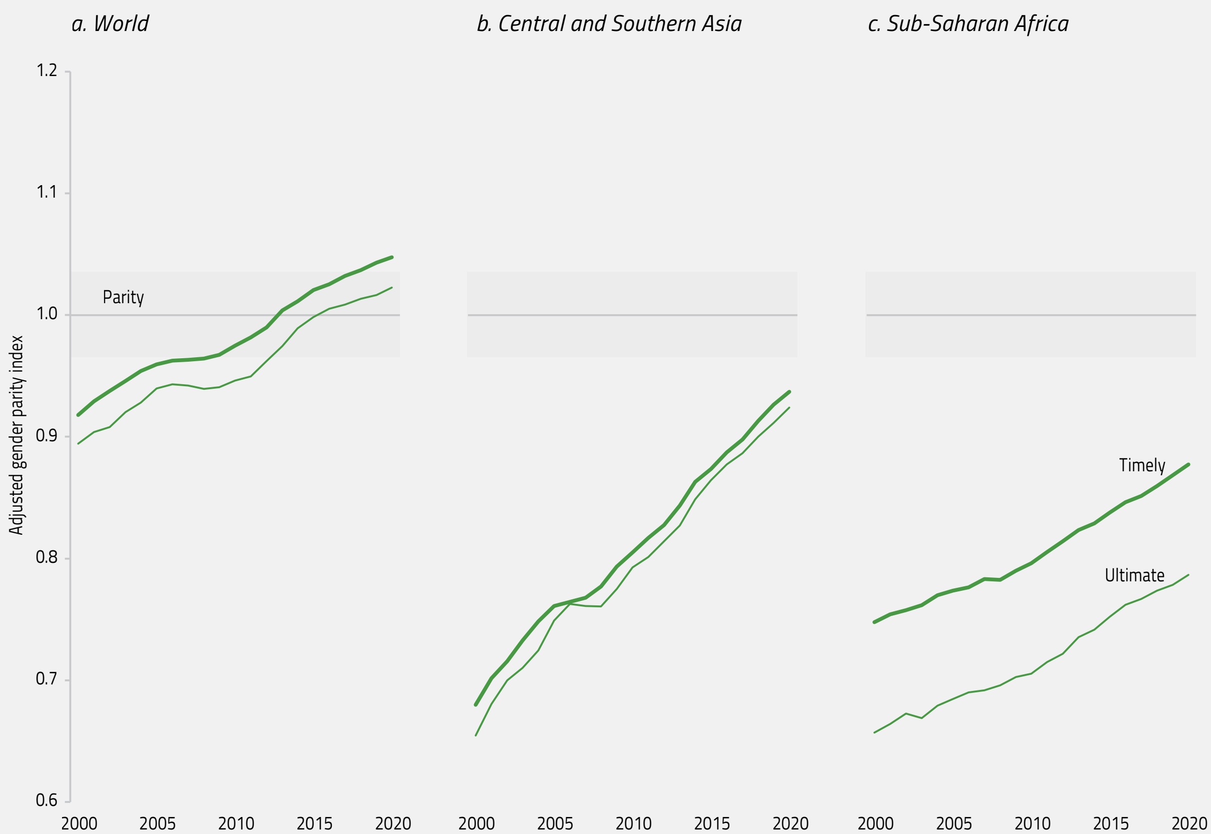
Global indicator 4.5.1, the education parity index that compares the education status of two groups, one disadvantaged and one privileged, is defined in terms of other global education indicators (e.g. completion or learning), at various education levels (e.g. primary or secondary) and for various individual characteristics (e.g. wealth or location). The potential combinations are so numerous that it is very difficult to talk of one trend. It is particularly challenging to make global comparisons in terms of characteristics whose definitions vary between countries. For example, definitions of urban and rural are not the same between countries, neither are definitions of poor and rich. The latter definition may be based on income, consumption or wealth, with each concept meaning different things and leading to different conclusions.

Progress towards gender parity in upper secondary completion is one of the most interesting trends to follow, given the variety of contexts around the world – and is also the Sustainable Development Goal (SDG) 4 benchmark indicator on equity. Globally, gender parity was achieved in 2010 but by 2017, there was reverse disparity, with 95 young men completing upper secondary school for every 100 young women. There are only two SDG regions where there is still disparity at the expense of young women but their trajectories have been very different. In Central and Southern Asia, for every 100 young men who completed upper secondary school, there were 68 young women in 2000 but 94 in 2020. Sub-Saharan Africa started from a more equal position (75 young women completing for every 100 young men in 2000) but progressed at half the rate (88 young women for every 100 young men in 2020). On the positive side, the rate of progress was twice as fast in 2008–20 as in 2000–08 (**Figure 16.2**).

FIGURE 16.2:

Central and Southern Asia has overtaken sub-Saharan Africa in the race to ensure gender parity in upper secondary completion

Adjusted gender parity index of the upper secondary timely and ultimate completion rate, 2000–20



GEM StatLink: https://bit.ly/GEM2023_fig16_2
Source: VIEW database.

Continued on next page

BOX 16.1: CONTINUED

However, it is necessary to not only look at disparity in the official 'timely' completion rate but also at the 'ultimate' completion rate, i.e. the percentage of those who complete upper secondary school even later than three to five years after the official graduation age. Disparity is lower in the latter rate: globally, there are 98 young men completing upper secondary school for every 100 young women. This means that young men are more likely to complete upper secondary school late.

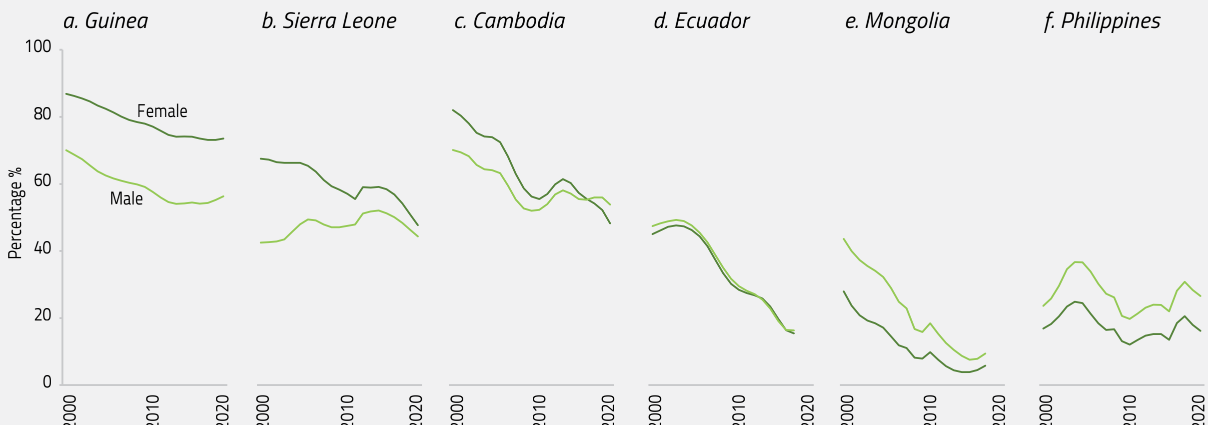
However, in sub-Saharan Africa, this gap is very large and indicative of a significant challenge facing girls and young women. While 88 young women complete upper secondary school on time for every 100 young men, ultimately only 79 young women do. Young women who do not finish upper secondary school on time are more likely to leave school early, under pressure to marry and have children, while young men can afford to persevere with their education for a little longer to obtain the upper secondary education certificate. There has been no progress at all in closing this gap in the past 20 years. By contrast, this problem is not present at all in Central and Southern Asia, and is one of the reasons that helps to explain the fast progress the region has achieved in closing the gender gap.

Second, countries' trajectories depart from the global trend. Globally, the gender gap in the out-of-school rate among youth of upper secondary school age fell from four percentage points in 2000 to zero in 2020. But it is possible to observe six patterns. Three have a starting point of an initial gap in favour of men, which remained constant (e.g. Guinea), declined (e.g. Sierra Leone) or reversed (e.g. Cambodia). One shows the maintenance of parity throughout (e.g. Ecuador). The other two start with an initial gap in favour of women, which declined (e.g. Mongolia) or remained constant (e.g. the Philippines) (**Figure 16.3**).

FIGURE 16.3:

Six country patterns can be observed in the evolution of the gender gap in upper secondary out-of-school rates

Upper secondary out-of-school rate, by sex, 2000–20



Initial gap in favour of men			Initial parity	Initial gap in favour of women	
Constant	Decreasing	Reversing	Constant	Decreasing	Constant
Benin, Cameroon, C. A. R, Chad, Côte d'Ivoire, Eritrea, Ethiopia, Guinea-Bissau, Iraq, Mali, Mozambique, South Sudan, Togo, Yemen, Zambia	Angola, D. R. Congo, Türkiye	Bhutan, Comoros, Gambia, India, Nepal, Viet Nam	Algeria, Armenia, Bolivia, Haiti, Kenya, Mexico, Rwanda, Saudi Arabia, South Africa	Costa Rica, Lao PDR, Saint Lucia, St Vincent/ Grenad., Suriname, Trinidad/Tobago, Uruguay	Cabo Verde, Honduras, Jamaica, Malaysia, Mauritius, Philippines, Thailand, Venezuela, B. R.

GEM StatLink: https://bit.ly/GEM2023_fig16_3
Source: VIEW database.

> While the situation of girls and young women has improved dramatically, some are trapped in pockets of disadvantage due to location and poverty – but also due to other social and cultural characteristics

Third, even though the parity index indicates disparity, it still only measures average disparity. While the situation of girls and young women has improved dramatically, some are trapped in pockets of disadvantage due to location and poverty – but also due to other social and cultural characteristics. For instance, in Mozambique, there are 73 young women in school for every 100 young men. But, while there is gender parity in urban areas, in rural areas there are 53 young women in school for every 100 young men. By contrast, in the relatively few countries where young men are, on average, at a disadvantage, their disadvantage tends to be higher in urban areas, such as in Mongolia and Palestine (**Figure 16.4a**).

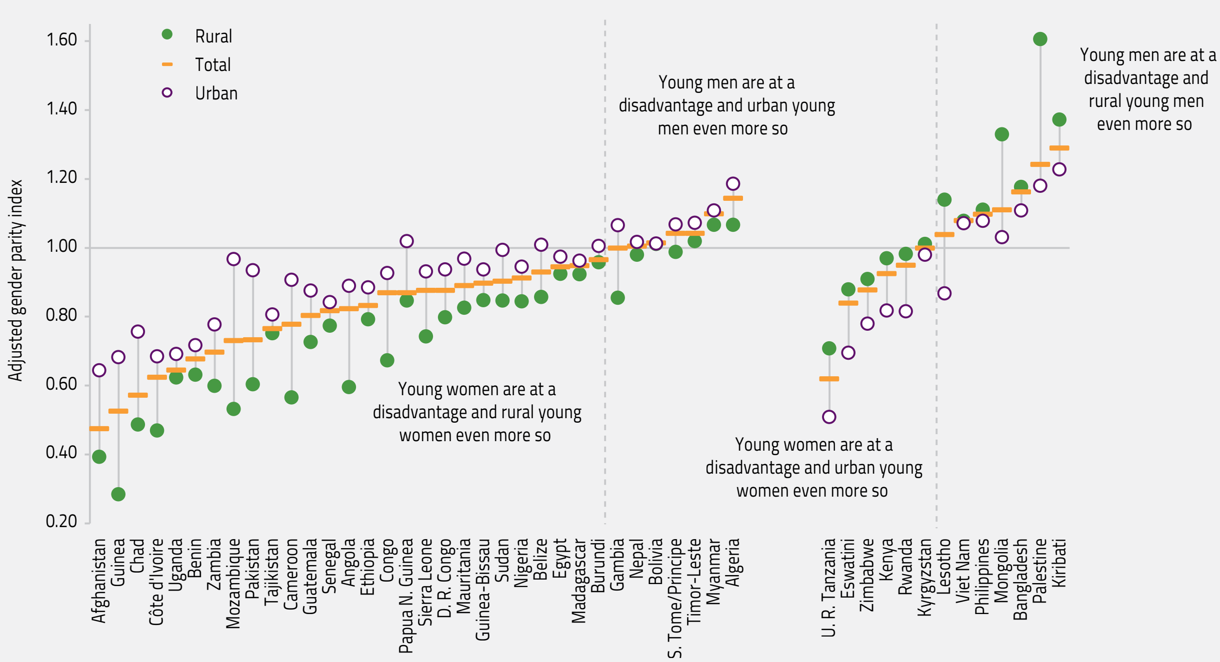
The disparity is even more exacerbated in terms of wealth. In a large number of low- and lower-middle-income countries, including the Democratic Republic of the Congo, Nigeria and Pakistan, there is gender parity in school attendance among the richest youth but substantial disparity among the poorest. In Côte d'Ivoire, there are 72 young women in school for every 100 young men but only 22 poor young women in school for every 100 poor young men. Again, in the few countries where young men are at a disadvantage, their disadvantage tends to be higher among the poorest, such as in Bangladesh and Lesotho (**Figure 16.4b**).

FIGURE 16.4:

Young women in poor and rural households tend to be educationally more disadvantaged than the average learner

Gender parity index of the attendance rate among youth of upper secondary school age, low- and lower-middle-income countries, 2014–19

a. By location

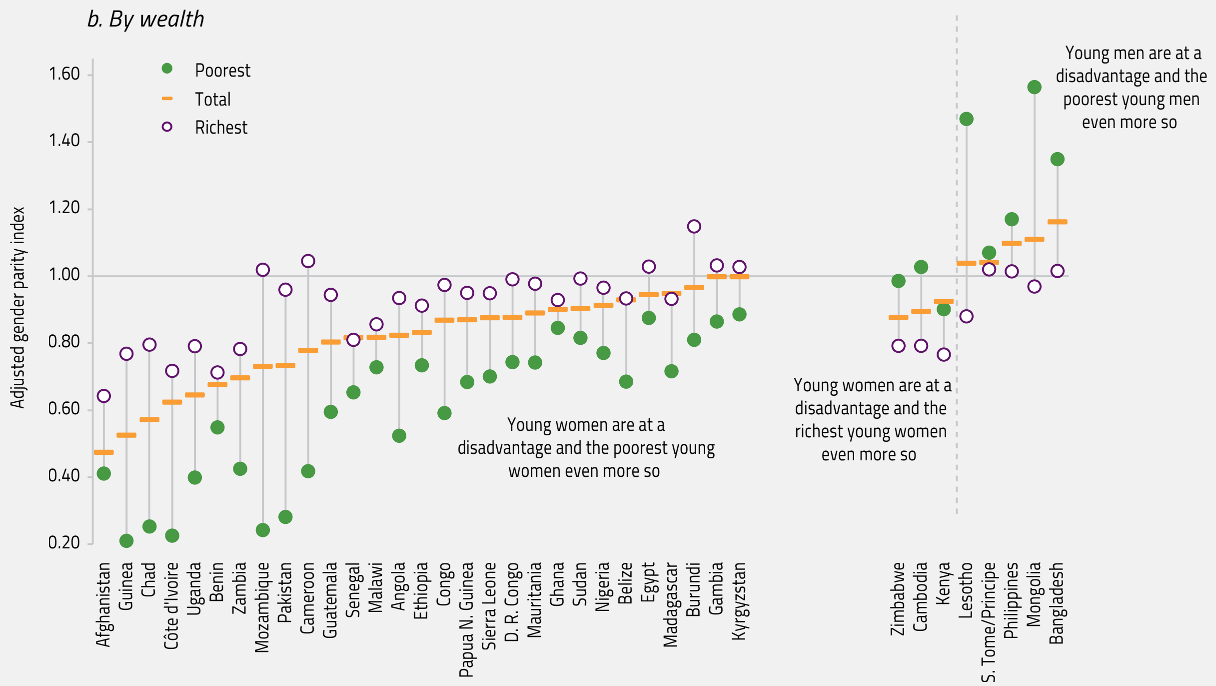


GEM StatLink: https://bit.ly/GEM2023_fig16_4
Source: WIDE database.

FIGURE 16.4: CONTINUED

Young women in poor and rural households tend to be educationally more disadvantaged than the average learner

Gender parity index of the attendance rate among youth of upper secondary school age, low- and lower-middle-income countries, 2014–19



GEM StatLink: https://bit.ly/GEM2023_fig16_4
Source: WIDE database.

While girls and young women still face hurdles in education access and completion in many poor countries, gaps in learning outcomes are of an entirely different kind. In reading, among 97 countries with data in upper primary and lower secondary education in 2016–19, only two low-income countries had a tiny gap favouring boys: Chad and the Democratic Republic of the Congo. In the other 95 countries, the share of girls with minimum proficiency was an average of 10 percentage points higher than the share of boys. Globally, for every 100 proficient boys, there are 115 proficient girls in reading at the end of lower secondary education.

Boys have a small advantage over girls in mathematics in primary education, but this is reversed in lower secondary education. In the 2019 Trends in Mathematics and Science Study, the share of grade 4 boys with minimum proficiency exceeded that of girls by 1.4 percentage points in 30 upper-middle and high-income countries. But by grade 8, it was girls that had a 1.4 percentage point advantage over boys (**Figure 16.5a**). In science, girls already have an advantage in grade 4 (by 1.9 percentage points), which doubles by grade 8 (4.3 percentage points) (**Figure 16.5b**).

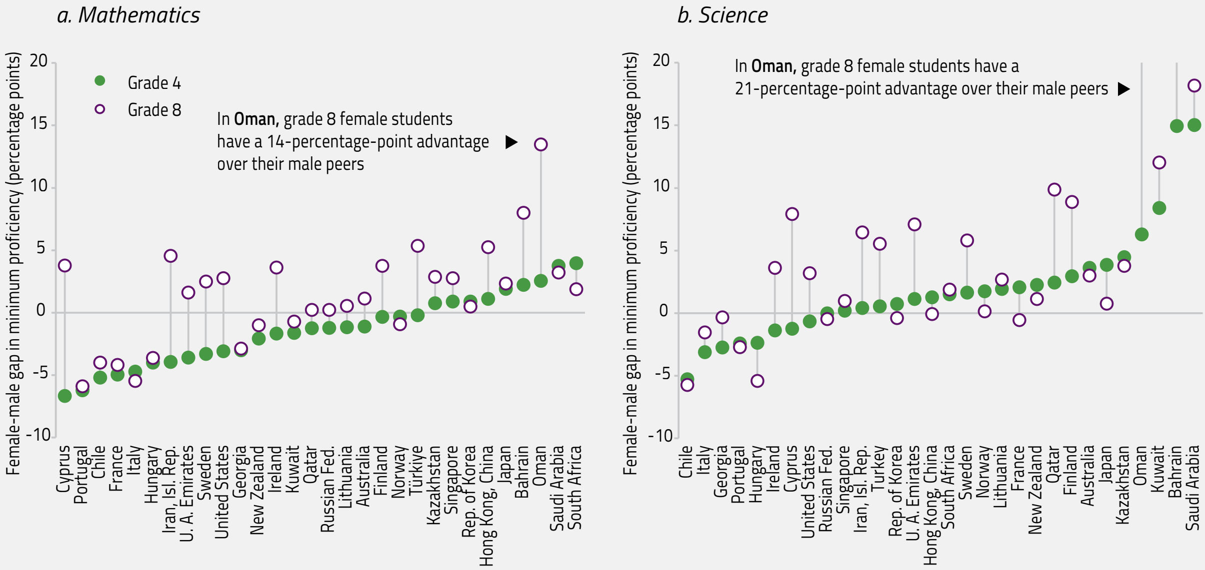
However, it should be noted that these gaps relate to the achievement of minimum proficiency; boys tend to have a considerable advantage over girls in science and mathematics at the higher end of performance (UNESCO, 2022). Although gender disparity has decreased over time, boys are still more likely to be over-represented among the highest performers in mathematics. Girls are underrepresented at the top of the mathematics skills distribution, even though they perform better than boys on average (Baye and Monseur, 2016).

“Boys have a small advantage over girls in mathematics in primary education, but this is reversed in lower secondary education”

FIGURE 16.5:

Girls' performance in mathematics and science is improving relative to boys' as they move from primary into lower secondary education

Female–male gap in share of students achieving minimum proficiency level in mathematics, grade 4 and grade 8, 2019



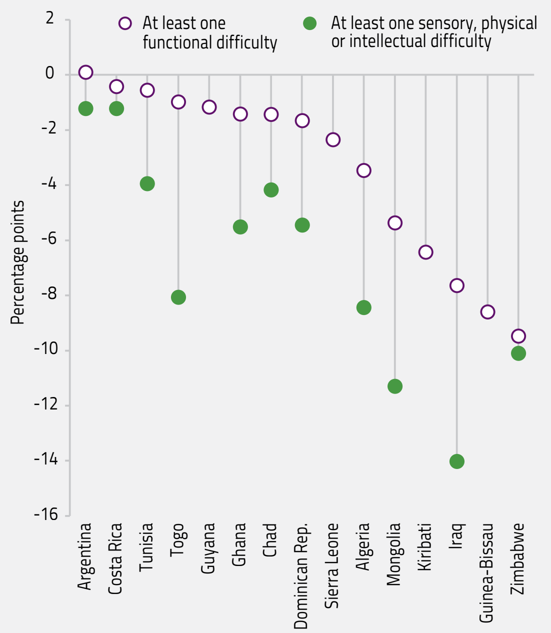
GEM StatLink: https://bit.ly/GEM2023_fig16_5
Source: WIDE database.

The COVID-19 pandemic exacerbated education inequality and had unequal impacts on learning. Students from lower socioeconomic backgrounds benefited less (Moscoviz and Evans, 2022) from remote learning solutions because they often lacked access to technology and were often not sufficiently supported by parents or siblings. As a result, learning loss was often concentrated among these students: the loss was 60% higher for students in the Netherlands whose parents had less education (Engzell et al., 2021). In Italy, among children of less educated parents, the learning loss was larger for girls (Contini et al., 2021). In Belgium and the United States, within-school inequalities increased (Kuhfeld et al., 2020; Maldonado and Witte, 2022). In Mexico, 10- to 15-year-olds in the states of Campeche and Yucatan were assessed in reading and numeracy between 2019 and 2021: overall, children and adolescents from low socioeconomic groups experienced greater losses than their peers, but losses were even greater for girls from the lowest socioeconomic groups (Hevia et al., 2022).

While sex, location and wealth are the main characteristics monitored in analyses of inequality in SDG 4, other characteristics deserve attention, such as parental education (**Focus 16.1**) and disability. The World Inequality Database on Education (WIDE) has added disability to the list of characteristics it uses to disaggregate educational status, with the UNICEF Multiple Indicators Cluster Survey being the main source of information. During the fieldwork, at most, one child aged 5–17 per household was assessed. Coverage varied widely across countries, from 25% in Gambia to 78% in Cuba, although in most countries it exceeded 50%. In general, households from the richest quintiles and/or where parents had higher levels of education had a smaller non-response rate than others. For example, in Ghana the non-response rate for disability was 64% among the poorest households and 50% among the wealthiest. In Mongolia, households where parents had completed primary education or less had a non-response rate of 51%, compared to 39% among those where parents had a higher education. Children appearing in the data with some type of disability are disproportionately likely to be located in households that are, on average, more privileged.

Overall, children with at least one functional difficulty were three percentage points less likely than the average child to complete primary school but the gap was six percentage points in Kiribati and nine in Guinea-Bissau. But children with at least one sensory, physical or intellectual difficulty, which is a narrower definition of disability, were 7 percentage points less likely than the average child to complete primary school and the gap was 10 percentage points in Zimbabwe and 14 points in Iraq (**Figure 16.6**). However, these numbers need to be interpreted in light of the fact that poorer families are less likely to report that they have a child with a disability.

FIGURE 16.6:
Children with disabilities are less likely to complete primary school
Gap in primary completion rate, average and children with functional difficulties, selected low- and lower-middle-income countries, 2017–19



GEM StatLink: https://bit.ly/GEM2023_fig16_6
Source: WIDE database.

FOCUS 16.1: FIRST-GENERATION STUDENTS HAVE IT HARD EVERYWHERE

The monitoring of target 4.5 has emphasized three individual characteristics for which data are most commonly available and which are assumed to be comparable between countries: gender, socioeconomic status and urban/rural location. While gaps in education access and outcomes relating to these three dimensions are considerable, other characteristics grouped under the catch-all category of 'vulnerable situations' have not received as much attention. One group that is not mentioned at all in the SDG 4 framework is first-generation learners, i.e. learners who are the first in their family to attend a particular level of schooling. Emerging analyses show that completing a level of education that one's parents never attended is a formidable challenge, whether for children of illiterate parents in low-income countries or first-in-their-family university students in high-income countries.

“Emerging analyses show that completing a level of education that one's parents never attended is a formidable challenge”

While parental education often serves as a proxy for socioeconomic status, first-generation learners face specific education challenges that are distinct from disadvantages resulting from poverty (Spiegler, 2013). These challenges have as much to do with cultural capital, such as familiarity with academic etiquette (Collier, 2008), and social capital, such as social connections with teachers or faculty, as they do with material resources. Less educated households may also not be as familiar with the written and unwritten rules of getting into higher levels of education.

First-generation students are more likely to have norms, such as a belief in collaboration, that are at odds with the more individualistic environment of higher education (Phillips et al., 2020). They are also more likely to doubt their skills and experience a fear of being exposed, a feeling exacerbated in courses which tend to be more competition-oriented, such as science, technology, engineering and mathematics (STEM) courses (Canning et al., 2020). First-generation students in France suffered a greater negative impact on their performance when compared explicitly to their classmates than did other students (Jury et al., 2015).

Some recent research in the United States has suggested that contrary to what is often believed, caregivers with different levels of education show little difference in parenting styles (Hastings and Pesando, 2022); in other words, it is not the case that the less educated are less demanding parents. Instead, a crucial constraint for schoolchildren is that their less educated parents may not be familiar with the learning material and cannot help with homework and assignments or give first-hand advice on effective strategies on how to learn (Portela et al., 2020).

Analysis from Germany shows that children from disadvantaged families, including less educated households, are not as likely to receive a good grade, even given identical performance, be recommended for the academic secondary track even when receiving identical grades, and actually choose the academic track even when recommended to do so. This is a triple disadvantage for learners taking a decision as early as the age of 10 to 12 (Maaz, 2020). Data from the Programme for the International Assessment of Adult Competencies show as few as one in five complete tertiary education in Organisation for Economic Co-operation and Development countries among those whose parents did not complete upper secondary school, compared to two in three whose parents were university educated (OECD, 2018).

Longitudinal data from the Young Lives project in Ethiopia, India, Peru and Viet Nam also allow an analysis of what happens when learners become first-generation students once they progress beyond their parents' schooling. At age 8, when they are in primary school, relatively few children are first-generation learners, except in Ethiopia, where more than one in three are. But by age 15, when they are in secondary school, two thirds are first-generation learners in all countries except Peru. In India and Viet Nam, they have a greater risk of dropping out from secondary school, a level above what their parents had achieved (Portela et al., 2020).

Even when first-generation students reach the top of the attainment distribution, there is still inequality in learning. In Ethiopia, first-generation learners are significantly disadvantaged in terms of learning, even accounting for poverty, and this gap widens over the course of schooling (Iyer et al., 2020). Inequality extends higher up the education ladder to distribution across disciplines and institution prestige. Only 14% of recent US-born economics Ph.D. recipients were first-generation college graduates, dropping to only 5% at the top 6 economics departments. This compares to 26% across all fields and over 40% of education Ph.D. recipients (Schultz and Stansbury, 2022).

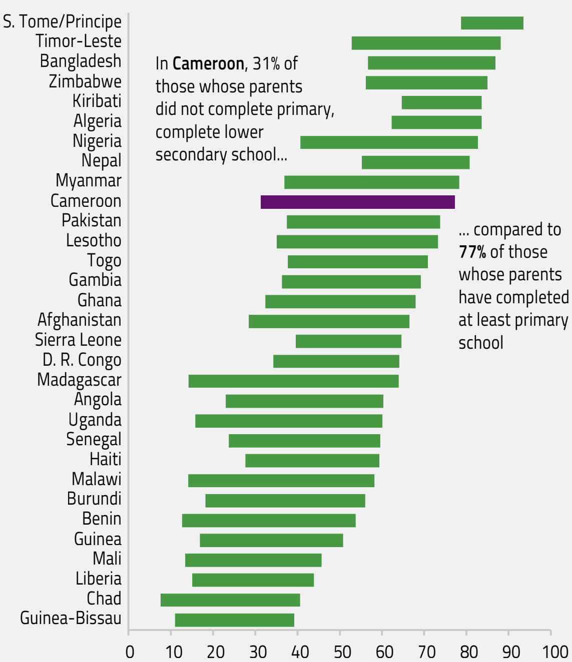
Such analyses require various methodological choices. Whose education determines a young person's first-generation status at a given level? Do they cease being first-generation if either of their parents attended that level themselves, or only if both did? In practice, although an imperfect choice, data coverage is maximized if the focus is on the education of the head of household or the highest-educated adult in the household, perhaps above a certain minimum age (e.g. 25 years), in an attempt to exclude older siblings. More than half of all students in tertiary education in the United States may be first-generation (Laiduc et al., 2021; Redford and Hoyer, 2017). However, this estimate is highly dependent on the definition used: a study using a sample of 7,300 students found that the share ranged from 22% to 77%, depending on which of several definitions was used (Toutkoushian et al., 2018).

In an extension of the WIDE, which has been documenting the level and change of education inequality since 2010, the GEM Report team has analysed individual education status according to the education level of the head of household, the aim of which is to understand the extent of first-generation learners' disadvantage compared to their peers. One measure is the relative gap in primary and lower-secondary completion by first-generation status in low- and lower-middle-income countries. The median gap in primary completion is 23 percentage points and exceeds 40 points in Nigeria, which is larger than the urban–rural gap. The median gap between first-generation and non-first-generation adolescents in lower secondary completion is 34 percentage points and reaches 46 points in Cameroon and 50 points in Madagascar (**Figure 16.7**).

FIGURE 16.7:

First-generation learners suffer a large disadvantage in education attainment

Lower secondary completion rate, by educational attainment of household head, low- and lower-middle income countries, 2015–21



GEM StatLink: https://bit.ly/GEM2023_fig16_7
Source: WIDE database.

First-generation disadvantage is related to but distinct from intergenerational educational mobility: the strong relationship between the educational attainment of parents and children means there is lower mobility (Bhalotra et al., 2015; Razzu and Wambile, 2022). In the context of educational expansion and increasing mobility where a large number of first-generation students is a positive development, the question then becomes how to help them succeed. In a context of few first-generation students and low mobility, the question is how to increase their number.

In a study of intergenerational educational mobility over 50 years in Comoros, Ghana, Guinea, Madagascar, Malawi, Nigeria, Rwanda, the United Republic of Tanzania and Uganda, parental education accounted for 51% of the inequality in children's years of schooling. This suggests that levels of educational mobility in sub-Saharan Africa are similar to those in Asia and higher than those observed in Latin America. In most countries in the study, there was a moderate increase in mobility over time, driven by progress towards universal, mandatory and free primary schooling. Notably, educational mobility was higher when education was given a higher priority in public expenditure (Azomahou and Yitbarek, 2016). While first-generation disadvantage persists in upper-middle- and high-income countries, examples of higher mobility have been documented, such as girls in Türkiye (Abdurrahman and Hakki, 2019), learners in richer regions in Italy (Güell et al., 2018) and in the United States (Chetty et al., 2014).

A range of initiatives tries to address challenges faced by first-generation learners (Whitley et al., 2018). For example, campaigns may focus on role models who highlight their status as first-in-their-family graduates who achieved academic success. First-generation students felt greater belonging and were more likely to seek support when meeting faculty whose own first-generation status was made explicit. The University of California implemented a First-Generation Initiative across its 10 campuses in 2017 to raise awareness, create an inclusive and supportive culture, and ensure that first-generation students were connected to relevant resources and networks (Laiduc et al., 2021).

While campaigns are focused on encouraging first-generation students to enrol, other mechanisms are required to support them at institutions once they do. Some schools offer support programmes by assigning mentors or buddies who can explain how things work at the university, reducing reliance on cultural capital at home. A study of a supplementary curriculum, a three-week orientation course followed by targeted counselling and mentorship, offered to first-generation students from poor rural families at an engineering school in Chennai, India, found that the special curriculum helped them to overcome social and cultural barriers but the participants doubted that higher education alone would be enough to overcome the challenges they face in competing with their peers for gainful employment (Vijayakumar, 2020).

First-generation learners can also be supported by programmes targeting their family members. If family members prioritize education, they can facilitate the success of their children through non-material support (Gofen, 2009), even if they are not familiar with higher education (Spiegler, 2013).

For support programmes to succeed, it must first be recognized that first-generation students are far from homogeneous, and that first-generation status intersects with other forms of disadvantage (Nguyen, 2018). Moreover, institutional support structures may undermine first-generation students' sense of belonging if they frame support in terms of overcoming a supposed limitation (Means and Pyne, 2017). Rejecting a deficit view, many first-generation students see themselves as being more motivated, adaptable and, almost by definition, more self-reliant (Tate, 2015), contributing positively to their academic confidence and consequently their learning.

Dasha, 17, attends a class at the school in the village of Hranitne, which is located along the so-called contact line that divides government and non-government controlled areas where fighting is most severe, eastern Ukraine, Thursday 9 March 2017.

Credit: UNICEF/UN058464/Kozalov*

KEY MESSAGES

The world youth literacy rate increased from 87% in 2000 to 91% in 2015, but increased by less than one further percentage point by 2020. The number of illiterate youth fell from 107 million in 2015 to 99 million in 2020.

The adult literacy rate (ages 15 to 64) increased from 81% in 2000 to 86% in 2015 and 87% in 2020; the increase was just 1.2 percentage points over the last five years.

Adult literacy rates increase because younger, more educated population cohorts replace older, less educated cohorts. Following individual cohorts in Cambodia, Kenya and Nepal shows that their literacy rates remain the same, or even decrease somewhat, as they get older.

Improvement in women's literacy status has been exceptionally fast. In India, 46% of 45- to 49-year-old women but 90% of 15- to 19-year-old women were literate in 2020–21. In Sierra Leone, 18% of 35- to 39-year-old women but 74% of 15- to 19-year-old women were literate in 2019. Male literacy rates, however, have progressed very slowly in Gambia, Liberia and Mauritania.

Average reading speed increases through primary school but differs significantly by language because languages and writing systems vary in how much information a single word conveys, and in how many words are required to express the same information.

CHAPTER 17

TARGET 4.6

Youth and adult literacy

By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy

GLOBAL INDICATOR

4.6.1 – *Percentage of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, by sex*

THEMATIC INDICATORS

4.6.2 – *Youth/adult literacy rate*

4.6.3 – *Participation rate of illiterate youth/adults in literacy programmes*

A literacy rate indicator based on direct assessment and recognizing multiple levels of proficiency was introduced in the SDG 4 monitoring framework to capture the evolution of thinking on what it means to be literate, as well as to motivate countries to invest in literacy assessments. However, due to the high cost of assessment, weak implementation capacity and insufficient demand, very few upper-middle- and high-income countries have carried out such assessments since 2015. As a result, literacy monitoring has reverted to the traditional binary distinction of literate vs non-literate.

However, the information sources available that make this distinction, reductive as it is, are not good enough. The traditional assumption that having completed four years of education is equivalent with being literate has long been disproved. Self-reporting of the ability to read and write is still being used in some population censuses and labour force surveys but is also problematic.

BOX 17.1:

Progress since 2015: SDG indicator 4.7.1

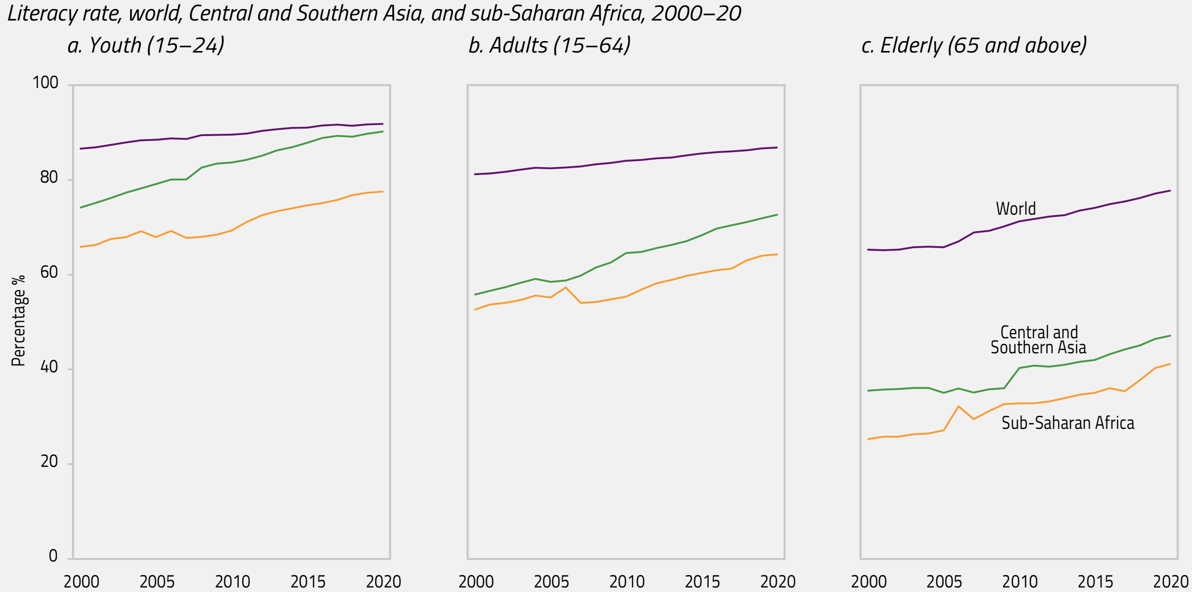
Globally, the youth literacy rate increased from 87% in 2000 to 91% in 2015, but has only increased by 0.8 percentage points since then. Of the two regions that were well below the global average in 2000, Central and Southern Asia has improved at an annual rate three times as fast as the global rate of progress, almost converging with the global average rate: its youth literacy rate increased from 74% in 2000 to 88% in 2015 and 90% in 2020. By contrast, sub-Saharan Africa's rate has converged more slowly, the youth literacy rate increasing from 66% in 2000 to 75% in 2015 and 77.5% in 2020 (**Figure 17.1a**). The number of illiterate youth fell from 107 million in 2015 to 99 million in 2020, of which 36 million were in Central and Southern Asia and 49 million were in sub-Saharan Africa. Women are 56% of all illiterate youth.

The adult literacy rate, for people aged 15 to 64 years, has increased from 81% in 2000 to 86% in 2015 and 87% in 2020, an increase of just 1.2 percentage points in five years. Sub-Saharan Africa has improved at a rate twice as fast as the global average since 2000, but its adult literacy rate was just 64% in 2020, compared to 73% in Central and Southern Asia. (**Figure 17.1b**). The number of illiterate adults dropped from 783 million in 2015 to 763 million in 2020, of which 367 million were in Central and Southern Asia and 205 million were in sub-Saharan Africa, where the number increased by 9 million. Women are 63% of all illiterate adults. Almost one quarter of the elderly above age 65 are illiterate (**Figure 17.1c**). The elderly literacy rate in Eastern and South-Eastern Asia increased from 60% in 2000 to 84% in 2020.

FIGURE 17.1:

Almost one in four youth in sub-Saharan Africa are illiterate

Literacy rate, world, Central and Southern Asia, and sub-Saharan Africa, 2000–20



GEM StatLink: https://bit.ly/GEM2023_fig17_1
Source: UIS database.

However, the UNESCO Institute for Statistics (UIS) has been incorporating into its literacy estimates (**Box 17.1**) information from household surveys, notably the Demographic and Health Survey (DHS) and the Multiple Indicator Cluster Survey (MICS), which include a rudimentary but direct measure of the ability to read a simple sentence. One disadvantage is that these surveys only sample adults aged 15 to 49 years, and usually only women, which requires more assumptions to be made for the entire adult population.

But even so, household surveys shed light on the process by which adult literacy rates change. There are two potential mechanisms in operation. First, as younger, more educated cohorts replace older, less educated cohorts, the adult literacy rate increases by virtue of the changing population composition. Second, adult literacy rates can also change through adult literacy programmes. Data from two Demographic and Health Surveys (DHS) rounds in selected low- and middle-income countries show little evidence that the latter mechanism is at play: literacy programmes, even when effective, rarely reach the scale required to have a visible impact at population level.

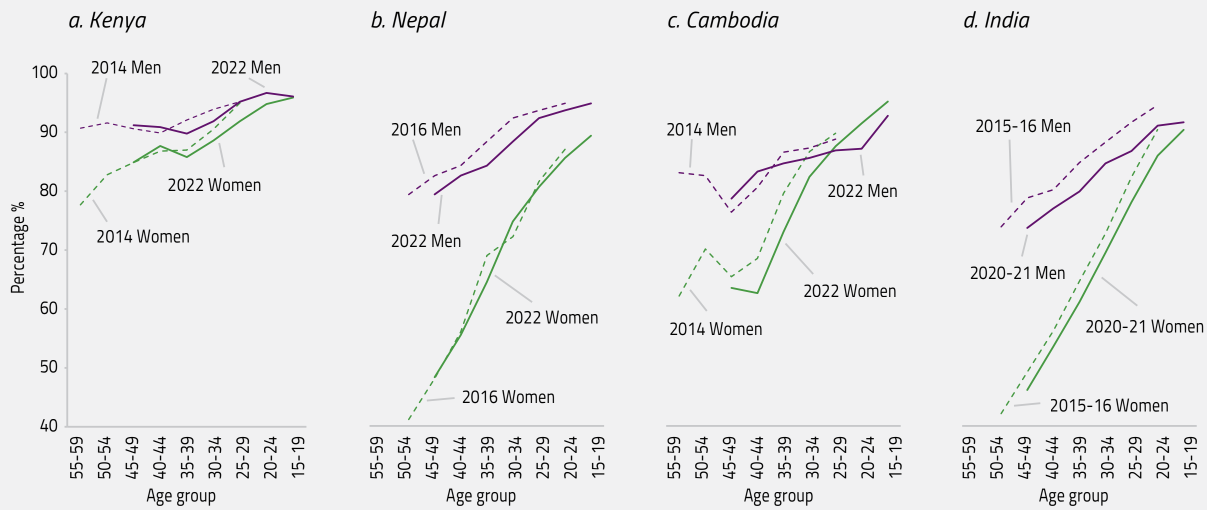
> Literacy programmes, even when effective, rarely reach the scale required to have a visible impact at population level

In India, two successive rounds of the DHS were carried out five years apart from each other, in 2015–16 and in 2020–21, respectively. If adult education programmes were effective and at scale, then the literacy rates of, say, the cohort of 30- to 34-year-old women in 2020–21 should be higher than the literacy rates of the cohort of 25- to 29-year-old women in 2015–16. But in India, as in Cambodia, Kenya and Nepal, the literacy rates of these cohorts remain the same or even decrease somewhat (**Figure 17.2d**).

FIGURE 17.2:

What little progress is observed in adult literacy is the result of more young, educated people in the population

Literacy rate by age group and sex, two waves of household surveys, selected countries



GEM StatLink: https://bit.ly/GEM2023_fig17_2

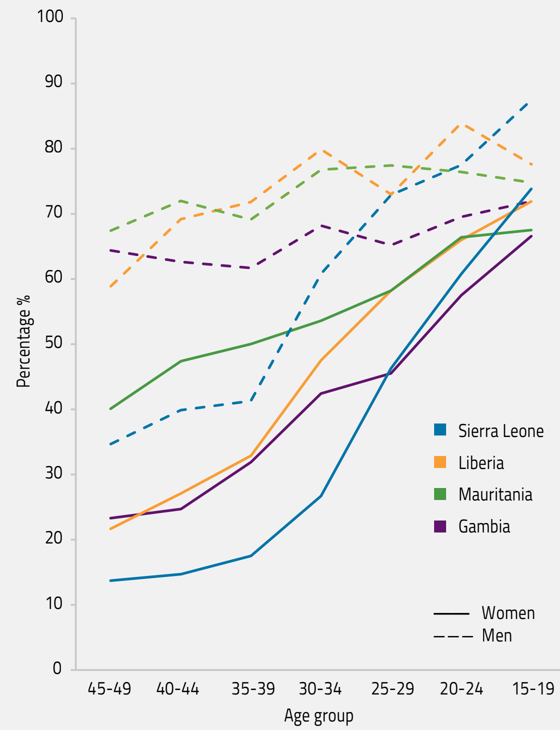
Notes: For every country, the continuous line represents the literacy rate of each age group by sex in the most recent survey. The dashed line represents the literacy rate of each age group by sex in the earlier survey but has been shifted to the left to facilitate comparisons. For instance, the dashed line for the 2015–16 DHS in India has been shifted by 5 years to the left so that the literacy rate of 15- to 19-year-olds in 2015–16 corresponds to the literacy rate of 20- to 24-year-olds five years later, in 2020–21. The dashed line has been shifted by 5 years also in Nepal (where the two survey rounds are 6 years apart) and by 10 years in Cambodia and Kenya (where the two survey rounds are 8 years apart).

Source: DHS country Final Reports.

Improvement in the literacy status of women has been exceptionally fast. In India, 46% of 45- to 49-year-old women but 90% of 15- to 19-year-old women were literate in 2020–21, closing an almost 30 percentage point gender gap in 30 years. In Cambodia, women's literacy rates have exceeded those of men in the youngest cohorts.

The cohort analysis also documents differences in countries' trajectories. For instance, it shows the devastating impact of the Cambodian genocide: adults in their 40s have lower literacy rates than their peers in their 50s (**Figure 17.2c**). It also shows that countries in the same region can achieve different rates of progress. For example, in western Africa: in Sierra Leone, where some of the lowest literacy rates in the world are found, female literacy rates have increased exponentially: in 2019, only 18% of 35- to 39-year-old women but 74% of 15- to 19-year-old girls could read. Male literacy rates have also increased rapidly. By contrast, male literacy rates have progressed very slowly in the Gambia, Liberia and Mauritania: in Gambia, 64% of 45- to 49-year-old men and 72% of 15- to 19-year-old young men are literate, an increase of just 8 percentage points in 30 years. In Liberia and Mauritania, youth literacy rates even appear to have fallen in the latest five-year period (**Figure 17.3**).

FIGURE 17.3:
Literacy rates for adult men have stagnated in Gambia, Liberia and Mauritania
Literacy rate by age group and sex, selected western African countries, 2019–21



GEM StatLink: https://bit.ly/GEM2023_fig17_3
Source: DHS country Final Reports.

Household surveys help improve the reliability of literacy estimates that previously relied only on indirect measurement. But it is important to remember that, even when direct assessments of sentence reading skills are used, the definition of functional literacy is very basic. There is a huge gap between such estimates of adult literacy and those based on more detailed direct assessments of adult literacy skills, such as the Programme for International Assessment of Adult Skills (PIAAC) surveys. For example, while the official literacy rate in Ecuador is 89%, only 28% of adults achieved the minimum level of proficiency in PIAAC (level 2), which recognizes the ability of respondents to match the text with additional information, to paraphrase and to draw low-level inferences, such as identifying information from various parts of a document.

Another strength of household surveys is that they enable literacy rates to be disaggregated by individual background factors. In a sample of 37 low- and middle-income countries, the average urban–rural gap in youth literacy (15–24 years) was 9 percentage points (reaching 29 points in the Democratic Republic of the Congo), while in adult literacy (25–49 years), it was 13 percentage points (reaching 34 points in Ghana).

Literacy is linked to various significant outcomes. A literate woman is more likely to benefit from health campaigns, be informed of modern health methods, and to have more tools to overcome detrimental gender norms (Deschênes and Hotte, 2021). According to MICS data, literacy is associated with a slightly higher probability of using modern contraceptives (by about 2.5 percentage points). In some countries, the difference is much bigger. In Palestine, the gap in modern contraceptive use between literate and illiterate women is 35 percentage points in urban areas and 22 percentage points in rural areas. Where the contraceptive supply is scarce and gender norms are pervasive, literacy may play an even more critical role.

> “A literate woman is more likely to benefit from health campaigns, be informed of modern health methods, and to have more tools to overcome detrimental gender norms”

Global indicator 4.6.1 covers literacy and numeracy. The five domains of numeracy (civic, digital, financial and business, health and workplace) (UNESCO Institute for Lifelong Learning, 2020) clearly relate to SDG targets 4.1 and 4.4. The quality of education and the acquisition of mathematics skills during primary and secondary school is a determinant for the acquisition of adult numeracy skills and relevant skills for employment. Unfortunately, data for numeracy are even more limited than for literacy. In the 38 mostly high-income countries that took part in the three waves of PIAAC in the 2010s, only Japan exceeded 90% in terms of the numeracy skills of its adult population. Fewer than half of adults from upper-middle-income countries that took part in the second (2015) and third (2017) rounds of PIAAC had minimum proficiency in numeracy, including in Ecuador (23%), Peru (25%), Mexico (40%) and Türkiye (49%). The only upper-middle-income country where the majority of adults had at least minimum numeracy skills was Kazakhstan (73%).

FOCUS 17.1: DOES READING SPEED MATTER?

Learning outcomes have risen to the top of the post-2015 international education agenda with reading comprehension the measure receiving the most attention. But if reading comprehension is to be improved, the means to that end – the mechanics of reading – must be understood.

Comprehension has a non-linear relationship with reading speed. Read too slowly, and you forget how a sentence started by the time you reach the end. But read too quickly, and you start skipping over information. While both effects are obvious at the extremes, the extent to which reading speed matters as a benchmark for learning is contested.

Reading speed differentials among individual students mirror their test score gaps. Cognitive correlates of higher reading speed include working memory and fluid intelligence (Johann et al., 2020). A positive correlation between reading speed and reading comprehension at the individual level has been empirically found in a diverse range of languages, including Turkish (Soysal, 2022b) and German (Johann et al., 2020).

Yet across countries, high levels of comprehension are achieved at different reading speeds. Some studies question the usefulness of reading speed as a metric or proxy for learning (Dowd and Bartlett, 2019; Graham and Ginkel, 2014), although the methodology of such analyses and their consistency with cognitive research are disputed (Abadzi and Centanni, 2020).

There are physiological limits to the speed at which the human eye can fixate and scan each word in a text (Seidenberg, 2018). At some point, reading faster means no longer processing every word. Reading, 'the processing of textual information so as to recover the intended meaning of each word, phrase, and sentence', turns into skimming – '[moving] one's eyes through the text to find a specific word or piece of information or to get a general idea of the text content' (Rayner et al., 2016, p. 5), which is a distinct skill in its own right.

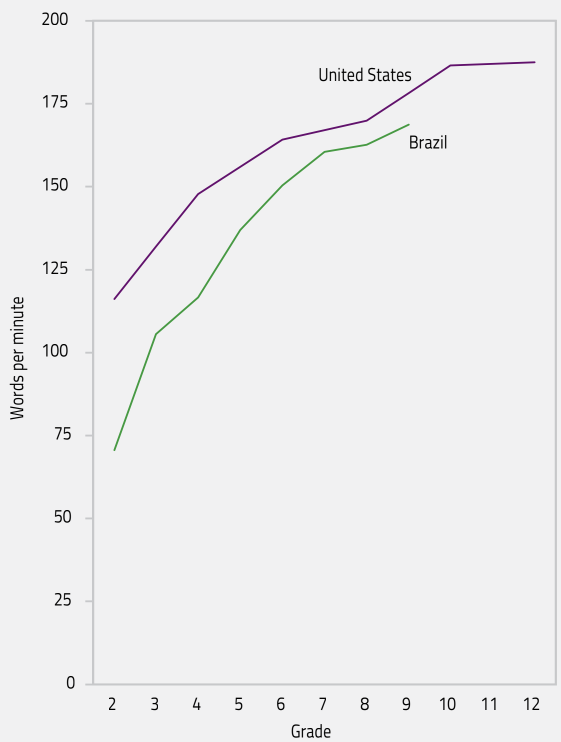
Efforts at 'speed reading' have a long and controversial history. There is a lack of evidence for the most optimistic claims of fantastic speeds with full comprehension (Rayner et al., 2016; Seidenberg, 2018), The question remains whether speed reading is even desirable (Tsvetkova, 2017; Wolf and Klein, 2022). Comprehension and retention inevitably deteriorate at extreme speeds. The fastest confirmed reading speed in English with comprehension achievable under laboratory conditions, with words displayed sequentially at the same point with no need for eye movement, and at an optimized print size, exceeds no more than 800 words per minute (wpm) (He et al., 2018).

The average words per minute for reading in the adult population, and what is expected of learners at different grade levels and ages, is far lower. Based on a meta-analysis of 190 studies, the silent reading speed for English non-fiction of most adults falls in the range of 175 to 300 wpm, with an average of 238 wpm (Brysbaert, 2019). Reading fiction is slightly faster, reflecting that it has, on average, shorter words.

Some studies focus on individual correlates. Reading is likely to benefit from many of the same factors that confer educational advantage in general, such as the availability of books in the home. But when, for instance, positive attitudes towards reading and higher reading speed go together, the direction of causality remains unclear. Do keen readers improve their speed by reading more, or are fluent readers more motivated to use their skill? Perhaps both work to create a virtuous circle. More telling is the effect of improvements in reading speed. Grade 4 to 6 students who received 28 hours of instruction in techniques to improve their reading speed reported greater enjoyment of reading, greater motivation caused by the ability to read more books in the same time, and further reported that they were no longer intimidated by long books (Soysal, 2022a).

Individual differences in reading speed tend to be larger than by age or grade. Despite this, reading speed data by age or grade reveal clear developmental patterns as children learn to read. Similar to findings from the United States (Spichtig et al. 2016), a study in Brazil found that the average reading speed continued to improve from grades 2 to 9, albeit more slowly beyond grade 7 (Alves et al., 2021) (**Figure 17.4**). This pattern is also reflected in grade norms (Hasbrouck and Tindal, 2017).

FIGURE 17.4:
Average reading speed continues increasing through primary school
Silent reading speed by grade, Brazil (2018) and United States (2010/11)



GEM StatLink: https://bit.ly/GEM2023_fig17_4
Source: Alves (2021) for Brazil and Spichtig et al. (2016) for the United States.

The extent to which reading speed depends on word decoding or language comprehension changes with increasing fluency and, by implication, school grade (Carretti et al., 2020). Reading speed continues to increase up to school-leaving age and starts to decline slowly around age 40, by some 10% by age 70 (Brysbaert, 2019). However, the decline is related to changing vision (Liu et al., 2017) and not necessarily cognition.

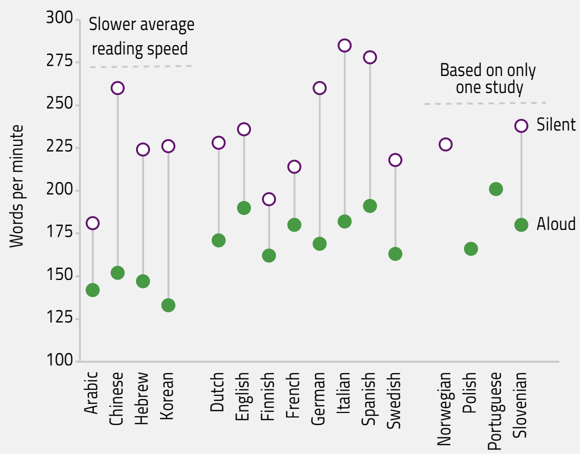
Measured reading speed drops further if only counting words read correctly. Oral reading fluency, as measured by the Early Grade Reading Assessment (EGRA), an international assessment tool, indicates the number of words correctly read aloud, which is inherently slower than silent reading. The instructions for EGRA are to not try to read as fast as possible. But correctness may add little extra statistical information beyond speed (Williams et al., 2011), because faster readers also tend to be more fluent. Correctness still offers some advantages as a measure. For instance, while outlier scores may be produced in the measurement of silent reading, when readers get stuck on a difficult word, a prompt can be given if they are reading aloud. Oral fluency may also be more closely related to comprehension; testing it allows the collection of information on errors (Piper and Zuilkowski, 2015). Crucially, however, such a link with comprehension does not persist across languages, calling into question the use of English reading fluency as a proxy target for learning among non-native speakers in sub-Saharan Africa, even when the language of instruction is English (Piper et al., 2016).

Even more challenging is the standardization of reading speed measurement across languages, and especially across different scripts and writing systems. Much research on reading deals specifically with reading English. This is unfortunate, not only in terms of cultural bias, but also because the linguistic properties of English are far from typical. In particular, English orthography is highly irregular. Unlike in Spanish, Korean and many other languages, it is not possible to reliably predict how an unfamiliar English word is pronounced based on written representation alone.

Directly comparable or not, reading speed measures have been adapted to various languages. The International Reading Speed Texts (IReST) consist of 10 short paragraphs of around 150 words each and are available for 17 languages (Trauzettel-Klosinski et al., 2012), including languages with non-Latin scripts including Greek (Gleni et al., 2019) and Chinese (Wang et al., 2018). A review of 232 reading speed studies (Brysbaert, 2019) in various languages not limited to IReST suggests that average reading speed differs significantly in different countries and languages (**Figure 17.5**).

These differences are measured in words per minute. But this raises the question of how to account for differences in the definition of a 'word', for instance with respect to prefixes, suffixes and whether articles and pronouns appear as separate words. Approaches to accounting for such effects include counting each component of compound words (Abadzi, 2012). In Chinese, word boundaries are well-defined even if, in writing, spaces between words are not normally inserted or indeed required for fluent reading (Ling and Liu, 2021). In contrast to English, which uses between five and six letters per

FIGURE 17.5:
Average reading speed differs significantly in different countries and languages
Average reading speed, by reading modality, selected languages



GEM StatLink: https://bit.ly/GEM2023_fig17_5
Note: Reading speed per language has been averaged over different studies.
Source: Brysbaert (2019).

word on average, Chinese words typically consist of only one or two complex characters (Brysbaert, 2019).

In summary, languages and writing systems differ in how much information is encoded in a single word, and in verbosity, that is, how many words are required to express the same information. Verbosity and average reading speed are correlated, meaning that each word tends to take longer to read in languages that encode more information per word (Brysbaert, 2019). As a result,

> "Reading unvowelled Arabic requires a significant amount of simultaneous grammatical decoding"

how long it takes to read the same information differs less between languages than the reading speed measured in words per minute.

A notable outlier in silent reading speed is Arabic. It is argued that Arabic is inherently slow to read because formal Arabic customarily omits the signs for short vowels in handwriting and print except in children's books (to help early readers) and religious texts (for unambiguity). As a result, reading unvowelled Arabic requires a significant amount of simultaneous grammatical decoding. Moreover, native Arabic speakers are almost universally native speakers of various Arabic dialects that differ from standard Arabic in vocabulary, grammar and pronunciation. Accordingly, formal Arabic is de facto their second language. The fact that reading speed points to the relative difficulty of written Arabic may be one explanation of why adult literacy in many Arab countries is lower than would be expected, given the levels of income and schooling.

A study of the reading speed achieved by learners of Arabic, who are not native speakers of a spoken variant of colloquial Arabic, at different proficiency levels showed interesting nuance (Midhwah and Alhawary, 2020): fully vowelled text is generally read more slowly than unvowelled text, but both variants are read faster by students learning from vowelled textbooks. The reading speed of Arabic is also slower than that of Hebrew, which uses a different script but is otherwise linguistically closely related (Eviatar et al., 2019).

Measurements of reading speed are not perfectly standardized, even when some parameters are fixed – for example, reading silently or aloud, counting all words or only those read correctly, and reading text or isolated words (or even non-words). The technical properties of the material being read also matter to some extent, including font size, colour and contrast (Wallace et al., 2022; Zhu, 2022), as well as environmental factors such as distance and lighting (Jung and Choi, 2021).

The effect of digital display technology on reading speed is ambiguous, however. Reading speeds on tablets and e-ink readers need not be slower than paper (Moys et al., 2018; Sackstein et al., 2015), but have no clear advantage either. Malay students were found to read faster on paper, but demonstrated better comprehension on screens (Tajuddin and Mohamad, 2019). A meta-analysis found that the consistent advantage of paper for reading speed has not declined over time with increasing digitalization (Delgado et al., 2018).

18

Avani, student at D.D.K.I. School, poses for a photograph as she sits near products from plastic waste collected by the school's Planet Warriors , displayed at their school in Mumbai, India, on 11 October 2022. UNICEF, in partnership with the Citizen's Association for Child Rights Mumbai and under their Collective Responsibility Drive-Plastic Waste Management Program in schools, reached out to select private and international schools in Mumbai, conducted awareness sessions with teachers and students, and encouraged them to start collecting plastic waste once a month and get it to school to get it recycled.

Credit: UNICEF/UN0825943/Singh*

KEY MESSAGES

Almost all governments report that their education systems cover most of the global citizenship and sustainability development themes identified in Sustainable Development Goal (SDG) target 4.7. Alternative monitoring mechanisms that do not rely on self-reporting include a new indicator on green content in curriculum frameworks and syllabuses, due for release in 2024; and a compilation of countries' laws and policies on climate change education and communication, to which the Global Education Monitoring (GEM) Report is contributing.

Analysis of 50 PEER (Profiles Enhancing Education Reviews) country profiles finds that even though countries are mainstreaming climate change in the curricula, only 39% have a national law, policy or strategy specifically focused on climate change education and 63% of teacher training plans include a focus on climate change. By contrast, 94% of countries mention public awareness in laws, policies or plans related to climate change communication.

There is little explicit concern in SDG 4 about how students learn, leaving out an important piece of the story of why learning occurs or does not. That missing piece is affect, or how learners feel.

Evidence from neuroimaging aligns with teacher experience indicating that social and emotional factors and skills strongly affect classroom learning. It is crucial both in traditional classrooms and in technology-heavy learning environments to ensure that learning is promoted rather than inhibited by learners' emotions. Unfortunately, few systematic international data are collected on the extent to which social and emotional skills learners have and if or how these are fostered at school.

CHAPTER 18

TARGET 4.7

Sustainable development and global citizenship

By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development

GLOBAL INDICATOR

4.7.1 – *Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in: (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment*

THEMATIC INDICATORS

4.7.2 – *Percentage of schools that provide life skills-based HIV and sexuality education*

4.7.3 – *Extent to which the framework on the World Programme on Human Rights Education is implemented nationally (as per the UNGA Resolution 59/113)*

4.7.4 – *Percentage of students by age group (or education level) showing adequate understanding of issues relating to global citizenship and sustainability*

4.7.5 – *Percentage of students in the final grade of lower secondary education showing proficiency in knowledge of environmental science and geoscience*

4.7.6 - *Extent to which national education policies and education sector plans recognize a breadth of skills that needs to be enhanced in national education systems*

SDG target 4.7 is unique among the 10 targets in its focus on education outcomes that cannot easily be measured: human rights, gender equality, peace and non-violence, global citizenship, and cultural diversity and culture's contribution to sustainable development. Nevertheless, global indicator 4.7.1 tries to tackle the difficult question of how to monitor progress. In particular, it invites countries to report on the extent to which they are mainstreaming global citizenship education and education for sustainable development in their education systems. It builds on a self-reporting mechanism, the consultation on implementation of UNESCO's 1974 Recommendation concerning Education for International Understanding, Cooperation and Peace and Education relating to Human Rights and Fundamental Freedoms. Reporting is meant to take place every four years, but data availability has been low, preventing a review of progress (**Box 18.1**).

BOX 18.1:

Progress since 2015: SDG indicator 4.7.1

Global indicator 4.7.1 monitors the extent to which global citizenship education and education for sustainable development are mainstreamed in national education policies, curricula, teacher education and student assessment. The indicator's four components are each scored on a scale of 0 to 1, based on whether eight themes have been mainstreamed: cultural diversity and tolerance, gender equality, human rights, peace and non-violence, climate change, environmental sustainability, human survival and well-being, and sustainable consumption and production.

According to the last consultation, which covers the period 2017–20 and whose results were published in 2021, almost all reporting governments claim that their education systems cover most of the themes to a substantial extent (**Figure 18.1**). For each of the four components, most countries scored above 0.8, which means at least six of the eight themes are mainstreamed into their curricula, policies, teacher education and assessment. Almost no countries scored below 0.5, i.e. reported that only a minority of the themes were mainstreamed. No relationship between responses and country income was found.

FIGURE 18.1:

Almost all governments report that their education systems cover most of the global citizenship and sustainability development themes

Extent to which countries mainstream global citizenship education and education for sustainable development, by domain and region, 2017–20

GEM StatLink: https://bit.ly/GEM2023_fig18_1
Note: The figure reports data for about 60 of the 75 countries that took part in the 2017–20 consultation.
Source: UIS database.

A UNESCO-led process aims to supersede the 1974 Recommendation with new text reflecting contemporary needs. The proposed text includes, for the first time, a section on follow-up and review, which provides guidance on actions that can be taken to monitor implementation of the Recommendation and learn from best practices. However, neither the Recommendation itself nor the guidance in the follow-up and review section would be binding.

In any case, self-reporting by governments will continue to be the source of information. While this arrangement facilitates higher participation by countries, the lack of reliability and comparability reduces its value as a monitoring mechanism. Complementary reporting that relies on expert analysis is needed to enrich the type of evidence used and to offer a future alternative for monitoring and reporting.

Two examples are worth mentioning. Climate change education was a focus of discussion at the UN Transforming Education Summit in September 2022 in New York. This has intensified calls for identifying a measure of progress, including a potential benchmark indicator. An initiative supported by UNESCO aims to introduce an indicator on prioritization and integration of green content in national curricular frameworks, and in the syllabuses of selected science and social science subjects, to measure the extent to which sustainability, climate change and environmental themes are covered in primary and secondary education. Official documents are being collected for some 100 countries and the first results are to be released in early 2024. These would be based on expert analysis of the frequency of selected keywords in these documents.

The other example is a collaboration between the GEM Report and the Monitoring and Evaluating Climate Communication and Education project. It involves gathering information in 70 countries on laws and policies supporting peer learning on climate change education and communication. These country profiles will enable comparison of countries' progress on Article 6 of the United Nations Framework Convention on Climate Change and Article 12 of the Paris Agreement, through Action for Climate Empowerment, and on SDG target 4.7. Each country profile analyses the context for climate change communication and education; climate change education policies and curriculum at all levels; climate change communication, including public awareness, public access to education and public participation; and monitoring and evaluation.

“Countries have made great strides in mainstreaming climate change in the curricula at all levels of education”

Some key findings can be drawn from a preliminary analysis of the first 50 profiles (UNESCO, 2022). Countries have made great strides in mainstreaming climate change in the curricula at all levels of education: 90% of countries have laws, policies or plans that include climate change in primary and secondary education. However, only 39% of countries have a national law, policy or strategy specifically focused on climate change education. In Ethiopia, the 2020 national curriculum framework includes environment and climate change in all subjects in grades 1 to 12 as a cross-cutting issue, supported by a 2019 guide on integrating climate change into the curriculum. In Zambia, the 2021 national climate change learning strategy commits to integrating climate change in learning and teaching materials from early childhood to secondary education.

Few countries incorporate psychosocial or social or emotional learning on climate change into primary and secondary education (**Focus 18.1**). In China, the Guidelines for the Implementation of Environment Education in Primary and Secondary Schools target feelings, attitudes and values and aspire to prepare learners to care for nature and respect life, different views and cultural diversity. In Ecuador, the Manual of Good Environmental Practices for Educational Institutions applies both cognitive and action learning dimensions by promoting campaigns, seminars and environmental activities at school. More commonly, countries address action learning in relation to climate change. In Ghana, the 2018 National Pre-Tertiary Education Curriculum Framework encourages learners to take climate actions that foster sustainable development. For instance, the science curriculum in grades 4 to 6 aims to help students understand the effects of climate change and take responsible action to protect the environment. Other countries – such as Namibia in its 2019 environmental education and education for sustainable development policy – encourage schools to run extracurricular activities. In Saint Lucia, children are involved in gardening with the support of farmers, caretakers and extension officers from the community.

Some countries are embracing the transition to green and sustainable schools. Japan promotes eco-schools, which save energy, reduce carbon emissions and offer environmental education. In Kenya, the UNESCO Associated Schools Project Network covers green school facilities management. For example, learners in nursery, primary and secondary schools study how to design and maintain the school garden and how to compost. At the global level, the international Eco-Schools initiative, launched in 1994 by the Foundation for Environmental Education, is now implemented in more than 43,000 schools around the world.

Capacity-building initiatives for climate change are gaining momentum: 63% of teacher training plans include a focus on climate change. In Cambodia, the education ministry introduced modules to help teachers integrate environmental topics such as climate change in formal and non-formal curricula. In all, 71% of the countries include training for government workers.

Public awareness is the most common communication approach, with 94% of the countries mentioning public awareness in laws, policies or plans related to climate change. In 2021, Malta's national public awareness campaign #ClimateON aimed to shift citizens' habits towards greener and more enriching lifestyles. Climate change plans and programmes focus on public participation, with 88% of countries including such an element in their laws, policies and plans, and 86% identifying youth as a target audience. In Nauru, the 2015 Framework for Climate Change Adaptation and Disaster Risk Reduction emphasizes including youth in planning and decision making.

FOCUS 18.1: ALL LEARNING IS SOCIAL AND EMOTIONAL

Aside from target 4.7, the SDG 4 indicator framework does not focus on the content of learning. Even the global and thematic indicators for target 4.7, however, are concerned almost exclusively with academic content knowledge and cognitive skills. There is little explicit concern for how students learn. This partly reflects a lack of suitable measurement instruments and comparative data. Yet the measurement challenges are not necessarily greater than for some of the cognitive indicators that are included in the framework. Moreover, ignoring the non-cognitive dimension of learning or reducing learning to only some skills, such as perseverance, leaves out an important piece of the story of why learning does or does not take place. That missing piece is affect, or how learners feel.

Early educational psychologists believed learning was inherently emotional. This has now been scientifically established through advances in neuroscience (Immordino-Yang et al., 2019). Cognitive skills important for learning, such as attention and memory, are strongly linked to or guided by emotions (LeBlanc and Posner, 2022). Moreover, cognitive tasks for learning invariably activate and use areas of the brain specialized in social and emotional activity. It is essentially impossible to perform a cognitive task without experiencing positive or negative emotions towards it, and people perform better on cognitive tasks towards which they have a positive attitude.

"Mathematics anxiety is common and is estimated to account for 14% of the variation in mathematics performance in OECD countries"

For example, emotions relating to social relationships with parents and teachers, as well as to cultural goals such as a desire to go to university, influence student motivation for trying to solve a mathematics problem. Emotions also guide cognitive steps, leading towards a solution or away from it (Immordino-Yang and Fischer, 2010). For instance, mathematics anxiety is common and is estimated to account for 14% of the variation in mathematics performance in OECD countries (Chang and Beilock, 2016). In addition, emotions guide judgement and action in transferring skills and knowledge from the structured school environment to real-world decision making (Immordino Yang and Damasio, 2007), which is critical for the changes in behaviour that target 4.7 is trying to achieve.

In addition to being emotional, learning is social. Humans have fewer hardwired behaviours than simpler species or even plants. The evolutionary loss of predetermined genetic information enables and necessitates social learning (Deacon, 2011; Rogoff, 2003). Conversely, social and environmental adversity and disadvantage, such as poverty, leave neurobiological traces that partly explain their detrimental effect on education (Sheridan and McLaughlin, 2016). Even controlling for genetic variation, socioeconomic status during childhood affects neural structure and cortical thickness, for instance.

Teachers and education researchers have long known from common sense, experience, and observational or quasi-experimental research that students' emotions and attitudes affect their learning (Pekrun and Linnenbrink-Garcia, 2014), including motivation and factors such as self-efficacy. Learners who want to study, and believe that if they do they will succeed, are more likely to learn. By contrast, anger is at best a distraction and at worst an obstacle to learning. However, this does not mean the relationship between positive and negative emotions and learning is deterministic. Students who are perfectly happy with their current state of knowledge may not be motivated to learn more. Conversely, moderate amounts of disappointment or frustration may be significant drivers of effort.

What is important is for emotions to be well-regulated. A meta-analysis found that the ability to understand and regulate one's emotions is a good predictor of academic performance (MacCann et al., 2020). A systematic review found that some social and emotional factors, particularly self-regulation, were more significant than intelligence in predicting academic achievement (Costa, 2019). However, few studies have examined multiple variables at the same time. Fluid intelligence, emotional skills and relational personality traits independently affected learning in a small study in Brazil (Castro et al., 2021), one of the few that jointly analysed these factors. A multidimensional understanding of emotions is important for pedagogic practice, but measurement difficulties mean that research evidence is stronger for the effect on learning of discrete basic emotions (Eliot and Hirumi, 2019), such as fear or anger.

Concern for emotions in the classroom is as relevant in high- as in low-income settings (Muwonge, 2018). A large meta-analysis of studies across 17 African countries found social and emotional skills to be associated with better education and higher earnings (Ajayi et al., 2022). Social and emotional learning is particularly relevant in emergency contexts (UNESCO, 2019). The Inter-agency Network for Education in Emergencies has developed a Psychosocial Support and Social and Emotional Learning Toolbox to support education needs in crisis settings (INEE, 2022).

Learners' emotions concern not only themselves and the learning content, but also their relationships with classroom peers, teachers and the wider school community. Social learning theory emphasizes the role of social relationships in enabling or hindering learning. Promoting an inclusive school climate that fosters a feeling of belonging in all school community members contributes to successful learning outcomes. Students who feel safer are more engaged (Côté-Lussier and Fitzpatrick, 2016).

Particularly in the past two decades, the notion that emotions matter for learning has been supported by research that has taken advantage of rapid advances in neuroimaging. Measurements of local blood flow or electric activity highlight which parts of the brain are activated during certain tasks and in response to certain stimuli and how the brain's structure adapts (Immordino Yang and Fischer, 2010). Refined imaging techniques are providing clearer views into how the brain functions and learns (Tan and Amiel, 2019). Brain imaging is now used to study not only neurological correlates of individual cognitive and non-cognitive factors, but also environmental factors such as the school climate (Hackman et al., 2022). Learning literally changes the brain. Such insights based on neuroscience are increasingly being packaged for practical classroom use by teachers, for instance in reframing long-standing practices such as reward and punishment (O'Mahony, 2020), thus adding nuance to traditional teacher knowledge about the importance of learner attitudes.

At the same time, the limitations of neuroscience research must be understood. Critics say there is a trend of viewing too broad a range of issues through a neurological lens in both education and business (Horvath, 2022). Findings from neuroscience do not translate directly into lessons for education policy or practice (Aspen Institute, 2019). Neuroscience research tends to be on adults and involve laboratory tasks, so its applicability to the classroom may be limited. While brain imaging can describe the relative activation of different brain regions in response to certain stimuli or tasks, this reveals little about actual behaviour and requires considerable interpretation to make sense of implications for education (Ansari and Lyons, 2016). Advocates for neuroscience see it not as providing definitive answers but as informing the development of new education theories and research questions (Immordino-Yang and Gotlieb, 2017).

A further issue is the complexity of transferring neuroscientific insights into teaching practice, which requires carefully designed professional development linked to teachers' existing knowledge (Tan and Amiel, 2019). Few experts are available to conduct such training (Elias, 2019). In addition, educators and neuroscientists 'often hold conflicting views and expectations of both brain-based learning and of each other' (Edelenbosch et al., 2015).

An evidence-based approach with emotional development at its centre is known as RULER: recognizing, understanding, labelling, expressing and regulating emotions. Applied for almost 20 years in the United States, it has been adopted by more than 2,000 schools, including in other high- and middle-income countries. In addition to integrating social and emotional learning into the curriculum, its implementation model adopts a community-wide approach, with training for school leaders, teachers and school staff, as well as systematic engagement with families (Brackett et al., 2019).

THEORIES OF SOCIAL AND EMOTIONAL LEARNING INFORM EDUCATION TECHNOLOGY

The discussions above on social and emotional learning have implications for learning technology (Howard-Jones et al., 2015) (**Chapter 4**). Understanding learners' emotional response to learning processes is particularly important in online learning environments (Xianglin et al., 2022). Education technology can make use of the connection between affect and cognition to motivate users. Computer game designers have long tried to find the right degree of difficulty and challenge, not to optimize learning outcomes but to ensure that games are motivating (or even addictive) (Parkin, 2017). Beyond motivation, emotions such as surprise and pride are used consciously in game-like and other education technology. Incorporating emotional design (e.g. using colours or shapes aligned with emotions) into materials such as electronic textbooks sometimes results in improved learning outcomes. However, the evidence is mixed overall (Chang and Chen, 2022).

Education technology can make use of the connection between affect and cognition to motivate users

Because of the social nature of learning, one main difficulty learners encounter is that, unlike when face to face with another person, they may struggle to anticipate and understand a computer's reactions and the reasons for them (Immordino-Yang and Singh, 2011). Making computer programs' goals and motivations transparent could reduce frustration and improve the 'social' relationship between learners and education technology.

Education technology can try to actively recognize and monitor learners' emotions (Gottardo, 2018; Wang et al., 2014). This would help it intelligently adapt and, for example, give appropriate feedback (Grawemeyer et al., 2017). Early attempts at determining learner emotions were based on intrusive measurement of biophysical variables, such as heart rate, blood pressure and brain activity (Shen et al., 2009), or on devices, such as posture-sensing chairs. More recent attempts to gauge engagement or boredom use other tools, including gaze detection (Jaques et al., 2014; Grawemeyer et al., 2017).

While early efforts were directed at eliciting positive emotional responses to education technology, it is now being recognized that negative and ambivalent emotions can positively affect student learning. Teacher disappointment, for instance, expressed or signalled through body language or tone, can serve an important pedagogical function (Dobrosovestnova and Hannibal, 2020).

MONITORING OF SOCIAL AND EMOTIONAL LEARNING INTENTIONS AND OUTCOMES IS LACKING

No systematic cross-country data exist on patterns in the teaching of non-cognitive, social and emotional content. Some surveys and assessments, however, contain teacher or student reports on their social and emotional learning or their social and emotional state with respect to learning.

A mapping exercise was carried out on the breadth of skills in 152 countries' education mission or vision statements, policy documents, or curricula. It showed that the four most commonly mentioned skills were creativity, communication, problem-solving and critical thinking; each was mentioned by between 45 and 61 countries (Roth et al., 2017). Affective skills, such as emotion regulation, appeared less frequently. Peruvian education policy identifies a need for learners to demonstrate 'self-esteem and autonomy, in favour of their own physical and emotional well-being'. The 2015 Revised National Curriculum in the Republic of Korea includes self-management competency and aesthetic-emotional competency among skills to be acquired. Overall, a broad range of skills was included in 76% of countries' policy documents but in less than half of countries' curricula.

The most ambitious large-scale, cross-national effort to assess individual social and emotional learning is the OECD's Survey on Social and Emotional Skills. Its main data collection took place in 2019 in 10 cities: Bogota (Colombia), Daegu (Republic of Korea), Helsinki (Finland), Houston (United States), Istanbul (Türkiye), Manizales (Colombia), Moscow (Russian Federation), Ottawa (Canada), Sintra (Portugal) and Suzhou (China). The survey assessed three skills for each of the 'big five' personality domains (openness, conscientiousness, extraversion, agreeableness and neuroticism), plus two additional skills: self-efficacy and achievement motivation (OECD, 2021).

The study assessed 10- and 15-year-olds. It revealed a dip in social and emotional skills in adolescence. Both developmental and school factors may play a role. The survey also found that while gender differences in emotional control were minimal at age 10, the gender gap had grown considerably by age 15: boys experienced a similar level of emotional control as the younger group, but girls experienced much lower emotional control at age 15. Often this translates into lower emotional well-being. Teachers in secondary school thus continue to play an important role in identifying signs of distress and require training to support students.

FIGURE 18.2:

Promoting social and emotional learning development is common practice

Percentage of teachers reporting that social and emotional learning (SEL) is promoted at their school and agreeing 'a lot' or 'very much' that they were trained to develop SEL skills in children in their pre- and in-service training, selected cities, 2019

GEM StatLink: https://bit.ly/GEM2023_fig18_2
Source: OECD (2021).

In addition to skills assessment, the survey collected self-reported information from teachers on the extent to which social and emotional learning development was institutionalized in their training and at their schools (**Figure 18.2**). About half of teachers in most cities strongly agreed that they had experienced such training opportunities, although only around a quarter did so in Helsinki and Ottawa. About 9 in 10 teachers reported promoting social and emotional learning in their general practice. Dedicated social and emotional learning classes or activities were reported by between 43% (Sintra) and 82% (Suzhou) of teachers.

A slightly broader set of skills than that covered in the Survey on Social and Emotional Skills was included in data collection for the 2021 Programme for International Student Assessment, which was postponed to 2022 due to the COVID-19 pandemic and whose results are not yet available. A module of the context questionnaire on general social and emotional characteristics contains a set of items on 'student beliefs, attitudes, feelings, and behaviours', including emotional control (Bertling and Alegre, 2019).

To conclude, evidence from neuroimaging aligns with teachers' experience indicating that social and emotional factors and skills strongly affect classroom learning. This means it is as crucial in traditional classrooms as in technology-heavy learning environments to ensure that learners' emotions contribute to learning rather than inhibiting it. Unfortunately, few systematic international data are collected on which social and emotional skills learners have and if or how these are fostered at school.

Puri, is the only female artisan in a group of 75 male artisans, building toilet facilities at Tego Baptist Primary School in Central Hagen, Western Highlands Province in Papua New Guinea. This is part of the UNICEF–EU supported WASH project in the country.

Credit: UNICEF/UN0525857*

KEY MESSAGES

Most school infrastructure indicators were either stable or improved only slowly between 2015 and 2020. But more schools have been connected to electricity, with the share over the period rising from 66% to 76% in primary and from 77% to 86% in lower secondary education.

Over 20% of primary schools in Central and Southern Asia and in Eastern and South-eastern Asia lack functional single-sex bathrooms, as do 83% in Mali and 94% in Togo.

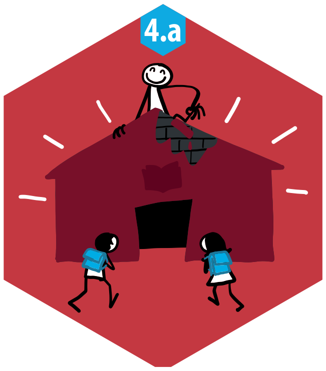
The 2022 Global Coalition to Protect Education from Attack report found that attacks on education and military use of schools and universities increased in 2020–21 from 2018–19, notably in Mali and Myanmar.

Technology can help protect buildings from natural disasters. Schools built to Peru's new codes withstood the Pisco earthquake far better than older schools. During the 2015 earthquake in Nepal, retrofitted school buildings largely remained intact.

Solar power technology can help accelerate school electrification. Of 31 countries where more than half of primary schools are without electricity, 28 have above global average solar power potential.

The share of school trips made in private vehicles is almost 55% in the United States. Various types of technology can help make public transport to and from school smoother, safer, more efficient and more equitable. In the United States, a 2021 law provided for investment of USD 5 billion in low- and zero-emission school buses over five years.

CHAPTER 19



TARGET 4.a

Education facilities and learning environments

Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all.

GLOBAL INDICATOR

4.a.1 - *Proportion of schools offering basic services, by type of service*

THEMATIC INDICATORS

4.a.2 - *Percentage of students experiencing bullying in the last 12 months*

4.a.3 - *Number of attacks on students, personnel and institutions*

Safe, welcoming environments are essential for effective learning and should be available to all. Target 4.a responds to this call by covering a range of both facility- and environment-related indicators that monitor student safety and well-being.

Sustainable Development Goal (SDG) global indicator 4.a.1 focuses on infrastructure. New technologies can help improve school construction, though many challenges remain (**Focus 19.1**). One of the most important infrastructures for gender equality is the availability of single-sex sanitation facilities, meaning separate bathrooms for males and females, which is often a prerequisite for girls to attend school because of concerns over their safety (Levy and Houston, 2017). Over 20% of primary schools in Central and Southern Asia and in Eastern and South-eastern Asia lack functional single-sex bathrooms; in Mali and Togo, they are lacking in 83% and 94% of schools, respectively.

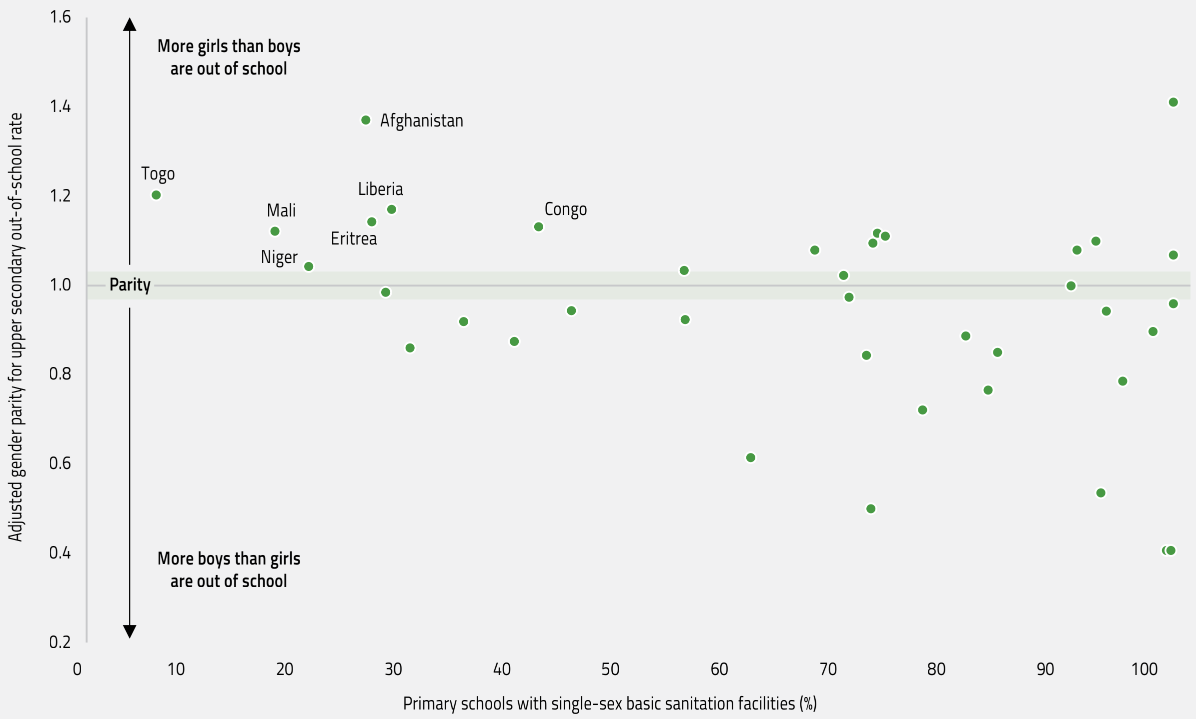
Single-sex bathrooms are more common in secondary than in primary schools. In Burundi, for example, 35% of primary and 100% of upper secondary schools had single-sex bathrooms in 2018. But this might be too late for some girls, given very high levels of over-age enrolment, as in 2018 when 31% of primary school students were at least 2 years over-age for their grade. A lack of menstrual hygiene facilities, stigma and stress lead to many girls missing up to one week of school a month, increasing the chances of falling behind and dropping out (UNICEF, 2023b).

A lower share of primary schools with single-sex bathrooms is associated with a higher out-of-school rate for girls than for boys in upper secondary education (**Figure 19.1**). This negative relationship may also reflect broader gender bias patterns. In Afghanistan, the lack of single-sex bathrooms in three quarters of primary schools in 2018 may have been indicative of an overall lack of priority for gender equality in education, even before the Taliban takeover in 2021 (Save the Children, 2022).

FIGURE 19.1:

The availability of single-sex toilets in primary education is associated with relatively lower out-of-school rates for girls of secondary school age

Share of primary schools with single-sex sanitation facilities and adjusted gender parity index for out-of-school rate of upper secondary youth in low- and lower-middle-income countries, 2016–22



GEM StatLink: https://bit.ly/GEM2023_fig19_1
Source: UIS database (single-sex sanitation facilities) and VIEW database (out-of-school).

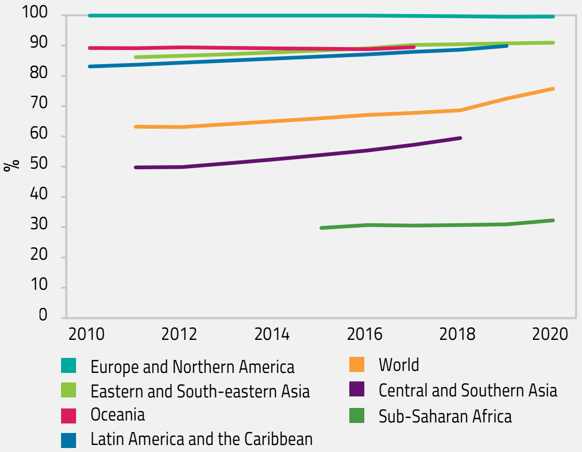
Electricity is another basic need, but is still lacking in around a quarter of schools worldwide (**Chapter 7**). The share of schools with electricity is particularly low in Central and Southern Asia and in sub-Saharan Africa, where it barely increased from 30% in 2015 to 32% in 2020 (**Figure 19.2**). Solar power technology can help accelerate school electrification (**Focus 19.2**).

Without electricity, students and teachers cannot use information and communication technology (ICT) in schools. Indicator 4.a.1, which monitors the availability of computers and internet for pedagogical purposes, shows that in many countries, a considerable number of schools have only one or the other (**Figure 19.3**). Usually, the share of schools with computers exceeds that of schools with internet. In Turkmenistan for example, nearly all primary schools have a computer, but only 31% of them have internet. But in a few countries, the opposite is true: in Lebanon and Maldives, over 90% of schools have internet for teaching and learning, but only some 70% have a computer.

FIGURE 19.2:

There has been no progress in school electrification in sub-Saharan Africa

Proportion of primary schools with access to electricity, by region, 2010–20

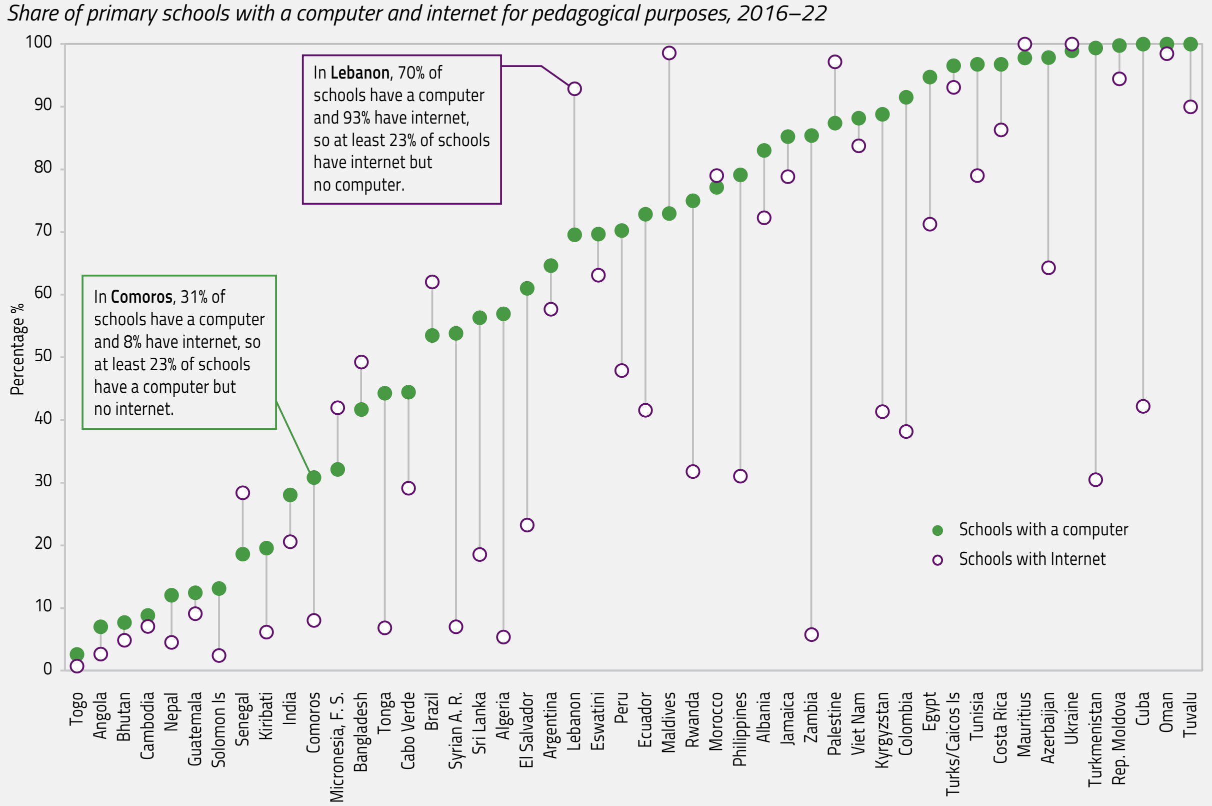


GEM StatLink: https://bit.ly/GEM2023_fig19_2
Source: UIS database.

FIGURE 19.3:

In many countries, schools have computers but no internet connection

Share of primary schools with a computer and internet for pedagogical purposes, 2016–22



GEM StatLink: https://bit.ly/GEM2023_fig19_3
Source: UIS database.

The Giga initiative, which was launched in 2019 with the goal of connecting every school to the internet, has mapped schools and their real-time connectivity levels in 45 countries by combining national data sources with machine learning and satellite images (Giga, 2023b). It has provided location details for 7,000 schools to the government of Colombia to improve planning (Giga, 2023a). In Brazil, a national initiative to map school connectivity launched in 2021, Mapa Integrado de Conectividade na Educação (Integrated Map of Education Connectivity), and allowed policymakers to analyse whether connectivity in schools was lower than in nearby residential and commercial buildings, in order to facilitate contract renegotiations with providers (CIEB, 2021).

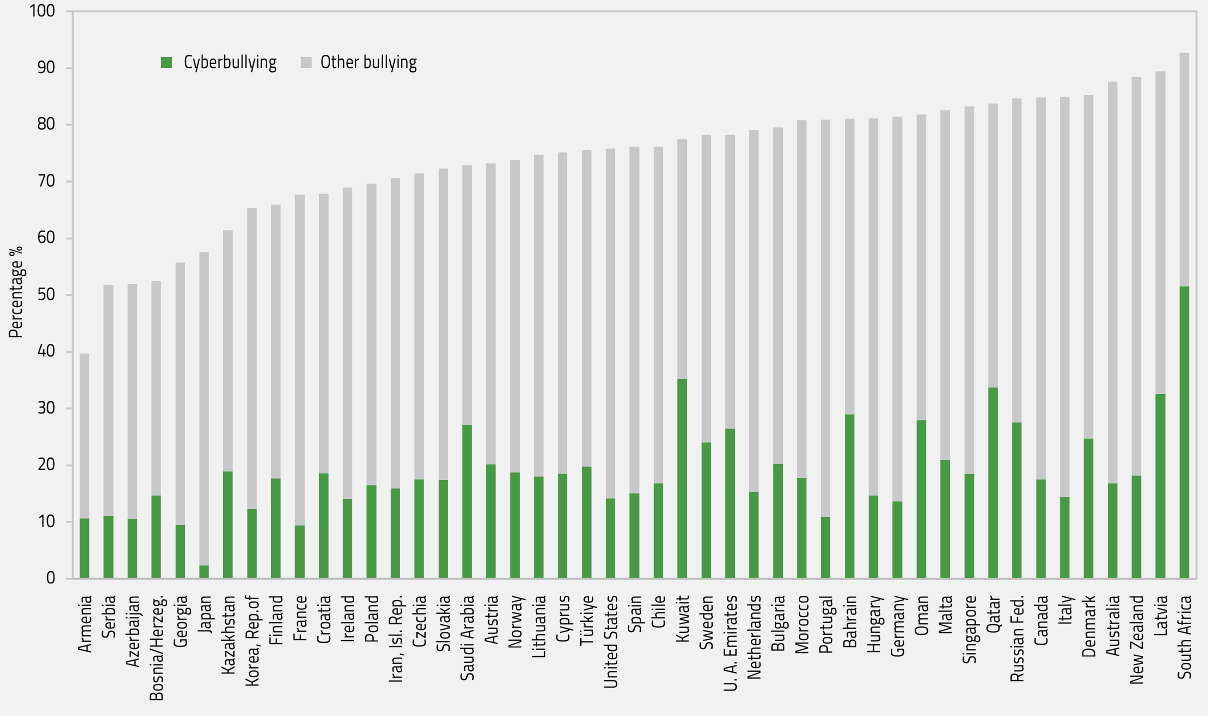
But increased internet access also poses threats to students. Cyberbullying has become a global phenomenon. Indicator 4.a.2 measures the percentage of students who experienced bullying in the past 12 months based on cross-national health and learning achievement surveys. Among the latter, the 2019 Trends in International Mathematics and Science Study (TIMSS) asked grade 4 and grade 8 students about online bullying. In nearly all participating countries, at least 10% of grade 4 students had experienced cyberbullying in the past year, defined as having received 'nasty or hurtful messages', 'nasty or hurtful things' or 'embarrassing photos' online (**Figure 19.4**). The share of students who have experienced cyberbullying is even higher among grade 8 students: over 20% of students in 26 out of the 32 countries with available data.

Cyberbullying tends to be higher in countries with an overall high prevalence of bullying. In Latvia and South Africa, where 30% and 50% of students experienced cyberbullying, respectively, around 90% of students experienced some type of bullying. Indeed, bullying is a common experience in most countries, especially for boys. In almost every one of the 116 countries with available data, more than a quarter of students experienced bullying. Boys reported having been bullied more often than girls did in 83 of those 116 countries (UNESCO, 2023).

FIGURE 19.4:

In most middle- and high-income countries, over 10% of primary students have experienced cyberbullying

Share of grade 4 students who have experienced bullying in the past 12 months, by type of bullying, 2019

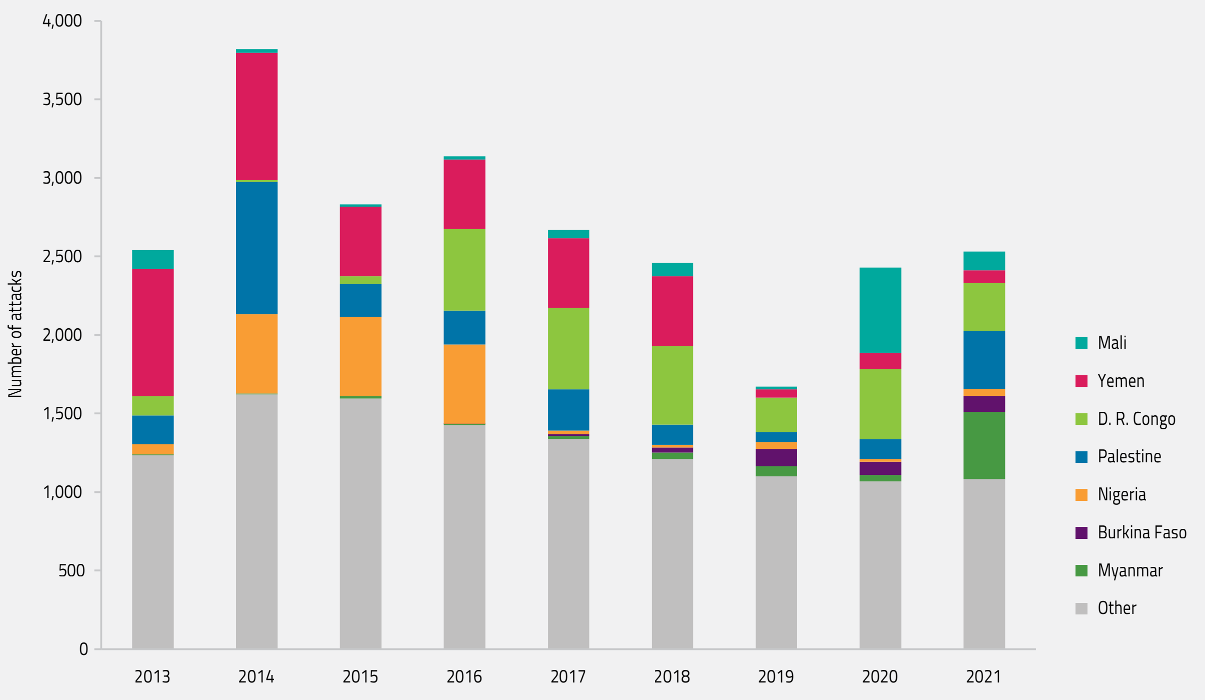


GEM StatLink: https://bit.ly/GEM2023_fig19_4
Source: 2019 TIMSS.

> Various types of technologies can help make commuting safer and more efficient but conflict continues to put students and teachers at grave risk

In addition to students' well-being and safety within schools, SDG target 4.a. also recognizes that schools must be safe to reach. Various types of technologies can help make commuting safer and more efficient (**Focus 19.3**). But conflict continues to put students and teachers at grave risk of various dangers, including gang violence, as in Haiti (**Box 19.1**). Indicator 4.a.3 monitors the number of attacks on schools and higher education; military use of schools and universities; and attacks on students, teachers and personnel inside or outside of schools. It also counts incidents of child recruitment or sexual violence perpetrated in schools or along school routes. Data for this indicator are compiled by the Global Coalition to Protect Education from Attack (GCPEA), through three main methods: reviews of relevant reports, media searches and outreach to GCPEA members. The 2022 GCPEA report found that attacks on education and the military use of schools and universities increased in 2020–21 compared to 2018–19, notably in Mali and Myanmar (**Figure 19.5**). The number of students and teachers harmed, however, decreased (GCPEA, 2022).

FIGURE 19.5:
Attacks on education are concentrated in a handful of countries
Number of attacks on students, personnel and institutions by country, 2013–21



GEM StatLink: https://bit.ly/GEM2023_fig19_5
Source: UIS database.

BOX 19.1:

Armed violence is severely disrupting education in Haiti

Gang violence has skyrocketed in Haiti since the assassination of former president Jovenel Moïse in 2021. It is estimated that up to 200 armed groups operate in the capital Port-au-Prince and control 60% of the city, forcing many to flee their homes and many children to leave school (Murrin, 2022; UNICEF, 2023a). Between October 2022 and February 2023, 72 schools were targeted, compared to 8 in the previous year. Acts of violence against and at schools include shootings, kidnappings, looting of school equipment, and stealing ingredients used for school meals (UNICEF, 2023a). Gangs have also recruited students, often forcefully, or have taken control of schools, forcing school directors to pay for safety (UNICEF, 2022a).

Principals pre-emptively close schools to protect children during periods of increased violence or social unrest (UNICEF, 2023a). In April 2022, 1,700 schools were closed in Port-au-Prince alone due to increased violence, keeping half a million children out of school (Murrin, 2022). Moreover, many schools close because they are occupied by displaced families (UNICEF, 2022a). Overall, one in four schools stayed closed from October 2022 until at least March 2023 (Alonso, 2023).

As a result, children's education has been severely disrupted. At least 10,000 grade 9 students were unable to take the official end-of-year exams in 2022 because of gang violence (Joseph, 2022). In January 2023 alone, children lost on average 1.5 school days per week. The United Nations Children's Fund (UNICEF) predicted they would lose about 36 days between January and the end of June 2023 if violence continues (UNICEF, 2023a).

FOCUS 19.1: SCHOOL BUILDINGS HAVE AMPLE TECHNOLOGY

Schooling does not require a building, but buildings such as tents and temporary structures can provide ventilation, hygiene facilities and shelter from the natural elements. Appropriate technology can help improve the safety, sustainability, efficiency and speed of school construction.

There is no shortage of sustainable building materials for schools, including wood, bamboo and mud bricks (Robles et al., 2015). In India, school walls are built from 'bricks' made of used plastic water bottles filled with sand (Manjarekar, 2019). Prototype schools in Malawi were constructed at one quarter the cost of a conventional school by using locally sourced timber and soil blocks, allowing lighting and ventilation without electricity (Arup, 2023). Materials technology has also provided non-toxic alternatives to water pipes and paint containing lead, and fireproofing containing asbestos.

> "Innovation may be in the building technique as much as the materials"

Innovation may be in the building technique as much as the materials. In Malawi, a single-classroom school for 50 students was 3D-printed in less than a day using concrete 'ink' that is less energy- and carbon-intensive than standard construction methods. Another pilot school was printed in Madagascar (Matchar, 2021). In Europe, the first 3D-printed schools may appear as part of the reconstruction efforts in Ukraine (Hanaphy, 2022). However, the high cost of 3D-printing equipment currently constrains the parallel construction of multiple sites (Pensulo, 2021). Historically, innovations in school construction have not matched proven methods such as reinforced concrete (Theunynck, 2009).

An exception is emergency settings, which require modularity, mobility and rapid deployment not offered by conventional, permanent construction. In Türkiye, UNICEF procured 300 modular container classrooms to accommodate 60,000 Syrian refugee children. In Bangladesh, UNICEF supported the Ministry of Education and the Ministry of Disaster Management and Relief with the construction of learning centres from bamboo and sungrass (UNICEF, 2022b). Geodesic domes are an ingenious way of assembling thin-shelled dome-shaped structures out of a lattice of interconnected rods or bars that can withstand strong forces even when made out of relatively light or flexible materials. Because they are easy to transport and quick to set up, they are suitable for providing emergency shelter and schooling spaces in crisis situations (Friedrich Naumann Foundation, 2016; Solardome 2023).

Classrooms can also be produced by converting shipping containers or similar prefabricated modules. In the United States, an industry survey in 2012 showed that some 5 million students were taught in 280,000 trailer

BOX 19.2:

Progress since 2015: SDG indicator 4.a.1

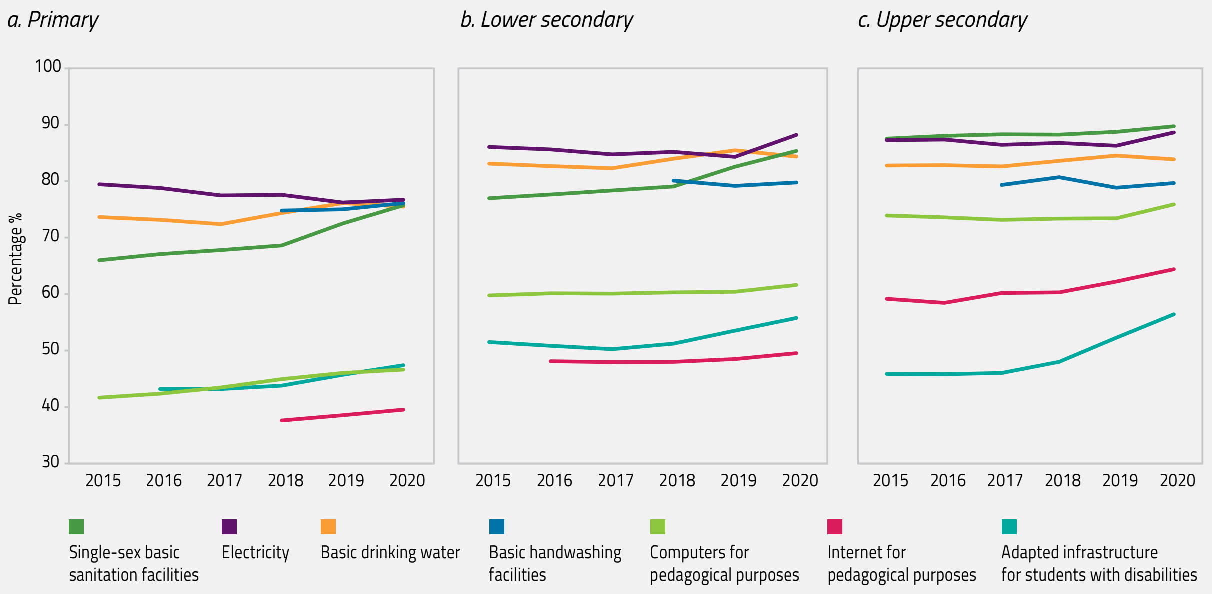
Global indicator 4.a.1 measures the proportion of schools with access to seven different infrastructure and resource dimensions: electricity, internet, computers, drinking water, handwashing facilities, single-sex bathrooms, and adapted infrastructure and materials for students with disabilities.

Most of these indicators have either remained stable or only slowly improved between 2015 and 2020 (**Figure 19.6**). However, there are some exceptions. The share of schools with adapted infrastructure and materials for students with disabilities increased at all levels of education, and most significantly in upper secondary from 46% in 2015 to 56% in 2020. Electricity has also been on the rise, from 66% to 76% in primary and from 77% to 86% in lower secondary education.

FIGURE 19.6:

School infrastructure conditions have been improving very slowly

Share of schools with access to selected infrastructure features, by level, 2015–20



GEM StatLink: https://bit.ly/GEM2023_fig19_6
Source: UIS database.

classrooms (Baker, 2014). They made up 30% of all available classroom space in the Los Angeles Unified School District (Clough, 2015). While adequate in the short term, challenges arise when such structures end up being used indefinitely (Inside Science, 2009). Temporary structures are often used as a way to circumvent rules and regulations on air quality and other standards that apply to standard school buildings (Profita, 2014).

Technology can also help protect buildings from natural disasters, which frequently destroy or damage schools (**Table 19.1**). Suitable construction, adapted to the most prevalent hazards in a given school location, makes a difference. For instance, lightweight timber construction is beneficial in the case of an earthquake, but more vulnerable to damage from high winds (Arup International Development, 2013). In 2007, schools built to Peru's new codes withstood the Pisco earthquake far better than older schools (Bastidas and Petal, 2012). Similarly, during the 2015 earthquake in Nepal, 7,000 schools were destroyed or damaged (GFDRR, 2015), but retrofitted school buildings largely remained intact (ADB, 2015).

Technological innovations can alleviate other safety and well-being concerns. Some governments have taken steps to improve the ventilation of classrooms, an issue that became prominent during the COVID pandemic. In the Republic of Korea, the government mandated the

TABLE 19.1:
Number of schools damaged or destroyed by major natural disasters 2010–23

			Structural damage		
Location	Year	Type of disaster	Damaged	Severely damaged/ destroyed	Damaged, severely damaged, destroyed
Syrian A. R. and Türkiye	2023	Earthquake	1,239	2,100	
Pakistan	2022	Floods			27,000
Indonesia	2022	Earthquake	500		
Madagascar	2022	Cyclone		508	
Mozambique	2022	Cyclone		307	
Haiti	2021	Earthquake	888	171	
Mozambique	2019	Cyclone	778		
Philippines	2019	Earthquake		1,047	
Indonesia	2018	Earthquake	1,000	2,700	
Mexico	2017	Earthquake			5,100
Bangladesh, India and Nepal	2017	Flooding			18,000
Nepal	2015	Earthquake	5,000	2,000	
Pakistan	2015	Earthquake	2,000	200	
Myanmar	2015	Flooding	4,116	608	
Philippines	2013	Typhoon	2,500		
Pakistan	2010	Flooding		11,000	
Chile	2010	Earthquake	631	1,019	
Haiti	2010	Earthquake	6,000	2,000	

Sources: GEM Report collation of various sources.

installation of air cleaning systems and air quality sensors in classrooms, which can then be monitored by parents and school councils (Arin, 2019). Technology has also helped improve acoustic design and sound insulation (Shield and Richardson, 2018), which can prevent disturbances and improve long-term health (Klatte et al., 2013). In Florida, schools moving from non-compliant to new compliant buildings saw an increase in scores and pass rates on standardized tests (Lumpkin et al., 2014).

Finally, technology can help optimize school construction planning. For example, 3D laser scanning can support modelling to inform sustainable refurbishment by efficiently capturing detailed information on the physical shape and dimensions of school buildings (Le, 2021). Virtual reality technology has been used to simulate fire emergency evacuations from a school building, taking into account the spread of fire and smoke as well as the dynamic movement of students and teachers (Cimellaro et al., 2019; Lorusso et al., 2022). Such studies can inform new school construction, the adaptation of existing buildings and the design of escape routes. Agent-based modelling, i.e. computer simulations used to study the interactions among people, things, places and time, can give insights into preventing stampede risks in emergencies by optimizing the design and placement of stairs and toilets in primary schools (Xie, 2018).

FOCUS 19.2 CAN SOLAR POWER CLOSE THE SCHOOL ELECTRIFICATION GAP?

Large numbers of schools in low- and middle-income countries, especially primary schools, do not have electricity. Investment into large-scale infrastructure for expanding the electricity grid is an obvious but costly solution. Decentralized electric power generation offers an alternative, where the electricity consumed by the school is generated close by. This is not a new concept: diesel-powered generators have long been used for remote hospitals and schools, but they rely on the delivery of heavy fuel and therefore do not create true electricity independence (Jiménez and Lawand, 2000). More recently, PV electricity generation, i.e. solar panels that turn sunlight into an electric current, have created new options for decentralized power generation.

The first known deployment of a solar panel to a primary school occurred in Niger in 1968 (Sovacool and Ryan, 2016). In the Brazilian state of Minas Gerais, the large-scale rural school electrification programme Luz no Saber (Light in Knowledge) provided solar power to some 1,000 of the most remote schools between 1995 and 2005 (Diniz et al., 2006).

As with many technologies, however, the revolutionary potential of PV electricity generation was triggered not when it first became available, but when it became affordable. This has occurred in the last 10 years. The global average price of solar panels dropped 88% between 2010 and 2021, from USD 0.42 per kWh to USD 0.05 per kWh (IRENA, 2022); prices for large-scale PV projects in Africa are even lower (IRENA, 2016). These price drops are partly due to the higher efficiency of modern PV panels, and partly to technological progress in the manufacturing process. Moreover, auxiliary technologies have matured, such as battery technology for buffering fluctuations and smart algorithms for managing local grids with many independent power inputs.

> “The global average price of solar panels dropped 88% between 2010 and 2021”

The feasibility of solar solutions for electricity generation is illustrated by their rapid adoption in Africa. Between 2010 and 2019, the number of people in Africa connected to solar minigrids increased 45-fold from only 39,000 to 1,736,000 (IRENA, 2021). Schools lacking electricity are concentrated in climate zones with high solar potential (**Figure 19.7**). Among the 31 countries where more than half of all primary schools are without electricity, only three – Congo, Liberia and Nepal – have an average PV power potential below the global average. Among all countries with primary schools that are not electrified, the theoretical PV potential of even the least sunny, Bhutan, is still one third higher than in the Netherlands, which has the second-highest installed solar PV capacity per capita after Australia (IEA, 2022). Climate change may change current patterns of average cloud coverage and solar panels are less efficient at higher temperatures. However, even taking these factors into account, the solar potential in Africa is not projected to diminish due to climate change (Soares et al., 2019).

However, being located in a favourable climate zone is not enough. Sophisticated technical and economic analyses and optimization are required for the design of a feasible system, taking into account factors such as the site and buildings, solar radiation, load profiles, cost and the lifetime of components (Chatterjee et al., 2018; Endaylalu, 2018). Across Indian states and territories, the percentage of schools with solar power is highest in Chandigarh and Delhi, two of the richest and most urban territories in the country. This suggests that PV technology for school electrification is still driven by local technical and investment capacity potential.

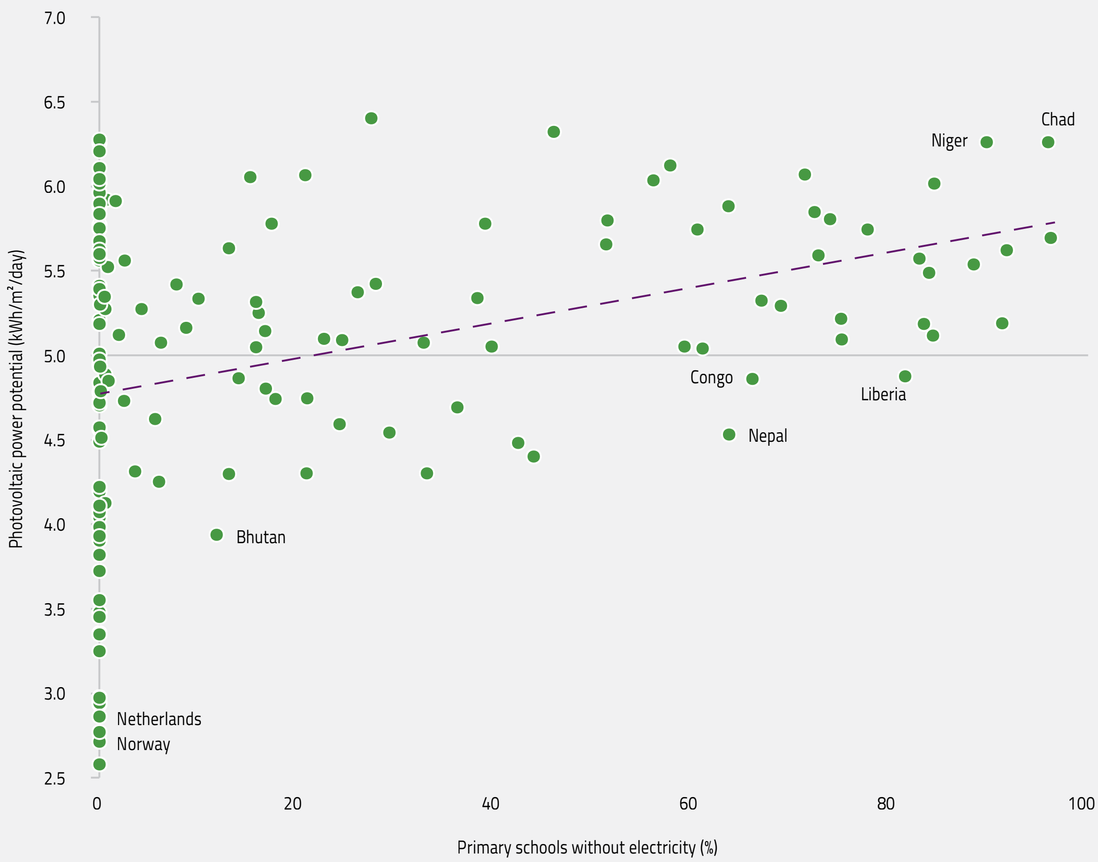
Barriers to large-scale electrification of schools include upfront costs, procurement, vandalism and theft (Sovacool and Ryan, 2016). Perhaps due to such challenges, as well as a scarcity of trained technicians for maintenance, some large-scale policies for solar electrification of schools in the early to mid-2010s did not meet their objectives. In Papua New Guinea, a solar lighting programme for rural schools equipped 2,400 classrooms, but a lack of maintenance meant ‘only a handful of units’ were still operating five years later (Sovacool and Ryan, 2016).

It may be crucial for the sustainability of projects to ensure that the wider community benefits from solar installations at schools. Part of the problem in Papua New Guinea was that solar panels installed at schools were frequently vandalized or stolen because their exclusive benefit to the school did not align with local understandings of common property rights (Sovacool and Ryan, 2016). A promising – but challenging – approach is to integrate school and community electrification in the form of microgrids (Kirchhoff et al., 2016), local electrical grids with defined electrical boundaries, acting as single and controllable entities. But school electrification can be designed to also benefit households even without microgrids. Under the award-winning Solar Cow initiatives, students take portable batteries to school and charge them during the school day (Chang, 2021). The batteries are sufficient to

FIGURE 19.7:

Countries with large school electrification gaps tend to have high potential for solar power generation

Primary schools without electricity but with photovoltaic power potential, selected countries, 2019 or later



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Source: UIS database (schools with electricity) and ESMAP (2020) on PV power potential.

charge mobile phones and power lights and a radio at home. Pilot programmes in Kenya and the United Republic of Tanzania are benefiting 550 households, and the initiative plans to expand to the Democratic Republic of Congo, Indonesia and Rwanda.

Finally, technologies that allow schools to exploit solar energy can provide benefits besides electricity. Direct exposure to solar UV radiation is surprisingly effective at disinfecting water (Schulte, 2011). Sunlight can be captured for heating school buildings through technologies that optimize window area and design against insulation (Liu, 2018). Solar energy can even be used for cooling. Besides electric air conditioning powered by photovoltaics, 'solar thermal' or 'solar thermo-mechanical' systems use solar energy to directly cool classrooms (Aguilar-Jiménez, 2020).

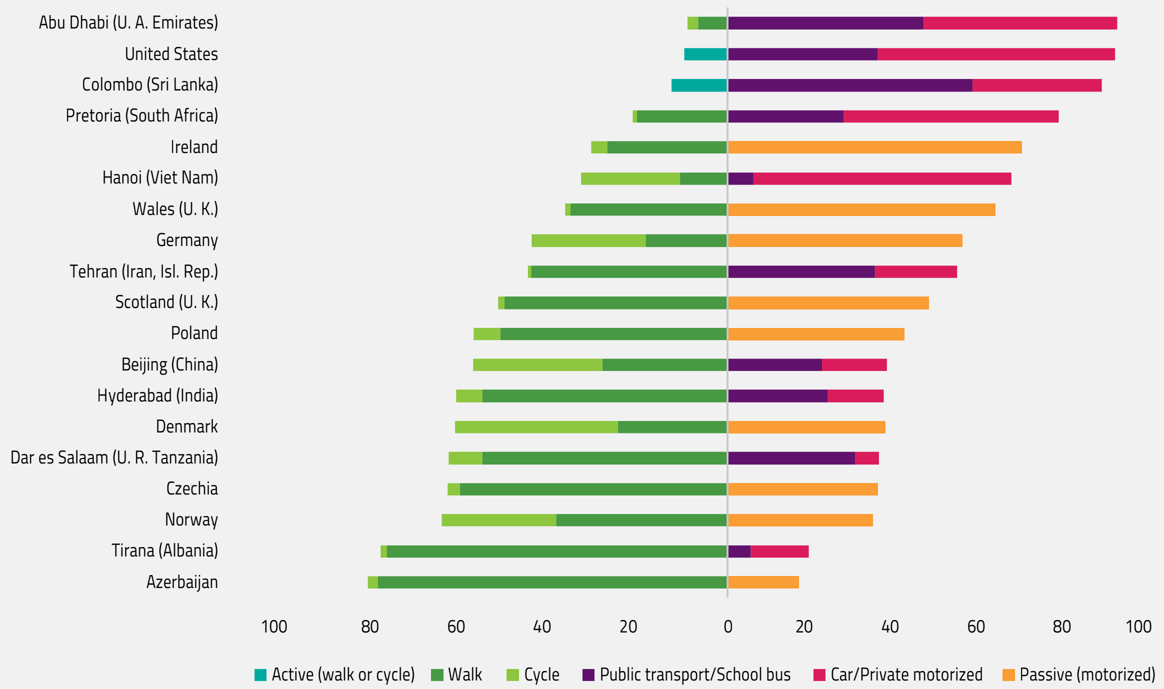
FOCUS 19.3: TECHNOLOGY AFFECTS THE SCHOOL COMMUTE

The means by which children and adolescents get to school does not follow a predictable relationship with countries' economic development (**Figure 19.8**). In the United States, according to the 2017 National Household Travel Survey, almost 55% of school trips were made in private vehicles, 35% on school buses, public transport or 'other', and 10% on foot or bicycle (Pfledderer et al., 2021). This pattern is mirrored in Abu Dhabi and Colombo. In contrast, in Dar es Salaam, 60% of school trips are made by walking or cycling, 37% by public transport and only 3% by car or motorcycle. Similar patterns are observed in Hyderabad, India, and across Czechia.

FIGURE 19.8:

In some countries, almost all school commutes are motorized, in others a majority of children walk or cycle to school

Distribution of students by mode of transport to school, by location, 2010s



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Note: Studies differ with respect to specific age groups, distinguishing journeys to and from school and other factors, potentially affecting comparability.

Sources: United States (Pfledderer et al., 2021), Colombo (Damsara et al., 2021), Abu Dhabi (Badri, 2013), Pretoria (Goon, 2016), Hanoi (Nguyen, 2021), Tehran (Ermagun and Levinson, 2017), Beijing (Zhang et al., 2017), Hyderabad (Tetali et al., 2016), Dar es Salaam (Bwire, 2020) and Tirana (Pojani and Boussauw, 2014); for the remaining locations, Kleszczewska et al., (2020).

Various types of technology can help make public transportation to and from school smoother, safer, more efficient and more equitable. In the United States, a 2021 law established an investment of USD 5 billion for low- and zero-emission school buses to be spent over five years (Beierle, 2022). In Yogyakarta, Indonesia, the most important barriers to bus use were travel time, long distances to the nearest stop and a lack of direct routes. Technological approaches to encourage greater bus use among students include the provision of Wi-Fi connections on buses, and geographic positioning systems (GPS) tracking to provide real-time information on arrival times (Fariha et al., 2021). In Brazil, the national funding programme for improving school routes included resources for improving public school boats – a mode of transportation used by 300,000 children in the Amazon region. Using technological innovations for optimizing their hull shape has been estimated to generate substantial cost savings, in addition to environmental benefits (Hernández-Fontes et al., 2021).

“The introduction of digital geographic information systems (GIS) into education planning has allowed for detailed analyses of school distribution and transportation networks”

The introduction of digital geographic information systems (GIS) into education planning has allowed for detailed analyses of school distribution and transportation networks. In Singapore, a large-scale experiment collected high-frequency ‘crowd-sensed’ geolocation and environmental data from students equipped with a special mobile device. An analysis showed the high complexity of school routing, with most students having between 6 and 52 different potential pickup locations. Based on the data, a last-mile shuttle service was designed by algorithmic optimization that would save most students more than 20% travel time (Panrong et al., 2021).

Technology can also help encourage children to walk or cycle to school, and their caregivers to allow them to do so. GIS has been used to identify the safest walking or cycling routes to a given school, for instance by mapping road accidents and identifying 'hot spots' to avoid. Mobile phones and GPS tracking may provide reassurance to families (Samah et al., 2019; Sute et al., 2019; Sweeney and Hagen, 2016), whether used to monitor children's commute in real time, for children to send a confirmation upon arrival, or merely 'just in case'. Other examples include app-based gamification of the school commute (Coombes and Jones, 2016; Kazhamiakin et al., 2021; Marconi et al., 2018) and swipe card technology at checkpoints along walking routes that make it feasible for schools to support students walking to school without continuous location tracking (Hunter et al., 2015).

Cycling to school is an active and environmentally friendly alternative, though its prevalence varies widely across countries. Traffic safety and poor road conditions are major concerns (Idei et al., 2020; Tetali et al., 2015). In sub-Saharan Africa, most primary schools are not accessible via a paved road (**Figure 19.9**).

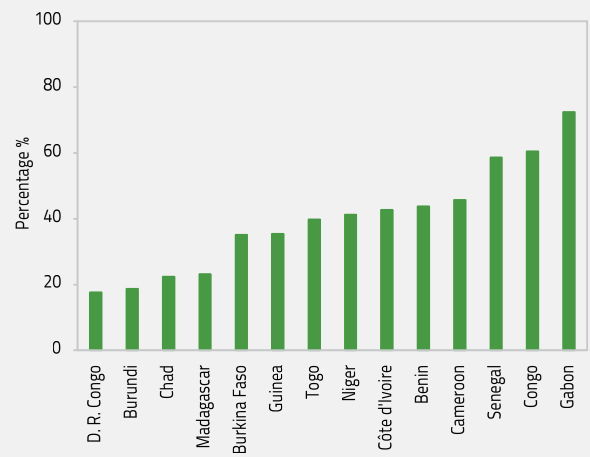
Technological developments can help address some of these cycling challenges. Since 2005, World Bicycle Relief has distributed over 600,000 purpose-built bikes for rugged terrain in different programme locations, including Colombia, Indonesia and Zimbabwe (World Bicycle Relief, 2022). A rigorous evaluation of their partnership with Zambia's Ministry of Education pointed to improvements in absenteeism, dropout rates and learning (Fiala et al., 2022). The First African Bicycle Information Organization launched an electronic bike, an e-bike, designed specifically for the needs of sub-Saharan Africa: low-price, but especially robust (with reinforced frames and spokes), chargeable with solar energy, and with non-electric components that can be repaired with local spare parts (FABIO, 2022).

Moreover, a cost–benefit analysis of e-bikes and conversion kits in the United Republic of Tanzania concluded that students would save money compared to bus fares on a recurrent basis (excluding the initial cost of purchase) and save students over three hours per day compared to walking or riding buses in congested urban traffic. A conversion kit for an existing mechanical bike can be obtained for under USD 100, compared to USD 450 to 600 for a complete e-bike (Greyson et al., 2021), around half of the average Gross Domestic Product (GDP) per capita.

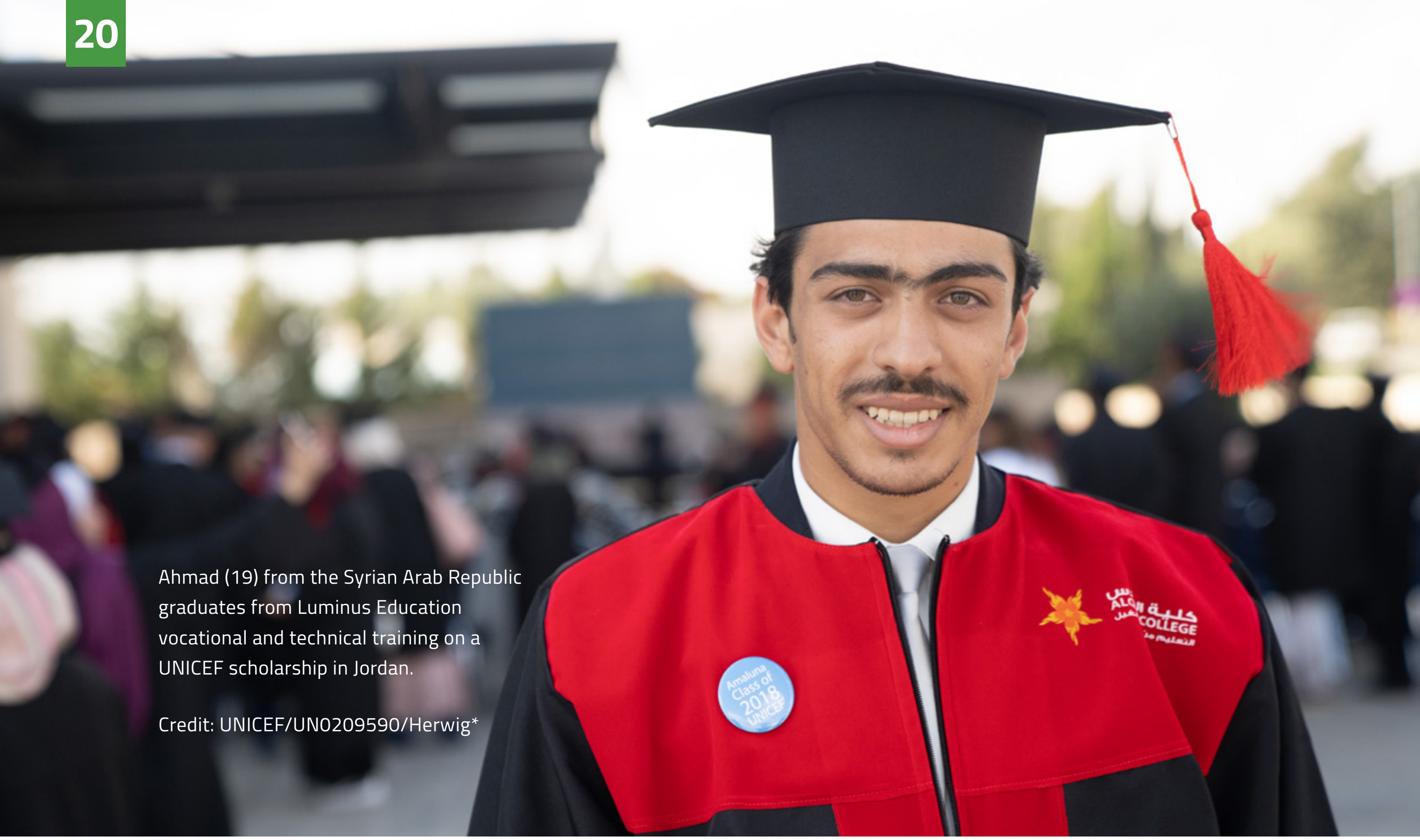
FIGURE 19.9:

Most primary schools in sub-Saharan Africa cannot be reached by paved road

Percentage of grade 6 students attending a school which can be reached by a paved road, francophone African countries, 2019



GEM StatLink: https://bit.ly/GEM2023_fig19_9
Source: GEM Report team analysis of 2019 PASEC data.



Ahmad (19) from the Syrian Arab Republic graduates from Luminus Education vocational and technical training on a UNICEF scholarship in Jordan.

Credit: UNICEF/UN0209590/Herwig*

KEY MESSAGES

In 2020, over USD 4.4 billion was disbursed in scholarships and imputed student costs, an increase of USD 1.3 billion, or 42%, since 2015. However, scholarship disbursements declined in 2020 and 2021 by 24%, likely attributable to the global impact of COVID-19: Scholarship money may have been available but not disbursed as student movements were restricted.

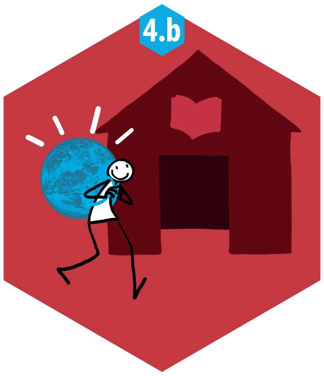
In 2020, only 11% of scholarships and imputed student costs were related to low-income countries, compared with 76% to middle-income countries.

Globally, the number of outbound international students tripled between 2000 and 2020, a greater increase than that observed for students from sub-Saharan and Northern Africa (2.2 times) and small island developing states (SIDS) (1.5 times).

By far the most common destination for students from these regions is Northern America and Western Europe, which accounts for over 70% of students from SIDS and Northern Africa and 48% of students from sub-Saharan Africa. The second most common destination for students from sub-Saharan Africa is the region itself, accounting for 20% of outbound international students.

Students' online searches for international scholarships reveal a period of stability over 2010–19, followed by a visible, if moderate, drop in early 2020 in response to COVID-19 uncertainty and travel restrictions. Since then there has been a sharp increase, exceeding pre-pandemic levels.

CHAPTER 20



TARGET 4.b

Scholarships

By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing states and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries

GLOBAL INDICATOR

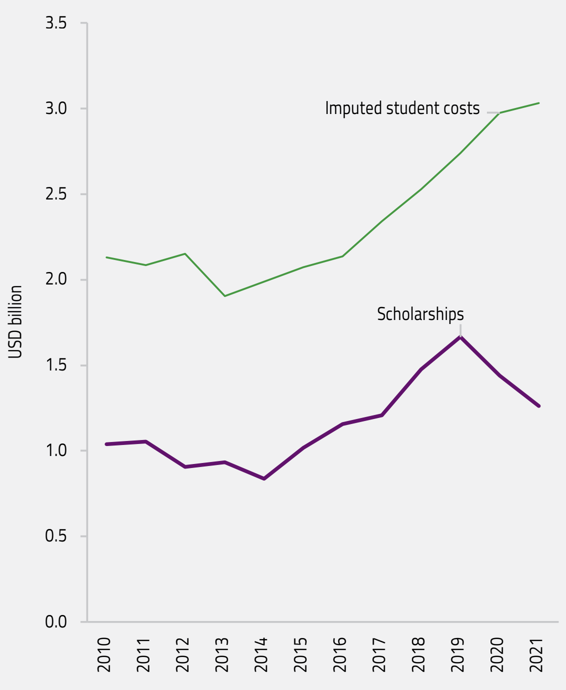
4.b.1 - *Volume of official development assistance flows for scholarships, by sector and type of study*

The Sustainable Development Goal (SDG) target 4.b deadline was 2020, unlike most other targets in the 2030 Agenda for Sustainable Development. By 2020, over USD 4.4 billion was disbursed in scholarships and imputed student costs (**Box 20.1**), an increase of USD 1.3 billion, or 42%, since 2015 (**Figure 20.1**). By contrast, scholarships and imputed student costs remained relatively stable between 2010 and 2015. However, funds declined in 2020 and 2021 as a result of a 24% drop in scholarships, from USD 1.7 billion in 2019 to USD 1.3 billion in 2021. This drop is likely attributable to the global impact of COVID-19: money for scholarships may have been available but not disbursed due to restrictions on student movement. Imputed student costs continued to grow, although they tapered off in 2021. Such disbursements for scholarships and imputed student costs are recorded only by those countries which choose to do so under the official development assistance (ODA) budget. But not all countries choose to do so – and the amount recorded does not include scholarships by private providers.

FIGURE 20.1:

Scholarships and imputed student costs increased by USD 1.3 billion between 2015 and 2020

Aid to education in the form of direct scholarships and imputed student costs, 2010–21



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Source: OECD DAC CRS database.

BOX 20.1:

Scholarships and imputed costs: An important distinction

Official development assistance (ODA) flows for scholarships comprise two parts. Direct scholarships are a form of financial aid awarded to individual students for full-time studies in higher education institutions which charge fees at the point of study. Imputed student costs refer to support provided to students in countries with non-fee charging educational institutions (OECD, 2019). It is important to acknowledge imputed student costs as a form of scholarship because otherwise the indirect cost of students studying in non-fee charging systems would be overlooked.

Both direct scholarships and imputed student costs can be reported as ODA if: (a) students are from ODA-eligible countries; and (b) the costs are recognized in official budgets with appropriate involvement from the authorities responsible for ODA programmes. Scholarships and traineeships, even though they are primarily awarded for studies in the provider country and do not involve fund transfers to ODA-eligible countries, are recorded in the balance of payments as a cross-border flow. This is because they represent a resource transfer between residents and non-residents. This treatment also applies to imputed student costs, where the absence of fees paid by students is considered a 'travel credit' in the balance of payments. The current ODA definition only recognizes the international flow from the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD) and from non-DAC donors to developing countries. A new definition is being developed that will also allow flows to be recognized between developing countries.

This distinction poses a challenge for how to interpret data. It is unclear what proportion of scholarships helps students study abroad and what proportion helps students study in their home countries. By definition, imputed student costs are purely for those studying abroad. OECD Creditor Reporting System microdata offer some insights. In 2021, Germany, the largest contributor to imputed student costs, reported spending USD 336 million for Chinese students, USD 103 million for Iranian students and USD 30 million for Brazilian students. France allocated USD 26 million to support students from Côte d'Ivoire. Scholarship programmes tend for have smaller budgets and reach fewer beneficiaries. For instance, Saudi Arabia granted scholarships and training to 271 Nigerian students, for a value of USD 3.6 million. Portugal sponsored senior officials from Brazil in Portugal with USD 6.2 million, while Hungary dedicated USD 3.6 million to Brazilians to study at Hungarian tertiary institutions.

The longer-term trend since 2015 of funds increasing has mainly been the result of two factors. First, bilateral flows with unspecified recipient countries increased, driven by European Union (EU) institutions and Japan, which started reporting all its scholarship aid under this category in 2017. Second, imputed student costs largely related to refugee flows to Germany also increased after 2015 and refugee students were eligible for entry into the country's essentially free tertiary education system.

It is important to chart not only the scale of disbursements, but also where they are directed to. In 2020, only 11% of scholarships and imputed student costs were disbursed to low-income countries, compared to 76% to middle-income countries (**Figure 20.2**). However, low-income countries have benefited more in relative terms. Scholarships and imputed student costs disbursed doubled in 2015–20, more than for the other income groups.

In 2014, the year before the Sustainable Development Goals (SDGs) came into effect, China was the single largest recipient of scholarships and imputed student costs of USD 371 million, 13% of the global total, or over 3 times more than the second largest recipient, India, and 1.7 times more than all low-income countries combined. By 2021, China was still the largest recipient, with USD 392 million; however, this amount now accounted for just 9% of the total and was less than the disbursements to low-income countries (USD 491 million).

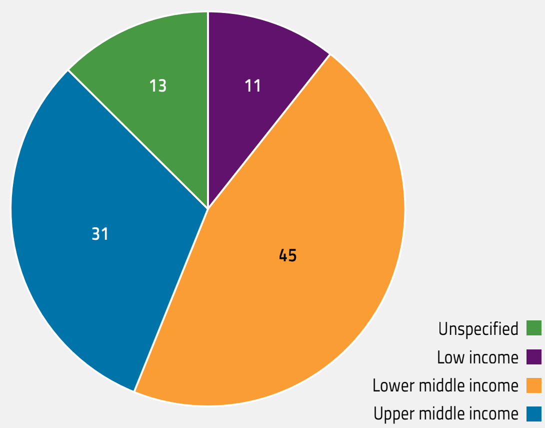
> Target 4.b calls for a substantial increase in aid to support student mobility, particularly for those in the 'least developed countries, small island developing states, and African countries'

Target 4.b calls for a substantial increase in aid to support student mobility, particularly for those in the 'least developed countries, small island developing states, and African countries'. The number of outbound international students from these countries has continuously increased for the past two decades. Globally, the number of outbound international students tripled between 2000 and 2020, a greater increase than that observed for students from sub-Saharan and Northern Africa (2.2 times) and small island developing states (SIDS) (1.5 times) (**Figure 20.3a**). Still, outbound mobility has increased more slowly than their national tertiary programmes. The ratio of outbound international students to the total tertiary enrolment in countries has decreased in sub-Saharan Africa since 2000, although it has been growing among the least developed countries group since 2012 and for SIDS since 2008 (**Figure 20.3b**).

FIGURE 20.2:

Only a tenth of direct scholarships and imputed student costs are disbursed to lower-income countries

Volume of aid to education disbursed by country income group, 2020, (%)



GEM StatLink: https://bit.ly/GEM2023_fig20_2
Source: OECD DAC CRS database.

The most common destination for students from these regions is, by far, Northern America and Western Europe, which account for almost 75% of students from SIDS and Northern Africa (**Figure 20.4**). Regional distribution is less concentrated for students from sub-Saharan Africa, only 48% of whom go to Northern America and Western Europe. The second most common destination for students from sub-Saharan Africa is the region itself, accounting for 20% of outbound international students. South Africa is the most popular destination in the region, having received nearly 30,000 students from other sub-Saharan countries in 2020.

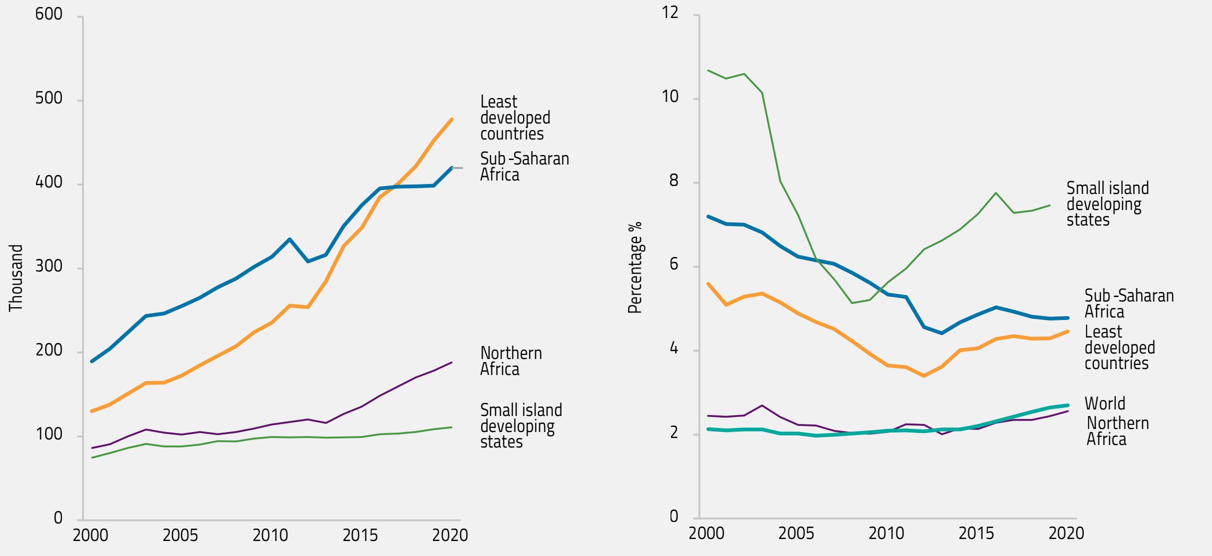
Although the SDG target aims to reduce inequality in access, there is also a risk of exacerbating disparities by targeting countries instead of individuals. This is because scholarship beneficiaries tend to have privileged backgrounds and they may not contribute to the economic development of their home countries (**Box 20.2**).

FIGURE 20.3:

Outbound mobility has increased in focus regions, but not as much as countries' national tertiary systems

a. Number of outbound international students, 2000–20

b. Number of outbound international students as a ratio of total tertiary enrolment in the region, 2000–20

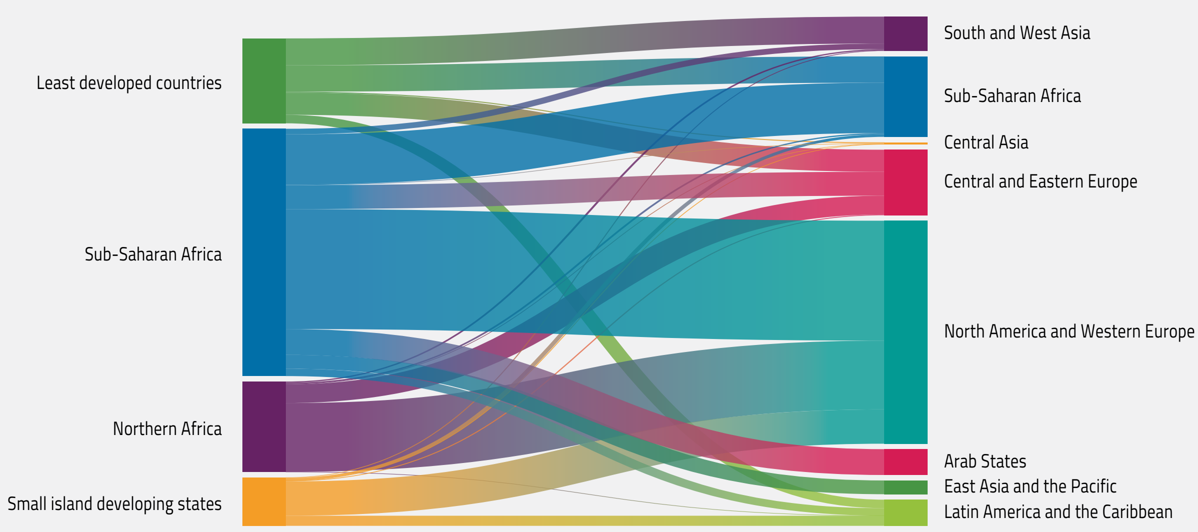


GEM StatLink: https://bit.ly/GEM2023_fig20_3
Source: UIS database.

FIGURE 20.4:

Most students who study abroad do so in Northern America and Western Europe

Distribution of outbound international students, by origin and destination, 2020



GEM StatLink: https://bit.ly/GEM2023_fig20_4
Source: UIS database.

BOX 20.2:

A government-sponsored scholarship programme in Brazil did not lead to expected results

In 2011, the Brazilian government launched Ciência sem Fronteiras (Science without Borders), a scholarship programme for tertiary students in science, technology, engineering and mathematics fields to pursue a fully funded academic year abroad. The programme was originally focused on bachelor's students, who received nearly 80% of the scholarships in the first six years, but the programme ended in 2017. During those six years, the government issued more than 100,000 scholarships at a cost of over BRL 15 billion (USD 3 billion), 15 times more than the total budget of the country's National Council for Scientific and Technological Development (Conceição et al., 2023; SBPC, 2017). Note that such programmes have not been counting towards the achievement of SDG target 4.b, as progress has been measured exclusively on the basis of OECD DAC aid terms.

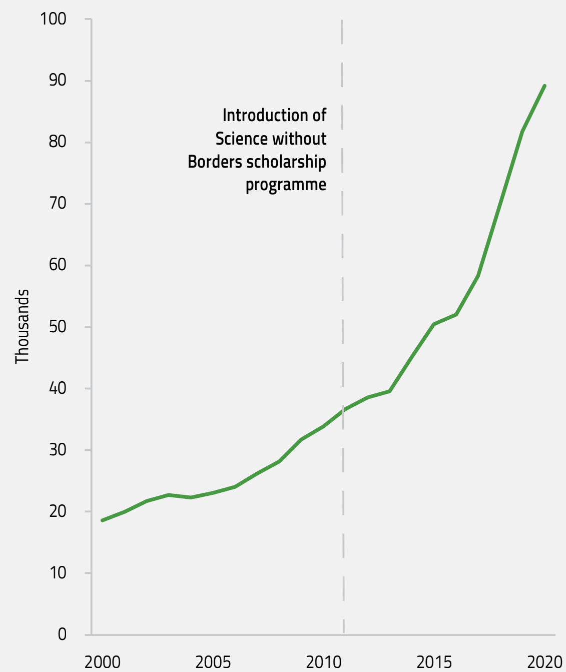
Studies analysing the impact of the Ciência sem Fronteiras programme highlight its many shortcomings. First, there are criticisms that it mostly benefited students from privileged backgrounds, who came from the country's most prestigious universities and richest states. This inequity was compounded by the programme's requirement that students speak a foreign language (Feltrin et al., 2021; Moreno, 2014). Second, the programme's rushed implementation led to significant flaws in the design: a lack of quality control of the foreign universities; lack of compatibility between courses, which meant students often could not use any of the credits completed abroad; and lack of sufficient foreign language knowledge leading to premature student return to Brazil (Fabiano, 2014; Moreno, 2014; SBPC, 2017). A programme evaluation after six years confirmed that it did not achieve its goals of increasing student participation in master's or doctoral programmes, in the formal labour market, or as entrepreneurs (Conceição et al., 2023).

Nonetheless, the programme did succeed in increasing the number of Brazilian tertiary students studying abroad (**Figure 20.5**). There are some indications that the programme increased international collaboration among researchers for publications and increased partnerships between Brazilian and foreign tertiary institutions, although much of this may have resulted from scholarships provided to master's and doctoral students (Manços and Coelho, 2017).

FIGURE 20.5:

A government-sponsored scholarship programme increased the number of outbound international students from Brazil

Number of outbound international tertiary students from Brazil, 2000–20



GEM StatLink: https://bit.ly/GEM2023_fig20_5
Source: UIS database.

FOCUS 20.1: WHAT DO ONLINE SEARCHES REVEAL ABOUT INTEREST IN INTERNATIONAL SCHOLARSHIPS?

More and more people rely on the internet for an increasing number of activities, including those related to work and education. Accordingly, insights can be gained from data collected about these activities. For example, the rise and fall in the number of people searching online for flu symptoms might track flu incidence. This premise has given rise to hundreds of studies using Google Trends data alone (Jun et al., 2018), just one data source among many. Studies have employed various forms of online or mobile phone data, including to estimate macroeconomic indicators (Narita and Yin, 2018) or small-area illiteracy estimates in Senegal (Schmid et al., 2017). The 2021 World Development Report, which focused on data, called for the use of alternative data sources to monitor public health, target resources and service delivery, analyse information not collected by the government (such as access to financial services), and hold governments accountable, while noting limitations in terms of representativeness and risks of discrimination and manipulation more precisely.

Despite a proliferation of research of this nature exploring questions relating to international development and migration, hardly any of these studies focus on student migration and none on international scholarships or scholarship holders. This seems a missed opportunity to gain insights into the interest in international scholarships around the world.

> Monitoring scholarships suffers from a lack of robust data

Monitoring scholarships suffers from a lack of robust data. There is no consensus on how to provide standardized, transparently defined and comprehensive information on the number of international scholarships available to students from low- and middle-income countries. In the absence of such standard data, the GEM Report team has conducted experimental research, albeit with careful attention to methodology, analysis and interpretation.

The first step to identifying an overseas scholarship opportunity is often an online search, using general search engines such as Google or Baidu; their searches are highly correlated in China, although Baidu accounts for a vastly higher volume (Vaughan and Chen, 2015). Specialized scholarship platforms provide an alternative, or complementary, tool for some students, while others rely on low-tech information sources, such as word-of-mouth. Still, patterns of online searches for international scholarship opportunities using general search engines may unveil broad trends.

The report team analysed the volume of searches related to international scholarships on the Google search engine. Trends in searches for given keywords are publicly available through the Google Trends portal. What Google provides is not the absolute number of searches but search interest relative to a benchmark. For trend analysis, the benchmark (scaled to an index value of 100) is the highest number of daily searches during the period in question. For comparisons between search terms, the benchmark is the highest among them.

Easy access and the high share of Google in the online search market are general advantages that explain the popularity of these data. However, the market share and representativeness vary greatly across countries. And while searches in other languages are covered in principle, in practice only English language searches provide a sufficient sample size for analysis for many search terms. Moreover, the underlying data are proprietary, and the methodological choices are opaque. Care must be taken with how the data are extracted and interpreted.

Some patterns are predictable. For example, students receive their grades and the diplomas they need to apply for scholarships at specific points in time. Most scholarships have application deadlines. Even if the exact timing of these markers differs by country or even institution, a seasonal pattern could be expected that repeats each academic year. In 2020 and 2021, however, a pronounced drop could be predicted, as travel opportunities were curtailed by the COVID-19 pandemic. It is also a recognized fact that international student mobility is influenced by historic, cultural and especially linguistic proximity. Accordingly, search interest in scholarships for study in the United Kingdom could be assumed to be higher in an anglophone African country than in its francophone neighbour, for instance.

Indeed, the African countries where 'international scholarships UK' had the highest index value over the past five years are Ghana, Kenya, Nigeria, South Africa and Uganda. This contrasts with the equivalent French term 'bourse en France', which attracted the most interest in Benin, Cameroon, Congo, Côte d'Ivoire, Madagascar and Senegal. Search activity for the United Kingdom–based Chevening scholarship displays a pronounced period of heightened interest from approximately June to October, and drops off precipitously in early November after the application deadline.

Despite these signs that search engine analysis may be promising, there are several caveats. Google Trends data themselves fluctuate too much (Fenga, 2020). For example, identical searches for the same past time period do not give identical results when conducted on different days (Cebrián and Domenech, 2022). This is because Google Trends uses a random sample of internet protocol (IP) addresses (Böhme, 2020). While this variation may be large enough to make trend analysis unreliable for short timescales (Behnen et al., 2020), it is unlikely to influence the results of looking at large trends over months and years. All figures display the average search index values over multiple queries.

More problematic is that it has been observed that completely unrelated search terms share common trends in Google Trends data (Bokelmann and Lessmann, 2019), suggesting spurious patterns driven by changes in overall search volume or methodological changes. This is reported to have been the most pronounced in the 2000s, when the service was relatively new and the online search market more dynamic. Because of this, the analysis is limited to the period since 2010.

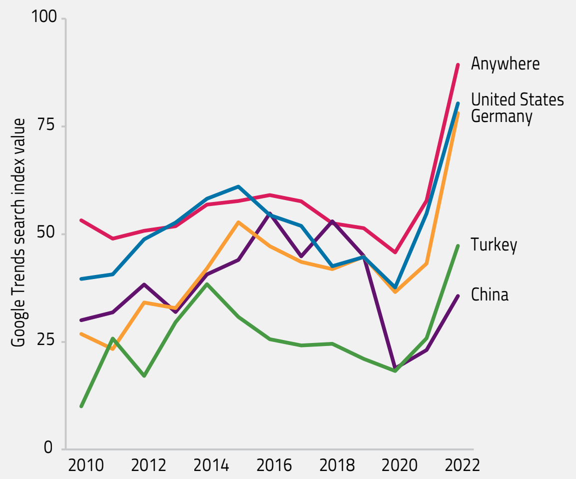
Trends were analysed for the generic search term 'international scholarships' as well as for scholarships in the United States, Germany as the major non-anglophone European destination, and emerging destinations such as China and Turkey (reflecting the country's name at that time, prior to its official change to Türkiye). Each series is normalized independently, meaning that the values are not directly comparable between series. In particular, it would be a mistake to interpret the graphs as showing the same number of searches, when, for example, searches for Turkey were about half as common as searches for the United States. At the same scale, destination-agnostic searches outnumber those specific to the United States as a destination by a factor of 10, and searches for Turkey as a scholarship destination by a factor of 100.

For the generic search, a long period of stability can be seen in 2010–19, followed by a visible, if moderate, drop in early 2020 in response to COVID-19 uncertainty and travel restrictions, and by a sharp increase afterwards, even exceeding pre-pandemic levels. However, the most recent data are difficult to interpret due to changes in Google's data collection in early 2022 (**Figure 20.6**).

FIGURE 20.6:

Since the onset of the pandemic, online search interest in international scholarships has increased sharply

Google Trends normalized search index for terms 'international scholarships' (anywhere) or 'international scholarships <country>', 2010–22



GEM StatLink: https://bit.ly/GEM2023_fig20_6
Note: The index value is the yearly average of monthly values.
Source: GEM Report team anaysis of Google Trends.

For scholarships to the United States, a previous upward trend reversed following the election of Donald Trump as US President in 2016. This matches official data on new international student enrolment, that increased by 50% from around 200,000 in 2009/10 to 300,000 in 2015/16, but then steadily declined by a total of 10% up to the academic year that started in autumn 2019 (OpenDoors, 2023). Searches for scholarships in Turkey increased rapidly from 2010 to 2014 but declined relatively steadily until 2020 before picking up again in 2020–21. Searches for China did not recover from the pandemic decline until now, unlike for traditional destinations.

> An alternative to analysing search terms is to examine how advertising algorithms classify internet users

An alternative to analysing search terms is to examine how advertising algorithms classify internet users (Zagheni et al., 2017). Facebook's Advertising Manager was developed to improve the accuracy of audience targeting. It can display an estimate of the number of individuals meeting certain criteria explicitly reported by Facebook users (such as being between 18 and 24 years old and being an upper secondary school graduate) in combination with classifications inferred by Facebook from their activities and interactions on the internet, such as having an interest in a certain topic (for example, international scholarships).

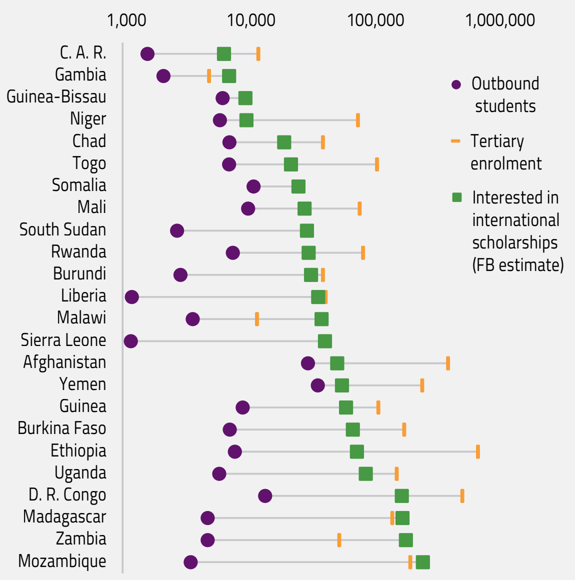
A study validating Facebook's data against self-reporting results in an online survey with respondents recruited through targeted Facebook advertisements indicated good overall accuracy of demographic classification (Grow et al., 2022). However, the age group 18-24 was misclassified relatively often, perhaps because respondents had made themselves older at the time of initially joining the platform. With respect to inferred interest, the underlying algorithm is proprietary and not transparent. The resulting estimates, therefore, cannot be taken at face value. However, the fact that uncertainty is recognized, and a range provided, increases credibility.

With these caveats in mind, Facebook's estimates of 18- to 24-year-olds with upper secondary school certificates and an interest in international scholarships are charted in various countries alongside the number enrolled in tertiary education or studying abroad. Under the assumption that the estimates are of the right order of magnitude, two conclusions can be drawn. On the one hand, only a small fraction of all students, and even fewer upper secondary school graduates, in low- and middle-income countries display an interest in international scholarships in their online behaviour. On the other hand, despite being a relatively small group, the number of those who are interested by far exceeds the availability of scholarships. The 2020 GEM Report estimated that the top 50 scholarship providers offered only around 30,000 new scholarships in 2019; yet, in Uganda alone, almost 100,000 youth were considered to be among those 'interested' in a scholarship (**Figure 20.7**).

FIGURE 20.7:

Facebook's estimate of its users interested in international scholarships typically far exceeds the number of students already abroad

Facebook Ad Manager estimate of 'audience size' (number of Facebook users) aged 18-24 who completed upper secondary schooling and an inferred interest in international scholarships, 2023



GEM StatLink: https://bit.ly/GEM2023_fig20_7
Note: The scale of the horizontal axis is logarithmic.
Source: Facebook Ad Manager, 2023.

To respect both privacy and sample size concerns, neither Google nor Facebook publish estimates that are too small. On Google Trends, the search index for a given keyword and matching country is not published if the number of searches falls below a certain threshold. Facebook Advertising data do not provide estimates for audiences smaller than 1,000, precluding its use for looking for scholarship holders from specific countries (Fatehkia et al., 2022).

Most problematically, data on online behaviour are almost entirely proprietary. Some data are made available to the public, some through ad hoc requests and some are commercially available for marketing purposes. In any case, data availability is at the discretion of the companies owning the data. The data themselves are, at best, calibrated internally, but there is no outside validation, at least none that is publicly available. It can only be assumed, without knowing for certain, that an increase in online searches for the term 'scholarships UK' indicates an increase in actual interest. Even less is known about increases in scholarship applications. Academic research suggests that the intention to migrate internationally does affect migration overall, albeit in a complex interplay with diverse factors such as opportunities, social capital, skills and information that vary between individuals (Wanner, 2021). This experimental analysis does not try to predict actual scholarship mobility. Non-traditional data sources show some promise where official data are not forthcoming. However, many obstacles prevent satisfactory estimates from Google Trends (Leysen and Verhaeghe, 2022). The analysis presented here only scratches the surface, and the limitations must be noted, such as results relying upon the selection of an exact search term.

A teacher in the Mexican state of Jalisco.

Credit: UNICEF/UNI177022/Richter*

KEY MESSAGES

Progress on increasing the proportion of qualified teachers was uneven across regions and education levels between 2015 and 2020. The greatest improvement took place in sub-Saharan Africa, where the share of qualified teachers increased from 53% to 60% in pre-primary education and from 59% to 65% in upper secondary education. Nevertheless, the region is still far from achieving its 2030 benchmarks.

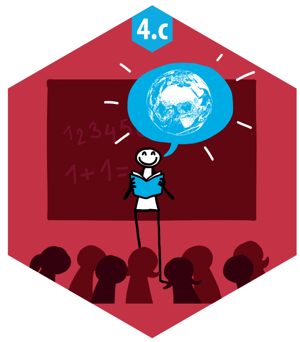
Teachers are often qualified but not trained or trained but not qualified. In Lebanon, 77% of primary school teachers have the minimum required academic qualifications but only 23% have the minimum pedagogical training.

Efforts to increase the supply of qualified teachers must consider teacher attrition, which varies widely across countries and education levels. In Ethiopia, primary school teacher attrition rates fell from 5% in 2015 to below the 2020 target of 2%.

In high-income countries, teachers tend to be paid less than similarly educated workers in other sectors. Primary teacher salaries in Czechia increased by over 50% between 2010 and 2020, but teachers still earned 26% less than other tertiary-educated workers.

Many countries face a shortage of science and mathematics teachers because few enter the profession and even fewer stay. In the United States, there were over 30,000 vacancies for physics teachers in 2019. Policies to encourage recruitment, training and retention of teachers in these subjects include bonuses upon signing, salary supplements and the targeting of graduates or professionals who currently have a non-teaching career.

CHAPTER 21



TARGET 4.c

Teachers

By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States

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GLOBAL INDICATOR

4.c.1 – *Proportion of teachers with the minimum required qualifications, by education level*

THEMATIC INDICATORS

4.c.2 – *Pupil-trained teacher ratio by education level*

4.c.3 – *Percentage of teachers qualified according to national standards by level and type of institution*

4.c.4 – *Pupil-qualified teacher ratio by education level*

4.c.5 – *Average teacher salary relative to other professions requiring a comparable level of qualification*

4.c.6 – *Teacher attrition rate by education level*

4.c.7 – *Percentage of teachers who received in-service training in the last 12 months by type of training*

SDG target 4.c emphasizes the importance of teacher quality by referring to the supply of qualified teachers. But even if there are clear definitions on paper, there is not a shared understanding about who is a 'qualified' teacher. Some understand 'qualified' in terms of academic qualifications, while others focus on training requirements. The target covers both aspects. Global indicator 4.c.1 – the proportion of teachers 'with the minimum required qualifications' – measures the share of teachers with at least the minimum organized pedagogical teacher training required for teaching at the relevant level in each country. It is complemented by thematic indicator 4.c.3 – the percentage of teachers 'qualified according to national standards', which captures the share of teachers with at least the minimum academic qualifications required.

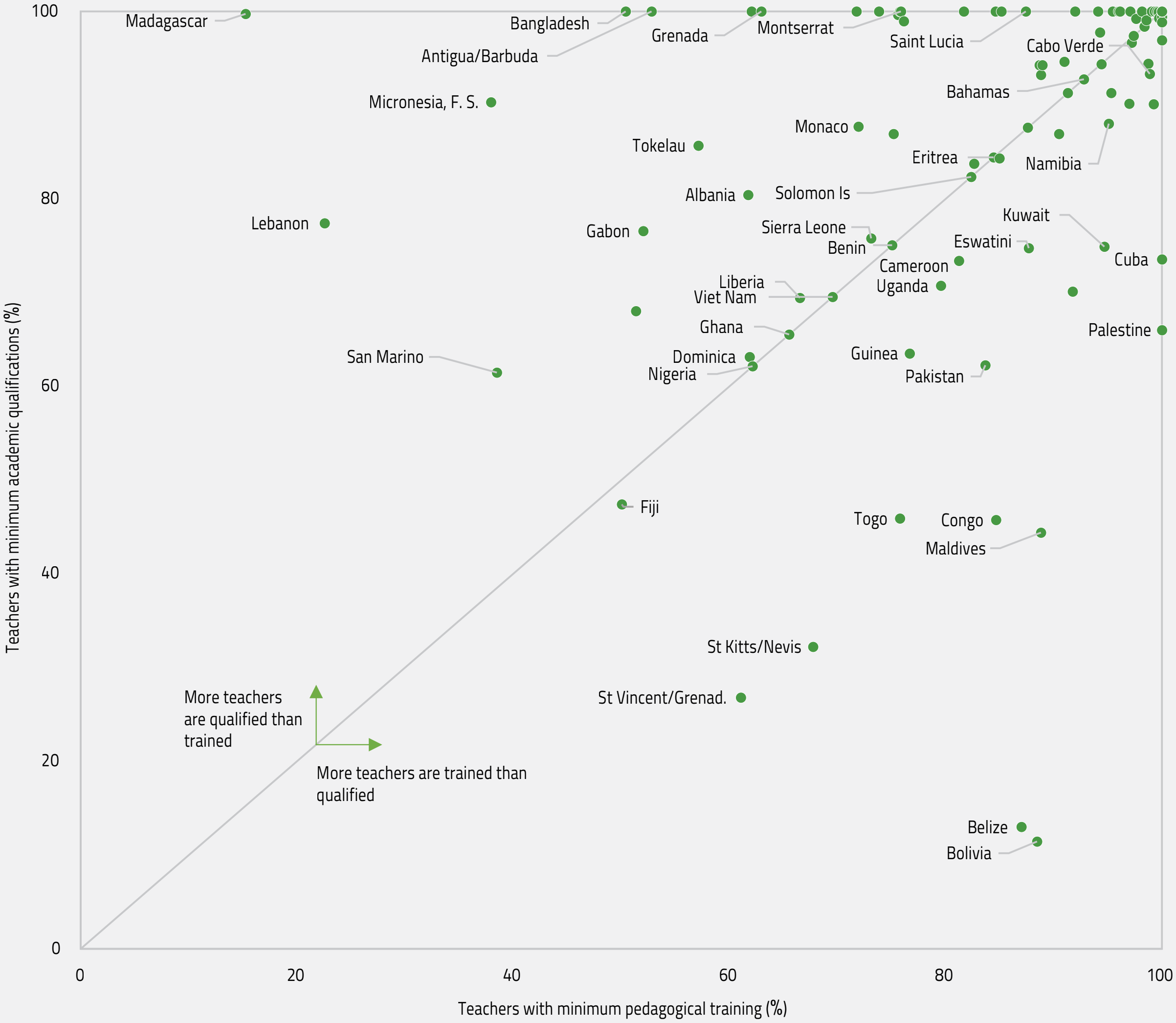
> Even if there are clear definitions on paper, there is not a shared understanding about who is a 'qualified' teacher

Teachers are often qualified but not trained, or they are trained but not qualified (**Figure 21.1**). In Lebanon, for example, 77% of primary school teachers have the

FIGURE 21.1:

Teachers are often qualified but not trained, or trained but not qualified

Share of teachers who have at least the minimum academic qualifications and the minimum pedagogical training required to teach in primary education, 2017–22



GEM StatLink: https://bit.ly/GEM2023_fig21_1
Source: UIS database.

minimum required academic qualifications, but only 23% have the minimum pedagogical training. Interpreting these statistics is impossible without knowing the minimum required academic and training qualifications in each country. In Uruguay, a teacher must complete a bachelor's degree to teach in a primary school, while in India, an upper secondary certificate suffices. Comparisons across training requirements are arguably even harder, as there is no common international classification for training programmes. What is even more confusing is that in some countries, qualifications and training are considered one and the same, leading many to report the same number for both indicators.

UNESCO is taking steps to improve data collection on teachers. In 2019, the UNESCO General Conference endorsed the development of an International Standard Classification of Teacher Training Programmes (ISCED-T) to support the monitoring of SDG target 4.c. ISCED-T is a framework for assembling, compiling and analysing cross-nationally comparable statistics on teacher training programmes (UNESCO, 2021). The UNESCO Institute for Statistics (UIS) has also started collecting information from countries on their minimum qualification and training requirements for teaching at each level of education.

BOX 21.1:

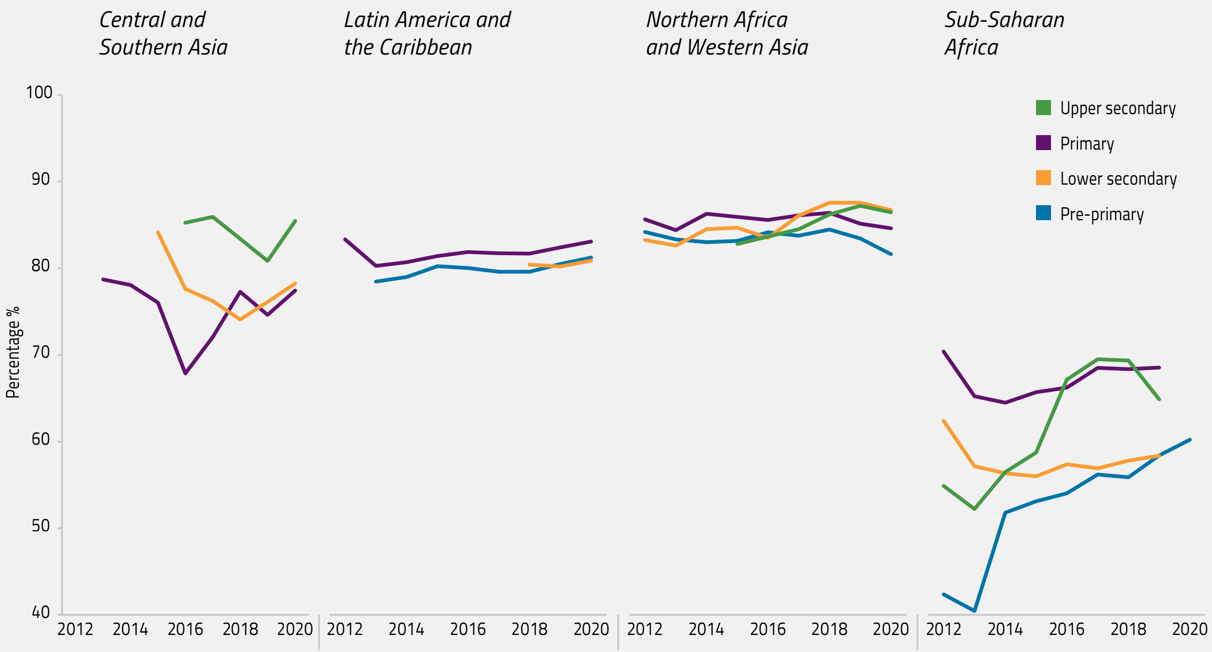
Progress since 2015: SDG indicator 4.c.1

Progress on increasing the proportion of teachers with the minimum required qualifications – or, more specifically, who have received at least the minimum organized pedagogical teacher training pre-service and in-service – has been uneven and limited across regions and education levels (**Figure 21.2**). To the extent that comparisons can be made with the available data, the greatest increases since 2015 have occurred in sub-Saharan Africa, although the region still lags behind all others at all levels of education. At the pre-primary level, which had the lowest starting point, the share increased from 53% in 2015 to 60% in 2020. In upper secondary education, the share increased from 59% to 65%. Countries in the region are also far from achieving their national 2030 benchmarks of 84% for pre-primary, 92% for primary and lower secondary, and 89% for upper secondary education.

FIGURE 21.2:

Progress since 2015 has been limited across regions and education levels

Proportion of teachers with the minimum required qualifications, by region and level of education, 2012–20



GEM StatLink: https://bit.ly/GEM2023_fig21_2
Source: UIS database.

Attrition must be discussed in the context of efforts to increase the supply of qualified teachers. In the United States, for instance, attrition accounts for about 90% of the annual demand for teachers (Carver-Thomas and Darling-Hammond, 2017). Attrition is also linked to teacher shortages, which is a growing problem not only in Northern America (Garcia and Weiss, 2019) but also in Europe (Albert et al., 2022) and other high-income countries (Welch, 2022). While some level of voluntary and involuntary attrition is to be expected, excessive attrition wastes resources and can severely disrupt education systems.

Indicator 4.c.6 estimates attrition rates by considering current-year data on total teachers and new teachers and previous-year data on total teachers. Although data are patchy, results highlight that attrition rates vary widely across countries and education levels (**Figure 21.3**). For instance, teacher attrition in lower secondary education is around 15% in both Rwanda and Sierra Leone, but is 21% in Sierra Leone and 3% in Rwanda in primary education.

Measuring attrition is difficult, and there are limitations to interpreting the data of indicator 4.c.6. First, it does not distinguish between permanent leavers and temporary ones, for example on maternity or sick leave. Second, it considers each level of education separately, so it cannot be used to estimate system-level attrition. In Lithuania, for instance, teacher attrition from the education system (from pre-primary to upper secondary education combined) was 4% in 2016 but ranged from 0.8% in primary to nearly 8% in upper secondary (OECD, 2021a). Teachers who move between levels count as 'leavers' in one level and 'new entrants' in another. Movement across levels is common in some countries, especially when multiple levels are integrated in a single structure, as is the case for primary and lower secondary education in Finland (OECD, 2021a). Third, it uses headcounts – the total number of teachers – as opposed to full-time equivalents, so it counts both full- and part-time teachers equally and does not capture changes in work intensity. In Norway, teacher attrition in primary education in 2016 was 12% using headcounts, but 8% using full-time equivalents, suggesting that many leavers worked part-time (OECD, 2021a).

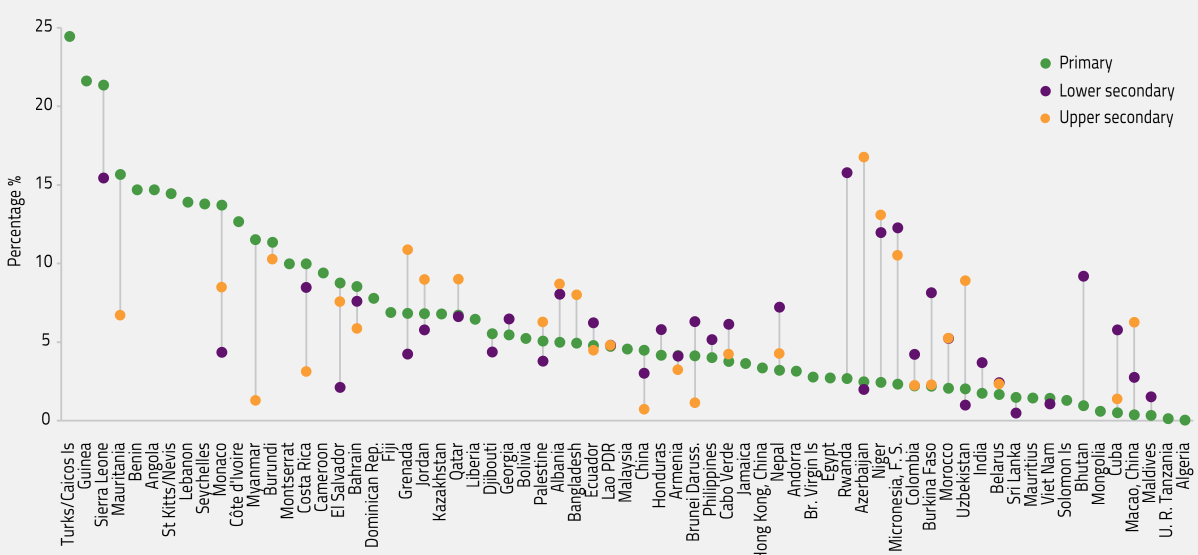
> "It is important to distinguish involuntary attrition – retirement and sickness – from voluntary attrition, which may signal bad working conditions or other disincentives"

Policies to address attrition rates must also consider the reasons for attrition. At a minimum, it is important to distinguish involuntary attrition – retirement and sickness – from voluntary attrition, which may signal

FIGURE 21.3:

Teacher attrition varies widely across countries and education levels

Teacher attrition rates in primary, lower and upper secondary education, 2015–22



GEM StatLink: https://bit.ly/GEM2023_fig21_3
Source: UIS database.

bad working conditions or other disincentives. Data from an OECD survey of 13 upper-middle and high-income countries show that teacher attrition drops by an average of 2 percentage points when excluding retiring teachers (OECD, 2021a). Finally, analysing national attrition levels may mask significant distribution challenges within countries (**Box 21.2**). And even if a system has low attrition rates overall, there may be major shortages of teachers in specific areas, such as science and mathematics (**Focus 21.1**).

BOX 21.2:

Ethiopia has set ambitious goals for teacher attrition

Over the past decade, Ethiopia has set two ambitious goals for reducing teacher attrition rates. In its 2016–20 Education Sector Development Plan (ESDP V), Ethiopia set a target to reduce attrition to 2% by 2020, which was then further lowered to 1% by 2025 in the following plan (EDSP VI) (Ethiopia Ministry of Education, 2015a; 2021a). The achievement of these targets is monitored annually through the education management information system, which disaggregates data by region, gender, education level and reason for leaving. Between 2015 and 2022, attrition rates decreased considerably for both primary and secondary education, though only primary education met the 2020 target of 2%. Both levels are on track to reach the 2025 target (**Figure 21.4**).

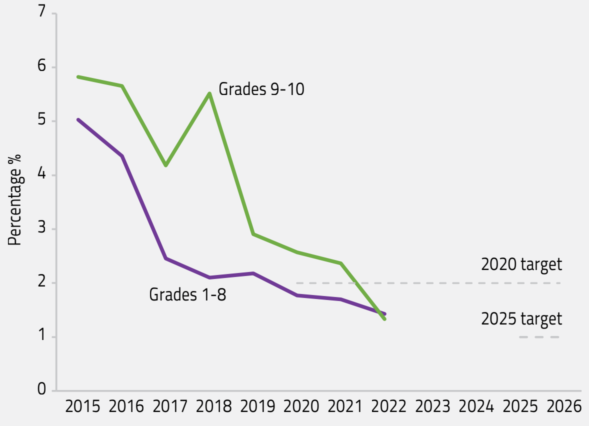
But rates vary considerably within the country in primary education, from nearly 4% in Harari to less than 0.5% in Amhara. Rates also vary by gender, particularly at the secondary level. In 2022, the attrition rate of female teachers (2.4%) was more than twice that of male teachers (1.1%). This is of concern given that female teachers are already a minority at this level of education, representing only 20% of the teaching force (Ethiopia Ministry of Education, 2022).

Designing policies to reduce attrition requires understanding the reasons why teachers are leaving. In 2022, 37% of primary teachers who left did so for what can be classified as avoidable reasons from a public policy perspective, namely 'leaving the teaching profession', 'political post' or 'ethical problem'. Attrition for involuntary reasons – retirement, death or prolonged sickness – comprised 32% of attrition (**Figure 21.5**). The proportions are very similar at the secondary level.

FIGURE 21.4:

Attrition rates in Ethiopia are falling and on track to reach the 2025 target

Teacher attrition rate, grades 1–8 and grades 9–10, Ethiopia, 2015–22



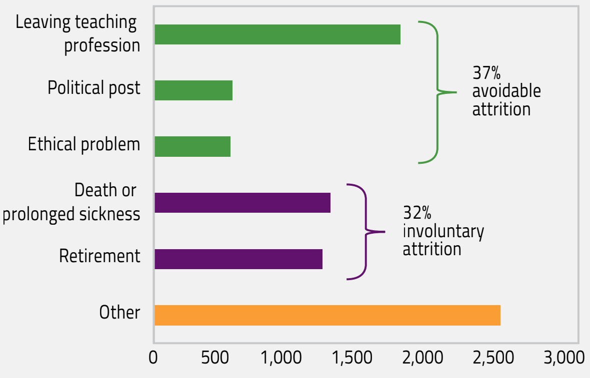
GEM StatLink: https://bit.ly/GEM2023_fig21_4

Source: Ethiopia Ministry of Education, various editions of the Education Statistics Annual Abstract.

FIGURE 21.5:

The main reason for teacher attrition is leaving the teaching profession

Distribution of teacher attrition in grades 1–8 by reason for leaving, Ethiopia, 2022



GEM StatLink: https://bit.ly/GEM2023_fig21_5

Source: Ethiopia Ministry of Education (2022).

Various factors influence teachers' decisions to enter and stay in the profession. Indicator 4.c.5 aims to capture one of these factors by measuring the 'average teacher salary relative to other professions requiring a comparable level of qualifications' – a proxy for the attractiveness of the teaching profession.

> In high-income countries, teachers tend to be paid less than similarly educated workers in other sectors

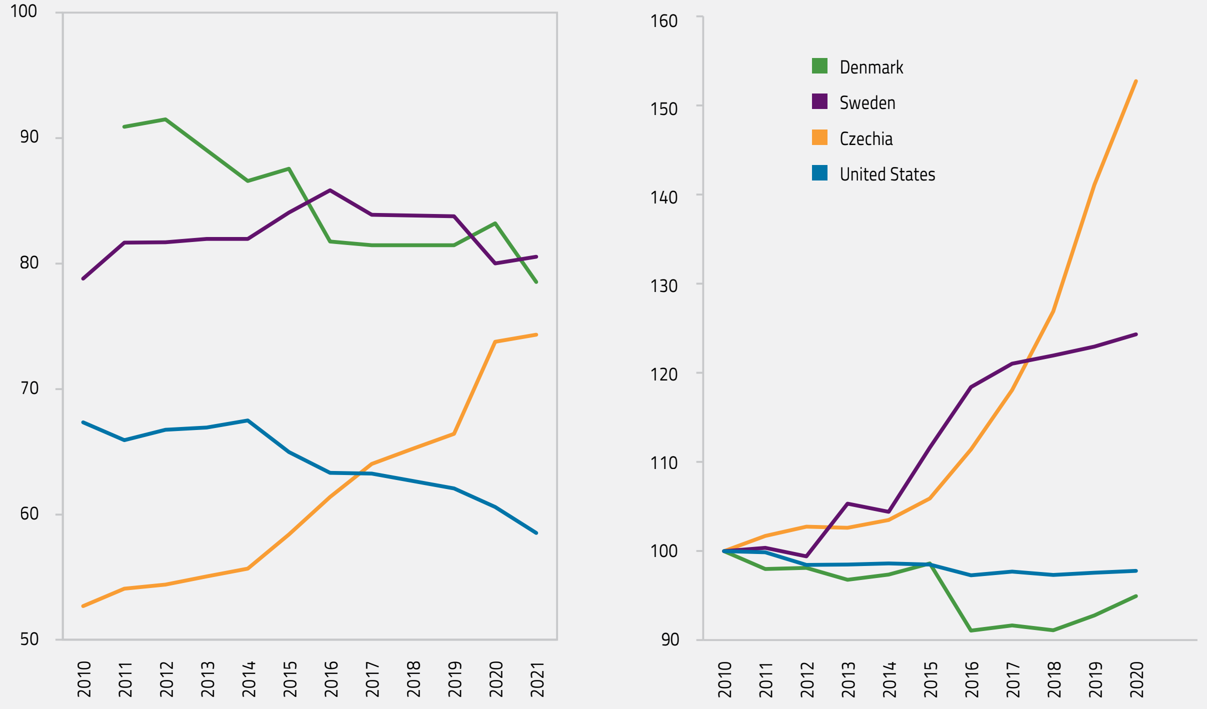
In high-income countries, teachers tend to be paid less than similarly educated workers in other sectors. In Sweden, for example, primary education teachers earned 20% less than tertiary-educated workers in 2020. This share has remained relatively stable over the past decade, even though teachers' salaries have increased by over 20% in the same period (**Figure 21.6**). In Czechia, primary teacher salaries increased by over 50% between 2010 and 2020, somewhat closing the gap with the salaries of other tertiary-educated workers, from 53% in 2010 to 74% in 2020. Czechia's Department of Education, Health Care, Culture and Social Security Statistics highlights that increases in teacher salaries have become more dynamic since 2019 and that pay gaps differ by age – older teachers received greater increases in salaries – and by region – in Prague, teachers earn 93% of the gross average wage in the city (Ribas, 2020).

In low- and middle-income countries, the reported values for this indicator show that teachers are more likely to earn higher salaries than other professionals. Yet, measurement challenges – including weakly developed formal labour markets and uncaptured income – may obscure comparisons (UNESCO, 2021). Other demographic and social factors may also influence the interpretation of this indicator. A study of 15 countries in sub-Saharan Africa found that teachers earned more than other workers in 10 countries, but after controlling for education, age, gender and location, teachers had a premium in only 5 countries and had lower salaries in 7 (Evans et al., 2022).

FIGURE 21.6:

Changes in teacher salaries do not always mirror changes in other professions

Index of changes in primary teacher salaries (2010=100) and primary school teacher salary as a share of the average earnings of tertiary-educated workers, 2010–21



GEM StatLink: https://bit.ly/GEM2023_fig21.6
Source: OECD database, various editions of Education at a Glance.

A more recent review of teacher salaries in sub-Saharan Africa highlights the shortcomings of arguments and data that point to teachers being relatively well paid in the region. Concerns include the non-differentiation of teacher salaries by contract type or type of institution, low sample sizes and the workers considered 'comparable wage workers' (Bennell, 2023).

FOCUS 21.1: STEM TEACHERS ARE IN SHORT SUPPLY

Among teaching specialities, the science, technology, engineering and mathematics (STEM) subjects face some of the greatest staffing shortfalls. One reason is that not enough people enter the profession. In England, United Kingdom, entry into initial teacher training is only 17% of the target number for physics and 30% for computing (United Kingdom, Department for Education, 2023). In the United States, there were over 30,000 vacancies for physics teachers in 2019 but only some 6,000 physics majors (Foresman, 2019).

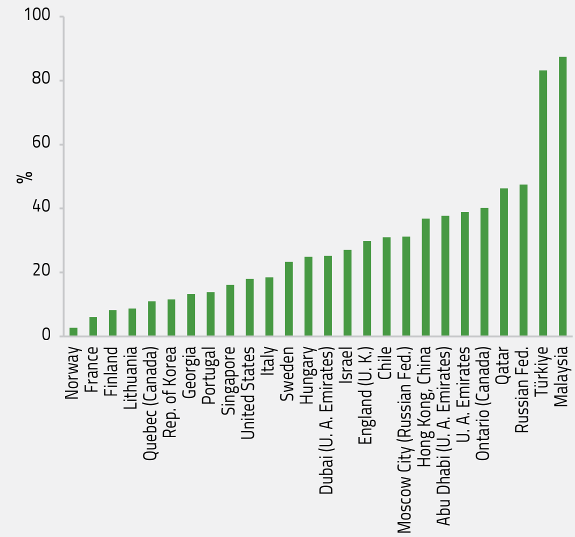
Another problem is that even fewer teachers stay in the subjects. Turnover rates in STEM are consistently the highest, including compared to other shortage subjects such as special education or English as a second language (Malkus et al., 2015). In rural areas, STEM teachers rarely stay in a teaching position for more than five years (Aragon, 2016; Goodpaster et al., 2012).

One internationally comparable source of school-level data on STEM teacher shortages is the principals' questionnaire of the Trends in International Mathematics and Science Study (TIMSS). In some middle-income countries, such as Malaysia or Türkiye, more than 80% of secondary schools face a shortage of adequate mathematics and science teachers. On average, close to 30% of schools across participating countries face such a shortage (**Figure 21.7**).

This shortage is particularly acute in sub-Saharan Africa. Only around 30% of the region's short-cycle tertiary enrolment is in STEM subjects (25% of female and 34% of male enrolments) (Phiri, 2021). According to an estimate produced for this report,[1] sub-Saharan Africa is the only region where its small number of STEM graduates is insufficient to provide an adequate number of STEM teachers to meet SDG 4 needs by 2030, even if every single STEM graduate could be recruited into teaching.

STEM graduates often enjoy many alternatives to teaching (Worth et al., 2022; Han and Hur, 2022). The shortfall by 2030 of people who can work in computing and mathematics is estimated to be as high as 6 million workers in the United States and around 1 million in Germany[1] (Strack et al., 2021). The average pay gap for mathematics and science graduates between teaching and non-teaching careers is higher than for other subjects (Britton et al., 2016; LiVecchi, 2017; Migration Advisory Committee, 2016; Benhenda and Sims, 2022), and STEM students may further overestimate this gap and the financial disadvantage of becoming teachers (Marder et al., 2018).

FIGURE 21.7:
A lack of sufficient or competent STEM teachers affects instruction in many schools
Percent of grade 8 principals stating that instruction at their school is affected 'some' or 'a lot' by a shortage or inadequacy of STEM staff, selected countries, 2019



GEM StatLink: https://bit.ly/GEM2023_fig21_7
Note: Norway is for grade 9.
Source: 2019 TIMSS.

Various policies have been implemented to encourage the recruitment, training and retention of STEM teachers. Recruitment incentives sometimes include significant bonuses for signing on teachers in shortage subjects. In England, United Kingdom, a target 8% gross salary supplement for early-career mathematics and physics teachers made them 23% less likely to leave their teaching post in public education (Benhenda and Sims, 2022), mirroring similar results in the United States. Retaining an additional teacher via the incentive resulted in a 32% lower

1 Annual STEM graduates were estimated as the average between the share of STEM graduates multiplied by overall tertiary enrolment, assuming 10% of enrolled students graduate in a given year, and the share of STEM graduates multiplied by the gross graduation ratio from tertiary education applied to one fifth of the tertiary-age population. The annual recruitment need is taken from UIS 2016 estimates, dividing the annual recruitment need for 2015–30 uniformly across years.

cost than training a replacement. Another approach is to target graduates or professionals who currently have a non-teaching career. In the German states of Berlin and Saxony, those having gone through alternative certification schemes already make up half of all newly recruited teachers (Tillmann, 2019), and the same is true of STEM teachers in the US state of Texas (Fuller and Pendola, 2019).

The African Institute for Mathematical Sciences, a non-governmental network of centres of excellence in post-graduate training in Cameroon, Ghana, Rwanda, Senegal and South Africa, established the five-year STEM-focused Teacher Training Program to provide not only professional development but also classroom resources. Both the centres in Ghana and South Africa use blended combinations of in-person and online training to improve teachers' subject knowledge and teaching skills, especially those serving disadvantaged populations (AAMN, 2022). In Cameroon, the training model includes building the capacity of 'master trainers' at teacher training institutions and raising awareness among principals regarding the importance of providing support to mathematics teachers (AIMS Cameroon, 2023). In Rwanda, VVOB, a non-governmental organization, similarly focuses on training STEM mentors and subject leaders and establishing communities of practice among them (Kuppens, 2019).

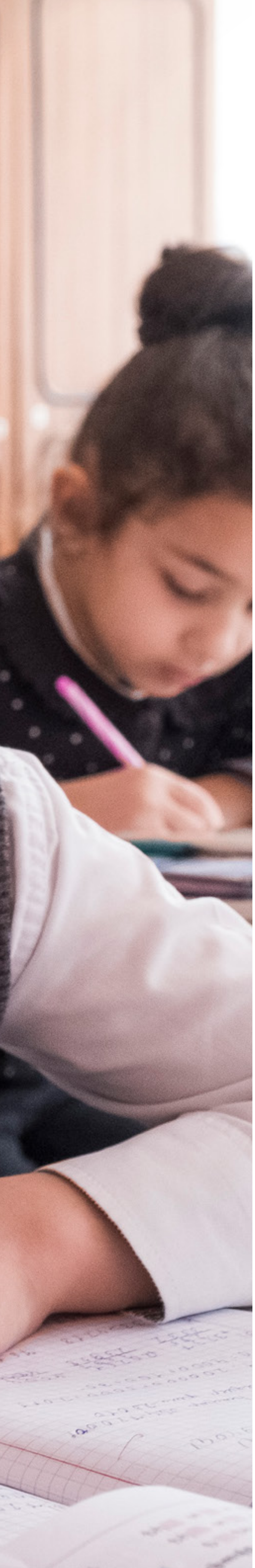
Enabling teachers already in the system to teach STEM subjects can be an effective way to increase coverage. One option is to train interdisciplinary STEM teachers already at the initial teacher training stage (Zonnefeld and Zonnefeld, 2019). However, qualifying teachers across subjects can be challenging. In 2018 in Thailand, under the Teacher Development Coupon scheme for in-service teacher training for 270,000 teachers, only 0.5% of the coupons were for STEM-related courses (Yamkasikorn, 2021).

> “Where there is scarcity, there is inequity”

Where there is scarcity, there is inequity. The shortage of STEM teachers brings heightened challenges of diversity and equitable provision (Foresman, 2019). In the US state of California, three quarters of secondary STEM students are non-white, but only one quarter of secondary STEM classes are taught by a non-white teacher (Ridley-Kerr et al., 2020). And STEM teachers are not distributed equally across schools. STEM teachers are missing from schools that are already disadvantaged, further aggravating inequality. In the United States, asymmetric teacher mobility between schools results in a significant share of mathematics and science teachers shifting from poor to better-off schools, from schools with more minority students to schools with fewer, and from urban to suburban schools (Ingersoll and May, 2012).

In 2018 in Armenia, a boy in grade 3 looks up from his work, in a maths class in Inclusive School No. 162 in Yerevan, the capital. UNICEF supported the government to strengthen policies and practices to provide inclusive education for all children.

Credit: UNICEF/UN0198748/Sokhin*



CHAPTER

22

Finance

KEY MESSAGES

Global education funding increased slightly from 3.9% of GDP in 2005 to 4.2% in 2021. Government spending on education amounted to 14.1% of total public expenditure in 2021. Among the 178 countries with available data for 2017–22, 34% did not meet either of the established benchmarks of at least 4% of GDP and 15% of total public expenditure.

Between 2000 and 2020, general government revenue increased from 24% to 26% of GDP. In Ecuador and Tajikistan, it rose by 12 percentage points of GDP and the share of education in total public expenditure grew by 6 percentage points. In Argentina and Azerbaijan, general government revenue also increased by 12 percentage points of GDP, but the share of education in total public expenditure fell by 4 percentage points in Argentina and 11 percentage points in Azerbaijan.

The proportion of lower-income countries either in or at high risk of debt distress rose from 21% in 2013 to 58% in March 2022. Debt repayment as a share of gross national income reached 7% in Rwanda, 8% in Zambia and 9% in Sudan, even before the outbreak of civil conflict.

At the peak of the previous debt crisis in 1994, the median country had a public debt/GDP ratio of 72%, compared with 33% at the end of 2021. Still, if recent trends continue, 1990s levels could be reached within seven years. The two crises differ in debt composition, with the share of domestic debt being higher; in addition, the creditor countries have changed.

Aid to education decreased by 7% from USD 19.3 billion in 2020 to USD 17.8 billion in 2021; it fell by 20% in sub-Saharan Africa. The share of aid allocated to education reached its lowest point since 2015, with only 9.8% dedicated to the sector in 2021.

The annual financing gap for low- and lower-middle-income countries to achieve their national SDG 4 benchmarks by 2030 is estimated at USD 97 billion. This represents 2.2% of GDP and 24% of the total cost, on average.

Three scenarios of increasing ambition have been developed to capture the cost of digital transformation in education. If low-income countries implemented a basic offline scenario while lower-middle-income countries worked towards a scenario of fully connected schools, these countries would need to spend USD 21 billion per year between 2024 and 2030 for capital expenditure and USD 12 billion per year for operational expenditure. The combined cost would increase their financing gap by 50%.

School feeding programmes, which are crucial social protection interventions in low- and middle-income countries, can increase household income by up to 15% in low-income areas.

Public expenditure 320
Aid expenditure 325
Household expenditure 337

Global expenditure on education, from public, donor and household sources, increased slightly to USD 5.4 trillion in 2021, driven by increases in government spending in low- and middle-income countries. Governments accounted for 78% of global education spending in 2021 (UNESCO and World Bank, 2023).

This chapter reviews the latest financial statistics on public and aid expenditure and also explores three policy issues in more depth. First, it describes the growing debt crisis and how it affects poorer countries' ability to spend on education. Second, it estimates what it would cost countries to achieve national education targets by 2030 as well as the cost of digital transformation, analysing three scenarios. Third, in the context of rising prices and increasing difficulties for the poorest families, it describes the contexts in which school feeding programmes can help.

PUBLIC EXPENDITURE

The Education 2030 Framework for Action sets two public education spending benchmarks. Ambiguously, it urged countries to spend 4% to 6% of their gross domestic product (GDP) on education 'and/or' 15% to 20% of their total public expenditure. Considering that poorer countries tend to have small budgets but a high demographic pressure to prioritize education while richer countries have large budgets but a relatively small school-age population, the GEM Report has long argued that meeting either of the two benchmarks should be considered a minimum requirement. For instance, France spent 5.4% of GDP on education in 2018, one of the highest ratios in the world, which, however, corresponds to just 9.7% of total public expenditure. In contrast, Indonesia had one of the highest education shares in total public expenditure in 2020 – 19.1% – but one of the lowest as a share of GDP – 2.8%.

> Globally, the median public education expenditure increased slightly from 3.9% of GDP in 2005 to 4.3% of GDP

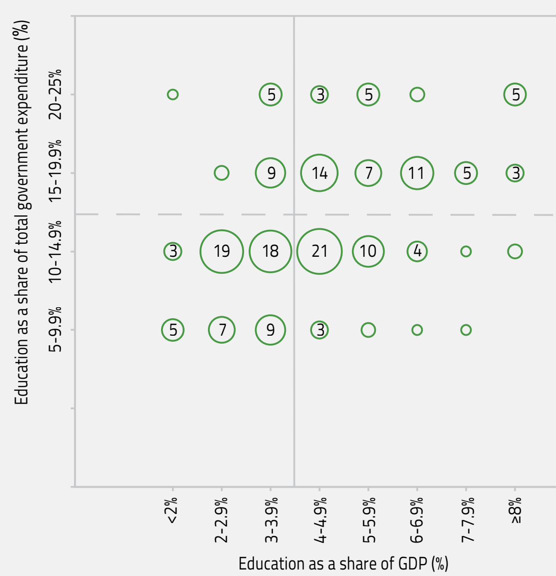
Globally, median public education expenditure increased slightly from 3.9% of GDP in 2005 to 4.3% of GDP, ranging from 3.3% in Eastern and South-eastern Asia to 5.4% in Oceania. Globally, the median share of education in total public spending was 14.2% in 2021, ranging from 9.6% in Northern Africa and Western Asia to 16.5% in sub-Saharan Africa. High-income countries spend 1.3 percentage points of GDP more but 4.4 percentage points of total government expenditure less than low-income countries.

Among the 178 countries with available data in 2017–22, 61 – or 34% – did not meet either of the established benchmarks (**Figure 22.1**). These countries span income levels and regions, and include Cameroon, China, Ireland, Luxembourg, Paraguay, Saint Lucia, Thailand and

FIGURE 22.1:

One in three countries spends below both international benchmarks

Public education expenditure as a share of GDP and as a share of total public expenditure, 2017–22



GEM StatLink: https://bit.ly/GEM2023_fig22_1
Source: UIS database.

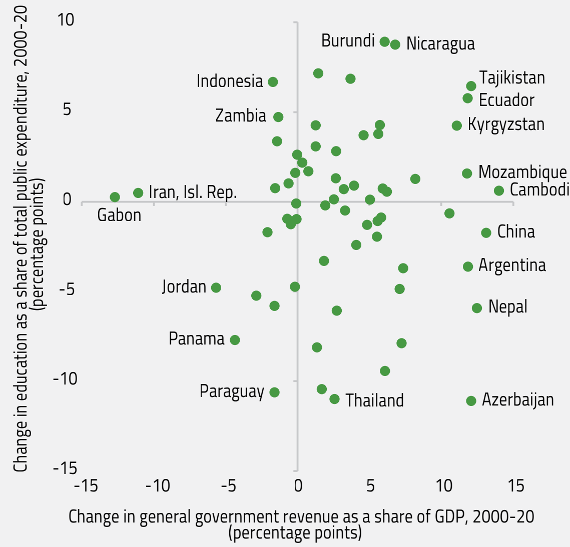
Sri Lanka. Over 45% of countries (but 56% of low- and lower-middle-income countries) spent less than 4% of GDP on education. Similarly, almost 45% of countries (but 78% of high-income countries) spent less than 15% of total public expenditure on education.

Since 2000, countries have increased their general government revenues from taxes and social contributions as a share of GDP from 24% to 26%. Middle-income countries increased their revenues from 21% in 2000 to 25% in 2020. In some countries, higher revenue has been accompanied by higher prioritization of education. For instance, in Ecuador and Tajikistan, general government revenue increased by 12 percentage points of GDP and the share of education in total government expenditure increased by 6 percentage points between 2000 and 2020. By contrast, Argentina and Azerbaijan also increased their general government revenue by 12 percentage points of GDP in this period, but the share of education in total government expenditure fell by 4 and 11 percentage points, respectively. The share of education remained constant in Cambodia (at just under 12%) and in the Islamic Republic of Iran (at 22%) over the 20 years, even though general revenue increased by 14 percentage points of GDP in the former and decreased by 11 percentage points in the latter (**Figure 22.2**).

FIGURE 22.2:

More tax revenue does not always mean more priority assigned to education

Change in general government revenue as share of GDP and education as a share of total public expenditure, selected low- and middle-income countries, 2000–20



GEM StatLink: https://bit.ly/GEM2023_fig22.2
Source: IMF Economic Outlook (2023) and UIS database.

SOME FEAR A RETURN TO THE DEBT CRISIS OF THE 1980S

The debt crisis facing poor countries, specifically the 69 lower-income countries within the Debt Sustainability Framework, has intensified in recent years. While they had emerged relatively unscathed from the financial crisis that hit the Global North in 2008–09, they have been affected adversely by increasing expenditure and falling revenue during the COVID-19 pandemic and by the food, fertilizer and energy price hikes triggered by the war in Ukraine. The median public gross financing need is a measure used by the International Monetary Fund (IMF) to describe pressure on government finances brought about by debt service payments and other requirements to cover fiscal deficits. In just three years, up to the end of 2022, the median public gross financing need in the 69 lower-income countries showed an increase from 5.5% to 9.3% of GDP. This pressure, combined with a negative outlook in global financial markets, has worsened the terms with which these countries can borrow (Chuku et al., 2023).

By the end of March 2022, the proportion of lower-income countries either in or at high risk of debt distress had risen to 58%, compared to just 21% in 2013 (IMF, 2022). By the end of May 2023, the number of those in distress had

> “By the end of March 2022, the proportion of lower-income countries either in or at high risk of debt distress rose to 58%, compared to just 21% in 2013”

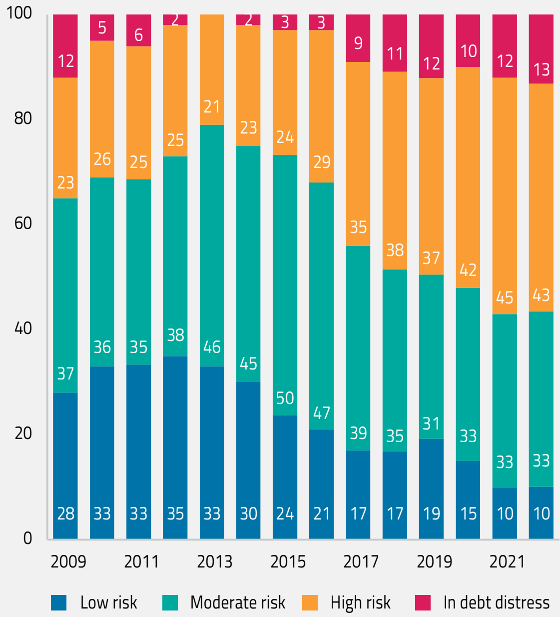
risen from 9 to 11, or 16% of all countries (IMF, 2023b). Debt burden varies widely among these countries. Debt repayment as a share of gross national income (GNI) had reached 7% in Rwanda, 8% in Zambia and 9% in Sudan even before the outbreak of the civil conflict (IMF, 2022). It is unclear how high these repayments are in Mozambique, where a ‘hidden debts’ scandal involving the now discredited and bankrupt Credit Suisse has been looming since 2016 (Gebregziabher and Sala, 2022; Jones, 2022). In 2020, external debt servicing payments had already exceeded education spending in 21 out of 69 Debt Sustainability Framework countries (Munnelly, 2022). Prior to its agreement with the IMF, Ghana spent almost twice as much on debt servicing as it did on education in 2019.

Poor countries experienced a major debt crisis in the 1980s. At the time, debt to official creditors was

FIGURE 22.3:

Most lower-income countries are in or are at high risk of debt distress

Degree of debt distress faced by lower-income countries, 2009–22

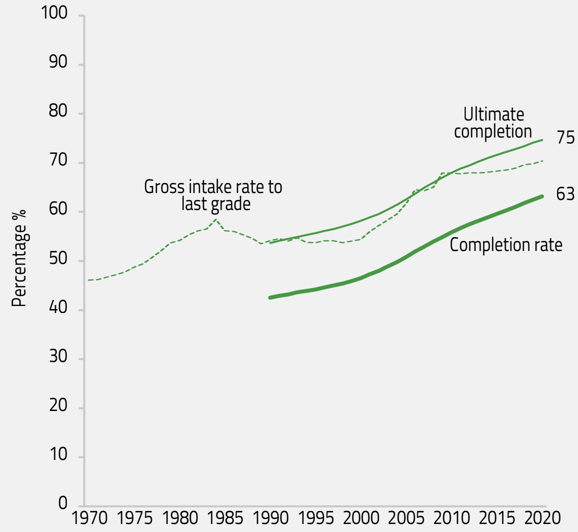


GEM StatLink: https://bit.ly/GEM2023_fig22_3
Source: IMF Economic Outlook (2023) and UIS database.

FIGURE 22.4:

Primary completion rates in Africa did not recover for 20 years as a result of debt and structural adjustment in the 1980s and 1990s

Selected measures of primary completion, sub-Saharan Africa, 1970–2020



GEM StatLink: https://bit.ly/GEM2023_fig22_4
Source: World Development Indicators (gross intake rate) and VIEW website (completion rates).

rescheduled but this protracted response did not prevent arrears from accumulating (Chuku et al., 2023). The IMF and the World Bank meanwhile implemented structural adjustment packages, which included measures such as reducing public service employment, eliminating food subsidies and cutting social expenditure (Buchmann, 1996). Although data quality does not allow precise analyses of that period, two studies indicate how spiralling debt and structural adjustment influenced education expenditure. First, an analysis of seven, mostly lower-middle-income countries has shown that for every 1% increase in the external debt-to-exports ratio, a key measure of the debt servicing burden, there was a corresponding reduction of 0.33% in public education expenditure (Khundadze and Alvarez, 2022). Second, public spending on education was shown to be highly volatile in the 1990s, and more volatile than health spending (Lewis and Verhoeven, 2010).

The consequences of debt and structural adjustment policies for education and overall social development were far-reaching, devastating and long-term. In sub-Saharan Africa, for example, the gross intake rate to the last grade of primary school peaked at 59% in 1984 and did not reach the same level for another 20 years. Even today, one in four children in the region do not complete primary school (**Figure 22.4**). Debt also had equity implications. Female secondary school enrolment dropped during the period while male enrolment remained constant (Buchmann, 1996).

During the early 1990s, the toll of structural adjustment programmes was recognized and the programmes started protecting essential social services, such as education. But it was not until the Heavily Indebted Poor Countries (HIPC) Initiative, launched by the IMF and World Bank in 1996 after strong lobbying from non-governmental organizations, that more decisive action was taken. In 2005, it was extended through the Multilateral Debt Relief Initiative. These actions helped eligible countries receive complete debt relief from the IMF, the World Bank, the African Development Fund and the Inter-American Development Bank, whose volume was estimated to reach USD 59 billion by 2005 (Chauvin and Kraay, 2007).

To qualify for the HIPC, countries had to develop poverty reduction strategy papers, introduce social sector policy reforms and increase social expenditure. Views on the impact of the HIPC vary. An increase in debt relief did not increase health and education spending as a share of total public expenditure (Chauvin and Kraay, 2005; 2007). Another analysis qualified the conclusion, arguing that education expenditure increased in those African countries that improved their institutions (Dessy and Vencatachellum, 2007). However, these analyses may have been premature: a long-term, more recent review confirms that debt relief did help indebted countries get their education development trajectory back on track (Ferry et al., 2022).

The current crisis is not yet as severe. At the peak of the previous crisis in 1994, the median country had a public debt-to-GDP ratio of 72%, while the same ratio was 33% at the end of 2021. The public and publicly guaranteed external debt-to-export ratio was 318% in 1994 but 137% in 2021; in 1994, 38 of the 69 countries had breached the 150% limit for this indicator, compared to 25 countries in 2021. Still, if recent trends are to continue, the levels of the 1990s could be reached within seven years (Chuku et al., 2023).

However, the two crises differ significantly in the composition of the debt. First, the share of domestic debt in total debt, which was less than 20% in the mid-1990s, had grown to 35% by 2021: while this reduces the risk to exchange rate depreciation, it exposes countries even more to systemic crisis. Second, external debt is more diversified, which affects the scope of potential solutions. The previous crisis mainly involved borrowing from official creditors (known as the Paris Club and accounting for 39% of total debt in the mid-1990s), which was mainly in concessional terms (Chuku et al., 2023). Between 2006 and 2020, the share of Paris Club creditors in total debt fell further from 28% to 10%, while the share of China and other non-Paris creditors increased from 8% to 22% and that of commercial creditors from 10% to 19% (Chabert et al., 2022). The borrowing agreements with creditors other than multilateral agencies and the Paris Club sometimes lacks explicit information on the exposure of indebted countries to risks (Chuku et al., 2023; Rieffel, 2021).

Triggered by the COVID-19 emergency in 2020, the Debt Service Suspension Initiative enabled 73 eligible countries to not make any interest payments or repayments, relieving costs of USD 12.9 billion between May 2020 and December 2021 (Siaba Serrate, 2023). By the end of 2020, the G20 Common Framework for Debt Treatment was established to provide substantive relief, albeit on a country-by-country basis (Chuku et al., 2023). The shift of this dialogue under the auspices of the G20 reflects the changes in debt composition (Brautigam and Huang, 2023). But while the intention to move from rescheduling debt to more radical solutions was declared faster than in the 1990s, implementation has not followed suit (Chuku et al., 2023). Only Chad has succeeded among the handful of countries that requested debt treatment (Chabert et al., 2022). Across countries, the share of debt relief in official development assistance, which rose from 6% in 1995 to 21% in 2005 at the peak of the HIPC programme implementation, has since been negligible (**Figure 22.5**).

Yet more action is needed. The gap between social spending and debt service payments in lower-income countries was just over one percentage point in 1996, increased to eight percentage points by 2011 but by 2020 had gradually fallen to less than six percentage points in HIPC countries (Chuku et al., 2023). In two countries that have been particularly affected by the unfolding debt crisis, interest payments have increased considerably: from a negligible 0.3% of GNI in 2011, they increased to 1.7% in Ghana in 2021 and to 3.5% in Zambia in 2019, before falling by two thirds in 2021. Education spending, which had reached very high levels in Ghana around 2010, fell from 4.6% of GDP in 2013 to 3.9% in 2018. In Zambia, education spending levels increased after the HIPC programme implementation from a very low 1.1% of GDP in 2008 to 3.7% in 2012, and fluctuated at around 4% of GDP in the 2010s (**Figure 22.6**).

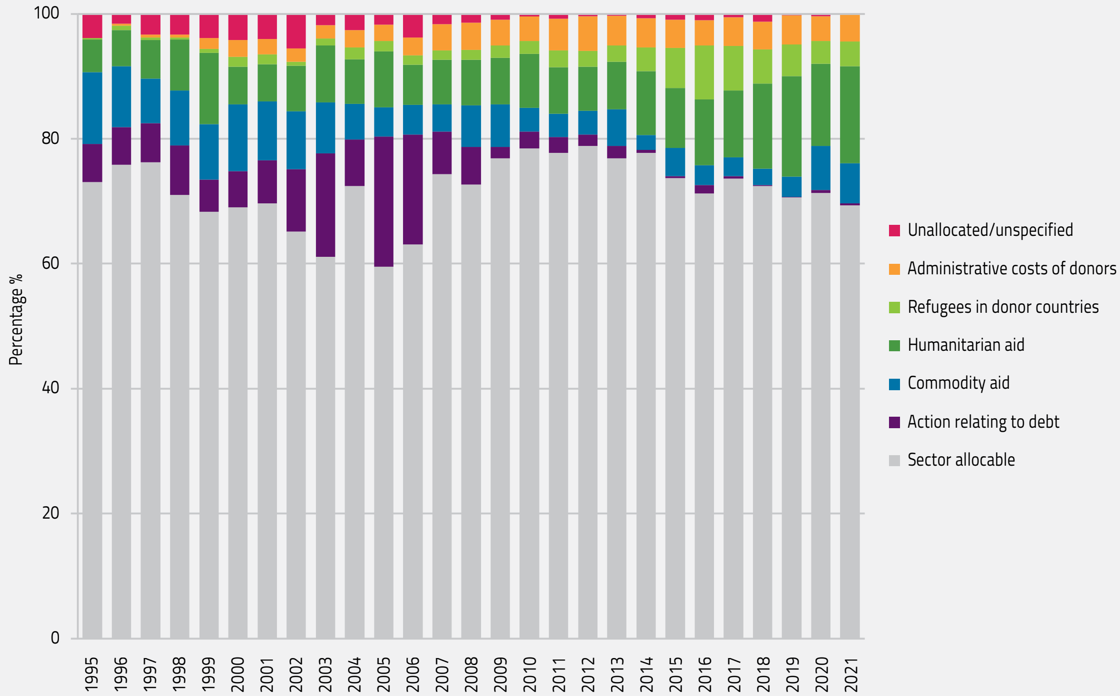
Ghana defaulted on its external debt in December 2022 and has applied for debt restructuring under the G20 Common Framework (Acheampong, 2023). However, 53% of Ghana's external debt is in the hands of private creditors, which makes restructuring complicated. Nevertheless, after its bilateral creditors, of which China was the largest, agreed to a debt restructuring, Ghana reached a USD 3 billion agreement with the IMF. Under the terms of the agreement, the government has committed to increase school capitation grants, strengthen teacher in-service training, invest in primary teaching and learning materials for schools, and continue building its student assessment system. In response to IMF criticism that the commitment to free secondary education is inequitable, the government has also undertaken to 'incentivize' the poorest to enrol in upper secondary education (IMF, 2023a).

Zambia defaulted in November 2020, the first African country to do so in this debt crisis. It also applied for debt restructuring under the G20 Common Framework. Protracted negotiations, which were described as a 'test case' for the G20 Common Framework, reached a successful conclusion to restructure USD 6.3 billion of its external debt in the run-up to the Summit on a New Global Financing Pact in June 2023 (Reuters, 2023; Short, 2023). Bilateral creditors, led by China, agreed to a three-year

FIGURE 22.5:

Debt relief no longer plays a significant role in aid

Distribution of official development assistance commitments by type, 1995–2021

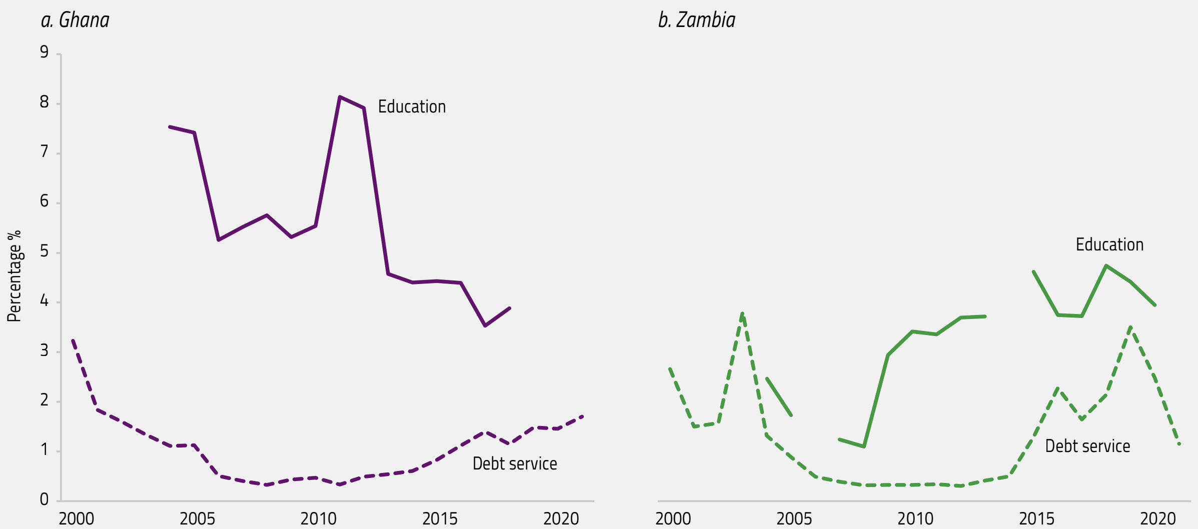


GEM StatLink: https://bit.ly/GEM2023_fig22_5
Source: OECD Creditor Reporting System database (2023).

FIGURE 22.6:

Debt servicing increased at the expense of education in Ghana and Zambia

Public expenditure on interest payments on external debt (as a share of GNI) and education (as a share of GDP), 2000–21



GEM StatLink: https://bit.ly/GEM2023_fig22_6
Source: World Bank International Debt Statistics and UIS database.

grace period on interest payments and to extend maturities, which will help Zambia access a USD 1.3 billion bailout from the IMF (Cotterill et al., 2023).

AID EXPENDITURE

While domestic financing is by far the most important component of education financing, external financing can still play an important role in the countries which are most in need, as long as it follows the principles of aid effectiveness. In other words, it is not enough to judge aid solely by its volume: it should also be evaluated according to whether donors respect ownership, alignment, harmonization, results orientation and mutual accountability in their partnerships with beneficiaries (UNESCO, 2021).

> It is not enough to judge aid solely by its volume

Nevertheless, volume remains the main aid characteristic under scrutiny. In 2022, according to the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) database, official donors provided USD 233 billion in official development assistance (ODA), an increase of USD 30 billion (or 14%) over 2021, the largest year-on-year increase since 2016. The increase was largely due to donor countries' expenditure to accommodate Ukrainian refugees. As a result, DAC donor aid levels reached 0.36%, a level not seen since 1982, even if well below the 0.7% DAC target. Germany exceeded this target for the first time and reached 0.83% in 2022; by contrast, the United Kingdom, which met this target between 2013 and 2020, dropped to 0.51% in 2022.

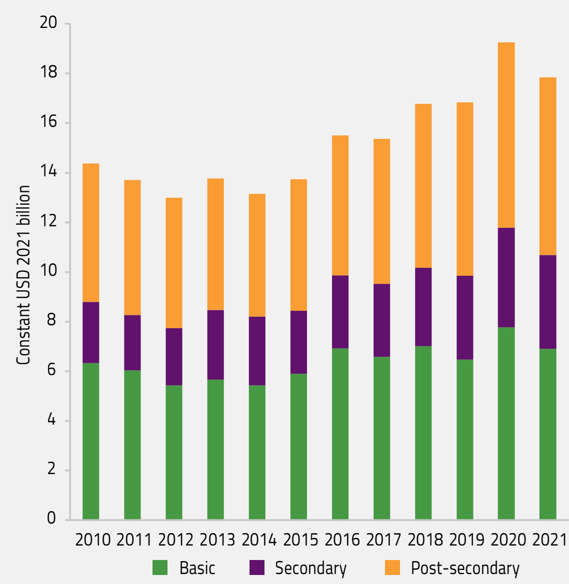
Scandinavian countries, the world's most generous donors, have also gradually reduced their aid levels, more gradually in the case of Denmark (from 0.86% in 2014 to 0.70% in 2022) and more abruptly in 2020–22 in the case of Norway (from 1.11% to 0.86%) and Sweden (from 1.14% to 0.90%). In response to growing refugee numbers, Nordic countries have also redirected some of their ODA to support refugees in their own countries (Hill, 2022). Norway initially planned to reallocate NOK 4 billion (USD 410 million) from its contributions to United Nations (UN) agencies to accommodate refugees, but later reconsidered due to recalculated costs (Chadwick, 2022b). Norway has proposed to reduce its ODA from 1.15% of GNI to 0.75% in 2023 (IIRR, 2023). Sweden redistributed 17% of its ODA to refugee admissions in 2023 and has set a fixed amount for ODA for the next few years, which means its share would drop further to 0.88% of GNI by 2023 (Chadwick, 2022a, 2022d, 2022c; The Local, 2022).

The overall increase in ODA has not translated into more aid to education. According to the OECD Creditor Reporting System (CRS), aid to education fell from USD 19.3 billion in 2020 to USD 17.8 billion in 2021 – a 7% drop (**Figure 22.7**). The main reason behind this decline was the reduction in general budget support, which returned to pre-COVID levels. Excluding budget support, direct aid to education has remained stagnant since 2018 at USD 15.1 billion annually. Basic education accounts for 39% of total aid, secondary education for 21% and tertiary education for 40%. Since 2010, the share of basic education has fallen by five percentage points while the share of secondary education has increased by four percentage points.
In terms of primary school-age children, the CRS database assigns almost 85% of aid to education to individual recipient countries. Of that amount, low-income countries have received 22% of aid to education and 28% of aid to basic education since 2010. But since 2015, there has been a notable increase in aid to basic education targeted at low-income countries. In absolute terms, the amount they received almost doubled from USD 1.1 billion in 2015 to USD 2.0 billion in 2020, before falling to USD 1.7 billion in

FIGURE 22.7:

Aid to education fell by 7% from 2020 to 2021

Total aid to education disbursements, by education level, 2010–21



GEM StatLink: https://bit.ly/GEM2023_fig22_7
Source: GEM Report team estimates based on the OECD CRS database (2023).

2021. In relative terms, the share increased from 23% in 2015 to 32% in 2020 before falling to 29% in 2021.

Sub-Saharan Africa, which has over half of the world's out-of-school children, is also the largest recipient of aid for basic education, accounting for USD 2.1 billion, or 31% of the total in 2021, remaining roughly at the same level as it was in 2010 (USD 1.9 billion, or 20% of the total). By contrast, the amount of aid to basic education disbursed in Middle East and North Africa increased from USD 0.8 billion in 2010 to USD 1.9 billion in 2021, or from 12% to 28% of the total, largely as a result of the response to the Syrian refugee crisis.

In 2021, more than 50% of the total aid to education came from the European Union, France, Germany, Saudi Arabia and the World Bank. Nearly 70% was from these five donors plus Japan, the United Kingdom and the United States. In the three-year period from 2019 to 2021, Germany was the largest donor, allocating an average of USD 3.3 billion per year. But Germany, as well as France, allocates nearly 60% of its aid to education at the post-secondary level, largely through scholarships and imputed student fees, which are waived tuition expenses whose economic value is estimated and recorded as aid. Japan allocates more than one third of its aid to scholarships and imputed student fees. The United States, by contrast, does not provide aid in the form of scholarships.

Excluding scholarships and imputed student fees, the World Bank is the largest donor (USD 1.8 billion per year), followed by Germany and the United States (USD 1.4 billion each), and the European Union (USD 1 billion). However, the level of aid from the United States has plateaued in the last few years while that of the United Kingdom dropped by 39% between 2014–16 and 2019–21, as a result of the policy decision to no longer allocate 0.7% of GNI to ODA (**Figure 22.8**).

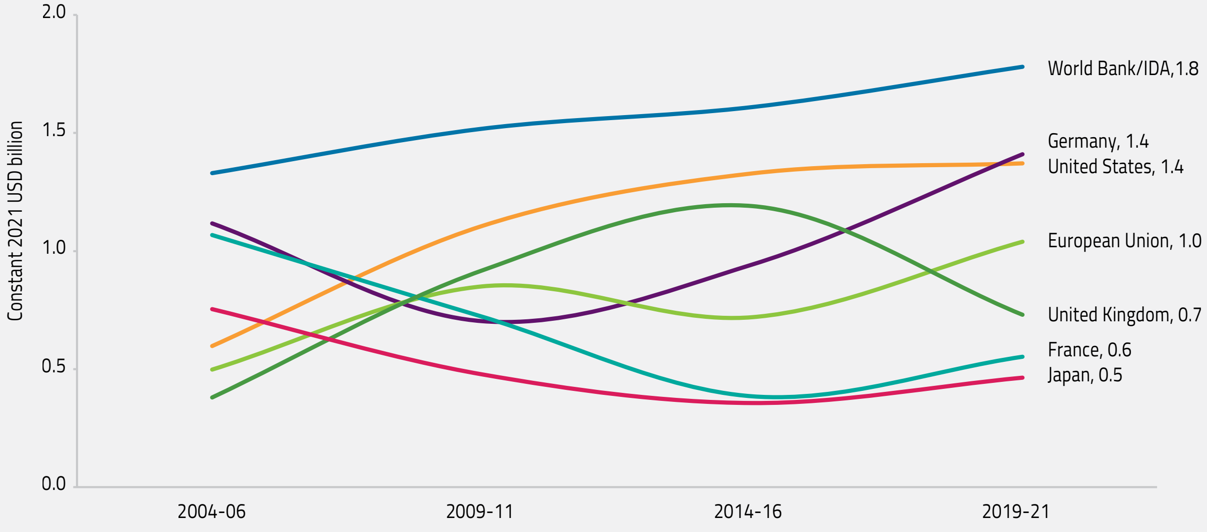
The share of education in total sector allocable aid fell throughout the 2000s and reached a low point of 9.7% in 2013. Although there were some subsequent signs that the share might be recovering – reaching 10.9% in 2019 – it fell back to 9.7% in 2020–21, absorbing part of the impact from the shift in donor focus towards health, which increased from 16.5% in 2019 to 19.5% in 2020 and 23.3% in 2021.

While analyses of aid traditionally focus on disbursements, the OECD CRS database also offers information on commitments. However, comparing the two is not straightforward: commitments predate disbursements by some years. While the two measures tend to be broadly consistent with each other, in recent years, there has been a larger discrepancy between commitments and

FIGURE 22.8:

The European Union, Germany and the World Bank have been increasing aid to education

Three-year average of aid to education, excluding scholarships and imputed student fees, seven largest donors, 2004–06, 2009–11, 2014–16 and 2019–21



GEM StatLink: https://bit.ly/GEM2023_fig22_8
Note: IDA: International Development Association
Source: GEM Report team estimates based on the OECD CRS database (2023).

disbursements towards education among multilateral donors. In 2020, this could have been the result of prior commitments that could not be absorbed by recipient countries during COVID-19, but the discrepancy was first observed in 2017–18 (**Figure 22.9**). Even before such an increase in discrepancy, the Global Partnership for Effective Development Cooperation called for analysis of the drivers of this gap (GPEDC, 2016).

A particular case of disbursement lags is the Global Partnership for Education (GPE). Since its establishment in 2003, GPE had approved USD 7.8 billion in implementation grants, of which it had disbursed USD 6 billion by the end of 2022. The average time lag between a GPE project's approval and its implementation was five months (GPE, 2021a). But the lag between grant approvals and grant disbursements is some three years on average. After peaking at over USD 1 billion in 2013, grant approvals fell by more than 90% by 2017 before picking up speed, reaching USD 400 million in 2018-19 and then returning to historic heights of over USD 1 billion during the COVID-19 crisis. GPE is currently conducting an evaluation to assess the effectiveness of this considerable increase in the middle of the pandemic. Grant disbursements exceeded USD 500 billion for the first time in 2021–22 (**Figure 22.10**). The amount represents about 10% of aid to basic education for low- and middle-income countries, similar to levels previously achieved in 2013–15.

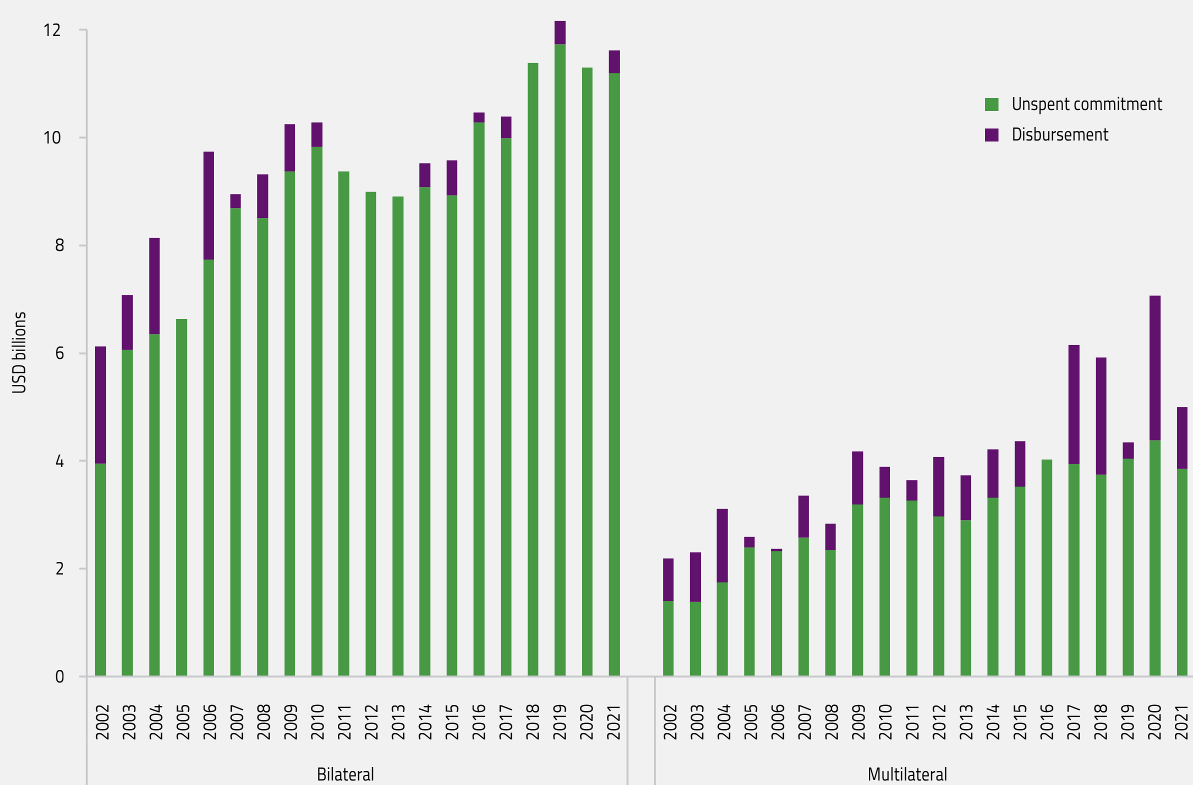
> Comparing disbursements and commitments is not straightforward as commitments predate disbursements by some years

Grants dominate ODA to education. In 2021, they accounted for 71% of the total, compared to 63% in health, 47% in agriculture, 20% in energy and 8% in transport. Within the education sector, grants made up as much as 84% of the total in low-income countries, compared to 61% in lower-middle-income countries (**Figure 22.11**).

FIGURE 22.9:

Multilateral commitments to education have exceeded disbursements in recent years

Total aid to education disbursements and unused commitments, by type of donor, 2002–21

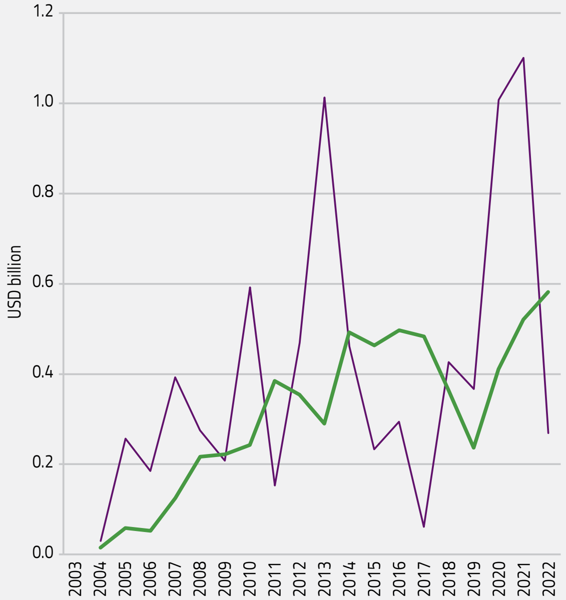


GEM StatLink: https://bit.ly/GEM2023_fig22_9
Source: GEM Report team estimates based on the OECD CRS database (2023).

FIGURE 22.10:

GPE annual disbursements exceeded USD 500 billion in 2021–22

Global Partnership for Education implementation grant approvals and disbursements, USD billion, 2003–22



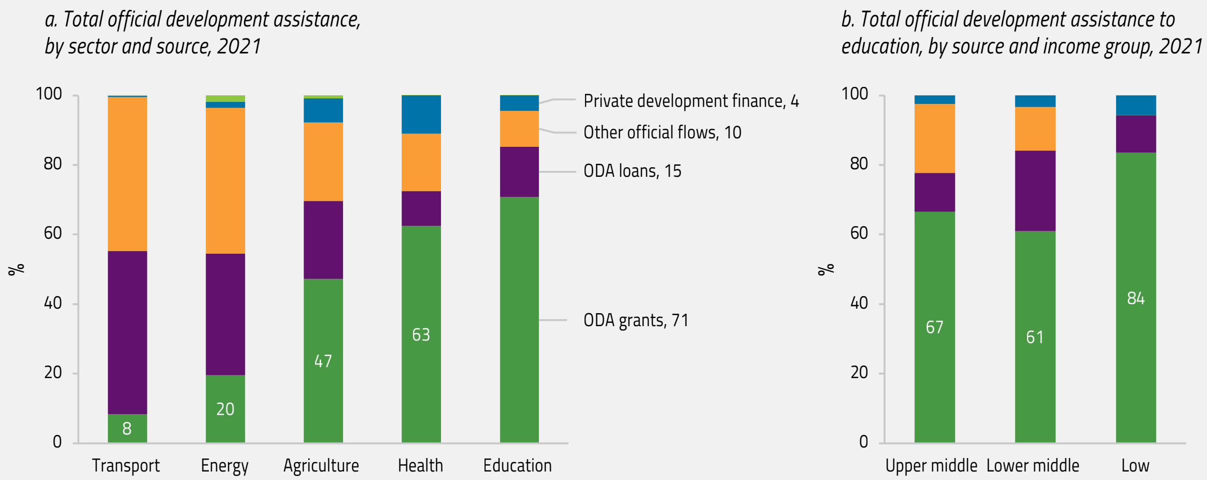
GEM StatLink: https://bit.ly/GEM2023_fig22_10
Source: GPE database.

In education, ODA loans and official financial flows (non-concessional loans) increased from USD 3.5 billion in 2011 to USD 5.5 billion in 2021.

Countries that are no longer eligible for concessional loans are less inclined to seek non-concessional loans for their social sectors, especially education (Gatti and Mohpal, 2019). The International Finance Facility for Education, which was launched at the Transforming Education Summit in September 2022, aims to make non-concessional lending more appealing to lower-middle-income countries by lowering their borrowing cost, and to development banks by providing them with donor guarantees, which will give them access to additional capital market funds (IFFEd, 2023). However, at a time when countries are under debt distress, loans, even ones with more attractive conditions, may put further pressure on countries' finances.

FIGURE 22.11:

The education sector receives most of its total official financial flows in the form of grants



GEM StatLink: https://bit.ly/GEM2023_fig22_11
Note: Official development assistance (ODA)
Source: GEM Report team estimates based on the OECD CRS database (2023).

CAN COUNTRIES AFFORD THEIR NATIONAL SDG 4 BENCHMARKS?

The international community has committed to ambitious education targets to be achieved by 2030, notably universal secondary completion. The challenge was always going to be a major one, but slow progress since 2015 and the unexpected onset of COVID-19 mean that it is no longer useful to estimate the cost to low- and lower-middle-income countries of achieving the Sustainable Development Goal 4 (SDG 4) targets, as this report has done twice before, in 2015 and 2020. No matter how much money is spent, the targets are no longer achievable. Arguably, these targets were always aspirational instead of achievable. However, a notable development in the past two years has been that countries have set national benchmarks for selected SDG 4 indicators to be achieved by 2025 and 2030 (**Chapter 11**). This step invites a reformulation of the challenge: what will it take countries to achieve the 2030 targets they have set for themselves? An updated model accounts for each country's progress and unique challenges yet assumes that countries will meet their national education targets by 2030 for basic and secondary education, using indicators such as the percentage of out-of-school pupils for primary and secondary education and participation rates in pre-primary education.

> No matter how much money is spent, the targets are no longer achievable

In 2015, the Global Education Monitoring (GEM) Report team estimated that the cost of achieving the key SDG 4 targets, that is, ensuring universal pre-primary, primary and secondary education by 2030 in low- and lower-middle-income countries, would cost a cumulative USD 5.1 trillion, equivalent to about USD 340 billion per year from 2015 to 2030. In relative terms, the total cost would have to increase from 3.5% to 6.3% of GDP between 2012 and 2030 (UNESCO, 2015). The model did not attempt to cost the achievement of at least a minimum level of proficiency in reading and mathematics, mainly because there are no established models that associate the impact of a dollar spent in education on learning outcomes.

In 2020, maintaining most of these assumptions, the estimates were updated to take into account progress achieved to date. The cumulative cost of achieving SDG 4 by 2030 in low- and lower-middle-income countries remained the same, but the annual financing need was increased from USD 340 billion to USD 504 billion, mainly because of the shorter time frame. Of that, only USD 356 billion would be covered by available domestic financing resources, increasing the annual financing gap from USD 39 billion to USD 148 billion, or from 12% to 29% of the total cost (UNESCO, 2020). Adding to the lower-than-expected progress and the shorter time frame, four other factors accounted for the increased financing gap: lower-than-expected GDP growth in low-income countries; a slight increase in the projected numbers of students by 2030; updated classroom construction cost parameters; and faster-than-expected convergence towards pupil/teacher ratio targets. However, this financial gap excluded the potential cost implications of COVID-19, for which separate calculations were made.

There is an annual financing gap of almost USD 100 billion

As noted, this updated edition of the costing model focuses on the cost of achieving the targets that countries have set for 2030, which fall short of the universal global SDG 4 aspiration. A few other assumptions have also been revised, notably those related to the calculation of classroom costs (**Table 22.1**). The costing model covers the period 2023–30 and has been calculated for the 79 low- and lower-middle-income countries classified by the World Bank in 2019. Figures are expressed in constant 2019 USD. While post-secondary education costs are recorded, they are not included in the costing model, which would add about 0.8% of GDP to current education budgets.

IMF projections for GDP are used for each year up to 2026; beyond then, GDP is assumed to grow at the average rate of the last three years in each country. IMF projections are also used for tax revenue as a share of GDP up to 2026; beyond then, tax revenue is expected to grow at a decreasing rate from the starting values (e.g. by 1 percentage point per year if they are between 10% and 12.5% of tax revenue as a share of GDP but by 0.5 percentage points per year if they are between 20% and 25%). Similar assumptions are used for the share of education in the budget.

A portion of ODA by DAC member countries is already directed to government budgets: it is assumed that 60% of ODA to education should be deducted from each recipient country's public education expenditure. It is further assumed that ODA will remain constant until 2030, based on recent trends, at just over 0.3% of GNI. The model also assumes that about 8% of total ODA is allocated to education or 10% of the ODA that is allocated to specific sectors. Finally, DAC donor allocations per low- and lower-middle-income country in 2016–19 are assumed to be replicated up to 2030.

TABLE 22.1:
SDG 4 costing model assumptions

	2015 and 2020 models	2023 model
4.1: Primary and secondary education	Universal transition to upper secondary education achieved by 2030	National out-of-school rate benchmarks
4.2: Pre-primary education	100% pre-primary gross enrolment ratio by 2030	National early childhood education participation benchmarks
4.5: Equity	20% to 40% markup on the per student cost to capture the additional costs expected for out-of-school students to address socioeconomic barriers	As before, the proportion of the population considered disadvantaged has been adjusted from the global (USD 2 per day) to the national poverty line
4.6: Youth literacy and numeracy	Costs of second-chance education incorporated for young people who missed out on formal education	The target for youth literacy and numeracy has been absorbed into primary education
4.a: Learning environments	▪ One classroom per teacher ▪ Old classrooms replaced ▪ New classroom construction spread over 10 years ▪ Cost of each classroom equal to a base cost multiplied by a furniture cost ▪ Countries will gradually allocate one quarter of recurrent expenditures for purposes other than teacher salaries (e.g. textbooks, teacher training) ▪ Maintenance cost of 5% ▪ Utility cost of 6%	As before, except for the following adjustments: ▪ Classroom construction multipliers linked to GDP per capita have been recalculated based on data on construction labour costs, a proxy for material costs and average construction costs per square metre, as per the COVID-19 cost analysis ▪ 30% teacher classroom sharing rate to fully utilize the available classrooms ▪ Classroom depreciation based on a useful life of 30 years, with value at the end of this period at 10% of the original value ▪ 20% markup cost for classrooms constructed in poor and rural areas at all levels of education
4.c: Qualified teachers	▪ Target pupil/teacher ratios: pre-primary (20:1), primary (40:1) and secondary (30:1) education ▪ Long-term relationship between teacher salaries and GDP per capita: countries will gradually converge at the salary level of the 50% of countries that pay teachers more to ensure pay is sufficient for attracting the best candidates to the profession	As before, except for the following adjustment: ▪ A 30% increase to teacher salaries was applied to those teaching disadvantaged students

Source: GEM Report team assumptions.

Achieving the national targets in low- and lower-middle-income countries will cost a cumulative USD 3.7 trillion between 2023 and 2030, or USD 461 billion per year on average. Of that, the average annual cost will be USD 52 billion in low-income and USD 408 billion in lower-middle-income countries. This averages out to USD 97 billion per year. The cost of pre-primary education will more than triple during the period.

Despite optimistic budget projections, many countries will not manage to increase their budgets sufficiently because of low tax revenues. As a result, the annual average financing gap between 2023 and 2030 is estimated to be USD 97 billion, or 21% of the total cost of achieving the national targets. The average gap is USD 26 billion (50% of the total cost) in low-income countries and USD 71 billion (17% of the total cost) in lower-middle-income countries. (**Table 22.2a**). This annual financing gap is equivalent to 2.3% of GDP during the period (**Table 22.2b**).

TABLE 22.2:
Average annual total budget, cost and financing gap, by education level, 2023–30
a. In USD billion

	Low income			Lower middle income			Total		
	Budget	Cost	Gap	Budget	Cost	Gap	Budget	Cost	Gap
Pre-primary	2	5	3	21	39	17	23	44	20
Primary	14	25	10	169	188	19	183	213	29
Lower secondary	5	13	7	88	104	16	93	117	23
Upper secondary	4	9	5	59	78	19	63	87	24
Total	26	52	26	337	408	71	363	461	97
Share (%)			50			17			21

b. As a share of GDP (%)

	Low income			Lower middle income			Total		
	Budget	Cost	Gap	Budget	Cost	Gap	Budget	Cost	Gap
Pre-primary	0.4	0.9	0.5	0.3	0.5	0.2	0.3	0.7	0.4
Primary	2.3	3.7	1.4	2.2	2.5	0.3	2.2	2.9	0.7
Lower secondary	0.8	1.9	1.1	1.1	1.4	0.3	1.0	1.6	0.6
Upper secondary	0.7	1.5	0.8	0.7	1.1	0.4	0.7	1.3	0.6
Total	4.2	8.0	3.8	4.3	5.6	1.3	4.2	6.5	2.3

Note: Reported estimates are unweighted country averages.
Source: GEM Report team analysis.

Sub-Saharan African countries represent half of the low- and lower-middle-income countries (41 out of 79) but account for the largest share of the financing gap: USD 70 billion per year on average. While the annual average total budget is expected to increase from 3.4% of GDP in 2023 to 4% by 2027 and 4.6% by 2030, it remains limited due to the low tax base, which accounts for only 20% to 25% of total government spending, and falls short of meeting the growing financing needs. As a share of GDP, the total cost is expected to increase from an average of 5.7% in 2023 to 7.4% in 2027 and 9.7% in 2030 – and 11.9% if post-secondary education financing needs are also taken into account. Sub-Saharan Africa has the highest education exclusion rates, with 20% of primary school age children and almost 60% of upper secondary school age youth not in school.

“Sub-Saharan African countries account for the largest share of the financing gap: USD 70 billion per year on average”

Compared to the 2015 costing model, with an annual average cost of USD 340 billion between 2015 and 2030, the 2023 model has an annual average cost of USD 461 billion, even though the financing gap doubles to an average gap of USD 97 billion. As a share of GDP, the 2015 model predicted a cost increase from 3.5% to 6.3% between 2012 and 2030, while the 2023 model predicts an increase from 5.4% in 2023 to 7.9% in 2030. The increase is explained by the fact that slow past progress implies a much faster increase in student and teacher numbers, even though the targets are more modest.

Compared to the 2020 costing model, with an estimated annual average cost of USD 504 billion between 2020 and 2030, the 2023 costing model has both a lower estimated cost and a lower financing gap despite the shorter time frame, thanks to the less ambitious nature of the targets. Based on estimates made before the COVID-19 pandemic, the model predicted that domestic financing could cover USD 356 billion of the total annual financing need, which is almost the same as the average financing capacity of low- and lower-middle-income countries predicted for the period 2023–30.

The number of teachers in the model is about equal to the number of students per level of education divided by the pupil/teacher ratios. In total, it is estimated that 5 million more teachers will be needed between 2023 and 2030 for low- and lower-middle-income countries to achieve their targets in pre-primary, primary and secondary education. Pre-primary education will bear the brunt of this increase: relative to the 2023 baseline, the number of pre-primary educators needs to triple in low-income countries and double in lower-middle-income countries by 2030. Additionally, the number of primary school teachers will need to increase by nearly 50% in low-income countries in the same period.

As the assumptions have made clear, the model focuses on the essential needs for low- and lower-middle-income countries to accelerate their progress and set them on course to achieving SDG 4. Arguably, this is not enough, as the world is changing rapidly. Digital transformation is one of the additional demands that education systems need to engage with. But there are formidable cost implications and real trade-offs facing governments and development agencies.

CAN COUNTRIES AFFORD THE COST OF DIGITAL TRANSFORMATION IN EDUCATION?

The cost of achieving the SDG 4 targets that low- and lower-middle-income countries have set for themselves is beyond reach. This is despite the fact that the level of ambition in this costing exercise has been lowered, substituting the unachievable targets of universal pre-primary, primary and secondary education with the relatively more realistic national benchmarks that reflect countries' own education sector plans. This costing exercise did not include countries' post-secondary education ambitions. But it did consider other government aspirations, such as the digital transformation of their education systems.

The cost of digital transformation in education should be put into context and its components unpacked. Doing so does not imply that countries have to shoulder these costs. As this report has argued at great length, the adoption of education technology cannot follow a blanket approach. It must be appropriate to particular contexts, compatible with equity and inclusion objectives, commensurate to scaling potential, and mindful of long-term adverse consequences. This costing exercise contributes to the discussion on the current cost implications of scaling up education technology investments, should such investments be included in education sector plans.

Proponents of investment in education technology have put forward three arguments for including education technology at the expense of other education system priorities. First, the adoption of education technology is inevitable, given how technology is permeating all aspects of social and economic life – a valid point, even if it mainly relates to teaching about technology (for which investment does not need to be large-scale) rather than teaching through technology. Second, the adoption of education technology is necessary to build system resilience, as the experience of the COVID-19 pandemic shows. However, that experience is rare enough that it cannot justify such a massive investment, except possibly for countries and contexts more vulnerable than average to emergencies.

Third, and most critically, it has been argued that using new technology will increase education system efficiency to such an extent that it will be possible to do more with less resources, for example, through replacing less effective teachers, accessing learners whose marginal cost to reach is well above average or personalizing teaching. While this argument has merit, there is no evidence that this is now happening, except perhaps in parts of higher education or where radio and television have matured as technologies in specific contexts. The conditions are simply not yet in place to allow economies of scale. If anything, in the short- to medium-term, such investment would basically displace other necessary investments, such as making classrooms conducive to learning, filling teacher gaps and ensuring every student has a textbook. In the analysis that follows, it is therefore assumed that any such investment would be additional. The level of investment in low- and lower-middle-income countries would be so high that policymakers would need to think extremely carefully before committing to costs that would inevitably benefit few learners and do nothing to help the education of disadvantaged populations.

Three transformation scenarios and four types of cost have been calculated

The range of potential investments under the umbrella of digital transformation is extensive. This analysis was built on three scenarios of progressively increasing ambition and complexity. The first scenario (basic offline) involves some digital teaching and learning opportunities in schools, with shared devices. All schools will have power, even if not connected to the grid, but there will be no internet connection beyond levels currently available. The second scenario (fully connected schools) involves some tailored digital learning, still shared – but more – devices, and fully electrified and connected schools. The third scenario (fully connected schools and homes) involves a scenario not unlike what the world's richest countries experienced during COVID-19 with tailored digital learning in schools and at home and the universal availability of devices, electricity and internet connectivity.

As these scenarios indicate, four major components of digital transformation of an education system were analysed with assumptions based on the literature and discussions with experts (**Table 22.3**). This breakdown of cost items follows a model developed by UNICEF (Yaoi et al., 2021). First, preparing systems for digital learning involves content development, teacher training, student and family engagement, capacity for data use at national and school level, and capacity for policy development. For instance, teachers will need to be trained, both initially and on an ongoing basis, while schools will need to be equipped with devices and capacities for managing and using data.

Second, devices would need to be distributed to students and teachers: it is assumed that there would be 10 students sharing a device under the basic offline scenario and 5 under the fully connected schools scenario, before switching to a one-to-one ratio under the fully connected schools and homes scenario. One-to-one ratios for teachers would apply for the last two scenarios. Devices would be replaced every five years, with the cost varying from USD 100 per device in low-income countries in the basic scenario to USD 400 per device in middle-income countries in the latter two scenarios.

Third, the cost of internet connectivity was incorporated under the second and third scenarios. Under the second scenario, one-off cost assumptions to connect an average school (USD 15,000) were based on the Giga project, excluding some of the most remote schools, which it would take millions of dollars to connect. Under the third scenario, it was assumed that the cost would be equivalent to 90% of the International Telecommunication Union (ITU) estimate of the cost of universal connection for all those age 10 and older to 4G or the equivalent, including mobile infrastructure, fibre, network operations, remote area coverage, policy and additional digital skill training (ITU, 2021). On top of these costs, it is necessary to add the operational cost of paying for data consumption both at school (for both scenarios) and at home. The home-based scenario is predicated on the Alliance for Affordable Internet estimate that the cost of 1 GB of mobile broadband should be no more than 2.45% of monthly income to meet the affordability criterion in low- and lower-middle-income countries.

Fourth, progressively ambitious assumptions under each scenario relate to electrification. Under the basic offline scenario, all remaining schools would get power through solar panels. Under the fully connected schools scenario, all schools would be connected to the grid at a fraction of the cost that it takes to connect households. Under the fully connected schools and homes scenario, all homes would be connected through a mix of solar, microgrid and grid supply. Electricity use costs were calculated based on levels of consumption and specific assumptions on prices.

> The cost of digital transformation need not exclusively be a burden on the education ministries' budget

Many of these assumptions are difficult to specify with precision: it depends on how targets are defined, on the price level at the time the estimate is made and on the reference period considered. In the case of internet connectivity, for example, the UN estimated that the cost of connecting the remaining 3 billion people to the internet by 2030 would be USD 428 billion (ITU, 2020). In contrast, a consulting firm estimated a figure five times as high – or USD 2.1 trillion – only cutting the current connectivity gap by half by 2025 but increasing the percentage of high-speed internet users from 53% to 80% (Rastogi et al., 2020). Even these estimates may only partially address some of the cost elements required to support digital learning. Still, the cost of digital transformation need not exclusively be a burden on the education ministries' budget; some of the costs may even be undertaken outside of governments, for instance, investments in connection to the internet. However, identifying financing sources and mechanisms is beyond the scope of this analysis.

The cost of digital transformation is well beyond poor countries' reach

The cost of achieving digital transformation varies widely between the three scenarios (**Table 22.4**). In the case of the basic offline scenario, the capital expenditure adds up to USD 67 billion, of which USD 52 billion is spent in low- and lower-middle-income countries. The operational expenditure amounts to USD 13 billion on average, to be spread across 7 years, of which USD 10 billion would have to cover costs in low- and lower-middle-income countries.

Under the fully connected schools scenario, the capital expenditure increases to USD 225 billion, of which USD 183 billion is for low- and lower-middle-income countries. The operational expenditure will add up to USD 188 billion, again spread across 7 years, of which USD 112 billion would have to cover costs in low- and lower-middle-income countries.

TABLE 22.3:
Selected key assumptions used in the digital transformation cost model, by item, scenario and country income group

Assumption	Unit	Type	Scenario	Low	Lower middle	Upper middle	High
Digital learning							
Students per school			All	300	300	450	500
Students per teacher			1	30	30	30	0
			2	30	30	30	30
			3	20	20	20	20
Content development: Upfront cost	USD million	Capital	1	3	3	3	0
			2	6	6	6	0
			3	8	8	8	0
Content development: Annual updating	Share of upfront cost	Operational	1	10%	10%	10%	0%
			2	20%	20%	20%	20%
			3	20%	20%	20%	20%
Upskilling: Teachers upfront cost	USD per teacher	Capital	1	400	400	400	0
			2	650	650	650	650
			3	1,300	1,300	1,300	1,300
Upskilling: Teachers updating	Share of upfront cost	Operational	1	10%	10%	10%	10%
			2	10%	10%	10%	10%
			3	10%	10%	10%	10%
Data and analytics: School capacity	USD per school	Capital	1	2,700	5,300	7,900	0
			2	3,100	5,600	8,100	10,600
			3	3,300	5,800	8,300	10,800
Data and analytics: School updating	USD per school	Operational	1	965	1,610	2,405	0
			2	1,345	1,970	2,895	3,620
			3	4,410	5,660	8,410	10,160
Devices							
Students per device			1	10	10	10	0
			2	5	5	5	5
			3	1	1	1	1
Teachers per device			1	4	4	4	0
			2	1	1	1	1
			3	1	1	1	1
Cost per device	USD	Capital	1	100	150	200	0
			2	300	300	300	300
			3	400	400	400	400
Device maintenance/replacement	Share of upfront cost	Operational	1	20%	20%	20%	0%
			2	20%	20%	20%	20%
			3	20%	20%	20%	20%
Connectivity							
School connectivity	USD per school	Capital	2	15,000	15,000	15,000	15,000
	Share of ITU estimate		3	90	90	90	90
In school usage (operational)	USD per school/year	Operational	2	3,800	3,800	3,800	3,800
			3	19,000	19,000	19,000	19,000
At home usage (operational)	Share of monthly income	Operational	3	2.45%	2.45%	2.45%	1.69%
Electricity							
School electrification	USD per school (solar)	Capital	1	5,400	5,400	5,400	0
	Share of IEA estimate		2	20%	15%	10%	5%
	USD billion		3	54	164	79	19
School electricity cost	USD per student (solar)	Operational	1	1	1	1	0
	USD per kWh		2	0.12	0.09	0.12	0.20
	USD per kWh		3	0.12	0.09	0.12	0.20
School electricity consumption	kWh	Operational	2	700	700	700	700
			3	1,400	1,400	1,400	1,400

Note: Scenario 1 refers to basic offline, 2 to fully connected schools, and 3 to fully connected schools and homes.
Source: GEM Report team based on ITU (2020), Yao et al. (2021) and experts.

TABLE 22.4:
Digital transformation cost, by item and country income group, USD billion

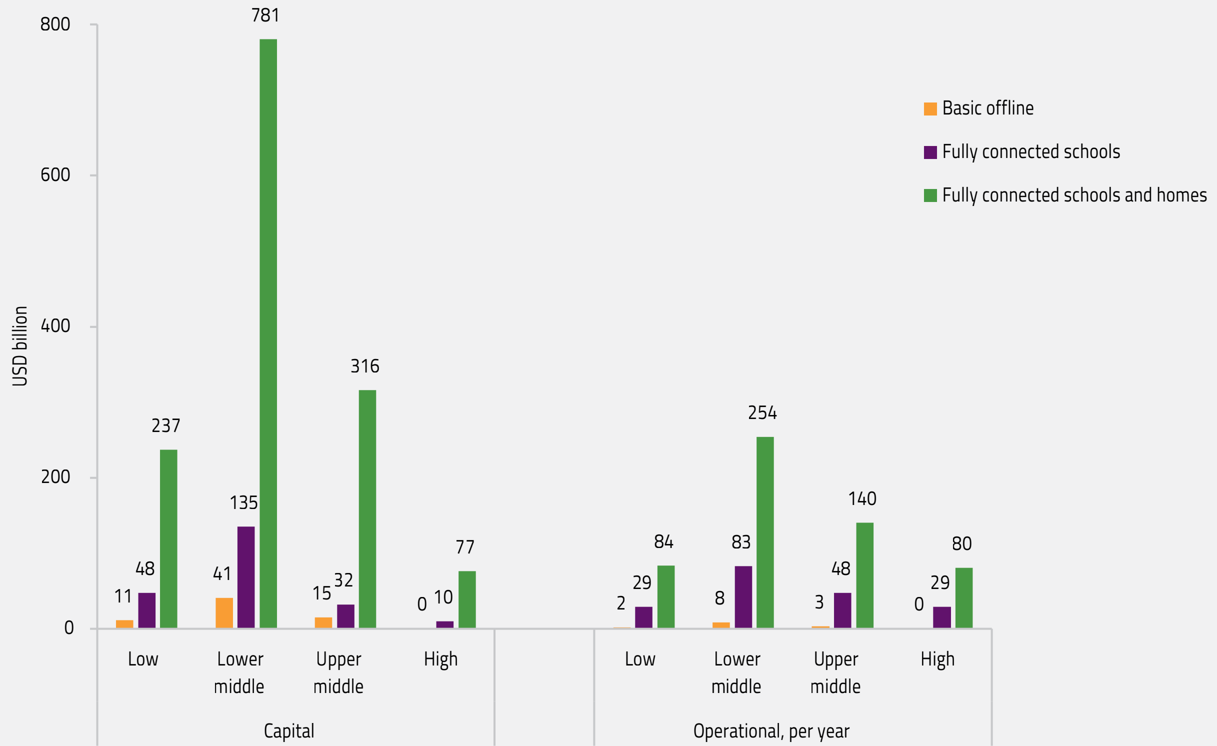
	Capital expenditure					Operational expenditure, annual				
	Low	Lower middle	Upper middle	High income	Total	Low	Lower middle	Upper middle	High income	Total
Basic offline scenario										
Digital learning	**5.7**	**26.4**	**14.7**	**0.0**	**46.8**	**1.2**	**5.7**	**3.2**	**0.0**	**10.0**
Content development	0.1	0.2	0.2	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Upskilling teachers/facilitators	3.3	11.0	6.1	0.0	20.4	0.3	1.1	0.6	0.0	2.0
Upskilling students/families	0.1	0.4	0.3	0.0	0.8	0.0	0.1	0.1	0.0	0.3
Building policy	0.0	0.0	0.0	0.0	0.1					
Data, analytics and research	2.3	14.7	8.1	0.0	25.1	0.8	4.4	2.4	0.0	7.7
Devices	**2.7**	**12.1**	**0.0**	**0.0**	**14.8**	**0.5**	**2.4**	**0.0**	**0.0**	**3.0**
Students	2.5	11.2	0.0	0.0	13.7					
Teachers	0.2	0.9	0.0	0.0	1.1					
Electricity	**2.8**	**2.2**	**0.2**	**0.0**	**5.1**	**0.2**	**0.1**	**0.0**	**0.0**	**0.3**
Connectivity	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total	**11.2**	**40.7**	**14.9**	**0.0**	**66.7**	**1.8**	**8.2**	**3.2**	**0.0**	**13.3**
Fully connected schools scenario										
Digital learning	**8.3**	**34.6**	**19.1**	**8.5**	**70.3**	**1.7**	**7.5**	**4.2**	**1.8**	**15.2**
Content development	0.2	0.3	0.3	0.0	0.8	0.0	0.1	0.1	0.0	0.2
Upskilling teachers/facilitators	5.4	17.9	9.8	4.0	37.2	0.5	1.8	1.0	0.4	3.7
Upskilling students/families	0.1	0.7	0.6	0.3	1.6	0.0	0.2	0.2	0.1	0.5
Building policy	0.0	0.0	0.0	0.1	0.2					
Data, analytics and research	2.6	15.6	8.3	4.1	30.6	1.1	5.4	2.9	1.3	10.8
Devices	**17.3**	**52.3**	**2.6**	**0.0**	**72.3**	**3.5**	**10.5**	**0.5**	**0.0**	**14.5**
Students	14.8	44.9	2.3	0.0	61.9					
Teachers	2.5	7.5	0.4	0.0	10.3					
Electricity	**10.7**	**24.6**	**7.9**	**0.9**	**44.1**	**20.6**	**54.1**	**39.1**	**26.0**	**139.9**
Connectivity	**11.4**	**23.6**	**2.6**	**0.2**	**37.8**	**3.1**	**10.5**	**3.8**	**1.4**	**18.9**
Total	**47.7**	**135.1**	**32.2**	**9.6**	**224.6**	**28.9**	**82.6**	**47.7**	**29.3**	**188.4**
Fully connected schools and homes scenario										
Digital learning	**19.3**	**71.8**	**39.6**	**16.9**	**147.6**	**5.4**	**21.5**	**11.9**	**5.2**	**43.9**
Content development	0.2	0.4	0.4	0.0	1.1	0.0	0.1	0.1	0.0	0.2
Upskilling teachers/facilitators	16.1	53.8	29.5	12.1	111.5	1.6	5.4	3.0	1.2	11.2
Upskilling students/families	0.2	1.3	1.1	0.6	3.3	0.1	0.4	0.4	0.2	1.0
Building policy	0.0	0.1	0.1	0.1	0.2					
Data, analytics and research	2.8	16.1	8.5	4.2	31.6	3.6	15.6	8.5	3.8	31.5
Devices	**103.8**	**337.4**	**105.9**	**16.0**	**563.1**	**20.8**	**67.5**	**21.2**	**3.2**	**112.6**
Students	98.9	321.3	100.9	15.2	536.3					
Teachers	4.9	16.1	5.0	0.8	26.8					
Electricity	**53.6**	**163.8**	**78.8**	**18.9**	**315.0**	**41.1**	**108.2**	**78.3**	**52.1**	**279.7**
Connectivity	**60.7**	**207.6**	**91.6**	**24.7**	**384.5**	**16.2**	**56.8**	**28.9**	**20.0**	**121.9**
Total	**237.4**	**780.6**	**315.8**	**76.5**	**1,410.3**	**83.5**	**254.0**	**140.2**	**80.4**	**558.1**

Source: GEM Report team calculations.

FIGURE 22.12:

It would cost low- and lower-middle-income countries USD 183 billion of capital expenditure to connect all their schools to the internet

Capital and annual operational expenditure to achieve the digital transformation of education systems, by country income group and scenario, 2024–30



GEM StatLink: https://bit.ly/GEM2023_fig22_12
Source: GEM Report team calculations.

Finally, under the fully connected schools and homes scenario, the capital expenditure increases to USD 1.4 trillion, of which more than USD 1 trillion is for low- and lower-middle-income countries (**Figure 22.12**). This is basically the cost estimated by the United Nations Children's Fund (UNICEF) (Yao et al., 2021). However, the operational expenditure adds up to USD 558 billion, spread across 7 years, of which USD 338 billion would have to cover costs in low- and lower-middle-income countries. This is 10 times higher than the operational expenditure of USD 46 billion envisaged in the UNICEF model.

The relative weight of each cost item varies by scenario and between country income groups. Under the basic offline scenario, teacher preparation takes up about 30% to 40% of the total cost, while the cost of introducing data and analytics rises from 20% in low-income to 54% in upper-middle-income countries. The cost of electrification through solar panels is one quarter of the total in low-income countries (**Figure 22.13**).

Under the second scenario, universal school connectivity and electricity account for about one fifth each of the total cost of digital transformation, while devices for students account for one third in low- and lower-middle-income countries. By contrast, content development costs, including teacher preparation, account for 60% of the total capital cost in upper-middle-income and almost 90% in high-income countries.

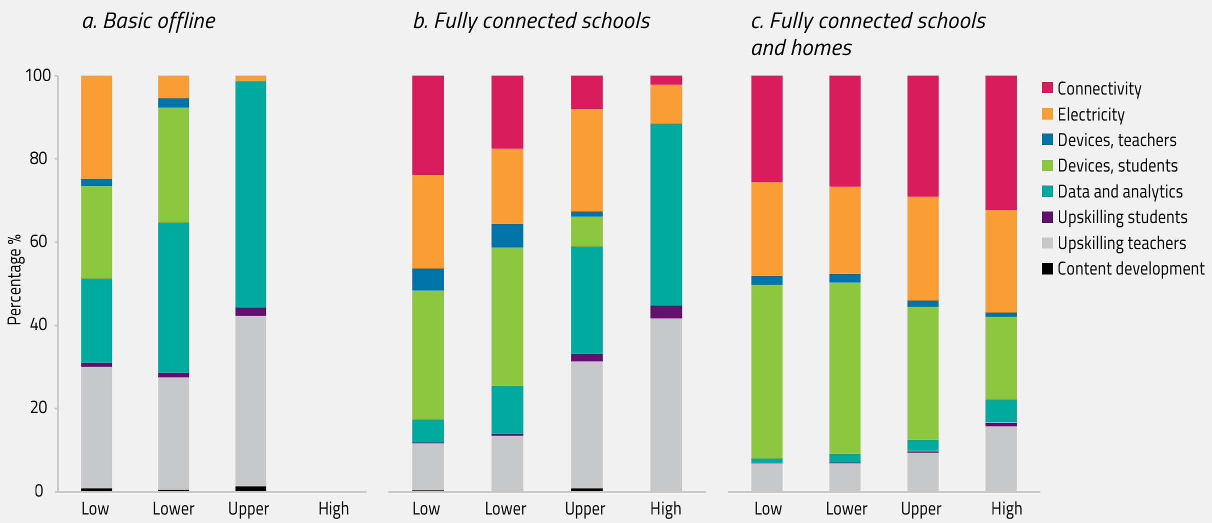
Finally, under the third scenario, the distribution of the various capital cost items is more equal between country income groups. Electricity accounts for about one quarter and internet connectivity for a little over one quarter of the total cost of digital transformation. However, devices for students account for 40% in low- and lower-middle-oncome countries but only 20% in high-income countries.

As the pace of adoption of education technology accelerated during the COVID-19 pandemic, digital learning featured as one of the five thematic action tracks identified

FIGURE 22.13:

Devices are a sizeable part of the cost of digital transformation in poor countries

Distribution of digital transformation capital expenditure, by item, country income group and scenario, 2024–30

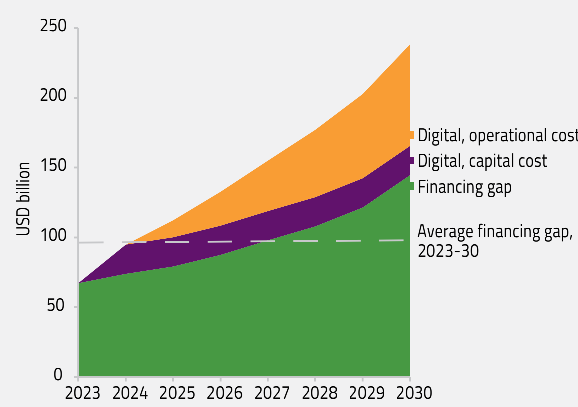


GEM StatLink: https://bit.ly/GEM2023_fig22_13
Source: GEM Report team calculations.

at the Transforming Education Summit in September 2022. Governments do not want to be excluded from the changes that new technologies are bringing to economies and societies; many believe they can leapfrog some of the challenges that have marred their development in the past. Understanding the cost implications of bringing forward digital transformation in education – as well as which elements are transformative – is a key current policy issue.

The analysis presented in this section suggests that supporting digital learning at home is well out of low- and lower-middle-income countries' reach. One working hypothesis is that by 2030, low-income countries could aspire to achieve the first, basic offline scenario, while lower-middle-income countries could work towards the second scenario of fully connected schools. The implication is that these countries would need to spend USD 21 billion per year between 2024 and 2030 for capital expenditure. In addition, operational expenditure would increase by USD 12 billion per year. The combined cost, when added to the financing gap which low- and lower-middle-income countries are already facing to reach their national SDG 4 benchmarks, would increase their financing gap by 50% (**Figure 22.14**).

FIGURE 22.14:



Even modest digital transformation would increase the poorest countries' financing gap to achieve their SDG 4 national targets by more than 50%

Evolution of financing gap to achieve SDG 4 national targets, alongside the capital and annual operational expenditure of digital transformation by 2030, low- and lower-middle-income countries

GEM StatLink: https://bit.ly/GEM2023_fig22_14
Notes: The projection assumes that low-income countries aspire to a basic offline digital learning target and lower-middle-income countries aim for a fully connected schools target by 2030. The grey section corresponds to the financing gap of achieving national SDG 4 benchmarks by 2030 in low- and lower-middle-income countries.
Source: GEM Report team calculations.

HOUSEHOLD EXPENDITURE

The 2021/22 GEM Report estimated that in the average country, households contribute 30% of total education spending, a factor that contributes to increasing education inequality as some households cannot afford to spend out of pocket. But household finances have been adversely hit by the global economic slowdown caused by the COVID-19 pandemic. Per capita income was expected to fall by nearly 5% below pre-pandemic levels in 2023 (World Bank, 2022a). The war in Ukraine further contributed to increased inflation, hitting low- and middle-income countries hard (Gill and Nagle, 2022). High energy prices and food market volatility are putting additional economic pressure on households. The Food and Agriculture Organization's Food Price Index was 30% higher in April 2022 than the same month in 2021. Prices of items like cereals, meat, milk, eggs and cooking oil have been on the rise across markets in many countries (Jaramillo and Taliercio O'Brien, 2022; Kanamugire, 2022). The UN Special Crisis Task Force reported that more than 60 countries faced challenges in paying for food imports (NEPAD and WFP, 2022; Wax, 2022). An additional 75 to 95 million people were expected to fall back into extreme poverty by 2022 (Mahler et al., 2022).

SCHOOL FEEDING CAN ALLEVIATE SOME OF THE FINANCIAL STRESS

As poor families in low- and middle-income countries face the burden of meeting basic food needs, school feeding programmes have emerged as a crucial social protection intervention. They provide in-kind benefits to families, which can add up to 15% of household income in low-income areas (Bundy et al., 2018; Verguet et al., 2020). School meals serve as a powerful incentive for parents to send their children to school, improving access and participation. Moreover, they enhance learning outcomes by providing macro- and micronutrients, leading to significant gains in height, weight and the number of school days attended (Aurino et al., 2020; Cohen et al., 2021; Kristjansson et al., 2016; Wang et al., 2021; Zar et al., 2020).

The median cost of school feeding in low- and middle-income countries is USD 30 per child per year, but this ranges from USD 10 in India to USD 270 in Botswana (Kristjansson et al., 2016). In Africa, USD 22 is spent per beneficiary child per year, ranging from USD 16 in low-income to USD 56 in middle- and high-income countries (Wineman et al., 2022)

School feeding programmes are widespread globally, with 125 out of 139 low- and middle-income countries having at least one major programme in 2021 (Global Child Nutrition Foundation, 2022). Many low-income countries have adopted school feeding as part of multisectoral strategies incorporating health and agriculture (Alderman and Bundy 2012; Drake et al. 2017). In 2020, these programmes cost a total of USD 35.3 billion, reaching at least 330 million children, or 27% of primary and secondary school children. The share of children benefiting from school feeding programmes ranges from 10% in low-income to 47% in high-income countries. Most programmes in low- and middle-income countries focus on primary schools and target children living in areas with food insecurity. Overall, governments are the primary source of school meal finance but aid accounts for three quarters of funding in low-income countries (WFP, 2020) (**Figure 22.15**). Despite the coverage of these programmes, some 73 million children still need food assistance (Cupertino et al., 2022). An additional USD 5.8 billion is estimated to be required, with some USD 3 billion needed in low-income and USD 2.7 billion in middle-income countries (Drake et al., 2020).

FIGURE 22.15:
International aid is crucial for school feeding in low-income countries
Distribution of school feeding programmes, by financing source and country income group, 2020, 2013

GEM StatLink: https://bit.ly/GEM2023_fig22_15
Source: WFP (2020).

Building national capacity, resilience and social protection is critical for ensuring that school feeding becomes a national responsibility. From 1970 to 2013, 38 programmes initially supported by the World Food Programme (WFP) transferred policy ownership to the government (Permanent Mission of France, 2021).

Armenia launched its school feeding programme in 2010, beginning with the most deprived areas and later expanding to all provinces. School feeding is now included in the national planning process. Since 2013, the government has been financing the transportation, storage and handling costs of the project administered by the WFP through an established trust fund. Starting with the 2014/15 school year, the government took over the school feeding programme in 3 of 11 provinces (Sarr and Karanovic, 2016); by 2017/18, it accounted for 38% of funding.

Brazil's National School Feeding Programme is a federal school feeding programme that is mainly financed by public funds and is available free of charge to all students in all types of public schools enrolled at all levels of basic education and youth and adult education (Cupertino et al., 2022). It supports 44 million students per year (Silva et al., 2023) and is administered by the National Fund for Educational Development and the Ministry of Education. In 2022, the federal government provided about BRL 3.1 billion (USD 0.6 billion), which is just under a quarter of the BRL 15 billion that the federal government transfers monthly to beneficiaries of the Bolsa Familia programme, Brazil's social security programme (Brazil Government, 2023; Cristóvão, 2023; Draibe, 2014; OAE and FINEDUCA, 2022; Silva, 2021).

In Cabo Verde, school feeding began in 1979. In 2010, the national programme, which had been funded by the WFP since its inception, became the first national programme in western Africa to be fully owned and operated by the government. The programme covers 788 schools and supports almost 90,000 pre-primary, primary and secondary school students; in 2020/21, 92% of schools received government support, covering 64% of primary and secondary school students (WFP, 2022).

Ethiopia's school feeding programme is a joint effort between the WFP, the Federal Ministry of Education and the regional bureaux of education. Parents and local community members also contribute in-kind items such as firewood and a small payment for cooks (WFP, 2019b). In recent years, the government has committed to expand the programme's reach and ensure its sustainability. In 2021, it allocated USD 109 million to support school feeding and other nutrition interventions (Ethiopia News Agency, 2023).

Cambodia's school meals programme was funded by donors for several years. Following the adoption of homemade school meals in the National Social Protection Policy Framework 2016–25, the National Social Protection Council under the Ministry of Economy and Finance established the programme within the national budget from 2019/20 onwards (WFP, 2019a).

Nigeria's National Own School Feeding Programme is part of a social investment programme to address poverty, hunger and unemployment. It has been fully funded by the national government and operating nationwide since 2016. It operates in 31 of Nigeria's 36 states and feeds nearly 9.5 million students in more than 56,000 public schools, making it the largest programme of its kind in Africa. It is managed by the Social Investment Programme Office in the Office of the Vice-President in collaboration with the education, agriculture, health, budget and national planning, justice, and women's ministries (WFP, 2019a).

Among the 125 countries with school feeding programmes, 69% have a dedicated line item for school feeding in the budget. The coverage rate is on average 19 percentage points higher in South Asia, East Asia and the Pacific and 16 percentage points higher in sub-Saharan Africa for countries with such a line item, which allocate a larger budget per beneficiary child than those without. For instance, in sub-Saharan Africa, countries with a line item have a budget of USD 46 per child, while countries without a line item have a budget of USD 23.50 per child (Global Child Nutrition Foundation, 2022).

Besides the different financial costs, the level of administrative involvement of local government in school feeding budget allocation varies. In Mali, the government channels funds through the Ministry of Finance to regional offices, which send funds to district-level communes. The communes then purchase food at local markets, and after ensuring adequate school infrastructure, school management committees transport the food to schools (Nafula, 2015). In Sri Lanka, the Ministry of Education manages school meals, transferring resources from the central government to caterers facilitated through zonal education offices, which also oversee programme implementation (WFP, 2019a). In Tunisia, the School Services Directorate of the Ministry of Education is responsible for the programme's operating costs, including food procurement.

In contrast, other countries have opted for direct budget transfers from the central government to school caterers or local governments. The Nigerian government transfers financial resources directly to over 100,000 cooks across the country, with cooks responsible for purchasing ingredients at local markets and preparing them in schools (WFP, 2019a). Kenya has implemented the Home Grown School Feeding model, which sources local food to keep costs down and support agricultural production. The Ministry of Education transferred a fixed budget of USD 0.05 per child per day directly to a dedicated school bank account for food procurement and made the school committee responsible for purchasing the food (Nafula, 2015). The budget allocated for the feeding programme in 2023/24 is KSH 5 billion (USD 35 million), 0.8% of the education budget (Muchunguh, 2023). In Tunisia, the Ministry of Education manages the programme's budget and infrastructure, with regional antennae of the Office of School Services transferring resources to schools for food purchase and programme implementation (WFP, 2019a).

> School meal budgets may not increase proportionately with rising food prices

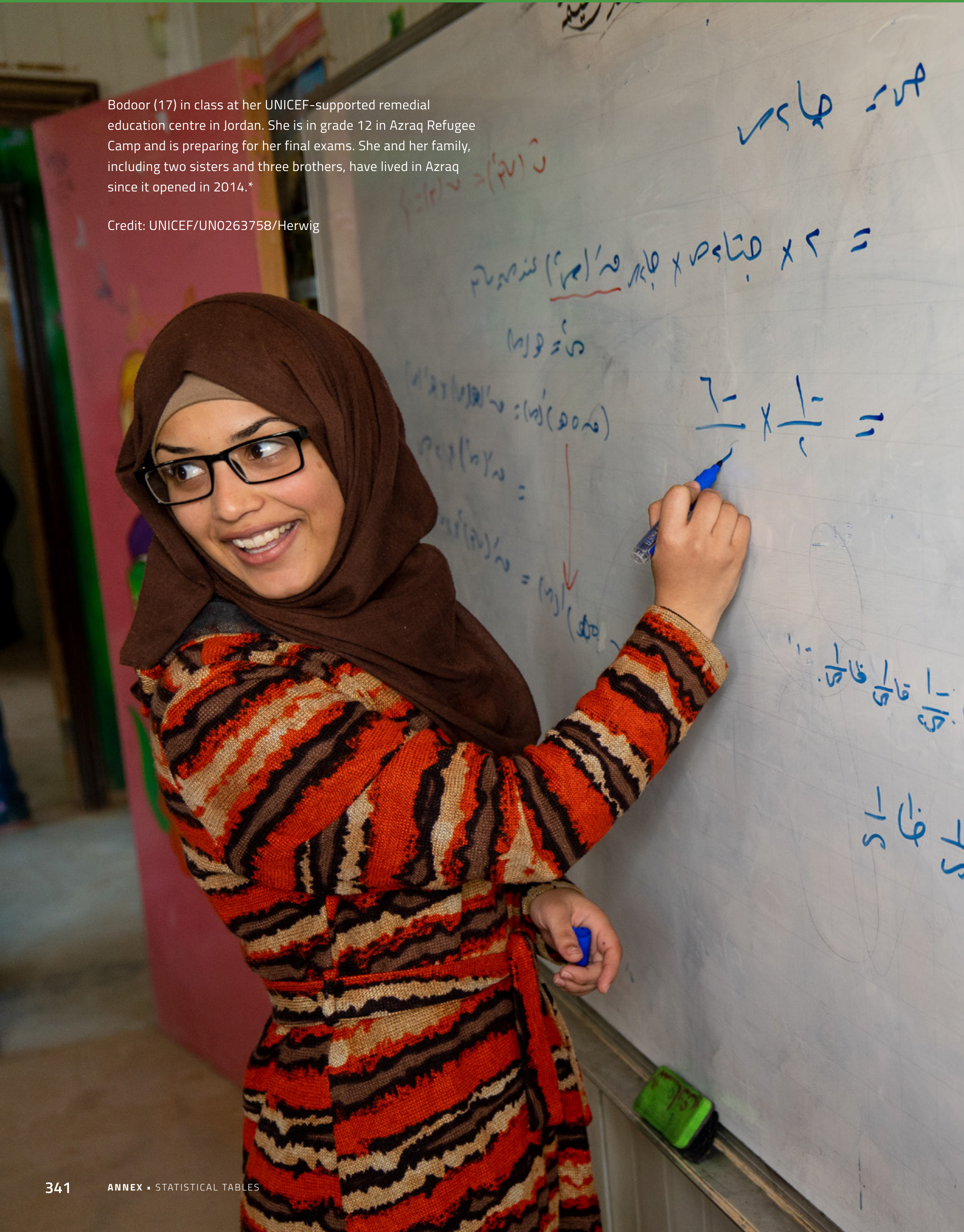
School meal budgets may not increase proportionately with rising food prices. The average budgets did not change between 2013 and 2020, resulting in many governments being forced to curtail provision (CBS, 2022). In Malawi, the Home Garden School Feeding Scheme was difficult to implement, as inflation caused payments to farmers to be lower than the costs of provision (Brigham and Haug, 2022). Price increases also lead to the purchase of ultra-processed foods. A study in Brazil showed that from 2008 to 2010, the prices of healthy, nutritious foods rose faster than those of ultra-processed foods. Moreover, the average price of ultra-processed foods was 30% to 40% lower than the price of unprocessed foods or minimally processed foods (Teo, 2018) (**Chapter 12**).

In response to the 2007–08 financial crisis, the World Bank established the Global Food Crisis Response Program (GFRP), which provided a total of USD 1.2 billion to 49 affected countries, including Benin, Kyrgyzstan, Sierra Leone and Yemen (World Bank, 2022b). Some countries received budget support in the form of loans. However, an evaluation criticized the low number of grants for international development association target countries under the GFRP, less than USD 11 million per country, and the high number of grants for four countries – Bangladesh, Ethiopia, the Philippines and the United Republic of Tanzania (IEG, 2014).

In response to the latest food price crisis, GPE announced almost USD 1 million in grants for school feeding in Senegal (GPE, 2021b). In Benin, the President, with the support of the WFP, committed to increasing the national budget for the school meals feeding programme from USD 79 million to USD 240 million by 2027 (ReliefWeb, n.d.; 2022). While emergency loans for low-income countries focus on social protection programmes, they also stipulate requirements for government budget cuts and pay freezes that may ultimately affect school feeding.

Some countries have responded to the food price crisis by increasing school meal funding. Nigeria announced an increase to per-meal funding from USD 0.09 to USD 0.13 and so will be spending about USD 1.3 million daily to feed an estimated 10 million children (Nnodim, 2022). In Rwanda, an additional USD 4.4 million was allocated in the 2021/22 supplementary budget to cover outstanding school meal payments, as parents pay for school meals (Kanamugire, 2022).

In high-income countries, strict means testing has come under scrutiny, as families are increasingly unable to afford to pay for school lunches. In the United Kingdom, an estimated 80,000 children who do not meet the government's free school meal eligibility criteria are unable to pay for school meals (Phillips, 2022). In the United States, 1.54 million pupils cannot afford school meals but do not qualify for discounted school meals, according to the School Lunch Debt database (Education Data Initiative, 2021). The US Department of Agriculture added an estimated USD 750 million to school meals programmes nationwide, meaning schools will receive an additional USD 0.25 per lunch to counter higher food costs and other issues (Mackey, 2022).



Bodoor (17) in class at her UNICEF-supported remedial education centre in Jordan. She is in grade 12 in Azraq Refugee Camp and is preparing for her final exams. She and her family, including two sisters and three brothers, have lived in Azraq since it opened in 2014.*

Credit: UNICEF/UN0263758/Herwig

STATISTICAL TABLES[1]

Table 1 presents basic information on demographic and education system characteristics as well as on domestic education finance. Tables 2–7 are organized by each of the seven Sustainable Development Goal (SDG) 4 targets (4.1–4.7) and three means of implementation (4.a–4.c). The tables mainly focus on the SDG 4 monitoring framework of 44 internationally comparable indicators: 12 global and 32 thematic indicators. An additional indicator, 'Proportion of children/young people prepared for the future, by sex', is the product of the two global indicators of SDG target 4.1. The tables also include additional indicators, which are not formally part of the SDG 4 monitoring framework, such as transition from primary to secondary education and student mobility.

METHODOLOGICAL NOTES

Most data in the statistical tables come from the UNESCO Institute for Statistics (UIS). Where the statistical tables include data from other sources, these are mentioned in footnotes. The most recent UIS data on pupils, students, teachers and education expenditure presented in the tables are from the March 2023 release and refer to the school year or financial year ending in 2021.[2] These statistics refer to formal education, both public and private, by level of education. The statistical tables list 209 countries and territories, all of which are UNESCO Member States or associate members. Most report their data to the UIS using standard questionnaires issued by the UIS itself. For 46 countries, education data are collected by the UIS via the UIS/OECD/Eurostat (UOE) questionnaires.[3]

POPULATION DATA

The population-related indicators used in the statistical tables, including enrolment ratios, number of out-of-school children, adolescents and youth, and number of youth and adults, are based on the 2019 revision of population estimates produced by the UN Population Division. Because of possible differences between national population estimates and those of the United Nations, these indicators may differ from those published by individual countries or by other organizations.[4] In the 2019 revision, single year age data are not provided for countries with a total population of less than 90,000. For these countries, as well as some special cases, population estimates are derived from Eurostat (Demographic Statistics), the Secretariat of the Pacific Community (Statistics and Demography Programme) or national statistical offices.

ISCED CLASSIFICATION

Education data reported to the UIS are in conformity with the International Standard Classification of Education (ISCED), 2011 revision. Countries may have their own definitions of education levels that do not correspond to ISCED 2011. Differences between nationally and internationally reported education statistics may be due to the use of nationally defined education levels rather than the ISCED level, in addition to the population issue raised above.

1 The statistical tables are accessible on the GEM Report website at: https://en.unesco.org/gem-report/statistical-tables.

2 This means 2020/21 for countries with a school year that overlaps two calendar years and 2021 for those with a calendar school year. The most recent reference year for education finance for the UOE countries is the year ending in 2019.

3 The countries concerned are most European countries, non-European Organisation for Economic Co-operation and Development (OECD) countries, and a changing set of other countries.

4 Where obvious inconsistencies exist between enrolment reported by countries and the United Nations population data, the UIS may decide not to calculate or publish enrolment ratios for some or all levels of education.

ESTIMATES AND MISSING DATA

Regarding statistics produced by the UIS, both observed and estimated education data are presented throughout the statistical tables. The latter are marked with subscript (i). Wherever possible, the UIS encourages countries to make their own estimates. Where this does not happen, the UIS may make its own estimates if sufficient supplementary information is available. Gaps in the tables may arise where data submitted by a country are found to be inconsistent. The UIS makes every attempt to resolve such problems with the countries concerned, but reserves the final decision on omitting data it regards as problematic. If information for the year ending in 2021 is not available, data for earlier or later years are used, and are indicated by footnotes.

AGGREGATES

Figures for regional and other aggregates represent either sums, the percentage of countries meeting some condition(s), medians or weighted averages, as indicated in the tables, depending on the indicator. Weighted averages take into account the size of the relevant population of each country, or more generally of the denominator in case of indicators that are ratios. The aggregates are derived from both published data and imputed values, for countries for which no recent data or reliable publishable data are available. Aggregates marked with (i) in the tables are based on incomplete country coverage of reliable data (between 33% and 60% of the population [or aggregate denominator value] of a given region or country grouping). GEM Report calculated sums are flagged for incomplete coverage if less than 95% of the population of a given region or country income group is represented among the countries for which data are available.

REGIONAL AND COUNTRY INCOME GROUPS

In terms of regional groups, the statistical tables use the SDG regional classification of the United Nations Statistical Division, with some adjustments. This classification includes all territories, whether independent national entities or parts of larger entities. However, the list of countries presented in the statistical tables includes only full UNESCO Member States and associate members, as well as Bermuda and the Turks and Caicos Islands, both of which are non-member states that were included in the statistical tables of the Education for All Global Monitoring Report. The UIS does not collect data for the Faroe Islands, so this territory is not included in the GEM Report, despite its status as a UNESCO associate member. In terms of country income groups, the statistical tables use the World Bank groups, which are updated each year on 1 July.

SYMBOLS USED IN THE STATISTICAL TABLES

± n Reference year differs
(e.g. -2: reference year 2019 instead of 2021)

i Estimate and/or partial coverage

\- Magnitude nil or negligible

… Data not available or category not applicable

Notes by indicator (**Table I.2**), footnotes to the tables and a glossary provide additional help for interpreting the data.

TABLE I.1: SDG 4 monitoring framework indicators

	Indicator
	Target 4.1
4.1.0	Proportion of children/young people prepared for the future, by sex
4.1.1	Proportion of children and young people (a) in grade 2 or 3; (b) at the end of primary education; and (c) at the end of lower secondary education achieving at least a minimum proficiency level in (i) reading and (ii) mathematics, by sex
4.1.2	Completion rate (primary education, lower secondary education, upper secondary education)
4.1.3	Gross intake ratio to the last grade (primary education, lower secondary education)
4.1.4	Out-of-school rate (one year before primary, primary education, lower secondary education, upper secondary education)
4.1.5	Percentage of children over-age for grade (primary education, lower secondary education)
4.1.6	Administration of a nationally-representative learning assessment (a) in grade 2 or 3; (b) at the end of primary education; and (c) at the end of lower secondary education
4.1.7	Number of years of (a) free and (b) compulsory primary and secondary education guaranteed in legal frameworks
	Target 4.2
4.2.1	Proportion of children aged 24-59 months who are developmentally on track in health, learning and psychosocial well-being, by sex
4.2.2	Participation rate in organized learning (one year before the official primary entry age), by sex
4.2.3	Percentage of children under 5 years experiencing positive and stimulating home learning environments
4.2.4	Gross early childhood education enrolment ratio in (a) pre-primary education and (b) and early childhood educational development
4.2.5	Number of years of (a) free and (b) compulsory pre-primary education guaranteed in legal frameworks
	Target 4.3
4.3.1	Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex
4.3.2	Gross enrolment ratio for tertiary education by sex
4.3.3	Participation rate in technical-vocational programmes (15- to 24-year-olds) by sex
	Target 4.4
4.4.1	Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill
4.4.2	Percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills
4.4.3	Youth/adult educational attainment rates by age group, economic activity status, level of education and programme orientation
	Target 4.5
4.5.1	Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous peoples and conflict-affected, as data become available) for all education indicators on this list that can be disaggregated
4.5.2	Percentage of students in (a) early grades; (b) at the end of primary; and (c) at the end of lower secondary education who have their first or home language as language of instruction
4.5.3	Existence of funding mechanisms to reallocate education resources to disadvantaged populations
4.5.4	(i) Education expenditure per student by level of education and source of funding (ii) Initial financing for education by financing unit as a percent of GDP (general government, private sector households, rest-of-world ODA)
4.5.5	Percentage of total aid to education allocated to least developed countries
	Target 4.6
4.6.1	Percentage of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, by sex
4.6.2	Youth/adult literacy rate
	Target 4.7
4.7.1	Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed at all levels in: (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment
4.7.2	Percentage of schools that provide life skills-based HIV and sexuality education
4.7.3	Extent to which the framework on the World Programme on Human Rights Education is implemented nationally (as per the UNGA Resolution 59/113)
4.7.4	Percentage of students by age group (or education level) showing adequate understanding of issues relating to global citizenship and sustainability
4.7.5	Percentage of 15-year-old students showing proficiency in knowledge of environmental science and geoscience
4.7.6	(i) Percentage of schools with green accreditation in compliance with the UNESCO Quality Standard on Green Schools ('Green schools' indicator) (ii) National policy intentions based on the analysis of the content of relevant policy documents 'Green policy intentions' indicator
	Target 4.a
4.a.1	Proportion of schools offering basic services, by type of service
4.a.2	Percentage of students experiencing bullying in the last 12 months in (a) primary and (b) lower secondary education
4.a.3	Number of attacks on students, personnel and institutions
4.a.4	Proportion of school attending children receiving school meals
	Target 4.b
4.b.1	Volume of official development assistance flows for scholarships by sector and type of study
	Target 4.c
4.c.1	Proportion of teachers with the minimum required qualifications, by education level
4.c.2	Pupil-trained teacher ratio by education level
4.c.3	Proportion of teachers qualified according to national standards by education level and type of institution
4.c.4	Pupil-qualified teacher ratio by education level
4.c.5	Average teacher salary relative to other professions requiring a comparable level of qualification
4.c.6	Teacher attrition rate by education level
4.c.7	Percentage of teachers who received in-service training in the last 12 months by type of training

Notes: Global indicators are highlighted in grey shading.
Source: UIS.

TABLE I.2: Notes of indicators in the statistical tables

	Indicator Notes
	Table 1
A	**Compulsory education by level** Number of years during which children are legally obliged to attend school.
B	**Free years of education by level** Number of years during which children are legally guaranteed to attend school free of charge.
C	**Official primary school starting age** The official age at which students are expected to enter primary school. This is expressed in whole years, not accounting for cutoff dates other than the beginning of the school year. The official entrance age to a given programme or level is typically, but not always, the most common entrance age.
D	**Duration of each education level** Number of grades or years in a given level of education.
E	**Official school-age population by level** Population of the age group officially corresponding to a given level of education, whether enrolled in school or not.
F	**Total absolute enrolment by level** Individuals officially registered in a given educational programme, or stage or module thereof, regardless of age.
G	**Initial government expenditure on education as a percentage of gross domestic product (GDP)** Total general (local, regional and central, current and capital) initial government funding of education includes transfers paid (such as scholarships to students), but excludes transfers received, in this case, international transfers to government for education (when foreign donors provide education sector budget support or other support integrated in the government budget).
H	**Expenditure on education as a percentage of total government expenditure** Total general (local, regional and central) government expenditure on education (current, capital and transfers), expressed as a percentage of total general government expenditure on all sectors (including health, education, social services, etc.). It includes expenditures funded by transfers from international sources to government.
I	**Initial government expenditure per pupil by level, in constant 2019 purchasing power parity (PPP) USD and as a percentage of GDP per capita** Total general (local, regional and central, current and capital) initial government funding of education per student, which includes transfers paid (such as scholarships to students), but excludes transfers received, in this case, international transfers to government for education (when foreign donors provide education sector budget support or other support integrated in the government budget).
	Table 2
A	**Out-of-school children, total number and as a percentage of corresponding age group** Children in the official school age range who are not enrolled in either primary or secondary school (*Source:* UIS and GEM Report analysis of household surveys and administrative data, VIEW database).
B	**Education completion rate by level** Percentage of children aged 3-5 years older than the official age of entry into the last grade of an education level who have reached the last grade of that level. For example, the primary completion rate in a country with a 6-year cycle where the official age of entry into the last grade is 11 is the percentage of 14- to 16-year-olds who have reached grade 6 (*Source:* UIS and GEM Report analysis of household surveys, VIEW database).
C	**Percentage of pupils over-age for grade by level** The percentage of pupils in each level of education whose age is two years or more above the intended age for their grade.
D	**Gross enrolment ratio in primary education** Total enrolment in primary education, regardless of age, expressed as a percentage of the population in the official age group. It can exceed 100% because of early or late entry and/or grade repetition.
E	**Primary adjusted net enrolment rate** Enrolment of the official age group for primary education either at that level or the levels above, expressed as a percentage of the population in that age group.
F	**Gross intake ratio to last grade of primary education** Total number of new entrants to the last grade of primary education, regardless of age, expressed as a percentage of the population at the official school entrance age for that grade.
G	**Effective transition from primary to lower secondary general education** Number of new entrants to the first grade of lower secondary education in the following year expressed as a percentage of the students enrolled in the last grade of primary education in the given year who do not repeat that grade the following year.
H	**Lower secondary total net enrolment rate** Number of pupils of the official school age group for lower secondary education who are enrolled in any level of education, expressed as a percentage of the corresponding school age population.
I	**Gross intake ratio to last grade of lower secondary education** Total number of new entrants to the last grade of lower secondary education, regardless of age, expressed as a percentage of the population at the official school entrance age for that grade.
J	**Upper secondary total net enrolment rate** Number of pupils of the official school age group for upper secondary education who are enrolled in any level of education, expressed as a percentage of the corresponding school age population.
K	**Administration of nationally representative learning assessment in early grades (grade 2 or 3), or final grade of primary or lower secondary** The definition includes any nationally representative, national or cross-national formative, low-stake learning assessment.
L	**Percentage of students achieving at least a minimum proficiency level in reading and mathematics** The minimum proficiency level in reading and mathematics is defined by each assessment. Data need to be interpreted with caution since the different assessments are not comparable. In the absence of assessments conducted in the proposed grade, surveys of student learning achievement in the grade below or above the proposed indicator grade are used as placeholders.

	Indicator Notes
	Table 3
A	**Percentage of children aged 36 to 59 months who are developmentally on track in health, learning and psychosocial well-being** The UNICEF Early Childhood Development Index is collected through the UNICEF Multiple Indicator Cluster Surveys and is a measure of fulfilment of developmental potential that assesses children aged 36 to 59 months in four domains: (a) literacy-numeracy; (b) physical development; (c) social-emotional development; and (d) learning (ability to follow simple instructions, ability to occupy themselves independently). The percentage of children who are developmentally on track overall is the percentage of children on track in at least three of the four domains.
B	**Under-5 moderate or severe stunting rate** Proportion of children in a given age group whose height for their age is below minus two standard deviations from median height for age established by the National Center for Health Statistics and the World Health Organization (WHO) (*Source:* 2021 UNICEF, WHO and World Bank Joint Child Malnutrition Estimates [JME]. Regional aggregates are JME statistical estimates for the reference year, not weighted averages of the observed country values in the country table).
C	**Percentage of children aged 36 to 59 months experiencing positive and stimulating home learning environments** Percentage of children 36 to 59 months old with whom an adult has engaged in four or more of the following activities to promote learning and school readiness in the previous three days: (a) reading books to the child; (b) telling stories to the child; (c) singing songs to the child; (d) taking the child outside the home; (e) playing with the child; and (f) spending time with the child naming, counting or drawing things (*Source:* UNICEF database).
D	**Percentage of children under 5 years living in households with three or more children's books** Percentage of children aged 0 to 59 months who have three or more books or picture books (*Source:* UNICEF database).
E	**Gross early childhood education enrolment ratio in pre-primary education** Total enrolment in pre-primary education, regardless of age, expressed as a percentage of the population in the official age group. It can exceed 100% because of early or late entry.
F	**Adjusted net enrolment rate one year before the official primary school entry age** Enrolment of children one year before official primary school entry age in pre-primary or primary education, expressed as a percentage of the population in that age group.
	Table 4
A	**Participation rate in adult education and training** Participation rate of adults (aged 25 to 54) in formal or non-formal education and training in the last 12 months. Estimates based on other reference periods, in particular 4 weeks, are included when no data are available on the last 12 months.
B	**Percentage of youth enrolled in technical and vocational education** Youth (aged 15 to 24) enrolled in technical and vocational education at ISCED levels 2–5, as a percentage of the total population of that age group.
C	**Share of technical and vocational education in total enrolment by level** Total number of students enrolled in vocational programmes at a given level of education, expressed as a percentage of the total number of students enrolled in all programmes (vocational and general) at that level.
D	**TVET share of post-secondary non-tertiary (%)** Share of technical and vocational education and training (TVET) in post-secondary non-tertiary enrolment (%).
E	**Gross graduation ratio from tertiary (%)** Number of graduates from first degree programmes (at ISCED 6 and 7) expressed as a percentage of the population of the theoretical graduation age of the most common first degree programme.
F	**Gross enrolment ratio in tertiary education** Total enrolment in tertiary education, regardless of age, expressed as a percentage of the population in the five-year age group above the official graduation age from upper secondary. It can exceed 100% because of early or late entry and prolonged study.
G	**Percentage of adults (15 and over) with specific information and communication technology (ICT) skills** Individuals are considered to have such skills if they have undertaken certain computer-related activities in the last three months: copying or moving a file or folder; using copy and paste tools to duplicate or move information within a document; using basic arithmetic formulas in a spreadsheet; writing a computer program using a specialized programming language.
H	**Percentage of adults (25 and over) who have attained at least a given level of education** Number of persons aged 25 and above by the highest level of education attained, expressed as a percentage of the total population in that age group. Primary refers to ISCED 1 or higher, lower secondary to ISCED 2 or higher, upper secondary to ISCED 3 or higher, post-secondary to ISCED 4 or higher.
I	**Percentage of population of a given age group achieving at least a fixed level of proficiency in functional literacy/numeracy skills** The threshold level corresponds to level 2 on the Programme for the International Assessment of Adult Competencies scale.
J	**Youth (15 to 24)/adult (15 and above) literacy rate**
K	**Number of youth (aged 15 to 24)/adult (aged 15 and above) illiterates** Number of literate youth (aged 15 to 24) and adults (aged 15 and above), expressed as a percentage of the total population in that age group. Literacy data include both national observed data from censuses or household surveys and UIS estimates. As definitions and methodologies used for data collection differ by country, data need to be used with caution.
	Table 5
	Adjusted gender parity index, by indicator The gender parity index (GPI) is the ratio of female to male values of a given indicator. If the female value is less than or equal to the male value, adjusted gender parity index (GPIA) = GPI. If the female value is greater than the male value, GPIA = 2 - 1/GPI. This ensures the GPIA is symmetrical around 1 and limited to a range between 0 and 2. A GPIA equal to 1 indicates parity between females and males (*Sources:* UIS database; GEM Report team calculations based on national and international household surveys).
A	**Completion rate, by level**
B	**Percentage of students with a minimum level of proficiency at the end of a given level**
C	**Youth and adult literacy rate**
D	**Percentage of adults (16 and over) achieving at least a fixed level of proficiency in functional literacy and numeracy skills**
E	**Gross enrolment ratio, by level**
	Location and wealth disparity The location parity index is the ratio of rural to urban values of a given indicator. The wealth parity index is the ratio of the poorest 20% to the richest 20% of values of a given indicator.
F	**Completion rate, by level**
G	**Percentage of students with a minimum level of proficiency at the end of a given level**

	Indicator Notes
	Table 6
A	**Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed at all levels in: (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment** Information is collected with the questionnaire for monitoring the implementation by UNESCO Member States of the 1974 Recommendation concerning Education for International Understanding, Co-operation and Peace and Education relating to Human Rights and Fundamental Freedoms. For each of the four components of the indicator (policies, curricula, teacher education and student assessment), a number of criteria are measured, which are then combined to give a single score between zero and one for each component (*Source:* UNESCO, 2020).
B	**Percentage of schools providing life skills-based HIV/AIDS education** Percentage of lower secondary schools providing life skills-based HIV/AIDS education (all institutions).
C	**Percentage of schools with basic drinking water, basic (single-sex) sanitation or toilets, and basic handwashing facilities** Basic drinking water means drinking water from an improved source, and water available at the school at the time of the survey. Basic sanitation or toilets means improved sanitation facilities at the school that are single-sex and usable (available, functional and private) at the time of the survey. Basic handwashing facilities means handwashing facilities with water and soap available at the school at the time of the survey.
D	**Percentage of public schools with electricity** Regularly and readily available sources of power (e.g. grid/mains connection, wind, water, solar and fuel-powered generator) that enable the adequate and sustainable use of ICT infrastructure by pupils and teachers to support course delivery or independent teaching and learning needs.
	Percentage of public schools with internet used for pedagogical purposes Internet that is available for enhancing teaching and learning and is accessible by pupils irrespective of the device used. Access can be via a fixed narrowband, fixed broadband or mobile network.
	Percentage of public schools with computers Use of computers to support course delivery or independent teaching and learning needs, including to meet information needs for research purposes, develop presentations, perform hands-on exercises and experiments, share information, and participate in online discussion forums for educational purposes. The definition includes desktops, laptops and tablets.
E	**Percentage of public primary schools with access to adapted infrastructure and materials for students with disabilities** Any built environments related to education facilities that are accessible to all users, including those with various types of disability, enabling them to gain access to use and exit from them. Accessibility includes ease of independent approach, entry, evacuation and/or use of a building and its services and facilities (such as water and sanitation) by all of the building's potential users with an assurance of individual health, safety and welfare during the course of those activities.
F	**Percentage of students experiencing school-related bullying in lower secondary education** Percent of students subjected to bullying in the past 12 months (or alternative period as available in the source data) at the lower secondary level. The definition of bullying includes, when possible, physical, verbal and relational abuse. This scope reflects current research on bullying as well as the definitions for major international student assessments.
G	**Level of attacks on students, teachers or institutions** Number of violent attacks, threats or deliberate use of force in a given time period (e.g. the last 12 months, a school year or a calendar year) directed against students, teachers and other personnel or against education buildings, materials and facilities, including transport. The indicator focuses on attacks carried out for political, military, ideological, sectarian, ethnic or religious reasons by armed forces or non-state armed groups.
H	**Internationally mobile students, inbound and outbound numbers enrolled, and mobility rates** Number of students from abroad studying in a given country, expressed as a percentage of total tertiary enrolment in that country. Number of students from a given country studying abroad, expressed as a percentage of total tertiary enrolment in that country.
I	**Volume of official development assistance for scholarships** Total gross disbursement of official development assistance flows (all sectors) for scholarships (all levels). The sum of the values of regions and country income groups does not add up to the global total because some aid is not allocated by country.
	Imputed student costs Costs incurred by donor countries' higher education institutions when they receive students from developing countries.

	Indicator Notes
	Table 7
A	**Number of classroom teachers** Persons employed full-time or part-time in an official capacity to guide and direct the learning experience of pupils and students, irrespective of their qualifications or the delivery mechanism (i.e. face-to-face and/or at a distance). This definition excludes educational personnel who have no active teaching duties (e.g. headmasters, headmistresses or principals), or who work occasionally or in a voluntary capacity in educational institutions.
B	**Pupil/teacher ratio** Average number of pupils per teacher at a given level of education, based on headcounts of pupils and teachers.
C	**Percentage of trained classroom teachers** Trained teachers are defined as those who have received at least the minimum organized and recognized pre-service and in-service pedagogical training required to teach at a given level of education. Data are not collected for UIS/OECD/Eurostat (UOE) countries.
D	**Percentage of qualified classroom teachers** Qualified teachers are defined as those who have the minimum academic qualification necessary to teach at a specific level of education according to national standards.
E	**Teacher attrition rate** Number of teachers at a given level of education leaving the profession in a given school year, expressed as a percentage of teachers at that level and in that school year.
F	**Relative teacher salary level** Teacher salary relative to other professionals with equivalent academic qualifications. Data refer to actual salaries of all teachers relative to earnings for full-time, full-year workers with tertiary education (ISCED 5 to 8). The indicator is defined as a ratio of salary, using annual average salaries (including bonuses and allowances) of teachers in public institutions relative to the wages of workers with similar educational attainment (weighted average) and to the wages of full-time, full-year workers aged 25 to 64 with tertiary education.
G	**Percentage of teachers who received in-service training in the last 12 months** For data representative of teachers at a level of education or grade, the proportion of teachers that have received in-service training in the past 12 months (or time period available in the dataset). For data representative of students' teachers, the proportion of students' teachers that have received in-service training in the past 12 months (or time period available in the dataset). For cross-national assessments with more than one assessment in the same level of education, the average of all grades is used.

TABLE 1: Education system characteristics and education expenditure

	Education systems																
	A		B		C	D				E				F			
	Compulsory		Free			Duration (years)				School age population (000,000)				Enrolment (000,000)			
	1 year of pre-primary	9 years of primary-secondary	1 year of pre-primary	12 years of primary-secondary	Official primary school starting age	Pre-primary	Primary	Lower secondary	Upper secondary	Pre-primary	Primary	Secondary	Tertiary	Pre-primary	Primary	Secondary	Tertiary
SDG indicator	4.2.5	4.1.7	4.2.5	4.1.7													
Reference year	2021									2022				2021			
Region	**% of countries**				**Median**					**Sum**							
World	25	74	51	54	6	3	6	3	3	353	731	799	586	215	745	614	236
Sub-Saharan Africa	2	44	18	25	6	3	6	3	3	78	179	150	93_i	21_i	178_i	66_i	9_i
Northern Africa and Western Asia	12	92	58	75	6	3	6	3	3	26	57	58	43	9_i	57_i	48_i	21_i
Northern Africa	-	83	50	50	6	2	6	3	3	11	30	27	20	5_i	31_i	21_i	7_i
Western Asia	17	94	61	83	6	3	6	3	3	15	27	32	23	4	27_i	27	13
Central and Southern Asia	14	64	50	50	6	3	5	4	3	99	187	260	180	60	190	189	49
Central Asia	20	100	100	40	7	4	4	5	2	6	6	9	6	3	6	9	2
Southern Asia	11	44	22	56	6	2	5	3	4	93	181	251	175	58	184	180	47
Eastern and South-eastern Asia	22	78	38	38	6	3	6	3	3	81	179	179	152	68	186	157	77
Eastern Asia	29	100	57	43	6	3	6	3	3	58	115	112	97	52	118	101	58
South-eastern Asia	18	64	22	33	6	3	6	3	3	24	64	67	54_i	16_i	68_i	56_i	19_i
Oceania	18	65	55_i	64_i	6	2	6	4	3	2	4	4	3	1_i	4	4	2
Latin America and the Caribbean	54	83	71	58	6	2	6	3	3	28	59	65	54	21	62	63	29
Caribbean	27	82	53	58	5	2	6	3	2	…	4_i	4_i	3_i	…	2_i	2_i	…
Central America	100	86	86	57	6	3	6	3	3	…	19	19	15	…	20	17	6
South America	75	83	92	58	6	3	6	3	3	…	35_i	41_i	30_i	…	37	43	19_i
Europe and Northern America	37	93	63	71	6	3	5	4	3	39	66	84	62	34	66	87	50
Europe	40	93	60	69	6	3	5	4	3	26	39	56	38	24	40	60	29
Northern America	-	100	100	100	6	3	6	3	3	13	27	27	24	9	27	28	21
Low income	4	43	27	23	6	3	6	3	3	56	109	95	60_i	11_i	112_i	37_i	6_i
Middle income	23	68	46	48	6	3	6	3	3	257	542	614	454	170	553	481	173
Lower middle	17	59	34	34	6	3	6	3	3	155	349	411	287	91	353	290	76
Upper middle	29	77	58	62	6	3	6	3	3	102	193	203	167	79	199	191	97
High income	38	94	66	73	6	3	6	3	3	39	77	88	70	32	77	93	55

A Years of compulsory education, by level.
B Years of free education, by level.
C Official primary school starting age.
D Official duration of education levels in years.
E Official school-age population by level (for tertiary: the five years following upper secondary).
F Total absolute enrolment by level.
G Initial government expenditure on education as a % of gross domestic product (GDP).
H Initial government expenditure on education as a % of total government expenditure.
I Initial government expenditure per pupil by level, in constant 2019 PPP USD and as a % of GDP per capita.

Note: PPP = purchasing power parity.
Source: UIS unless noted otherwise. Data refer to school year ending in 2021 unless noted otherwise.
Aggregates represent countries listed in the table with available data and may include estimates for countries with no recent data.
(-) Magnitude nil or negligible.
(…) Data not available or category not applicable.
(± n) Reference year differs (e.g. -2: reference year 2019 instead of 2021).
(i) Estimate and/or partial coverage.

Finance									
G	H	I							
		Government education expenditure per pupil							
		2019 PPP USD				% of GDP per capita			
Government education expenditure (% of GDP)	Education share of total government expenditure (%)	Pre-primary	Primary	Secondary	Tertiary	Pre-primary	Primary	Secondary	Tertiary
	1.a.2	4.5.4							
2021									
Median									
4.2	14.2	2,340$_i$	2,989$_i$	3,660$_i$	5,008$_i$	12$_i$	15$_i$	20$_i$	25$_i$
3.6	16.5	104$_i$	306$_i$	481$_i$	…	4$_i$	13$_i$	17$_i$	…
3.5$_i$	9.6$_i$	3,103$_i$	4,616$_i$	5,779$_i$	6,037$_i$	12$_i$	14$_i$	20$_i$	18$_i$
…	…	…	…	3,589$_i$	…	…	…	32$_i$	…
3.5$_i$	9.6$_i$	4,256$_i$	5,679$_i$	8,136$_i$	5,760$_i$	13$_i$	15$_i$	20$_i$	17$_i$
4.3	14.6	192	907$_i$	1,131	1,973	3	11$_i$	16	22
4.6	22.8	1,502	906$_i$	3,274$_i$	1,099	24	11$_i$	18$_i$	19
3.2	11.6	61	907	915	3,236	1	11	16	25
3.3	15.5	3,504$_i$	5,840$_i$	12,654$_i$	7,624$_i$	12$_i$	15$_i$	21$_i$	21$_i$
4.3	14.7	6,070$_i$	10,342$_i$	15,152$_i$	8,768	13$_i$	19$_i$	…	21$_i$
2.9	15.5	…	4,747$_i$	5,626$_i$	4,542$_i$	…	13$_i$	21$_i$	21$_i$
5.4	10.9$_i$	…	…	…	…	…	…	…	…
4.3	16.0$_i$	1,349$_i$	2,231$_i$	2,832$_i$	2,457$_i$	11$_i$	14$_i$	18$_i$	22$_i$
4.0	14.2$_i$	546$_i$	2,147$_i$	3,226$_i$	…	5$_i$	14$_i$	19$_i$	6$_i$
4.3	22.7	1,137$_i$	2,084$_i$	1,968$_i$	2,281	10$_i$	14$_i$	13$_i$	23
5.1	16.0	1,707	2,565	2,408	3,214	13	15	19	22
4.7	11.2	7,546	8,984	10,665	10,858	18	21	22	27
4.6	11.0	7,414	8,984	10,665	10,471	18	21	22	28
4.8	12.7	10,356	9,447	11,545	14,428	14	14	17	23
3.2	16.2	52$_i$	240$_i$	295$_i$	…	2$_i$	11$_i$	17$_i$	…
4.1	15.4	1,076$_i$	1,657$_i$	1,950$_i$	2,662$_i$	10$_i$	14$_i$	17$_i$	23$_i$
4.0	15.7	474$_i$	776$_i$	924$_i$	2,252$_i$	9$_i$	11$_i$	13$_i$	31$_i$
4.3	14.5	1,657$_i$	2,290$_i$	3,036$_i$	3,214$_i$	11$_i$	15$_i$	21$_i$	18$_i$
4.5	11.8	7,148$_i$	9,300	10,475	13,826	17	20	22	27

TABLE 1: Continued

Country or territory	A Compulsory: Years of pre-primary	A Compulsory: Years of primary-secondary	B Free: Years of pre-primary	B Free: Years of primary-secondary	C Official primary school starting age	D Duration (years): Pre-primary	D Duration (years): Primary	D Duration (years): Lower secondary	D Duration (years): Upper secondary	E School age population (000,000): Pre-primary	E School age population (000,000): Primary	E School age population (000,000): Secondary	E School age population (000,000): Tertiary	F Enrolment (000,000): Pre-primary	F Enrolment (000,000): Primary	F Enrolment (000,000): Secondary	F Enrolment (000,000): Tertiary
SDG indicator	4.2.5	4.1.7	4.2.5	4.1.7													
Reference year	2021									2022				2021			
Sub-Saharan Africa																	
Angola	-	6	-	6	6	2	6	3	3	2,277	6,189	5,103	...	...	4,697	...	...
Benin	-	6	-	6	6	2	6	4	3	732	1,997	1,967	1,119	166	2,280	918	124
Botswana	-	-	...	...	6	3	7	3	2	163	373	243	211	...	365	176	52
Burkina Faso	-	10	-	10	6	3	6	4	3	2,022	3,645	3,570	1,993	130	3,290	1,370	190
Burundi	-	-	...	...	7	3	6	3	3	1,182	2,070	1,622	1,032	126	2,302	741	42
Cabo Verde	-	10	-	8	6	3	6	3	3	32	63	60	49	24	63	54	12
Cameroon	-	6	-	6	6	2	6	4	3	1,595	4,420	4,381	2,319	565	4,732	1,919	331
Central African Republic	-	10	-	13	6	3	6	4	3	432	830	895	...	12	1,029	138	...
Chad	-	10	-	10	6	3	6	4	3	1,690	2,972	2,861	...	21	2,719	664	...
Comoros	-	6	-	6	6	3	6	4	3	73	135	135	76	15	124	74	...
Congo	-	10	3	13	6	3	6	4	3	488	915	896	433	67	783	517	55
Côte d'Ivoire	-	10	-	10	6	3	6	4	3	2,404	4,279	4,300	2,548	258	4,253	2,564	253
D. R. Congo	-	6	-	6	6	3	6	2	4	9,186	16,097	13,044	8,061	603	18,789	...	564
Djibouti	-	10	1	12	6	2	5	4	3	40	98	125	90	5	72	71	...
Equat. Guinea	-	6	-	6	7	3	6	4	2	113	197	162	...	...	118	...	...
Eritrea	-	8	-	8	6	2	5	3	4	189	474	645	...	46	347	266	...
Eswatini	-	7	-	7	6	3	7	3	2	85	200	142	...	...	236	...	...
Ethiopia	-	8	-	8	7	3	6	4	2	9,689	17,728	16,049	...	2,867	18,447	...	...
Gabon	-	10	-	10	6	3	5	4	3	189	279	310	...	75	270	205	...
Gambia	-	9	-	9	7	4	6	3	3	312	403	332	...	131	414	370	...
Ghana	2	9	2	9	6	2	6	3	4	1,642	4,611	4,660	2,972	1,820	4,730	3,163	581
Guinea	-	6	-	6	7	3	6	4	3	1,193	2,167	2,211	1,128	230	2,108	764	...
Guinea-Bissau	-	9	...	...	6	3	6	3	3	180	328	277	...	...	...	...	...
Kenya	-	12	-	12	6	3	6	2	4	4,210	8,360	7,992	5,258	2,739	6,413	...	528_{i}
Lesotho	-	7	-	7	6	3	7	3	2	147	312	209	212	47	330	140	22
Liberia	-	6	-	6	6	3	6	3	3	434	806	723	...	543	608	275	...
Madagascar	-	5	3	12	6	3	5	4	3	2,394	3,648	4,566	2,758	902	4,649	1,495	152
Malawi	-	8	-	8	6	3	6	4	2	1,744	3,297	3,021	...	525	4,288	1,097	...
Mali	-	9	4	12	7	3	6	3	3	2,033	3,637	3,000	1,607	148	2,734	1,033	...
Mauritania	-	9	3	13	6	3	6	4	3	406	731	713	416	...	654	258	24
Mauritius	-	11	-	13	5	2	6	3	4	26	82	117	94	24	84	114	43
Mozambique	-	-	...	...	6	3	7	3	2	3,075	6,376	3,945	2,926	...	7,220	1,467	214
Namibia	-	7	-	7	7	2	7	3	2	133	435	263	245	48	536	...	67
Niger	-	-	...	...	7	3	6	4	3	2,655	4,495	4,026	1,902	180	2,806	787	80
Nigeria	-	9	-	9	6	1	6	3	3	6,433	35,246	29,409	...	1,391	28,078	11,374	...
Rwanda	-	6	-	9	7	3	6	3	3	1,096	1,992	1,788	1,217	294	2,729	783	88
Sao Tome and Principe	-	6	-	6	6	3	6	3	3	19	37	33	18	...	37	26	...
Senegal	-	11	-	11	6	3	6	4	3	1,554	2,863	2,741	1,564	270	2,270	1,243	244
Seychelles	-	10	-	11	6	2	6	3	4	3	10	10	6	3	9	8	1
Sierra Leone	-	9	-	9	6	3	6	3	4	678	1,267	1,321	...	167	1,964	492	...
Somalia	-	-	...	...	6	3	6	2	4	1,614	2,820	2,425	...	18	250	130	...
South Africa	-	9	-	12	7	4	7	2	3	4,632	8,085	5,263	4,886	822	7,716	5,101	1,184
South Sudan	-	8	-	8	6	3	6	2	4	1,002	1,835	1,610	...	114	...	...	...
Togo	-	10	-	5	6	3	6	4	3	715	1,330	1,360	746	206	1,629	852	115
Uganda	-	7	...	...	6	3	7	4	2	4,645	9,825	7,060	...	609	8,841	1,434	...
United Republic of Tanzania	-	7	1	13	7	1	7	4	2	1,841	11,770	8,442	5,443	1,391	11,197	2,338	400
Zambia	-	7	-	7	7	4	7	2	3	2,331	3,719	2,304	...	184	3,285	...	...
Zimbabwe	-	7	...	...	6	2	7	2	4	853	3,055	2,170	...	655	2,899	...	...

Finance										Country code
G	H	I								
		Government education expenditure per pupil								
		2019 PPP USD				% of GDP per capita				
Government education expenditure (% of GDP)	Education share of total government expenditure (%)	Pre-primary	Primary	Secondary	Tertiary	Pre-primary	Primary	Secondary	Tertiary	Country code
	1.a.2	4.5.4								
2021										
2.1	...	...	...	...	...	...	...	...	...	AGO
3.2	17.7$_{-3i}$	269	207	245	1,652	9	7	8	55	BEN
8.1$_{-1}$	...	...	...	...	...	...	...	...	...	BWA
5.2	22.7$_{-3i}$	169	286	329	6,232	8	15	16	308	BFA
5.1$_{-1}$	19.5$_{-3}$	...	...	...	...	...	...	...	...	BDI
6.5	15.2$_{-2}$	43$_{-2}$	1,657$_{-2}$	1,159$_{-2}$	2,689$_{-4}$	1$_{-2}$	23$_{-2}$	16$_{-2}$	40$_{-4}$	CPV
2.8	16.9$_{-3i}$	...	...	...	...	...	...	...	...	CMR
1.9	...	...	...	...	...	...	...	...	...	CAF
2.9	15.7	3	110$_{-3}$	225$_{-3}$	...	0.2	7$_{-3}$	14$_{-3}$	...	TCD
...	...	...	...	...	...	...	...	...	...	COM
3.9	15.6$_{-3i}$	...	...	...	...	...	...	...	...	COG
3.5	16.6	513	507	606	4,542$_{-1}$	9	9	11	84$_{-1}$	CIV
2.7	14.0$_{-4i}$	-	...	...	...	-	...	...	...	COD
3.8$_{-3i}$	14.0$_{-3i}$	...	1,260	25	...	...	28	...	...	DJI
0.3	...	...	...	...	...	...	...	...	...	GNQ
...	...	...	...	...	...	...	...	...	...	ERI
5.5$_{+1}$	...	...	...	...	...	...	...	...	...	SWZ
3.7$_{+1}$	...	62	136	289	...	4	8	17	...	ETH
3.0	...	...	...	...	...	...	...	...	...	GAB
2.9	11.4$_{-3i}$	-	184	...	...	-	9	...	...	GMB
3.9$_{-3i}$	18.6$_{-3i}$	...	...	...	...	...	...	...	...	GHA
2.1	14.3$_{-1}$	...	171$_{-1}$	...	...	...	6$_{-1}$	...	...	GIN
2.6	...	...	...	...	...	...	...	...	...	GNB
5.1$_{-3i}$	19.0$_{-3i}$	52	409	...	2,852	1	10	...	67	KEN
6.1$_{+1}$	14.4$_{-3}$	...	644$_{-3}$	933$_{-3}$	1,391$_{-3}$	...	24$_{-3}$	35$_{-3}$	52$_{-3}$	LSO
2.6$_{+1}$	7.4	164	243	301	...	10	15	18	...	LBR
3.2	19.8$_{-3i}$	...	...	...	...	...	...	...	...	MDG
3.3$_{-3i}$	15.8$_{-3i}$	-	124	365	...	-	8	24	...	MWI
4.4	16.2	43$_{-4}$	289$_{-4}$	601$_{-4}$	3,718	2$_{-4}$	13$_{-4}$	26$_{-4}$	171	MLI
1.7	9.1	...	345$_{-1}$	481$_{-1}$	3,390$_{-1}$	...	6$_{-1}$	9$_{-1}$	60$_{-1}$	MRT
4.7	14.5$_{-2}$	698	3,638	6,701	2,029	3	17	32	10	MUS
6.9	17.4$_{-3i}$	...	...	...	...	...	...	...	...	MOZ
9.5$_{+1}$	...	...	...	...	...	...	...	...	...	NAM
3.5$_{-3}$	16.3$_{-3}$	146$_{-3}$	118$_{-4}$	143$_{-4}$	2,343$_{-3}$	12$_{-3}$	10$_{-4}$	12$_{-4}$	186$_{-3}$	NER
...	...	...	...	...	...	...	...	...	...	NGA
4.0$_{+1}$	15.5	115	272	533	1,985$_{-3}$	5	13	25	98$_{-3}$	RWA
5.3	20.1$_{-3i}$	...	...	...	...	...	...	...	...	STP
5.6	21.5$_{-3}$	474	430	643	4,776$_{-3}$	15	14	20	134$_{-3}$	SEN
5.5	11.8$_{-3}$	3,332	3,907	4,210	19,457	12	14	15	68	SYC
3.3	21.6	-	322	247$_{-4}$	...	-	19	15$_{-4}$	...	SLE
-	3.0$_{-3}$	...	...	...	...	...	...	...	...	SOM
6.6$_{+1}$	20.9$_{-2}$	1,016	2,733	3,349	8,498	8	20	25	64	ZAF
...	...	...	...	...	...	...	...	...	...	SSD
4.2	21.8$_{-3i}$	104	247	...	1,230$_{-4}$	5	12	...	59$_{-4}$	TGO
2.6$_{+1}$	16.5$_{-2}$	...	...	...	...	...	...	...	...	UGA
3.4$_{+1}$	20.5$_{-3i}$	...	...	...	...	...	...	...	...	TZA
3.9$_{-1}$	17.1$_{-3i}$	69	474$_{-4}$	...	...	2	13$_{-4}$	...	...	ZMB
2.1$_{-3i}$	19.0$_{-3i}$	...	...	...	...	...	...	...	...	ZWE

TABLE 1: Continued

	Education systems																
	A		B		C	D				E				F			
	Compulsory		Free			Duration (years)				School age population (000,000)				Enrolment (000,000)			
Country or territory	Years of pre-primary	Years of primary-secondary	Years of pre-primary	Years of primary-secondary	Official primary school starting age	Pre-primary	Primary	Lower secondary	Upper secondary	Pre-primary	Primary	Secondary	Tertiary	Pre-primary	Primary	Secondary	Tertiary
SDG indicator	4.2.5	4.1.7	4.2.5	4.1.7													
Reference year	2021									2022				2021			
Northern Africa and Western Asia																	
Algeria	-	10	1	12	6	1	5	4	3	994	4,633	5,046	2,858	551	5,051	5,501	1,536
Armenia	-	12	3	12	6	3	4	5	3	126	172	310	167	37	156	269	93
Azerbaijan	1	9	5	11	6	3	4	5	3	464$_i$	684$_i$	1,082$_i$	651$_i$	215	646	1,014	249
Bahrain	-	9	-	12	6	3	6	3	3	68	131	113	79	36	116	102	51
Cyprus	1	9	1	12	6	3	6	3	3	28$_i$	59$_i$	55$_i$	57$_i$	25	59	56	53
Egypt	-	12	-	12	6	2	6	3	3	5,265	14,502	11,095	8,476	1,480	13,265	9,414	3,621
Georgia	-	9	-	12	6	3	6	3	3	167	339	287	222	165	336	282	161
Iraq	-	6	2	12	6	2	6	3	3	2,180	6,199	5,299	3,815	...	...	...	...
Israel	3	12	3	12	6	3	6	3	3	512	979	858	632	565	980	863	386
Jordan	-	10	1	12	6	2	6	4	2	435	1,372	1,323	978	120	1,112	945	333
Kuwait	-	9	-	12	6	2	5	4	3	121	319	411	207	60	265	...	122
Lebanon	-	10	3	9	6	3	6	3	3	...	...	...	...	187	510	424	274
Libya	-	9	2	12	6	2	6	3	3	259	791	725	543	...	...	...	...
Morocco	-	9	-	9	6	2	6	3	3	1,377	4,081	3,678	2,886	834	4,553	3,048	1,254
Oman	-	10	-	12	6	2	4	6	2	172	309	487	239	45	310	473	114
Palestine	-	10	1	12	6	2	4	5	3	279	543	934	503	138	501	838	215
Qatar	-	12	-	12	6	3	6	3	3	83	162	143	164	45	163	129	41
Saudi Arabia	-	9	-	12	6	3	6	3	3	1,815	3,539	3,004	2,203	335	3,551	3,206	1,573
Sudan	-	8	2	11	6	2	6	3	3	2,454	6,878	6,197	4,190	1,100	5,118	2,216	...
Syrian Arab Republic	-	9	3	12	6	3	6	3	3	1,152	2,116	2,031	1,620	134	2,170	1,321	...
Tunisia	-	9	-	11	6	3	6	3	4	623	1,199	1,143	797	...	1,304	...	299
Türkiye	-	12	3	12	6	3	4	4	4	4,012	5,461	10,825	6,811	1,630	5,280	11,332	7,976
United Arab Emirates	-	12	2	12	6	2	4	4	4	208	417	726	566	224	468	765	313
Yemen	-	9	-	9	6	3	6	3	3	2,458	4,654	4,117	2,949	...	...	...	...
Central and Southern Asia																	
Afghanistan	-	9	1	12	7	1	6	3	3	1,105	6,457	6,008	4,080	...	6,778	3,064	431
Bangladesh	-	5	-	5	6	3	5	3	4	8,582	14,552	21,009	15,429	3,136	16,965	16,023	3,522
Bhutan	-	-	-	11	6	2	7	4	2	25	87	80	74	13	80	76$_i$	12
India	-	8	-	8	6	3	5	3	4	69,227	117,829	176,594	124,624	27,631	131,348	139,098	39,968
Iran, Islamic Republic of	-	9	-	9	6	1	6	3	3	1,474	8,221	7,171	5,467	1,025	8,670	6,122	3,183
Kazakhstan	-	9	3	11	6	3	4	5	2	1,185	1,577	2,230	1,047	891	1,513	2,024	740
Kyrgyzstan	1	9	4	11	7	4	4	5	2	638	609	806	498	249	577	772	267
Maldives	-	7	-	12	6	3	7	3	2	22	53	32	42	17	51	21	14
Nepal	1	8	1	12	5	2	5	3	4	1,078	2,737	4,107	3,256	1,010	3,485	3,513	467
Pakistan	-	12	-	12	5	2	5	3	4	11,053	25,926	32,807	21,147	8,725	23,588	14,189	2,584
Sri Lanka	-	11	-	13	5	2	5	4	4	657	1,663	2,721	1,580	337	1,695	2,728	350
Tajikistan	-	9	4	11	7	4	4	5	2	1,072	960	1,307	849	91	771	...	265
Turkmenistan	-	12	3	12	6	3	4	6	2	417	549	846	460	151	609	805	80
Uzbekistan	-	12	4	12	7	4	4	5	3	2,738	2,604	4,447	2,702	1,196	2,504	3,819	574
Eastern and South-eastern Asia																	
Brunei Darussalam	-	9	...	...	6	3	6	2	5	19	42	45	35	13	40	42	11
Cambodia	-	-	-	9	6	3	6	3	3	1,069	2,088	1,888	1,481	359	2,133	1,062	198
China	-	9	-	9	6	3	6	3	3	51,227	103,866	99,980	84,625	48,187	107,730	90,919	53,823
DPR Korea	1	11	1	11	7	2	5	3	3	686	1,674	2,083	1,962	...	1,508	...	526
Hong Kong, China	-	9	-	12	6	3	6	3	3	207	361	336	322	167	368	343	285
Indonesia	-	9	-	12	7	2	6	3	3	9,801	28,695	27,676	22,134	5,909$_i$	25,203	24,894	8,037
Japan	-$_{-1}$	9$_{-1}$	-$_{-1}$	9$_{-1}$	6	3	6	3	3	3,146	6,609	6,776	5,951	2,864	6,440	6,786	3,885
Lao PDR	-	9	-	9	6	3	5	4	3	471	768	1,041	698	231	756	618	94
Macao, China	1	9	3	12	6	3	6	3	3	22	39	28	30	19	35	28	39
Malaysia	-	6	-	11	6	2	6	3	3	1,053	3,030	2,973	2,772	913	3,088	2,536	1,147
Mongolia	-	12	4	12	6	4	5	4	3	305	362	373	215	247	357	364	149
Myanmar	-	5	-	5	5	2	5	4	2	1,781	4,465	5,754	4,954	154	5,300	4,187	932
Philippines	1	12	1	12	6	1	6	4	2	2,239	13,649	12,902	10,257	2,054	12,529	11,567	3,644
Republic of Korea	-	9	3	9	6	3	6	3	3	1,217	2,716	2,761	2,922	1,174	2,703	2,674	2,994
Singapore	-	6	...	...	6	3	6	2	2	114$_i$	232$_i$	160$_i$	214$_i$	109	233	165	199
Thailand	-	9	3	12	6	3	6	3	3	2,186	4,645	5,020	4,557	1,626	4,725	5,035	2,004
Timor-Leste	-	9	-	9	6	3	6	3	3	101	184	185	...	27	203	162	...
Viet Nam	1	9	-	5	6	3	5	4	3	4,710	7,574	9,720	6,490	4,328	8,885	...	2,298

Finance: G. Government education expenditure (% of GDP)	Finance: H. Education share of total government expenditure (%)	I. Government education expenditure per pupil, 2019 PPP USD: Pre-primary	Primary	Secondary	Tertiary	I. Government education expenditure per pupil, % of GDP per capita: Pre-primary	Primary	Secondary	Tertiary	Country code
	1.a.2	4.5.4								
2021										
…	…	…	…	…	…	…	…	…	…	DZA
2.8	10.0_{-2}	4,256	2,022	1,979	1,339	28	14	13	9	ARM
3.5	8.6_{-2}	$1,950_{-1i}$	$1,904_{-1i}$	$3,416_{-1i}$	$5,008_{-1i}$	13_{-1i}	13_{-1i}	24_{-1i}	35_{-1i}	AZE
2.3_{-4}	7.2_{-4}	…	5,679	8,906	…	…	11	17	…	BHR
5.2_{-2}	13.4_{-2}	$4,311_{-2}$	$11,899_{-2}$	$14,978_{-2}$	$6,511_{-2}$	10_{-2}	28_{-2}	35_{-2}	15_{-2}	CYP
…	…	748_{-2}	776_{-2}	$1,400_{-2}$	…	7_{-2}	7_{-2}	12_{-2}	…	EGY
3.6	12.1_{-1}	…	…	…	1,008	…	…	…	6	GEO
…	…	…	…	…	…	…	…	…	…	IRQ
6.1_{-2}	17.8_{-2}	$5,719_{-2}$	$9,296_{-2}$	$8,136_{-2}$	$7,499_{-2}$	14_{-2}	22_{-2}	20_{-2}	18_{-2}	ISR
3.2	9.6	108	1,454	1,644	783	1	15	17	8	JOR
…	…	…	…	…	…	…	…	…	…	KWT
…	…	…	…	…	…	…	…	…	…	LBN
…	…	…	…	…	…	…	…	…	…	LBY
…	…	…	…	…	…	…	…	…	…	MAR
…	…	$1,896_{-1}$	$9,303_{-1}$	$9,952_{-1}$	13,949	5_{-1}	27_{-1}	29_{-1}	38	OMN
5.5	17.9	…	…	…	407	…	…	…	7	PSE
3.2_{-1}	9.3_{-1}	…	…	…	…	…	…	…	…	QAT
…	…	…	…	…	…	…	…	…	…	SAU
…	…	…	…	…	…	…	…	…	…	SDN
…	…	…	…	…	…	…	…	…	…	SYR
…	…	…	…	5,779	6,037	…	…	51	53	TUN
3.4_{-1}	9.4_{-1}	$4,293_{-2}$	$3,553_{-2}$	$3,931_{-2}$	$7,860_{-2}$	16_{-2}	13_{-2}	15_{-2}	29_{-2}	TUR
3.9	5.4_{-2}	…	$14,268_{-1}$	$18,284_{-1}$	$14,445_{-1}$	…	20_{-1}	26_{-1}	20_{-1}	ARE
…	…	…	…	…	…	…	…	…	…	YEM
2.9_{-1}	8.2_{-4}	$-_{-4}$	238_{-4}	263_{-4}	…	$-_{-4}$	11_{-4}	12_{-4}	…	AFG
1.8	10.2	…	…	371_{-1}	949_{-1}	…	…	7_{-1}	17_{-1}	BGD
7.0	19.7_{+1}	-	…	3,044	…	-	…	31	…	BTN
4.6	14.6	192_{-1}	928	1,147	3,597	3_{-1}	15	18	56	IND
3.2_{-1}	22.7_{-1}	148_{-1}	$1,606_{-1}$	$2,354_{-1}$	$3,372_{-1}$	1_{-1}	11_{-1}	16_{-1}	23_{-1}	IRN
4.5	19.0_{-2}	1,818	71_{-2}	5,416	$2,333_{-2}$	7	0.3_{-2}	21	8_{-2}	KAZ
6.6_{-1}	20.1_{-2}	$1,185_{-4}$	…	…	261_{-4}	22_{-4}	…	…	5_{-4}	KGZ
5.0	10.9	$2,479_{-2}$	$3,303_{-2}$	$4,530_{-2}$	…	11_{-2}	15_{-2}	21_{-2}	…	MDV
4.0	12.4_{+1}	61	365	308_{i}	713	2	11	9_{i}	22	NPL
2.1	11.6_{-2}	…	396	784	$3,099_{-4}$	…	9	17	63_{-4}	PAK
2.0_{-3}	11.3_{-3}	$-_{-2}$	907_{-2}	915_{-3}	$3,841_{-3}$	$-_{-2}$	6_{-2}	6_{-3}	26_{-3}	LKA
5.7	…	823	…	…	585	26	…	…	19	TJK
3.1_{-2}	28.0_{-1}	…	…	…	…	…	…	…	34_{-2}	TKM
4.6	25.6_{-2}	2,817	1,741	1,131	1,613	35	21	14	20	UZB
…	…	671	5,840	15,561	21,013	1	9	24	32	BRN
1.7	15.7	…	…	…	…	…	…	…	…	KHM
3.5_{-3}	11.5_{-3}	…	…	…	…	…	…	…	…	CHN
…	…	…	…	…	…	…	…	…	…	PRK
4.0	17.5_{-2}	6,776	11,355	15,152	16,230	12	19	26	28	HKG
2.8_{-2}	17.3_{-2}	…	1,422	1,126	2,224	…	13	11	21	IDN
3.2_{-2}	8.2_{-2}	$5,365_{-2}$	$9,330_{-2}$	$10,156_{-2}$	$8,768_{-2}$	13_{-2}	…	…	…	JPN
1.9	10.8	…	…	…	…	…	…	…	…	LAO
6.4_{-1}	15.6_{-2}	…	…	…	$24,782_{-1}$	…	…	…	43_{-1}	MAC
4.3	15.5_{-1}	$1,213_{-1}$	$4,747_{-1}$	$5,626_{-1}$	$4,542_{-1}$	4_{-1}	17_{-1}	21_{-1}	17_{-1}	MYS
6.5	20.5_{-3}	$1,642_{-4}$	$1,563_{-4}$	…	379_{-4}	14_{-4}	13_{-4}	…	3_{-4}	MNG
2.1_{-2}	9.8_{-2}	…	376_{-3}	496_{-3}	804_{-3}	…	8_{-3}	11_{-3}	18_{-3}	MMR
3.9	15.4_{+1}	…	…	…	…	…	…	…	…	PHL
4.7_{-2}	13.8_{-2}	$7,765_{-2}$	$13,415_{-2}$	$16,607_{-2}$	$6,481_{-2}$	17_{-2}	29_{-2}	36_{-2}	14_{-2}	KOR
2.5_{+1}	16.5_{-2}	…	$17,040_{-1}$	$21,057_{-1}$	$22,286_{-1}$	…	17_{-1}	21_{-1}	22_{-1}	SGP
3.0	14.5_{-2}	…	…	…	…	…	…	…	…	THA
5.5	7.5	…	…	…	…	…	…	…	…	TLS
3.0	16.1_{-3}	…	…	…	…	…	…	…	…	VNM

TABLE 1: Continued

	Education systems																
	A		B		C	D				E				F			
	Compulsory		Free			Duration (years)				School age population (000,000)				Enrolment (000,000)			
Country or territory	Years of pre-primary	Years of primary-secondary	Years of pre-primary	Years of primary-secondary	Official primary school starting age	Pre-primary	Primary	Lower secondary	Upper secondary	Pre-primary	Primary	Secondary	Tertiary	Pre-primary	Primary	Secondary	Tertiary
SDG indicator	4.2.5	4.1.7	4.2.5	4.1.7													
Reference year	2021									2022				2021			
Oceania																	
Australia	-	10	1	13	5	2	7	4	2	680	2,343	1,960	1,544	529	2,269	2,517	1,763
Cook Islands	-	12	2	13	5	2	6	4	3	0.5	2	2	...	0.4	2	2	...
Fiji	-	-	...	...	6	3	6	4	3	53	105	112	72	17	119	107	38
Kiribati	-	9	-	9	6	3	6	3	4	9	17	18	...	8	18	...	...
Marshall Islands	1	12	1	12	6	1	6	2	4	1	9	9	6	1	6	6	2
Micronesia, F. S.	-	8	-	8	6	3	6	2	4	7	14	14	...	0.4	13	...	...
Nauru	2	12	2	12	6	2	6	4	2	1	2	1	...	0.3	1	1	...
New Zealand	-	10	2	13	5	2	6	4	3	121	374	450	313	111	387	528	250
Niue	-	11	1	12	5	1	6	4	3	-	0.2	0.2	...	-	0.2	0.2	...
Palau	-	12	-	12	6	3	6	2	4	1	1	1	...	1	2	1	...
Papua New Guinea	-	-	...	...	7	4	6	4	2	876	1,244	1,167	...	386	1,394	518	...
Samoa	-	8	-	8	5	2	6	2	5	11	30	31	18	4	35	...	3
Solomon Is	-	-	...	...	6	3	6	3	4	62	113	107	...	55	107	...	...
Tokelau	-	11	...	...	5	2	6	4	3	-	0.1	0.1	0.1	0.1	0.2	0.2	...
Tonga	2	13	-	8	6	2	6	5	2	5	15	17	10	2	17	15	2
Tuvalu	-	9	...	...	6	3	6	4	3	1	2	2	...	1	1	1	...
Vanuatu	-	-	...	...	6	2	6	4	3	17	47	50	...	17	57	26	...
Latin America and the Caribbean																	
Anguilla	-	12	-	12	5	2	7	3	2	0.4	1	1	...	0.4	2	1	...
Antigua and Barbuda	-	11	-	11	5	2	7	3	2	3	10	7	...	2	10	8	...
Argentina	2	12	3	12	6	3	6	3	3	2,244	4,459	4,308	3,490	1,714	4,804	4,712	3,461
Aruba	2	11	2	11	6	2	6	2	3	2	7	7	...	...	...	...	...
Bahamas	-	12	2	12	5	2	6	3	3	10	32	38	...	4	30	26	...
Barbados	-	11	2	11	5	2	6	3	2	6	18	18	...	4	19	19	...
Belize	-	8	2	8	5	2	6	4	2	16	47	46	40	5	45	41	9
Bolivia, P. S.	2	12	2	12	6	2	6	2	4	472	1,411	1,385	...	351	1,394	1,273	...
Brazil	2	12	2	12	6	2	5	4	3	6,025[i]	14,566[i]	21,284[i]	16,467[i]	5,178	15,367	22,162	8,987
British Virgin Islands	-	12	-	12	5	2	7	3	3	1	2	2	2	0.5	3	2	1
Cayman Islands	1	11	2	12	5	2	6	3	3	1	5	5	...	1	5	4	...
Chile	-	12	2	12	6	3	6	2	4	700	1,512	1,496	1,324	625	1,542	1,535	1,214
Colombia	1	11	3	11	6	3	5	4	2	2,223	3,688	4,603	4,287	1,942	4,192	4,927	2,448
Costa Rica	2	11	2	11	6	2	6	3	2	140	429	356	370	135	458	505	222
Cuba	-	9	3	12	6	3	6	3	3	359	751	730	667	369	756	719	358
Curaçao	2	12	...	...	6	2	6	2	4	4	12	13	...	4	16	15	...
Dominica	-	12	-	12	5	2	7	3	2	2	6	5	5	1	6	5	...
Dominican Republic	3	12	3	12	6	3	6	3	3	573[i]	1,153[i]	1,141[i]	929[i]	192	1,117	864	557
Ecuador	3	12	3	12	6	3	6	3	3	996	1,926	1,863	1,573	581	1,850	1,879	827
El Salvador	3	9	3	12	7	3	6	3	3	342	678	680	641	189	603	458	192
Grenada	-	12	2	12	5	2	7	3	2	4	13	8	9	5	13	9	9
Guatemala	3	9	3	12	7	3	6	3	3	1,228	2,366	2,314	1,807	607	2,397	1,096	400
Guyana	-	6	-	6	6	3	6	3	2	45	88	70	...	...	...	...	...
Haiti	-	6	-	6	6	3	6	3	4	752	1,477	1,643	1,074	...	...	...	...
Honduras	1	11	3	11	6	3	6	3	2	607	1,185	1,021	1,038	203	1,046	581	264
Jamaica	-	6	-	6	6	3	6	3	2	...	...	...	242	92	217	196	...
Mexico	2	12	2	12	6	3	6	3	3	6,640	13,446	13,386	11,005	4,744	13,903	13,709	4,931
Montserrat	-	12	-	12	5	2	7	3	2	0.1	0.4	0.3	0.2	0.1	0.4	0.3	...
Nicaragua	1	6	-	11	6	3	6	3	2	393	787	631	...	275	881	...	...
Panama	2	9	2	12	6	2	6	3	3	156	463	444	353	98	466	361	157
Paraguay	1	12	3	12	6	3	6	3	3	420	819	806	...	210	701	612	...
Peru	3	11	3	11	6	3	6	3	2	1,690	3,142	2,687	2,430	1,577	3,835	2,939	1,896
Saint Kitts and Nevis	-	12	-	12	5	2	7	3	2	1	5	4	...	1	5	4	...
Saint Lucia	-	10	-	10	5	2	7	3	2	4	15	11	15	3	15	11	2
Saint Vincent/Grenadines	-	12	2	12	5	2	7	3	2	3	12	8	9	4	13	10	...
Sint Maarten	2	11	2	11	6	3	6	2	3	2	3	2	...	...	...	...	...
Suriname	-	6	...	...	6	2	6	4	3	21	63	72	49	17	63	50	...
Trinidad and Tobago	-	7	...	...	5	2	7	3	2	36	...	...	87	24	130	86	...
Turks and Caicos Islands	2	11	2	11	6	2	6	3	2	1	3	3	3	1	3	2	...
Uruguay	2	12	2	12	6	3	6	3	3	142	284	281	251	139	294	343	170
Venezuela, B. R.	3	11	3	11	6	3	6	3	2	1,487	3,261	2,627	...	1,190	3,285	2,391	...

Finance										
G	H	I								
Government education expenditure (% of GDP)	Education share of total government expenditure (%)	Government education expenditure per pupil								Country code
		2019 PPP USD				% of GDP per capita				
		Pre-primary	Primary	Secondary	Tertiary	Pre-primary	Primary	Secondary	Tertiary	
	1.a.2	4.5.4								
2021										
5.1_{-2}	15.2_{-2}	$6,748_{-2}$	$10,827_{-2}$	$9,175_{-2}$	$8,422_{-2}$	12_{-2}	20_{-2}	17_{-2}	16_{-2}	AUS
4.6	9.1_{-2}	...	...	...	...	...	...	...	...	COK
5.6	...	...	...	...	...	...	...	...	...	FJI
13.6_{-4}	12.2_{-2}	...	...	...	...	...	...	...	...	KIR
15.7	15.0_{-2}	$1,437_{-2}$	$1,883_{-2}$	935_{-2}	373_{-2}	24_{-2}	32_{-2}	16_{-2}	6_{-2}	MHL
10.2_{-2}	...	...	...	...	...	...	...	...	...	FSM
9.5_{+1}	9.6_{-3}	...	...	...	...	...	...	...	...	NRU
5.2_{-2}	15.9_{-2}	$7,536_{-2}$	$7,163_{-2}$	$6,825_{-2}$	$12,359_{-2}$	16_{-2}	15_{-2}	15_{-2}	27_{-2}	NZL
...	...	...	...	...	$-_{-4}$	...	...	...	$-_{-4}$	NIU
...	...	...	...	...	...	...	...	...	...	PLW
1.9_{-3i}	9.2_{-3i}	...	...	...	...	...	...	...	...	PNG
4.8_{-1}	...	107	557	809	...	2	9	13	...	WSM
...	...	...	...	...	...	...	...	...	...	SLB
...	...	...	...	...	...	...	...	...	...	TKL
6.6	...	...	...	...	...	...	...	...	...	TON
...	...	...	...	...	...	...	...	...	...	TUV
2.2_{-1}	5.0_{-1}	...	85_{-1}	341_{-1}	...	...	3_{-1}	11_{-1}	...	VUT
4.0_{-1}	...	...	...	...	...	...	...	...	...	AIA
4.3_{+1}	...	...	...	...	...	...	...	...	...	ATG
5.1_{-1}	11.9_{-1}	$2,848_{-1}$	$3,090_{-1}$	$3,651_{-1}$	$3,030_{-1}$	14_{-1}	15_{-1}	18_{-1}	15_{-1}	ARG
...	...	...	...	...	33,992	...	...	...	87	ABW
2.8_{+1}	...	...	...	...	...	...	...	...	...	BHS
5.9_{+1}	14.8	...	3,665	3,274	...	...	25	23	...	BRB
7.7_{-1}	22.2_{-2}	$1,349_{-1}$	$1,349_{-1}$	$1,947_{-2}$	$2,084_{-2}$	14_{-1}	14_{-1}	21_{-2}	23_{-2}	BLZ
8.4_{-1}	22.2_{-1}	997_{-1}	$2,463_{-1}$	$1,952_{-1}$	...	12_{-1}	30_{-1}	24_{-1}	...	BOL
6.0_{-2}	16.0_{-2}	...	$3,184_{-2}$	$3,321_{-2}$	$4,917_{-2}$	...	21_{-2}	21_{-2}	32_{-2}	BRA
2.6_{-1}	...	...	...	...	...	0.1_{-1}	8_{-1}	14_{-1}	56_{-2}	VGB
2.1_{-2}	...	...	...	...	...	...	...	...	...	CYM
5.6_{-2}	21.2_{-2}	$6,129_{-2}$	$5,148_{-2}$	$5,338_{-2}$	$5,815_{-2}$	23_{-2}	19_{-2}	20_{-2}	22_{-2}	CHL
5.2_{-1}	15.6_{-1}	$1,076_{-3}$	$2,667_{-3}$	$2,770_{-3}$	$3,398_{-3}$	8_{-1}	23_{-1}	23_{-1}	17_{-1}	COL
6.7_{-1}	30.1_{-1}	$2,039_{-1}$	$5,193_{-1}$	$5,542_{-1}$	$14,371_{-1}$	9_{-1}	23_{-1}	25_{-1}	65_{-1}	CRI
$-_{-1}$	...	...	...	...	...	...	...	...	...	CUB
7.7_{-1}	...	...	...	...	...	...	...	...	...	CUW
5.2_{+1}	10.7_{-1}	384_{-1}	$2,055_{-1}$	$3,177_{-1}$	$-_{-1}$	3_{-1}	16_{-1}	25_{-1}	$-_{-1}$	DMA
3.7	...	2,271	3,800	2,673	...	12	19	14	...	DOM
3.7	10.4	3,265	1,147	681	$2,634_{-1}$	29	10	6	24_{-1}	ECU
4.6	14.3_{-2}	983_{-2}	$1,415_{-2}$	$1,246_{-2}$	$1,048_{-2}$	10_{-2}	15_{-2}	13_{-2}	11_{-2}	SLV
4.1	14.0_{-4}	$1,005_{-4}$	$1,400_{-4}$	$1,865_{-4}$	890_{-4}	6_{-4}	9_{-4}	12_{-4}	6_{-4}	GRD
3.1	23.0	1,137	1,199	509	$1,628_{-2}$	12	13	5	18_{-2}	GTM
4.5_{-3i}	16.0_{-3i}	...	...	...	...	...	...	...	...	GUY
1.8	14.6_{-3}	...	...	...	...	...	...	...	...	HTI
6.1_{-3}	23.2_{-3}	...	...	...	2,281	...	...	...	42	HND
5.2_{-2}	17.3_{-2}	546_{-2}	$2,296_{-2}$	$2,894_{-2}$	3,541	5_{-2}	22_{-2}	27_{-2}	35	JAM
4.3_{-3}	16.6_{-3}	...	$2,753_{-2}$	$2,690_{-2}$	$4,811_{-2}$	...	13_{-2}	13_{-2}	23_{-2}	MEX
5.1	...	...	...	...	...	32_{-2}	14_{-2}	31_{-2}	...	MSR
4.1	22.4_{-4i}	...	...	...	...	...	...	...	...	NIC
3.5	...	...	...	...	...	...	...	...	...	PAN
3.5	23.6	1,607	1,754	1,818	...	11	12	13	...	PRY
4.0	16.7	1,707	1,589	2,046	$1,423_{-4}$	13	12	16	11_{-4}	PER
2.8	7.2	3,420	1,911	3,669	1,588	11	7	13	5	KNA
4.9_{+1}	14.4_{-1}	$-_{-1}$	$2,117_{-1}$	$3,383_{-1}$	$-_{-1}$	$-_{-1}$	13_{-1}	21_{-1}	$-_{-1}$	LCA
6.6_{-1}	19.0_{-3}	403	$2,284_{-3}$	$2,628_{-3}$	...	3	15_{-3}	18_{-3}	...	VCT
...	...	...	...	...	...	...	...	...	...	SXM
4.0	...	...	...	...	...	...	...	...	...	SUR
3.0	9.8	168	2,177	3,371	...	1	9	14	...	TTO
3.7_{+1}	11.2	6,771	1,302	3,765	$-_{-2}$	35	7	20	$-_{-2}$	TCA
4.5	13.9_{-1}	$2,719_{-1}$	$2,989_{-1}$	$3,329_{-1}$	$5,590_{-1}$	12_{-1}	13_{-1}	14_{-1}	24_{-1}	URY
...	...	...	...	...	...	...	...	...	...	VEN

TABLE 1: Continued

Country or territory	A Compulsory: Years of pre-primary	A Compulsory: Years of primary-secondary	B Free: Years of pre-primary	B Free: Years of primary-secondary	C Official primary school starting age	D Duration (years): Pre-primary	D Duration (years): Primary	D Duration (years): Lower secondary	D Duration (years): Upper secondary	E School age population (000,000): Pre-primary	E School age population (000,000): Primary	E School age population (000,000): Secondary	E School age population (000,000): Tertiary	F Enrolment (000,000): Pre-primary	F Enrolment (000,000): Primary	F Enrolment (000,000): Secondary	F Enrolment (000,000): Tertiary
SDG indicator	4.2.5	4.1.7	4.2.5	4.1.7													
Reference year	2021									2022				2021			
Europe and Northern America																	
Albania	-	9	3	12	6	3	5	4	3	102	167	236	218	71	159	236	124
Andorra	-	11	-	10	6	3	6	4	2	...	...	...	...	2	4	5	1
Austria	1	12	1	12	6	3	4	4	4	267	343	688	484	266	344	693	422
Belarus	-	9	-	11	6	3	4	5	2	351	484	690	421	353	445	699	346
Belgium	-	12	3	12	6	3	6	2	4	388	807	798	644	442	824	1,175	521
Bermuda	-	13	1	13	5	1	6	3	4	-	3	5	4	0.3	4	...	1
Bosnia and Herzegovina	-	9	-	9	6	3	5	4	4	83	...	...	211	22	148	231	83
Bulgaria	2	9	4	12	7	4	4	4	4	250	272	564	301	218	248	473	227
Canada	-	10	1	12	6	3	6	3	3	1,189	2,383	2,403	2,232	578	2,428	2,682	1,775
Croatia	-	8	-	8	7	4	4	4	4	151	162	326	237	112	157	325	162
Czechia	1	9	-	13	6	3	5	4	4	330	555	878	468	369	572	834	319
Denmark	-	10	-	10	6	3	7	3	3	178	430	409	371	178	452	530	308
Estonia	-	9	-	12	7	4	6	3	3	57	91	83	58	...	90	89	45
Finland	1	9	1	12	7	4	6	3	3	225	372	365	311	209	373	514	296
France	3	10	3	12	6	3	5	4	3	2,273$_i$	4,145$_i$	5,934$_i$	3,963$_i$	2,485	4,279	6,157	2,748
Germany	-	13	-	13	6	3	4	6	3	2,408	3,075	7,020	4,494	2,491	3,015	6,877	3,280
Greece	1	9	2	12	6	2	6	3	3	168	576	649	532	165	626	677	802
Hungary	3	10	3	12	7	4	4	4	4	358	359	775	517	321	359	802	285
Iceland	-	10	...	10	6	3	7	3	4	13	32	31	23	12	33	35	19
Ireland	-	10	...	10	5	2	8	3	2	127$_i$	557$_i$	332$_i$	317$_i$	121	570	443	237
Italy	-	12	-	8	6	3	5	3	5	1,447	2,674	4,600	2,923	1,415	2,763	4,636	2,031
Latvia	2	9	6	12	7	4	6	3	3	87$_i$	120$_i$	114$_i$	84$_i$	82	120	117	79
Liechtenstein	1	8	...	...	7	2	5	4	3	1$_i$	2$_i$	3$_i$	2$_i$	1	2	3	1
Lithuania	1	10	1	12	7	4	4	6	2	119$_i$	115$_i$	208$_i$	150$_i$	106	119	224	106
Luxembourg	2	10	3	13	6	3	6	3	4	20	40	47	39	18	40	50	7
Malta	-	11	2	13	5	2	6	3	4	9	26	28	24	10	27	31	17
Monaco	-	11	3	12	6	3	5	4	3	1$_i$	2$_i$	3$_i$	2$_i$	1	2	3	1
Montenegro	-	9	-	13	6	3	5	4	4	22	37	63	41	16	38	57	23
Netherlands	1	12	2	12	6	3	6	4	3	520	1,078	1,364	1,019	485	1,162	1,612	937
North Macedonia	-	13	-	13	6	3	5	4	4	69	116	184	131	22	108	150	56
Norway	-	10	-	10	6	3	7	3	3	183	442	389	348	177	446	455	294
Poland	1	9	4	12	7	4	4	4	4	1,490	1,526	3,013	1,972	1,401	1,334	3,359	1,390
Portugal	-	12	2	12	6	3	6	3	3	244	535	604	540	251	602	742	380
Republic of Moldova	1	12	4	12	7	4	4	5	3	137$_i$	127$_i$	234$_i$	129$_i$	124	137	227	81
Romania	-	10	3	13	6	3	5	4	4	551	963	1,677	1,021	526	904	1,438	543
Russian Federation	-	11	4	11	7	4	4	5	2	7,619	7,437	11,147	6,496	6,496	7,123	10,543	5,698
San Marino	-	10	-	13	6	3	5	3	5	1$_i$	2$_i$	3$_i$	2$_i$	1	2	2	1
Serbia	-	8	-	12	7	4	4	4	4	260$_i$	263$_i$	553$_i$	351$_i$	166	255	511	243
Slovakia	1	10	1	13	6	3	4	5	4	170	226	497	291	172	233	443	138
Slovenia	-	9	-	13	6	3	6	3	4	63	131	139	96	61	134	148	77
Spain	-	10	3	10	6	3	6	3	3	1,208	2,736	2,933	2,236	1,282	3,007	3,473	2,145
Sweden	1	9	1	12	7	4	6	3	3	478	713	684	537	475	892	948	453
Switzerland	2	9	2	9	7	2	6	3	4	179	512	591	489	179	528	606	320
Ukraine	-	11	-	11	6	3	4	5	2	...	...	...	...	998	1,722	2,616	1,402
United Kingdom	-	11	2	13	5	2	6	3	4	1,595	4,943	5,465	3,935	1,727	4,904	6,135	2,734
United States	-	12	1	12	6	3	6	3	3	12,071$_i$	24,391$_i$	25,056$_i$	21,420$_i$	8,739	24,466	25,183	18,757

Finance										
G	H	I								
		Government education expenditure per pupil								
		2019 PPP USD				% of GDP per capita				
Government education expenditure (% of GDP)	Education share of total government expenditure (%)	Pre-primary	Primary	Secondary	Tertiary	Pre-primary	Primary	Secondary	Tertiary	Country code
	1.a.2	4.5.4								
2021										
3.3$_{-1}$	11.4$_{-2}$	…	5,395$_{-2}$	1,391$_{-2}$	2,221$_{-1}$	…	38$_{-2}$	10$_{-2}$	16$_{-1}$	ALB
3.2$_{-2}$	10.9$_{-2}$	…	…	…	…	13$_{-2}$	12$_{-2}$	13$_{-2}$	16$_{-2}$	AND
5.2$_{-2}$	9.9$_{-2}$	10,445$_{-2}$	13,438$_{-2}$	15,265$_{-2}$	21,786$_{-2}$	17$_{-2}$	22$_{-2}$	25$_{-2}$	36$_{-2}$	AUT
4.7	13.1$_{-2}$	6,226	…	…	4,371	30	…	…	21	BLR
6.3$_{-2}$	11.8$_{-2}$	9,977$_{-2}$	11,811$_{-2}$	13,233$_{-2}$	19,208$_{-2}$	18$_{-2}$	21$_{-2}$	23$_{-2}$	34$_{-2}$	BEL
1.9$_{+1}$	7.8$_{-4}$	12,591	5,837	8,650	17,529$_{-4}$	16	7	11	22$_{-4}$	BMU
…	…	2,408$_{-3}$	1,955$_{-3}$	5,028$_{-3}$	4,827$_{-2}$	16$_{-3}$	13$_{-3}$	33$_{-3}$	31$_{-2}$	BIH
4.2$_{-2}$	10.7$_{-2}$	7,644$_{-2}$	5,665$_{-2}$	5,965$_{-2}$	6,080$_{-2}$	30$_{-2}$	22$_{-2}$	23$_{-2}$	24$_{-2}$	BGR
4.8$_{-2}$	12.7$_{-2}$	…	…	…	13,826$_{-2}$	…	…	…	28$_{-2}$	CAN
3.9$_{-2}$	10.2$_{-2}$	…	…	…	980$_{-2}$	…	…	…	3$_{-2}$	HRV
4.5$_{-2}$	11.9$_{-2}$	7,414$_{-2}$	7,466$_{-2}$	11,990$_{-2}$	13,761$_{-2}$	17$_{-2}$	17$_{-2}$	27$_{-2}$	31$_{-2}$	CZE
6.9$_{-2}$	12.7$_{-2}$	9,108$_{-2}$	12,452$_{-2}$	13,769$_{-2}$	26,913$_{-2}$	15$_{-2}$	20$_{-2}$	22$_{-2}$	44$_{-2}$	DNK
5.3$_{-2}$	15.5$_{-2}$	…	8,757$_{-2}$	7,863$_{-2}$	10,608$_{-2}$	…	23$_{-2}$	20$_{-2}$	27$_{-2}$	EST
6.4$_{-2}$	10.6$_{-2}$	10,598$_{-2}$	10,908$_{-2}$	12,637$_{-2}$	14,723$_{-2}$	20$_{-2}$	21$_{-2}$	24$_{-2}$	28$_{-2}$	FIN
5.4$_{-2}$	9.5$_{-2}$	9,310$_{-2}$	9,328$_{-2}$	12,833$_{-2}$	15,023$_{-2}$	18$_{-2}$	18$_{-2}$	25$_{-2}$	29$_{-2}$	FRA
5.1$_{-2}$	9.6$_{-2}$	10,837$_{-2}$	10,754$_{-2}$	14,008$_{-2}$	18,676$_{-2}$	19$_{-2}$	19$_{-2}$	24$_{-2}$	32$_{-2}$	DEU
3.6$_{-2}$	8.3$_{-2}$	5,568$_{-2}$	6,698$_{-2}$	6,173$_{-2}$	3,027$_{-2}$	18$_{-2}$	22$_{-2}$	20$_{-2}$	10$_{-2}$	GRC
4.2$_{-2}$	11.0$_{-3}$	7,172$_{-2}$	7,376$_{-2}$	6,645$_{-2}$	8,957$_{-2}$	21$_{-2}$	21$_{-2}$	19$_{-2}$	26$_{-2}$	HUN
7.6$_{-2}$	16.1$_{-2}$	15,035$_{-2}$	14,218$_{-2}$	13,039$_{-2}$	14,176$_{-2}$	26$_{-2}$	24$_{-2}$	22$_{-2}$	24$_{-2}$	ISL
3.3$_{-2}$	12.8$_{-2}$	3,246	8,742$_{-2}$	10,299$_{-2}$	16,073$_{-2}$	4	10$_{-2}$	12$_{-2}$	18$_{-2}$	IRL
4.1$_{-2}$	8.0$_{-2}$	9,339$_{-2}$	9,965$_{-2}$	10,679$_{-2}$	10,858$_{-2}$	20$_{-2}$	22$_{-2}$	23$_{-2}$	24$_{-2}$	ITA
4.4$_{-2}$	15.0$_{-2}$	6,309$_{-2}$	6,706$_{-2}$	7,274$_{-2}$	5,139$_{-2}$	19$_{-2}$	20$_{-2}$	22$_{-2}$	16$_{-2}$	LVA
…	…	…	…	…	…	…	…	…	…	LIE
4.0$_{-2}$	13.3$_{-2}$	7,148$_{-2}$	6,610$_{-2}$	6,560$_{-2}$	6,745$_{-2}$	18$_{-2}$	17$_{-2}$	17$_{-2}$	17$_{-2}$	LTU
3.7$_{-2}$	11.0$_{-2}$	22,024$_{-2}$	21,970$_{-2}$	24,764$_{-2}$	47,378$_{-2}$	18$_{-2}$	18$_{-2}$	20$_{-2}$	39$_{-2}$	LUX
5.0$_{-2}$	14.2$_{-2}$	9,572$_{-2}$	9,396$_{-2}$	15,137$_{-2}$	20,740$_{-2}$	20$_{-2}$	19$_{-2}$	31$_{-2}$	43$_{-2}$	MLT
1.4	5.9	…	…	…	…	5	4	11	1	MCO
…	…	…	…	…	…	…	…	…	…	MNE
5.2$_{-2}$	11.8$_{-2}$	7,546$_{-2}$	10,565$_{-2}$	13,617$_{-2}$	19,355$_{-2}$	12$_{-2}$	17$_{-2}$	22$_{-2}$	31$_{-2}$	NLD
…	…	…	…	…	…	…	…	…	…	MKD
7.9$_{-2}$	10.9$_{-2}$	13,802$_{-2}$	14,569$_{-2}$	16,882$_{-2}$	25,075$_{-2}$	22$_{-2}$	23$_{-2}$	27$_{-2}$	40$_{-2}$	NOR
4.7$_{-2}$	12.0$_{-2}$	6,959$_{-2}$	8,241$_{-2}$	7,426$_{-2}$	10,335$_{-2}$	20$_{-2}$	23$_{-2}$	21$_{-2}$	29$_{-2}$	POL
4.6$_{-2}$	10.3$_{-2}$	5,514$_{-2}$	8,698$_{-2}$	10,651$_{-2}$	7,945$_{-2}$	15$_{-2}$	23$_{-2}$	28$_{-2}$	21$_{-2}$	PRT
5.8	18.4$_{-2}$	4,548	3,044	3,197	3,866	31	21	22	26	MDA
3.6$_{-2}$	10.1$_{-2}$	4,622$_{-2}$	3,141$_{-2}$	6,746$_{-2}$	9,863$_{-2}$	14$_{-2}$	9$_{-2}$	20$_{-2}$	29$_{-2}$	ROU
3.5$_{-2}$	9.3$_{-2}$	…	…	…	5,552$_{-3}$	…	…	…	18$_{-3}$	RUS
3.4$_{-1}$	8.9$_{-2}$	10,271$_{-1}$	14,946$_{-1}$	14,472$_{-1}$	5,490$_{-1}$	17$_{-1}$	25$_{-1}$	24$_{-1}$	9$_{-1}$	SMR
3.6$_{-2}$	8.6$_{-2}$	…	…	…	5,557$_{-2}$	…	…	…	29$_{-2}$	SRB
4.3$_{-2}$	9.8$_{-2}$	6,282$_{-2}$	7,305$_{-2}$	7,167$_{-2}$	9,781$_{-2}$	19$_{-2}$	22$_{-2}$	22$_{-2}$	30$_{-2}$	SVK
4.9$_{-2}$	12.6$_{-2}$	7,319$_{-2}$	9,211$_{-2}$	9,698$_{-2}$	11,242$_{-2}$	17$_{-2}$	22$_{-2}$	23$_{-2}$	27$_{-2}$	SVN
4.2$_{-2}$	9.6$_{-2}$	6,806$_{-2}$	7,257$_{-2}$	8,145$_{-2}$	9,094$_{-2}$	16$_{-2}$	17$_{-2}$	19$_{-2}$	21$_{-2}$	ESP
7.6$_{-2}$	14.1$_{-2}$	13,948$_{-2}$	12,799$_{-2}$	13,610$_{-2}$	20,610$_{-2}$	24$_{-2}$	22$_{-2}$	24$_{-2}$	36$_{-2}$	SWE
5.1$_{-2}$	15.6$_{-2}$	14,169$_{-3}$	17,355$_{-3}$	16,615$_{-3}$	26,142$_{-3}$	20$_{-3}$	24$_{-3}$	23$_{-3}$	36$_{-3}$	CHE
5.6	14.6$_{-2}$	4,627$_{-1}$	3,723$_{-1}$	3,730$_{-1}$	4,689$_{-1}$	35$_{-1}$	28$_{-1}$	29$_{-1}$	36$_{-1}$	UKR
5.2$_{-2}$	11.9$_{-2}$	4,035$_{-2}$	11,062$_{-2}$	10,759$_{-2}$	17,997$_{-2}$	8$_{-2}$	23$_{-2}$	22$_{-2}$	37$_{-2}$	GBR
5.0$_{-2}$	15.7$_{-3}$	8,121$_{-2}$	13,057$_{-2}$	14,441$_{-2}$	14,428$_{-2}$	13$_{-2}$	20$_{-2}$	23$_{-2}$	23$_{-2}$	USA

TABLE 2: SDG 4, Target 4.1 – Primary and secondary education

By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes

	Participation/completion																	
	A						B			C		D	E	F	G	H	I	J
	Out-of-school (000,000)			Out-of-school rate (%)			Completion rate (%)			Over-age for grade (%)		GER primary (%)	NERA primary (%)	GIR last primary (%)	Transition from primary to lower secondary (%)	NERT lower secondary (%)	GIR last lower secondary grade (%)	NERT upper secondary (%)
	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary							
SDG indicator				4.1.4			4.1.2			4.1.5				4.1.3			4.1.3	
Reference year	2021						2020			2021		2021						
Region	**Sum**			**Weighted average**								**Weighted average**						
World	67	57	121	9	14	30	87	76	58	10_{-1i}	10_{-1i}	102_{-1}	91_{-1i}	90_{-1i}	88_{-1}	85_{-1i}	77_{-1i}	67_{-1i}
Sub-Saharan Africa	36	28	34	20	33	48	63	44	27	26_{-1i}	34_{-1i}	99_{-1i}	80_{-1i}	72_{-1i}	70_{-1}	64_{-1i}	44_{-1i}	42_{-1i}
Northern Africa and Western Asia	5	3	7	9	10	23	89	72	57	8_{-1i}	11_{-1i}	100_{-1i}	91_{-1i}	90_{-1i}	81_{-1}	88_{-1i}	80_{-1i}	70_{-1i}
Northern Africa	3	1	3	8	9	25	89	71	60	8_{-1i}	15_{-1i}	102_{-1i}	92_{-1i}	94_{-1i}	80_{-1}	90_{-1i}	75_{-1i}	70_{-1i}
Western Asia	2	2	3	8	10	21	90_{i}	83_{i}	61_{i}	7_{-1i}	8_{-1}	97_{-1i}	90_{-1i}	85_{-1i}	92_{-1i}	87_{-1}	84_{-1i}	70_{-1i}
Central and Southern Asia	13	15	57	7	13	39	88	79	53	7_{-1}	6_{-1}	102_{-1}	92_{-1}	93_{-1}	90_{-1}	85_{-1}	81_{-1}	59_{-1}
Central Asia	0.1_{i}	0.2_{i}	0.5_{i}	3	2	18	99_{i}	99_{i}	91_{i}	1_{-1}	1_{-1i}	102_{-1}	97_{-1}	103_{-1}	100_{-1i}	99_{-1}	98_{-1i}	80_{-1i}
Southern Asia	13	15	56	7	13	39	86	78	51	7_{-1}	6_{-1}	102_{-1}	92_{-1}	93_{-1}	91_{-1}	84_{-1}	80_{-1}	58_{-1}
Eastern and South-eastern Asia	7	7	14	4	7	16	97	88	71	5_{-4i}	9_{-2i}	104_{-1}	97_{-1i}	98_{-1i}	90_{-1}	91_{-1i}	92_{-1i}	81_{-1i}
Eastern Asia	4	3	5	4	6	8	98	91	77	…	…	103_{-1}	97_{-1i}	95_{-1i}	93_{-1}	93_{-1i}	96_{-1i}	86_{-1i}
South-eastern Asia	3	4	9	4	9	28	95	80	62	3_{-1i}	9_{-1i}	106_{-1i}	96_{-1i}	102_{-1i}	85_{-1}	89_{-1i}	86_{-1i}	72_{-1i}
Oceania	0.3	0.1	0.3	7	4	20	86	73	62	15_{-1}	13_{-1}	105_{-1}	98_{-1}	96_{-2i}	85_{-1}	89_{-1}	72_{-2i}	77_{-1}
Latin America and the Caribbean	2	2	6	4	7	20	93	83	62	8_{-1}	13_{-1}	106_{-1}	96_{-1}	99_{-1i}	89_{-1}	94_{-1}	80_{-1i}	79_{-1}
Caribbean	0.3	0.2	0.5	8	10	21	74	67	40	6_{i}	9_{i}	…	…	…	90_{-1}	…	…	…
Central America	1	1	3	4	11	30	95	83	54	3	6	103	97	100	87_{-1}	86	85	65
South America	1	1	3	3	4	15	94	84	69	6	13	106_{i}	96_{i}	102_{i}	90_{-1}	96_{i}	91_{i}	86_{i}
Europe and Northern America	1	1	3	2	3	9	100	98	89	2_{-1}	3_{-1}	100_{-1}	98_{-1}	99_{-1}	98_{-1}	99_{-1}	94_{-1}	94_{-1}
Europe	1_{i}	1_{i}	1_{i}	2	2	7	100	98	87	1_{-1i}	2_{-1i}	100_{-1}	98_{-1}	99_{-1i}	98_{-1}	98_{-1}	94_{-1i}	93_{-1}
Northern America	0.5	0.1	1	2	1	4	100	99	93	3_{-1}	4_{-1}	100_{-1}	98_{-1}	101_{-1}	99_{-1}	100_{-1}	95_{-1}	96_{-1}
Low income	21	17	23	19	32	53	55	34	18	25_{-1i}	28_{-2i}	103_{-1i}	79_{-1i}	68_{-1i}	62_{-1}	63_{-2i}	41_{-1i}	38_{-2i}
Middle income	41	37	94	8	12	30	89	79	57	8_{-1i}	10_{-1i}	102_{-1}	92_{-1i}	93_{-1i}	89_{-1}	86_{-1i}	81_{-1i}	67_{-1i}
Lower middle	34	32	81	10	16	37	87	75	53	10_{-1i}	10_{-1}	101_{-1}	90_{-1i}	92_{-1i}	87_{-1}	82_{-1i}	76_{-1i}	60_{-1i}
Upper middle	8	7	15	4	6	15	96	88	70	5_{-1i}	9_{-1i}	103_{-1}	96_{-1i}	96_{-1i}	92_{-1}	93_{-1i}	91_{-1i}	82_{-1i}
High income	1	1	2	2	2	5	100	97	90	2_{-1}	4_{-1}	100_{-1}	98_{-1}	99_{-1}	98_{-1}	98_{-1}	94_{-1}	95_{-1}

A Out-of-school children, total number and out-of-school rate as a percentage of the corresponding age group [*Source:* UIS and GEM Report analysis of administrative data and household surveys for the regional and global aggregates; UIS database for country data].

B Education completion rate by level [*Source:* UIS and GEM Report analysis of household surveys].

C Percentage of pupils who are at least two years over-age for their current grade, by level.

D Gross enrolment ratio (GER) in primary education.

E Primary adjusted net enrolment rate (NERA) (%).

F Gross intake ratio (GIR) to last grade of primary education (%).

G Effective transition rate from primary to lower secondary general education (%).

H Lower secondary total net enrolment rate (NERT) (%).

I Gross intake ratio (GIR) to last grade of lower secondary education (%).

J Upper secondary total net enrolment rate (NERT) (%).

K Administration of nationally representative learning assesssment in early grades (grade 2 or 3), or final grade of primary or lower secondary.

L Percentage of students achieving at least a minimum proficiency level in reading and mathematics.

Source: UIS unless noted otherwise. Data refer to school year ending in 2021 unless noted otherwise.

Aggregates represent countries listed in the table with available data and may include estimates for countries with no recent data.

(-) Magnitude nil or negligible.

(…) Data not available or category not applicable.

(± n) Reference year differs (e.g. -2: reference year 2019 instead of 2021).

(i) Estimate and/or partial coverage.

Learning											
K Administration of nationally representative learning assessment						L Achieving minimum proficiency (%)					
Early grades		End of primary		End of lower secondary		Early grades		End of primary		End of lower secondary	
Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics
4.1.6						4.1.1					
2021											
% of countries						Weighted average					
57	56	67	68	52	54	...	...	58_{-2i}	44_{-2i}	64_{-2i}	51_{-2i}
69	69	52	52	17	17	36_{-2i}	52_{-2i}	30_{-2i}	11_{-2i}	...	...
12	12	54	58	54	71	...	...	...	32_{-2i}	63_{-2i}	31_{-2i}
17	17	33	17	17	33	...	...	...	...	...	...
11	11	61	72	67	83	...	...	...	...	...	...
57	50	50	57	50	50	...	...	...	...	...	...
60	40	40	40	40	40	...	...	...	...	...	...
56	56	56	67	56	56	...	...	...	...	...	...
50	50	78	78	83	83	...	...	...	...	55_{-2i}	47_{-2i}
43	43	57	57	86	86	...	...	...	...	...	...
55	55	91	91	82	82	...	...	...	...	...	...
100	100	100	100	35	35	94_{-2i}	71_{-2i}	...	64_{-2i}	81_{-2i}	76_{-2i}
55	52	57	57	40	40	68_{-2i}	65_{-2i}	43_{-2i}	36_{-2i}	52_{-2i}	36_{-2i}
26	26	35	35	13	13	...	...	...	...	...	...
100	100	100	100	86	86	...	...	...	...	...	...
83	75	75	75	67	67	...	...	...	...	...	...
57	54	85	87	93	93	...	...	97_{-2i}	77_{-2i}	81_{-2i}	75_{-2i}
58	56	84	86	93	93	...	...	...	...	...	...
33	33	100	100	100	100	...	...	...	...	...	...
64	64	46	46	14	14	37_{-2i}	49_{-2i}	17_{-2i}	10_{-2i}	...	...
58	58	67	69	52	53	...	...	...	...	...	...
65	63	65	65	39	41	...	...	54_{-2i}	...	...	39_{-2i}
52	52	69	73	65	65	63_{-2i}	65_{-2i}	52_{-2i}	46_{-2i}	56_{-2i}	44_{-2i}
51	49	75	77	72	77	...	...	93_{-2i}	72_{-2i}	81_{-2i}	71_{-2i}

TABLE 2: Continued

Country or territory	Participation/completion																			
	A						B			C		D	E	F	G	H	I	J
	Out-of-school (000,000)			Out-of-school rate (%)			Completion rate (%)			Over-age for grade (%)		GER primary (%)	NERA primary (%)	GIR last primary (%)	Transition from primary to lower secondary (%)	NERT lower secondary (%)	GIR last lower secondary grade (%)	NERT upper secondary (%)
	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary							
SDG indicator					4.1.4			4.1.2		4.1.5				4.1.3			4.1.3	
Reference year			2021					2020		2021					2021			
Sub-Saharan Africa																		
Angola	…	…	…	…	…	…	59	37	18	…	…	85_{-3}	…	…	62_{-1}	…	…	…
Benin	60	484	508	3	42	66	62	29	12	13	26	117	97	73	47_{-1}	58	37	34
Botswana	31_{-4}	13_{-4}	27_{-2}	9_{-4}	10_{-4}	31_{-2}	…	…	…	15_{-4}	22_{-2}	99	91_{-4}	…	…	90_{-4}	89_{-2}	69_{-2}
Burkina Faso	887	987	940	25	48	68	…	…	…	23	56	92	75	67	…	53	39	32
Burundi	202_{-1}	246_{-1}	449_{-1}	10_{-1}	30_{-1}	62_{-1}	52	27	8	29_{-1}	50_{-1}	115_{-1}	90_{-1}	53_{-1}	52_{-1}	70_{-1}	30_{-1}	38_{-1}
Cabo Verde	5_{-2}	4_{-2}	8_{-2}	8_{-2}	13_{-2}	27_{-2}	…	…	…	8_{-2}	31_{-2}	101_{-2}	92_{-2}	100_{-2}	…	87_{-2}	71_{-2}	73_{-2}
Cameroon	178	1,234	1,107	4	48	65	76	45	19	14	23	109	96	69	59_{-1}	52	36	35
Central African Republic	85_{-4}	252_{-4}	260_{-4}	11_{-4}	52_{-4}	81_{-4}	31	17	9	37_{-4}	57_{-4}	128_{-4}	89_{-4}	55_{-4}	54_{-1}	48_{-4}	12_{-4}	19_{-4}
Chad	646	975	848	22	58	76	31	17	6	28	35	94	78	45	54_{-1}	42	19	24
Comoros	23_{-3}	14_{-3}	25_{-3}	18_{-3}	19_{-3}	50_{-3}	74_{-3}	43_{-3}	20_{-3}	27_{-4}	…	100_{-3}	82_{-3}	77_{-4}	58_{-4}	81_{-3}	44_{-4}	50_{-3}
Congo	131_{-3}	135_{-3}	128_{-3}	16_{-3}	29_{-3}	41_{-3}	87	56	28	14_{-3}	31_{-3}	94_{-3}	84_{-3}	67_{-3}	64_{-1}	71_{-3}	63_{-3}	59_{-3}
Côte d'Ivoire	135	951	998	3	42	58	58	31	13	9_{+1}	26	99_{+1}	97	74_{+1}	54_{-1}	62	59	43
D. R. Congo	…	…	…	…	…	…	58	47	21	16_{-1}	…	124_{-1}	…	81_{-1}	81_{-1}	…	59_{-1}	…
Djibouti	33_{+1}	27_{+1}	29_{+1}	33_{+1}	39_{+1}	54_{+1}	…	…	…	8_{+1}	21_{+1}	73_{+1}	67_{+1}	66_{+1}	…	61_{+1}	53_{+1}	46_{+1}
Equat. Guinea	…	…	…	…	…	…	…	…	…	…	…	67_{-2}	…	…	…	…	…	…
Eritrea	242_{-2}	109_{-2}	142_{-2}	48_{-2}	39_{-2}	48_{-2}	…	…	…	36_{-2}	49_{-2}	69_{-2}	52_{-2}	56_{-2}	…	61_{-2}	51_{-2}	52_{-2}
Eswatini	31_{-2}	…	…	15_{-2}	…	…	66_{-1}	46_{-1}	30_{-1}	39_{-2}	66_{-2}	114_{-2}	85_{-2}	89_{-2}	70_{-2}	…	70_{-2}	…
Ethiopia	$3,880_{i}$	…	…	22_{i}	…	…	57	27	14	19	…	106	78_{i}	69	48_{-1}	…	…	…
Gabon	58_{-2}	51_{-2}	47_{-2}	23_{-2}	30_{-2}	42_{-2}	57_{-3}	24_{-3}	10_{-3}	35_{-2}	64_{-2}	108_{-2}	77_{-2}	78_{-2}	42_{-4}	70_{-2}	59_{-2}	58_{-2}
Gambia	57_{+1}	23_{+1}	67_{+1}	14_{+1}	13_{+1}	42_{+1}	69	53	30	29	39	103_{+1}	86_{+1}	86_{+1}	76_{-1}	87_{+1}	60_{+1}	58_{+1}
Ghana	265_{-1}	65	579	6_{-1}	3	30	77	54	37	32	42_{-1}	105	94_{-1}	94_{-3}	70_{-1}	97	78_{-2}	70
Guinea	302_{-1}	675_{-1}	648_{-1}	14_{-1}	54_{-1}	75_{-1}	53	37	22	12_{-1}	22_{-1}	101_{-1}	86_{-1}	59_{-1}	69_{-1}	46_{-1}	33_{-1}	25_{-1}
Guinea-Bissau	…	…	…	…	…	…	25	13	10	…	…	…	…	…	53_{-1}	…	…	…
Kenya	…	…	…	…	…	…	74_{-1}	66_{-1}	39_{-1}	…	…	77_{-2}	…	…	89_{-2}	…	…	…
Lesotho	25_{-2}	20_{-2}	40_{-2}	8_{-2}	15_{-2}	45_{-2}	78	36	22	28_{-2}	44_{-2}	108_{-2}	92_{-2}	91_{-2}	46_{-1}	85_{-2}	48_{-2}	55_{-2}
Liberia	211_{-1}	129_{-1}	125_{-1}	27_{-1}	36_{-1}	37_{-1}	29	21	13	86_{-1}	84_{-1}	77_{-1}	73_{-1}	61_{-4}	74_{-1}	64_{-1}	44_{-4}	63_{-1}
Madagascar	81_{-2}	764_{-2}	$1,132_{-2}$	2_{-2}	30_{-2}	64_{-2}	52	30	11	44_{-2}	55_{-2}	134_{-2}	98_{-2}	63_{-2}	58_{-1}	70_{-2}	35_{-2}	36_{-2}
Malawi	…	342_{-2}	571_{-2}	…	29_{-2}	69_{-2}	48	25	14	36_{-2}	…	130_{+1}	98_{-2}	89	51_{-1}	81_{-2}	23_{+1}	31_{-2}
Mali	$1,343_{-3}$	719_{-3}	893_{-3}	41_{-3}	53_{-3}	75_{-3}	53	26	11	11_{-3}	17_{-4}	79_{-1}	59_{-3}	50_{-4}	49_{-1}	47_{-3}	30_{-4}	25_{-3}
Mauritania	156_{-2}	110_{-2}	163_{-2}	23_{-2}	28_{-2}	61_{-2}	46	46	22	39_{-2}	42_{-2}	94_{-1}	77_{-2}	73_{-2}	100_{-1}	72_{-2}	46_{-2}	39_{-2}
Mauritius	3_{+1}	4_{+1}	12_{+1}	3_{+1}	9_{+1}	17_{+1}	…	…	…	1_{+1}	12_{+1}	103_{+1}	97_{+1}	98_{+1}	…	91_{+1}	134_{+1}	83_{+1}
Mozambique	53_{-1}	879_{-1}	885_{-1}	1_{-1}	38_{-1}	61_{-1}	…	…	…	37_{-1}	55_{-1}	118_{-1}	99_{-1}	58_{-1}	…	62_{-1}	32_{-1}	39_{-1}
Namibia	6	2	16	1	1	16	82_{-2}	51_{-2}	34_{-2}	22	44	126	99	110	62_{-3}	99	95	84
Niger	1,830	1,685	1,318	41	72	87	40_{-3}	8_{-3}	2_{-3}	3	20	65	58	58	20_{-4}	28	16	13
Nigeria	…	…	…	…	…	…	80	71	62	…	…	86_{-2}	…	…	89_{-1}	…	…	…
Rwanda	130	23	315	7	3	39	57	29	18	37	45	141	93	91	50_{-1}	97	45	61
Sao Tome and Principe	2_{-4}	…	…	6_{-4}	…	…	88	82	47	15_{-4}	43_{-4}	107_{-4}	94_{-4}	84_{-4}	94_{-1}	…	74_{-4}	…
Senegal	766_{i}	…	…	27_{i}	…	…	51	28	10	6	…	81	73_{i}	63	56_{-1}	…	42	…
Seychelles	0.2	0.2	1	2	4	12	…	…	…	1	0.5	99	98	99	…	96	103	88
Sierra Leone	…	268_{-3}	432_{-3}	…	49_{-3}	65_{-3}	66	43	12	1	13	156	98	98	65_{-1}	51_{-3}	56	35_{-3}
Somalia	…	…	…	…	…	…	…	…	…	…	…	9	…	…	…	…	…	…
South Africa	925_{-1}	224_{-1}	534_{-1}	12_{-1}	11_{-1}	18_{-1}	98	88	49	7_{-1}	21_{-1}	97_{-1}	88_{-1}	92_{-1}	90_{-1}	89_{-1}	85_{-1}	82_{-1}
South Sudan	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Togo	21	145	288	2	18	54	80	42	19	14	26	124	98	91	53_{-1}	82	57	46
Uganda	$1,197_{-4}$	$2,001_{-4}$	$1,371_{-4}$	14_{-4}	49_{-4}	75_{-4}	40	34	16	34_{-4}	48_{-4}	103_{-4}	86_{-4}	53_{-4}	84_{-1}	51_{-4}	26_{-4}	25_{-4}
United Republic of Tanzania	$1,813_{-1}$	…	…	16_{-1}	…	…	74	32	11	…	…	97	84_{-1}	69_{-1}	44_{-1}	…	33_{-1}	…
Zambia	496_{-4}	…	…	15_{-4}	…	…	69	46	28	27_{-4}	…	99_{-4}	85_{-4}	…	66_{-1}	…	…	…
Zimbabwe	186	315	399	6	22	61	87	73	8	24	26	96	94	85	84_{-1}	78	58	39

Learning												
K Administration of nationally representative learning assessment						L Achieving minimum proficiency (%)						
Early grades		End of primary		End of lower secondary		Early grades		End of primary		End of lower secondary		
Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Country code
4.1.6						4.1.1						
2021												
No	No	No	No	No	No	…	…	…	…	…	…	AGO
Yes	Yes	Yes	Yes	No	No	38_{-2}	62_{-2}	46_{-2}	19_{-2}	…	…	BEN
No	No	No	No	No	No	…	…	…	…	…	…	BWA
Yes	Yes	Yes	Yes	No	No	34_{-2}	61_{-2}	33_{-2}	25_{-2}	…	…	BFA
Yes	Yes	Yes	Yes	No	No	79_{-2}	99_{-2}	4_{-2}	18_{-2}	…	…	BDI
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	CPV
Yes	Yes	Yes	Yes	No	No	39_{-2}	58_{-2}	30_{-2}	11_{-2}	…	…	CMR
Yes	Yes	No	No	No	No	…	…	…	…	…	…	CAF
Yes	Yes	Yes	Yes	No	No	34_{-2}	64_{-2}	8_{-2}	2_{-2}	…	…	TCD
No	No	No	No	No	No	…	…	…	…	…	…	COM
Yes	Yes	Yes	Yes	No	No	63_{-2}	86_{-2}	34_{-2}	8_{-2}	…	…	COG
Yes	Yes	Yes	Yes	No	No	33_{-2}	68_{-2}	22_{-2}	3_{-2}	…	…	CIV
Yes	Yes	Yes	Yes	No	No	42_{-2}	77_{-2}	9_{-2}	3_{-2}	…	…	COD
No	No	No	No	No	No	…	…	…	…	…	…	DJI
No	No	No	No	No	No	…	…	…	…	…	…	GNQ
No	No	No	No	No	No	…	…	…	…	…	…	ERI
No	No	No	No	No	No	…	…	…	…	…	…	SWZ
Yes	Yes	No	No	Yes	Yes	…	…	…	…	…	…	ETH
Yes	Yes	Yes	Yes	No	No	66_{-2}	88_{-2}	76_{-2}	23_{-2}	…	…	GAB
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	GMB
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	GHA
Yes	Yes	Yes	Yes	No	No	23_{-2}	60_{-2}	22_{-2}	7_{-2}	…	…	GIN
Yes	Yes	No	No	No	No	…	…	…	…	…	…	GNB
Yes	Yes	Yes	Yes	Yes	Yes	…	…	47	74	…	…	KEN
Yes	Yes	No	No	No	No	…	…	…	…	…	…	LSO
Yes	Yes	No	No	No	No	…	…	…	…	…	…	LBR
Yes	Yes	Yes	Yes	No	No	55_{-2}	79_{-2}	6_{-2}	6_{-2}	…	…	MDG
Yes	Yes	No	No	No	No	…	…	…	…	…	…	MWI
No	No	No	No	No	No	…	…	…	…	…	…	MLI
No	No	No	No	No	No	…	…	…	…	…	…	MRT
No	No	No	No	Yes	Yes	…	…	…	…	…	…	MUS
Yes	Yes	No	No	No	No	…	…	…	…	…	…	MOZ
No	No	Yes	Yes	No	No	…	…	…	…	…	…	NAM
Yes	Yes	Yes	Yes	No	No	44_{-2}	67_{-2}	14_{-2}	8_{-2}	…	…	NER
No	No	No	No	No	No	…	…	…	…	…	…	NGA
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	RWA
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	STP
Yes	Yes	Yes	Yes	No	No	48_{-2}	79_{-2}	41_{-2}	27_{-2}	9_{-4}	8_{-4}	SEN
Yes	Yes	No	No	No	No	…	…	…	…	…	…	SYC
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	SLE
No	No	No	No	No	No	…	…	…	…	…	…	SOM
Yes	Yes	Yes	Yes	Yes	Yes	…	16_{-2}	…	…	…	…	ZAF
No	No	No	No	No	No	…	…	…	…	…	…	SSD
Yes	Yes	Yes	Yes	No	No	24_{-2}	47_{-2}	19_{-2}	16_{-2}	…	…	TGO
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	UGA
Yes	Yes	No	No	No	No	…	…	…	…	…	…	TZA
No	No	Yes	Yes	No	No	…	…	2	2	5_{-4}	2_{-4}	ZMB
Yes	Yes	No	No	No	No	…	…	…	…	…	…	ZWE

TABLE 2: Continued

Country or territory	Participation/completion																		
	A						B			C		D	E	F	G	H	I	J
	Out-of-school (000,000)			Out-of-school rate (%)			Completion rate (%)			Over-age for grade (%)								
	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	GER primary (%)	NERA primary (%)	GIR last primary (%)	Transition from primary to lower secondary (%)	NERT lower secondary (%)	GIR last lower secondary grade (%)	NERT upper secondary (%)
SDG indicator				4.1.4			4.1.2			4.1.5				4.1.3			4.1.3	
Reference year	2021						2020			2021		2021						
Northern Africa and Western Asia																			
Algeria	28_{+1}	…	…	1_{+1}	…	…	95	68	43	5_{+1}	18_{+1}	109_{+1}	99_{+1}	96_{+1}	72_{-1}	…	78_{+1}	…
Armenia	18	17	5	11	9	5	100	98	97	1	1	91	89	92	98_{-1}	91	88	95
Azerbaijan	77_{i}	8_{i}	1_{i}	11_{i}	1_{i}	0.4_{i}	…	…	…	2	8	94_{i}	89_{i}	94_{i}	…	99_{i}	108_{i}	100_{i}
Bahrain	3_{-2}	2_{-2}	6_{-2}	2_{-2}	4_{-2}	13_{-2}	…	…	…	1_{-2}	3_{-2}	98_{-2}	98_{-2}	100_{-2}	…	96_{-2}	93_{-2}	87_{-2}
Cyprus	0.2_{-1i}	0.2_{-1i}	2_{-1i}	0.4_{-1i}	1_{-1i}	7_{-1i}	100	100	94	0.4_{-1}	2_{-1}	101_{-1i}	100_{-1i}	100_{-1i}	100_{-1}	99_{-1i}	82_{-1i}	93_{-1i}
Egypt	91_{-2}	128_{-2}	$1,209_{-2}$	1_{-2}	2_{-2}	23_{-2}	94_{-1}	85_{-1}	84_{-1}	2_{-3}	3_{-2}	106_{-2}	99_{-2}	105_{-2}	90_{-2}	98_{-2}	88_{-2}	77_{-2}
Georgia	4	1	5	1	1	4	100	99	92	1	1	101	99	91	99_{-1}	99	95	96
Iraq	…	…	…	…	…	…	76	47	45	…	…	…	…	…	62_{-1}	…	…	…
Israel	5_{-1}	0.3_{-1}	8_{-2}	0.5_{-1}	0.1_{-1}	2_{-2}	100_{-2}	99_{-2}	93_{-2}	0.4_{-1}	1_{-1}	104_{-1}	100_{-1}	107_{-1}	99_{-3}	100_{-1}	104_{-1}	98_{-2}
Jordan	285	215	155	20	24	37	98	91	59	1	2	80	80	81	93_{-1}	76	69	63
Kuwait	…	…	…	…	…	…	…	…	…	1	3	83	81	79	…	…	87	…
Lebanon	…	…	…	…	…	…	…	…	…	6	11	…	…	…	…	…	…	…
Libya	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Morocco	14	114	453	0.4	6	25	…	…	…	10	24	113	100	104	…	94	76	75
Oman	0.3	16	9_{-2}	0.1	4	10_{-2}	…	…	…	0.2	3	104	100	99	…	96	115	90_{-2}
Palestine	37	16	67	7	3	21	99	97	81	0.3	1	94	93	97	98_{-1}	97	93	79
Qatar	2	7	…	1	10	…	99_{-3}	96_{-3}	84_{-3}	1	3	102	99	95	97_{-4}	90	92	…
Saudi Arabia	21	22	8	1	1	1	…	…	…	3	5	102	99	105	…	99	100	99
Sudan	$2,131_{-3}$	687_{-3}	$1,462_{-3}$	33_{-3}	34_{-3}	52_{-3}	73_{-1}	48_{-1}	29_{-1}	26_{-3}	33_{-3}	79_{-3}	67_{-3}	64_{-3}	65_{-2}	66_{-3}	51_{-3}	48_{-3}
Syrian Arab Republic	42_{+1}	221_{+1}	574_{+1}	2_{+1}	21_{+1}	59_{+1}	…	…	…	1_{+1}	2_{+1}	103_{+1}	98_{+1}	94_{+1}	…	79_{+1}	73_{+1}	41_{+1}
Tunisia	9	…	…	1	…	…	96	89	66	7	18	112	99	105	93_{-1}	…	88	…
Türkiye	268_{-1}	111_{-1}	980_{-1}	5_{-1}	2_{-1}	19_{-1}	100_{-2}	96_{-2}	64_{-2}	2_{-1}	3_{-1}	97_{-1}	95_{-1}	94_{-1}	96_{-3}	98_{-1}	123_{-1}	82_{-1}
United Arab Emirates	3_{+1}	2_{+1}	15_{+1}	1_{+1}	0.4_{+1}	4_{+1}	…	…	…	$-_{+1}$	$-_{+1}$	112_{+1}	99_{+1}	102_{+1}	…	100_{+1}	100_{+1}	96_{+1}
Yemen	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Central and Southern Asia																			
Afghanistan	…	…	$1,481_{-3i}$	…	…	56_{-3i}	65	49	34	…	14_{-2}	107_{-2}	…	84_{-2}	75_{-1}	…	58_{-2}	44_{-3i}
Bangladesh	154_{-3}	916	4,471	1_{-3}	10	36	85	68	32	4	4	116	99_{-3}	122	79_{-1}	90	88_{-3}	64
Bhutan	2	7	6	3	13	20	…	…	…	7	88	106	97	90	…	87	85	80
India	$1,022_{+1}$	$10,027_{+1}$	$44,350_{+1}$	1_{+1}	13_{+1}	44_{+1}	94	86	59	2_{+1}	3_{+1}	111_{+1}	99_{+1}	115_{+1}	91_{-1}	87_{+1}	86_{+1}	56_{+1}
Iran, Islamic Republic of	11_{-1}	62_{-1}	571_{-1}	0.1_{-1}	2_{-1}	17_{-1}	…	…	…	2_{-1}	2_{-1}	110_{-1}	100_{-1}	101_{-1}	…	98_{-1}	91_{-1}	83_{-1}
Kazakhstan	145_{-1}	0.3_{-1}	5_{-3}	10_{-1}	$-_{-1}$	1_{-3}	100	100	98	2_{-1}	2_{-1}	100_{-1}	90_{-1}	102_{-1}	100_{-1}	100_{-1}	104_{-1}	99_{-3}
Kyrgyzstan	9	1	41	2	0.1	21	99	98	96	0.3	0.4	99	98	102	99_{-1}	100	99	79
Maldives	$-_{-1}$	1_{-1}	3_{-1}	0.1_{-1}	4_{-1}	50_{-2}	99	94	34	1_{-1}	5_{-1}	101_{-1}	100_{-1}	92_{-2}	95_{-1}	96_{-1}	111_{-2}	70_{-1}
Nepal	65_{+1}	111_{+1}	540_{+1}	2_{+1}	7_{+1}	22_{+1}	82	71	36	23_{+1}	25_{+1}	127_{+1}	98_{+1}	106_{+1}	87_{-1}	93_{+1}	103_{+1}	78_{+1}
Pakistan	…	…	…	…	…	…	54	48	24	…	…	95_{-2}	…	73_{-2}	89_{-1}	…	49_{-2}	…
Sri Lanka	9_{-3}	2_{-3}	211_{-3}	1_{-3}	0.1_{-3}	16_{-3}	…	…	…	0.1_{-1}	0.2_{-1}	100_{-1}	99_{-3}	98_{-1}	…	100_{-3}	101_{-1}	84_{-3}
Tajikistan	4_{-4}	…	…	1_{-4}	…	…	99	98	76	$-_{-4}$	$-_{-4}$	101_{-4}	99_{-4}	95_{-4}	99_{-1}	…	96_{-4}	…
Turkmenistan	…	…	…	…	…	…	100	100	94	…	…	115	…	118	100_{-1}	…	…	…
Uzbekistan	100	16	531	4	1	35	…	…	…	-	0.1_{-2}	98	96	101	…	99	95_{-2}	65
Eastern and South-eastern Asia																			
Brunei Darussalam	1_{-1}	$-_{-1}$	10_{-1}	2_{-1}	0.3_{-1}	30_{-1}	…	…	…	1_{-1}	2_{-1}	98_{-1}	98_{-1}	105_{-1}	…	100_{-1}	111_{-1}	70_{-1}
Cambodia	279	177	388	13	18	44	74_{-1}	46_{-1}	22_{-1}	22	27	103	87	91	62_{-2}	82	58	56
China	…	…	…	…	…	…	98	91	75	…	…	104	…	…	93_{-1}	…	…	…
DPR Korea	…	…	…	…	…	…	…	…	…	…	…	89_{-3}	…	…	…	…	…	…
Hong Kong, China	8_{i}	2_{i}	1_{i}	2_{i}	1_{i}	1_{i}	…	…	…	1	4	104	98_{i}	101	…	99_{i}	103	99_{i}
Indonesia	$1,555_{-3}$	$2,299_{-3}$	$3,137_{-3}$	6_{-3}	16_{-3}	23_{-3}	97	88	67	0.3_{-3}	9_{-3}	90_{-1}	94_{-3}	102_{-3}	91_{-1}	84_{-3}	90_{-4}	77_{-3}
Japan	169_{-1}	86_{-1}	70_{-1}	3_{-1}	3_{-1}	2_{-1}	100_{-2}	94_{-2}	96_{-2}	…	…	97_{-1}	97_{-1}	…	94_{-3}	97_{-1}	…	98_{-1}
Lao PDR	59	196	216	8	32	50	…	…	…	6	14	98	92	88	…	68	61	50
Macao, China	2	-	1	5	0.1	5	…	…	…	1	7	97	95	101	…	100	105	95
Malaysia	67	136	603	2	9	39	…	…	…	-	-	103	98	102	…	91	87	61
Mongolia	3	1	15	1	0.2	11	99	98	88	0.5	1	102	99	97	99_{-1}	100	91	89
Myanmar	92_{-3}	848_{-3}	884_{-3}	2_{-3}	21_{-3}	43_{-3}	84	53	22	…	9_{-3}	112_{-3}	98_{-3}	95_{-3}	62_{-1}	79_{-3}	65_{-3}	57_{-3}
Philippines	1,187	1,040	905	9	12	22	91	72	71	7	14	92	91	95	79_{-1}	88	90	78
Republic of Korea	38_{-1}	33_{-1}	129_{-1}	1_{-1}	2_{-1}	9_{-1}	100	100	99	0.1_{-1}	0.2_{-1}	99_{-1}	99_{-1}	100_{-1}	100_{-1}	98_{-1}	90_{-1}	91_{-1}
Singapore	0.3_{-1i}	1_{-1i}	1_{-1i}	0.1_{-1i}	1_{-1i}	1_{-1i}	…	…	…	0.3_{-1}	1_{-1}	101_{-1i}	100_{-1i}	101_{-1i}	…	99_{-1i}	100_{-1i}	99_{-1i}
Thailand	13_{+1}	165_{+1}	819	0.3_{+1}	7_{+1}	32	99	88	65	2_{+1}	2_{+1}	102_{+1}	100_{+1}	97_{+1}	89_{-1}	93_{+1}	126_{+1}	68
Timor-Leste	9_{-1}	10_{-1}	24_{-1}	5_{-1}	11_{-1}	25_{-1}	77	62	52	20_{-1}	29_{-1}	111_{-1}	95_{-1}	101_{-1}	80_{-1}	89_{-1}	92_{-1}	75_{-1}
Viet Nam	…	…	…	…	…	…	98_{-1}	93_{-1}	60_{-1}	…	…	118	98	110_{-3}	95_{-2}	…	98_{-3}	…

Learning												
K Administration of nationally representative learning assessment						L Achieving minimum proficiency (%)						
Early grades		End of primary		End of lower secondary		Early grades		End of primary		End of lower secondary		
Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Country code
4.1.6						4.1.1						
2021												
No	No	No	No	No	No	...	...	...	...	...	...	DZA
No	No	No	Yes	Yes	Yes	...	...	...	64_{-2}	...	...	ARM
No	No	Yes	Yes	Yes	Yes	...	...	...	72_{-2}	...	...	AZE
No	No	Yes	Yes	No	Yes	...	...	...	54_{-2}	...	55_{-2}	BHR
No	No	Yes	Yes	Yes	Yes	...	...	...	77_{-2}	56_{-3}	63_{-3}	CYP
No	No	Yes	No	No	Yes	...	...	...	...	...	27_{-2}	EGY
No	No	Yes	Yes	Yes	Yes	...	...	...	56_{-2}	36_{-3}	39_{-3}	GEO
No	No	No	No	No	No	...	...	...	...	...	...	IRQ
No	No	Yes	Yes	Yes	Yes	...	...	...	...	69_{-3}	66_{-3}	ISR
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	59_{-3}	41_{-3}	JOR
No	No	No	Yes	No	Yes	...	...	...	21_{-2}	...	21_{-2}	KWT
No	No	No	No	Yes	Yes	...	...	...	...	32_{-3}	27_{-2}	LBN
No	No	No	No	No	No	...	...	...	...	...	...	LBY
No	No	Yes	Yes	Yes	Yes	...	...	...	18_{-2}	27_{-3}	24_{-3}	MAR
No	No	Yes	Yes	No	Yes	...	...	...	33_{-2}	...	27_{-2}	OMN
Yes	Yes	No	No	Yes	Yes	...	...	...	...	...	...	PSE
No	No	Yes	Yes	Yes	Yes	...	...	...	40_{-2}	49_{-3}	37_{-2}	QAT
No	No	Yes	Yes	Yes	Yes	...	...	...	23_{-2}	48_{-3}	27_{-3}	SAU
No	No	No	No	No	No	...	...	...	...	...	...	SDN
No	No	No	No	No	No	...	...	...	...	...	...	SYR
Yes	Yes	No	No	No	No	...	...	...	...	...	...	TUN
No	No	Yes	Yes	Yes	Yes	...	...	...	70_{-2}	74_{-3}	56_{-2}	TUR
No	No	Yes	Yes	Yes	Yes	...	...	...	53_{-2}	57_{-3}	50_{-2}	ARE
No	No	No	No	No	No	...	...	...	...	...	...	YEM
No	No	No	No	No	No	...	...	...	...	...	...	AFG
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	...	BGD
Yes	Yes	Yes	Yes	No	No	...	...	...	...	...	...	BTN
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	...	IND
No	No	Yes	Yes	No	Yes	...	...	...	39_{-2}	...	37_{-2}	IRN
No	No	Yes	Yes	Yes	Yes	...	...	...	71_{-2}	36_{-3}	51_{-3}	KAZ
Yes	Yes	No	No	No	No	...	...	...	...	...	...	KGZ
No	No	No	No	No	No	...	...	...	...	...	...	MDV
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	...	NPL
Yes	Yes	No	Yes	Yes	Yes	...	...	...	8_{-2}	...	...	PAK
No	No	No	No	Yes	No	...	...	...	...	...	...	LKA
Yes	No	No	No	No	No	...	...	...	...	...	...	TJK
Yes	Yes	No	No	No	No	...	...	...	...	...	...	TKM
No	No	Yes	Yes	Yes	Yes	...	...	...	...	...	...	UZB
Yes	Yes	No	No	Yes	Yes	...	...	...	...	48_{-3}	52_{-3}	BRN
No	No	Yes	Yes	Yes	Yes	...	...	11_{-2}	18_{-2}	8_{-4}	10_{-4}	KHM
Yes	Yes	No	No	Yes	Yes	...	...	...	...	...	...	CHN
No	No	No	No	No	No	...	...	...	...	...	...	PRK
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	96_{-2}	87_{-3}	91_{-3}	HKG
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	30_{-3}	28_{-3}	IDN
No	No	Yes	Yes	Yes	Yes	...	...	...	...	...	...	JPN
No	No	Yes	Yes	No	No	...	...	2_{-2}	8_{-2}	...	...	LAO
No	No	Yes	No	Yes	Yes	...	...	...	...	89_{-3}	95_{-3}	MAC
No	No	Yes	Yes	Yes	Yes	...	...	58_{-2}	64_{-2}	54_{-3}	59_{-3}	MYS
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	...	MNG
No	No	Yes	Yes	No	No	...	...	11_{-2}	12_{-2}	...	...	MMR
Yes	Yes	Yes	Yes	Yes	Yes	...	...	10_{-2}	17_{-2}	19_{-3}	19_{-3}	PHL
No	No	No	Yes	Yes	Yes	...	...	...	95_{-2}	85_{-3}	85_{-3}	KOR
No	No	Yes	Yes	Yes	Yes	...	...	...	96_{-2}	89_{-3}	92_{-2}	SGP
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	40_{-3}	47_{-3}	THA
Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	...	TLS
Yes	Yes	Yes	Yes	Yes	Yes	...	...	82_{-2}	91_{-2}	90_{-3}	84_{-3}	VNM

TABLE 2: Continued

	Participation/completion																	
	A						B			C		D	E	F	G	H	I	J
	Out-of-school (000,000)			Out-of-school rate (%)			Completion rate (%)			Over-age for grade (%)								
Country or territory	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	GER primary (%)	NERA primary (%)	GIR last primary (%)	Transition from primary to lower secondary (%)	NERT lower secondary (%)	GIR last lower secondary grade (%)	NERT upper secondary (%)
SDG indicator				4.1.4			4.1.2			4.1.5				4.1.3			4.1.3	
Reference year	2021						2020			2021		2021						
Oceania																		
Australia	33_{-1}	26_{-1}	44_{-1}	1_{-1}	2_{-1}	7_{-1}	100	98	88	0.2_{-1}	1_{-1}	99_{-1}	99_{-1}	...	99_{-1}	98_{-1}	...	93_{-1}
Cook Islands	...	$-_{-4}$	0.2	...	3_{-4}	19	...	...	...	0.1	0.1	110	99	118	...	97_{-4}	114	81
Fiji	1_{-1}	1	10	1_{-1}	1	23	98_{-1}	93_{-1}	85_{-1}	1	2	114	99_{-1}	117	95_{-2}	99	103	77
Kiribati	1_{-1}	...	...	3_{-1}	...	...	93	79	18	3_{-1}	8_{-1}	108_{-1}	97_{-1}	93_{-1}	84_{-1}	...	100_{-1}	...
Marshall Islands	3	1	3	32	30	41	...	...	...	8	17	73	68	72	...	70	96	59
Micronesia, F. S.	2	1	3	17	21	30	...	...	...	10	13	90	83	88	...	79	74	70
Nauru	0.1_{-1}	0.1_{-2i}	$-_{-2i}$	4_{-1}	8_{-2i}	6_{-2i}	...	...	...	2_{-1}	0.4_{-1}	96_{-1}	96_{-1}	109_{-1}	...	92_{-2i}	96_{-1}	94_{-2i}
New Zealand	0.2_{-1}	0.1_{-1}	2_{-1}	0.1_{-1}	$-_{-1}$	1_{-1}	...	...	...	0.2_{-1}	0.2_{-1}	102_{-1}	100_{-1}	...	...	100_{-1}	...	99_{-1}
Niue	...	...	...	...	...	...	...	...	...	-	-	133	100	131	...	...	116	...
Palau	-	0.1_{-1}	-	2	16_{-1}	5	...	...	...	5	7	104	98	102	...	84_{-1}	104	95
Papua New Guinea	...	206_{-3}	195_{-3}	...	28_{-3}	55_{-3}	59	30	12	41_{-3}	53_{-3}	116_{-3}	98_{-3}	...	51_{-1}	72_{-3}	37_{-3}	45_{-3}
Samoa	0.4_{-3}	0.2_{-2}	3_{-2}	1_{-3}	2_{-2}	16_{-2}	98	97	57	11	10	122	99	114	99_{-1}	98_{-2}	107	84_{-2}
Solomon Is	7_{-2}	...	...	7_{-2}	...	...	...	...	...	75_{-2}	75_{-2}	104_{-2}	93_{-2}	86_{-2}	...	...	70_{-2}	...
Tokelau	...	...	-	...	...	1	...	...	...	-	$-_{-1}$	146	95	148	...	...	104_{-1}	99
Tonga	0.1_{-1}	1_{-1}	2_{-1}	1_{-1}	11_{-1}	41_{-1}	99	86	86	0.1_{-1}	1_{-1}	115_{-1}	99_{-1}	108_{-1}	88_{-1}	89_{-1}	76_{-1}	59_{-1}
Tuvalu	0.1	0.2	0.4	9	24	57	98	79	52	0.1	-	92	91	88	80_{-1}	76	66	43
Vanuatu	2_{-1}	5	8	3_{-1}	18	45	...	...	...	30	55	123	97_{-1}	102	...	82	57	55
Latin America and the Caribbean																		
Anguilla	$-_{-2}$	...	$-_{-2}$	1_{-2}	...	4_{-2}	...	...	...	1_{-2}	1_{-2}	106_{-2}	99_{-2}	96_{-2}	...	...	...	96_{-2}
Antigua and Barbuda	0.2_{-2}	0.1_{-2}	0.4_{-2}	2_{-2}	3_{-2}	13_{-2}	...	...	...	2_{-2}	12_{-2}	102_{-2}	98_{-2}	99_{-2}	...	97_{-2}	103_{-2}	87_{-2}
Argentina	9_{-1}	40_{-1}	185_{-1}	0.2_{-1}	4_{-1}	12_{-1}	96	75	64	2_{-1}	11_{-1}	109_{-1}	100_{-1}	103	78_{-1}	98_{-1}	94_{-1}	91_{-1}
Aruba	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bahamas	...	...	...	...	...	...	...	...	...	6_{-2}	...	...	...	...	...	...	...	...
Barbados	1	0.4_{-1}	0.5_{-1}	4	4_{-1}	6_{-1}	99_{-3}	99_{-3}	94_{-3}	0.1	1	98	96	98	100_{-4}	96_{-1}	102	94_{-1}
Belize	4	1	4	9	4	35	83	40	16	14	24	103	92	107	48_{-1}	96	77	74
Bolivia, P. S.	59	53	189	4	11	21	98	91	72	2	7	99	96	93_{-1}	93_{-1}	89	89_{-1}	79
Brazil	658_{-1i}	409_{-1i}	$1,252_{-1i}$	5_{-1i}	3_{-1i}	13_{-1i}	91	85	68	6_{-1}	15_{-1}	105_{-1i}	95_{-1i}	...	94_{-1}	97_{-1i}	...	87_{-1i}
British Virgin Islands	$-_{-3}$	-	...	2_{-3}	2	...	...	...	...	3	11	131	98	114	...	98	84	58_{-3}
Cayman Islands	0.4	0.2	0.4	9	6	17	...	...	...	1	1	94	91	90_{-3}	...	94	80_{-3}	83
Chile	9_{-1}	8_{-1}	49_{-1}	1_{-1}	2_{-1}	5_{-1}	99	98	83	3_{-1}	9_{-1}	101_{-1}	99_{-1}	101_{-1}	99_{-1}	98_{-1}	99_{-1}	95_{-1}
Colombia	42	21	223	1	1	14	94	78	64	12	21	113	99	105	83_{-1}	99	87	86
Costa Rica	0.3_{-1}	8_{-1i}	12_{-1i}	0.1_{-1}	4_{-1i}	8_{-1i}	98	71	54	5_{-1}	20_{-1}	107	100_{-1}	105	73_{-1}	96_{-1i}	102	92_{-1i}
Cuba	9	37	70	1	10	18	99	96	71	0.4	1	101	99	100	96_{-1}	90	82	82
Curaçao	1_{-1}	1_{-1}	1_{-1}	7_{-1}	15_{-1}	23_{-1}	...	...	...	10_{-1}	26_{-1}	130	93_{-1}	...	...	85_{-1}	...	77_{-1}
Dominica	0.2	$-_{i}$	0.2_{i}	3	1_{i}	13_{i}	...	...	...	3	...	102	97	102	...	99_{i}	...	87_{i}
Dominican Republic	122_{i}	93_{i}	184_{i}	11_{i}	16_{i}	32_{i}	93	88	58	8	16	97_{i}	89_{i}	88_{i}	95_{-1}	84_{i}	69_{i}	68_{i}
Ecuador	73	12	192	4	1	21	98	93	73	2	5	96	96	98	95_{-1}	99	105	79
El Salvador	...	...	142	...	...	41	91	70	34	10	16	...	...	...	76_{-1}	...	71_{-2}	59
Grenada	0.1_{-3}	...	$-_{-3}$	1_{-3}	...	0.1_{-3}	...	...	...	2_{-3}	11_{-1}	107_{-3}	99_{-3}	123_{-3}	...	...	106_{-1}	100_{-3}
Guatemala	222	401	775	9	35	66	83	53	37	12	19	102	91	87	64_{-1}	65	55	34
Guyana	...	...	...	...	...	...	99	89	66	...	...	...	...	...	90_{-1}	...	...	...
Haiti	...	...	...	...	...	...	46	36	17	...	...	...	...	...	78_{-1}	...	...	...
Honduras	222	277	249	19	45	60	91	74	45	8	21	88	81	...	82_{-1}	55	...	40
Jamaica	...	...	21	...	...	23	...	...	...	1	3	...	...	...	...	...	82_{-2}	77
Mexico	104_{-1}	525_{-1}	$1,913_{-1}$	1_{-1}	8_{-1}	28_{-1}	98	90	59	1_{-1}	2_{-1}	104_{-1}	99_{-1}	103_{-1}	92_{-1}	92_{-1}	91_{-1}	72_{-1}
Montserrat	...	$-_{-2}$	$-_{-2}$	...	7_{-2}	16_{-2}	...	...	...	$-_{-2}$	0.5_{-2}	106_{-2}	92_{-2}	97_{-2}	...	93_{-2}	110_{-2}	84_{-2}
Nicaragua	...	...	...	...	...	...	...	...	...	...	...	112_{-1}	...	...	...	...	...	...
Panama	18	26_{-4}	...	4	12_{-4}	...	94_{-2}	76_{-2}	61_{-2}	5	9	101	96	94	81_{-3}	88_{-4}	83	56_{-4}
Paraguay	...	...	129	...	...	33	93	78	65	6	10	...	...	...	84_{-1}	...	...	67
Peru	48_{-3}	49	36	1_{-3}	3	4	98	92	88	3	6	122	98	116	95_{-1}	97	100	96
Saint Kitts and Nevis	0.1	...	0.2	2	...	11	...	...	...	1	1	111	98	121	...	...	...	89
Saint Lucia	0.5_{-1}	1_{-1}	1_{-1}	9_{-1}	8_{-1}	23_{-1}	99_{-3}	96_{-3}	86_{-3}	1_{-1}	5_{-1}	101_{-1}	97_{-1}	100_{-1}	97_{-4}	91_{-1}	92_{-2}	84_{-1}
Saint Vincent/Grenadines	$-_{-1}$	0.2_{-1}	1_{-1}	0.1_{-1}	4_{-1}	16_{-1}	...	...	...	1_{-1}	14_{-1}	113_{-1}	100_{-1}	116_{-1}	...	96_{-1}	92_{-3}	84_{-1}
Sint Maarten	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Suriname	11	...	...	17	...	...	86	56	30	17	33	101	83	80	65_{-1}	...	45	...
Trinidad and Tobago	...	...	11_{i}	...	...	31_{i}	...	...	...	25	6	...	...	...	...	...	...	69_{i}
Turks and Caicos Islands	0.1	0.2	0.4	5	27	40	...	...	...	2	3	111	97	114	...	89	82	66
Uruguay	1_{-1}	2_{-1}	17_{-1}	0.3_{-1}	1_{-1}	12_{-1}	98	70	43	3_{-1}	12_{-1}	104_{-1}	100_{-1}	103_{-1}	72_{-1}	99_{-1}	95_{-2}	88_{-1}
Venezuela, B. R.	325_{-4}	232_{-4}	249_{-4}	10_{-4}	14_{-4}	23_{-4}	...	...	...	8_{-4}	12_{-4}	97_{-4}	90_{-4}	93_{-4}	...	86_{-4}	75_{-4}	77_{-4}

Learning												
K Administration of nationally representative learning assessment						L Achieving minimum proficiency (%)						
Early grades		End of primary		End of lower secondary		Early grades		End of primary		End of lower secondary		
Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Country code
4.1.6						4.1.1						
2021												
Yes	Yes	Yes	Yes	Yes	Yes	…	70_{-2}	…	68_{-2}	80_{-3}	78_{-3}	AUS
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	COK
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	FJI
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	KIR
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	MHL
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	FSM
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	NRU
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	56_{-2}	81_{-3}	78_{-3}	NZL
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	NIU
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	PLW
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	PNG
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	WSM
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	SLB
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	TKL
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	TON
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	TUV
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	VUT
No	No	No	No	No	No	…	…	…	…	…	…	AIA
No	No	Yes	Yes	No	No	…	…	…	…	…	…	ATG
Yes	Yes	Yes	Yes	Yes	Yes	54_{-2}	51_{-2}	32_{-2}	13_{-2}	48_{-3}	31_{-3}	ARG
No	No	No	No	No	No	…	…	…	…	…	…	ABW
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	BHS
No	No	No	No	No	No	…	…	…	…	…	…	BRB
No	No	No	No	No	No	…	…	…	…	…	…	BLZ
No	No	No	No	No	No	48_{-4}	38_{-4}	15_{-4}	8_{-4}	…	…	BOL
Yes	Yes	Yes	Yes	Yes	Yes	72_{-2}	69_{-2}	44_{-2}	29_{-2}	50_{-3}	32_{-3}	BRA
No	No	No	No	No	No	…	…	…	…	…	…	VGB
No	No	Yes	Yes	No	No	…	…	…	…	…	…	CYM
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	68_{-3}	33_{-2}	CHL
Yes	Yes	Yes	Yes	Yes	Yes	64_{-2}	56_{-2}	38_{-2}	17_{-2}	50_{-3}	35_{-3}	COL
Yes	Yes	Yes	Yes	Yes	Yes	75_{-2}	67_{-2}	54_{-2}	21_{-2}	58_{-3}	40_{-3}	CRI
Yes	Yes	Yes	Yes	Yes	Yes	70_{-2}	75_{-2}	44_{-2}	21_{-2}	…	…	CUB
No	No	No	No	No	No	…	…	…	…	…	…	CUW
No	No	Yes	Yes	No	No	…	…	…	…	…	…	DMA
Yes	Yes	Yes	Yes	Yes	Yes	27_{-2}	20_{-2}	16_{-2}	2_{-2}	21_{-3}	9_{-3}	DOM
Yes	Yes	Yes	Yes	Yes	Yes	58_{-2}	57_{-2}	26_{-2}	23_{-2}	49_{-4}	29_{-4}	ECU
Yes	Yes	Yes	Yes	Yes	Yes	56_{-2}	50_{-2}	29_{-2}	8_{-2}	…	…	SLV
No	No	No	No	No	No	…	…	…	…	…	…	GRD
Yes	Yes	Yes	Yes	Yes	Yes	39_{-2}	35_{-2}	16_{-2}	7_{-2}	30_{-4}	11_{-4}	GTM
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	GUY
No	No	No	No	No	No	…	…	…	…	…	…	HTI
Yes	Yes	Yes	Yes	Yes	Yes	47_{-2}	54_{-2}	16_{-2}	11_{-2}	30_{-4}	15_{-4}	HND
No	No	Yes	Yes	Yes	Yes	…	…	…	…	…	…	JAM
Yes	Yes	Yes	Yes	Yes	Yes	63_{-2}	65_{-2}	42_{-2}	38_{-2}	55_{-3}	44_{-3}	MEX
No	No	No	No	No	No	…	…	…	…	…	…	MSR
Yes	Yes	Yes	Yes	No	No	36_{-2}	35_{-2}	13_{-2}	3_{-2}	…	…	NIC
Yes	Yes	Yes	Yes	Yes	Yes	41_{-2}	32_{-2}	18_{-2}	3_{-2}	36_{-3}	19_{-3}	PAN
Yes	Yes	Yes	Yes	Yes	Yes	49_{-2}	38_{-2}	19_{-2}	6_{-2}	32_{-4}	8_{-4}	PRY
Yes	Yes	Yes	Yes	Yes	Yes	76_{-2}	71_{-2}	49_{-2}	39_{-2}	…	…	PER
No	No	No	No	No	No	…	…	…	…	…	…	KNA
No	No	No	No	No	No	…	…	…	…	…	…	LCA
No	No	No	No	No	No	…	…	…	…	…	…	VCT
No	No	No	No	No	No	…	…	…	…	…	…	SXM
Yes	Yes	No	No	No	No	…	…	…	…	…	…	SUR
Yes	Yes	Yes	Yes	No	No	…	…	…	…	…	…	TTO
Yes	Yes	No	No	No	No	…	…	…	…	…	…	TCA
Yes	Yes	Yes	Yes	Yes	Yes	64_{-2}	63_{-2}	44_{-2}	38_{-2}	58_{-3}	49_{-3}	URY
Yes	No	No	No	No	No	…	…	…	…	…	…	VEN

TABLE 2: Continued

Country or territory	Participation/completion																	
	A						B			C		D	E	F	G	H	I	J
	Out-of-school (000,000)			Out-of-school rate (%)			Completion rate (%)			Over-age for grade (%)		GER primary (%)	NERA primary (%)	GIR last primary (%)	Transition from primary to lower secondary (%)	NERT lower secondary (%)	GIR last lower secondary grade (%)	NERT upper secondary (%)
	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary	Upper secondary	Primary	Lower secondary							
SDG indicator				4.1.4			4.1.2			4.1.5				4.1.3			4.1.3	
Reference year	2021						2020			2021		2021						
Europe and Northern America																		
Albania	13	3	18	8	2	16	97	97	84	2	3	96	92	98	99_{-1}	98	95	84
Andorra	…	…	…	…	…	…	…	…	…	2	4	…	…	…	…	…	…	…
Austria	1_{-1}	4_{-1}	33_{-1}	0.3_{-1}	1_{-1}	9_{-1}	100	100	85	5_{-1}	9_{-1}	102_{-1}	100_{-1}	100_{-1}	100_{-1}	99_{-1}	96_{-1}	91_{-1}
Belarus	30	1_{-1}	13	6	0.1_{-1}	7	100	99	92	1	1	94	94	94	99_{-1}	100_{-1}	100	93
Belgium	9_{-1}	1_{-1}	8_{-1}	1_{-1}	1_{-1}	2_{-1}	100	91	86	1_{-1}	3_{-1}	102_{-1}	99_{-1}	…	91_{-1}	99_{-1}	95_{-1}	98_{-1}
Bermuda	…	…	…	…	…	…	…	…	…	…	…	98_{-1}	…	…	…	…	…	…
Bosnia and Herzegovina	…	…	24	…	…	19	…	…	…	1	1	…	…	…	…	…	94_{-3}	81
Bulgaria	45_{-1}	48_{-1}	46_{-1}	15_{-1}	17_{-1}	18_{-1}	100	93	84	1_{-1}	4_{-1}	85_{-1}	85_{-1}	88_{-1}	94_{-1}	83_{-1}	…	82_{-1}
Canada	8_{-1}	…	118_{-1}	0.3_{-1}	…	10_{-1}	…	…	…	…	…	102_{-1}	100_{-1}	…	…	…	…	90_{-1}
Croatia	3_{-1}	2_{-1}	17_{-1}	2_{-1}	1_{-1}	11_{-1}	100	100	97	0.3_{-1}	0.3_{-1}	93_{-1}	98_{-1}	96_{-1}	100_{-1}	99_{-1}	98_{-1}	89_{-1}
Czechia	8_{-1}	0.4_{-1}	19_{-1}	1_{-1}	0.1_{-1}	5_{-1}	100	100	92	4_{-1}	5_{-1}	100_{-1}	99_{-1}	101_{-1}	100_{-1}	100_{-1}	93_{-1}	95_{-1}
Denmark	3_{-1}	0.1_{-1}	16_{-1}	1_{-1}	0.1_{-1}	8_{-1}	100	100	79	0.2_{-1}	1_{-1}	100_{-1}	99_{-1}	99_{-1}	100_{-1}	100_{-1}	104_{-1}	92_{-1}
Estonia	2_{-4}	0.3_{-1}	2_{-1}	2_{-4}	1_{-1}	4_{-1}	100	97	88	1_{-1}	3_{-1}	98_{-1}	98_{-4}	98_{-1}	97_{-1}	99_{-1}	101_{-1}	96_{-1}
Finland	6_{-1}	1_{-1}	5_{-1}	2_{-1}	0.3_{-1}	3_{-1}	100	100	89	…	…	100_{-1}	98_{-1}	99_{-1}	100_{-1}	100_{-1}	102_{-1}	97_{-1}
France	6_{-1i}	1_{-1i}	78_{-1i}	0.1_{-1i}	$-_{-1i}$	3_{-1i}	100	97	88	…	1_{-1}	103_{-1i}	100_{-1i}	…	97_{-1}	100_{-1i}	100_{-1i}	97_{-1i}
Germany	61_{-1}	195_{-1}	416_{-1}	2_{-1}	4_{-1}	17_{-1}	100	95	88	…	…	101_{-1}	98_{-1}	99_{-1}	95_{-1}	96_{-1}	…	83_{-1}
Greece	3_{-1}	11_{-1}	14_{-1}	0.4_{-1}	3_{-1}	5_{-1}	100	97	92	1_{-1}	4_{-1}	101_{-1}	100_{-1}	101_{-1}	97_{-1}	97_{-1}	94_{-1}	95_{-1}
Hungary	21_{-1}	8_{-1}	48_{-1}	6_{-1}	2_{-1}	12_{-1}	99	94	85	1_{-1}	3_{-1}	96_{-1}	94_{-1}	94_{-1}	95_{-1}	98_{-1}	96_{-1}	88_{-1}
Iceland	0.1_{-1}	0.1_{-1}	3_{-1}	0.4_{-1}	1_{-1}	15_{-1}	100_{-2}	100_{-2}	67_{-2}	$-_{-1}$	$-_{-1}$	101_{-1}	100_{-1}	99_{-1}	100_{-3}	99_{-1}	103_{-1}	85_{-1}
Ireland	0.2_{-1i}	1_{-1i}	2_{-1i}	$-_{-1i}$	1_{-1i}	1_{-1i}	100_{-2}	98_{-2}	91_{-2}	$-_{-1}$	0.2_{-1}	101_{-1i}	100_{-1i}	99_{-1i}	98_{-3}	99_{-1i}	100_{-1i}	99_{-1i}
Italy	116_{-1}	39_{-1}	185_{-1}	4_{-1}	2_{-1}	6_{-1}	100	99	87	0.3_{-1}	2_{-1}	100_{-1}	96_{-1}	98_{-1}	99_{-1}	98_{-1}	99_{-1}	94_{-1}
Latvia	2_{-1i}	1_{-1i}	3_{-1i}	1_{-1i}	2_{-1i}	5_{-1i}	100	99	83	1_{-1}	3_{-1}	100_{-1i}	99_{-1i}	98_{-1i}	99_{-1}	98_{-1i}	98_{-1i}	95_{-1i}
Liechtenstein	$-_{i}$	$-_{i}$	0.1_{i}	1_{i}	3_{i}	10_{i}	…	…	…	0.1	1	102_{i}	99_{i}	89_{i}	…	97_{i}	94_{i}	90_{i}
Lithuania	0.1_{-1i}	0.2_{-1i}	1_{-1i}	0.1_{-1i}	0.1_{-1i}	2_{-1i}	100	100	90	0.2_{-1}	1_{-1}	103_{-1i}	100_{-1i}	104_{-1i}	100_{-1}	100_{-1i}	101_{-1i}	98_{-1i}
Luxembourg	0.3_{-1}	0.2_{-1}	5_{-1}	1_{-1}	1_{-1}	18_{-1}	100	88	79	2_{-1}	8_{-2}	106_{-1}	99_{-1}	84_{-1}	88_{-1}	99_{-1}	117_{-2}	82_{-1}
Malta	0.1_{-4}	0.2_{-2}	1_{-1}	0.2_{-4}	2_{-2}	5_{-1}	100_{-2}	100_{-2}	75_{-2}	0.4_{-1}	0.5_{-1}	107_{-1}	100_{-1}	109_{-1}	100_{-3}	98_{-2}	106_{-1}	95_{-1}
Monaco	…	…	…	…	…	…	…	…	…	$-_{+1}$	0.2_{+1}	118_{+1i}	99_{+1i}	108_{+1i}	…	…	125_{+1i}	…
Montenegro	0.2	1	4	0.5	3	13	99	98	87	1	1	102	100	101	99_{-1}	97	89	87
Netherlands	3_{-1}	18_{-1}	25_{-1}	0.3_{-1}	2_{-1}	4_{-1}	100	93	81	…	…	106_{-1}	100_{-1}	…	93_{-1}	98_{-1}	…	96_{-1}
North Macedonia	5_{-1}	…	…	5_{-1}	…	…	99	97	82	1_{-1}	1_{-1}	95_{-1}	95_{-1}	95_{-1}	98_{-1}	…	83_{-1}	…
Norway	1_{-1}	1_{-1}	16_{-1}	0.2_{-1}	0.4_{-1}	8_{-1}	100_{-2}	100_{-2}	97_{-2}	$-_{-1}$	$-_{-1}$	100_{-1}	100_{-1}	99_{-1}	100_{-3}	100_{-1}	100_{-1}	92_{-1}
Poland	3_{-1}	36_{-1}	29_{-1}	0.2_{-1}	2_{-1}	2_{-1}	100	98	93	1_{-1}	2_{-1}	84_{-1}	100_{-1}	95_{-2}	98_{-1}	98_{-1}	103_{-2}	98_{-1}
Portugal	0.2_{-1}	1_{-1}	2_{-1}	$-_{-1}$	0.2_{-1}	1_{-1}	100	93	76	4_{-1}	10_{-1}	108_{-1}	100_{-1}	105_{-1}	93_{-1}	100_{-1}	99_{-1}	99_{-1}
Republic of Moldova	0.3_{i}	1_{i}	12_{i}	0.3_{i}	1_{i}	15_{i}	99_{-3}	95_{-3}	79_{-3}	0.2	0.4	108_{i}	100_{i}	107_{i}	96_{-4}	99_{i}	108_{i}	85_{i}
Romania	127_{-1}	94_{-2i}	164_{-1}	12_{-1}	11_{-2i}	21_{-1}	100	97	76	3_{-2}	4_{-2}	88_{-1}	88_{-1}	85_{-1}	98_{-1}	89_{-2i}	87_{-1}	79_{-1}
Russian Federation	5_{-2}	18_{-2i}	67_{-2i}	0.1_{-2}	0.2_{-2i}	2_{-2i}	100	100	91	…	…	104_{-2}	100_{-2}	105_{-2}	100_{-1}	100_{-2i}	104_{-2}	98_{-2i}
San Marino	$-_{i}$	0.1_{i}	1_{i}	2_{i}	8_{i}	61_{i}	…	…	…	-	-	97_{i}	98_{i}	99_{i}	…	92_{i}	88_{i}	39_{i}
Serbia	10_{i}	7_{i}	41_{i}	4_{i}	3_{i}	14_{i}	100	99	80	0.3	1	97_{i}	96_{i}	98_{i}	99_{-1}	97_{i}	96_{i}	86_{i}
Slovakia	7_{-1}	12_{-1}	23_{-1}	3_{-1}	4_{-1}	11_{-1}	100	100	96	…	…	102_{-1}	97_{-1}	98_{-1}	100_{-1}	96_{-1}	77_{-1}	89_{-1}
Slovenia	0.1_{-1}	0.3_{-1}	1_{-1}	$-_{-1}$	1_{-1}	1_{-1}	100	100	92	1_{-1}	1_{-1}	103_{-1}	100_{-1}	104_{-1}	100_{-1}	99_{-1}	94_{-1}	99_{-1}
Spain	54_{-1}	6_{-1}	11_{-1}	2_{-1}	0.4_{-1}	1_{-1}	99	91	69	0.2_{-1}	6_{-1}	103_{-1}	98_{-1}	99_{-1}	92_{-1}	100_{-1}	96_{-1}	99_{-1}
Sweden	1_{-1}	…	4_{-1}	0.1_{-1}	…	1_{-1}	100	100	92	0.1_{-1}	0.2_{-1}	126_{-1}	100_{-1}	105_{-1}	100_{-1}	…	107_{-1}	99_{-1}
Switzerland	1_{-1}	1_{-1}	67_{-1}	0.1_{-1}	0.5_{-1}	19_{-1}	100_{-2}	99_{-2}	94_{-2}	0.1_{-1}	1_{-1}	106_{-1}	100_{-1}	100_{-1}	99_{-3}	100_{-1}	97_{-1}	81_{-1}
Ukraine	…	…	…	…	…	…	100_{-3}	99_{-3}	96_{-3}	1	1	…	…	…	99_{-4}	…	…	…
United Kingdom	97_{-1}	3_{-1}	82_{-1}	2_{-1}	0.1_{-1}	3_{-1}	100_{-2}	100_{-2}	92_{-2}	$-_{-1}$	$-_{-1}$	100_{-1}	98_{-1}	99_{-1}	100_{-3}	100_{-1}	99_{-1}	97_{-1}
United States	489_{-1i}	22_{-1i}	371_{-1i}	2_{-1i}	0.2_{-1i}	3_{-1i}	100	99	93	3_{-1}	4_{-1}	100_{-1i}	98_{-1i}	101_{-1i}	99_{-1}	100_{-1i}	104_{-1i}	97_{-1i}

Learning												
K Administration of nationally representative learning assessment						L Achieving minimum proficiency (%)						
Early grades		End of primary		End of lower secondary		Early grades		End of primary		End of lower secondary		
Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Reading	Mathematics	Country code
4.1.6						4.1.1						
2021												
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	62_{-2}	48_{-3}	58_{-3}	ALB
No	No	No	No	No	No	…	…	…	…	…	…	AND
No	No	Yes	Yes	Yes	Yes	…	…	…	84_{-2}	76_{-3}	79_{-3}	AUT
Yes	Yes	No	No	Yes	Yes	…	…	…	…	77_{-3}	71_{-3}	BLR
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	80_{-2}	79_{-3}	80_{-3}	BEL
No	No	Yes	Yes	Yes	Yes	…	…	…	…	…	…	BMU
No	No	No	Yes	Yes	Yes	…	…	…	40_{-2}	46_{-3}	42_{-3}	BIH
No	No	Yes	Yes	Yes	Yes	…	…	…	71_{-2}	53_{-3}	56_{-3}	BGR
No	No	Yes	Yes	Yes	Yes	…	…	…	69_{-2}	86_{-3}	84_{-3}	CAN
No	No	Yes	Yes	Yes	Yes	…	…	…	70_{-2}	78_{-3}	69_{-3}	HRV
Yes	No	Yes	Yes	Yes	Yes	…	…	…	78_{-2}	79_{-3}	80_{-3}	CZE
Yes	Yes	Yes	Yes	Yes	Yes	…	75_{-2}	…	…	84_{-3}	85_{-3}	DNK
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	89_{-3}	90_{-3}	EST
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	78_{-2}	86_{-3}	85_{-3}	FIN
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	57_{-2}	79_{-3}	79_{-3}	FRA
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	75_{-2}	79_{-3}	79_{-3}	DEU
No	No	No	No	Yes	Yes	…	…	…	…	69_{-3}	64_{-3}	GRC
No	No	Yes	Yes	Yes	Yes	…	…	…	74_{-2}	75_{-3}	68_{-2}	HUN
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	74_{-3}	79_{-3}	ISL
Yes	Yes	Yes	Yes	Yes	Yes	…	84_{-2}	…	…	88_{-3}	84_{-3}	IRL
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	73_{-2}	77_{-3}	62_{-2}	ITA
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	85_{-2}	78_{-3}	83_{-3}	LVA
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	…	…	LIE
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	81_{-2}	76_{-3}	74_{-3}	LTU
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	71_{-3}	73_{-3}	LUX
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	69_{-2}	64_{-3}	70_{-3}	MLT
No	No	No	No	No	No	…	…	…	…	…	…	MCO
No	No	Yes	Yes	Yes	Yes	…	…	…	43_{-2}	56_{-3}	54_{-3}	MNE
No	No	Yes	Yes	Yes	Yes	…	…	…	84_{-2}	76_{-3}	84_{-3}	NLD
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	52_{-2}	45_{-3}	39_{-3}	MKD
Yes	Yes	Yes	Yes	Yes	Yes	…	82_{-2}	…	65_{-2}	81_{-3}	81_{-3}	NOR
No	No	Yes	Yes	Yes	Yes	…	…	…	73_{-2}	85_{-3}	85_{-3}	POL
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	74_{-2}	80_{-3}	77_{-3}	PRT
No	No	Yes	Yes	Yes	Yes	…	…	…	…	57_{-3}	50_{-3}	MDA
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	59_{-3}	53_{-3}	ROU
No	No	Yes	Yes	Yes	Yes	…	…	…	91_{-2}	78_{-3}	78_{-3}	RUS
No	No	No	No	No	No	…	…	…	…	…	…	SMR
No	No	Yes	Yes	Yes	Yes	…	…	…	68_{-2}	62_{-3}	60_{-3}	SRB
No	No	Yes	Yes	Yes	Yes	…	…	…	71_{-2}	69_{-3}	75_{-3}	SVK
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	…	82_{-3}	84_{-3}	SVN
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	65_{-2}	…	75_{-3}	ESP
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	74_{-2}	82_{-3}	81_{-3}	SWE
No	No	No	No	Yes	Yes	…	…	…	…	76_{-3}	83_{-3}	CHE
No	No	Yes	Yes	Yes	Yes	…	…	…	…	74_{-3}	64_{-3}	UKR
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	83_{-2}	83_{-3}	81_{-3}	GBR
Yes	Yes	Yes	Yes	Yes	Yes	…	…	…	77_{-2}	81_{-3}	73_{-3}	USA

TABLE 3: SDG 4, Target 4.2 – Early childhood

By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education

	A	B	C	D	E	F
	Children under 5 developmentally on track (%)	Under-5 stunting (%)	Stimulating home environment (%)	Children under 5 with 3+ children's books (%)	GER pre-primary (%)	NERA one year before primary entry (%)
SDG indicator	4.2.1		4.2.3		4.2.4	4.2.2
Reference year	2021					
Region	**Weighted average**					
World	…	22	…	…	61$_{-1}$	75$_{-1i}$
Sub-Saharan Africa	…	32	…	…	28$_{-1i}$	48$_{-1i}$
Northern Africa and Western Asia	…	18	…	…	34$_{-1i}$	52$_{-1i}$
Northern Africa	…	22	…	…	42$_{-1i}$	53$_{-1i}$
Western Asia	…	14	…	…	29$_{-1}$	50$_{-1i}$
Central and Southern Asia	…	30	…	…	61$_{-1}$	85$_{-1}$
Central Asia	…	8	…	…	42$_{-1}$	62$_{-1}$
Southern Asia	…	31	…	…	62$_{-1}$	87$_{-1}$
Eastern and South-eastern Asia	…	14	…	…	84$_{-1}$	84$_{-2i}$
Eastern Asia	…	5	…	…	90$_{-1}$	…
South-eastern Asia	…	27	…	…	68$_{-1i}$	84$_{-1i}$
Oceania	…	44	…	…	63$_{-1i}$	79$_{-1}$
Latin America and the Caribbean	…	12	…	…	76$_{-1}$	94$_{-1}$
Caribbean	…	12	…	…	…	…
Central America	…	17	…	…	66	95
South America	…	9	…	…	81$_{i}$	94$_{i}$
Europe and Northern America	…	4	…	…	86$_{-1}$	94$_{-1}$
Europe	…	4	…	…	94$_{-1}$	96$_{-1}$
Northern America	…	4	…	…	70$_{-1}$	92$_{-1}$
Low income	…	34	…	…	20$_{-1i}$	43$_{-1i}$
Middle income	…	22	…	…	66$_{-1}$	78$_{-1i}$
Lower middle	…	29	…	…	58$_{-1}$	76$_{-1i}$
Upper middle	…	8	…	…	78$_{-1}$	83$_{-1i}$
High income	…	4	…	…	84$_{-1}$	92$_{-1}$

A Percentage of children aged 36 to 59 months who are developmentally on track in health, learning and psychosocial well-being [UNICEF Early Childhood Development Index].

B Under-5 moderate or severe stunting rate (%) [*Source:* UNICEF, WHO, World Bank Joint Child Malnutrition Estimates (JME)]. (Regional aggregates are weighted averages of statistical JME estimates for the reference year, not of the observed country values in the country table; Eastern Asia excludes Japan, Oceania excludes Australia and New Zealand, Northern America is based only on the United States.)

C Percentage of children aged 36 to 59 months experiencing a positive and stimulating home learning environments [*Source:* UNICEF].

D Percentage of children under age 5 living in households with three or more children's books [*Source:* UNICEF database].

E Gross enrolment ratio (GER) in pre-primary education.

F Adjusted net enrolment rate (NERA) one year before the official primary school entry age.

Source: UIS unless noted otherwise. Data refer to school year ending in 2021 unless noted otherwise.
Aggregates represent countries listed in the table with available data and may include estimates for countries with no recent data.
(-) Magnitude nil or negligible.
(…) Data not available or category not applicable.
(± n) Reference year differs (e.g. -2: reference year 2019 instead of 2021).
(i) Estimate and/or partial coverage.

TABLE 3: Continued

Country or territory	A Children under 5 developmentally on track (%)	B Under-5 stunting (%)	C Stimulating home environment (%)	D Children under 5 with 3+ children's books (%)	E GER pre-primary (%)	F NERA one year before primary entry (%)	Country code
SDG indicator	4.2.1		4.2.3		4.2.4	4.2.2	
Reference year	2021						
Sub-Saharan Africa							
Angola	...	43	...	...	...	...	AGO
Benin	54_{-3}	31	39_{-3}	2_{-3}	23	85_{-3}	BEN
Botswana	...	22	...	...	...	...	BWA
Burkina Faso	...	22	...	...	7	21	BFA
Burundi	40_{-4}	56	58_{-4}	0.1_{-4}	11_{-1}	49_{-1}	BDI
Cabo Verde	...	10	...	...	75_{-2}	81_{-2}	CPV
Cameroon	...	27	...	...	36	41	CMR
Central African Republic	36_{-2}	40	...	0.4_{-2}	3_{-4}	22_{-4}	CAF
Chad	45_{-2}	33	...	$-_{-2}$	1	17	TCD
Comoros	...	20	...	...	22_{-3}	30_{-3}	COM
Congo	...	17	...	...	14_{-3}	29_{-3}	COG
Côte d'Ivoire	...	21	...	...	11_{+1}	23	CIV
D. R. Congo	57_{-3}	41	...	$-_{-3}$	7_{-1}	22_{-1}	COD
Djibouti	...	20	...	...	14_{+1}	17_{+1}	DJI
Equat. Guinea	...	17	...	...	...	...	GNQ
Eritrea	...	51	...	...	24_{-2}	27_{-2}	ERI
Eswatini	...	22	...	...	...	...	SWZ
Ethiopia	...	35	...	...	30	42	ETH
Gabon	...	14	...	...	43_{-2}	...	GAB
Gambia	67_{-3}	14	16_{-3}	1_{-3}	42_{+1}	55_{+1}	GMB
Ghana	68_{-3}	13	...	7_{-3}	112	93_{-1}	GHA
Guinea	...	28	...	...	20	47_{-1}	GIN
Guinea-Bissau	73_{-2}	28	...	$-_{-2}$	...	...	GNB
Kenya	...	19	...	...	65_{-2}	...	KEN
Lesotho	73_{-3}	32	28_{-3}	3_{-3}	33_{-2}	39_{-2}	LSO
Liberia	...	27	...	...	128_{-1}	71_{-1}	LBR
Madagascar	67_{-3}	39	25_{-3}	1_{-3}	40_{-2}	59_{-2}	MDG
Malawi	...	35	...	1_{-1}	30_{+1}	...	MWI
Mali	...	24	...	...	8_{-1}	45_{-3}	MLI
Mauritania	...	23	...	...	...	...	MRT
Mauritius	...	9	...	...	92_{+1}	63_{+1}	MUS
Mozambique	...	37	...	...	...	...	MOZ
Namibia	...	17	...	...	37	69_{-3}	NAM
Niger	...	47	...	...	7	21	NER
Nigeria	61_{-4}	34	63_{-4}	4	23_{-3}	...	NGA
Rwanda	82_{-1}	31	...	2_{-1}	28	68	RWA
Sao Tome and Principe	63_{-2}	11	...	6_{-2}	...	...	STP
Senegal	67_{-2}	17	29_{-4}	1_{-2}	18	18	SEN
Seychelles	...	7	...	...	104	99	SYC
Sierra Leone	51_{-4}	27	19_{-4}	2_{-4}	25	41	SLE
Somalia	...	19	...	...	1	...	SOM
South Africa	...	23	...	...	18_{-1}	73_{-1}	ZAF
South Sudan	...	28	...	...	12_{-3}	...	SSD
Togo	52_{-4}	23	18_{-4}	$-_{-4}$	29	99	TGO
Uganda	...	24	...	...	14_{-4}	...	UGA
United Republic of Tanzania	...	31	...	...	77	56_{-1}	TZA
Zambia	...	32	...	...	9_{-4}	...	ZMB
Zimbabwe	71_{-2}	22	37_{-2}	3_{-2}	74	56	ZWE
Northern Africa and Western Asia							
Algeria	77_{-2}	9	...	8_{-2}	55_{+1}	67_{+1}	DZA
Armenia	...	8	...	...	29	38	ARM
Azerbaijan	...	14	...	...	46_{i}	84_{i}	AZE
Bahrain	...	5	...	...	53_{-1}	70_{-2}	BHR
Cyprus	...	...	...	...	87_{-1i}	99_{-1i}	CYP

Country or territory	A Children under 5 developmentally on track (%)	B Under-5 stunting (%)	C Stimulating home environment (%)	D Children under 5 with 3+ children's books (%)	E GER pre-primary (%)	F NERA one year before primary entry (%)	Country code
SDG indicator	4.2.1		4.2.3		4.2.4	4.2.2	
Reference year	2021						
Northern Africa and Western Asia continued							
Egypt	...	21	...	...	29_{-2}	37_{-2}	EGY
Georgia	90_{-3}	5	78_{-3}	56_{-3}	95_{-1}	...	GEO
Iraq	79_{-3}	10	44_{-3}	3_{-3}	...	...	IRQ
Israel	...	...	...	...	111_{-1}	100_{-1}	ISR
Jordan	71_{-3}	7	92_{-3}	16_{-3}	27	48	JOR
Kuwait	...	7	...	...	49	44	KWT
Lebanon	...	8	...	...	...	...	LBN
Libya	...	51	...	...	...	...	LBY
Morocco	...	13	36_{-3}	...	60	66	MAR
Oman	...	13	...	...	27	63	OMN
Palestine	84_{-1}	8	...	12_{-1}	49	59	PSE
Qatar	...	5	...	...	54	88	QAT
Saudi Arabia	...	12	...	...	18	46	SAU
Sudan	...	36	...	...	47_{-3}	40_{-3}	SDN
Syrian Arab Republic	...	26	...	...	12_{+1}	45_{+1}	SYR
Tunisia	82_{-3}	9	73_{-3}	24_{-3}	...	...	TUN
Türkiye	74_{-3}	6	...	...	40_{-1}	79_{-1}	TUR
United Arab Emirates	...	...	...	...	108_{+1}	99_{+1}	ARE
Yemen	...	36	...	...	...	...	YEM
Central and Southern Asia							
Afghanistan	...	34	...	...	...	...	AFG
Bangladesh	74_{-2}	28	63_{-2}	6_{-2}	36	91	BGD
Bhutan	...	23	...	...	52	85	BTN
India	...	32	...	...	40_{+1}	95_{+1}	IND
Iran, Islamic Republic of	...	5	...	36_{-4}	72_{-1}	64_{-1}	IRN
Kazakhstan	...	5	...	...	74_{-1}	78_{-1}	KAZ
Kyrgyzstan	72_{-3}	11	87_{-3}	21_{-3}	39	84	KGZ
Maldives	93_{-4}	14	96_{-4}	59_{-4}	76_{-1}	92_{-1}	MDV
Nepal	65_{-2}	28	...	3_{-2}	94_{+1}	71_{+1}	NPL
Pakistan	...	35	...	...	83_{-2}	94_{-2i}	PAK
Sri Lanka	...	16	...	...	72_{-1}	...	LKA
Tajikistan	...	14	...	...	10_{-4}	12_{-4}	TJK
Turkmenistan	95_{-2}	7	...	32_{-2}	35	...	TKM
Uzbekistan	...	7	...	32_{+1}	44	69	UZB
Eastern and South-eastern Asia							
Brunei Darussalam	...	11	...	...	63_{-1}	95_{-1}	BRN
Cambodia	...	23	...	...	34	70_{-1}	KHM
China	...	5	...	...	93	...	CHN
DPR Korea	88_{-4}	18	95_{-4}	50_{-4}	...	...	PRK
Hong Kong, China	...	...	...	...	101_{-2}	100_{-1}	HKG
Indonesia	88_{-3}	31	...	...	62_{-3i}	96_{-3i}	IDN
Japan	...	5	...	...	...	...	JPN
Lao PDR	89_{-4}	29	30_{-4}	4_{-4}	49	71	LAO
Macao, China	...	...	...	...	86	88	MAC
Malaysia	...	22	...	...	87	86	MYS
Mongolia	76_{-3}	6	58_{-3}	29_{-3}	80	96	MNG
Myanmar	...	25	...	...	9_{-3}	12_{-3}	MMR
Philippines	...	29	...	...	90	66	PHL
Republic of Korea	...	2	...	...	92_{-1}	90_{-1}	KOR
Singapore	...	3	...	...	96_{-1i}	97_{-1i}	SGP
Thailand	93_{-2}	12	...	34_{-2}	74_{+1}	97_{+1}	THA
Timor-Leste	...	46	...	...	28_{-1}	60_{-1}	TLS
Viet Nam	...	20	...	27	92	100_{-3}	VNM

TABLE 3: Continued

Country or territory	A Children under 5 developmentally on track (%)	B Under-5 stunting (%)	C Stimulating home environment (%)	D Children under 5 with 3+ children's books (%)	E GER pre-primary (%)	F NERA one year before primary entry (%)	Country code
SDG indicator	4.2.1		4.2.3		4.2.4	4.2.2	
Reference year	2021						
Oceania							
Australia	...	3	...	...	80_{-1}	82_{-1}	AUS
Cook Islands	...	...	...	...	86	88	COK
Fiji	83	7	...	24	31	89	FJI
Kiribati	80_{-2}	14	...	4_{-2}	89_{-1}	98_{-1}	KIR
Marshall Islands	79_{-4}	31	72_{-4}	18_{-4}	68	59	MHL
Micronesia, F. S.	...	...	...	...	6	13	FSM
Nauru	...	15	...	...	48_{-1}	96_{-1}	NRU
New Zealand	...	...	...	...	92_{-1}	90_{-1}	NZL
Niue	...	...	...	...	88	91	NIU
Palau	...	...	...	...	71_{-1}	89_{-1}	PLW
Papua New Guinea	...	51	...	...	46_{-3}	71_{-3}	PNG
Samoa	73_{-1}	7	...	9_{-1}	41	35	WSM
Solomon Is	...	30	...	...	93_{-2}	66_{-2}	SLB
Tokelau	...	...	...	...	164	75	TKL
Tonga	79_{-2}	2	...	24_{-2}	48_{-1}	95_{-1}	TON
Tuvalu	69_{-1}	5	...	24_{-1}	86	89	TUV
Vanuatu	...	31	...	...	103	98_{-1}	VUT
Latin America and the Caribbean							
Anguilla	...	...	...	...	96_{-2}	93_{-2}	AIA
Antigua and Barbuda	...	...	...	...	70_{-3}	91_{-3}	ATG
Argentina	86_{-1}	9	...	48_{-1}	76_{-1}	100_{-1}	ARG
Aruba	...	...	...	...	...	...	ABW
Bahamas	...	...	...	...	40_{-2}	43_{-2}	BHS
Barbados	...	6	...	...	75	86	BRB
Belize	...	12	...	...	34	43	BLZ
Bolivia, P. S.	...	12	...	...	74	91	BOL
Brazil	...	7	...	...	86_{-1i}	93_{-1i}	BRA
British Virgin Islands	...	...	...	...	88	96	VGB
Cayman Islands	...	...	...	...	89_{-3}	99	CYM
Chile	...	2	...	...	85_{-1}	97_{-1}	CHL
Colombia	...	11	...	...	88	99	COL
Costa Rica	86_{-3}	9	...	39_{-3}	95	98_{-1}	CRI
Cuba	95_{-2}	7	...	42_{-2}	100	96	CUB
Curaçao	...	...	...	...	94_{-1}	91_{-1}	CUW
Dominica	...	...	...	...	66	96	DMA
Dominican Republic	87_{-2}	6	...	9_{-2}	33_{i}	73_{i}	DOM
Ecuador	...	23	...	28_{-3}	58	82	ECU
El Salvador	...	10	...	17	...	...	SLV
Grenada	...	...	...	...	131_{-1}	85_{-1i}	GRD
Guatemala	...	44	...	...	50	82	GTM
Guyana	...	8	...	...	...	...	GUY
Haiti	65_{-4}	20	54_{-4}	8_{-4}	...	...	HTI
Honduras	75_{-2}	18	...	6_{-2}	34	72	HND
Jamaica	...	6	...	...	...	...	JAM
Mexico	80_{-2}	13	71_{-2}	35	71_{-1}	99_{-1}	MEX
Montserrat	...	...	...	...	76_{-2}	90_{-2}	MSR
Nicaragua	...	15	...	...	69_{-1}	...	NIC
Panama	...	14	...	...	63	80	PAN
Paraguay	...	4	...	...	50	76	PRY
Peru	...	11	...	...	96	100	PER
Saint Kitts and Nevis	...	...	...	...	94	96	KNA
Saint Lucia	...	2	...	...	78_{-1}	98_{-1}	LCA
Saint Vincent/Grenadines	...	...	...	...	114_{-1}	79_{-3}	VCT
Sint Maarten	...	...	...	...	...	...	SXM
Suriname	77_{-3}	8	66_{-3}	26_{-3}	78	84	SUR
Trinidad and Tobago	...	9	...	...	64	79_{-1}	TTO
Turks and Caicos Islands	91_{-1}	3	...	55_{-1}	96	89	TCA
Uruguay	...	6	...	...	97_{-1}	82_{-1}	URY
Venezuela, B. R.	...	10	...	...	70_{-4}	86_{-4}	VEN

Country or territory	A Children under 5 developmentally on track (%)	B Under-5 stunting (%)	C Stimulating home environment (%)	D Children under 5 with 3+ children's books (%)	E GER pre-primary (%)	F NERA one year before primary entry (%)	Country code
SDG indicator	4.2.1		4.2.3		4.2.4	4.2.2	
Reference year	2021						
Europe and Northern America							
Albania	...	9	78_{-3}	...	69	81	ALB
Andorra	...	...	...	...	...	...	AND
Austria	...	...	...	...	103_{-1}	99_{-1}	AUT
Belarus	87_{-2}	4	...	91_{-2}	97	96	BLR
Belgium	...	2	...	...	112_{-1}	97_{-1}	BEL
Bermuda	...	...	...	...	56_{-1}	...	BMU
Bosnia and Herzegovina	...	8	...	...	25	29	BIH
Bulgaria	...	6	...	...	84_{-1}	84_{-1}	BGR
Canada	...	...	...	...	49_{-1}	99_{-1}	CAN
Croatia	...	...	...	...	71_{-1}	93_{-1}	HRV
Czechia	...	2	...	...	114_{-1}	96_{-1}	CZE
Denmark	...	...	...	...	103_{-1}	100_{-1}	DNK
Estonia	...	1	...	...	...	93_{-4}	EST
Finland	...	...	...	...	88_{-1}	97_{-1}	FIN
France	...	...	...	...	107_{-1i}	99_{-1i}	FRA
Germany	...	2	...	...	108_{-1}	98_{-1}	DEU
Greece	...	2	...	...	93_{-1}	99_{-1}	GRC
Hungary	...	...	...	...	91_{-1}	94_{-1}	HUN
Iceland	...	...	...	...	95_{-1}	97_{-1}	ISL
Ireland	...	...	...	...	95_{-1i}	98_{-1i}	IRL
Italy	...	...	...	...	93_{-1}	92_{-1}	ITA
Latvia	...	2	...	...	95_{-1i}	98_{-1i}	LVA
Liechtenstein	...	...	...	...	105_{i}	98_{i}	LIE
Lithuania	...	5	...	...	89_{-1i}	95_{-1i}	LTU
Luxembourg	...	...	...	...	92_{-1}	99_{-1}	LUX
Malta	...	...	...	...	112_{-1}	99_{-1}	MLT
Monaco	...	...	...	...	100_{+1i}	92_{+1i}	MCO
Montenegro	90_{-3}	8	91_{-3}	58_{-3}	73	80	MNE
Netherlands	...	2	...	...	92_{-1}	99_{-1}	NLD
North Macedonia	82_{-2}	4	...	55_{-2}	31_{-1}	35_{-1}	MKD
Norway	...	...	...	...	96_{-1}	96_{-1}	NOR
Poland	...	2	...	...	94_{-1}	96_{-1}	POL
Portugal	...	3	...	...	99_{-1}	97_{-1}	PRT
Republic of Moldova	...	4	...	...	90_{i}	100_{i}	MDA
Romania	...	8	...	...	95_{-1}	88_{-1}	ROU
Russian Federation	...	...	...	...	86_{-2}	93_{-2}	RUS
San Marino	...	...	...	...	100_{i}	98_{i}	SMR
Serbia	97_{-2}	5	...	78_{-2}	64_{i}	92_{i}	SRB
Slovakia	...	...	...	...	102_{-1}	87_{-1}	SVK
Slovenia	...	...	...	...	94_{-1}	94_{-1}	SVN
Spain	...	...	...	...	102_{-1}	100_{-1}	ESP
Sweden	...	...	...	...	100_{-1}	100_{-1}	SWE
Switzerland	...	...	...	...	103_{-1}	100_{-1}	CHE
Ukraine	...	14	...	...	...	...	UKR
United Kingdom	...	...	...	...	106_{-1}	100_{-1}	GBR
United States	...	4	...	...	72_{-1i}	91_{-1i}	USA

TABLE 4: SDG 4, Target 4.3 – Technical, vocational, tertiary and adult education

By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university

SDG 4, Target 4.4 – Skills for work

By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship

	A	B	C	D	E	F	G			H			
							% of adults 15+ with ICT skills			% of adults 25+ having attained at least			
	Participation in adult education and training (%)	% of youth enrolled in TVET	TVET share of secondary enrolment (%)	TVET share of post-secondary non-tertiary (%)	Gross graduation ratio from tertiary (%)	GER tertiary (%)	Copy and paste within document	Use formula in spreadsheet	Write computer program	Primary	Lower secondary	Upper secondary	Post-secondary
SDG indicator	4.3.1	4.3.3				4.3.2	4.4.1			4.4.3			
Reference year	2021						2021						
Region	**Weighted average**						**Weighted average**						
World	...	5_{-1}	11_{-1}	...	...	40_{-1}	...	24_{i}	4_{i}	77_{i}	65_{i}	49_{i}	21_{i}
Sub-Saharan Africa	...	1_{-1i}	6_{-1i}	...	...	9_{-1i}	...	...	...	...	...	...	...
Northern Africa and Western Asia	...	8_{-1i}	12_{-1i}	...	...	49_{-1i}	49_{i}	23_{i}	7	91_{i}	74_{i}	59_{i}	27_{i}
Northern Africa	...	8_{-1i}	14_{-1i}	...	...	37_{-1i}	45	17	8	...	73_{i}	67_{i}	13_{i}
Western Asia	...	9_{-1i}	11_{-1}	...	...	59_{-1}	54_{i}	31_{i}	7	91	75	55	39_{i}
Central and Southern Asia	...	2_{-1}	4_{-1}	...	...	27_{-1}	...	...	...	61	48	32	14
Central Asia	...	16_{-1i}	19_{-1i}	...	...	31_{-1}	19	21	...	100	99	95	68
Southern Asia	...	2_{-1}	4_{-1}	...	...	27_{-1}	...	...	...	60	47	30	13
Eastern and South-eastern Asia	...	7_{-1}	15_{-1}	...	...	51_{-1}	...	...	...	...	...	...	...
Eastern Asia	...	7_{-1}	17_{-1}	...	...	60_{-1}	...	...	...	...	...	...	...
South-eastern Asia	...	7_{-2i}	13_{-1i}	...	...	34_{-1i}	42	19	3	81	59	36	...
Oceania	...	10_{-1}	22_{-1}	...	...	74_{-1}	...	...	...	...	92	79	51
Latin America and the Caribbean	...	7_{-1}	12_{-1}	...	...	54_{-1}	28	19	5	82	63	48	19_{i}
Caribbean	...	...	21	...	...	...	21_{i}	19_{i}	6_{i}	...	...	...	...
Central America	...	...	27	...	...	40	32	26	7	78	59	35	18
South America	...	...	8	...	...	63_{i}	26	16	4	84	65	53	...
Europe and Northern America	...	12_{-1}	15_{-1}	...	...	80_{-1}	50_{i}	34_{i}	5_{i}	98	92	79	32_{i}
Europe	...	18_{-1}	22_{-1}	...	...	77_{-1}	50_{i}	34	5	98	90	73	32_{i}
Northern America	...	2_{-1}	0.4_{-1}	...	...	87_{-1}	...	...	...	99	96	91	...
Low income	...	1_{-2i}	7_{-1i}	...	...	9_{-1i}	...	...	...	...	...	...	...
Middle income	...	5_{-1}	10_{-1}	...	...	38_{-1}	...	...	3_{i}	71_{i}	56_{i}	38_{i}	17_{i}
Lower middle	...	3_{-1i}	7_{-1}	...	...	27_{-1}	...	...	3_{i}	66	51	33	14_{i}
Upper middle	...	8_{-1}	15_{-1}	...	...	58_{-1}	...	...	3_{i}	...	...	...	...
High income	...	11_{-1}	15_{-1}	...	...	80_{-1}	63_{i}	43_{i}	6_{i}	98	91	78	34_{i}

A Participation rate of adults (25 to 54) in formal or non-formal education and training in the last 12 months (%).
Estimates based on other reference periods, in particular 4 weeks, are included in the country when no data are available on the last 12 months, but not in regional aggregates.
B Percentage of youth (15 to 24) enrolled in technical and vocational education and training (TVET) programmes (ISCED levels 2 to 5) (%).
C Share of technical and vocational education and training (TVET) in total secondary enrolment (%).
D Share of technical and vocational education and training (TVET) in post-secondary non-tertiary enrolment (%).
E Gross graduation ratio from first degree programmes in tertiary education (ISCED levels 6 and 7).
F Gross enrolment ratio (GER) in tertiary education.
G Percentage of adults (15 and over) with specific information and communication technology (ICT) skills.
H Percentage of adults (25 and over) who have attained at least a given level of education.
I Percentage of population achieving at least a fixed level of proficiency in functional literacy and numeracy skills.
J Literacy rate, among youth (15 to 24) and adults (15 and above).
K Number of youth and adult illiterates, and percentage female.

Source: UIS unless noted otherwise. Data refer to school year ending in 2021 unless noted otherwise.
Aggregates represent countries listed in the table with available data and may include estimates for countries with no recent data.
(-) Magnitude nil or negligible.
(...) Data not available or category not applicable.
(± n) Reference year differs (e.g. -2: reference year 2019 instead of 2021).
(i) Estimate and/or partial coverage.

SDG 4, Target 4.6 – Literacy and numeracy

By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy

I		J		K			
% achieving proficiency in		Literacy rate (%)		Illiterates			
				% female		Number (000,000)	
Literacy	Numeracy	Youth	Adults	Youth	Adults	Youth	Adults
4.6.1		4.6.2					
2021							
Weighted average						Sum	
…	…	92$_{-1}$	87$_{-1}$	56$_{-1}$	63$_{-1}$	99$_{-1}$	763$_{-1}$
…	…	78$_{-1}$	68$_{-1}$	56$_{-1}$	61$_{-1}$	49$_{-1}$	205$_{-1}$
…	…	89$_{-1}$	81$_{-1}$	56$_{-1}$	63$_{-1}$	9$_{-1}$	71$_{-1}$
…	…	89$_{-1}$	73$_{-1}$	51$_{-1}$	62$_{-1}$	4$_{-1}$	44$_{-1}$
…	…	89$_{-1}$	87$_{-1}$	62$_{-1}$	64$_{-1}$	5$_{-1}$	27$_{-1}$
…	…	90$_{-1i}$	75$_{-1i}$	57$_{-1i}$	63$_{-1i}$	36$_{-1i}$	367$_{-1i}$
…	…	100$_{-1}$	100$_{-1}$	44$_{-1}$	61$_{-1}$	-$_{-1}$	0.1$_{-1}$
…	…	90$_{-1i}$	74$_{-1i}$	57$_{-1i}$	63$_{-1i}$	36$_{-1i}$	367$_{-1i}$
…	…	99$_{-1}$	96$_{-1}$	45$_{-1}$	69$_{-1}$	2$_{-1}$	71$_{-1}$
…	…	100$_{-1}$	97$_{-1}$	45$_{-1}$	73$_{-1}$	1$_{-1}$	43$_{-1}$
…	…	99$_{-1}$	94$_{-1}$	44$_{-1}$	64$_{-1}$	2$_{-1}$	28$_{-1}$
…	…	…	…	…	…	…	…
…	…	99$_{-1}$	94$_{-1}$	43$_{-1}$	55$_{-1}$	2$_{-1}$	29$_{-1}$
…	…	…	…	…	…	…	…
49	40	98	94	…	…	0.5$_{i}$	8$_{i}$
…	…	99	…	…	…	0.5$_{i}$	15$_{i}$
…	…	99$_{i}$	98$_{i}$	48$_{i}$	63$_{i}$	1$_{i}$	19$_{i}$
…	…	100$_{i}$	98$_{i}$	47$_{i}$	66$_{i}$	0.4$_{i}$	16$_{i}$
81	71	100$_{i}$	99$_{i}$	54$_{i}$	54$_{i}$	0.2$_{i}$	4$_{i}$
…	…	72$_{-1}$	61$_{-1}$	56$_{-1}$	61$_{-1}$	38$_{-1}$	156$_{-1}$
…	…	94$_{-1}$	87$_{-1}$	56$_{-1}$	63$_{-1}$	59$_{-1}$	578$_{-1}$
…	…	91$_{-1i}$	79$_{-1i}$	56$_{-1i}$	63$_{-1i}$	54$_{-1i}$	496$_{-1i}$
…	…	98$_{-1}$	96$_{-1}$	49$_{-1}$	65$_{-1}$	5$_{-1}$	82$_{-1}$
…	…	…	…	…	…	0.1$_{i}$	4$_{i}$

TABLE 4: Continued

Country or territory	A Participation in adult education and training (%)	B % of youth enrolled in TVET	C TVET share of secondary enrolment (%)	D TVET share of post-secondary non-tertiary (%)	E Gross graduation ratio from tertiary (%)	F GER tertiary (%)	G % of adults 15+ with ICT skills Copy and paste within document	 Use formula in spreadsheet	 Write computer program	H % of adults 25+ having attained at least Primary	 Lower secondary	 Upper secondary	 Post-secondary
SDG indicator	4.3.1	4.3.3				4.3.2	4.4.1			4.4.3			
Reference year	2021						2021						
Sub-Saharan Africa													
Angola	…	…	…	…	…	11_{-2}	…	…	…	…	…	…	…
Benin	2_{-3i}	2	4	…	…	11_{-1}	…	…	…	…	…	…	…
Botswana	2_{-1i}	…	…	100	…	25	…	…	…	…	…	…	…
Burkina Faso	3_{-3i}	1	3	…	3	10	…	…	…	15_{-3}	13_{-3}	6_{-3}	3_{-3}
Burundi	…	3_{-1}	9_{-1}	…	…	6	…	…	…	18_{-4}	9_{-4}	6_{-4}	…
Cabo Verde	…	1_{-2}	2_{-2}	100_{-2}	14_{-3}	24_{-3}	18_{-2}	6_{-2}	…	…	…	…	…
Cameroon	…	5	19	…	…	14_{-3}	…	…	…	…	…	…	…
Central African Republic	…	…	4_{-4}	…	…	…	2_{-2}	1_{-2}	1_{-2}	…	…	…	…
Chad	2_{-3i}	-	1	…	…	…	2_{-2}	1_{-2}	$-_{-2}$	…	…	…	…
Comoros	3_{i}	$-_{-3}$	$-_{-3}$	…	…	…	…	…	…	…	…	…	…
Congo	…	…	7_{-3}	…	…	13_{-4}	…	…	…	…	…	…	…
Côte d'Ivoire	4_{-2i}	2	5	…	…	10_{-1}	12_{-2}	3_{-2}	1_{-2}	…	…	…	…
D. R. Congo	…	…	…	…	…	7_{-1}	…	…	…	…	…	…	…
Djibouti	43_{-4i}	3	7_{+1}	…	…	…	16_{-4}	12_{-4}	5_{-4}	…	…	…	…
Equat. Guinea	…	…	…	…	…	6	…	…	…	…	…	…	…
Eritrea	…	0.5_{-3}	1_{-2}	100_{-2}	…	…	…	…	…	…	…	…	…
Eswatini	3_{i}	…	…	…	…	…	…	…	…	…	…	…	…
Ethiopia	7_{i}	…	…	…	…	10_{-3}	…	…	…	…	…	…	…
Gabon	…	…	7_{-2}	…	…	21_{-2}	…	…	…	…	…	…	…
Gambia	2_{-3i}	…	47	…	…	…	…	…	…	…	…	…	…
Ghana	2_{-4i}	1	3	…	10	20	…	…	…	…	…	…	…
Guinea	3_{-2i}	…	7_{-1}	…	6_{-4}	7	…	…	…	19_{-3}	13_{-3}	7_{-3}	6_{-3}
Guinea-Bissau	6_{-3i}	…	…	…	…	…	…	…	…	…	…	…	…
Kenya	1_{-2i}	…	…	…	$-_{-2}$	10_{-2i}	…	…	…	…	…	…	…
Lesotho	2_{-2i}	…	3_{-2}	…	4_{-3}	10_{-3}	…	…	…	…	…	…	…
Liberia	7_{-4i}	…	…	…	…	…	…	…	…	…	…	…	…
Madagascar	…	1	3_{-2}	100_{-2}	4_{-1}	6_{-1}	…	…	…	49_{-3}	29_{-3}	10_{-3}	…
Malawi	1_{-1i}	$-_{-2}$	…	100	…	3_{+1}	…	…	…	…	…	…	…
Mali	1_{-1i}	4_{-3}	1_{-1}	100_{-3}	…	5_{-2}	…	…	…	13_{-1}	12_{-1}	5_{-1}	3_{-1}
Mauritania	4_{-4i}	0.2_{-2}	2_{-1}	…	4_{-2i}	6_{-1}	…	…	…	…	…	…	…
Mauritius	1_{-1i}	1_{+1}	7	49	29_{-4}	45	…	…	…	…	…	…	…
Mozambique	…	…	6_{-1}	…	4_{-3}	7_{-3}	…	…	…	46_{-4}	15_{-4}	9_{-4}	…
Namibia	7_{-3i}	…	…	100_{-3}	17_{-1}	27_{-1}	…	…	…	…	…	…	…
Niger	2_{-4i}	1_{-4}	7_{-4}	100_{-4}	4_{-2}	4_{-1}	8_{-4}	1_{-4}	1_{-4}	…	…	…	…
Nigeria	4_{-2i}	…	…	…	…	12_{-3}	…	…	…	…	…	…	…
Rwanda	2_{-1i}	4	13	…	2_{-1}	7	…	…	…	36_{-3}	13_{-3}	10_{-3}	…
Sao Tome and Principe	…	…	6_{-4}	…	…	…	16_{-2}	7_{-2}	4_{-2}	…	…	…	…
Senegal	3_{-2i}	…	6	…	…	16	…	…	…	22_{-4}	18_{-4}	11_{-4}	10_{-4}
Seychelles	2_{-1i}	24	11	100	6	17	…	…	…	…	…	…	…
Sierra Leone	2_{-3i}	…	…	…	…	…	…	…	…	…	…	…	…
Somalia	7_{-2i}	…	2	…	…	…	…	…	…	…	…	…	…
South Africa	2_{i}	2_{-1}	6_{-1}	100_{-1}	13_{-1}	24_{-1}	…	…	…	86_{-2}	82_{-2}	70_{-2}	45_{-2}
South Sudan	…	…	…	100_{-3}	…	1_{-3}	…	…	…	…	…	…	…
Togo	4_{-4i}	3	6	100	…	15_{-1}	3_{-4}	1_{-4}	0.5_{-4}	…	…	…	…
Uganda	2_{-4i}	…	4_{-4}	…	…	…	…	…	…	…	…	…	…
United Republic of Tanzania	1_{-1i}	0.1_{-4}	1	96_{-3}	3	8_{-1}	…	…	…	…	…	…	…
Zambia	2_{-1i}	…	…	…	…	…	…	…	…	…	…	…	…
Zimbabwe	1_{-2i}	…	…	…	…	9_{-4}	…	…	…	82_{-4}	65_{-4}	12_{-4}	…

I % achieving proficiency in		J Literacy rate (%)		K Illiterates				Country code
				% female		Number (000,000)		
Literacy	Numeracy	Youth	Adults	Youth	Adults	Youth	Adults	
4.6.1		4.6.2						
2021								
...	...	83_{i}	72_{i}	59_{i}	69_{i}	$1,145_{i}$	$5,065_{i}$	AGO
...	...	65_{i}	46_{i}	60_{i}	61_{i}	864_{i}	$3,930_{i}$	BEN
...	...	...	...	...	...	...	...	BWA
...	...	65_{i}	46_{i}	51_{i}	58_{i}	$1,506_{i}$	$6,485_{i}$	BFA
...	...	93_{i}	75_{i}	55_{i}	64_{i}	173_{i}	$1,703_{i}$	BDI
...	...	99_{i}	91_{i}	30_{i}	68_{i}	1_{i}	37_{i}	CPV
...	...	86_{-1i}	78_{-1i}	58_{-1i}	62_{-1i}	726_{-1i}	$3,348_{-1i}$	CMR
...	...	38_{-1i}	37_{-1i}	57_{-1i}	60_{-1i}	666_{-1i}	$1,705_{-1i}$	CAF
...	...	35_{i}	27_{i}	55_{i}	56_{i}	$2,269_{i}$	$6,661_{i}$	TCD
...	...	81_{i}	62_{i}	47_{i}	56_{i}	32_{i}	207_{i}	COM
...	...	82_{i}	81_{i}	58_{i}	64_{i}	192_{i}	648_{i}	COG
...	...	84_{-2}	90_{-2}	77_{-2}	65_{-2}	819_{-2}	$1,502_{-2}$	CIV
...	...	88_{i}	80_{i}	62_{i}	74_{i}	$2,160_{i}$	$10,037_{i}$	COD
...	...	...	...	...	...	...	...	DJI
...	...	...	...	...	...	...	...	GNQ
...	...	93_{-3i}	77_{-3i}	54_{-3i}	67_{-3i}	42_{-3i}	470_{-3i}	ERI
...	...	96_{-1i}	89_{-1i}	35_{-1i}	51_{-1i}	10_{-1i}	78_{-1i}	SWZ
...	...	73_{-4i}	52_{-4i}	51_{-4i}	58_{-4i}	$6,273_{-4i}$	$30,147_{-4i}$	ETH
...	...	90_{i}	85_{i}	40_{i}	51_{i}	36_{i}	208_{i}	GAB
...	...	73_{i}	58_{i}	43_{i}	59_{i}	132_{i}	586_{i}	GMB
...	...	93_{-1i}	80_{-1i}	50_{-1i}	60_{-1i}	391_{-1i}	$3,833_{-1i}$	GHA
...	...	60_{i}	45_{i}	63_{i}	67_{i}	$1,146_{i}$	$4,227_{i}$	GIN
...	...	68_{i}	53_{i}	61_{i}	66_{i}	128_{i}	554_{i}	GNB
...	...	89_{i}	83_{i}	47_{i}	59_{i}	$1,306_{i}$	$5,926_{i}$	KEN
...	...	89_{i}	81_{i}	21_{i}	30_{i}	45_{i}	278_{i}	LSO
...	...	77_{-2}	48_{-4i}	60_{-4i}	64_{-4i}	409_{-4i}	$1,423_{-4i}$	LBR
...	...	81_{i}	77_{i}	51_{i}	54_{i}	$1,134_{i}$	$3,891_{i}$	MDG
...	...	76_{i}	67_{i}	44_{i}	57_{i}	985_{i}	$3,692_{i}$	MWI
...	...	46_{-1}	31_{-1}	57_{-1}	57_{-1}	$2,136_{-1}$	$7,388_{-1}$	MLI
...	...	76_{i}	67_{i}	52_{i}	57_{i}	214_{i}	954_{i}	MRT
...	...	99_{i}	92_{i}	30_{i}	62_{i}	1_{i}	84_{i}	MUS
...	...	72_{i}	63_{i}	57_{i}	66_{i}	$1,836_{i}$	$6,612_{i}$	MOZ
...	...	96_{i}	92_{i}	38_{i}	52_{i}	22_{i}	127_{i}	NAM
...	...	47_{i}	37_{i}	56_{i}	57_{i}	$2,606_{i}$	$7,945_{i}$	NER
...	...	81	62_{-3i}	63_{-3i}	62_{-3i}	$9,365_{-3i}$	$41,764_{-3i}$	NGA
...	...	87_{i}	76_{i}	37_{i}	57_{i}	341_{i}	$1,942_{i}$	RWA
...	...	98_{i}	94_{i}	44_{i}	72_{i}	1_{i}	8_{i}	STP
...	...	76_{i}	56_{i}	57_{i}	66_{i}	795_{i}	$4,335_{i}$	SEN
...	...	99_{-1i}	96_{-1i}	20_{-1i}	43_{-1i}	0.1_{-1i}	3_{-1i}	SYC
...	...	72_{i}	48_{i}	54_{i}	57_{i}	468_{i}	$2,556_{i}$	SLE
...	...	...	...	...	...	...	...	SOM
87_{-4}	98_{-4}	98_{-2}	95_{-2}	36_{-2}	56_{-2}	157_{-2}	$2,069_{-2}$	ZAF
...	...	48_{-3i}	35_{-3i}	50_{-3i}	55_{-3i}	$1,157_{-3i}$	$4,181_{-3i}$	SSD
...	...	88_{-2}	67_{-2}	67_{-2}	70_{-2}	189_{-2}	$1,555_{-2}$	TGO
...	...	91_{i}	79_{i}	44_{i}	63_{i}	913_{i}	$5,391_{i}$	UGA
...	...	88_{i}	82_{i}	47_{i}	60_{i}	$1,442_{i}$	$6,342_{i}$	TZA
...	...	93_{-1i}	88_{-1i}	53_{-1i}	65_{-1i}	265_{-1i}	$1,279_{-1i}$	ZMB
...	...	91_{i}	90_{i}	30_{i}	48_{i}	288_{i}	912_{i}	ZWE

TABLE 4: Continued

Country or territory	A	B	C	D	E	F	G			H			
							% of adults 15+ with ICT skills			% of adults 25+ having attained at least			
	Participation in adult education and training (%)	% of youth enrolled in TVET	TVET share of secondary enrolment (%)	TVET share of post-secondary non-tertiary (%)	Gross graduation ratio from tertiary (%)	GER tertiary (%)	Copy and paste within document	Use formula in spreadsheet	Write computer program	Primary	Lower secondary	Upper secondary	Post-secondary
SDG indicator	4.3.1	4.3.3				4.3.2	4.4.1			4.4.3			
Reference year	2021						2021						
Northern Africa and Western Asia													
Algeria	...	...	10_{+1}	...	43	54	18_{-3}	9_{-3}	7_{-3}	...	...	...	...
Armenia	1_{-1i}	10	9	...	47	55	...	...	...	99_{-1}	96_{-1}	90_{-1}	47_{-1}
Azerbaijan	...	14_{i}	11	100	23_{-1i}	38_{i}	67_{-2}	22_{-2}	1_{-3}	99_{-2}	96_{-2}	88_{-2}	30_{-2}
Bahrain	...	4_{-2}	7_{-2}	100_{-1}	32	65	58_{-2}	36_{-2}	18_{-2}	93_{-1}	82_{-1}	69_{-1}	33_{-1}
Cyprus	6_{-1i}	7_{-1i}	8_{-1}	...	29_{-1i}	93_{-1i}	48_{-2}	28_{-2}	4_{-2}	96_{-1}	83_{-1}	74_{-1}	40_{-1}
Egypt	$-_{-1i}$	12_{-2}	22_{-2}	...	...	43_{-1}	59_{-2}	19_{-2}	8_{-2}	...	73_{-4}	67_{-4}	13_{-4}
Georgia	1_{-1i}	3	3	100	37	73	33_{-2}	11_{-2}	1_{-2}	99_{-2}	98_{-2}	92_{-2}	57_{-2}
Iraq	...	...	...	...	...	...	25_{-3}	7_{-3}	5_{-3}	...	...	...	...
Israel	12_{-4i}	17_{-1}	20_{-1}	...	40_{-1}	61_{-1}	...	...	...	...	...	...	...
Jordan	1_{-1i}	1	3	...	...	34	...	...	...	89_{-1}	81_{-1}	50_{-1}	33_{-1}
Kuwait	...	...	...	...	38_{-1}	59	60_{-4}	38_{-2}	13_{-2}	62_{-3}	56_{-3}	31_{-3}	...
Lebanon	...	...	16	...	...	...	...	...	...	...	...	...	...
Libya	...	...	...	...	...	...	...	...	...	...	...	...	...
Morocco	...	6	6	100	19	43	49_{-2}	22_{-2}	9_{-2}	...	...	...	...
Oman	...	1	0.2	...	27	47	84_{-2}	25_{-2}	8_{-2}	99_{-1}	99_{-1}	62_{-1}	23_{-1}
Palestine	2_{i}	3	1	100	31	43	15_{-2}	8_{-2}	3_{-2}	95_{-1}	68_{-1}	46_{-1}	...
Qatar	...	1	1	...	9	25	44_{-2}	25_{-2}	5_{-2}	88_{-4}	68_{-4}	41_{-4}	24_{-4}
Saudi Arabia	1_{-1i}	5	-	100_{-2}	51	71	68_{-2}	47_{-2}	14_{-2}	89_{-1}	77_{-1}	62_{-1}	38_{-1}
Sudan	...	...	2_{-3}	...	...	...	...	...	...	...	...	...	...
Syrian Arab Republic	...	2_{+1}	6_{+1}	79_{+1}	...	...	...	...	...	...	...	...	...
Tunisia	...	...	...	...	29_{+1}	37_{+1}	23_{-2}	18_{-2}	16_{-2}	...	...	...	...
Türkiye	7_{-1i}	22_{-1}	20_{-1}	...	42_{-1}	117_{-1}	...	...	3_{-2}	91_{-2}	66_{-2}	42_{-2}	...
United Arab Emirates	...	1_{-1}	2_{-1}	100_{+1}	15_{-4}	55_{+1}	91_{-2}	76_{-2}	18_{-2}	93	84	73	55
Yemen	...	...	...	...	...	...	...	...	...	...	...	...	...
Central and Southern Asia													
Afghanistan	0.1_{i}	1_{-3}	1_{-3}	55_{-3}	11_{-1}	11_{-1}	...	...	...	15	12	9	5
Bangladesh	1_{-4i}	3_{-1}	5	100	...	25	...	...	0.2_{-2}	63_{-1}	45_{-2}	31_{-2}	16_{-2}
Bhutan	3_{-1i}	$-_{-3i}$	2_{-3i}	100_{-1}	...	23	...	...	...	32_{-4}	28_{-4}	17_{-4}	11_{-4}
India	1_{-1i}	2_{+1}	3_{+1}	100_{+1}	31	32_{+1}	...	...	...	61_{-1}	49_{-1}	32_{-1}	13_{-1}
Iran, Islamic Republic of	2_{-1i}	9_{-1}	16_{-1}	...	26_{-1}	58_{-1}	21_{-4}	7_{-4}	1_{-4}	...	...	...	...
Kazakhstan	...	19_{-1}	10_{-1}	100_{-1}	69_{-1}	71_{-1}	14_{-2}	40_{-2}	6_{-3}	100_{-3}	99_{-3}	97_{-3}	79_{-3}
Kyrgyzstan	0.2_{-1i}	7	8	100	32	53	...	...	...	...	...	...	...
Maldives	7_{-2i}	...	6_{-2}	...	...	34_{-2}	...	...	...	...	...	...	...
Nepal	3_{-4i}	$-_{-4}$	1_{+1}	...	9_{-3}	17_{+1}	9_{-2}	5_{-2}	1_{-2}	...	...	...	...
Pakistan	0.4_{i}	...	3_{-2}	100_{-2}	...	12_{-2}	5_{-2}	2_{-2}	1_{-2}	50_{-2}	26_{-2}	12_{-2}	4_{-2}
Sri Lanka	1_{-2i}	4_{-3}	4_{-3}	100_{-1}	12	22	...	...	...	...	82	64	...
Tajikistan	...	...	...	...	...	31_{-4}	...	...	...	...	95_{-4}	81_{-4}	...
Turkmenistan	...	2	...	100	...	17	...	...	...	...	...	...	...
Uzbekistan	...	25_{-2}	34_{-2}	100	...	21	22_{-3}	10_{-3}	...	100	100	96	62
Eastern and South-eastern Asia													
Brunei Darussalam	1_{-1i}	8_{-1}	12_{-1}	...	23_{-1}	32_{-1}	60_{-2}	42_{-2}	28_{-2}	...	...	...	...
Cambodia	1_{-2i}	...	1	100	...	13	29_{-2}	9_{-2}	1_{-2}	...	...	...	...
China	...	8_{i}	18	75	39	64	...	...	...	...	...	...	...
DPR Korea	...	...	...	100_{-3}	21_{-3}	27_{-3}	42_{-4}	27_{-4}	9_{-4}	...	...	...	...
Hong Kong, China	...	3_{i}	1	67	...	88	54_{-2}	36_{-2}	1_{-2}	96_{-2}	80_{-2}	64_{-2}	31_{-2}
Indonesia	2_{i}	13_{-3}	20_{-3}	...	21_{-3}	36_{-3}	60_{-4}	25_{-4}	4_{-4}	82_{-1}	55_{-1}	38_{-1}	...
Japan	...	...	11_{-1}	...	49_{-2}	65_{-1}	65_{-2}	53_{-2}	4_{-3}	...	...	...	...
Lao PDR	4_{+1i}	3	1	100	9_{-2}	13	...	...	...	...	...	...	...
Macao, China	...	1	3	...	82	132	46_{-2}	38_{-2}	4_{-2}	...	...	...	...
Malaysia	...	5	5	...	16	41	59_{-2}	27_{-2}	8_{-2}	94_{-2}	77_{-2}	63_{-2}	23_{-2}
Mongolia	1_{-1i}	6_{-2}	10	100	60_{+1}	69_{+1}	17_{-3}	14_{-3}	4_{-3}	91_{-1}	76_{-1}	45_{-1}	40_{-1}
Myanmar	$-_{-1i}$	0.3_{-3}	0.2_{-3}	100_{-4}	...	19_{-3}	...	...	...	63_{-2}	43_{-2}	23_{-2}	11_{-2}
Philippines	...	...	9	100	...	36	6_{-2}	2_{-2}	1_{-2}	82_{-2}	71_{-2}	30_{-2}	30_{-2}
Republic of Korea	2_{i}	14_{-1}	9_{-1}	...	54_{-1}	102_{-1}	85_{-2}	46_{-2}	6_{-2}	...	...	...	...
Singapore	2_{i}	24_{-1i}	...	73_{-1}	65_{-1i}	93_{-1i}	54_{-2}	40_{-2}	7_{-2}	89_{-1}	83_{-1}	75_{-1}	58_{-1}
Thailand	0.3_{-1i}	11_{+1}	14_{+1}	...	...	44_{+1}	21_{-2}	16_{-2}	1_{-2}	71_{-2}	50_{-2}	35_{-2}	...
Timor-Leste	...	5_{-1}	9_{-1}	...	...	...	...	...	...	...	...	...	...
Viet Nam	1_{i}	...	...	...	19	35	...	...	...	89_{-2}	65_{-2}	32_{-2}	...

I		J		K				
% achieving proficiency in		Literacy rate (%)		Illiterates				
				% female		Number (000,000)		
Literacy	Numeracy	Youth	Adults	Youth	Adults	Youth	Adults	Country code
4.6.1		4.6.2						
2021								
…	…	74_{-2}	81_{-3i}	52_{-3i}	66_{-3i}	156_{-3i}	$5,484_{-3i}$	DZA
…	…	100_{-1}	100_{-1}	38_{-1}	66_{-1}	0.4_{-1}	5_{-1}	ARM
…	…	100_{-2}	100_{-2}	67_{-2}	68_{-2}	1_{-2}	16_{-2}	AZE
…	…	…	…	…	…	…	…	BHR
…	…	100_{i}	99_{i}	42_{i}	67_{i}	0.2_{i}	6_{i}	CYP
…	…	92_{i}	73_{i}	52_{i}	61_{i}	$1,467_{i}$	$18,566_{i}$	EGY
…	…	100_{-4}	99_{-4}	67_{-4}	59_{-4}	2_{-4}	21_{-4}	GEO
…	…	94_{-4}	86_{-4}	60_{-4}	69_{-4}	487_{-4}	$3,321_{-4}$	IRQ
…	…	…	…	…	…	…	…	ISR
…	…	99_{i}	98_{i}	37_{i}	59_{i}	12_{i}	110_{i}	JOR
…	…	99_{-1}	96_{-1}	28_{-1}	48_{-1}	3_{-1}	120_{-1}	KWT
…	…	100_{-2i}	95_{-2i}	31_{-2i}	68_{-2i}	3_{-2i}	240_{-2i}	LBN
…	…	…	…	…	…	…	…	LBY
…	…	98_{i}	76_{i}	53_{i}	69_{i}	96_{i}	$6,609_{i}$	MAR
…	…	99_{-3}	96_{-3}	29_{-3}	51_{-3}	9_{-3}	161_{-3}	OMN
…	…	99_{-1}	98_{-1}	48_{-1}	76_{-1}	8_{-1}	78_{-1}	PSE
…	…	…	…	…	…	…	…	QAT
…	…	99_{-1}	98_{-1}	53_{-1}	66_{-1}	23_{-1}	630_{-1}	SAU
…	…	73_{-3i}	61_{-3i}	49_{-3i}	57_{-3i}	$2,296_{-3i}$	$9,774_{-3i}$	SDN
…	…	…	…	…	…	…	…	SYR
…	…	98_{i}	83_{i}	48_{i}	69_{i}	37_{i}	$1,567_{i}$	TUN
…	…	100_{-2}	97_{-2}	80_{-2}	86_{-2}	13_{-2}	$2,089_{-2}$	TUR
…	…	100	98	47	48	4	140	ARE
…	…	…	…	…	…	…	…	YEM
…	…	56	37	66	60	3,794	14,584	AFG
…	…	94_{-1}	75_{-1}	37_{-1}	55_{-1}	$1,700_{-1}$	$30,239_{-1}$	BGD
…	…	97_{i}	71_{i}	47_{i}	59_{i}	4_{i}	171_{i}	BTN
…	…	95_{-1}	…	…	…	…	…	IND
…	…	99_{i}	89_{i}	46_{i}	66_{i}	142_{i}	$7,200_{i}$	IRN
74_{-4}	73_{-4}	100_{-1i}	100_{-1i}	100_{-1i}	69_{-1i}	1_{-1i}	20_{-1i}	KAZ
…	…	100_{-2i}	100_{-2i}	39_{-2i}	64_{-2i}	3_{-2i}	17_{-2i}	KGZ
…	…	99_{i}	98_{i}	47_{i}	25_{i}	0.4_{i}	9_{i}	MDV
…	…	94_{i}	71_{i}	59_{i}	71_{i}	371_{i}	$6,157_{i}$	NPL
…	…	73_{-2}	58_{-2}	61_{-2}	62_{-2}	$11,547_{-2}$	$58,832_{-2}$	PAK
…	…	99	92	40	59	34	1,244	LKA
…	…	99_{-4}	…	…	…	…	…	TJK
…	…	…	…	…	…	…	…	TKM
…	…	100	100	50	99	-	1	UZB
…	…	100_{i}	98_{i}	35_{i}	63_{i}	0.2_{i}	8_{i}	BRN
…	…	96_{i}	84_{i}	44_{i}	66_{i}	130_{i}	$1,889_{i}$	KHM
…	…	100_{-1i}	97_{-1i}	45_{-1i}	76_{-1i}	314_{-1i}	$33,811_{-1i}$	CHN
…	…	100_{-3i}	100_{-3i}	27_{-3i}	70_{-3i}	$-_{-3i}$	0.4_{-3i}	PRK
…	…	…	…	…	…	…	…	HKG
…	…	100_{-1}	96_{-1}	48_{-1}	68_{-1}	101_{-1}	$8,098_{-1}$	IDN
…	…	…	…	…	…	…	…	JPN
…	…	94_{i}	87_{i}	59_{i}	67_{i}	80_{i}	653_{i}	LAO
…	…	100_{i}	97_{i}	9_{i}	75_{i}	0.1_{i}	16_{i}	MAC
…	…	…	…	…	…	…	…	MYS
…	…	99_{-1}	99_{-1}	42_{-1}	48_{-1}	4_{-1}	18_{-1}	MNG
…	…	95_{-2}	89_{-2}	49_{-2}	67_{-2}	449_{-2}	$4,335_{-2}$	MMR
…	…	98_{-2}	96_{-2}	33_{-2}	43_{-2}	331_{-2}	$2,795_{-2}$	PHL
…	…	100_{-3i}	99_{-3i}	$-_{-3i}$	67_{-3i}	3_{-3i}	535_{-3i}	KOR
…	…	100_{-1}	97_{-1}	36_{-1}	72_{-1}	2_{-1}	141_{-1}	SGP
…	…	99_{i}	94_{i}	35_{i}	63_{i}	114_{i}	$3,455_{i}$	THA
…	…	85_{-1i}	70_{-1i}	44_{-1i}	55_{-1i}	42_{-1i}	250_{-1i}	TLS
…	…	97_{-1}	96_{-2}	52_{-2}	65_{-2}	187_{-2}	$3,144_{-2}$	VNM

TABLE 4: Continued

Country or territory	A	B	C	D	E	F	G			H			
	Participation in adult education and training (%)	% of youth enrolled in TVET	TVET share of secondary enrolment (%)	TVET share of post-secondary non-tertiary (%)	Gross graduation ratio from tertiary (%)	GER tertiary (%)	% of adults 15+ with ICT skills: Copy and paste within document	Use formula in spreadsheet	Write computer program	% of adults 25+ having attained at least: Primary	Lower secondary	Upper secondary	Post-secondary
SDG indicator	4.3.1	4.3.3				4.3.2	4.4.1			4.4.3			
Reference year	2021						2021						
Oceania													
Australia	…	16$_{-1}$	29$_{-1}$	100$_{-1}$	67$_{-1}$	114$_{-1}$	…	…	…	…	95$_{-1}$	80$_{-1}$	52$_{-1}$
Cook Islands	…	-	…	…	…	…	…	…	…	…	…	…	…
Fiji	…	1$_{-1}$	1	…	…	53$_{-2}$	…	…	…	…	87$_{-4}$	45$_{-4}$	…
Kiribati	2$_{-1i}$	…	…	…	…	…	…	…	…	…	…	…	…
Marshall Islands	2$_{-2i}$	1	2	49$_{-2}$	3$_{-2}$	26$_{-2}$	…	…	…	…	…	…	…
Micronesia, F. S.	…	…	…	…	…	…	…	…	…	…	…	…	…
Nauru	…	…	…	…	…	…	…	…	…	…	…	…	…
New Zealand	…	14$_{-1}$	17$_{-1}$	92$_{-1}$	43$_{-1}$	80$_{-1}$	…	…	…	…	82$_{-1}$	75$_{-1}$	51$_{-1}$
Niue	…	4$_{-1}$	4$_{-1}$	…	…	…	…	…	…	…	…	…	…
Palau	…	-	…	100$_{-1}$	…	…	…	…	…	…	…	…	…
Papua New Guinea	…	0.5$_{-3}$	2$_{-3}$	…	…	…	…	…	…	…	…	…	…
Samoa	0.4$_{-4i}$	…	…	…	4	19	…	…	…	…	…	…	…
Solomon Is	…	…	…	…	…	…	…	…	…	…	…	…	…
Tokelau	…	-	…	…	-$_{-1}$	…	…	…	…	…	…	…	…
Tonga	1$_{-3i}$	7$_{-1}$	5$_{-1}$	32$_{-1}$	…	18$_{-1}$	…	…	…	…	…	…	…
Tuvalu	…	2	3	…	…	…	…	…	…	…	…	…	…
Vanuatu	1$_{-2i}$	…	…	100	…	…	…	…	…	…	…	…	…
Latin America and the Caribbean													
Anguilla	…	-$_{-2}$	-$_{-2}$	-$_{-2}$	…	…	…	…	…	…	…	…	…
Antigua and Barbuda	…	2$_{-3}$	4$_{-3}$	…	…	…	…	…	…	…	…	…	…
Argentina	9$_{i}$	-$_{-1}$	…	…	17$_{-1}$	99$_{-1}$	…	…	…	…	…	…	…
Aruba	…	…	…	…	…	…	…	…	…	…	…	…	…
Bahamas	…	…	…	…	…	…	…	…	…	…	…	…	…
Barbados	…	-$_{-1}$	…	46	…	…	…	…	…	…	…	…	…
Belize	2$_{-2i}$	3	9	…	…	23	…	…	…	81$_{-1}$	52$_{-1}$	43$_{-1}$	21$_{-1}$
Bolivia, P. S.	8$_{i}$	29	65	…	…	…	…	…	…	69	64	50	31$_{-1}$
Brazil	7$_{i}$	4$_{-1i}$	5$_{-1}$	100$_{-1}$	…	55$_{-1i}$	24$_{-2}$	12$_{-2}$	3$_{-2}$	86	66	54	…
British Virgin Islands	…	1$_{-3}$	3	…	…	30	…	…	…	…	…	…	…
Cayman Islands	…	-$_{-1}$	…	…	…	…	…	…	…	…	…	…	…
Chile	2$_{i}$	13$_{-1}$	11$_{-1}$	…	12$_{-1}$	92$_{-1}$	…	43$_{-4}$	12$_{-4}$	89$_{-1}$	83$_{-1}$	63$_{-1}$	…
Colombia	5$_{-2i}$	9	8	…	30	57	33$_{-2}$	23$_{-2}$	5$_{-2}$	82	58	54	23$_{-1}$
Costa Rica	10$_{i}$	9$_{-2}$	26$_{-1}$	…	…	58$_{-2}$	…	…	…	84	49	40	…
Cuba	…	15	29	100	…	54	22$_{-2}$	22$_{-2}$	6$_{-2}$	…	…	…	…
Curaçao	…	25$_{-1}$	42$_{-1}$	…	…	…	29$_{-4}$	21$_{-4}$	4$_{-4}$	99$_{-1}$	90$_{-1}$	51$_{-1}$	…
Dominica	…	-$_{-1}$	-	…	…	…	…	…	…	…	…	…	…
Dominican Republic	4$_{-1i}$	6$_{i}$	13	…	31$_{-4i}$	60$_{-4i}$	…	…	…	74	66	43	…
Ecuador	5$_{i}$	7	15	…	36$_{-3}$	53$_{-1}$	27$_{-2}$	20$_{-2}$	5$_{-2}$	84	54	45	15
El Salvador	2$_{-1i}$	…	16	…	14$_{-2}$	30$_{-2}$	…	…	…	62$_{-1}$	47$_{-1}$	34$_{-1}$	…
Grenada	…	-$_{-1}$	…	100$_{-1}$	…	105$_{-3}$	…	…	…	…	…	…	…
Guatemala	3$_{-2i}$	8	29	…	…	22$_{-2}$	…	…	…	51$_{-2}$	32$_{-2}$	24$_{-2}$	5$_{-2}$
Guyana	2$_{-2i}$	…	…	90$_{-2}$	…	…	…	…	…	…	…	…	…
Haiti	…	…	…	…	…	…	…	…	…	…	…	…	…
Honduras	4$_{-2i}$	…	37	…	11$_{-2}$	25$_{-2}$	…	…	…	62$_{-2}$	33$_{-2}$	26$_{-2}$	…
Jamaica	2$_{-1i}$	-	…	91	…	…	15$_{-4}$	6$_{-4}$	…	…	…	…	…
Mexico	3$_{i}$	12$_{-1}$	27$_{-1}$	…	27$_{-4}$	45$_{-1}$	32$_{-2}$	26$_{-2}$	7$_{-2}$	82$_{-1}$	64$_{-1}$	36$_{-1}$	19$_{-1}$
Montserrat	…	…	…	…	…	…	…	…	…	…	…	…	…
Nicaragua	…	…	…	…	…	…	…	…	…	…	…	…	…
Panama	5$_{i}$	7$_{-4}$	18	…	14$_{-1}$	44$_{-1}$	…	…	…	89	67	51	27$_{-2}$
Paraguay	6$_{-4i}$	5	14	…	…	…	…	…	…	78	54	42	…
Peru	4$_{i}$	1	2	…	…	71$_{-4}$	31$_{-2}$	20$_{-2}$	4$_{-3}$	73	61	55	…
Saint Kitts and Nevis	…	-	-	…	…	…	…	…	…	…	…	…	…
Saint Lucia	0.3$_{-2i}$	1$_{-1}$	2$_{-1}$	35$_{-1}$	…	16$_{-1}$	…	…	…	…	47$_{-2}$	41$_{-2}$	15$_{-2}$
Saint Vincent/Grenadines	…	-$_{-4}$	-$_{-4}$	31$_{-4}$	…	8$_{-3}$	…	…	…	91$_{-4}$	42$_{-4}$	…	4$_{-4}$
Sint Maarten	…	…	…	…	…	…	…	…	…	…	…	…	…
Suriname	…	…	42	…	…	…	…	…	…	…	…	…	…
Trinidad and Tobago	…	1$_{-2}$	…	39$_{-1}$	5	…	…	…	…	…	…	…	…
Turks and Caicos Islands	…	-	…	…	…	…	…	…	…	…	…	…	…
Uruguay	9$_{i}$	11$_{-1}$	26$_{-1}$	…	19$_{-1}$	68$_{-1}$	…	…	…	92	61	34	…
Venezuela, B. R.	4$_{-4i}$	…	5$_{-4}$	…	…	…	…	…	…	…	…	…	…

I: % achieving proficiency in		J: Literacy rate (%)		K: Illiterates				Country code
				% female		Number (000,000)		
Literacy	Numeracy	Youth	Adults	Youth	Adults	Youth	Adults	
4.6.1		4.6.2						
2021								
...	...	...	...	...	...	...	...	AUS
...	...	...	...	...	...	...	...	COK
...	...	98	...	...	...	...	...	FJI
...	...	86_{-3}	...	...	...	...	...	KIR
...	...	...	...	...	...	...	...	MHL
...	...	...	...	...	...	...	...	FSM
...	...	...	...	...	...	...	...	NRU
...	...	...	...	...	...	...	...	NZL
...	...	...	...	...	...	...	...	NIU
...	...	...	...	...	...	...	...	PLW
...	...	...	...	...	...	...	...	PNG
...	...	99_{i}	99_{i}	31_{i}	40_{i}	0.3_{i}	1_{i}	WSM
...	...	...	...	...	...	...	...	SLB
...	...	...	...	...	...	...	...	TKL
...	...	99_{i}	99_{i}	40_{i}	46_{i}	0.1_{i}	0.4_{i}	TON
...	...	83_{-2}	...	...	...	...	...	TUV
...	...	97_{i}	89_{i}	43_{i}	53_{i}	2_{i}	21_{i}	VUT
...	...	...	...	...	...	...	...	AIA
...	...	...	...	...	...	...	...	ATG
...	...	...	...	...	...	...	...	ARG
...	...	100_{-1i}	98_{-1i}	61_{-1i}	53_{-1i}	0.1_{-1i}	2_{-1i}	ABW
...	...	...	...	...	...	...	...	BHS
...	...	...	...	...	...	...	...	BRB
...	...	...	...	...	...	...	...	BLZ
...	...	100	94_{-1}	52_{-1}	79_{-1}	10_{-1}	492_{-1}	BOL
...	...	99	94_{i}	33_{i}	50_{i}	199_{i}	$9,694_{i}$	BRA
...	...	...	...	...	...	...	...	VGB
...	...	...	...	...	...	...	...	CYM
...	...	99_{i}	97_{i}	54_{i}	52_{i}	23_{i}	460_{i}	CHL
...	...	99	96_{-1}	35_{-1}	49_{-1}	86_{-1}	$1,728_{-1}$	COL
...	...	100_{i}	98_{i}	41_{i}	49_{i}	4_{i}	80_{i}	CRI
...	...	100_{i}	100_{i}	41_{i}	44_{i}	2_{i}	31_{i}	CUB
...	...	...	...	...	...	...	...	CUW
...	...	...	...	...	...	...	...	DMA
...	...	99	95_{i}	58_{i}	49_{i}	20_{i}	385_{i}	DOM
28_{-4}	23_{-4}	96	94	25	54	31	718	ECU
...	...	99_{-1}	90_{-1}	43_{-1}	63_{-1}	18_{-1}	477_{-1}	SLV
...	...	...	...	...	...	...	...	GRD
...	...	96_{i}	83_{i}	54_{i}	64_{i}	158_{i}	$2,039_{i}$	GTM
...	...	98_{i}	89_{i}	42_{i}	52_{i}	3_{i}	64_{i}	GUY
...	...	...	...	...	...	...	...	HTI
...	...	96_{-2}	89_{-2}	34_{-2}	50_{-2}	81_{-2}	772_{-2}	HND
...	...	...	...	...	...	...	...	JAM
49_{-4}	40_{-4}	99_{-1}	95_{-1}	45_{-1}	60_{-1}	203_{-1}	$4,544_{-1}$	MEX
...	...	...	...	...	...	...	...	MSR
...	...	...	...	...	...	...	...	NIC
...	...	99	96_{-2}	50_{-2}	55_{-2}	8_{-2}	132_{-2}	PAN
...	...	99	95_{-1}	48_{-1}	53_{-1}	18_{-1}	276_{-1}	PRY
29_{-4}	25_{-4}	99	94_{-1}	60_{-1}	73_{-1}	29_{-1}	$1,371_{-1}$	PER
...	...	...	...	...	...	...	...	KNA
...	...	...	...	...	...	...	...	LCA
...	...	...	...	...	...	...	...	VCT
...	...	...	...	...	...	...	...	SXM
...	...	99_{i}	95_{i}	57_{i}	66_{i}	1_{i}	22_{i}	SUR
...	...	...	...	...	...	...	...	TTO
...	...	100_{-2}	...	...	...	...	...	TCA
...	...	99	99_{-2}	34_{-2}	41_{-2}	5_{-2}	34_{-2}	URY
...	...	99_{i}	98_{i}	35_{i}	48_{i}	60_{i}	516_{i}	VEN

TABLE 4: Continued

Country or territory	A: Participation in adult education and training (%)	B: % of youth enrolled in TVET	C: TVET share of secondary enrolment (%)	D: TVET share of post-secondary non-tertiary (%)	E: Gross graduation ratio from tertiary (%)	F: GER tertiary (%)	G: % of adults 15+ with ICT skills: Copy and paste within document	G: Use formula in spreadsheet	G: Write computer program	H: % of adults 25+ having attained at least: Primary	H: Lower secondary	H: Upper secondary	H: Post-secondary
SDG indicator	4.3.1	4.3.3				4.3.2	4.4.1			4.4.3			
Reference year	2021						2021						
Europe and Northern America													
Albania	1_{-2i}	5	8	…	43	57	16_{-2}	…	2_{-2}	…	…	…	…
Andorra	…	…	11	100	…	…	…	…	6_{-4}	…	…	…	…
Austria	14_{-1i}	28_{-1}	35_{-1}	100_{-1}	38_{-1}	87_{-1}	…	…	9_{-2}	…	…	81_{-2}	32_{-2}
Belarus	19_{-1i}	18	12	100	67	82	41_{-2}	20_{-2}	2_{-2}	100_{-2}	98_{-2}	95_{-2}	74_{-2}
Belgium	7_{-1i}	24_{-1}	42_{-1}	91_{-1}	56_{-1}	81_{-1}	57_{-2}	45_{-2}	4_{-2}	97_{-2}	88_{-2}	71_{-2}	37_{-2}
Bermuda	…	…	…	…	$-_{-3}$	19_{-3}	…	…	…	…	…	…	…
Bosnia and Herzegovina	2_{i}	22	37	…	28	39	22_{-2}	8_{-2}	2_{-2}	91_{-1}	88_{-1}	69_{-1}	14_{-1}
Bulgaria	2_{-1i}	16_{-1}	31_{-1}	100_{-1}	48_{-1}	75_{-1}	44_{-2}	…	1_{-2}	…	96_{-1}	78_{-1}	26_{-1}
Canada	5_{i}	8_{-1}	4_{-1}	…	43_{-1}	80_{-1}	…	…	…	…	…	…	…
Croatia	4_{-1i}	21_{-1}	37_{-1}	…	44_{-1}	68_{-1}	59_{-2}	43_{-2}	9_{-2}	…	…	…	…
Czechia	6_{-1i}	28_{-1}	34_{-1}	25_{-1}	45_{-1}	68_{-1}	51_{-2}	45_{-2}	6_{-2}	100_{-2}	100_{-2}	91_{-2}	…
Denmark	22_{-1i}	12_{-1}	21_{-1}	…	59_{-1}	83_{-1}	…	54_{-2}	14_{-2}	…	95_{-1}	79_{-1}	38_{-1}
Estonia	20_{-1i}	11_{-1}	22_{-1}	100_{-1}	4_{-1}	69_{-4}	…	…	7_{-4}	100_{-1}	98_{-1}	86_{-1}	49_{-1}
Finland	31_{-1i}	19_{-1}	43_{-1}	100_{-1}	65_{-1}	95_{-1}	…	48_{-2}	9_{-2}	…	…	77_{-2}	38_{-2}
France	15_{-1i}	19_{-1i}	17_{-1}	42_{-1}	50_{-1i}	69_{-1i}	…	…	6_{-4}	98_{-2}	86_{-2}	72_{-2}	32_{-2}
Germany	9_{-1i}	20_{-1}	19_{-1}	94_{-1}	45_{-1}	73_{-1}	57_{-2}	35_{-2}	5_{-2}	100_{-1}	96_{-1}	84_{-1}	40_{-1}
Greece	5_{-1i}	13_{-1}	17_{-1}	100_{-1}	44_{-1}	151_{-1}	53_{-4}	38_{-2}	4_{-2}	96_{-1}	74_{-1}	65_{-1}	35_{-1}
Hungary	6_{-1i}	22_{-1}	25_{-1}	100_{-1}	139_{-1}	55_{-1}	52_{-2}	…	4_{-2}	100_{-1}	98_{-1}	80_{-1}	32_{-1}
Iceland	23_{-1i}	9_{-1}	18_{-1}	98_{-1}	54_{-1}	84_{-1}	82_{-4}	71_{-4}	13_{-4}	…	100_{-1}	74_{-1}	46_{-1}
Ireland	12_{-1i}	7_{-1i}	15_{-1}	100_{-1}	…	75_{-1i}	53_{-3}	36_{-3}	6_{-3}	…	86_{-4}	71_{-4}	43_{-4}
Italy	4_{i}	21_{-1}	32_{-1}	100_{-1}	42_{-1}	69_{-1}	…	…	…	97_{-1}	82_{-1}	52_{-1}	17_{-1}
Latvia	8_{-1i}	17_{-1i}	20_{-1}	100_{-1}	47_{-1i}	95_{-1i}	…	32_{-2}	3_{-2}	100_{-2}	…	91_{-2}	48_{-2}
Liechtenstein	…	25_{i}	34	…	5_{-1i}	46_{i}	…	…	…	…	…	…	…
Lithuania	8_{-1i}	7_{-1i}	8_{-1}	100_{-1}	59_{-1i}	71_{-1i}	59_{-2}	42_{-2}	5_{-2}	99_{-1}	97_{-1}	90_{-1}	58_{-1}
Luxembourg	19_{-1i}	22_{-1}	33_{-1}	100_{-1}	8_{-1}	19_{-1}	…	69_{-4}	11_{-4}	…	…	…	…
Malta	12_{-1i}	11_{-1}	16_{-1}	…	52_{-1}	71_{-1}	…	41_{-2}	6_{-4}	99_{-1}	85_{-1}	48_{-1}	33_{-1}
Monaco	…	14_{+1i}	12_{+1}	100_{+1}	154_{i}	62_{+1i}	…	…	…	…	…	…	…
Montenegro	3_{-1i}	23	33	…	34	56	…	28_{-2}	4_{-2}	…	…	…	…
Netherlands	22_{-1i}	23_{-1}	39_{-1}	…	52_{-1}	92_{-1}	72_{-2}	54_{-2}	9_{-2}	99_{-1}	91_{-1}	73_{-1}	37_{-1}
North Macedonia	3_{i}	…	29_{-1}	100_{-1}	25_{-1}	43_{-1}	…	…	…	94_{-1}	68_{-1}	68_{-1}	22_{-1}
Norway	18_{-1i}	18_{-1}	29_{-1}	100_{-1}	57_{-1}	84_{-1}	78_{-2}	60_{-2}	11_{-2}	100_{-2}	99_{-2}	79_{-2}	41_{-2}
Poland	4_{-1i}	24_{-1}	26_{-1}	100_{-1}	46_{-1}	70_{-1}	…	28_{-2}	3_{-2}	99_{-1}	89_{-1}	88_{-1}	31_{-1}
Portugal	15_{i}	16_{-1}	23_{-1}	100_{-1}	56_{-1}	70_{-1}	49_{-2}	37_{-2}	8_{-2}	94_{-1}	61_{-1}	43_{-1}	23_{-1}
Republic of Moldova	…	16_{i}	13	100	49_{-1i}	63_{i}	…	…	…	99_{-2}	97_{-2}	75_{-2}	…
Romania	1_{-1i}	19_{-2}	28_{-1}	100_{-1}	42_{-1}	53_{-1}	21_{-2}	5_{-2}	1_{-4}	99_{-2}	91_{-2}	69_{-2}	18_{-2}
Russian Federation	…	19_{-2i}	15_{-2}	100_{-2}	57_{-2}	86_{-2}	40_{-2}	24_{-2}	1_{-2}	…	…	…	…
San Marino	…	2_{i}	5	…	45_{-1i}	57_{i}	…	…	…	97_{-3}	83_{-3}	54_{-3}	16_{-3}
Serbia	6_{i}	25_{i}	36	100	…	69_{i}	…	24_{-4}	4_{-2}	99_{-2}	92_{-2}	74_{-2}	23_{-2}
Slovakia	3_{-1i}	23_{-1}	29_{-1}	100_{-1}	33_{-1}	48_{-1}	…	35_{-2}	4_{-2}	100_{-2}	99_{-2}	88_{-2}	25_{-2}
Slovenia	10_{-1i}	35_{-1}	43_{-1}	…	46_{-1}	80_{-1}	60_{-2}	44_{-2}	4_{-4}	100_{-2}	98_{-2}	83_{-2}	…
Spain	17_{i}	17_{-1}	19_{-1}	100_{-1}	47_{-1}	96_{-1}	…	38_{-2}	7_{-2}	93_{-1}	81_{-1}	53_{-1}	34_{-1}
Sweden	31_{-1i}	14_{-1}	21_{-1}	74_{-1}	51_{-1}	85_{-1}	64_{-2}	46_{-2}	11_{-2}	100_{-2}	92_{-2}	77_{-2}	40_{-2}
Switzerland	30_{-1i}	23_{-1}	36_{-1}	79_{-1}	56_{-1}	65_{-1}	…	57_{-2}	10_{-2}	100_{-2}	97_{-2}	87_{-2}	…
Ukraine	…	…	6	100	…	…	…	…	…	…	…	…	…
United Kingdom	7_{i}	17_{-1}	28_{-1}	…	51_{-1}	69_{-1}	61_{-4}	46_{-2}	9_{-2}	100_{-1}	100_{-1}	80_{-1}	…
United States	5_{i}	2_{-1i}	…	100_{-1}	…	88_{-1i}	…	…	…	99_{-1}	96_{-1}	91_{-1}	…

I		J		K				Country code
% achieving proficiency in		Literacy rate (%)		Illiterates				
				% female		Number (000,000)		
Literacy	Numeracy	Youth	Adults	Youth	Adults	Youth	Adults	
4.6.1		4.6.2						
2021								
…	…	99_{i}	98_{i}	15_{i}	57_{i}	2_{i}	37_{i}	ALB
…	…	…	…	…	…	…	…	AND
…	…	…	…	…	…	…	…	AUT
…	…	100_{-2}	100_{-2}	38_{-2}	53_{-2}	1_{-2}	10_{-2}	BLR
…	…	…	…	…	…	…	…	BEL
…	…	…	…	…	…	…	…	BMU
…	…	100_{i}	98_{i}	47_{i}	85_{i}	1_{i}	53_{i}	BIH
…	…	98_{i}	98_{i}	54_{i}	60_{i}	12_{i}	93_{i}	BGR
…	…	…	…	…	…	…	…	CAN
…	…	100_{i}	99_{i}	45_{i}	73_{i}	1_{i}	19_{i}	HRV
…	…	…	…	…	…	…	…	CZE
…	…	…	…	…	…	…	…	DNK
…	…	100_{i}	100_{i}	32_{i}	51_{i}	$-_{i}$	1_{i}	EST
…	…	…	…	…	…	…	…	FIN
…	…	…	…	…	…	…	…	FRA
…	…	…	…	…	…	…	…	DEU
…	…	…	…	…	…	…	…	GRC
81_{-4}	82_{-4}	99_{i}	99_{i}	41_{i}	53_{i}	13_{i}	74_{i}	HUN
…	…	…	…	…	…	…	…	ISL
…	…	…	…	…	…	…	…	IRL
…	…	100_{-2i}	99_{-2i}	28_{-2i}	62_{-2i}	7_{-2i}	342_{-2i}	ITA
…	…	100_{i}	100_{i}	37_{i}	44_{i}	0.3_{i}	2_{i}	LVA
…	…	…	…	…	…	…	…	LIE
…	…	100_{i}	100_{i}	44_{i}	49_{i}	0.1_{i}	4_{i}	LTU
…	…	…	…	…	…	…	…	LUX
…	…	99_{i}	95_{i}	33_{i}	35_{i}	0.2_{i}	19_{i}	MLT
…	…	…	…	…	…	…	…	MCO
…	…	99_{i}	99_{i}	55_{i}	74_{i}	1_{i}	5_{i}	MNE
…	…	…	…	…	…	…	…	NLD
…	…	…	…	…	…	…	…	MKD
…	…	…	…	…	…	…	…	NOR
…	…	100_{i}	100_{i}	33_{i}	52_{i}	5_{i}	64_{i}	POL
…	…	100_{i}	97_{i}	43_{i}	67_{i}	3_{i}	285_{i}	PRT
…	…	100_{i}	100_{i}	49_{i}	65_{i}	1_{i}	14_{i}	MDA
…	…	100_{i}	99_{i}	48_{i}	61_{i}	10_{i}	179_{i}	ROU
…	…	100_{-1i}	100_{-1i}	42_{-1i}	55_{-1i}	48_{-1i}	357_{-1i}	RUS
…	…	…	…	…	…	…	…	SMR
…	…	100_{-2}	99_{-2}	50_{-2}	88_{-2}	$-_{-2}$	38_{-2}	SRB
…	…	…	…	…	…	…	…	SVK
…	…	…	…	…	…	…	…	SVN
…	…	100_{-1}	99_{-1}	32_{-1}	66_{-1}	17_{-1}	562_{-1}	ESP
…	…	…	…	…	…	…	…	SWE
…	…	…	…	…	…	…	…	CHE
…	…	100_{i}	100_{i}	$-_{i}$	55_{i}	4_{i}	$-_{i}$	UKR
…	…	…	…	…	…	…	…	GBR
81_{-4}	71_{-4}	…	…	…	…	…	…	USA

TABLE 5: SDG 4, Target 4.5 – Equity

By 2030, eliminate gender disparities in education and ensure equal access at all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations

	Gender														
	A			B				C		D		E			
	GPIA in completion			GPIA in minimum proficiency				GPIA in literacy rate		GPIA in adult proficiency		GPIA in gross enrolment ratio			
				End of primary		End of lower secondary									
	Primary	Lower secondary	Upper secondary	Reading	Mathematics	Reading	Mathematics	Youth	Adults	Literacy	Numeracy	Pre-primary	Primary	Secondary	Tertiary
SDG indicator	4.5.1														
Reference year	2021														
Region	Median							Weighted average							
World	1.01	1.01	1.05	…	1.01_{i}	1.15_{i}	1.00_{i}	0.97_{-1}	0.93_{-1}	…	…	0.99_{-1}	0.98_{-1}	0.99_{-1}	1.14_{-1}
Sub-Saharan Africa	1.10	1.02	0.92	1.07_{i}	0.99_{i}	…	…	0.93_{-1}	0.82_{-1}	…	…	0.99_{-1i}	0.96_{-1i}	0.90_{-1i}	0.78_{-1i}
Northern Africa and Western Asia	1.00_{i}	1.01_{i}	1.05_{i}	…	0.99_{i}	1.32_{i}	1.04_{i}	0.96_{-1}	0.87_{-1}	…	…	0.99_{-1i}	0.96_{-1i}	0.97_{-1i}	1.07_{-1i}
Northern Africa	1.02	1.06	1.12	…	…	…	…	0.99_{-1}	0.84_{-1}	…	…	0.99_{-1i}	0.98_{-1i}	1.01_{-1i}	1.15_{-1i}
Western Asia	1.00_{i}	1.01_{i}	1.04_{i}	…	1.00_{i}	1.33_{i}	1.03_{i}	0.94_{-1}	0.90_{-1}	…	…	0.99_{-1}	0.94_{-1i}	0.93_{-1}	1.02_{-1i}
Central and Southern Asia	1.00	1.00	1.00	…	…	…	…	0.96_{-1i}	0.82_{-1i}	…	…	0.99_{-1}	0.99_{-1}	0.99_{-1}	1.06_{-1}
Central Asia	1.00	1.00	1.00	…	…	…	…	1.00_{-1}	1.00_{-1}	…	…	0.97_{-1}	0.99_{-1}	0.99_{-1}	1.03_{-1}
Southern Asia	1.00	1.02	1.01	…	…	…	…	0.96_{-1i}	0.81_{-1i}	…	…	0.99_{-1}	0.99_{-1}	0.99_{-1}	1.06_{-1}
Eastern and South-eastern Asia	1.01	1.06	1.12	1.23_{i}	1.02_{i}	1.23_{i}	1.03_{i}	1.00_{-1}	0.97_{-1}	…	…	0.99_{-1}	1.00_{-1}	1.02_{-1}	1.13_{-1}
Eastern Asia	1.00_{i}	1.02_{i}	1.05_{i}	…	…	1.08_{i}	1.01_{i}	1.00_{-1}	0.97_{-1}	…	…	1.01_{-1}	1.01_{-1}	1.02_{-1}	1.13_{-1}
South-eastern Asia	1.03	1.08	1.20	1.23_{i}	1.08_{i}	1.31_{i}	1.07_{i}	1.00_{-1}	0.97_{-1}	…	…	0.96_{-1i}	0.98_{-1i}	1.03_{-1i}	1.18_{-1i}
Oceania	1.02_{i}	1.11_{i}	1.25_{i}	…	…	…	…	…	…	…	…	0.98_{-1i}	0.98_{-1}	0.96_{-1}	1.29_{-1}
Latin America and the Caribbean	1.02_{i}	1.06_{i}	1.09_{i}	1.16_{i}	0.87_{i}	…	…	1.00_{-1}	0.99_{-1}	…	…	1.01_{-1}	0.98_{-1}	1.05_{-1}	1.25_{-1}
Caribbean	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Central America	1.01	1.05	1.07	1.16	0.85	1.11	0.82	…	…	…	…	…	…	…	…
South America	1.02	1.07	1.09	1.14	0.89	1.12_{i}	0.78_{i}	…	…	…	…	…	…	…	…
Europe and Northern America	1.00	1.00	1.05	…	1.04_{i}	1.13	1.00	…	…	…	…	0.99_{-1}	1.00_{-1}	0.99_{-1}	1.23_{-1}
Europe	1.00	1.01	1.05	…	1.04_{i}	1.13	1.00	…	…	…	…	0.99_{-1}	1.00_{-1}	1.00_{-1}	1.19_{-1}
Northern America	1.00_{i}	1.00_{i}	1.02	…	1.07	1.09	0.99	…	…	…	…	1.00_{-1}	0.99_{-1}	0.98_{-1}	1.29_{-1}
Low income	1.08	0.97	0.89	…	…	…	…	0.91_{-1}	0.78_{-1}	…	…	1.00_{-1i}	0.93_{-1i}	0.82_{-1i}	0.64_{-1i}
Middle income	1.01	1.05	1.07	…	1.00_{i}	…	…	0.98_{-1}	0.92_{-1}	…	…	0.99_{-1}	0.99_{-1}	1.00_{-1}	1.13_{-1}
Lower middle	1.03	1.06	1.05	…	1.01_{i}	…	…	0.97_{-1i}	0.86_{-1i}	…	…	0.98_{-1}	0.99_{-1}	1.00_{-1}	1.08_{-1}
Upper middle	1.01	1.03	1.09	…	0.99_{i}	1.22_{i}	1.00_{i}	1.00_{-1}	0.97_{-1}	…	…	1.00_{-1}	0.99_{-1}	1.02_{-1}	1.17_{-1}
High income	1.00_{i}	1.01_{i}	1.05_{i}	…	1.03_{i}	1.13_{i}	1.00	…	…	…	…	1.00_{-1}	1.00_{-1}	0.99_{-1}	1.21_{-1}

A Adjusted gender parity index (GPIA) in school completion rate by level.
B Adjusted gender parity index (GPIA) in percentage of students with minimum level of proficiency at the end of given level.
C Adjusted gender parity index (GPIA) in youth and adult literacy rate.
D Adjusted gender parity index (GPIA) in percentage of adults aged 16 and over achieving at least a fixed level of proficiency in functional literacy and numeracy skills.
E Adjusted gender parity index (GPIA) in gross enrolment ratio by level.
F Adjusted parity index for location (rural-urban) and wealth (poorest to richest quintile) in school completion by level.
G Adjusted parity index for wealth (poorest to richest quintile) in achievement of minimum proficiency.

Source: UIS and GEM Report analysis of household surveys. Data refer to school year ending in 2021 unless noted otherwise.
Aggregates represent countries listed in the table with available data and may include estimates for countries with no recent data.
(-) Magnitude nil or negligible.
(…) Data not available or category not applicable.
(± n) Reference year differs (e.g. -2: reference year 2019 instead of 2021).
(i) Estimate and/or partial coverage.

Location/wealth															
F												G			
Disparity in primary completion				Disparity in lower secondary completion				Disparity in upper secondary completion				Wealth disparity in minimum proficiency			
Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		End of primary		End of lower secondary	
Location	Wealth	M	F	Location	Wealth	M	F	Location	Wealth	M	F	Reading	Mathematics	Reading	Mathematics
4.5.1															
2021															
Median															
0.99[i]	0.91[i]	86[i]	92[i]	0.94[i]	0.68[i]	63[i]	70[i]	0.76[i]	0.34[i]	28[i]	34[i]	...	...	0.61[i]	0.60[i]
0.66	0.42[i]	34[i]	34[i]	0.43	0.18[i]	13[i]	11[i]	0.26	0.06[i]	5[i]	1[i]	...	...	...	...
1.00[i]	0.92[i]	92[i]	94[i]	0.96[i]	0.77[i]	66[i]	75[i]	0.84[i]	0.48[i]	...	...	...	0.81[i]	0.47[i]	0.53[i]
0.98[i]	0.92[i]	89[i]	92[i]	0.83[i]	0.57[i]	49[i]	61[i]	0.69[i]	0.37[i]	21[i]	40[i]	...	...	...	...
1.00[i]	0.99[i]	99[i]	100[i]	0.98[i]	0.92[i]	...	92[i]	0.86[i]	...	...	...	...	0.83[i]	0.48[i]	0.59[i]
0.99[i]	0.97[i]	96[i]	96[i]	0.95[i]	0.86[i]	75[i]	89[i]	0.72[i]	0.25[i]	20[i]	19[i]	...	...	...	...
1.00	1.00	99	100	0.99	0.97	97	97	0.92	0.81	77[i]	81[i]	...	...	...	...
0.98[i]	0.77[i]	72[i]	79[i]	0.93[i]	0.66[i]	58[i]	61[i]	0.49[i]	0.24[i]	16[i]	9[i]	...	...	...	...
0.98[i]	0.93[i]	91[i]	95[i]	0.89[i]	0.68[i]	63[i]	70[i]	0.68[i]	0.40[i]	33[i]	40[i]	...	...	0.43[i]	0.48[i]
...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.89[i]	0.89[i]
0.97[i]	0.91[i]	88[i]	94[i]	0.91[i]	0.68[i]	63[i]	69[i]	0.65[i]	0.34[i]	33[i]	32[i]	...	...	0.40[i]	0.42[i]
1.01[i]	0.96[i]	92[i]	95[i]	0.95[i]	0.82[i]	81[i]	87[i]	0.71[i]	...	...	...	...	...	...	...
0.99[i]	0.95[i]	93[i]	96[i]	0.91[i]	0.78[i]	71[i]	79[i]	0.75[i]	0.54[i]	47[i]	53[i]	0.32[i]	0.22[i]	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
0.96	0.93	91	94	0.85	0.76	69	79	0.72	0.52	43	41	0.26	0.15	0.35	0.20
0.99	0.98	97	97	0.93	0.82	76	86	0.81	0.62	54	60	0.32[i]	0.24[i]	0.44[i]	0.27[i]
1.00[i]	...	...	...	1.00[i]	...	...	...	0.99	...	...	...	...	0.71[i]	0.70	0.68
1.00	...	...	...	1.00	...	...	...	0.99	...	...	...	...	0.70[i]	0.69	0.68
...	0.99[i]	99[i]	99[i]	...	0.98[i]	98[i]	98[i]	0.95[i]	0.93	91	91	...	0.74	0.81	0.71
0.59	0.42[i]	25[i]	34[i]	0.32	0.18[i]	11[i]	8[i]	0.23[i]	0.05[i]	5[i]	1[i]	...	...	...	...
0.98[i]	0.92[i]	89[i]	94[i]	0.92[i]	0.73[i]	66[i]	74[i]	0.74[i]	0.45[i]	33[i]	41[i]	...	...	...	...
0.93	0.82[i]	78[i]	87[i]	0.81	0.55[i]	45[i]	59[i]	0.52	0.32[i]	20[i]	24[i]	...	...	...	...
1.00[i]	0.97[i]	96[i]	97[i]	0.97[i]	0.84[i]	78[i]	86[i]	0.81[i]	0.54[i]	47[i]	53[i]	...	0.58[i]	0.45[i]	0.44[i]
1.00[i]	...	...	...	1.00[i]	...	...	...	0.99[i]	...	...	...	...	0.67[i]	0.71[i]	0.70

TABLE 5: Continued

	Gender															
	A			B				C		D		E				
				GPIA in minimum proficiency												
	GPIA in completion			End of primary		End of lower secondary		GPIA in literacy rate		GPIA in adult proficiency		GPIA in gross enrolment ratio				
Country or territory	Primary	Lower secondary	Upper secondary	Reading	Mathematics	Reading	Mathematics	Youth	Adults	Literacy	Numeracy	Pre-primary	Primary	Secondary	Tertiary	
SDG indicator	4.5.1															
Reference year	2021															
Sub-Saharan Africa																
Angola	1.01_{-1}	0.84_{-1}	0.77_{-1}	...	...	...	...	0.93_{i}	0.76_{i}	...	...	...	0.94_{-3}	...	0.89_{-2}	
Benin	0.88_{-1}	0.67_{-1}	0.49_{-1}	1.07_{-2}	1.03_{-2}	...	...	0.79_{i}	0.61_{i}	...	...	1.02	0.93	0.83	0.51_{-1}	
Botswana	...	...	...	...	...	...	...	...	...	...	...	...	0.98	1.10	1.37	
Burkina Faso	1.04_{-2}	0.82_{-2}	0.90_{-4}	1.02_{-2}	0.90_{-2}	...	...	0.96_{i}	0.69_{i}	...	...	1.01	1.02	1.11	0.60	
Burundi	1.18_{-1}	0.69_{-1}	0.96_{-1}	0.93_{-2}	0.61_{-2}	...	...	0.98_{i}	0.84_{i}	...	...	1.03_{-1}	1.01_{-1}	1.18_{-1}	0.77	
Cabo Verde	...	...	0.79_{-4}	...	...	...	...	1.01_{i}	0.93_{i}	...	...	1.02_{-2}	0.94_{-2}	1.08_{-2}	1.33_{-3}	
Cameroon	1.06_{-1}	1.01_{-1}	0.94_{-1}	1.13_{-2}	1.15_{-2}	...	...	0.95_{-1i}	0.88_{-1i}	...	...	1.03	0.91	0.89	0.89_{-3}	
Central African Republic	0.87_{-1}	0.69_{-1}	0.67_{-1}	...	...	...	...	0.61_{-1i}	0.53_{-1i}	...	...	1.04_{-4}	0.77_{-4}	0.67_{-4}	...	
Chad	0.95_{-1}	0.53_{-1}	0.47_{-1}	0.95_{-2}	1.17_{-2}	...	...	0.71_{i}	0.51_{i}	...	...	0.94	0.80	0.58	...	
Comoros	1.15_{-4}	1.24_{-4}	1.39_{-4}	...	...	...	...	1.02_{i}	0.85_{i}	...	...	1.03_{-3}	1.00_{-3}	1.06_{-3}	...	
Congo	0.97_{-1}	0.65_{-1}	0.78_{-1}	1.18_{-2}	1.15_{-2}	...	...	0.93_{i}	0.88_{i}	...	...	1.08_{-3}	0.97_{-3}	0.92_{-3}	0.67_{-4}	
Côte d'Ivoire	0.85_{-1}	0.73_{-1}	0.83_{-1}	1.09_{-2}	0.62_{-2}	...	...	0.82_{-2}	0.93_{-2}	...	...	1.10_{+1}	0.96_{+1}	0.86	0.78_{-1}	
D. R. Congo	1.12_{-1}	1.06_{-1}	0.90_{-1}	0.86_{-2}	0.80_{-2}	...	...	0.93_{i}	0.79_{i}	...	...	1.07_{-1}	0.95_{-1}	...	0.60_{-1}	
Djibouti	0.92_{-4}	0.88_{-4}	0.80_{-4}	...	...	...	...	...	...	...	...	0.92_{+1}	0.90_{+1}	1.03_{+1}	...	
Equat. Guinea	...	...	...	...	...	...	...	...	...	...	...	...	0.99_{-2}	...	0.87	
Eritrea	...	...	...	...	...	...	...	0.99_{-3i}	0.82_{-3i}	...	...	0.99_{-2}	0.86_{-2}	0.92_{-2}	...	
Eswatini	1.21_{-2}	1.18_{-2}	1.16_{-2}	...	...	...	...	1.02_{-1i}	1.00_{-1i}	...	...	...	0.92_{-2}	...	...	
Ethiopia	1.23_{-1}	1.22_{-1}	1.23_{-1}	...	...	...	...	0.98_{-4i}	0.75_{-4i}	...	...	0.95	0.91	...	0.60_{-3}	
Gabon	1.12_{-4}	1.21_{-4}	1.17_{-4}	1.07_{-2}	0.76_{-2}	...	...	1.04_{i}	0.98_{i}	...	...	1.03_{-2}	0.97_{-2}	1.07_{-2}	1.20_{-2}	
Gambia	1.09_{-1}	1.00_{-1}	1.08_{-1}	...	...	...	...	1.10_{i}	0.79_{i}	...	...	1.08_{+1}	1.11_{+1}	1.15	...	
Ghana	1.10_{-1}	1.09_{-1}	1.09_{-1}	...	...	...	...	1.00_{-1i}	0.90_{-1i}	...	...	1.02	1.02	1.01	0.94	
Guinea	0.83_{-1}	0.75_{-1}	0.62_{-1}	1.03_{-2}	0.79_{-2}	...	...	0.69_{i}	0.51_{i}	...	...	0.98	0.85_{-1}	0.72_{-1}	0.46	
Guinea-Bissau	1.17_{-1}	1.07_{-1}	0.65_{-1}	...	...	...	...	0.82_{i}	0.60_{i}	...	...	...	...	...	...	
Kenya	1.09_{-1}	1.10_{-1}	1.03_{-1}	1.07	1.01	...	...	1.01_{i}	0.93_{i}	...	...	0.98_{-2}	0.97_{-2}	...	0.74_{-4}	
Lesotho	1.35_{-1}	1.44_{-1}	1.27_{-1}	...	...	...	...	1.13_{i}	1.18_{i}	...	...	1.02_{-2}	0.95_{-2}	1.19_{-2}	1.35_{-3}	
Liberia	1.23_{-1}	1.09_{-1}	0.88_{-1}	...	...	...	...	0.83_{-2}	0.54_{-4i}	...	...	1.08_{-1}	1.00_{-1}	0.98_{-1}	...	
Madagascar	1.14	1.04	0.91	1.24_{-2}	1.12_{-2}	...	...	0.99_{i}	0.96_{i}	...	...	1.10_{-2}	1.02_{-2}	1.04_{-2}	0.97_{-1}	
Malawi	1.17_{-1}	0.97_{-1}	0.97_{-1}	...	...	...	...	1.07_{i}	0.90_{i}	...	...	1.14_{+1}	1.05_{+1}	1.04_{+1}	0.71_{+1}	
Mali	0.87_{-1}	0.50_{-1}	0.47_{-1}	...	...	...	...	0.70_{-1}	0.55_{-1}	...	...	1.05_{-1}	0.91_{-1}	0.88_{-1}	0.50_{-2}	
Mauritania	1.10_{-1}	0.96_{-1}	1.07_{-1}	...	...	...	...	0.96_{i}	0.87_{i}	...	...	...	1.07_{-1}	1.06_{-1}	0.62_{-1}	
Mauritius	...	...	1.19_{-4}	...	...	...	...	1.01_{i}	0.96_{i}	...	...	0.99_{+1}	1.03_{+1}	1.05	1.33	
Mozambique	...	...	...	...	...	...	...	0.91_{i}	0.73_{i}	...	...	...	0.94_{-1}	0.93_{-1}	0.81_{-3}	
Namibia	1.17_{-3}	1.25_{-3}	1.19_{-3}	...	...	...	...	1.02_{i}	1.00_{i}	...	...	1.05	0.97	...	1.47_{-1}	
Niger	0.82_{-4}	0.53_{-4}	0.35_{-4}	1.18_{-2}	0.89_{-2}	...	...	0.72_{i}	0.63_{i}	...	...	1.07	0.91	0.75_{-4}	0.48_{-1}	
Nigeria	1.01	0.98	0.89	...	...	...	...	0.81	0.74_{-3i}	...	...	0.92_{-3}	1.01_{-2}	0.95_{-3}	0.72_{-3}	
Rwanda	1.15_{-1}	1.12_{-1}	1.08_{-1}	...	...	...	...	1.08_{i}	0.93_{i}	...	...	1.06	0.99	1.13	0.80	
Sao Tome and Principe	1.13_{-1}	1.07_{-1}	1.12_{-1}	...	...	...	...	1.00_{i}	0.94_{i}	...	...	...	0.97_{-4}	1.13_{-4}	...	
Senegal	1.12_{-1}	1.11_{-1}	0.95_{-1}	1.12_{-2}	0.98_{-2}	1.11_{-4}	0.86_{-4}	0.91_{i}	0.66_{i}	...	...	1.13	1.14	1.17	0.92	
Seychelles	...	...	...	...	...	...	...	1.01_{-1i}	1.01_{-1i}	...	...	1.01	1.03	1.08	1.73	
Sierra Leone	1.06_{-1}	0.98_{-1}	0.70_{-1}	...	...	...	...	0.94_{i}	0.73_{i}	...	...	1.08	1.04	0.97_{-4}	...	
Somalia	...	...	...	...	...	...	...	...	...	...	...	0.80	...	...	...	
South Africa	1.00	1.03	1.07	...	...	...	...	1.01_{-2}	0.99_{-2}	0.99_{-4}	0.99_{-4}	1.02_{-1}	0.96_{-1}	1.08_{-1}	1.36_{-1}	
South Sudan	0.82_{-4}	1.14_{-4}	1.60_{-4}	...	...	...	...	0.98_{-3i}	0.72_{-3i}	...	...	0.88_{-3}	...	...	0.30_{-3}	
Togo	0.98_{-1}	0.81_{-1}	0.60_{-1}	1.08_{-2}	1.00_{-2}	...	...	0.91_{-2}	0.69_{-2}	...	...	1.04	0.96	0.81	0.56_{-1}	
Uganda	1.29_{-1}	0.88_{-1}	1.00_{-1}	...	...	...	...	1.02_{i}	0.88_{i}	...	...	1.04_{-4}	1.03_{-4}	0.90_{-4}	...	
United Republic of Tanzania	1.17_{-1}	1.10_{-1}	0.93_{-1}	...	...	...	...	1.01_{i}	0.91_{i}	...	...	0.99	1.04	1.08	0.84_{-1}	
Zambia	1.12_{-1}	1.05_{-1}	0.86_{-1}	0.92	1.05	1.46_{-4}	1.26_{-4}	0.99_{-1i}	0.93_{-1i}	...	...	1.09_{-4}	1.02_{-4}	...	...	
Zimbabwe	1.08_{-1}	1.09_{-1}	0.66_{-1}	...	...	...	...	1.08_{i}	1.03_{i}	...	...	1.00	1.01	...	1.17_{-4}	

Location/wealth																
F												G				
Disparity in primary completion				Disparity in lower secondary completion				Disparity in upper secondary completion				Wealth disparity in minimum proficiency				
Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		End of primary		End of lower secondary		
Location	Wealth	M	F	Location	Wealth	M	F	Location	Wealth	M	F	Reading	Mathematics	Reading	Mathematics	Country code
4.5.1																
2021																
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	AGO
0.70$_{-3}$	0.28$_{-3}$	24$_{-3}$	18$_{-3}$	0.43$_{-3}$	0.08$_{-3}$	5$_{-3}$	3$_{-3}$	0.25$_{-3}$	0.02$_{-3}$	1$_{-3}$	0.2$_{-3}$	…	…	…	…	BEN
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	BWA
0.66$_{-2}$	0.65$_{-2}$	…	…	0.40$_{-2}$	0.28$_{-2}$	…	…	0.09$_{-4}$	0.04$_{-2}$	…	…	…	…	…	…	BFA
0.70$_{-4}$	0.41$_{-4}$	24$_{-4}$	32$_{-4}$	0.47$_{-4}$	0.19$_{-4}$	12$_{-4}$	…	0.20$_{-4}$	0.05$_{-4}$	…	…	…	…	…	…	BDI
…	…	…	…	…	…	…	…	0.84$_{-4}$	…	…	…	…	…	…	…	CPV
0.66$_{-3}$	0.35$_{-3}$	36$_{-3}$	30$_{-3}$	0.42$_{-3}$	0.11$_{-3}$	13$_{-3}$	5$_{-3}$	0.21$_{-3}$	0.02$_{-3}$	3$_{-3}$	0.3$_{-3}$	…	…	…	…	CMR
0.21$_{-2}$	0.16$_{-2}$	11$_{-2}$	7$_{-2}$	0.05$_{-2}$	0.03$_{-2}$	2$_{-2}$	1$_{-2}$	-$_{-2}$	-$_{-2}$	…	…	…	…	…	…	CAF
0.35$_{-2}$	0.16$_{-2}$	11$_{-2}$	8$_{-2}$	0.20$_{-2}$	0.07$_{-2}$	3$_{-2}$	2$_{-2}$	0.09$_{-2}$	0.06$_{-2}$	2$_{-2}$	0.1$_{-2}$	…	…	…	…	TCD
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	COM
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	COG
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	CIV
0.66$_{-3}$	0.45$_{-3}$	44$_{-3}$	39$_{-3}$	0.54$_{-3}$	0.37$_{-3}$	31$_{-3}$	31$_{-3}$	0.26$_{-3}$	0.13$_{-3}$	10$_{-3}$	…	…	…	…	…	COD
0.57$_{-4}$	…	…	…	0.30$_{-4}$	…	…	…	0.18$_{-4}$	…	…	…	…	…	…	…	DJI
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	GNQ
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	ERI
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SWZ
0.57$_{-2}$	…	…	…	0.30$_{-2}$	…	…	…	0.12$_{-2}$	…	…	…	…	…	…	…	ETH
1.43$_{-4}$	0.64$_{-4}$	53$_{-4}$	62$_{-4}$	1.71$_{-4}$	0.39$_{-4}$	21$_{-4}$	30$_{-4}$	1.90$_{-4}$	0.31$_{-4}$	10$_{-4}$	11$_{-4}$	…	…	…	…	GAB
0.68$_{-1}$	0.55$_{-1}$	40$_{-1}$	46$_{-1}$	0.51$_{-1}$	0.33$_{-1}$	24$_{-1}$	21$_{-1}$	0.47$_{-1}$	0.25$_{-1}$	8$_{-1}$	14$_{-1}$	…	…	…	…	GMB
0.82$_{-3}$	0.61$_{-3}$	51$_{-3}$	54$_{-3}$	0.60$_{-3}$	0.29$_{-3}$	21$_{-3}$	25$_{-3}$	0.46$_{-3}$	0.14$_{-3}$	10$_{-3}$	10$_{-3}$	…	…	…	…	GHA
0.40$_{-3}$	0.20$_{-3}$	23$_{-3}$	…	0.16$_{-3}$	…	…	…	…	…	…	…	…	…	…	…	GIN
0.48$_{-2}$	0.32$_{-2}$	25$_{-2}$	19$_{-2}$	0.32$_{-2}$	0.18$_{-2}$	10$_{-2}$	12$_{-2}$	0.32$_{-2}$	0.17$_{-2}$	8$_{-2}$	3$_{-2}$	…	…	…	…	GNB
0.84$_{-1}$	…	…	…	0.81$_{-1}$	…	…	…	0.59$_{-1}$	…	…	…	…	…	…	…	KEN
0.80$_{-3}$	0.60$_{-3}$	40$_{-3}$	79$_{-3}$	0.46$_{-3}$	0.16$_{-3}$	…	19$_{-3}$	0.41$_{-3}$	…	…	…	…	…	…	…	LSO
0.38$_{-2}$	0.15$_{-2}$	6$_{-2}$	11$_{-2}$	0.25$_{-2}$	0.09$_{-2}$	5$_{-2}$	5$_{-2}$	0.20$_{-2}$	0.04$_{-2}$	4$_{-2}$	1$_{-2}$	…	…	…	…	LBR
0.58	0.15	13	13	0.31	0.03	4	1	0.20	0.01	-	1	…	…	…	…	MDG
0.59$_{-1}$	0.33$_{-1}$	21$_{-1}$	30$_{-1}$	0.30$_{-1}$	0.06$_{-1}$	5$_{-1}$	2$_{-1}$	0.26$_{-1}$	0.04$_{-1}$	2$_{-1}$	2$_{-1}$	…	…	…	…	MWI
0.50$_{-1}$	0.76$_{-1}$	43$_{-1}$	35$_{-1}$	0.23$_{-1}$	0.53$_{-1}$	22$_{-1}$	10$_{-1}$	0.20$_{-1}$	0.33$_{-1}$	6$_{-1}$	4$_{-1}$	…	…	…	…	MLI
0.40$_{-1}$	0.15$_{-1}$	12$_{-1}$	10$_{-1}$	0.19$_{-1}$	0.06$_{-1}$	6$_{-1}$	1$_{-1}$	0.16$_{-1}$	0.07$_{-1}$	1$_{-1}$	1$_{-1}$	…	…	…	…	MRT
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	MUS
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	MOZ
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	NAM
0.54$_{-3}$	0.51$_{-3}$	…	…	0.26$_{-3}$	0.09$_{-3}$	…	…	0.15$_{-3}$	-$_{-3}$	…	…	…	…	…	…	NER
0.68	0.35	34	34	0.63	0.29	29	24	0.49	0.17	19	13	…	…	…	…	NGA
0.74$_{-1}$	0.43$_{-1}$	31$_{-1}$	41$_{-1}$	0.55$_{-1}$	0.12$_{-1}$	6$_{-1}$	6$_{-1}$	0.34$_{-1}$	0.04$_{-1}$	2$_{-1}$	2$_{-1}$	…	…	…	…	RWA
1.01$_{-2}$	0.76$_{-2}$	62$_{-2}$	87$_{-2}$	0.96$_{-2}$	0.37$_{-2}$	41$_{-2}$	27$_{-2}$	0.89$_{-2}$	0.33$_{-2}$	14$_{-2}$	21$_{-2}$	…	…	…	…	STP
0.54$_{-2}$	0.35$_{-2}$	26$_{-2}$	27$_{-2}$	0.29$_{-2}$	0.12$_{-2}$	11$_{-2}$	3$_{-2}$	0.23$_{-2}$	0.07$_{-2}$	…	…	…	…	0.28$_{-4}$	0.36$_{-4}$	SEN
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SYC
0.66$_{-2}$	0.53$_{-2}$	45$_{-2}$	47$_{-2}$	0.45$_{-2}$	0.21$_{-2}$	17$_{-2}$	15$_{-2}$	0.37$_{-2}$	0.10$_{-2}$	6$_{-2}$	1$_{-2}$	…	…	…	…	SLE
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SOM
0.99	…	…	…	0.97	…	…	…	0.74	…	…	…	…	…	…	…	ZAF
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SSD
0.88$_{-4}$	0.71$_{-4}$	67$_{-4}$	55$_{-4}$	0.60$_{-4}$	0.33$_{-4}$	30$_{-4}$	…	0.29$_{-4}$	…	…	…	…	…	…	…	TGO
0.66$_{-2}$	…	…	…	0.76$_{-2}$	0.20$_{-2}$	…	…	0.41$_{-2}$	0.05$_{-2}$	…	…	…	…	…	…	UGA
0.93$_{-2}$	…	…	…	0.32$_{-2}$	…	…	…	0.11$_{-3}$	…	…	…	…	…	…	…	TZA
0.69$_{-3}$	0.42$_{-3}$	38$_{-3}$	40$_{-3}$	0.46$_{-3}$	0.17$_{-3}$	20$_{-3}$	12$_{-3}$	0.27$_{-3}$	…	…	…	…	…	0.04$_{-4}$	0.04$_{-4}$	ZMB
0.88$_{-2}$	0.79$_{-2}$	75$_{-2}$	81$_{-2}$	0.51$_{-2}$	0.22$_{-2}$	20$_{-2}$	18$_{-2}$	0.21$_{-2}$	…	…	…	…	…	…	…	ZWE

TABLE 5: Continued

Country or territory	Gender															
	A			B				C		D		E			
	GPIA in completion			GPIA in minimum proficiency				GPIA in literacy rate		GPIA in adult proficiency		GPIA in gross enrolment ratio			
				End of primary		End of lower secondary									
	Primary	Lower secondary	Upper secondary	Reading	Mathematics	Reading	Mathematics	Youth	Adults	Literacy	Numeracy	Pre-primary	Primary	Secondary	Tertiary
SDG indicator	4.5.1															
Reference year	2021															
Northern Africa and Western Asia																
Algeria	1.03$_{-1}$	1.26$_{-1}$	1.46$_{-1}$	…	…	…	…	1.23$_{-2}$	0.86$_{-3i}$	…	…	1.02$_{+1}$	0.97$_{+1}$	1.02$_{+1}$	1.40
Armenia	1.00$_{-1}$	1.01$_{-1}$	1.02$_{-1}$	…	0.96$_{-2}$	…	…	1.00$_{-1}$	1.00$_{-1}$	…	…	1.05	1.01	1.03	1.31
Azerbaijan	…	…	…	…	0.98$_{-2}$	…	…	1.00$_{-2}$	1.00$_{-2}$	…	…	1.00$_{i}$	1.01$_{i}$	0.98$_{i}$	1.16$_{i}$
Bahrain	…	…	…	…	0.96$_{-2}$	…	1.14$_{-2}$	…	…	…	…	1.11$_{-1}$	0.99$_{-2}$	1.08$_{-2}$	1.41
Cyprus	1.01	1.01	1.04	…	1.08$_{-2}$	1.32$_{-3}$	…	1.00$_{i}$	1.00$_{i}$	…	…	0.97$_{-1i}$	0.99$_{-1i}$	0.97$_{-1i}$	1.11$_{-1i}$
Egypt	1.02$_{-2}$	1.05$_{-2}$	1.05$_{-2}$	…	…	…	1.13$_{-2}$	0.99$_{i}$	0.86$_{i}$	…	…	1.00$_{-2}$	1.01$_{-2}$	0.99$_{-2}$	0.99$_{-1}$
Georgia	1.00$_{-1}$	1.01$_{-1}$	1.02$_{-1}$	…	1.06$_{-2}$	1.37$_{-3}$	1.04$_{-3}$	1.00$_{-4}$	1.00$_{-4}$	…	…	…	1.01	1.00	1.15
Iraq	0.98$_{-1}$	1.05$_{-1}$	0.93$_{-1}$	…	…	…	…	0.97$_{-4}$	0.88$_{-4}$	…	…	…	…	…	…
Israel	1.00$_{-3}$	1.00$_{-3}$	1.06$_{-3}$	…	…	1.22$_{-3}$	1.09$_{-3}$	…	…	…	…	0.99$_{-1}$	1.01$_{-1}$	1.01$_{-1}$	1.32$_{-1}$
Jordan	1.02$_{-1}$	1.03$_{-1}$	1.22$_{-1}$	…	…	1.35$_{-3}$	1.01$_{-3}$	1.00$_{i}$	0.99$_{i}$	…	…	1.02	0.99	1.02	1.23
Kuwait	…	…	…	…	1.07$_{-2}$	…	0.96$_{-2}$	1.00$_{-1}$	0.98$_{-1}$	…	…	1.05	1.13	…	1.40
Lebanon	…	…	…	…	…	1.22$_{-3}$	0.96$_{-2}$	1.00$_{-2i}$	0.96$_{-2i}$	…	…	…	…	…	…
Libya	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Morocco	…	…	…	…	0.94$_{-2}$	1.31$_{-3}$	…	1.00$_{i}$	0.79$_{i}$	…	…	0.99	0.97	0.97	1.10
Oman	…	…	…	…	0.92$_{-2}$	…	1.39$_{-2}$	1.01$_{-3}$	0.96$_{-3}$	…	…	0.97	1.00	0.94	1.22
Palestine	1.00$_{-1}$	1.10$_{-1}$	1.30$_{-1}$	…	…	…	…	1.00$_{-1}$	0.97$_{-1}$	…	…	1.04	0.99	1.08	1.40
Qatar	0.99$_{-4}$	1.01$_{-4}$	1.03$_{-4}$	…	1.03$_{-2}$	1.41$_{-3}$	1.01$_{-2}$	…	…	…	…	1.01	1.02	…	1.83
Saudi Arabia	…	…	…	…	0.85$_{-2}$	1.44$_{-3}$	…	1.00$_{-1}$	0.97$_{-1}$	…	…	1.07	1.01	0.96	0.99
Sudan	1.01$_{-2}$	0.97$_{-2}$	0.93$_{-2}$	…	…	…	…	1.01$_{-3i}$	0.86$_{-3i}$	…	…	1.00$_{-3}$	0.93$_{-3}$	1.02$_{-3}$	…
Syrian Arab Republic	…	…	…	…	…	…	…	…	…	…	…	1.00$_{+1}$	0.99$_{+1}$	1.11$_{+1}$	…
Tunisia	1.03$_{-1}$	1.08$_{-1}$	1.20$_{-1}$	…	…	…	…	1.00$_{i}$	0.86$_{i}$	…	…	…	0.98	…	1.46$_{+1}$
Türkiye	1.00$_{-3}$	0.98$_{-3}$	1.05$_{-3}$	…	1.00$_{-2}$	1.14$_{-3}$	1.09$_{-2}$	1.00$_{-2}$	0.95$_{-2}$	…	…	0.97$_{-1}$	0.99$_{-1}$	0.97$_{-1}$	0.97$_{-1}$
United Arab Emirates	…	…	…	…	1.06$_{-2}$	1.33$_{-3}$	1.03$_{-2}$	1.00	0.98	…	…	1.00$_{+1}$	1.01$_{+1}$	0.98$_{+1}$	1.23$_{+1}$
Yemen	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Central and Southern Asia																
Afghanistan	0.74$_{-1}$	0.62$_{-1}$	0.49$_{-1}$	…	…	…	…	0.58	0.43	…	…	…	0.67$_{-2}$	0.57$_{-3}$	0.39$_{-1}$
Bangladesh	1.14$_{-1}$	1.20$_{-1}$	0.97$_{-1}$	…	…	…	…	1.03$_{-1}$	0.93$_{-1}$	…	…	1.05	1.02	1.20	0.83
Bhutan	…	…	…	…	…	…	…	1.00$_{i}$	0.81$_{i}$	…	…	0.99	1.04	1.11$_{-3i}$	1.03
India	1.01	0.99	0.89	…	…	…	…	0.92$_{-1}$	…	…	…	1.06$_{+1}$	1.01$_{+1}$	1.00$_{+1}$	1.08$_{+1}$
Iran, Islamic Republic of	…	…	…	…	1.10$_{-2}$	…	1.11$_{-2}$	1.00$_{i}$	0.92$_{i}$	…	…	1.03$_{-1}$	1.06$_{-1}$	0.99$_{-1}$	0.97$_{-1}$
Kazakhstan	1.00$_{-1}$	1.00$_{-1}$	1.00$_{-1}$	…	0.99$_{-2}$	1.31$_{-3}$	1.00$_{-3}$	1.00$_{-1i}$	1.00$_{-1i}$	1.03$_{-4}$	1.01$_{-4}$	0.98$_{-1}$	1.00$_{-1}$	1.00$_{-1}$	1.17$_{-1}$
Kyrgyzstan	1.00$_{-1}$	1.00$_{-1}$	1.00$_{-1}$	…	…	…	…	1.00$_{-2i}$	1.00$_{-2i}$	…	…	1.01	1.00	1.00	1.20
Maldives	1.00$_{-1}$	1.07$_{-1}$	1.32$_{-1}$	…	…	…	…	1.00$_{i}$	1.01$_{i}$	…	…	1.05$_{-1}$	1.00$_{-1}$	0.93$_{-2}$	1.73$_{-2}$
Nepal	1.04$_{-1}$	1.06$_{-1}$	1.05$_{-1}$	…	…	…	…	0.98$_{i}$	0.78$_{i}$	…	…	0.89$_{+1}$	0.92$_{+1}$	0.99$_{+1}$	1.10$_{+1}$
Pakistan	0.98$_{-1}$	0.89$_{-1}$	1.12$_{-1}$	…	1.00$_{-2}$	…	…	0.82$_{-2}$	0.67$_{-2}$	…	…	0.88$_{-2}$	0.88$_{-2}$	0.87$_{-2}$	0.98$_{-2}$
Sri Lanka	…	…	…	…	…	…	…	1.00	0.98	…	…	1.05$_{-1}$	1.00$_{-1}$	1.04$_{-3}$	1.36
Tajikistan	0.99$_{-1}$	0.98$_{-1}$	0.81$_{-1}$	…	…	…	…	0.98$_{-4}$	…	…	…	0.87$_{-4}$	0.99$_{-4}$	…	0.76$_{-4}$
Turkmenistan	1.00$_{-1}$	1.00$_{-1}$	1.03$_{-1}$	…	…	…	…	…	…	…	…	…	0.98	0.98	0.92
Uzbekistan	1.00	1.00	0.98	…	…	…	…	1.00	1.00	…	…	0.97	0.98	1.00	0.87
Eastern and South-eastern Asia																
Brunei Darussalam	…	…	…	…	…	1.23$_{-3}$	1.07$_{-3}$	1.00$_{i}$	0.99$_{i}$	…	…	0.99$_{-1}$	1.00$_{-1}$	1.03$_{-1}$	1.36$_{-1}$
Cambodia	1.05$_{-1}$	1.03$_{-1}$	1.33$_{-1}$	1.41$_{-2}$	1.16$_{-2}$	1.31$_{-4}$	0.83$_{-4}$	1.01$_{i}$	0.90$_{i}$	…	…	1.05	0.98	1.13	1.03
China	1.01$_{-1}$	1.06$_{-1}$	1.13$_{-1}$	…	…	…	…	1.00$_{-1i}$	0.97$_{-1i}$	…	…	1.01	1.01	…	1.15
DPR Korea	…	…	…	…	…	…	…	1.00$_{-3i}$	1.00$_{-3i}$	…	…	…	1.00$_{-3}$	…	0.51$_{-3}$
Hong Kong, China	…	…	…	…	0.99$_{-2}$	1.10$_{-3}$	1.03$_{-3}$	…	…	…	…	1.05$_{-1}$	1.04	0.99	1.10
Indonesia	1.02$_{-1}$	1.06$_{-1}$	1.08$_{-1}$	…	…	1.31$_{-3}$	1.13$_{-3}$	1.00$_{-1}$	0.97$_{-1}$	…	…	0.90$_{-3i}$	0.97$_{-3}$	1.02$_{-3}$	1.13$_{-3}$
Japan	1.00$_{-3}$	1.03$_{-3}$	1.01$_{-3}$	…	…	…	…	…	…	…	…	…	1.00$_{-1}$	1.00$_{-1}$	0.98$_{-1}$
Lao PDR	1.00$_{-4}$	0.98$_{-4}$	0.97$_{-4}$	1.33$_{-2}$	1.08$_{-2}$	…	…	0.98$_{i}$	0.91$_{i}$	…	…	1.02	0.97	0.95	1.13
Macao, China	…	…	…	…	…	1.06$_{-3}$	1.00$_{-3}$	1.00$_{i}$	0.97$_{i}$	…	…	0.97	0.98	1.00	1.26
Malaysia	…	…	…	1.24$_{-2}$	1.10$_{-2}$	1.23$_{-3}$	1.07$_{-3}$	…	…	…	…	1.02	1.01	1.05	1.24
Mongolia	1.00$_{-1}$	1.01$_{-1}$	1.08$_{-1}$	…	…	…	…	1.00$_{-1}$	1.00$_{-1}$	…	…	0.98	0.98	1.02	1.37$_{+1}$
Myanmar	1.05$_{-1}$	1.10$_{-1}$	1.29$_{-1}$	1.21$_{-2}$	1.02$_{-2}$	…	…	1.00$_{-2}$	0.93$_{-2}$	…	…	1.02$_{-3}$	0.96$_{-3}$	1.08$_{-3}$	1.29$_{-3}$
Philippines	1.08$_{-1}$	1.21$_{-1}$	1.20$_{-1}$	1.23$_{-2}$	1.08$_{-2}$	1.34$_{-3}$	…	1.01$_{-2}$	1.01$_{-2}$	…	…	0.99	0.98	1.07	1.27
Republic of Korea	1.00$_{-1}$	1.00$_{-1}$	1.00$_{-1}$	…	0.99$_{-2}$	1.08$_{-3}$	1.01$_{-3}$	1.00$_{-3i}$	0.99$_{-3i}$	…	…	1.00$_{-1}$	1.00$_{-1}$	0.99$_{-1}$	0.83$_{-1}$
Singapore	…	…	…	…	0.99$_{-2}$	1.07$_{-3}$	1.03$_{-2}$	1.00$_{-1}$	0.97$_{-1}$	…	…	…	1.00$_{-1i}$	0.99$_{-1i}$	1.10$_{-1i}$
Thailand	1.01$_{-1}$	1.11$_{-1}$	1.20$_{-1}$	…	…	1.38$_{-3}$	1.16$_{-3}$	1.01$_{i}$	0.97$_{i}$	…	…	1.00$_{+1}$	0.99$_{+1}$	1.06$_{+1}$	1.27$_{+1}$
Timor-Leste	1.13$_{-1}$	1.19$_{-1}$	1.12$_{-1}$	…	…	…	…	1.03$_{-1i}$	0.91$_{-1i}$	…	…	1.05$_{-1}$	0.98$_{-1}$	1.09$_{-1}$	…
Viet Nam	1.01	1.06	1.23	1.05$_{-2}$	1.00$_{-2}$	…	…	0.99$_{-1}$	0.98$_{-2}$	…	…	1.03	1.02	…	1.11

Location/wealth																
F												G				
Disparity in primary completion				Disparity in lower secondary completion				Disparity in upper secondary completion				Wealth disparity in minimum proficiency				
Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		End of primary		End of lower secondary		
Location	Wealth	M	F	Location	Wealth	M	F	Location	Wealth	M	F	Reading	Mathematics	Reading	Mathematics	Country code
4.5.1																
2021																
0.98$_{-2}$	0.92$_{-2}$	89$_{-2}$	94$_{-2}$	0.83$_{-2}$	0.57$_{-2}$	45$_{-2}$	61$_{-2}$	0.69$_{-2}$	0.37$_{-2}$	21$_{-2}$	40$_{-2}$	…	…	…	…	DZA
1.00$_{-3}$	0.99$_{-3}$	98$_{-3}$	100$_{-3}$	0.98$_{-3}$	0.98$_{-3}$	…	93$_{-3}$	0.84$_{-3}$	0.91$_{-3}$	…	…	…	0.93$_{-2}$	…	…	ARM
…	…	…	…	…	…	…	…	…	…	…	…	…	1.07$_{-2}$	…	…	AZE
…	…	…	…	…	…	…	…	…	…	…	…	…	0.83$_{-2}$	…	0.83$_{-2}$	BHR
1.01	…	…	…	0.97	…	…	…	1.06	…	…	…	…	0.67$_{-2}$	0.58$_{-3}$	…	CYP
0.99$_{-4}$	0.92$_{-4}$	92$_{-4}$	88$_{-4}$	0.92$_{-4}$	0.77$_{-4}$	68$_{-4}$	75$_{-4}$	0.87$_{-4}$	0.71$_{-4}$	67$_{-4}$	58$_{-4}$	…	…	…	0.51$_{-2}$	EGY
1.00$_{-3}$	1.00$_{-3}$	100$_{-3}$	100$_{-3}$	0.96$_{-3}$	0.93$_{-3}$	95$_{-3}$	91$_{-3}$	0.76$_{-3}$	0.58$_{-3}$	54$_{-3}$	52$_{-3}$	…	0.85$_{-2}$	0.39$_{-3}$	0.40$_{-3}$	GEO
0.87$_{-3}$	0.58$_{-3}$	62$_{-3}$	45$_{-3}$	0.76$_{-3}$	0.32$_{-3}$	26$_{-3}$	19$_{-3}$	0.80$_{-3}$	0.24$_{-3}$	15$_{-3}$	11$_{-3}$	…	…	…	…	IRQ
1.00$_{-3}$	1.00$_{-3}$	100$_{-3}$	100$_{-3}$	1.00$_{-3}$	0.99$_{-3}$	99$_{-3}$	98$_{-3}$	…	…	…	…	…	…	0.57$_{-3}$	0.53$_{-3}$	ISR
1.01$_{-3}$	0.92$_{-3}$	88$_{-3}$	93$_{-3}$	1.02$_{-3}$	0.66$_{-3}$	64$_{-3}$	66$_{-3}$	0.88$_{-3}$	0.31$_{-3}$	20$_{-3}$	31$_{-3}$	…	…	0.60$_{-3}$	0.52$_{-3}$	JOR
…	…	…	…	…	…	…	…	…	…	…	…	…	0.61$_{-2}$	…	1.12$_{-2}$	KWT
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.25$_{-3}$	0.43$_{-2}$	LBN
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	LBY
…	…	…	…	…	…	…	…	…	…	…	…	…	0.35$_{-2}$	0.33$_{-3}$	…	MAR
…	…	…	…	…	…	…	…	…	…	…	…	…	1.22$_{-2}$	…	0.49$_{-2}$	OMN
1.00$_{-1}$	1.00$_{-1}$	99$_{-1}$	99$_{-1}$	0.99$_{-1}$	0.91$_{-1}$	81$_{-1}$	95$_{-1}$	0.97$_{-1}$	0.63$_{-1}$	36$_{-1}$	58$_{-1}$	…	…	…	…	PSE
…	…	…	…	…	…	…	…	…	…	…	…	…	0.52$_{-2}$	0.46$_{-3}$	0.79$_{-2}$	QAT
…	…	…	…	…	…	…	…	…	…	…	…	…	0.36$_{-2}$	0.42$_{-3}$	…	SAU
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SDN
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SYR
0.93$_{-3}$	0.89$_{-3}$	85$_{-3}$	92$_{-3}$	0.72$_{-3}$	0.55$_{-3}$	49$_{-3}$	56$_{-3}$	0.52$_{-3}$	0.30$_{-3}$	17$_{-3}$	32$_{-3}$	…	…	…	…	TUN
…	…	…	…	…	…	…	…	…	…	…	…	…	0.78$_{-2}$	0.71$_{-3}$	0.65$_{-2}$	TUR
…	…	…	…	…	…	…	…	…	…	…	…	…	0.95$_{-2}$	0.48$_{-3}$	0.88$_{-2}$	ARE
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	YEM
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	AFG
0.99$_{-2}$	0.77$_{-2}$	62$_{-2}$	79$_{-2}$	0.95$_{-2}$	0.52$_{-2}$	38$_{-2}$	49$_{-2}$	0.78$_{-2}$	0.24$_{-2}$	16$_{-2}$	8$_{-2}$	…	…	…	…	BGD
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	BTN
0.98	0.88	86	87	0.94	0.72	71	69	0.72	0.25	24	17	…	…	…	…	IND
…	…	…	…	…	…	…	…	…	…	…	…	…	0.43$_{-2}$	…	0.40$_{-2}$	IRN
…	…	…	…	…	…	…	…	…	…	…	…	…	0.84$_{-2}$	0.56$_{-3}$	0.75$_{-3}$	KAZ
1.00$_{-3}$	1.01$_{-3}$	100$_{-3}$	100$_{-3}$	0.99$_{-3}$	0.97$_{-3}$	96$_{-3}$	97$_{-3}$	0.91$_{-3}$	0.81$_{-3}$	74$_{-3}$	81$_{-3}$	…	…	…	…	KGZ
0.98$_{-4}$	0.97$_{-4}$	96$_{-4}$	97$_{-4}$	0.93$_{-4}$	0.86$_{-4}$	75$_{-4}$	89$_{-4}$	0.49$_{-4}$	0.34$_{-4}$	16$_{-4}$	22$_{-4}$	…	…	…	…	MDV
0.96$_{-2}$	0.77$_{-2}$	72$_{-2}$	75$_{-2}$	0.83$_{-2}$	0.66$_{-2}$	58$_{-2}$	61$_{-2}$	0.41$_{-2}$	0.16$_{-2}$	10$_{-2}$	9$_{-2}$	…	…	…	…	NPL
0.68$_{-3}$	0.31$_{-3}$	39$_{-3}$	19$_{-3}$	0.59$_{-3}$	0.15$_{-3}$	22$_{-3}$	4$_{-3}$	0.44$_{-3}$	0.03$_{-3}$	3$_{-3}$	1$_{-3}$	…	0.63$_{-2}$	…	…	PAK
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	LKA
1.00$_{-4}$	0.99$_{-4}$	99$_{-4}$	96$_{-4}$	0.98$_{-4}$	0.96$_{-4}$	95$_{-4}$	95$_{-4}$	0.93$_{-4}$	0.82$_{-4}$	77$_{-4}$	55$_{-4}$	…	…	…	…	TJK
1.00$_{-2}$	1.00$_{-2}$	98$_{-2}$	99$_{-2}$	0.99$_{-2}$	0.98$_{-2}$	98$_{-2}$	97$_{-2}$	0.30$_{-2}$	0.17$_{-2}$	…	…	…	…	…	…	TKM
1.00	1.00	99	100	0.99	1.00	100	99	1.00	0.93	92	88	…	…	…	…	UZB
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.40$_{-3}$	0.47$_{-3}$	BRN
0.79$_{-1}$	…	…	…	0.56$_{-1}$	…	…	…	0.43$_{-1}$	…	…	…	…	…	0.22$_{-4}$	0.19$_{-4}$	KHM
0.98$_{-3}$	…	…	…	0.88$_{-3}$	…	…	…	0.91$_{-3}$	…	…	…	…	…	…	…	CHN
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	PRK
…	…	…	…	…	…	…	…	…	…	…	…	…	0.95$_{-2}$	0.89$_{-3}$	0.89$_{-3}$	HKG
0.97$_{-4}$	0.91$_{-4}$	88$_{-4}$	94$_{-4}$	0.89$_{-4}$	0.68$_{-4}$	64$_{-4}$	69$_{-4}$	0.68$_{-4}$	0.34$_{-4}$	31$_{-4}$	32$_{-4}$	…	…	0.39$_{-3}$	0.37$_{-3}$	IDN
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	JPN
0.83$_{-4}$	0.59$_{-4}$	61$_{-4}$	55$_{-4}$	0.57$_{-4}$	0.18$_{-4}$	21$_{-4}$	12$_{-4}$	0.35$_{-4}$	0.06$_{-4}$	5$_{-4}$	4$_{-4}$	…	…	…	…	LAO
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.96$_{-3}$	0.96$_{-3}$	MAC
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.45$_{-3}$	0.48$_{-3}$	MYS
0.98$_{-3}$	0.97$_{-3}$	95$_{-3}$	98$_{-3}$	0.89$_{-3}$	0.84$_{-3}$	79$_{-3}$	90$_{-3}$	0.68$_{-3}$	0.53$_{-3}$	44$_{-3}$	61$_{-3}$	…	…	…	…	MNG
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	MMR
0.98$_{-3}$	0.80$_{-3}$	71$_{-3}$	89$_{-3}$	0.92$_{-3}$	0.54$_{-3}$	40$_{-3}$	68$_{-3}$	0.89$_{-3}$	0.51$_{-3}$	42$_{-3}$	56$_{-3}$	…	…	0.11$_{-3}$	…	PHL
…	…	…	…	…	…	…	…	…	…	…	…	…	0.94$_{-2}$	0.82$_{-3}$	0.80$_{-3}$	KOR
…	…	…	…	…	…	…	…	…	…	…	…	…	0.90$_{-2}$	0.83$_{-3}$	0.14$_{-2}$	SGP
0.99$_{-2}$	0.98$_{-2}$	96$_{-2}$	99$_{-2}$	0.94$_{-2}$	0.69$_{-2}$	63$_{-2}$	74$_{-2}$	0.82$_{-2}$	0.45$_{-2}$	33$_{-2}$	49$_{-2}$	…	…	0.41$_{-3}$	0.54$_{-3}$	THA
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	TLS
1.00	0.95	94	95	0.93	0.69	63	71	0.61	0.33	33	28	…	…	…	…	VNM

TABLE 5: Continued

Country or territory	Gender														
	A			B				C		D		E			
	GPIA in completion			GPIA in minimum proficiency				GPIA in literacy rate		GPIA in adult proficiency		GPIA in gross enrolment ratio			
				End of primary		End of lower secondary									
	Primary	Lower secondary	Upper secondary	Reading	Mathematics	Reading	Mathematics	Youth	Adults	Literacy	Numeracy	Pre-primary	Primary	Secondary	Tertiary
SDG indicator	4.5.1														
Reference year	2021														
Oceania															
Australia	1.00$_{-1}$	1.01$_{-1}$	1.07$_{-1}$	…	1.01$_{-2}$	1.11$_{-3}$	0.99$_{-3}$	…	…	…	…	0.96$_{-1}$	1.00$_{-1}$	0.96$_{-1}$	1.28$_{-1}$
Cook Islands	…	…	…	…	…	…	…	…	…	…	…	0.97	0.94	1.04	…
Fiji	1.01	1.11	1.25	…	…	…	…	1.03	…	…	…	0.95	0.96	1.07	1.32$_{-2}$
Kiribati	1.07$_{-1}$	1.22$_{-1}$	1.37$_{-1}$	…	…	…	…	1.14$_{-3}$	…	…	…	1.09$_{-1}$	1.05$_{-1}$	…	…
Marshall Islands	…	…	…	…	…	…	…	…	…	…	…	1.01	0.94	1.09	1.11$_{-2}$
Micronesia, F. S.	…	…	…	…	…	…	…	…	…	…	…	1.14	1.00	…	…
Nauru	…	…	…	…	…	…	…	…	…	…	…	1.08$_{-1}$	1.03$_{-1}$	1.03$_{-2}$	…
New Zealand	…	…	…	…	1.04$_{-2}$	1.11$_{-3}$	0.99$_{-3}$	…	…	…	…	0.99$_{-1}$	1.00$_{-1}$	1.05$_{-1}$	1.35$_{-1}$
Niue	…	…	…	…	…	…	…	…	…	…	…	0.92	0.98	1.05	…
Palau	…	…	…	…	…	…	…	…	…	…	…	1.08$_{-1}$	0.97	1.08	…
Papua New Guinea	1.14$_{-1}$	1.21$_{-1}$	0.88$_{-1}$	…	…	…	…	…	…	…	…	0.98$_{-3}$	0.93$_{-3}$	0.80$_{-3}$	…
Samoa	1.02$_{-1}$	1.03$_{-1}$	1.30$_{-1}$	…	…	…	…	1.01$_{i}$	1.00$_{i}$	…	…	1.09	1.00	…	1.53
Solomon Is	…	…	…	…	…	…	…	…	…	…	…	1.02$_{-2}$	0.99$_{-2}$	…	…
Tokelau	…	…	…	…	…	…	…	…	…	…	…	1.32	1.05	0.94	…
Tonga	1.01$_{-1}$	1.10$_{-1}$	1.12$_{-1}$	…	…	…	…	1.00$_{i}$	1.00$_{i}$	…	…	1.09$_{-1}$	0.95$_{-1}$	1.15$_{-1}$	1.60$_{-1}$
Tuvalu	1.02$_{-1}$	1.19$_{-1}$	1.26$_{-1}$	…	…	…	…	1.18$_{-2}$	…	…	…	0.90	0.96	1.06	…
Vanuatu	…	…	…	…	…	…	…	1.01$_{i}$	0.98$_{i}$	…	…	0.99	0.98	1.07	…
Latin America and the Caribbean															
Anguilla	…	…	…	…	…	…	…	…	…	…	…	1.08$_{-2}$	0.99$_{-2}$	0.97$_{-2}$	…
Antigua and Barbuda	…	…	…	…	…	…	…	…	…	…	…	1.10$_{-3}$	0.98$_{-2}$	0.96$_{-3}$	…
Argentina	1.02$_{-1}$	1.11$_{-1}$	1.19$_{-1}$	1.16$_{-2}$	0.85$_{-2}$	1.11$_{-3}$	0.78$_{-3}$	…	…	…	…	1.01$_{-1}$	1.00$_{-1}$	1.04$_{-1}$	1.42$_{-1}$
Aruba	…	…	…	…	…	…	…	1.00$_{-1i}$	1.00$_{-1i}$	…	…	…	…	…	…
Bahamas	…	…	…	…	…	…	…	…	…	…	…	1.08$_{-2}$	…	…	…
Barbados	1.01$_{-4}$	1.00$_{-4}$	1.07$_{-4}$	…	…	…	…	…	…	…	…	1.04	0.97	1.03	…
Belize	1.11$_{-1}$	1.30$_{-1}$	1.33$_{-1}$	…	…	…	…	…	…	…	…	1.04	0.96	1.03	1.40
Bolivia, P. S.	1.01	1.03	1.00	1.13$_{-4}$	0.84$_{-4}$	…	…	1.00	0.93$_{-1}$	…	…	1.02	1.00	1.00	…
Brazil	1.02	1.06	1.10	1.14$_{-2}$	0.87$_{-2}$	1.20$_{-3}$	0.88$_{-3}$	1.00	1.00$_{i}$	…	…	1.00$_{-1i}$	0.95$_{-1i}$	1.04$_{-1i}$	1.30$_{-1i}$
British Virgin Islands	…	…	…	…	…	…	…	…	…	…	…	1.05	0.99	1.10$_{-4}$	1.48
Cayman Islands	…	…	…	…	…	…	…	…	…	…	…	0.98$_{-3}$	1.01	1.01$_{-3}$	…
Chile	1.02$_{-1}$	1.01$_{-1}$	1.04$_{-1}$	…	…	1.13$_{-3}$	0.88$_{-2}$	1.00$_{i}$	1.00$_{i}$	…	…	0.98$_{-1}$	0.97$_{-1}$	0.99$_{-1}$	1.15$_{-1}$
Colombia	1.03	1.09	1.09	1.11$_{-2}$	0.87$_{-2}$	1.07$_{-3}$	0.75$_{-3}$	1.01	1.01$_{-1}$	…	…	1.02	0.97	1.04	1.16
Costa Rica	1.00	1.06	1.09	1.09$_{-2}$	0.84$_{-2}$	1.11$_{-3}$	0.80$_{-3}$	1.00$_{i}$	1.00$_{i}$	…	…	1.01	0.99	1.08$_{-1}$	1.18$_{-2}$
Cuba	1.00$_{-1}$	1.03$_{-1}$	1.10$_{-1}$	1.23$_{-2}$	1.02$_{-2}$	…	…	1.00$_{i}$	1.00$_{i}$	…	…	0.99	0.98	1.01	1.46
Curaçao	…	…	…	…	…	…	…	…	…	…	…	1.00$_{-1}$	0.95$_{-1}$	1.18$_{-1}$	…
Dominica	…	…	…	…	…	…	…	…	…	…	…	0.99	0.95	0.99	…
Dominican Republic	1.06	1.07	1.20	1.41$_{-2}$	1.01$_{-2}$	1.37$_{-3}$	0.94$_{-3}$	1.00	1.00$_{i}$	…	…	1.03$_{i}$	0.97$_{i}$	1.09$_{i}$	1.44$_{-4i}$
Ecuador	1.00	1.00	1.06	1.14$_{-2}$	0.97$_{-2}$	1.09$_{-4}$	0.71$_{-4}$	1.00	0.99	0.96$_{-4}$	0.77$_{-4}$	1.05	1.02	1.02	1.16$_{-1}$
El Salvador	1.04$_{-1}$	1.05$_{-1}$	1.03$_{-1}$	1.19$_{-2}$	0.85$_{-2}$	…	…	1.00$_{-1}$	0.97$_{-1}$	…	…	…	…	…	1.12$_{-2}$
Grenada	…	…	…	…	…	…	…	…	…	…	…	0.96$_{-1}$	0.98$_{-3}$	1.03$_{-1}$	1.20$_{-3}$
Guatemala	0.99$_{-1}$	0.97$_{-1}$	1.01$_{-1}$	1.05$_{-2}$	0.74$_{-2}$	1.15$_{-4}$	0.84$_{-4}$	0.99$_{i}$	0.90$_{i}$	…	…	1.02	0.98	1.02	1.14$_{-2}$
Guyana	1.02$_{-1}$	1.11$_{-1}$	1.21$_{-1}$	…	…	…	…	1.01$_{i}$	0.99$_{i}$	…	…	…	…	…	…
Haiti	1.33$_{-1}$	1.24$_{-1}$	1.07$_{-1}$	…	…	…	…	…	…	…	…	…	…	…	…
Honduras	1.04$_{-1}$	1.12$_{-1}$	1.11$_{-1}$	1.23$_{-2}$	0.87$_{-2}$	1.11$_{-4}$	0.66$_{-4}$	1.03$_{-2}$	1.01$_{-2}$	…	…	1.03	1.02	…	1.28$_{-2}$
Jamaica	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Mexico	1.01$_{-1}$	1.02$_{-1}$	1.06$_{-1}$	1.16$_{-2}$	1.05$_{-2}$	1.11$_{-3}$	0.88$_{-3}$	1.00$_{-1}$	0.98$_{-1}$	0.99$_{-4}$	0.80$_{-4}$	1.02$_{-1}$	1.01$_{-1}$	1.09$_{-1}$	1.08$_{-1}$
Montserrat	…	…	…	…	…	…	…	…	…	…	…	1.15$_{-2}$	1.12$_{-2}$	1.08$_{-2}$	…
Nicaragua	…	…	…	1.16$_{-2}$	0.61$_{-2}$	…	…	…	…	…	…	1.04$_{-1}$	0.99$_{-1}$	…	…
Panama	1.02	1.08	1.11	1.21$_{-2}$	0.96$_{-2}$	1.16$_{-3}$	0.82$_{-3}$	1.00	0.99$_{-2}$	…	…	1.01	0.99	1.04	1.35$_{-1}$
Paraguay	1.03	1.08	1.06	1.26$_{-2}$	0.91$_{-2}$	1.12$_{-4}$	0.56$_{-4}$	1.01	0.99$_{-1}$	…	…	1.01	…	…	…
Peru	1.01	1.04	1.02	1.16$_{-2}$	1.02$_{-2}$	…	…	1.00	0.95$_{-1}$	0.89$_{-4}$	0.74$_{-4}$	1.02	0.97	0.95	1.05$_{-4}$
Saint Kitts and Nevis	…	…	…	…	…	…	…	…	…	…	…	0.91	0.95	0.99	…
Saint Lucia	1.00$_{-4}$	1.03$_{-4}$	1.17$_{-4}$	…	…	…	…	…	…	…	…	1.02$_{-1}$	1.02$_{-1}$	0.98$_{-1}$	1.51$_{-1}$
Saint Vincent/Grenadines	…	…	…	…	…	…	…	…	…	…	…	0.99$_{-1}$	0.98$_{-1}$	1.03$_{-3}$	1.68$_{-3}$
Sint Maarten	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Suriname	1.11$_{-1}$	1.25$_{-1}$	1.34$_{-1}$	…	…	…	…	1.00$_{i}$	0.97$_{i}$	…	…	1.05	0.99	1.18	…
Trinidad and Tobago	…	…	…	…	…	…	…	…	…	…	…	1.02	…	…	…
Turks and Caicos Islands	1.02$_{-1}$	1.01$_{-1}$	0.96$_{-1}$	…	…	…	…	1.00$_{-2}$	…	…	…	1.08	1.05	0.99	…
Uruguay	1.01	1.07	1.30	1.13$_{-2}$	0.98$_{-2}$	1.17$_{-3}$	0.93$_{-3}$	1.00	1.01$_{-2}$	…	…	1.12$_{-1}$	0.99$_{-1}$	1.10$_{-1}$	1.40$_{-1}$
Venezuela, B. R.	…	…	…	…	…	…	…	1.01$_{i}$	1.00$_{i}$	…	…	1.01$_{-4}$	0.98$_{-4}$	1.07$_{-4}$	…

Location/wealth																
F												G				
Disparity in primary completion				Disparity in lower secondary completion				Disparity in upper secondary completion				Wealth disparity in minimum proficiency				
Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		End of primary		End of lower secondary		
Location	Wealth	M	F	Location	Wealth	M	F	Location	Wealth	M	F	Reading	Mathematics	Reading	Mathematics	Country code
4.5.1																
2021																
…	0.93$_{-3}$	89$_{-3}$	85$_{-3}$	…	0.98$_{-3}$	99$_{-3}$	96$_{-3}$	…	0.90$_{-3}$	84$_{-3}$	85$_{-3}$	…	0.54$_{-2}$	0.76$_{-3}$	0.71$_{-3}$	AUS
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	COK
1.01	0.99	97	100	0.94	0.82	74	87	0.69	0.38	27	34	…	…	…	…	FJI
0.97$_{-2}$	0.92$_{-2}$	85$_{-2}$	93$_{-2}$	0.85$_{-2}$	0.69$_{-2}$	52$_{-2}$	75$_{-2}$	0.28$_{-2}$	…	…	…	…	…	…	…	KIR
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	MHL
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	FSM
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	NRU
…	…	…	…	…	…	…	…	…	…	…	…	…	0.38$_{-2}$	0.75$_{-3}$	0.70$_{-3}$	NZL
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	NIU
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	PLW
0.74$_{-3}$	0.45$_{-3}$	41$_{-3}$	36$_{-3}$	0.74$_{-3}$	0.33$_{-3}$	31$_{-3}$	20$_{-3}$	0.41$_{-3}$	…	…	…	…	…	…	…	PNG
1.00$_{-2}$	0.99$_{-2}$	95$_{-2}$	99$_{-2}$	0.99$_{-2}$	0.97$_{-2}$	93$_{-2}$	97$_{-2}$	0.75$_{-2}$	0.49$_{-2}$	26$_{-2}$	50$_{-2}$	…	…	…	…	WSM
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SLB
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	TKL
1.02$_{-2}$	0.98$_{-2}$	97$_{-2}$	97$_{-2}$	0.95$_{-2}$	0.88$_{-2}$	88$_{-2}$	86$_{-2}$	1.00$_{-2}$	0.21$_{-2}$	5$_{-2}$	23$_{-2}$	…	…	…	…	TON
1.01$_{-1}$	…	…	…	0.99$_{-1}$	0.82$_{-1}$	…	…	0.74$_{-1}$	0.45$_{-1}$	…	…	…	…	…	…	TUV
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	VUT
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	AIA
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	ATG
…	…	…	…	…	…	…	…	…	…	…	…	0.31$_{-2}$	0.19$_{-2}$	0.36$_{-3}$	0.20$_{-3}$	ARG
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	ABW
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	BHS
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	BRB
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	BLZ
0.99	0.99	98	98	0.97	0.95	93	95	0.75	0.74	72	61	…	…	…	…	BOL
0.98	0.95	94	96	0.91	0.82	76	86	0.73	0.58	48	60	0.35$_{-2}$	0.17$_{-2}$	0.45$_{-3}$	0.26$_{-3}$	BRA
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	VGB
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	CYM
0.98$_{-1}$	0.98$_{-1}$	97$_{-1}$	98$_{-1}$	0.98$_{-1}$	0.96$_{-1}$	96$_{-1}$	96$_{-1}$	0.98$_{-1}$	0.84$_{-1}$	78$_{-1}$	84$_{-1}$	…	…	0.63$_{-3}$	0.28$_{-2}$	CHL
0.94	0.92	89	93	0.79	0.73	64	72	0.68	0.62	54	60	0.32$_{-2}$	0.17$_{-2}$	0.44$_{-3}$	0.34$_{-3}$	COL
1.00	0.95	94	96	0.99	0.76	69	79	0.87	0.54	47	53	0.44$_{-2}$	0.15$_{-2}$	0.50$_{-3}$	0.37$_{-3}$	CRI
1.00$_{-2}$	1.00$_{-2}$	100$_{-2}$	100$_{-2}$	0.98$_{-2}$	1.14$_{-2}$	100$_{-2}$	100$_{-2}$	0.79$_{-2}$	1.49$_{-2}$	86$_{-2}$	84$_{-2}$	0.52$_{-2}$	0.58$_{-2}$	…	…	CUB
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	CUW
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	DMA
1.00	0.93	85	91	0.98	0.91	82	91	0.79	0.61	44	54	0.14$_{-2}$	0.03$_{-2}$	0.22$_{-3}$	0.12$_{-3}$	DOM
1.00	0.99	98	98	0.97	0.91	91	87	0.87	0.73	65	70	0.23$_{-2}$	0.34$_{-2}$	0.41$_{-4}$	0.27$_{-4}$	ECU
0.93$_{-1}$	0.92$_{-1}$	86$_{-1}$	90$_{-1}$	0.80$_{-1}$	0.73$_{-1}$	68$_{-1}$	65$_{-1}$	0.70$_{-1}$	0.48$_{-1}$	42$_{-1}$	38$_{-1}$	0.23$_{-2}$	0.05$_{-2}$	…	…	SLV
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	GRD
…	…	…	…	…	…	…	…	…	…	…	…	0.09$_{-2}$	0.03$_{-2}$	0.25$_{-4}$	0.10$_{-4}$	GTM
0.99$_{-1}$	0.95$_{-1}$	93$_{-1}$	97$_{-1}$	0.89$_{-1}$	0.68$_{-1}$	59$_{-1}$	73$_{-1}$	0.81$_{-1}$	0.43$_{-1}$	30$_{-1}$	43$_{-1}$	…	…	…	…	GUY
0.61$_{-4}$	0.26$_{-4}$	17$_{-4}$	24$_{-4}$	0.46$_{-4}$	0.12$_{-4}$	7$_{-4}$	9$_{-4}$	0.30$_{-4}$	0.02$_{-4}$	1$_{-4}$	1$_{-4}$	…	…	…	…	HTI
0.91$_{-2}$	0.83$_{-2}$	81$_{-2}$	80$_{-2}$	0.57$_{-2}$	0.34$_{-2}$	28$_{-2}$	31$_{-2}$	0.41$_{-2}$	0.23$_{-2}$	15$_{-2}$	20$_{-2}$	0.32$_{-2}$	0.87$_{-2}$	0.35$_{-4}$	0.20$_{-4}$	HND
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	JAM
0.99$_{-1}$	0.97$_{-1}$	96$_{-1}$	97$_{-1}$	0.91$_{-1}$	0.85$_{-1}$	81$_{-1}$	83$_{-1}$	0.74$_{-1}$	0.52$_{-1}$	43$_{-1}$	41$_{-1}$	0.43$_{-2}$	0.50$_{-2}$	0.47$_{-3}$	0.44$_{-3}$	MEX
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	MSR
…	…	…	…	…	…	…	…	…	…	…	…	0.26$_{-2}$	0.47$_{-2}$	…	…	NIC
0.96	0.93	91	94	0.85	0.76	72	79	0.72	0.52	48	52	0.07$_{-2}$	0.02$_{-2}$	0.27$_{-3}$	0.15$_{-3}$	PAN
0.99	0.95	91	95	0.84	0.81	66	78	0.62	0.44	41	34	0.19$_{-2}$	0.24$_{-2}$	0.34$_{-4}$	0.15$_{-4}$	PRY
0.98	1.00	97	97	0.93	0.91	88	90	0.83	0.79	75	77	0.34$_{-2}$	0.35$_{-2}$	…	…	PER
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	KNA
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	LCA
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	VCT
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SXM
0.88$_{-3}$	0.69$_{-3}$	60$_{-3}$	77$_{-3}$	0.67$_{-3}$	0.30$_{-3}$	16$_{-3}$	32$_{-3}$	0.49$_{-3}$	…	…	…	…	…	…	…	SUR
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	TTO
1.01$_{-1}$	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	TCA
1.02	0.98	98	99	0.97	0.69	65	70	1.18	0.28	16	33	0.37$_{-2}$	0.32$_{-2}$	0.46$_{-3}$	0.39$_{-3}$	URY
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	VEN

TABLE 5: Continued

	Gender														
	A			B				C		D		E			
	GPIA in completion			GPIA in minimum proficiency				GPIA in literacy rate		GPIA in adult proficiency		GPIA in gross enrolment ratio			
				End of primary		End of lower secondary									
Country or territory	Primary	Lower secondary	Upper secondary	Reading	Mathematics	Reading	Mathematics	Youth	Adults	Literacy	Numeracy	Pre-primary	Primary	Secondary	Tertiary
SDG indicator	4.5.1														
Reference year	2021														
Europe and Northern America															
Albania	1.01_{-1}	1.01_{-1}	1.05_{-1}	...	1.04_{-2}	1.35_{-3}	1.06_{-3}	1.01_{i}	1.00_{i}	...	...	1.00	1.02	1.03	1.39
Andorra	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Austria	1.00	1.01	1.07	...	1.01_{-2}	1.13_{-3}	0.99_{-3}	...	...	...	...	1.00_{-1}	0.99_{-1}	0.98_{-1}	1.19_{-1}
Belarus	1.00_{-1}	1.00_{-1}	1.03_{-1}	...	...	1.13_{-3}	0.99_{-3}	1.00_{-2}	1.00_{-2}	...	...	0.94	1.00	0.98	1.13
Belgium	1.01	1.00	1.06	...	1.05_{-2}	1.08_{-3}	0.97_{-3}	...	...	...	...	1.01_{-1}	1.01_{-1}	1.12_{-1}	1.26_{-1}
Bermuda	...	...	...	...	...	...	...	...	...	...	...	...	1.04_{-1}	...	1.33_{-3}
Bosnia and Herzegovina	...	...	...	...	1.14_{-2}	1.30_{-3}	...	1.00_{i}	0.97_{i}	...	...	0.94	...	...	1.36
Bulgaria	0.99	1.01	1.01	...	1.01_{-2}	1.27_{-3}	1.03_{-3}	1.00_{i}	0.99_{i}	...	...	0.99_{-1}	0.99_{-1}	0.98_{-1}	1.20_{-1}
Canada	...	...	1.01_{-4}	...	1.11_{-2}	1.09_{-3}	1.00_{-3}	...	...	...	...	0.99_{-1}	0.99_{-1}	1.01_{-1}	1.25_{-1}
Croatia	1.01	1.00	1.02	...	1.07_{-2}	1.16_{-3}	0.98_{-3}	1.00_{i}	1.00_{i}	...	...	1.00_{-1}	1.00_{-1}	1.05_{-1}	1.29_{-1}
Czechia	1.00_{-1}	1.00_{-1}	1.05_{-1}	...	1.05_{-2}	1.13_{-3}	1.01_{-3}	...	...	...	...	0.97_{-1}	1.00_{-1}	1.01_{-1}	1.28_{-1}
Denmark	1.00	1.01	1.11	...	...	1.11_{-3}	1.01_{-3}	...	...	...	...	0.98_{-1}	1.00_{-1}	0.99_{-1}	1.28_{-1}
Estonia	1.01	1.01	1.04	...	...	1.07_{-3}	1.00_{-3}	1.00_{i}	1.00_{i}	...	...	...	1.00_{-1}	1.04_{-1}	1.34_{-4}
Finland	1.00	0.99	0.98	...	1.01_{-2}	1.13_{-3}	1.04_{-3}	...	...	...	...	1.00_{-1}	1.00_{-1}	1.09_{-1}	1.19_{-1}
France	1.00	1.01	1.03	...	1.09_{-2}	1.11_{-3}	1.00_{-3}	...	...	...	...	0.99_{-1i}	0.99_{-1i}	1.00_{-1i}	1.22_{-1i}
Germany	1.00_{-1}	1.02	1.08	...	1.06_{-2}	1.10_{-3}	1.00_{-3}	...	...	...	...	0.99_{-1}	1.01_{-1}	0.95_{-1}	1.05_{-1}
Greece	1.00	1.02	1.02	...	...	1.22_{-3}	1.04_{-3}	...	...	...	...	1.01_{-1}	1.01_{-1}	0.95_{-1}	1.02_{-1}
Hungary	0.99	1.00	1.04	...	1.05_{-2}	1.12_{-3}	0.95_{-2}	1.00_{i}	1.00_{i}	1.04_{-4}	1.01_{-4}	0.98_{-1}	0.98_{-1}	0.99_{-1}	1.19_{-1}
Iceland	1.00_{-3}	1.00_{-3}	1.18_{-3}	...	...	1.19_{-3}	1.07_{-3}	...	...	...	...	0.98_{-1}	1.01_{-1}	0.96_{-1}	1.49_{-1}
Ireland	1.00_{-3}	1.00_{-3}	1.06_{-3}	...	...	1.07_{-3}	1.00_{-3}	...	...	...	...	1.00_{-1i}	1.00_{-1i}	1.09_{-1i}	1.15_{-1i}
Italy	1.00	1.00	1.08	...	1.06_{-2}	1.11_{-3}	0.92_{-2}	1.00_{-2i}	1.00_{-2i}	...	...	0.98_{-1}	1.00_{-1}	0.99_{-1}	1.27_{-1}
Latvia	1.00	1.01	1.11	...	1.01_{-2}	1.16_{-3}	1.00_{-3}	1.00_{i}	1.00_{i}	...	...	1.00_{-1i}	1.00_{-1i}	1.00_{-1i}	1.26_{-1i}
Liechtenstein	...	...	...	...	...	...	...	...	...	...	...	1.08_{i}	0.98_{i}	0.85_{i}	0.65_{i}
Lithuania	1.00	1.00	1.07	...	1.01_{-2}	1.18_{-3}	1.05_{-3}	1.00_{i}	1.00_{i}	...	...	0.99_{-1i}	1.00_{-1i}	0.97_{-1i}	1.30_{-1i}
Luxembourg	0.99	1.01	1.15	...	...	1.13_{-3}	0.97_{-3}	...	...	...	...	1.00_{-1}	0.99_{-1}	1.00_{-1}	1.16_{-1}
Malta	1.00_{-3}	1.00_{-3}	1.21_{-3}	...	1.03_{-2}	1.26_{-3}	...	1.00_{i}	1.03_{i}	...	...	1.00_{-1}	1.00_{-1}	1.01_{-1}	1.29_{-1}
Monaco	...	...	...	...	...	...	...	...	...	...	...	0.88_{+1i}	1.02_{+1i}	1.01_{+1i}	1.32_{+1i}
Montenegro	1.00_{-1}	1.01_{-1}	1.06_{-1}	...	1.06_{-2}	1.24_{-3}	0.94_{-3}	1.00_{i}	0.99_{i}	...	...	0.97	1.00	1.02	1.27
Netherlands	1.00_{-1}	1.02_{-1}	1.09_{-1}	...	1.03_{-2}	1.13_{-3}	1.02_{-3}	...	...	...	...	1.02_{-1}	1.00_{-1}	1.02_{-1}	1.14_{-1}
North Macedonia	1.00_{-1}	1.02_{-1}	1.01_{-1}	...	0.95_{-2}	1.41_{-3}	1.09_{-3}	...	...	...	...	1.04_{-1}	1.00_{-1}	0.99_{-1}	1.29_{-1}
Norway	1.01	1.00	1.05	...	0.98_{-2}	1.16_{-3}	1.05_{-3}	...	...	...	...	1.00_{-1}	1.00_{-1}	0.95_{-1}	1.33_{-1}
Poland	1.01	1.01	1.03	...	1.02_{-2}	1.11_{-3}	1.02_{-3}	1.00_{i}	1.00_{i}	...	...	1.00_{-1}	0.96_{-1}	0.99_{-1}	1.32_{-1}
Portugal	1.00	1.00	1.06	...	1.08_{-2}	1.10_{-3}	1.00_{-3}	1.00_{i}	0.98_{i}	...	...	0.99_{-1}	0.99_{-1}	1.00_{-1}	1.15_{-1}
Republic of Moldova	1.01_{-4}	1.03_{-4}	1.08_{-4}	...	...	1.26_{-3}	1.02_{-3}	1.00_{i}	1.00_{i}	...	...	0.99_{i}	0.99_{i}	0.99_{i}	1.29_{i}
Romania	0.99	1.02	1.00	...	...	1.22_{-3}	0.98_{-3}	1.00_{i}	1.00_{i}	...	...	1.00_{-1}	0.99_{-1}	1.00_{-1}	1.22_{-1}
Russian Federation	1.00	1.00	1.02	...	1.01_{-2}	1.12_{-3}	1.00_{-3}	1.00_{-1i}	1.00_{-1i}	...	...	0.99_{-2}	0.99_{-2}	0.97_{-2}	1.14_{-2}
San Marino	...	...	...	...	...	...	...	...	...	...	...	0.98_{i}	0.99_{i}	0.94_{i}	0.89_{i}
Serbia	1.00_{-1}	1.00_{-1}	1.12_{-1}	...	0.97_{-2}	1.22_{-3}	1.01_{-3}	1.00_{-2}	0.99_{-2}	...	...	1.00_{i}	1.00_{i}	1.02_{i}	1.30_{i}
Slovakia	1.00_{-1}	1.00_{-1}	1.01_{-1}	...	1.05_{-2}	1.18_{-3}	1.01_{-3}	...	...	...	...	0.98_{-1}	1.00_{-1}	1.01_{-1}	1.33_{-1}
Slovenia	1.02	1.00	1.05	...	...	1.16_{-3}	1.01_{-3}	...	...	...	...	0.98_{-1}	1.00_{-1}	1.02_{-1}	1.31_{-1}
Spain	1.00	1.01	1.11	...	1.08_{-2}	...	1.00_{-3}	1.00_{-1}	0.99_{-1}	...	...	1.00_{-1}	1.01_{-1}	1.03_{-1}	1.19_{-1}
Sweden	1.00	1.01	1.10	...	1.05_{-2}	1.11_{-3}	1.02_{-3}	...	...	...	...	0.99_{-1}	1.05_{-1}	1.08_{-1}	1.38_{-1}
Switzerland	1.00	1.00	1.00	...	...	1.12_{-3}	0.99_{-3}	...	...	...	...	0.99_{-1}	0.99_{-1}	0.95_{-1}	1.06_{-1}
Ukraine	1.00_{-4}	1.01_{-4}	1.03_{-4}	...	...	1.16_{-3}	...	1.00_{i}	1.00_{i}	...	...	...	...	...	...
United Kingdom	1.00_{-2}	1.00_{-2}	1.07_{-2}	...	1.00_{-2}	1.07_{-3}	0.97_{-3}	...	...	...	...	1.00_{-1}	1.00_{-1}	1.02_{-1}	1.26_{-1}
United States	1.00	1.00	1.02	...	1.04_{-2}	1.09_{-3}	0.98_{-3}	...	...	1.02_{-4}	0.97_{-4}	1.00_{-1i}	1.00_{-1i}	0.98_{-1i}	1.29_{-1i}

Location/wealth																
F												G				
Disparity in primary completion				Disparity in lower secondary completion				Disparity in upper secondary completion				Wealth disparity in minimum proficiency				
Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		Adjusted parity index		% of poorest completing		End of primary		End of lower secondary		
Location	Wealth	M	F	Location	Wealth	M	F	Location	Wealth	M	F	Reading	Mathematics	Reading	Mathematics	Country code
4.5.1																
2021																
0.97_{-4}	0.95_{-4}	91_{-4}	96_{-4}	0.99_{-4}	0.88_{-4}	89_{-4}	86_{-4}	0.85_{-4}	0.62_{-4}	60_{-4}	60_{-4}	…	0.71_{-2}	0.51_{-3}	0.75_{-3}	ALB
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	AND
1.01	…	…	…	1.03	…	…	…	1.10	…	…	…	…	0.77_{-2}	0.70_{-3}	0.70_{-3}	AUT
1.00_{-2}	1.00_{-2}	100_{-2}	100_{-2}	0.97_{-2}	0.99_{-2}	99_{-2}	100_{-2}	0.85_{-2}	0.83_{-2}	74_{-2}	82_{-2}	…	…	0.61_{-3}	0.54_{-3}	BLR
0.99	…	…	…	0.97	…	…	…	1.08	…	…	…	…	0.71_{-2}	0.68_{-3}	0.67_{-3}	BEL
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	BMU
…	…	…	…	…	…	…	…	…	…	…	…	…	0.88_{-2}	0.50_{-3}	…	BIH
1.01	…	…	…	0.98	…	…	…	0.80	…	…	…	…	0.50_{-2}	0.40_{-3}	0.45_{-3}	BGR
…	…	…	…	…	…	…	…	0.95_{-4}	0.94_{-4}	94_{-4}	91_{-4}	…	0.73_{-2}	0.85_{-3}	0.81_{-3}	CAN
0.99	…	…	…	1.00	…	…	…	0.99	…	…	…	…	0.98_{-2}	0.80_{-3}	0.68_{-3}	HRV
…	…	…	…	…	…	…	…	…	…	…	…	…	0.66_{-2}	0.68_{-3}	0.66_{-3}	CZE
1.00	…	…	…	1.00	…	…	…	0.85	…	…	…	…	…	0.78_{-3}	0.80_{-3}	DNK
1.01	…	…	…	1.00	…	…	…	0.93	…	…	…	…	…	0.90_{-3}	0.88_{-3}	EST
1.00	…	…	…	1.01	…	…	…	1.03	…	…	…	…	0.74_{-2}	0.85_{-3}	0.80_{-3}	FIN
1.00	…	…	…	0.99	…	…	…	1.00	…	…	…	…	0.54_{-2}	0.70_{-3}	0.64_{-3}	FRA
…	…	…	…	1.03	…	…	…	1.02	…	…	…	…	0.52_{-2}	0.71_{-3}	0.68_{-3}	DEU
1.01	…	…	…	1.02	…	…	…	1.02	…	…	…	…	…	0.63_{-3}	0.57_{-3}	GRC
1.00	…	…	…	0.98	…	…	…	0.86	…	…	…	…	0.48_{-2}	0.58_{-3}	0.42_{-2}	HUN
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.73_{-3}	0.76_{-3}	ISL
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.84_{-3}	0.78_{-3}	IRL
1.00	…	…	…	1.00	…	…	…	1.02	…	…	…	…	0.82_{-2}	0.72_{-3}	0.61_{-2}	ITA
0.99	…	…	…	1.01	…	…	…	0.93	…	…	…	…	0.67_{-2}	0.78_{-3}	0.78_{-3}	LVA
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	LIE
1.00	…	…	…	1.00	…	…	…	0.91	…	…	…	…	0.65_{-2}	0.68_{-3}	0.65_{-3}	LTU
1.01	…	…	…	1.01	…	…	…	1.10	…	…	…	…	…	0.58_{-3}	0.59_{-3}	LUX
…	…	…	…	…	…	…	…	…	…	…	…	…	0.61_{-2}	0.64_{-3}	…	MLT
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	MCO
1.02_{-3}	0.89_{-3}	84_{-3}	94_{-3}	1.03_{-3}	0.78_{-3}	70_{-3}	86_{-3}	1.00_{-3}	0.54_{-3}	52_{-3}	58_{-3}	…	0.81_{-2}	0.63_{-3}	0.60_{-3}	MNE
…	…	…	…	…	…	…	…	…	…	…	…	…	0.85_{-2}	0.73_{-3}	0.78_{-3}	NLD
1.02_{-2}	0.97_{-2}	97_{-2}	98_{-2}	1.03_{-2}	0.84_{-2}	79_{-2}	88_{-2}	1.02_{-2}	0.56_{-2}	63_{-2}	49_{-2}	…	0.60_{-2}	0.45_{-3}	0.39_{-3}	MKD
0.99	…	…	…	1.00	…	…	…	0.92	…	…	…	…	0.72_{-2}	0.81_{-3}	0.78_{-3}	NOR
1.01	…	…	…	1.01	…	…	…	0.99	…	…	…	…	0.65_{-2}	0.81_{-3}	0.78_{-3}	POL
1.00	…	…	…	0.99	…	…	…	0.97	…	…	…	…	0.82_{-2}	0.71_{-3}	0.65_{-3}	PRT
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.44_{-3}	0.38_{-3}	MDA
1.01	…	…	…	0.96	…	…	…	0.82	…	…	…	…	…	0.47_{-3}	0.40_{-3}	ROU
0.99	…	100	100	1.00	…	100	100	1.00	1.00_{-3}	85	90	…	0.89_{-2}	0.79_{-3}	0.76_{-3}	RUS
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SMR
1.00_{-2}	0.97_{-2}	100_{-2}	93_{-2}	0.99_{-2}	0.93_{-2}	95_{-2}	92_{-2}	0.93_{-2}	0.64_{-2}	63_{-2}	59_{-2}	…	0.70_{-2}	0.62_{-3}	0.60_{-3}	SRB
…	…	…	…	…	…	…	…	…	…	…	…	…	0.43_{-2}	0.56_{-3}	0.57_{-3}	SVK
0.99	…	…	…	1.00	…	…	…	1.03	…	…	…	…	…	0.79_{-3}	0.77_{-3}	SVN
1.00	…	…	…	0.99	…	…	…	1.02	…	…	…	…	0.63_{-2}	…	0.68_{-3}	ESP
1.00	…	…	…	1.00	…	…	…	0.89	…	…	…	…	0.66_{-2}	0.77_{-3}	0.73_{-3}	SWE
1.00	…	…	…	0.99	…	…	…	1.04	…	…	…	…	…	0.68_{-3}	0.76_{-3}	CHE
…	…	…	…	…	…	…	…	…	…	…	…	…	…	0.63_{-3}	…	UKR
1.00_{-2}	…	…	…	1.00_{-2}	…	…	…	1.02_{-2}	…	…	…	…	0.82_{-2}	0.81_{-3}	0.76_{-3}	GBR
…	0.99_{-1}	99_{-1}	99_{-1}	…	0.98_{-1}	98_{-1}	98_{-1}	…	0.93_{-1}	88_{-1}	91_{-1}	…	0.74_{-2}	0.76_{-3}	0.62_{-3}	USA

TABLE 6: SDG 4, Target 4.7 – Education for sustainable development and global citizenship

By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity, and of culture's contribution to sustainable development

	A				B
	Extent to which global citizenship education and education for sustainable development are mainstreamed				% of schools providing life skills-based HIV/AIDS education
	Education policies/ frameworks	Curriculum	In-service teacher training	Student assessment	
SDG indicator	4.7.1				4.7.2
Reference year	2020				2021
Region	**Median**				**Weighted average**
World	…	…	…	…	87$_{-1i}$
Sub-Saharan Africa	…	…	…	…	…
Northern Africa and Western Asia	0.88$_{i}$	0.76$_{i}$	0.88$_{i}$	0.83$_{i}$	50$_{-4i}$
Northern Africa	…	…	…	…	32$_{-4i}$
Western Asia	0.88$_{i}$	0.77$_{i}$	0.90$_{i}$	0.92	80$_{-1i}$
Central and Southern Asia	…	…	…	…	98$_{-1}$
Central Asia	…	…	…	…	59$_{-1i}$
Southern Asia	…	0.66$_{i}$	…	…	100$_{-1}$
Eastern and South-eastern Asia	0.94$_{i}$	…	0.92$_{i}$	0.83$_{i}$	90$_{-1i}$
Eastern Asia	…	…	…	…	88$_{-1}$
South-eastern Asia	0.94$_{i}$	…	0.92$_{i}$	0.92$_{i}$	92$_{-1i}$
Oceania	…	…	…	…	…
Latin America and the Caribbean	…	…	…	…	…
Caribbean	…	…	…	…	…
Central America	…	…	…	…	…
South America	…	…	0.81$_{i}$	0.96$_{i}$	…
Europe and Northern America	0.91$_{i}$	0.83$_{i}$	0.85$_{i}$	0.83$_{i}$	…
Europe	0.95	0.84$_{i}$	0.88$_{i}$	0.88$_{i}$	…
Northern America	0.88$_{i}$	0.78$_{i}$	0.70$_{i}$	0.83$_{i}$	…
Low income	…	…	…	…	…
Middle income	…	…	…	…	90$_{-1i}$
Lower middle	…	…	…	…	90$_{-1i}$
Upper middle	…	…	…	…	…
High income	0.91$_{i}$	0.86$_{i}$	0.85$_{i}$	0.83$_{i}$	…

A Extent to which (i) global citizenship education and (ii) education for sustainable development (including climate change education) are mainstreamed at all levels in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment.

B Percentage of lower secondary schools providing life skills-based HIV/AIDS education.

C Percentage of primary schools with water, sanitation and hygiene (WASH): basic drinking water, basic (single-sex) sanitation or toilets, and basic handwashing facilities.

D Percentage of primary schools with electricity, and computers or internet used for pedagogical purposes.

E Percentage of primary schools with access to adapted infrastructure and materials for students with disabilities.

F Percentage of lower secondary students experiencing bullying in the last 12 months.

G Number of attacks on students, teachers or institutions [*Source:* Global Coalition to Protect Education from Attack].

H Internationally mobile students, inbound and outbound numbers enrolled (thousand) and inbound and outbound mobility rates (as a percentage of total tertiary enrolment in the country).

I Volume of official development assistance flows (all sectors) for scholarships (all levels) and imputed student costs, total gross disbursements (million constant 2021 USD). Region totals include flows unallocated to specific countries. World total includes flows unallocated to specific countries or regions.

Note: ICT = information and communication technology.
Source: UIS unless noted otherwise. Data refer to school year ending in 2021 unless noted otherwise.
Aggregates represent countries listed in the table with available data and may include estimates for countries with no recent data.
(-) Magnitude nil or negligible.
(…) Data not available or category not applicable.
(± n) Reference year differs (e.g. -2: reference year 2019 instead of 2021).
(i) Estimate and/or partial coverage.

SDG 4, Means of implementation of target 4.a – Education facilities and learning environments

By 2030, build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments

SDG 4, Means of implementation of target 4.b – Scholarships

By 2020, substantially expand globally the number of scholarships available to developing countries

C			D			E	F	G	H				I	
% of schools with WASH facilities			% of schools with ICT for pedagogical purposes						Internationally mobile tertiary students				Official development assistance, USD (000,000)	
									Mobility rate (%)		Number (000)			
Basic drinking water	Basic sanitation or toilets	Basic handwashing	Electricity	Internet	Computers	% of schools with adapted infrastructure and materials for students with disabilities	% of students experiencing bullying	Number of attacks on education	Inbound	Outbound	Inbound	Outbound	Scholarships	Imputed student costs
4.a.1							4.a.2	4.a.3					4.b.1	
2021									2021					
Weighted average							—		Weighted average		Sum			
76$_{-1i}$	77$_{-1i}$	76$_{-1i}$	76$_{-1i}$	40$_{-1i}$	47$_{-1i}$	47$_{-1i}$	…	…	3$_{-1}$	3$_{-1}$	6,362$_{-1}$	6,362$_{-1}$	1,355$_{i}$	3,085$_{i}$
42$_{-4i}$	…	…	32$_{-1i}$	…	…	…	…	…	1$_{-1i}$	5$_{-1i}$	131$_{-1i}$	420$_{-1}$	204	433
92$_{-1i}$	92$_{-4i}$	96$_{-1i}$	92$_{-1i}$	70$_{-1i}$	86$_{-1i}$	…	…	…	3$_{-1i}$	3$_{-1i}$	723$_{-1}$	714$_{-1}$	218$_{i}$	939$_{i}$
89$_{-1i}$	90$_{-4i}$	95$_{-1i}$	89$_{-1i}$	61$_{-1i}$	86$_{-1i}$	…	…	…	1$_{-1i}$	3$_{-1i}$	92$_{-1i}$	188$_{-1}$	94	462
94$_{-1i}$	95$_{-4i}$	98$_{-1i}$	96$_{-1i}$	82$_{-1i}$	85$_{-1i}$	…	…	…	5$_{-1}$	4$_{-1}$	631$_{-1}$	526$_{-1}$	124$_{i}$	477$_{i}$
83$_{-1}$	79$_{-1}$	82$_{-1}$	59$_{-3}$	18$_{-1}$	28$_{-1}$	60$_{-1}$	…	…	0.3$_{-1}$	2$_{-1}$	160$_{-1}$	1,147$_{-1}$	141	593
95$_{-3i}$	80$_{-1i}$	94$_{-1i}$	100$_{-1}$	77$_{-1i}$	96$_{-1i}$	17$_{-1i}$	…	…	5$_{-1i}$	16$_{-1}$	83$_{-1i}$	286$_{-1}$	38	38
83$_{-1}$	79$_{-1}$	82$_{-1}$	77$_{-1}$	17$_{-1}$	26$_{-1}$	61$_{-1}$	…	…	0.2$_{-1}$	2$_{-1}$	77$_{-1}$	861$_{-1}$	103	555
78$_{-1i}$	74$_{-1i}$	83$_{-1i}$	91$_{-1i}$	78$_{-1i}$	69$_{-1i}$	…	…	…	1$_{-1}$	2$_{-1}$	800$_{-1}$	1,635$_{-1}$	133$_{i}$	537$_{i}$
97$_{-1}$	97$_{-1}$	97$_{-1}$	98$_{-1}$	95$_{-1}$	95$_{-1}$	…	…	…	1$_{-1}$	2$_{-1}$	610$_{-1}$	1,276$_{-1}$	30$_{i}$	384$_{i}$
66$_{-2i}$	60$_{-2i}$	74$_{-2i}$	87$_{-1i}$	67$_{-2i}$	53$_{-2i}$	…	…	…	1$_{-2i}$	2$_{-1i}$	181$_{-2i}$	359$_{-1}$	100$_{i}$	153$_{i}$
87$_{-4i}$	88$_{-4i}$	94$_{-4i}$	89$_{-4i}$	60$_{-4i}$	73$_{-4i}$	…	…	…	25$_{-1}$	2$_{-1}$	510$_{-1}$	31$_{-1}$	17$_{i}$	…
100$_{i}$	81$_{-4i}$	100$_{i}$	90$_{-2i}$	43$_{-3i}$	61$_{-3i}$	33$_{-3i}$	…	…	1$_{-1}$	1$_{-1}$	271$_{-1}$	412$_{-1}$	82$_{i}$	212$_{i}$
…	…	…	…	…	…	…	…	…	…	…	33$_{i}$	39$_{i}$	12$_{i}$	15$_{i}$
…	…	…	…	…	…	…	…	…	…	…	55	58$_{i}$	12	50
…	…	…	…	…	…	…	…	…	…	…	174$_{i}$	311$_{i}$	42$_{i}$	147$_{i}$
99$_{-1i}$	100$_{-1i}$	99$_{-1i}$	100$_{-1i}$	94$_{-4i}$	98$_{-4i}$	…	…	…	8$_{-1}$	2$_{-1}$	3,767$_{-1}$	1,196$_{-1}$	…	…
98$_{-1i}$	100$_{-1i}$	99$_{-1i}$	99$_{-1i}$	94$_{-3i}$	98$_{-3i}$	…	…	…	8$_{-1}$	4$_{-1}$	2,486$_{-1}$	1,034$_{-1}$	…	…
…	…	…	…	…	…	…	…	…	6$_{-1}$	1$_{-1}$	1,281$_{-1}$	162$_{-1}$	…	…
43$_{-4i}$	59$_{-4i}$	39$_{-1i}$	28$_{-1i}$	…	24$_{-1i}$	…	…	…	…	5$_{-1i}$	44$_{i}$	304$_{-1}$	150	349
77$_{-1i}$	77$_{-1i}$	79$_{-1i}$	79$_{-1i}$	36$_{-1i}$	44$_{-1i}$	47$_{-1i}$	…	…	1$_{-1}$	2$_{-1}$	1,663$_{-1}$	3,850$_{-1}$	722	2,641$_{i}$
70$_{-4i}$	74$_{-1i}$	75$_{-1i}$	63$_{-3}$	27$_{-1i}$	33$_{-1i}$	50$_{-1i}$	…	…	0.5$_{-1}$	2$_{-1}$	372$_{-1}$	1,815$_{-1}$	444	1,634$_{i}$
82$_{-1i}$	86$_{-4i}$	88$_{-1i}$	92$_{-1i}$	63$_{-1i}$	73$_{-1i}$	…	…	…	1$_{-1}$	2$_{-1}$	1,291$_{-1}$	2,035$_{-1}$	279	1,007$_{i}$
95$_{-1i}$	97$_{-1i}$	96$_{-1i}$	97$_{-1i}$	89$_{-4i}$	93$_{-4i}$	…	…	…	8$_{-1}$	2$_{-1}$	4,646$_{-1}$	1,369$_{-1}$	…	…

TABLE 6: Continued

Country or territory	A: Extent to which global citizenship education and education for sustainable development are mainstreamed — Education policies/ frameworks	Curriculum	In-service teacher training	Student assessment	B: % of schools providing life skills-based HIV/AIDS education
SDG indicator	4.7.1				4.7.2
Reference year	2020				2021
Sub-Saharan Africa					
Angola	...	...	...	...	...
Benin	...	...	...	...	...
Botswana	...	...	...	...	...
Burkina Faso	0.88	0.88	0.90	0.83	19
Burundi	0.62	0.62	0.62	0.62	100_{-4}
Cabo Verde	...	...	...	...	100_{-2}
Cameroon	...	...	...	...	...
Central African Republic	...	...	...	...	...
Chad	...	...	...	...	...
Comoros	...	...	...	...	...
Congo	...	...	...	...	...
Côte d'Ivoire	...	...	...	...	66
D. R. Congo	0.88	0.80	0.90	0.83	...
Djibouti	...	...	...	...	...
Equat. Guinea	...	...	...	...	...
Eritrea	...	...	...	...	...
Eswatini	...	...	...	...	100_{-3}
Ethiopia	...	...	...	...	...
Gabon	...	...	...	...	...
Gambia	...	...	...	...	...
Ghana	...	...	...	...	...
Guinea	...	...	...	...	...
Guinea-Bissau	...	...	...	...	...
Kenya	...	...	...	...	...
Lesotho	...	...	...	...	...
Liberia	...	...	...	...	...
Madagascar	...	...	...	...	...
Malawi	1.00	0.91	0.90	1.00	...
Mali	...	...	...	...	...
Mauritania	...	...	...	...	...
Mauritius	...	0.80	0.90	0.83	$-_{+1}$
Mozambique	...	...	...	...	...
Namibia	...	...	...	...	...
Niger	...	...	...	...	100
Nigeria	...	...	...	...	...
Rwanda	...	...	...	...	100
Sao Tome and Principe	...	...	...	...	100_{-4}
Senegal	...	...	...	...	...
Seychelles	...	...	...	...	87
Sierra Leone	...	...	...	...	34
Somalia	...	...	...	...	...
South Africa	...	...	...	...	...
South Sudan	...	...	...	...	...
Togo	...	...	...	...	1
Uganda	...	...	...	...	...
United Republic of Tanzania	...	...	...	...	68
Zambia	...	...	...	...	...
Zimbabwe	...	...	...	...	57_{-1}

C			D			E	F	G	H				I		
% of schools with WASH facilities			% of schools with ICT for pedagogical purposes			% of schools with adapted infrastructure and materials for students with disabilities	% of students experiencing bullying	Number of attacks on education	Internationally mobile tertiary students				Official development assistance, USD (000,000)		
									Mobility rate (%)		Number (000)				
Basic drinking water	Basic sanitation or toilets	Basic handwashing	Electricity	Internet	Computers				Inbound	Outbound	Inbound	Outbound	Scholarships	Imputed student costs	Country code
4.a.1							4.a.2	4.a.3					4.b.1		
2021									2021						
…	…	…	…	…	…	…	…	7	…	…	…	12_{-1i}	4	3	AGO
55	…	51_{-1}	33	…	…	…	…	2_{-1}	3_{-1}	7_{-1i}	4_{-1}	8_{-1i}	5	15	BEN
…	…	…	…	…	…	…	…	1_{-1}	2	4_{-1i}	1	2_{-1i}	0.5	0.3	BWA
72	45	47	26	0.2	1	44	…	103	2	5_{-1i}	4	7_{-1i}	4	8	BFA
39_{-2}	35_{-2}	20_{-2}	9_{-2}	$-_{-2}$	$-_{-2}$	$-_{-2}$	…	3	5_{-3}	9_{-3}	2_{-3}	3_{-1i}	2	3	BDI
100_{-2}	95_{-2}	81_{-2}	87_{-2}	29_{-2}	44_{-2}	…	…	…	1_{-3}	32_{-3}	0.2_{-3}	6_{-1i}	2	3	CPV
21	39_{-4}	…	33	…	…	…	…	70	3_{-3}	8_{-3}	9_{-3}	27_{-1i}	12	78	CMR
…	41_{-4}	…	4_{-4}	…	…	…	…	84	…	…	…	2_{-1i}	2	2	CAF
26	19	52	4	-	-	-	…	16	…	…	…	7_{-1i}	5	10	TCD
…	…	…	41_{-4}	8_{-4}	31_{-4}	…	…	…	…	…	…	6_{-1i}	6	7	COM
54_{-2}	42_{-3}	…	34_{-2}	…	12_{-3}	…	…	1	…	22_{-4}	…	11_{-1i}	6	16	COG
58	…	43	60	…	7_{-1}	23	…	4	2_{-1}	7_{-1i}	6_{-1}	17_{-1i}	9	28	CIV
39_{-2}	…	…	17_{-2}	…	…	…	…	302	0.4_{-1}	3_{-1i}	2_{-1}	14_{-1i}	8	7	COD
90_{+1}	94_{+1}	90_{+1}	85_{+1}	…	…	…	…	…	…	…	…	3_{-1i}	1	3	DJI
…	…	…	…	…	…	…	…	…	…	…	…	1_{-1i}	0.5	0.2	GNQ
…	26_{-3}	3_{-3}	29_{-3}	…	…	…	…	1_{-1}	…	…	…	2_{-1i}	1	2	ERI
79_{-4}	…	…	99_{-2}	63_{-2}	70_{-2}	…	…	10	…	…	…	2_{-1i}	0.3	-	SWZ
20	…	14	28	…	…	…	…	94	…	…	…	8_{-1i}	14	7	ETH
70_{-2}	…	44_{-2}	71_{-2}	…	…	4_{-2}	…	$-_{-2}$	…	…	…	9_{-1i}	3	17	GAB
86	83	…	40	…	22	…	…	…	…	…	…	2_{-1i}	4	1	GMB
…	91_{-4}	…	39	…	…	…	…	1	1	3_{-1i}	5	18_{-1i}	12	18	GHA
31_{-1}	75_{-1}	81_{-1}	17_{-1}	…	…	…	…	5_{-1}	…	…	0.4_{-4}	9_{-1i}	7	16	GIN
…	…	…	…	…	…	…	…	1_{-2}	…	…	…	6_{-1i}	2	11	GNB
…	…	…	…	…	…	…	…	8	1_{-2i}	3_{-2i}	7_{-2}	14_{-1i}	8	9	KEN
…	…	…	…	…	…	…	…	…	0.4_{-3}	14_{-3}	0.1_{-3}	5_{-1i}	0.4	0.1	LSO
59_{-4}	…	55_{-1}	19_{-1}	…	8_{-1}	…	…	1	…	…	…	1_{-1i}	1	0.2	LBR
53_{-2}	…	…	8_{-2}	0.1_{-2}	1_{-2}	…	…	10	2_{-1}	3_{-1i}	3_{-1}	5_{-1i}	3	10	MDG
87_{-4}	…	28_{-4}	27_{-2}	…	9_{-2}	…	…	5	…	…	…	4_{-1i}	2	0.3	MWI
…	…	…	16_{-4}	…	…	…	…	121	…	…	…	10_{-1i}	7	10	MLI
51_{-2}	28_{-2}	…	44_{-2}	…	14_{-4}	…	…	1	1_{-1}	20_{-1i}	0.4_{-1}	5_{-1i}	2	4	MRT
100_{+1}	100_{+1}	100_{+1}	100_{+1}	100_{+1}	98_{+1}	50_{+1}	…	…	7	16_{-1i}	3	7_{-1i}	1	8	MUS
…	…	…	…	…	…	…	…	26_{i}	0.4_{-3}	1_{-3}	1_{-3}	4_{-1i}	2	4	MOZ
…	…	…	73_{-3}	…	…	…	…	…	3_{-1}	7_{-1i}	2_{-1}	5_{-1i}	1	1	NAM
19	20_{-2}	61	10	2	2	4	…	22	5_{-2}	8_{-2i}	4_{-2}	6_{-1i}	2	4	NER
…	…	…	…	…	…	…	…	43	…	…	…	72_{-1i}	14	47	NGA
42	70	100	67	32	75	38	…	1_{-1}	4_{-1}	9_{-1i}	4_{-1}	8_{-1i}	6	4	RWA
88_{-4}	72_{-4}	88_{-4}	87_{-4}	…	59_{-4}	…	…	…	…	…	…	1_{-1i}	1	1	STP
81	63	94	49	28	19	35	…	15	6	8_{-1i}	15	16_{-1i}	8	51	SEN
100	100	100	100	100	100	7	…	…	-	66_{-1i}	-	1_{-1i}	…	…	SYC
69	70	82	16	1	1	15	…	3	…	…	…	1_{-1i}	2	1	SLE
…	…	…	…	…	…	…	…	34	…	…	…	12_{-1i}	5	1	SOM
…	…	…	…	…	100_{-2}	…	96_{-2}	16	3_{-1}	1_{-1i}	36_{-1}	12_{-1i}	6	4	ZAF
…	…	…	…	…	…	…	…	18	…	…	…	3_{-1i}	1	0.1	SSD
42	6	48	25	1	3	2	…	1	…	6_{-1i}	…	7_{-1i}	3	14	TGO
…	…	41_{-4}	…	…	…	…	…	11	…	…	…	6_{-1i}	7	3	UGA
…	…	…	49	…	93	…	…	$-_{-2}$	…	2_{-1i}	1_{+1}	7_{-1i}	7	2	TZA
82_{-4}	…	…	36_{-4}	6_{-4}	85_{-4}	…	…	2_{-1}	…	…	…	5_{-1i}	3	1	ZMB
61_{-1}	93_{-1}	68_{-1}	61	23_{-1}	35	19_{-1}	…	4	…	…	…	19_{-1i}	2	4	ZWE

TABLE 6: Continued

Country or territory	A: Extent to which global citizenship education and education for sustainable development are mainstreamed — Education policies/ frameworks	Curriculum	In-service teacher training	Student assessment	B: % of schools providing life skills-based HIV/AIDS education
SDG indicator	4.7.1				4.7.2
Reference year	2020				2021
Northern Africa and Western Asia					
Algeria	0.62	0.73	0.65	0.75	…
Armenia	0.88	0.70	0.85	0.83	100
Azerbaijan	…	…	…	…	…
Bahrain	1.00	0.94	1.00	1.00	100_{-1}
Cyprus	1.00	0.92	0.95	0.67	…
Egypt	…	…	…	…	…
Georgia	1.00	…	…	1.00	…
Iraq	…	…	…	…	…
Israel	…	…	…	…	…
Jordan	0.88	0.75	0.95	1.00	…
Kuwait	0.62	0.88	0.80	0.83	100
Lebanon	…	…	…	…	…
Libya	…	…	…	…	…
Morocco	…	…	…	…	…
Oman	0.81	0.73	0.85	0.83	100
Palestine	0.88	0.71	0.80	0.83	79_{+1}
Qatar	…	…	…	0.67	100
Saudi Arabia	0.75	…	…	1.00	100
Sudan	…	…	…	…	…
Syrian Arab Republic	…	0.77	0.90	1.00	100_{+1}
Tunisia	…	…	…	…	…
Türkiye	1.00	0.88	0.90	1.00	…
United Arab Emirates	…	…	…	…	…
Yemen	…	…	…	…	…
Central and Southern Asia					
Afghanistan	…	0.61	…	…	…
Bangladesh	0.81	0.66	0.82	0.83	100_{-3}
Bhutan	…	…	…	…	…
India	1.00	0.92	0.95	1.00	100_{+1}
Iran, Islamic Republic of	…	…	…	…	…
Kazakhstan	…	…	…	…	…
Kyrgyzstan	0.62	0.74	0.90	0.83	100_{-4}
Maldives	…	…	…	…	100_{-4}
Nepal	…	…	…	…	10_{+1}
Pakistan	…	…	…	…	…
Sri Lanka	…	…	…	…	100_{-2}
Tajikistan	…	…	…	…	…
Turkmenistan	…	…	…	…	100_{-1}
Uzbekistan	…	…	…	…	20_{-1}
Eastern and South-eastern Asia					
Brunei Darussalam	…	…	…	…	…
Cambodia	1.00	0.82	0.90	1.00	…
China	…	…	…	…	90
DPR Korea	…	…	…	…	…
Hong Kong, China	…	…	…	…	100_{i}
Indonesia	…	…	…	…	…
Japan	…	…	…	…	…
Lao PDR	…	…	…	…	…
Macao, China	…	…	…	…	100
Malaysia	0.88	0.88	0.90	0.83	100
Mongolia	0.88	0.75	0.85	0.83	…
Myanmar	1.00	0.90	1.00	0.83	85_{-3}
Philippines	…	…	…	…	100_{-1}
Republic of Korea	1.00	0.88	1.00	0.83	…
Singapore	…	…	…	…	86_{-1}
Thailand	0.84	…	0.95	1.00	100_{+1}
Timor-Leste	…	…	…	…	…
Viet Nam	…	…	…	…	73

C: % of schools with WASH facilities – Basic drinking water	C: Basic sanitation or toilets	C: Basic handwashing	D: % of schools with ICT for pedagogical purposes – Electricity	D: Internet	D: Computers	E: % of schools with adapted infrastructure and materials for students with disabilities	F: % of students experiencing bullying	G: Number of attacks on education	H: Internationally mobile tertiary students – Mobility rate (%) – Inbound	H: Mobility rate (%) – Outbound	H: Number (000) – Inbound	H: Number (000) – Outbound	I: Official development assistance, USD (000,000) – Scholarships	I: Imputed student costs	Country code
4.a.1							4.a.2	4.a.3					4.b.1		
2021									2021						
88_{+1}	100	100_{+1}	100_{+1}	5_{+1}	57_{+1}	…	…	1	1	2_{-1i}	10	31_{-1i}	23	108	DZA
98	…	98	100	100	100	…	…	3_{-1}	6	7_{-1i}	5	6_{-1i}	5	12	ARM
100	100	100	100	64	98	…	…	3	2	19_{-1i}	6	45_{-1i}	11	22	AZE
100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	83_{-2}	$-_{-2}$	12	11_{-1i}	6	5_{-1i}	…	…	BHR
…	…	…	…	…	79_{-2}	…	80_{-2}	…	27_{-1}	49_{-1i}	14_{-1}	26_{-1i}	…	…	CYP
…	…	…	…	71_{-2}	95_{-2}	…	72_{-2}	2_{-1}	1_{-1}	1_{-3}	34_{-1}	47_{-1i}	15	74	EGY
100	100	100	100	100	100	…	53_{-2}	$-_{-2}$	9	6_{-1i}	15	9_{-1i}	6	19	GEO
…	…	…	…	…	…	…	…	45	…	…	…	39_{-1i}	11	13	IRQ
…	…	…	…	…	…	…	…	5	3_{-1}	5_{-1i}	13_{-1}	18_{-1i}	…	…	ISR
100	…	…	100	34_{-1}	34_{-1}	…	69_{-2}	$-_{-2}$	12	9_{-1i}	41	29_{-1i}	16	20	JOR
100	100	100	100	100	100	100	76_{-2}	…	…	19_{-1i}	…	24_{-1i}	…	…	KWT
…	…	100	100	93	70	…	84_{-2}	2	12	8_{-2i}	34	20_{-1i}	7	38	LBN
…	…	…	…	…	…	…	…	2	…	…	…	9_{-1i}	3	7	LBY
81	91	81	97	79	77	20	87_{-2}	12	2	5_{-1i}	23	63_{-1i}	27	170	MAR
100	100	100	100	98	100	98	83_{-2}	…	3	13_{-1i}	4	16_{-1i}	…	…	OMN
99_{+1}	99_{+1}	97_{+1}	100_{+1}	97_{+1}	87_{+1}	58_{+1}	…	371	-	13_{-1i}	-	29_{-1i}	15	23	PSE
100	100	100	100	100	100	100	79_{-2}	…	38	22_{-1i}	15	8_{-1i}	…	…	QAT
100	100	100	100	100	100	100	68_{-2}	2	4	4_{-1i}	63	59_{-1i}	…	…	SAU
…	…	…	…	…	…	…	…	12	…	…	…	13_{-1i}	8	7	SDN
76_{+1}	81_{+1}	100_{+1}	82_{+1}	7_{+1}	54_{+1}	6_{+1}	…	61	…	…	…	87_{-1i}	24	195	SYR
90	100	90	100	79	97	…	…	1	3_{+1}	9_{-1i}	9_{+1}	25_{-1i}	17	96	TUN
…	…	…	…	…	94_{-2}	…	81_{-2}	30	2_{-1}	1_{-1i}	185_{-1}	51_{-1i}	16	117	TUR
100_{+1}	100_{+1}	100_{+1}	100_{+1}	100_{+1}	100_{+1}	100_{+1}	80_{-2}	$-_{-2}$	70_{+1}	5_{-1i}	220_{+1}	15_{-1i}	…	…	ARE
…	…	…	…	…	…	…	…	82	…	…	…	38_{-1i}	13	18	YEM
60_{-3}	26_{-3}	9_{-2}	16_{-2}	…	9_{-2}	5_{-2}	…	111	$-_{-1}$	7_{-1i}	$-_{-1}$	32_{-1i}	14	11	AFG
71	30	87	76	49	42	20	…	7	…	1_{-1i}	…	49_{-1i}	14	47	BGD
71	…	74_{-1}	88	5	8	…	…	…	…	43_{-1i}	…	5_{-1i}	1	0.2	BTN
98_{+1}	98_{+1}	93_{+1}	85_{+1}	21_{+1}	28_{+1}	77_{+1}	…	95	0.1	1_{-1i}	48	516_{-1i}	22	278	IND
…	…	…	…	…	27_{-2}	…	75_{-2}	8	1_{-1}	2_{-1i}	24_{-1}	67_{-1i}	12	128	IRN
…	…	…	100_{-1}	…	70_{-2}	7_{-3}	72_{-2}	1_{-1}	6_{-1}	12_{-1i}	41_{-1}	90_{-1i}	11	18	KAZ
…	…	100_{-4}	100_{-4}	41_{-4}	89_{-4}	…	…	2_{-1}	23	6_{-1i}	61	13_{-1i}	9	6	KGZ
100_{-4}	100_{-4}	100_{-4}	100_{-2}	99_{-2}	73_{-2}	100_{-4}	…	…	…	22_{-2i}	…	3_{-1i}	1	0.2	MDV
37_{+1}	39_{+1}	35_{+1}	36_{+1}	5_{+1}	12_{+1}	40_{+1}	…	1	…	22_{-1i}	…	95_{-1i}	8	21	NPL
73_{-4}	73_{-4}	…	62_{-4}	…	46_{-2}	…	…	28	…	2_{-2i}	…	65_{-1i}	25	65	PAK
79_{-2}	85_{-2}	79_{-2}	99_{-2}	19_{-2}	56_{-2}	…	…	1	0.4	9_{-1i}	1	29_{-1i}	6	5	LKA
…	…	…	…	…	…	…	…	…	1_{-4}	7_{-4}	2_{-4}	28_{-1i}	6	3	TJK
100	100_{-1}	100	100	31	99	1_{-1}	…	1_{-1}	0.2	95_{-1i}	0.1	68_{-1i}	2	2	TKM
73	67	89	100	96	97	50	…	…	1	19_{-1i}	4	86_{-1i}	9	10	UZB
…	100_{-1}	100_{-1}	100_{-1}	…	…	…	81_{-3}	…	4_{-1}	22_{-1i}	0.4_{-1}	2_{-1i}	…	…	BRN
92	55	98	75	7	9	22	…	…	0.3	3_{-2i}	1	8_{-1i}	9	4	KHM
100	100	99	99	99	99	…	…	5	0.4	2_{-1}	222	$1{,}088_{-1}$	18	375	CHN
…	…	…	…	…	…	…	…	1	…	0.3_{-3}	…	1_{-1i}	0.1	2	PRK
100	100	100	100	100	100	100_{i}	78_{-2}	…	16	12_{-1i}	47	35_{-1i}	…	…	HKG
58_{-3}	55_{-2}	69_{-3}	94_{-2}	…	40_{-3}	…	66_{-3}	21	0.1_{-3}	1_{-3}	8_{-3}	56_{-1i}	22	52	IDN
…	…	…	…	…	86_{-2}	…	53_{-2}	…	6_{-1}	1_{-2i}	223_{-1}	33_{-1i}	…	…	JPN
56_{-2}	47_{-2}	…	58	…	…	…	…	…	1_{-1}	10_{-1i}	1_{-1}	9_{-1i}	8	0.3	LAO
100	100	100	100	100	100	79	58_{-3}	…	59	8_{-1i}	23	3_{-1i}	…	…	MAC
89	100	100	100	100	100	25	94_{-2}	1_{-2}	8	5_{-1i}	93	55_{-1i}	8	15	MYS
…	…	…	…	…	…	…	…	…	1_{+1}	9_{-2i}	2_{+1}	15_{-1i}	12	7	MNG
82_{-2}	84_{-2}	56_{-3}	64_{-2}	0.2_{-3}	1_{-3}	1_{-3}	…	426	$-_{-3}$	1_{-3}	0.5_{-3}	13_{-1i}	8	1	MMR
58_{-1}	61_{-1}	86_{-1}	98_{-1}	31_{-1}	79_{-1}	8_{-1}	88_{-3}	7	…	1_{-1i}	…	26_{-1i}	12	4	PHL
100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	…	60_{-2}	1_{-2}	4_{-1}	3_{-1i}	112_{-1}	101_{-1i}	…	…	KOR
100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	92_{-1}	88_{-2}	…	…	…	55_{-1}	22_{-1i}	…	…	SGP
100_{+1}	…	100_{+1}	100_{+1}	100_{+1}	100_{+1}	…	50_{-3}	4	…	…	25_{-1}	32_{-1i}	9	10	THA
68_{-2}	…	68_{-2}	84_{-2}	…	…	…	…	…	…	…	…	2_{-1i}	2	1	TLS
50	93	77	94	84	88	34	62_{-3}	$-_{-2}$	0.4	6_{-2i}	8	133_{-1i}	21	65	VNM

TABLE 6: Continued

Country or territory	A: Extent to which global citizenship education and education for sustainable development are mainstreamed — Education policies/ frameworks	Curriculum	In-service teacher training	Student assessment	B: % of schools providing life skills-based HIV/AIDS education
SDG indicator	4.7.1				4.7.2
Reference year	2020				2021
Oceania					
Australia	...	...	...	...	...
Cook Islands	...	...	...	...	100
Fiji	...	...	...	...	...
Kiribati	...	...	...	...	...
Marshall Islands	...	...	...	...	-
Micronesia, F. S.	...	...	...	...	50
Nauru	...	...	...	...	20_{-1}
New Zealand	0.35	...	0.60	...	...
Niue	...	...	...	...	100_{-1}
Palau	...	...	...	...	100
Papua New Guinea	...	...	...	...	...
Samoa	...	...	...	...	100
Solomon Is	...	...	...	...	...
Tokelau	...	...	...	...	-
Tonga	...	...	...	...	...
Tuvalu	...	...	...	...	17
Vanuatu	...	...	...	...	...
Latin America and the Caribbean					
Anguilla	...	...	...	...	100_{-2}
Antigua and Barbuda	...	...	...	...	100_{-3}
Argentina	...	...	...	...	...
Aruba	...	...	...	...	...
Bahamas	...	...	...	...	...
Barbados	...	...	...	...	...
Belize	...	...	...	...	...
Bolivia, P. S.	...	...	0.77	0.75	...
Brazil	1.00	0.94	1.00	0.92	...
British Virgin Islands	...	...	...	...	100
Cayman Islands	...	...	...	...	100_{-1}
Chile	...	...	...	...	...
Colombia	1.00	0.88	0.85	1.00	...
Costa Rica	...	...	...	...	80_{-1}
Cuba	1.00	1.00	0.95	1.00	100
Curaçao	...	...	...	...	...
Dominica	...	...	...	...	100
Dominican Republic	0.97	0.87	0.82	1.00	...
Ecuador	...	...	...	...	...
El Salvador	...	...	...	...	...
Grenada	...	...	...	...	92_{-3}
Guatemala	...	...	...	...	...
Guyana	...	...	...	...	...
Haiti	...	...	...	...	...
Honduras	...	...	...	...	...
Jamaica	...	...	...	...	...
Mexico	0.75	...	0.80	1.00	...
Montserrat	...	...	...	...	100_{-2}
Nicaragua	0.88	0.79	0.90	1.00	...
Panama	...	...	...	...	...
Paraguay	...	...	...	...	...
Peru	1.00	0.81	0.20	1.00	...
Saint Kitts and Nevis	0.57	0.61	0.80	0.83	...
Saint Lucia	...	...	...	...	100_{-1}
Saint Vincent/Grenadines	...	...	...	...	96_{-3}
Sint Maarten	...	...	...	...	...
Suriname	...	...	...	...	...
Trinidad and Tobago	...	...	...	...	...
Turks and Caicos Islands	...	...	...	...	...
Uruguay	...	...	...	...	100_{-1}
Venezuela, B. R.	...	...	...	...	...

C			D			E	F	G	H				I		
% of schools with WASH facilities			% of schools with ICT for pedagogical purposes						Internationally mobile tertiary students				Official development assistance, USD (000,000)		
									Mobility rate (%)		Number (000)				
Basic drinking water	Basic sanitation or toilets	Basic handwashing	Electricity	Internet	Computers	% of schools with adapted infrastructure and materials for students with disabilities	% of students experiencing bullying	Number of attacks on education	Inbound	Outbound	Inbound	Outbound	Scholarships	Imputed student costs	Country code
4.a.1							4.a.2	4.a.3					4.b.1		
2021									2021						
…	…	…	…	…	…	…	85_{-2}	…	26_{-1}	1_{-1i}	458_{-1}	14_{-1i}	…	…	AUS
100	100	100	100	100	100	67	…	…	…	…	…	0.3_{-1i}	…	…	COK
88	…	91	96	…	…	…	…	…	…	3_{-2i}	…	1_{-1i}	1	-	FJI
67_{-1}	72_{-1}	…	42_{-1}	6_{-1}	20_{-1}	…	…	…	…	…	…	1_{-1i}	2	…	KIR
71	73	72	74	30	93_{-1}	40	…	…	6_{-2}	11_{-2i}	0.1_{-2}	0.2_{-1i}	0.1	…	MHL
87	77	86	79	42	32	31	…	…	…	…	…	0.1_{-1i}	0.1	…	FSM
100_{-1}	100_{-1}	75_{-1}	100_{-1}	$-_{-1}$	100_{-1}	$-_{-1}$	…	…	…	…	…	0.2_{-1i}	0.2	…	NRU
…	…	…	…	…	99_{-2}	…	85_{-2}	…	17_{-1}	2_{-1i}	44_{-1}	5_{-1i}	…	…	NZL
100	100	100	100	100	100	100	…	…	…	…	…	$-_{-1i}$	0.2	…	NIU
100	100	100	100	100	100	100	…	…	…	…	…	0.1_{-1i}	-	-	PLW
…	…	…	…	…	…	…	…	$-_{-2}$	…	…	…	1_{-1i}	3	-	PNG
100	100	74	100	45	45	45	…	…	4	33_{-1i}	0.1	1_{-1i}	4	…	WSM
46_{-2}	…	…	56_{-2}	2_{-2}	13_{-2}	…	…	…	…	…	…	3_{-1i}	2	…	SLB
100	100	100	100	100	100	100	…	…	$-_{-1}$	…	$-_{-1}$	0.1_{-1i}	-	…	TKL
98_{-1}	97_{-1}	86_{-1}	83_{-1}	7_{-1}	44_{-1}	1_{-1}	38_{-4}	…	1_{-1}	68_{-1i}	$-_{-1}$	1_{-1i}	2	-	TON
80	80	100	90	90	100	80	…	…	…	…	…	0.4_{-1i}	1	…	TUV
…	…	…	…	…	…	…	…	…	…	…	…	2_{-1i}	1	2	VUT
100_{-2}	100_{-2}	100_{-2}	100_{-2}	100_{-2}	100_{-2}	100_{-2}	…	…	…	…	…	0.1_{-1i}	…	…	AIA
100_{-3}	100_{-3}	100_{-3}	100_{-3}	90_{-3}	90_{-3}	5_{-3}	…	…	…	…	…	1_{-1i}	0.1	-	ATG
…	…	…	98_{-1}	58_{-1}	65_{-1}	…	62_{-3}	…	4_{-1}	0.3_{-1i}	122_{-1}	10_{-1i}	3	7	ARG
…	…	…	…	…	…	…	…	…	…	…	…	1_{-1i}	…	…	ABW
…	…	…	…	…	…	…	…	…	…	…	…	4_{-1i}	…	…	BHS
100	100	100	100	…	…	…	…	…	…	…	…	1_{-1i}	…	…	BRB
…	…	…	…	…	…	…	…	…	…	9_{-1i}	…	1_{-1i}	0.2	0.1	BLZ
…	…	…	…	…	…	…	…	1	…	…	…	21_{-1i}	1	4	BOL
…	…	95_{-4}	96_{-4}	62_{-4}	54_{-4}	28_{-4}	56_{-3}	6	0.2_{-1}	1_{-1i}	22_{-1}	89_{-1i}	19	51	BRA
100	100	100	100	100	100	50_{-1}	…	…	…	64_{-2i}	…	0.4_{-1i}	…	…	VGB
100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	…	…	…	…	…	1_{-1i}	…	…	CYM
…	…	…	…	…	52_{-2}	…	84_{-2}	10	1_{-1}	2_{-1i}	13_{-1}	18_{-1i}	…	…	CHL
…	…	11_{-2}	85	38	91	…	59_{-3}	83	0.2	2_{-1i}	5	57_{-1i}	7	47	COL
93_{-1}	76_{-1}	96_{-1}	99_{-1}	86_{-1}	97_{-1}	72_{-1}	52_{-3}	…	1_{-2}	2_{-2i}	3	4_{-1i}	1	4	CRI
100_{-3}	100_{-3}	100	100	42	100	…	…	…	2	1_{-1i}	8	3_{-1i}	1	2	CUB
…	…	…	…	…	…	…	…	…	…	…	…	0.2_{-1i}	…	…	CUW
100	100	100	100	100	100	100	…	…	…	…	…	1_{-1i}	0.3	0.3	DMA
…	…	…	…	…	…	…	66_{-3}	…	2_{-4}	1_{-4}	10_{-4}	4_{-1i}	2	1	DOM
41	…	86	80	42	73	…	…	$-_{-2}$	1_{-1}	3_{-1i}	8_{-1}	24_{-1i}	3	12	ECU
82_{-4}	…	…	98_{-3}	23_{-3}	61_{-3}	30_{-3}	…	…	0.4_{-2}	2_{-2i}	1_{-2}	5_{-1i}	1	2	SLV
100_{-1}	…	100_{-1}	100_{-1}	100_{-1}	72_{-3}	13_{-1}	…	…	85_{-3}	5_{-3}	8_{-3}	1_{-1i}	0.1	0.1	GRD
…	…	…	…	…	…	…	…	…	0.2_{-2}	1_{-2i}	1_{-2}	3_{-1i}	2	3	GTM
…	…	…	…	…	…	…	…	…	…	…	…	1_{-1i}	1	0.1	GUY
…	…	…	…	…	…	…	…	2	…	…	…	12_{-1i}	5	11	HTI
88_{-2}	…	…	91_{-2}	…	…	…	…	1_{-2}	1_{-2}	2_{-2i}	2_{-2}	5_{-1i}	1	2	HND
90_{-2}	95_{-2}	100_{-2}	100	79_{-2}	85_{-2}	12_{-4}	26_{-4}	…	…	…	6_{-2}	6_{-1i}	1	0.5	JAM
…	…	…	…	…	…	…	51_{-3}	5	1_{-1}	1_{-1i}	43_{-1}	35_{-1i}	7	38	MEX
100_{-2}	100_{-2}	100_{-2}	100_{-2}	100_{-2}	100_{-2}	25_{-3}	…	…	…	…	…	$-_{-1i}$	0.1	…	MSR
…	…	…	…	…	…	…	…	…	…	…	…	4_{-1i}	0.4	1	NIC
27_{-1}	…	54	82_{-1}	47	48_{-1}	…	57_{-3}	…	3_{-1}	2_{-1i}	5_{-1}	3_{-1i}	1	1	PAN
…	…	…	…	…	…	…	17_{-4}	1	…	…	…	16_{-1i}	1	1	PRY
55_{-3}	…	…	83	48	70	37_{-1}	52_{-3}	2	…	2_{-4}	…	35_{-1i}	4	15	PER
100	100	100	100	100	100	…	…	…	…	…	…	1_{-1i}	…	…	KNA
100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	1_{-1}	…	…	14_{-1}	35_{-1i}	0.3_{-1}	1_{-1i}	1	0.2	LCA
100_{-3}	100_{-3}	100_{-3}	100_{-3}	100_{-3}	100_{-3}	100_{-3}	…	…	…	…	…	1_{-1i}	0.1	0.1	VCT
…	…	…	…	…	…	…	…	…	…	…	…	0.2_{-1i}	…	…	SXM
…	…	…	…	…	…	…	…	…	…	…	…	1_{-1i}	1	0.2	SUR
…	…	…	…	…	…	…	…	1_{-2}	…	…	1	4_{-1i}	…	…	TTO
100	100	100	100	93	97	…	…	…	…	…	0.2	0.2_{-1i}	…	…	TCA
100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	55_{-3}	…	2_{-1}	4_{-1i}	4_{-1}	6_{-1i}	…	…	URY
…	…	…	…	…	…	…	…	1	…	…	…	32_{-1i}	1	8	VEN

TABLE 6: Continued

Country or territory	A: Extent to which global citizenship education and education for sustainable development are mainstreamed – Education policies/ frameworks	Curriculum	In-service teacher training	Student assessment	B: % of schools providing life skills-based HIV/AIDS education
SDG indicator	4.7.1				4.7.2
Reference year	2020				2021
Europe and Northern America					
Albania	0.72	…	0.68	0.83	85
Andorra	1.00	0.94	0.77	0.92	100
Austria	0.83	…	0.70	…	…
Belarus	…	…	…	…	…
Belgium	0.95	0.88	0.80	1.00	…
Bermuda	…	…	…	…	…
Bosnia and Herzegovina	0.58	…	…	0.50	…
Bulgaria	0.56	0.65	0.73	0.71	…
Canada	0.88	0.78	0.70	0.83	…
Croatia	…	…	…	…	…
Czechia	0.84	0.47	0.55	…	…
Denmark	…	0.68	0.77	0.83	…
Estonia	0.88	0.83	0.95	0.83	…
Finland	0.88	0.81	0.85	…	100_{-2i}
France	1.00	0.99	1.00	1.00	…
Germany	1.00	0.90	0.95	0.92	…
Greece	…	…	…	…	…
Hungary	1.00	0.86	0.93	0.79	…
Iceland	…	…	…	…	…
Ireland	0.88	0.81	0.85	0.83	…
Italy	0.88	0.88	0.80	0.83	…
Latvia	1.00	0.86	0.95	1.00	…
Liechtenstein	…	…	…	…	…
Lithuania	1.00	0.85	0.90	1.00	100_{-1}
Luxembourg	…	…	…	…	…
Malta	0.84	0.72	0.90	0.92	…
Monaco	0.88	0.79	0.85	0.67	100_{+1}
Montenegro	…	…	…	…	…
Netherlands	…	…	…	…	…
North Macedonia	…	…	…	…	…
Norway	…	…	…	…	…
Poland	1.00	0.80	0.90	1.00	…
Portugal	…	…	…	…	…
Republic of Moldova	0.86	0.76	0.75	0.83	100_{-2}
Romania	1.00	0.97	1.00	1.00	…
Russian Federation	1.00	…	0.90	…	…
San Marino	1.00	0.94	0.90	1.00	100
Serbia	…	…	…	…	…
Slovakia	0.51	0.64	…	0.25	…
Slovenia	1.00	0.93	0.85	1.00	…
Spain	1.00	0.91	0.95	1.00	…
Sweden	1.00	0.80	…	0.83	…
Switzerland	…	…	…	…	…
Ukraine	1.00	0.92	0.95	1.00	…
United Kingdom	0.41	0.59	…	0.83	…
United States	…	…	…	…	…

C			D			E	F	G	H				I		
% of schools with WASH facilities			% of schools with ICT for pedagogical purposes						Internationally mobile tertiary students				Official development assistance, USD (000,000)		
									Mobility rate (%)		Number (000)				
Basic drinking water	Basic sanitation or toilets	Basic handwashing	Electricity	Internet	Computers	% of schools with adapted infrastructure and materials for students with disabilities	% of students experiencing bullying	Number of attacks on education	Inbound	Outbound	Inbound	Outbound	Scholarships	Imputed student costs	Country code
4.a.1							4.a.2	4.a.3					4.b.1		
2021									2021						
72	82	100	100	72	83	8_{-1}	49_{-3}	…	2	9_{-1i}	2	12_{-1i}	9	40	ALB
100	100	100	100	100	100	100	…	…	43	247_{-1i}	0.3	2_{-1i}	…	…	AND
…	…	…	…	…	69_{-2}	…	53_{-3}	…	18_{-1}	6_{-1i}	76_{-1}	24_{-1i}	…	…	AUT
100	100	100	100	100	100	…	42_{-3}	$-_{-2}$	6	7_{-1i}	22	25_{-1i}	11	42	BLR
100_{-3}	…	100_{-3}	100_{-3}	100_{-3}	97_{-2}	…	54_{-3}	…	10_{-1}	3_{-1i}	54_{-1}	17_{-1i}	…	…	BEL
…	…	…	…	…	…	…	…	…	10_{-3}	225_{-3}	0.1_{-3}	1_{-1i}	…	…	BMU
…	…	…	…	…	28_{-2}	…	45_{-3}	…	7	18_{-1i}	6	15_{-1i}	3	35	BIH
…	…	…	…	…	36_{-2}	…	56_{-3}	…	8_{-1}	11_{-1i}	18_{-1}	25_{-1i}	…	…	BGR
…	…	…	…	…	86_{-2}	…	57_{-3}	…	18_{-1}	3_{-1i}	323_{-1}	51_{-1i}	…	…	CAN
…	…	…	…	…	22_{-2}	…	42_{-3}	…	3_{-1}	6_{-1i}	5_{-1}	10_{-1i}	…	…	HRV
…	…	…	…	…	61_{-2}	…	58_{-3}	…	15_{-1}	4_{-1i}	48_{-1}	12_{-1i}	…	…	CZE
…	…	…	…	…	…	…	61_{-3}	…	10_{-1}	2_{-1i}	31_{-1}	6_{-1i}	…	…	DNK
…	…	…	…	…	…	…	55_{-3}	…	12_{-1}	8_{-1i}	6_{-1}	4_{-1i}	…	…	EST
100_{-2i}	100_{-2i}	100_{-2i}	100_{-2i}	100_{-2i}	100_{-2i}	100_{-2i}	65_{-2}	…	8_{-1}	4_{-1i}	24_{-1}	11_{-1i}	…	…	FIN
100_{-2}	100_{-2}	100_{-2}	100_{-2}	99_{-2}	99_{-2}	…	80_{-2}	6	9_{-1}	4_{-1i}	252_{-1}	109_{-1i}	…	…	FRA
100_{-2}	100_{-2}	100_{-2}	100_{-2}	…	73_{-2}	…	57_{-3}	…	11_{-1}	4_{-1i}	369_{-1}	124_{-1i}	…	…	DEU
…	…	…	…	…	…	…	52_{-3}	9	3_{-1}	5_{-1i}	22_{-1}	40_{-1i}	…	…	GRC
88_{-2}	…	…	91_{-2}	…	…	…	80_{-2}	…	13_{-1}	5_{-1i}	38_{-1}	14_{-1i}	…	…	HUN
…	…	…	…	…	…	…	37_{-3}	…	9_{-1}	14_{-1i}	2_{-1}	3_{-1i}	…	…	ISL
…	…	…	…	…	67_{-2}	…	81_{-2}	$-_{-2}$	10_{-1}	6_{-1i}	24_{-1}	15_{-1i}	…	…	IRL
…	…	…	…	…	43_{-2}	…	84_{-2}	2	3_{-1}	4_{-1i}	59_{-1}	84_{-1i}	…	…	ITA
…	…	…	…	…	69_{-2}	…	71_{-3}	…	13_{-1}	6_{-1i}	10_{-1}	5_{-1i}	…	…	LVA
…	…	…	…	…	…	…	…	…	86	127_{-1i}	1	1_{-1i}	…	…	LIE
100_{-1}	100_{-1}	100_{-1}	100_{-1}	98_{-1}	98_{-1}	69_{-1}	77_{-2}	…	6_{-1}	10_{-1i}	7_{-1}	10_{-1i}	…	…	LTU
…	…	…	…	…	…	…	52_{-3}	…	48_{-1}	171_{-1i}	4_{-1}	13_{-1i}	…	…	LUX
…	…	…	…	…	99_{-2}	…	63_{-3}	…	14_{-1}	7_{-1i}	2_{-1}	1_{-1i}	…	…	MLT
100_{+1}	100_{+1}	100_{+1}	100_{+1}	100_{+1}	100_{+1}	100_{+1}	…	…	83_{+1}	54_{-1i}	1_{+1}	1_{-1i}	…	…	MCO
…	…	…	…	…	38_{-2}	…	45_{-3}	…	100	23_{-1i}	23	5_{-1i}	2	3	MNE
100_{-2}	100_{-2}	100_{-2}	100_{-2}	100_{-2}	100_{-2}	…	46_{-3}	…	13_{-1}	2_{-1i}	125_{-1}	19_{-1i}	…	…	NLD
…	…	…	…	…	82_{-2}	…	…	…	5_{-1}	10_{-1i}	3_{-1}	6_{-1i}	3	13	MKD
100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	100_{-1}	…	74_{-2}	…	4_{-1}	5_{-1i}	13_{-1}	16_{-1i}	…	…	NOR
…	…	…	…	…	…	…	57_{-3}	…	4_{-1}	2_{-1i}	62_{-1}	26_{-1i}	…	…	POL
100_{-3}	100_{-3}	100_{-3}	100_{-3}	100_{-3}	100_{-3}	…	72_{-2}	…	12_{-1}	6_{-1i}	44_{-1}	23_{-1i}	…	…	PRT
100_{-2}	100_{-2}	100_{-2}	100_{-2}	94	100	…	60_{-3}	…	6	20_{-1i}	5	16_{-1i}	55	5	MDA
…	…	…	…	…	…	…	83_{-2}	…	6_{-1}	6_{-1i}	33_{-1}	31_{-1i}	…	…	ROU
…	…	…	…	…	52_{-2}	…	76_{-2}	2	5_{-2}	1_{-2i}	283_{-2}	58_{-1i}	…	…	RUS
100	100	100	100	100	100	100	…	…	85	129_{-1i}	1	1_{-1i}	…	…	SMR
…	…	…	…	…	27_{-2}	…	43_{-3}	…	5	6_{-1i}	11	15_{-1i}	10	26	SRB
100	100	100	100	…	58_{-2}	…	56_{-3}	…	10_{-1}	22_{-1i}	14_{-1}	31_{-1i}	…	…	SVK
…	…	…	…	…	…	…	48_{-3}	…	8_{-1}	4_{-1i}	6_{-1}	3_{-1i}	…	…	SVN
100	100	100	100	100	100	…	44_{-3}	$-_{-2}$	4_{-1}	2_{-1i}	82_{-1}	47_{-1i}	…	…	ESP
…	…	…	…	…	97_{-2}	…	73_{-2}	$-_{-2}$	7_{-1}	3_{-1i}	32_{-1}	15_{-1i}	…	…	SWE
…	…	…	…	…	…	…	56_{-3}	…	18_{-1}	6_{-1i}	58_{-1}	19_{-1i}	…	…	CHE
…	…	87	100	100	99	67	52_{-3}	16	5	5_{-1i}	69	80_{-1i}	12	119	UKR
…	…	…	…	…	…	…	62_{-3}	1_{-1}	20_{-1}	1_{-1i}	551_{-1}	40_{-1i}	…	…	GBR
…	…	…	…	…	81_{-2}	…	81_{-2}	8	5_{-1}	1_{-1i}	957_{-1}	110_{-1i}	…	…	USA

TABLE 7: SDG 4, Means of implementation of target 4.c – Teachers

By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states

Pre-primary

	A	B	C	D	E
	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)
SDG indicator			4.c.1	4.c.3	4.c.6
Reference year	2021				
Region	Sum	Weighted average			
World	11,650$_{-1i}$	20	...	86$_{-1i}$	...
Sub-Saharan Africa	637$_{-1i}$	42$_{i}$	60$_{-1i}$	70$_{-1i}$	...
Northern Africa and Western Asia	452$_{-1i}$	21	82$_{-1i}$	89$_{-1i}$	...
Northern Africa	184$_{-1i}$	26	81$_{-1i}$	92$_{-1i}$	...
Western Asia	268$_{-1}$	17$_{i}$	82$_{-1i}$	86$_{-1i}$	...
Central and Southern Asia	2,392$_{-1i}$	10	...	92$_{-1i}$	...
Central Asia	220$_{-1i}$	11$_{i}$	88$_{-1i}$	91$_{-1i}$	...
Southern Asia	2,172$_{-1i}$	9	...	92$_{-1i}$	...
Eastern and South-eastern Asia	4,218$_{-1}$	15	...	88$_{-1}$	...
Eastern Asia	3,204$_{-1}$	16	...	92$_{-1}$	...
South-eastern Asia	1,013$_{-1i}$	13$_{i}$	88$_{-1i}$	74$_{-1i}$	...
Oceania	62$_{-4i}$	...	...	...	...
Latin America and the Caribbean	1,056$_{-1}$	21	81$_{-1i}$	...	...
Caribbean	...	16$_{i}$	...	...	...
Central America	...	19	...	...	...
South America	...	23	...	...	...
Europe and Northern America	2,837$_{-1}$	14	87$_{-1i}$	...	...
Europe	2,170$_{-1i}$	14	...	...	...
Northern America	667$_{-1}$	13	100$_{-1}$	100$_{-1}$	...
Low income	329$_{-1i}$	42	49$_{-3i}$	69$_{-1i}$	...
Middle income	8,993$_{-1i}$	15	...	86$_{-1i}$	...
Lower middle	3,850$_{-1i}$	14$_{i}$	...	85$_{-1i}$	...
Upper middle	5,143$_{-1}$	16	...	...	...
High income	2,279$_{-1}$	17	90$_{-1i}$	90$_{-1i}$	...

Primary

	A	B	C	D	E	F	G
	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training
SDG indicator			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7
Reference year	2021						
Region	Sum	Weighted average				Median	
World	33,050$_{-1}$	27	86$_{-1i}$	91$_{-1i}$	5$_{-1i}$	...	...
Sub-Saharan Africa	4,719$_{-1i}$	40	69$_{-2i}$	82$_{-1i}$	...	...	...
Northern Africa and Western Asia	2,884$_{-1i}$	21$_{i}$	85$_{-1i}$	92$_{-1i}$	7$_{-1i}$	...	90$_{i}$
Northern Africa	1,318$_{-1i}$	25	86$_{-1i}$	96$_{-1i}$	7$_{-1i}$	...	...
Western Asia	1,565$_{-1i}$	16$_{i}$	83$_{-1i}$	88$_{-1i}$	...	...	91$_{i}$
Central and Southern Asia	6,656$_{-1}$	33	77$_{-1}$	93$_{-1}$	3$_{-1}$	...	...
Central Asia	296$_{-1}$	21	93$_{-1}$	96$_{-1}$	5$_{-4i}$	...	...
Southern Asia	6,359$_{-1}$	34	77$_{-1}$	93$_{-1}$	3$_{-1}$	...	...
Eastern and South-eastern Asia	10,884$_{-1}$	16	...	94$_{-1}$	5$_{-1}$	...	89$_{i}$
Eastern Asia	7,240$_{-1}$	16	...	96$_{-1}$	5$_{-1}$	...	78$_{i}$
South-eastern Asia	3,643$_{-1i}$	17	98$_{-1i}$	91$_{-1i}$	6$_{-2i}$	1.02$_{i}$	...
Oceania	199$_{-4i}$	...	...	...	...	...	...
Latin America and the Caribbean	3,001$_{-1}$	21	83$_{-1i}$	...	...	...	...
Caribbean	178$_{i}$	16$_{i}$	...	...	...	...	...
Central America	803	24	...	...	...	1.04$_{i}$	...
South America	1,730$_{i}$	20	...	...	...	1.14$_{i}$	...
Europe and Northern America	4,704$_{-1}$	14	94$_{-1i}$	93$_{-1i}$	...	0.80$_{i}$	77$_{i}$
Europe	2,758$_{-1}$	13	93$_{-2i}$	...	...	0.80$_{i}$	75$_{i}$
Northern America	1,946$_{-1}$	14	98$_{-1}$	99$_{-1}$	...	0.88	87
Low income	2,945$_{-1i}$	43	74$_{-2i}$	88$_{-1i}$	...	...	...
Middle income	24,398$_{-1}$	26	86$_{-1i}$	90$_{-1}$	5$_{-1i}$	...	...
Lower middle	13,005$_{-1i}$	31	81$_{-1i}$	88$_{-1i}$	5$_{-1i}$	...	...
Upper middle	11,393$_{-1}$	17	...	93$_{-1}$	5$_{-1}$	...	...
High income	5,583$_{-1}$	14	94$_{-1i}$	96$_{-1i}$	...	0.83$_{i}$	82$_{i}$

Secondary

	A	B	C	D	E	F	G
	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training
SDG indicator			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7
Reference year	2021						
Region	Sum	Weighted average				Median	
World	37,567$_{-1}$	18	84$_{-1i}$	90$_{-1i}$	...	...	...
Sub-Saharan Africa	3,159$_{-1i}$	21$_{i}$	61$_{-2i}$	72$_{-2i}$	...	...	...
Northern Africa and Western Asia	3,310$_{-1i}$	15$_{i}$	87$_{-1i}$	93$_{-1i}$	...	...	91$_{i}$
Northern Africa	1,306$_{-1i}$	17$_{i}$	89$_{-1i}$	98$_{-1i}$	...	...	79$_{i}$
Western Asia	2,003$_{-1}$	14$_{i}$	85$_{-1i}$	91$_{-3i}$	...	...	94
Central and Southern Asia	9,270$_{-1}$	22	82$_{-1}$	91$_{-1}$	...	...	...
Central Asia	837$_{-1}$	10	93$_{-1}$	100$_{-1}$	...	...	...
Southern Asia	8,433$_{-1}$	23	80$_{-1}$	90$_{-1}$	...	...	...
Eastern and South-eastern Asia	10,646$_{-1}$	14	97	96$_{-1}$	...	...	94$_{i}$
Eastern Asia	7,624$_{-1}$	13	94$_{i}$	95$_{-1}$	...	...	91$_{i}$
South-eastern Asia	3,022$_{-1i}$	...	96$_{-1i}$	97$_{-2i}$	...	1.06$_{i}$	...
Oceania	158$_{i}$	...	56$_{i}$	96$_{i}$	...	...	...
Latin America and the Caribbean	3,945$_{-1}$	17	79$_{-1i}$	95$_{i}$	...	...	...
Caribbean	180$_{i}$	12$_{i}$	71$_{i}$	98$_{i}$	...	...	...
Central America	1,103	15	92$_{i}$	95$_{i}$	...	1.26$_{i}$	...
South America	2,027$_{i}$	18	78$_{i}$	79$_{i}$	...	1.12$_{i}$	89$_{i}$
Europe and Northern America	7,043$_{-1}$	13	86$_{-1i}$	91$_{-1i}$	...	0.78$_{i}$	96$_{i}$
Europe	5,167$_{-1}$	11$_{i}$	...	...	...	0.78$_{i}$	96$_{i}$
Northern America	1,876$_{-1}$	15	98$_{-1}$	100$_{-1}$	...	0.90	94$_{i}$
Low income	1,714$_{-1i}$	26$_{i}$	61$_{-1i}$	77$_{-1i}$	...	...	...
Middle income	28,300$_{-1}$	18	85$_{-1i}$	88$_{-1}$	...	...	...
Lower middle	14,863$_{-1}$	20$_{i}$	82$_{-1}$	87$_{-1i}$	...	...	...
Upper middle	13,437$_{-1}$	15	90$_{i}$	90$_{-1}$	...	...	...
High income	7,425$_{-1}$	13	88$_{-1i}$	97$_{-1i}$	...	0.84$_{i}$	94$_{i}$

A Number of classroom teachers.
B Pupil/teacher ratio, headcount basis.
C Percentage of teachers with the minimum required qualifications (received at least the minimum organized and recognized pre-service and in-service pedagogical training) to teach at a given level of education.
D Percentage of teachers qualified according to national standards.
E Teacher attrition rate (%).
F Ratio of actual teacher salaries (primary/lower secondary) to comparable workers.
G Percentage of teachers (primary/lower secondary) who received in-service training in the last 12 months.

Source: UIS unless noted otherwise. Data refer to school year ending in 2021 unless noted otherwise.
Aggregates represent countries listed in the table with available data and may include estimates for countries with no recent data.
(-) Magnitude nil or negligible.
(…) Data not available or category not applicable.
(± n) Reference year differs (e.g. -2: reference year 2019 instead of 2021).
(i) Estimate and/or partial coverage.

TABLE 7: Continued

Country or territory	Pre-primary					Primary							Secondary							
	A	B	C	D	E	A	B	C	D	E	F	G	A	B	C	D	E	F	G	
	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	Country code
SDG indicator			4.c.1	4.c.3	4.c.6			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7	
Reference year	2021					2021							2021							
Sub-Saharan Africa																				
Angola	...	...	...	...	...	89_{-3}	53_{-3}	...	...	...	...	...	...	...	...	...	...	...	...	AGO
Benin	7	23	53	53	2	59	39	75	75	15	1.78_{i}	...	51	18	36	94	...	...	...	BEN
Botswana	...	...	...	...	...	14	26	100_{-4}	...	...	...	...	15	11	...	...	...	...	...	BWA
Burkina Faso	8	16	29	31	8_{-2}	93	35	91	95	2	1.36_{-1i}	...	68	20	67	99	7	2.18_{-1i}	...	BFA
Burundi	2_{-1}	52_{-1}	100_{-3}	94_{-1}	5_{-3}	52_{-1}	44_{-1}	100_{-2}	94_{-1}	...	...	...	26_{-2}	...	100_{-3}	99_{-2}	...	...	...	BDI
Cabo Verde	1_{-2}	17_{-2}	30_{-2}	30_{-2}	...	3_{-2}	20_{-2}	99_{-2}	93_{-2}	4_{-3}	...	...	3_{-2}	15_{-2}	96_{-2}	93_{-2}	5_{-2}	...	...	CPV
Cameroon	29	19	73	61_{-4}	...	106	45	82	73_{-4}	9_{-4}	0.79_{-3i}	...	110	18	...	...	...	...	...	CMR
Central African Republic	1_{-4}	17_{-4}	...	...	...	11_{-4}	91_{-4}	...	...	...	...	...	4_{-4}	32_{-4}	...	...	...	...	...	CAF
Chad	1	26	...	83_{-2}	...	48	56	63	80_{-2}	...	...	...	23_{-2}	...	...	51_{-2}	...	...	...	TCD
Comoros	1_{-3}	28_{-3}	56_{-4}	44_{-4}	...	4_{-3}	28_{-3}	72_{-4}	...	...	...	...	9_{-3}	8_{-3}	...	...	...	...	...	COM
Congo	4_{-3}	17_{-3}	39_{-3}	14_{-3}	...	28_{-3}	28_{-3}	85_{-3}	46_{-3}	...	...	...	26_{-3}	20_{-3}	...	...	...	...	...	COG
Côte d'Ivoire	11_{+1}	24_{+1}	100	100	9	102_{+1}	42_{+1}	72_{+1}	100_{+1}	13	...	...	88	29	100	100	...	...	...	CIV
D. R. Congo	25_{-1}	24_{-1}	13_{-1}	100_{-3}	...	446_{-1}	42_{-1}	97_{-1}	100_{-3}	...	...	...	474_{-1}	...	22_{-1}	100_{-3}	...	...	...	COD
Djibouti	0.2_{+1}	26_{+1}	...	100_{+1}	...	3_{+1}	28_{+1}	100_{-3}	100_{+1}	6	...	...	3_{+1}	20_{+1}	...	100_{+1}	6_{-3}	...	...	DJI
Equat. Guinea	...	...	...	...	...	5_{-2}	23_{-2}	...	...	...	...	...	...	...	...	...	...	...	...	GNQ
Eritrea	2_{-2}	25_{-2}	38_{-2}	...	4_{-4}	9_{-2}	37_{-2}	84_{-3}	82_{-2}	...	...	...	7_{-2}	37_{-2}	...	84_{-4}	...	...	...	ERI
Eswatini	...	...	...	...	...	9_{-2}	26_{-2}	88_{-4}	92_{-3}	...	1.31_{-4i}	...	...	...	...	...	...	1.91_{-4i}	...	SWZ
Ethiopia	29	99	...	100_{-4}	...	516	36	...	90_{-1}	...	...	...	129	...	...	10	...	...	...	ETH
Gabon	5_{-2}	14_{-2}	40_{-2}	54_{-2}	...	10_{-2}	27_{-2}	52_{-2}	77_{-2}	...	...	...	10_{-2}	21_{-2}	...	72_{-2}	...	...	...	GAB
Gambia	4_{+1}	30_{+1}	75	76_{+1}	19_{-3}	13_{+1}	32_{+1}	88	88_{+1}	...	...	...	12	30	72	72	...	...	...	GMB
Ghana	64	29	61	61	...	173	27	66	66	...	...	...	196	16	78	78	...	...	...	GHA
Guinea	6	37	35_{-1}	89	...	44_{-1}	48_{-1}	77_{-1}	64_{-1}	...	...	...	35_{-1}	22_{-1}	50_{-2}	92_{-1}	...	...	...	GIN
Guinea-Bissau	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	GNB
Kenya	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	KEN
Lesotho	3_{-2}	18_{-2}	...	...	...	10_{-2}	32_{-2}	...	93_{-2}	...	...	...	6_{-2}	25_{-2}	...	...	...	...	...	LSO
Liberia	14_{-1}	40_{-1}	62_{-1}	72_{-1}	5_{-4}	29_{-1}	21_{-1}	67_{-1}	69_{-1}	6_{-4}	1.47_{-4i}	...	18_{-1}	15_{-1}	...	...	...	2.98_{-4i}	...	LBR
Madagascar	41_{-2}	22_{-2}	44_{-2}	99_{-2}	...	127_{-2}	37_{-2}	15_{-2}	100_{-2}	...	...	...	82_{-2}	18_{-2}	20_{-3}	85_{-3}	...	...	...	MDG
Malawi	35	...	...	...	...	83_{-2}	...	...	100_{-3}	...	...	...	15_{-2}	...	...	58_{-2}	...	...	...	MWI
Mali	7_{-3}	...	...	100_{-3}	...	64_{-1}	43_{-1}	...	...	...	...	...	56_{-1}	19_{-1}	...	...	...	...	...	MLI
Mauritania	...	...	...	...	...	17_{-2}	...	97_{-2}	...	16_{-2}	...	...	9_{-2}	...	93_{-2}	...	3_{-2}	...	...	MRT
Mauritius	2_{+1}	13_{+1}	100_{+1}	100_{+1}	15_{+1}	6_{+1}	14_{+1}	100_{+1}	100_{+1}	1_{+1}	0.88_{i}	...	10_{+1}	...	49_{+1}	100_{+1}	13_{+1}	1.06_{i}	...	MUS
Mozambique	...	...	...	...	...	125_{-1}	58_{-1}	98_{-1}	98_{-1}	...	...	...	32_{-1}	45_{-1}	...	...	...	...	...	MOZ
Namibia	2_{-3}	...	...	76_{-3}	...	19	28	95	88	...	...	...	11_{-4}	...	...	...	...	...	...	NAM
Niger	6	32	95	100	2_{-2}	69	41	96	100	2_{-2}	...	...	29_{-3}	...	...	100_{-3}	12_{-4}	...	...	NER
Nigeria	...	...	...	...	...	$1{,}001_{-2}$	28_{-2}	62_{-3}	80_{-2}	...	...	...	776_{-3}	15_{-3}	67_{-3}	67_{-3}	...	...	...	NGA
Rwanda	8	37	44	93	10_{-2}	61	45	76	99	3_{-2}	...	...	29	27	79	92	5_{-4}	...	...	RWA
Sao Tome and Principe	...	...	...	...	...	1_{-4}	31_{-4}	27_{-4}	...	...	...	...	...	...	...	...	...	...	...	STP
Senegal	13	20	39	96	...	68	34	76	100	...	...	...	51	25	77	100	...	...	...	SEN
Seychelles	0.2	20	68	77	17	1	16	75	87	14	...	...	1	12	92_{-1}	99_{-1}	16	...	...	SYC
Sierra Leone	6	27	69	52_{-2}	13	44	45	73	76	21	0.57_{i}	...	...	...	...	...	...	0.63_{i}	...	SLE
Somalia	1	24	63_{-2}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	SOM
South Africa	...	...	...	...	...	...	...	...	...	...	2.28_{-1i}	91_{-2i}	188_{-1}	27_{-1}	...	...	...	2.28_{-1i}	91_{-2i}	ZAF
South Sudan	3_{-3}	39_{-3}	29_{-3}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	SSD
Togo	8	26	65	42	-	42	39	76	46	-	1.81_{i}	...	33	26	34	69	...	2.09_{i}	...	TGO
Uganda	28_{-4}	22_{-4}	60_{-4}	40_{-4}	...	207_{-4}	43_{-4}	80_{-4}	71_{-4}	...	...	...	70_{-4}	20_{-4}	...	...	...	...	...	UGA
United Republic of Tanzania	14	98	52_{-4}	79	...	198	57	...	98	0.1	...	...	106_{-1}	...	...	99_{-1}	...	...	...	TZA
Zambia	...	...	...	...	...	78_{-4}	42_{-4}	99_{-4}	94_{-4}	...	...	...	...	...	...	...	...	...	...	ZMB
Zimbabwe	18	37	74	78	...	80	36	98	99	...	...	...	...	...	...	...	...	...	...	ZWE

TABLE 7: Continued

Country or territory	Pre-primary					Primary							Secondary							Country code
	A	B	C	D	E	A	B	C	D	E	F	G	A	B	C	D	E	F	G	
	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	
SDG indicator			4.c.1	4.c.3	4.c.6			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7	
Reference year	2021					2021							2021							
Northern Africa and Western Asia																				
Algeria	20_{+1}	27_{+1}	95_{+1}	…	-	207_{+1}	24_{+1}	96_{+1}	100_{-1}	$-_{+1}$	…	…	…	…	…	…	…	…	…	DZA
Armenia	8	5	75	100	9_{i}	8	19	74	100	4	…	54_{-2i}	24	11	75	100	…	…	…	ARM
Azerbaijan	11	19	91	95	…	40	16	100	100	2	…	71_{-2i}	120	8	99	100	…	…	…	AZE
Bahrain	3_{-1}	14_{-1}	100_{-1}	100_{-1}	5_{-2}	9_{-1}	…	100_{-1}	100_{-1}	9_{-2}	…	92_{-2i}	10_{-1}	…	100_{-1}	100_{-1}	7_{-2}	…	95_{-2i}	BHR
Cyprus	2_{-1}	13_{-1}	…	…	…	5_{-1}	12_{-1}	…	…	…	…	85_{-2i}	7_{-1}	8_{-1}	…	…	…	…	97_{-2i}	CYP
Egypt	60_{-2}	25_{-2}	83_{-2}	100_{-2}	…	531_{-2}	25_{-2}	85_{-2}	100_{-2}	3_{-2}	…	…	594_{-2}	16_{-2}	83_{-2}	100_{-2}	3_{-2}	…	87_{-2i}	EGY
Georgia	…	…	…	…	…	33	10	…	…	5	…	91_{-2i}	43_{-1}	…	…	…	…	…	95_{-2i}	GEO
Iraq	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	IRQ
Israel	…	…	…	…	…	82_{-1}	12_{-1}	…	…	…	0.65	…	…	…	…	…	…	0.66	89_{-2i}	ISR
Jordan	8	16	100	100	12	61	18	100	100	7	…	…	61	15	100	100	7	…	74_{-2i}	JOR
Kuwait	9	7	100	92_{-1}	…	33	8	100	75_{-1}	…	…	94_{-2i}	47	…	100	…	…	…	96_{-2i}	KWT
Lebanon	13	14	23	77	16	37	14	23	77	14	…	…	…	…	…	…	…	…	85_{-2i}	LBN
Libya	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	LBY
Morocco	…	…	…	…	…	172	27	100	100	2	…	46_{-2i}	148	21	100	100	5	…	71_{-2i}	MAR
Oman	4	12	100	100	38	25	12	100	100	…	…	94_{-2i}	39	12	100	100	…	…	89_{-2i}	OMN
Palestine	7	21	100_{-1}	38	47	24	21	100	66	5	1.66_{i}	…	48	17	100	55	5	1.66_{i}	…	PSE
Qatar	3	13	100	100	7	13	12	100	100	7	…	94_{-2i}	10	13	100	100	8	…	96_{-2i}	QAT
Saudi Arabia	25	13	100	100	…	240	15	100	100	…	…	89_{-2i}	238	13	100	100	…	…	93_{-2i}	SAU
Sudan	38_{-3}	29_{-3}	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SDN
Syrian Arab Republic	6_{+1}	24_{+1}	9_{+1}	57_{+1}	3	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SYR
Tunisia	…	…	…	…	…	79	17	100_{-1}	100_{-1}	…	…	…	88	…	100_{-1}	100_{-1}	…	…	…	TUN
Türkiye	99_{-1}	16_{-1}	…	…	…	309_{-1}	17_{-1}	…	…	…	1.08_{-1}	53_{-2i}	752_{-1}	15_{-1}	…	…	…	1.12_{-1}	61_{-2i}	TUR
United Arab Emirates	11_{+1}	20_{+1}	100_{+1}	100_{+1}	…	24_{+1}	19_{+1}	100_{+1}	100_{+1}	…	…	94_{-2i}	90_{+1}	8_{+1}	100_{+1}	100_{+1}	…	…	96_{-2i}	ARE
Yemen	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	YEM
Central and Southern Asia																				
Afghanistan	…	…	…	…	…	136_{-2}	50_{-2}	…	83_{-2}	…	…	…	92_{-3}	33_{-3}	…	79_{-3}	…	…	…	AFG
Bangladesh	…	…	…	…	…	359	47	50_{-4}	100	…	…	…	484	33	62	100	1_{-4}	…	…	BGD
Bhutan	1_{-1}	…	100_{-1}	100_{-1}	…	3	29	100	100	1	…	…	7_{-3i}	11_{-3i}	100_{-3i}	100_{-3i}	…	…	…	BTN
India	$2,972_{+1}$	9_{+1}	95_{+1}	99_{+1}	1_{+1}	$4,656_{+1}$	28_{+1}	89_{+1}	94_{+1}	2_{+1}	…	…	$6,679_{+1}$	21_{+1}	90_{+1}	91_{+1}	2_{+1}	…	…	IND
Iran, Islamic Republic of	…	…	…	…	…	286_{-4}	…	100_{-4}	100_{-4}	…	…	87_{-2i}	299_{-4}	…	98_{-4}	100_{-4}	…	…	86_{-2i}	IRN
Kazakhstan	…	…	…	…	…	90_{-1}	17_{-1}	100_{-1}	100_{-1}	7_{-4}	…	80_{-2i}	244_{-1}	8_{-1}	100_{-1}	100_{-1}	…	…	94_{-2i}	KAZ
Kyrgyzstan	11_{-3}	…	…	100_{-3}	…	23	25	95_{-4}	…	…	…	…	62	12	75_{-4}	…	…	…	…	KGZ
Maldives	1_{-2}	…	66_{-2}	19_{-2}	8_{-4}	5_{-2}	…	89_{-2}	44_{-2}	0.4_{-4}	…	…	4_{-2}	5_{-2}	94_{-2}	75_{-2}	…	…	…	MDV
Nepal	46_{+1}	22_{+1}	82	88	$-_{-4}$	153_{+1}	23_{+1}	97	97	3_{-1}	…	…	175	…	57	61	6_{-1}	…	…	NPL
Pakistan	…	…	…	…	…	493_{-2}	48_{-2}	77_{-2}	62_{-4}	…	…	62_{-2i}	655_{-3i}	…	…	…	…	…	…	PAK
Sri Lanka	38_{-1}	…	82_{-1}	86_{-2}	…	78_{-1}	22_{-1}	83_{-1}	84_{-1}	1_{-4}	0.87_{-1i}	…	154_{-1}	…	81_{-1}	82_{-1}	…	0.87_{-1i}	…	LKA
Tajikistan	8_{-4}	11_{-4}	…	57_{-4}	…	35_{-4}	22_{-4}	100_{-4}	97_{-4}	…	…	…	…	…	…	…	…	…	…	TJK
Turkmenistan	…	…	…	…	…	23	26	100	100	…	…	…	80	10	100	100	…	…	…	TKM
Uzbekistan	117	10	100	100	…	123	20	100	100	…	…	…	390	10	100	100	…	…	…	UZB
Eastern and South-eastern Asia																				
Brunei Darussalam	1_{-1}	18_{-1}	58_{-1}	54_{-1}	20_{-1}	4_{-1}	9_{-1}	85_{-1}	100_{-1}	4_{-2}	…	…	6_{-1}	7_{-1}	87_{-1}	92_{-1}	3_{-2}	…	…	BRN
Cambodia	43	8	100	100_{-1}	…	163	13	100	100_{-1}	…	…	…	107	10	100	…	…	…	…	KHM
China	3,112	15	…	92	8	6,683	16	…	96	4	…	…	6,839	13	…	94	2	…	…	CHN
DPR Korea	…	…	…	…	…	74_{-3}	20_{-3}	…	100_{-3}	…	…	…	124_{-3}	…	…	100_{-3}	…	…	…	PRK
Hong Kong, China	14	12	97	100	6	29	13	96	100	3	…	92_{-2i}	32	11	95	100	3	…	92_{-2i}	HKG
Indonesia	466_{-3i}	13_{-3i}	…	60_{-3i}	…	$1,580_{-1}$	16_{-1}	…	91_{-1}	…	…	…	$1,313_{-1}$	…	…	92_{-1}	…	…	…	IDN
Japan	100_{-1}	29_{-1}	…	…	…	436_{-1}	15_{-1}	…	…	…	…	67_{-2i}	634_{-1}	11_{-1}	…	…	…	…	81_{-2i}	JPN
Lao PDR	12	19	95	42_{-3}	4	34	22	99	90_{-3}	5	…	…	37	17	100	81_{-4}	5	…	…	LAO
Macao, China	1	13	100	100	3	3	13	99	100	0.4	…	…	3	10	93	100	1	…	99_{-3i}	MAC
Malaysia	68	13	37	100	6_{-3i}	267	12	97	100	5_{-2}	0.91_{i}	…	232	11	90	98	2_{-1}	0.91_{i}	94_{-2i}	MYS
Mongolia	9	28	96_{-2}	94	6	11	32	89_{-2}	100	1	…	…	22_{-2}	…	87_{-2}	94_{-2}	5_{-2}	…	…	MNG
Myanmar	10_{-3}	15_{-3}	81_{-3}	100_{-3}	…	218_{-3}	24_{-3}	95_{-3}	91_{-3}	12_{-3}	0.94_{-3i}	…	154_{-3}	27_{-3}	89_{-3}	97_{-3}	…	1.03_{-3i}	…	MMR
Philippines	79_{-1}	…	100_{-1}	100_{-1}	4_{-2}	525_{-1}	…	100_{-1}	99_{-1}	4_{-2}	1.09_{-1i}	85_{-2i}	475_{-1}	…	100_{-1}	100_{-1}	2_{-2}	1.09_{-1i}	…	PHL
Republic of Korea	96_{-1}	12_{-1}	100_{-1}	100_{-1}	…	166_{-1}	16_{-1}	100_{-1}	100_{-1}	…	1.22	78_{-2i}	227_{-1}	12_{-1}	100_{-1}	100_{-1}	…	1.20	91_{-2i}	KOR
Singapore	…	…	…	…	…	17_{-1}	14_{-1}	98_{-1}	100_{-1}	…	1.48_{-1i}	96_{-2i}	14_{-1}	11_{-1}	98_{-1}	100_{-1}	…	1.48_{-1i}	97_{-2i}	SGP
Thailand	182_{+1}	9_{+1}	100_{+1}	100_{+1}	…	339_{+1}	14_{+1}	100_{+1}	100_{+1}	…	…	…	229_{+1}	22_{+1}	100_{+1}	100_{+1}	…	…	…	THA
Timor-Leste	1_{-1}	35_{-1}	…	33_{-1}	…	8_{-1}	26_{-1}	…	76_{-1}	…	…	…	6_{-1}	26_{-1}	…	85_{-1}	…	…	…	TLS
Viet Nam	281	15	82	82	…	385	23	70	70	1	…	96_{-3}	…	…	…	…	…	…	97_{-3}	VNM

TABLE 7: Continued

Country or territory	Pre-primary					Primary							Secondary							Country code
	A	B	C	D	E	A	B	C	D	E	F	G	A	B	C	D	E	F	G	
	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	Country code
SDG indicator			4.c.1	4.c.3	4.c.6			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7	
Reference year	2021					2021							2021							
Oceania																				
Australia	…	…	…	…	…	…	…	…	…	…	1.08	84$_{-2i}$	…	…	…	…	…	1.08	91$_{-2i}$	AUS
Cook Islands	-	22	90	90	26$_{-1}$	0.1	15	97	97	…	…	…	0.1	17	98	98	…	…	…	COK
Fiji	1	13	95	94$_{-1}$	…	6	19	50	47	7$_{-1}$	…	…	…	…	…	…	…	…	…	FJI
Kiribati	1$_{-1}$	11$_{-1}$	94$_{-1}$	…	…	1$_{-1}$	26$_{-1}$	90$_{-1}$	87$_{-1}$	…	…	…	…	…	…	…	…	…	…	KIR
Marshall Islands	…	…	…	…	…	1	13	51	68	…	…	…	1$_{-1}$	…	55$_{-1}$	66$_{-1}$	…	…	…	MHL
Micronesia, F. S.	0.1	3	26	94	3$_{-2}$	1	20	38	90	2$_{-1}$	…	…	1	…	31	92	11	…	…	FSM
Nauru	-$_{-1}$	20$_{-1}$	…	92$_{-2}$	…	0.1$_{-1}$	23$_{-1}$	…	96$_{-2}$	…	…	…	-$_{-1}$	…	…	100$_{-2}$	…	…	…	NRU
New Zealand	15$_{-1}$	7$_{-1}$	…	…	…	27$_{-1}$	15$_{-1}$	…	…	…	0.99$_{-1}$	82$_{-2i}$	36$_{-1}$	15$_{-1}$	…	…	…	0.98$_{-1}$	87$_{-2i}$	NZL
Niue	-	23	100	100	…	-	18	100	100	…	…	…	-$_{-1}$	…	…	…	…	…	…	NIU
Palau	…	…	…	…	…	…	…	100	100	…	…	…	…	…	…	…	…	…	…	PLW
Papua New Guinea	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	PNG
Samoa	0.4	10	100$_{-3}$	100	…	1$_{-2}$	…	…	79$_{-2}$	…	1.09$_{-1i}$	…	…	…	…	…	…	1.09$_{-1i}$	…	WSM
Solomon Is	2$_{-2}$	29$_{-2}$	…	26$_{-4}$	11$_{-2}$	4$_{-2}$	25$_{-2}$	82$_{-2}$	82$_{-2}$	1$_{-2}$	…	…	2$_{-3}$	…	88$_{-3}$	93$_{-3}$	…	…	…	SLB
Tokelau	-	6	83	100	-	-	9	57	86	-	…	…	-	8	21	86	-	…	…	TKL
Tonga	0.2$_{-1}$	13$_{-1}$	53$_{-1}$	49$_{-1}$	…	1$_{-1}$	22$_{-1}$	94$_{-1}$	100$_{-1}$	…	…	…	…	…	…	…	…	…	…	TON
Tuvalu	0.1	10	100	100	9$_{-1}$	0.1	11	62	100	…	…	…	0.1	18	56	99	2	…	…	TUV
Vanuatu	1	13	100	100	…	2	27	100	100	…	…	…	1	25	100	100	…	…	…	VUT
Latin America and the Caribbean																				
Anguilla	-$_{-2}$	32$_{-2}$	…	…	…	0.2$_{-2}$	10$_{-2}$	…	…	…	…	…	0.1$_{-2}$	9$_{-2}$	…	…	…	…	…	AIA
Antigua and Barbuda	…	…	…	…	…	1$_{-3}$	…	53$_{-3}$	100$_{-3}$	…	…	…	1$_{-3}$	9$_{-3}$	48$_{-3}$	98$_{-3}$	…	…	…	ATG
Argentina	…	…	…	…	…	290$_{-2}$	…	…	…	…	0.99$_{-2i}$	…	…	…	…	…	…	0.79$_{-2i}$	…	ARG
Aruba	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	ABW
Bahamas	0.2$_{-2}$	20$_{-2}$	78$_{-2}$	78$_{-2}$	…	1$_{-2}$	20$_{-2}$	93$_{-2}$	93$_{-2}$	…	…	…	2$_{-2}$	11$_{-2}$	85$_{-2}$	85$_{-2}$	…	…	…	BHS
Barbados	0.4	13	70	100	…	2	12	76	100	…	1.08$_{i}$	…	1	16	51	100	…	1.08$_{i}$	…	BRB
Belize	0.4$_{+1}$	…	71$_{+1}$	32	…	3$_{+1}$	13$_{+1}$	88$_{+1}$	13	…	1.14$_{-1i}$	…	3	16	71	29	…	…	…	BLZ
Bolivia, P. S.	12	30	86	14	11	77	18	88	11	5	1.23$_{-1i}$	…	68	19	89	11	5	1.40$_{-1i}$	…	BOL
Brazil	319$_{-1}$	16$_{-1}$	82$_{-1}$	…	…	775$_{-1}$	20$_{-1}$	92$_{-1}$	…	…	…	…	1,358$_{-1}$	16$_{-1}$	80$_{-1}$	…	…	…	87$_{-3}$	BRA
British Virgin Islands	0.1$_{-1}$	…	49$_{-1}$	49$_{-1}$	…	0.3	9	85	84	3	…	…	0.3	9	68	94	…	…	…	VGB
Cayman Islands	0.1$_{-1}$	12$_{-1}$	100$_{-1}$	40$_{-1}$	…	0.3$_{-1}$	…	100$_{-1}$	100$_{-1}$	…	…	…	0.3$_{-1}$	10$_{-1}$	100$_{-1}$	100$_{-1}$	…	…	…	CYM
Chile	25$_{-1}$	25$_{-1}$	…	99$_{-4}$	…	90$_{-1}$	17$_{-1}$	…	…	…	0.77$_{-1}$	75$_{-2i}$	87$_{-1}$	18$_{-1}$	…	100$_{-4}$	…	0.77$_{-1}$	73$_{-2i}$	CHL
Colombia	43	45	88	88	9	180	23	94	94	2	2.14	…	188	26	97	97	4	2.14	91$_{-3}$	COL
Costa Rica	11	12	90$_{-1}$	97$_{-1}$	2$_{-1}$	25	18	94$_{-1}$	98$_{-1}$	10$_{-1}$	1.04	…	40$_{-1}$	13$_{-1}$	97$_{-1}$	99$_{-1}$	6$_{-1}$	1.07	…	CRI
Cuba	…	…	…	…	…	88	9	100	74	1$_{-2}$	…	…	86	8	100	76	3$_{-2}$	…	…	CUB
Curaçao	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	CUW
Dominica	0.2	6	28$_{-1}$	-	2	1	11	62	63	…	…	…	0.5	10	47	63	3	…	…	DMA
Dominican Republic	11	18	100	100	39	60	19	100	100	8	1.59$_{i}$	…	64	14	100	100	…	1.59$_{i}$	96$_{-3i}$	DOM
Ecuador	28	21	92	93	7	76	24	89	93	5	1.61$_{-1i}$	…	90	21	75	95	5	1.61$_{-1i}$	…	ECU
El Salvador	8$_{-3}$	…	95$_{-3}$	100$_{-3}$	4$_{-3}$	25$_{-3}$	…	95$_{-3}$	100$_{-3}$	9$_{-4}$	1.26$_{-3i}$	…	19$_{-3}$	…	92$_{-3}$	100$_{-3}$	4$_{-3}$	1.26$_{-3i}$	…	SLV
Grenada	0.3$_{-3}$	…	38$_{-3}$	…	3$_{-3}$	1$_{-1}$	…	63$_{-3}$	100$_{-3}$	7$_{-3}$	…	…	1$_{-1}$	12$_{-1}$	39$_{-1}$	100$_{-3}$	7$_{-3}$	…	…	GRD
Guatemala	41	15	…	…	…	114	21	…	…	…	…	…	114	10	…	…	…	…	…	GTM
Guyana	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	GUY
Haiti	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	HTI
Honduras	11	19	…	18	…	44	24	…	73	…	…	…	50	12	…	91	…	…	…	HND
Jamaica	8	12	100	100	23$_{-1}$	10	21	100	100	4$_{-1}$	…	…	11	18	100$_{-1}$	81	6$_{-1}$	…	…	JAM
Mexico	236$_{-1}$	20$_{-1}$	80$_{-1}$	…	…	573$_{-1}$	24$_{-1}$	90$_{-1}$	…	…	1.04	…	857$_{-1}$	16$_{-1}$	87$_{-1}$	…	…	1.30	89$_{-3}$	MEX
Montserrat	-$_{-2}$	6$_{-2}$	69$_{-2}$	100$_{-2}$	-$_{-3}$	-$_{-2}$	15$_{-2}$	76$_{-2}$	100$_{-2}$	10$_{-3}$	…	…	-$_{-2}$	9$_{-2}$	46$_{-2}$	100$_{-2}$	-$_{-3}$	…	…	MSR
Nicaragua	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	NIC
Panama	5	18	100$_{-4}$	…	…	22	21	99$_{-4}$	90$_{-4}$	…	…	…	24$_{-4}$	…	…	84$_{-4}$	…	…	96$_{-3i}$	PAN
Paraguay	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	PRY
Peru	81	20	…	…	…	213	18	…	81	…	…	…	211	14	…	64	…	…	96$_{-3i}$	PER
Saint Kitts and Nevis	0.1	10	…	…	…	0.4	13	68	32	…	…	…	1	8	…	…	…	…	…	KNA
Saint Lucia	1$_{-3}$	…	90$_{-3}$	…	…	1$_{-1}$	14$_{-1}$	86$_{-1}$	100$_{-2}$	…	…	…	1$_{-1}$	11$_{-1}$	71$_{-1}$	98$_{-2}$	…	…	…	LCA
Saint Vincent/Grenadines	0.4$_{-3}$	…	…	…	…	1$_{-1}$	14$_{-1}$	83$_{-1}$	27$_{-3}$	…	…	…	1$_{-1}$	…	62$_{-1}$	54$_{-3}$	…	…	…	VCT
Sint Maarten	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	SXM
Suriname	1	17	100	99	7$_{-1}$	5	12	100	99	…	…	…	4	12	…	…	…	…	…	SUR
Trinidad and Tobago	2	11	75$_{-1}$	100	2$_{-1}$	8	16	82$_{-1}$	100	…	…	…	7	12	91$_{-1}$	100	…	…	…	TTO
Turks and Caicos Islands	-	20	77	40	…	0.2	15	92	70	24	…	…	0.2	10	97	91	10	…	…	TCA
Uruguay	…	…	…	…	…	26$_{-1}$	11$_{-1}$	100$_{-1}$	100$_{-1}$	…	0.84$_{-1i}$	…	23$_{-1}$	15$_{-1}$	70$_{-1}$	…	…	0.84$_{-1i}$	…	URY
Venezuela, B. R.	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	VEN

TABLE 7: Continued

Country or territory	Pre-primary					Primary							Secondary							Country code
	A	B	C	D	E	A	B	C	D	E	F	G	A	B	C	D	E	F	G	
	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	Classroom teachers (000)	Pupil/teacher ratio	% of trained classroom teachers	% of qualified classroom teachers	Teacher attrition rate (%)	Relative teacher salary level	% receiving in-service training	
SDG indicator			4.c.1	4.c.3	4.c.6			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7			4.c.1	4.c.3	4.c.6	4.c.5	4.c.7	
Reference year	2021					2021							2021							
Europe and Northern America																				
Albania	5	14	53	68	1	10	16	62	80	5	0.88_{i}	81_{-2i}	23	10	67	57	8	0.93_{i}	98_{-3i}	ALB
Andorra	0.2	12	100	100	6	0.4	10	100	100	3	...	...	1	8	100	100	5	...	...	AND
Austria	24_{-1}	11_{-1}	...	...	...	32_{-1}	11_{-1}	...	...	...	0.65	85_{-2i}	74_{-1}	9_{-1}	...	...	...	0.68	99_{-3}	AUT
Belarus	45	8	95	54	1	22	20	99	100	2	...	...	74	9	97	100	...	...	...	BLR
Belgium	37_{-1}	12_{-1}	...	...	...	75_{-1}	11_{-1}	...	...	...	...	73_{-2i}	135_{-1}	9_{-1}	...	...	...	...	94_{-3}	BEL
Bermuda	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	BMU
Bosnia and Herzegovina	2	11	...	...	...	9	16	...	...	...	...	47_{-2i}	28	8	...	...	...	...	...	BIH
Bulgaria	19_{-1}	12_{-1}	...	...	...	22_{-1}	11_{-1}	...	...	...	...	56_{-2i}	40_{-1}	12_{-1}	...	...	...	...	96_{-3}	BGR
Canada	...	...	...	...	...	...	...	...	...	...	1.18	81_{-2i}	...	...	...	...	...	1.18	...	CAN
Croatia	10_{-1}	11_{-1}	...	...	...	13_{-1}	12_{-1}	...	...	...	...	87_{-2i}	53_{-1}	6_{-1}	...	...	...	...	98_{-3}	HRV
Czechia	...	...	...	...	...	...	...	...	...	...	0.58_{-1}	83_{-2i}	...	...	...	...	...	0.58_{-1}	97_{-3}	CZE
Denmark	19_{-1}	9_{-1}	...	...	...	45_{-1}	10_{-1}	...	...	...	0.77	64_{-2i}	53_{-1}	10_{-1}	...	...	...	0.78	94_{-3}	DNK
Estonia	...	...	...	...	...	8_{-1}	11_{-1}	...	...	...	...	...	9_{-1}	10_{-1}	...	...	...	...	98_{-3}	EST
Finland	21_{-1}	10_{-1}	...	...	...	28_{-1}	13_{-1}	...	...	...	0.70	43_{-2i}	41_{-1}	13_{-1}	...	...	...	0.75	71_{-2i}	FIN
France	117_{-2}	...	...	...	...	247_{-2}	...	...	...	...	0.70_{-1}	73_{-2i}	458_{-2}	...	...	...	...	0.72_{-1}	87_{-2i}	FRA
Germany	335_{-1}	7_{-1}	...	...	...	257_{-1}	12_{-1}	...	...	...	0.91	65_{-2i}	596_{-1}	12_{-1}	...	...	...	0.99	97_{-3i}	DEU
Greece	17_{-1}	10_{-1}	...	...	...	76_{-1}	8_{-1}	...	...	...	0.73	...	80_{-1}	8_{-1}	...	...	...	0.70	...	GRC
Hungary	26_{-1}	12_{-1}	...	...	...	38_{-1}	10_{-1}	...	...	...	0.48	58_{-2i}	77_{-1}	10_{-1}	...	...	...	0.48	64_{-2i}	HUN
Iceland	3_{-1}	4_{-1}	...	...	...	3_{-1}	10_{-1}	...	...	...	...	...	...	...	...	...	...	...	96_{-3}	ISL
Ireland	...	...	...	...	...	...	...	...	...	...	1.06	76_{-2i}	...	...	...	...	...	1.07	97_{-2i}	IRL
Italy	129_{-1}	11_{-1}	...	...	...	252_{-1}	11_{-1}	...	...	...	0.67	78_{-2i}	471_{-1}	10_{-1}	...	...	...	0.73	84_{-2i}	ITA
Latvia	8_{-1}	11_{-1}	100_{-2}	...	...	10_{-1}	11_{-1}	100_{-2}	...	...	...	82_{-2i}	13_{-1}	9_{-1}	100_{-2}	...	...	...	99_{-3}	LVA
Liechtenstein	0.1	7	...	...	...	0.3	7	...	...	...	...	...	0.3	10	...	...	...	...	...	LIE
Lithuania	12_{-1}	9_{-1}	83_{-1}	83_{-1}	...	9_{-1}	14_{-1}	91_{-1}	91_{-1}	...	1.12	89_{-2i}	28_{-1}	8_{-1}	95_{-1}	95_{-1}	...	1.12	96_{-2i}	LTU
Luxembourg	2_{-1}	7_{-1}	...	...	...	5_{-1}	8_{-1}	...	...	...	1.66	...	6_{-1}	8_{-1}	...	...	...	1.78	...	LUX
Malta	1_{-1}	11_{-1}	89_{-1}	...	...	2_{-1}	13_{-1}	80_{-1}	...	...	...	89_{-2i}	5_{-1}	7_{-1}	68_{-1}	...	...	...	91_{-3}	MLT
Monaco	0.1_{+1}	16_{+1}	79_{+1}	87_{+1}	$-_{+1}$	0.2_{+1}	11_{+1}	72_{+1}	88_{+1}	14_{+1}	...	...	0.5_{+1}	7_{+1}	80_{+1}	90_{+1}	7_{+1}	...	...	MCO
Montenegro	...	...	...	...	...	...	...	...	...	...	...	84_{-2i}	...	...	...	...	...	...	...	MNE
Netherlands	32_{-1}	15_{-1}	...	...	...	102_{-1}	11_{-1}	...	...	...	0.83	67_{-2i}	116_{-1}	14_{-1}	...	...	...	0.94	98_{-3}	NLD
North Macedonia	...	...	...	...	...	7_{-1}	15_{-1}	...	...	...	...	60_{-2i}	19_{-1}	8_{-1}	...	...	...	...	...	MKD
Norway	16_{-1}	11_{-1}	...	...	...	51_{-1}	9_{-1}	...	...	...	0.76	57_{-2i}	52_{-1}	9_{-1}	...	...	...	0.76	60_{-2i}	NOR
Poland	116_{-1}	12_{-1}	100_{-2}	...	...	135_{-1}	10_{-1}	100_{-2}	...	...	0.66	90_{-2i}	323_{-1}	10_{-1}	100_{-2}	...	...	0.66	...	POL
Portugal	16_{-1}	16_{-1}	100_{-1}	100_{-1}	...	51_{-1}	12_{-1}	100_{-1}	100_{-1}	...	1.28	74_{-2i}	83_{-2}	...	100_{-1}	100_{-1}	...	1.28	88_{-2i}	PRT
Republic of Moldova	12	11	100	90	...	8	18	100	99	...	...	...	21	11	100	95	...	...	...	MDA
Romania	35_{-1}	15_{-1}	...	97_{-3}	...	47_{-1}	19_{-1}	...	98_{-3}	...	...	...	123_{-1}	12_{-1}	...	98_{-3}	...	...	71_{-2i}	ROU
Russian Federation	670_{-2}	10_{-2}	...	99_{-2}	...	323_{-1}	...	99_{-3i}	99_{-2}	...	...	92_{-2i}	816_{-1}	...	...	99_{-2}	...	...	98_{-2i}	RUS
San Marino	0.1	7	46	54	...	0.2	6	39	61	...	...	...	0.3	6	5	95	...	...	...	SMR
Serbia	15	11	...	100	...	19	14	...	100	...	...	85_{-2i}	67	8	...	100	...	...	...	SRB
Slovakia	15_{-1}	11_{-1}	...	...	...	15_{-1}	16_{-1}	...	...	...	...	62_{-2i}	40_{-1}	11_{-1}	...	...	...	...	92_{-3}	SVK
Slovenia	3_{-1}	19_{-1}	...	...	...	...	...	...	...	...	0.92_{-1}	...	...	...	...	...	...	0.92_{-1}	98_{-3}	SVN
Spain	99_{-1}	13_{-1}	100_{-1}	100_{-1}	...	235_{-1}	13_{-1}	100_{-1}	100_{-1}	...	1.20	79_{-2i}	311_{-1}	11_{-1}	100_{-1}	100_{-1}	...	1.04	92_{-3}	ESP
Sweden	38_{-1}	12_{-1}	...	...	...	71_{-1}	13_{-1}	...	...	...	0.82_{-1}	63_{-2i}	76_{-1}	13_{-1}	...	...	...	0.77_{-1}	77_{-2i}	SWE
Switzerland	15_{-1}	12_{-1}	...	...	...	54_{-1}	10_{-1}	...	...	...	...	...	63_{-1}	10_{-1}	...	...	...	...	...	CHE
Ukraine	...	...	...	...	...	116	15	90	...	...	...	...	314	8	95	...	...	...	...	UKR
United Kingdom	29_{-1}	59_{-1}	...	...	...	281_{-1}	17_{-1}	...	...	...	...	...	355_{-1}	17_{-1}	...	...	...	...	100_{-3i}	GBR
United States	652_{-1}	13_{-1}	100_{-1}	100_{-1}	...	$1,695_{-1}$	14_{-1}	100_{-1}	100_{-1}	...	0.58	93_{-2i}	$1,733_{-1}$	15_{-1}	100_{-1}	100_{-1}	...	0.61	94_{-2i}	USA

Akame Iamis, a 36-year-old teacher at his school in Melong, in the West of Cameroon.

He says: "I'm not familiar with internet. I only use it at my phone. For research. It would be good if we had internet and computers at school. I can then adapt my lessons. It would be more practical, and children can learn and understand better. Coaching for the teachers would be welcome then, because it will be a different way of teaching."*

Credit: UNICEF/UN0668615/Dejongh

Aid tables

INTRODUCTION

Data in the following four tables on official development assistance (ODA) are derived from the International Development Statistics (IDS) database of the Organisation for Economic Co-operation and Development (OECD). The IDS database records information provided annually by all members of the OECD Development Assistance Committee (DAC), as well as a growing number of non-DAC donors. Figures for ODA come from the DAC database, while figures for aid to education come from the Creditor Reporting System (CRS), a database of individual projects. Figures in the DAC and CRS databases are expressed in constant 2021 US dollars. The DAC and CRS databases are available at: www.oecd.org/dac/stats/idsonline.htm.

In 2019, the methodology of defining ODA changed:

- The cash-flow approach, used for Tables 2-4, includes both grants and loans that (a) are undertaken by the official sector; (b) have promotion of economic development and welfare as their main objective; and, for loans, (c) are at concessional financial terms (having a grant element of at least 25%).
- The new grant-equivalent approach, which is used for Table 1, counts only grants and the grant element of concessional loans as ODA.

The DAC glossary of terms and concepts is available at: www.oecd.org/dac/financing-sustainable-development/development-finance-data/dac-glossary.htm.

AID RECIPIENTS AND DONORS

The DAC list of ODA recipients consists of all low- and middle-income countries, based on the World Bank income classification. For further information, see: www.oecd.org/development/financing-sustainable-development/development-finance-standards/historyofdaclistsofaidrecipientcountries.htm.

Bilateral donors are countries that provide development assistance directly to recipient countries. Most are DAC members. Bilateral donors also contribute substantially to the financing of multilateral donors through contributions recorded as multilateral ODA.

Multilateral donors are international institutions with government membership that conduct many or all of their activities supporting development and aid recipient countries. They include multilateral development banks (e.g. World Bank, regional development banks), United Nations agencies and regional agencies.

- *Bilateral flows* refers to bilateral donors contracting with multilateral donors to deliver a programme.
- *Multilateral flows* refers to bilateral donor contributions pooled with other contributions and disbursed at the discretion of the multilateral donor to fund its own programmes and running costs.

For a list of bilateral and multilateral donors, see the 'Donors' worksheet at: https://webfs.oecd.org/oda/DataCollection/Resources/DAC-CRS-CODES.xls

TABLE 1: DEVELOPMENT AND HUMANITARIAN ASSISTANCE

ODA comprises bilateral and multilateral development assistance, both sector allocable and non-allocable (e.g. general budget support, humanitarian aid, debt relief). ODA disbursements are reported as follows:

- Total ODA
  - As volume, in million US dollars
  - As a share of gross national income (GNI)
- Contributions to multilateral donors (a subset of total ODA)
  - As volume, in million US dollars
  - As a share of total ODA disbursements.

Reported humanitarian assistance is a subset of total ODA from the OECD CRS database.

TABLES 2 AND 3: DEVELOPMENT ASSISTANCE TO EDUCATION BY DONOR AND BY RECIPIENT

Direct aid to education is aid reported in the CRS database as direct allocations to the education sector. Four education levels are distinguished:

- *Basic* covers primary education, basic life skills for youth and adults, and early childhood education.
- *Secondary* covers general secondary education and vocational training.
- *Post-secondary* covers tertiary education as well as advanced technical and managerial training.
- *Level unspecified* refers to any activity that cannot be attributed solely to the development of a particular level of education, such as education research and teacher training. General education programme support is often reported in this subcategory.

Total aid to education adds to direct aid a component of general budget support (i.e. aid provided to governments without being earmarked for specific projects or sectors). It is reported as follows:

- *Total aid to education* is direct aid to education plus 20% of general budget support.
- *Total aid to basic education* is direct aid to basic education plus 50% of 'level unspecified' and 10% of general budget support.
- *Total aid to secondary education* is direct aid to secondary education plus 25% of 'level unspecified' and 5% of general budget support.
- *Total aid to post-secondary education* is direct aid to post-secondary education plus 25% of 'level unspecified' and 5% of general budget support.

The *share of education in total ODA* is calculated using total ODA as reported in Table 1.

TABLE 4: DEVELOPMENT ASSISTANCE TO EDUCATION BY DONOR – TOP 3 RECIPIENTS

This table reports the amount and share of bilateral and multilateral donor assistance to education and to basic education allocated to the top 3 recipients of assistance from each donor.

TABLE 1: Development and humanitarian assistance

Donor	OFFICIAL DEVELOPMENT ASSISTANCE (ODA)**** Disbursements																TOTAL HUMANITARIAN ASSISTANCE			
	Total								Of which, contributions to multilaterals											
	Constant 2021 USD millions				As a share of gross national income (%)				Constant 2021 USD millions				As a share of total grant equivalents (%)				Constant 2021 USD millions			
	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022
Australia	3,320	3,301	3,546	3,081	0.21	0.21	0.22	0.19	759	633	478	481	23	19	13	16	203	256	268	336
Austria	1,358	1,347	1,467	1,998	0.28	0.30	0.31	0.39	865	804	783	825	64	60	53	41	28	42	59	115
Belgium	2,400	2,503	2,616	2,799	0.41	0.48	0.43	0.45	1,150	1,266	1,266	1,323	48	51	48	47	203	170	200	182
Canada	5,446	5,841	6,303	7,513	0.27	0.31	0.32	0.37	1,723	1,338	1,372	1,929	32	23	22	26	755	647	668	772
Croatia	79	82	88	124	0.12	0.13	0.13	0.17	57	61	64	64	72	75	73	52	2	1	3	1
Czechia	352	331	366	978	0.13	0.13	0.13	0.36	243	250	278	271	69	76	76	28	19	18	21	15
Denmark	2,855	2,835	2,921	2,967	0.72	0.72	0.71	0.70	877	1,020	908	787	31	36	31	27	383	460	394	390
Estonia*	52	53	60	191	0.16	0.17	0.16	0.54	34	35	35	42	65	67	59	22	3	3	4	4
Finland	1,243	1,360	1,441	1,711	0.42	0.47	0.47	0.58	582	662	739	629	47	49	51	37	53	60	97	84
France	13,435	14,853	15,506	17,444	0.44	0.53	0.51	0.56	5,270	5,235	6,211	6,933	39	35	40	40	102	157	125	84
Germany	26,819	30,701	33,272	37,264	0.61	0.73	0.76	0.83	6,225	7,049	8,496	10,278	23	23	26	28	2,841	2,401	2,098	2,885
Greece	393	345	341	318	0.18	0.17	0.16	0.14	241	255	266	271	61	74	78	85	7	5	4	3
Hungary*	338	451	435	428	0.21	0.27	0.28	0.28	166	207	182	107	49	46	42	25	8	11	8	5
Iceland	65	65	71	93	0.25	0.27	0.28	0.34	11	13	13	22	16	20	19	23	7	5	5	8
Ireland	1,028	1,030	1,155	2,600	0.32	0.31	0.30	0.64	428	486	533	623	42	47	46	24	129	127	128	152
Italy	4,761	4,433	6,085	7,046	0.22	0.22	0.29	0.32	3,211	3,224	3,783	3,591	67	73	62	51	242	167	180	223
Japan	15,491	15,678	17,634	20,977	0.29	0.31	0.34	0.39	3,771	2,969	3,918	3,127	24	19	22	15	588	485	410	771
Kuwait*	431	413	443	265	0.25	0.28	0.29	0.15	1	34	31	65	0	8	7	25	…	…	39	24
Lithuania*	77	80	86	191	0.13	0.13	0.14	0.29	64	66	67	78	82	83	78	41	2	2	2	2
Luxembourg	553	498	539	563	1.03	1.03	0.99	1.00	129	161	175	165	23	32	32	29	69	71	67	67
Netherlands	5,840	5,700	5,288	6,880	0.59	0.59	0.52	0.67	2,060	1,772	1,498	2,479	35	31	28	36	312	229	364	300
New Zealand**	626	594	685	568	0.28	0.26	0.28	0.23	112	108	106	104	18	18	15	18	42	38	31	37
Norway	4,960	5,374	4,673	4,784	1.03	1.11	0.93	0.86	1,134	1,382	1,182	966	23	26	25	20	542	604	603	534
Poland	846	880	984	3,498	0.14	0.14	0.15	0.51	603	641	687	848	71	73	70	24	38	20	39	24
Portugal	448	435	459	539	0.17	0.18	0.18	0.23	288	267	292	330	64	61	64	61	7	11	6	4
Qatar	621	629	677	849	0.32	0.42	0.38	0.46	45	53	64	0	7	8	10	0	…	110	246	367
Republic of Korea	2,611	2,378	2,873	3,079	0.15	0.14	0.16	0.17	642	527	704	660	25	22	25	21	130	131	135	163
Romania*	278	328	417	426	0.10	0.13	0.15	0.14	208	248	331	321	75	76	79	75	9	10	4	3
Saudi Arabia	2,128	1,936	7,238	6,204	0.24	0.25	1.01	0.74	37	316	490	132	2	16	7	2	867	779	255	427
Slovakia	128	150	155	179	0.11	0.14	0.14	0.15	104	110	119	137	81	74	76	76	0	2	1	1
Slovenia	96	97	116	173	0.17	0.17	0.19	0.27	62	64	70	85	65	67	60	49	2	2	2	3
Spain	3,220	3,171	3,642	4,593	0.21	0.23	0.26	0.30	2,086	2,127	2,188	2,242	65	67	60	49	69	76	118	153
Sweden	6,034	7,024	5,934	6,051	0.96	1.14	0.91	0.90	2,013	3,079	2,015	2,188	33	44	34	36	535	552	609	593
Switzerland	3,379	3,699	3,912	4,540	0.44	0.49	0.50	0.56	806	901	959	823	24	24	25	18	347	358	443	369
Türkiye	10,395	10,475	7,711	8,846	1.15	1.14	0.96	0.79	237	117	83	126	2	1	1	1	8,547	9,084	9,375	6,785
United Arab Emirates*	2,452	1,970	1,483	1,400	0.55	0.52	0.40	0.33	122	26	98	50	5	1	7	4	1,288	588	446	565
United Kingdom**	21,951	19,988	15,712	16,760	0.70	0.70	0.50	0.51	6,980	6,828	5,883	4,365	32	34	37	26	1,939	2,246	2,114	1,022
United States	35,453	37,174	47,805	51,705	0.15	0.17	0.20	0.22	4,411	5,981	9,299	7,783	12	16	19	15	7,531	8,606	8,935	12,224
EU institutions	16,405	20,730	19,054	24,834					388	266	34	18	2	1	0	0	2,031	2,318	2,673	3,058
TOTAL* **	**200,624**	**211,062**	**224,299**	**255,955**	**0.31**	**0.34**	**0.34**	**0.39**	**48,997**	**51,318**	**56,101**	**55,722**	**24**	**24**	**25**	**22**	**29,894**	**30,873**	**31,218**	**32,772**

Source: OECD (2023).

* Not part of the Development Assistance Committee (DAC) but included in its Creditor Reporting System (CRS) database.
** Includes funds disbursed to overseas territories.
*** Includes ODA from other bilaterals and multilaterals not listed above.
**** ODA disbursements and contributions to multilaterals are calculated using a new grant-equivalent methodology.
(…) Data not available.

TABLE 2: Development assistance to education by donor

Donor	TOTAL ODA								DIRECT ODA								SHARE					
	Education		Basic education		Secondary education		Post-secondary education		Education		Basic education		Secondary education		Post-secondary education		Education in sector allocable ODA		Basic education in total ODA to education		Secondary education in total ODA to education	
	Constant 2021 USD millions								Constant 2021 USD millions								%					
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Australia	171	228	80	137	29	51	62	40	168	209	55	89	16	27	50	16	9	9	47	60	17	22
Austria	173	188	4	5	26	21	144	161	173	188	3	4	26	20	143	161	40	39	2	3	15	11
Belgium	117	119	21	23	33	37	62	59	117	119	16	18	31	35	60	57	15	15	18	19	29	31
Canada	349	278	186	165	114	75	49	37	346	276	129	119	85	52	21	14	13	8	53	59	33	27
Croatia	3	2	1	1	0	0	2	1	3	2	0	1	0	0	1	1	18	11	27	43	11	0
Czechia	10	7	1	1	1	1	7	5	10	7	0	0	1	1	7	5	21	12	13	13	11	16
Denmark	117	76	57	42	25	13	35	22	116	76	8	18	0	1	10	10	12	6	49	55	21	16
Estonia*	2	3	0	1	1	1	1	1	2	3	0	0	0	0	1	1	23	20	16	30	28	26
Finland	71	99	40	65	20	21	11	13	71	99	22	45	12	11	2	3	16	22	56	66	29	21
France	1,674	1,527	227	265	327	237	1,120	1,025	1,637	1,502	137	173	282	191	1,075	979	16	14	14	17	20	16
Germany	3,375	3,392	638	557	530	575	2,207	2,260	3,375	3,392	394	273	409	434	2,085	2,118	16	17	19	16	16	17
Greece	0	2	0	0	0	0	0	2	0	2	0	0	0	0	0	2	43	6	0	2	0	0
Hungary*	124	128	7	10	3	2	114	116	124	128	0	7	0	0	111	114	57	53	5	8	3	1
Iceland	6	6	4	4	1	2	1	1	6	6	2	1	0	0	0	0	17	16	64	56	18	24
Ireland	42	44	27	28	7	6	8	10	42	44	23	24	5	4	6	8	14	14	64	64	16	14
Italy	142	215	40	88	21	33	81	94	142	215	18	60	10	19	70	80	16	18	28	41	15	15
Japan	1,036	846	389	312	208	145	440	390	614	571	77	85	52	31	284	276	5	4	38	37	20	17
Kuwait*	22	40	7	20	4	10	11	10	22	40	0	0	0	0	8	0	3	5	31	50	16	25
Lithuania*	4	6	1	1	0	1	3	4	4	6	0	0	0	0	3	4	56	39	19	17	8	12
Luxembourg	43	50	14	16	25	28	4	6	43	50	8	7	23	24	1	2	18	21	32	32	59	56
Netherlands	107	93	53	15	11	6	43	72	107	93	52	15	10	6	42	72	4	3	50	16	10	7
New Zealand**	86	85	19	24	7	13	60	48	74	61	10	6	3	4	55	38	22	17	22	28	9	16
Norway	423	365	332	275	48	44	44	46	420	360	294	241	29	27	24	29	14	14	78	75	11	12
Poland	136	138	1	2	2	1	133	136	136	138	1	1	1	0	133	135	68	53	1	1	1	1
Portugal	63	69	17	17	10	10	36	42	63	69	2	2	3	3	29	34	53	48	26	25	16	15
Qatar	76	130	20	47	8	21	47	62	76	130	5	4	1	0	39	41	29	56	27	36	11	16
Republic of Korea	205	209	52	46	52	62	101	101	205	209	35	31	43	55	92	94	12	10	26	22	25	30
Romania*	65	64	0	0	2	0	62	63	65	64	0	0	2	0	62	63	88	78	0	1	4	0
Saudi Arabia	280	1,350	49	621	36	315	194	414	250	348	20	1	21	5	180	104	18	25	18	46	13	23
Slovakia	3	3	0	0	1	0	2	2	3	3	0	0	1	0	2	2	22	9	8	13	27	15
Slovenia	18	18	0	0	0	0	18	18	18	18	0	0	0	0	18	18	72	48	0	0	0	1
Spain	65	72	27	33	17	21	20	18	65	72	12	17	10	13	12	10	11	7	42	46	27	29
Sweden	160	126	100	77	17	12	43	37	160	126	79	67	7	7	33	32	6	4	62	61	11	10
Switzerland	158	168	64	73	65	69	29	26	157	167	39	47	52	56	17	13	9	8	41	44	41	41
Türkiye	291	420	98	117	45	64	148	239	284	414	16	5	4	8	107	183	33	71	34	28	16	15
United Arab Emirates*	303	91	144	40	74	22	85	29	103	58	5	5	5	4	15	12	21	9	48	44	25	24
United Kingdom**	757	632	350	271	208	144	199	218	757	632	202	133	134	75	124	149	9	10	46	43	28	23
United States	1,382	1,323	1,124	1,062	99	83	158	178	1,336	1,289	1,064	1,018	69	61	128	157	8	8	81	80	7	6
TOTAL bilaterals	**12,069**	**12,625**	**4,201**	**4,466**	**2,080**	**2,149**	**5,788**	**6,010**	**11,300**	**11,199**	**2,734**	**2,523**	**1,347**	**1,177**	**5,055**	**5,038**	**12**	**11**	**35**	**35**	**17**	**17**
African Development Fund	36	102	2	46	20	32	14	24	36	21	0	0	19	9	13	1	1	1	6	45	56	32
Asian Development Bank	304	277	90	65	185	181	29	31	304	277	62	29	171	164	15	13	6	8	30	23	61	65
EU institutions	2,207	1,478	1,016	627	623	469	569	383	1,540	1,052	275	161	253	236	198	150	8	6	46	42	28	32
International Monetary Fund (concessional trust funds)	2,022	844	1,011	422	506	211	506	211	0	0	0	0	0	0	0	0						
UN Relief and Works Agency for Palestine Refugees	502	442	502	442	0	0	0	0	502	442	502	442	0	0	0	0	80	76	100	100	0	0
UNICEF	72	69	47	47	13	12	11	10	72	69	25	26	1	2	0	0	16	18	66	67	18	18
World Bank (International Development Association)	1,770	1,870	762	739	511	664	497	467	1,770	1,870	409	410	335	499	320	303	8	9	43	40	29	35
TOTAL multilaterals* **	**7,186**	**5,217**	**3,568**	**2,443**	**1,940**	**1,622**	**1,678**	**1,152**	**4,380**	**3,859**	**1,333**	**1,108**	**822**	**954**	**560**	**485**	**7**	**7**	**50**	**47**	**27**	**31**
TOTAL	**19,256**	**17,842**	**7,769**	**6,909**	**4,020**	**3,771**	**7,466**	**7,162**	**15,680**	**15,058**	**4,067**	**3,631**	**2,169**	**2,132**	**5,615**	**5,523**	**10**	**10**	**40**	**39**	**21**	**21**

Source: OECD (2023).

* Not part of the Development Assistance Committee (DAC) but included in its Creditor Reporting System (CRS) database.

** Includes funds disbursed to overseas territories.

*** Includes official development assistance (ODA) from other bilaterals and multilaterals not listed above.

TABLE 3: Development assistance to education by recipient

Region	TOTAL ODA								DIRECT ODA								SHARE					
	Education		Basic education		Secondary education		Post-secondary education		Education		Basic education		Secondary education		Post-secondary education		Education in sector allocable ODA		Basic education in total ODA to education		Secondary education in total ODA to education	
	Constant 2021 USD millions								Constant 2021 USD millions								%					
Country	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Sub-Saharan Africa	**5,581**	**4,532**	**2,580**	**2,026**	**1,408**	**1,229**	**1,593**	**1,278**	**3,847**	**3,861**	**1,228**	**1,258**	**731**	**845**	**917**	**893**	**10**	**11**	**43**	**43**	**24**	**26**
Unallocated within the region	112	117	39	66	39	26	34	24	107	112	15	48	27	17	22	14	3	4	35	57	34	23
Angola	28	39	6	13	12	12	9	14	28	35	5	10	12	10	9	13	17	13	23	33	44	30
Benin	113	63	50	22	24	16	40	25	63	62	20	16	9	14	25	22	7	8	44	35	21	26
Botswana	6	6	1	1	3	4	1	1	6	6	1	1	3	3	1	1	6	6	26	23	54	60
Burkina Faso	180	184	82	78	46	46	53	59	120	175	35	57	22	35	30	49	9	13	45	43	25	25
Burundi	23	38	11	18	4	9	7	11	23	22	8	7	3	3	6	6	6	5	48	47	19	23
Cabo Verde	29	17	10	5	10	5	9	7	18	15	1	1	6	3	5	5	14	10	33	31	35	27
Cameroon	223	153	67	39	32	16	123	98	124	141	14	26	6	9	96	91	15	14	30	26	15	10
Central African Republic	50	28	27	12	9	8	13	8	30	20	12	6	2	4	6	4	7	6	54	45	19	28
Chad	105	70	52	29	25	16	28	25	51	48	18	11	8	7	11	15	9	14	50	42	24	23
Comoros	21	25	3	4	3	6	15	14	18	21	1	2	2	5	14	13	17	18	14	17	15	25
Congo	40	33	12	8	4	3	24	22	40	33	11	7	3	2	23	21	20	17	31	25	9	8
Côte d'Ivoire	179	105	68	23	39	36	71	46	91	104	16	13	13	31	45	41	8	7	38	22	22	35
D. R. Congo	231	331	104	216	77	63	50	52	152	230	42	152	46	30	19	20	7	11	45	65	33	19
Djibouti	39	25	19	12	7	4	13	9	23	22	9	8	2	2	8	7	11	15	48	49	18	15
Equat. Guinea	2	2	1	1	1	0	1	1	2	2	1	1	1	0	1	1	28	20	46	64	25	6
Eritrea	4	6	0	1	0	1	3	3	4	5	0	0	0	1	3	2	7	13	8	25	9	24
Eswatini	4	3	2	2	1	1	1	1	4	3	1	1	0	0	1	0	3	2	55	56	16	21
Ethiopia	360	165	196	76	102	54	62	35	320	165	129	64	68	48	29	29	7	6	54	46	28	32
Gabon	41	55	9	18	8	9	24	28	41	55	0	1	4	1	20	20	54	47	21	32	19	17
Gambia	41	31	19	14	6	6	16	12	26	19	8	5	0	1	10	8	10	10	47	43	14	18
Ghana	396	112	169	30	109	36	118	45	157	111	32	19	41	31	50	39	12	8	43	27	28	32
Guinea	105	44	38	15	25	4	42	25	55	44	12	14	11	3	29	24	11	8	36	34	24	9
Guinea-Bissau	23	29	8	11	2	3	14	15	23	24	6	7	1	1	13	12	17	17	33	38	7	12
Kenya	291	168	125	60	79	52	86	57	130	108	24	19	29	32	36	36	4	4	43	35	27	31
Lesotho	7	8	4	4	1	3	2	1	4	8	2	3	0	2	0	0	2	4	57	54	20	30
Liberia	63	57	45	38	8	14	9	5	39	52	32	33	2	12	3	2	7	10	72	67	13	25
Madagascar	163	80	75	42	42	16	46	22	82	58	14	25	12	8	15	14	9	7	46	52	26	20
Malawi	155	111	101	74	28	20	25	17	114	111	68	60	12	13	8	10	9	10	65	67	18	18
Mali	156	111	77	63	35	22	44	26	99	97	39	48	16	14	25	18	9	8	49	57	22	20
Mauritania	67	58	30	26	18	18	19	14	28	33	10	11	8	11	9	6	6	10	45	45	27	32
Mauritius	13	68	1	30	2	16	10	23	13	14	1	2	2	2	10	10	3	17	10	43	17	23
Mozambique	273	180	178	108	56	32	40	39	206	180	116	83	25	20	9	27	10	9	65	60	20	18
Namibia	23	16	15	4	5	8	3	5	23	16	14	2	4	7	3	4	11	7	66	23	20	48
Niger	138	217	74	67	38	121	26	28	89	193	41	24	21	100	10	7	6	15	53	31	27	56
Nigeria	198	380	83	159	43	121	72	101	198	380	62	120	32	101	62	82	6	12	42	42	22	32
Rwanda	357	155	175	63	124	51	58	41	305	145	106	50	89	45	24	35	22	12	49	40	35	33
Sao Tome/Principe	10	13	5	7	3	3	2	2	7	12	2	5	1	2	1	1	9	18	49	59	26	23
Senegal	241	199	92	75	55	49	94	76	177	185	49	56	34	39	72	67	12	14	38	37	23	24
Sierra Leone	116	99	59	54	34	27	23	18	74	80	20	25	14	13	4	3	12	14	51	54	29	28
Somalia	134	87	78	51	30	20	27	16	66	81	34	34	8	12	5	8	4	7	58	59	22	23
South Africa	61	60	20	23	18	17	24	21	61	60	10	11	13	11	19	15	4	4	32	39	29	27
South Sudan	91	113	63	67	16	27	13	19	80	77	41	34	5	11	2	2	11	10	68	59	17	24
Togo	73	37	26	14	18	4	28	19	40	37	7	12	9	3	19	18	9	11	36	37	25	12
Uganda	241	168	90	72	53	40	98	56	134	110	20	24	18	16	63	32	5	5	37	43	22	24
United Republic of Tanzania	265	369	135	168	82	124	48	78	265	251	89	70	59	75	25	29	11	12	51	45	31	33
Zambia	59	64	24	31	21	24	15	9	59	64	17	23	18	20	11	6	5	6	40	48	35	37
Zimbabwe	30	37	11	10	12	19	7	8	30	37	9	7	11	17	6	6	4	5	37	28	40	52
Northern Africa and Western Asia	**3,782**	**5,147**	**1,649**	**2,296**	**597**	**913**	**1,536**	**1,938**	**3,348**	**3,613**	**1,116**	**1,019**	**331**	**274**	**1,269**	**1,299**	**17**	**19**	**37**	**38**	**15**	**16**
Unallocated within the region	60	51	38	33	12	10	11	9	50	48	29	28	8	8	7	7	3	3	62	64	19	19
Algeria	146	146	3	4	6	6	137	136	146	146	1	1	5	5	136	134	55	62	2	3	4	4
Armenia	34	35	9	9	3	4	21	22	28	35	4	3	1	1	19	18	11	10	27	27	9	11
Azerbaijan	39	51	5	8	5	6	30	36	39	51	2	1	3	3	29	32	15	28	12	16	12	13
Egypt	251	1301	62	591	36	298	153	412	251	301	20	19	15	12	132	126	9	7	25	45	14	23
Georgia	91	49	32	12	19	10	40	27	53	46	5	7	6	8	27	25	5	5	35	24	21	20

TABLE 3: continued

Region	TOTAL ODA								DIRECT ODA								SHARE					
	Education		Basic education		Secondary education		Post-secondary education		Education		Basic education		Secondary education		Post-secondary education		Education in sector allocable ODA		Basic education in total ODA to education		Secondary education in total ODA to education	
	Constant 2021 USD millions								Constant 2021 USD millions								%					
Country	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Iraq	100	72	60	33	10	7	29	32	100	72	50	21	5	1	24	26	6	5	60	46	10	10
Jordan	474	719	338	494	49	94	87	131	369	630	263	327	11	10	49	47	15	30	71	69	10	13
Lebanon	287	248	185	149	32	23	69	75	287	248	169	135	24	16	61	68	29	28	65	60	11	9
Libya	16	18	1	3	3	3	12	12	16	18	0	0	3	2	11	11	7	7	6	16	20	16
Morocco	481	432	96	90	141	84	244	258	449	393	44	61	115	70	218	244	16	21	20	21	29	19
Palestine	466	437	370	340	37	39	58	58	449	430	326	303	15	20	36	40	32	38	80	78	8	9
Sudan	243	365	111	172	60	92	72	101	42	45	5	6	7	9	19	18	5	2	46	47	25	25
Syrian Arab Republic	331	316	92	65	17	21	221	231	331	316	76	48	9	12	213	222	43	28	28	21	5	7
Tunisia	183	240	31	57	25	48	127	135	162	169	13	15	16	27	118	114	11	13	17	24	14	20
Türkiye	494	487	177	151	131	132	187	204	494	487	76	12	80	62	136	134	25	22	36	31	26	27
Yemen	87	180	38	84	11	37	38	59	84	180	32	29	8	10	35	31	9	12	44	47	13	21
Central and Southern Asia	**2,628**	**2,354**	**919**	**665**	**545**	**523**	**1,164**	**1,165**	**2,230**	**2,287**	**457**	**366**	**314**	**373**	**933**	**1,016**	**16**	**14**	**29**	**26**	**23**	**23**
Unallocated within the region	13	19	2	6	6	7	5	6	13	19	1	5	6	7	4	6	4	4	12	30	50	37
Afghanistan	327	224	174	135	73	30	80	59	230	192	101	104	36	14	44	44	7	9	53	60	22	13
Bangladesh	546	410	254	107	170	216	122	87	430	410	125	70	105	198	57	69	8	7	47	26	31	53
Bhutan	8	6	3	1	3	3	2	2	8	6	1	0	2	3	1	2	4	4	35	18	36	51
India	481	569	44	44	34	50	402	475	455	562	14	16	19	36	387	461	9	9	9	8	7	9
Iran	132	142	1	2	1	1	130	140	132	142	0	1	0	0	130	139	69	53	1	1	1	0
Kazakhstan	57	53	2	1	2	1	53	52	57	53	0	0	1	1	52	52	55	50	4	1	3	1
Kyrgyzstan	108	84	40	24	18	21	50	39	90	84	14	9	5	14	38	31	21	15	37	28	17	25
Maldives	19	3	8	1	4	0	6	2	3	3	1	1	0	0	2	2	1	2	45	29	22	15
Nepal	313	230	137	127	87	51	89	52	266	230	55	86	46	30	48	32	17	14	44	55	28	22
Pakistan	377	408	176	154	73	88	127	166	376	408	119	41	45	31	99	109	11	11	47	38	19	22
Sri Lanka	65	71	20	21	23	24	22	26	65	71	18	14	22	20	21	22	8	9	31	30	36	34
Tajikistan	91	44	37	15	28	13	27	16	39	44	5	8	12	10	11	12	7	8	40	35	30	30
Turkmenistan	7	5	0	0	2	1	5	4	7	5	0	0	1	0	4	4	20	15	6	5	25	12
Uzbekistan	84	85	20	27	21	18	43	40	57	58	4	11	14	10	35	31	4	5	23	32	25	21
Eastern and South-eastern Asia	**2,138**	**1,491**	**474**	**321**	**534**	**298**	**1,130**	**872**	**1,830**	**1,420**	**140**	**141**	**368**	**208**	**964**	**782**	**15**	**15**	**28**	**27**	**22**	**16**
Unallocated within the region	25	15	9	4	7	2	8	9	25	15	0	3	3	2	3	8	8	4	38	27	29	16
Cambodia	151	157	54	67	60	53	37	38	151	112	22	26	43	32	21	17	10	9	36	43	39	33
China	678	542	24	15	149	110	505	417	678	542	3	2	139	104	495	410	45	47	4	3	22	20
DPR Korea	1	2	0	0	0	0	1	2	1	2	0	0	0	0	1	2	2	20	0	0	1	0
Indonesia	242	137	72	33	38	17	131	87	151	137	11	17	8	8	101	79	5	6	30	24	16	12
Lao PDR	83	107	33	53	31	25	19	29	83	107	25	30	28	13	15	17	14	17	40	50	38	23
Malaysia	33	28	2	2	2	1	29	25	33	28	0	0	1	1	28	24	46	32	6	7	6	5
Mongolia	115	49	38	8	31	7	47	34	70	49	10	5	17	6	33	33	12	13	33	16	27	15
Myanmar	292	81	101	35	133	25	58	21	213	57	22	13	94	14	19	10	9	5	35	44	46	31
Philippines	147	61	70	31	28	5	48	26	56	61	20	26	3	2	23	23	4	3	48	50	19	7
Thailand	40	36	8	5	4	3	28	28	40	36	3	2	2	1	26	27	11	10	20	14	10	8
Timor-Leste	38	34	22	20	7	6	9	8	35	33	13	11	3	1	4	4	15	15	58	59	19	16
Viet Nam	294	240	40	47	43	45	210	149	294	240	9	6	27	24	195	129	12	11	14	19	15	19
Oceania	**387**	**401**	**144**	**163**	**109**	**131**	**134**	**107**	**245**	**246**	**42**	**31**	**57**	**65**	**83**	**41**	**11**	**14**	**38**	**42**	**26**	**30**
Unallocated within the region	51	37	8	11	10	5	33	20	51	37	4	3	8	2	31	17	12	6	16	30	19	15
Fiji	15	57	5	28	3	14	8	15	14	14	2	2	2	1	6	2	8	4	30	48	19	25
Kiribati	10	15	6	6	1	4	4	5	8	14	4	0	0	1	3	2	15	20	57	39	6	28
Marshall Islands	23	22	12	11	5	6	6	5	2	8	1	1	0	1	0	0	2	20	51	48	24	28
Micronesia	25	30	13	15	6	7	6	7	2	10	1	1	0	0	0	0	4	32	52	51	24	24
Nauru	2	2	0	1	1	1	1	0	2	1	0	0	1	0	1	0	6	3	13	34	49	38
Niue	3	4	1	2	1	1	1	1	1	1	0	0	0	0	0	0	4	5	47	49	23	22
Palau	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	2	53	63	18	14
Papua New Guinea	108	81	48	42	26	19	35	20	30	26	5	8	4	2	13	3	4	3	44	52	24	23
Samoa	20	18	8	7	3	3	10	7	14	14	1	2	0	1	7	5	9	20	37	41	16	19
Solomon Islands	24	32	14	18	1	7	9	7	21	26	12	9	0	3	8	3	10	11	59	56	5	22
Tokelau	4	3	1	1	1	1	1	1	1	1	0	0	1	1	0	0	18	13	41	40	39	40
Tonga	13	13	2	3	7	6	4	4	12	8	2	1	6	5	4	2	8	10	19	26	51	47

TABLE 3: continued

Region	TOTAL ODA								DIRECT ODA								SHARE					
	Education		Basic education		Secondary education		Post-secondary education		Education		Basic education		Secondary education		Post-secondary education		Education in sector allocable ODA		Basic education in total ODA to education		Secondary education in total ODA to education	
	Constant 2021 USD millions								Constant 2021 USD millions								%					
Country	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
Tuvalu	3	4	1	2	0	1	2	2	2	4	0	1	0	0	2	1	6	11	24	47	12	17
Vanuatu	25	32	7	10	7	12	11	10	24	30	2	1	4	8	8	5	17	22	30	30	27	39
Latin America and the Caribbean	**934**	**783**	**323**	**268**	**221**	**154**	**391**	**360**	**837**	**771**	**189**	**181**	**154**	**110**	**324**	**317**	**8**	**7**	**34**	**31**	**24**	**24**
Unallocated within the region	12	27	5	4	3	3	4	20	12	27	4	3	3	3	3	19	1	3	42	15	27	12
Antigua/Barbuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	0	35	40
Argentina	31	17	8	3	4	2	19	12	31	17	2	2	1	1	16	12	25	9	25	17	14	10
Belize	1	2	0	0	1	1	0	0	1	2	0	0	0	1	0	0	3	4	34	17	37	67
Bolivia	28	29	8	9	9	9	11	11	28	29	3	4	7	7	9	9	6	5	27	29	33	32
Brazil	112	95	17	14	9	6	86	76	112	95	3	4	2	1	79	71	12	7	15	14	8	6
Colombia	88	86	20	20	7	9	61	58	88	86	13	12	4	5	57	54	5	5	22	23	8	10
Costa Rica	14	13	5	4	2	2	7	7	14	13	4	3	1	1	6	6	6	9	38	32	16	17
Cuba	9	9	0	1	1	1	8	7	9	9	0	0	0	0	8	6	6	6	4	13	7	10
Dominica	4	1	2	0	1	0	2	1	1	1	0	0	0	0	1	1	3	2	37	4	25	31
Dominican Republic	20	12	9	8	6	1	4	3	20	12	8	8	6	0	3	3	4	2	48	67	32	6
Ecuador	34	34	9	8	6	6	20	20	34	34	5	4	4	4	18	18	10	12	26	23	17	18
El Salvador	67	17	15	9	46	3	6	5	67	17	12	7	45	2	4	4	22	7	22	52	69	20
Grenada	5	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	47	1	28	64
Guatemala	77	57	57	39	13	12	6	6	77	57	53	36	11	11	4	5	12	13	75	68	17	21
Guyana	4	8	2	4	1	2	1	2	4	8	1	2	1	1	1	1	6	5	42	53	32	26
Haiti	98	74	46	41	25	15	27	18	65	73	23	37	13	13	15	16	11	9	47	55	25	20
Honduras	97	95	46	44	38	39	13	12	63	86	25	25	28	30	3	3	6	15	47	46	39	41
Jamaica	5	4	2	2	1	0	2	2	5	4	2	2	1	0	2	2	6	6	44	45	18	9
Mexico	75	66	11	11	9	6	55	49	75	66	4	6	5	3	51	46	8	9	15	17	12	9
Montserrat	3	2	1	1	1	1	1	1	3	2	0	0	0	0	0	0	5	6	49	48	24	24
Nicaragua	58	38	29	16	19	17	10	6	45	38	17	11	13	14	4	4	10	5	50	41	33	44
Panama	4	3	1	1	1	0	2	2	4	3	1	1	1	0	2	2	2	2	36	42	20	2
Paraguay	14	19	5	9	3	4	5	7	14	19	3	3	2	1	4	4	4	8	40	45	24	20
Peru	42	38	11	9	7	6	25	23	42	38	4	4	4	3	21	21	7	10	25	23	17	16
St Lucia	8	6	4	1	2	5	3	1	2	6	0	0	0	4	1	1	7	9	44	10	25	74
St Vincent/Grenad.	6	6	3	3	2	1	2	2	3	3	0	0	0	0	0	0	8	5	49	49	25	24
Suriname	2	1	0	0	0	0	1	1	2	1	0	0	0	0	1	1	9	5	2	2	16	23
Venezuela, B. R.	17	23	4	10	2	2	11	11	17	23	3	8	1	1	11	10	15	20	23	45	10	8
Europe and Northern America	**1,129**	**956**	**342**	**206**	**203**	**186**	**583**	**564**	**673**	**683**	**33**	**41**	**48**	**104**	**429**	**481**	**13**	**13**	**28**	**21**	**17**	**19**
Unallocated within the region	104	142	40	22	24	36	41	83	92	130	13	10	10	31	27	78	6	8	39	16	23	26
Albania	94	126	23	33	15	29	55	64	94	81	4	6	5	16	45	51	24	15	25	26	16	23
Belarus	164	65	55	1	31	2	79	62	58	65	0	0	4	2	52	61	18	41	33	2	19	4
Bosnia and Herzegovina	54	82	6	21	5	12	43	49	53	53	2	4	3	3	41	41	9	9	11	26	9	14
Moldova	114	95	26	16	19	14	70	65	77	77	4	3	8	7	59	59	17	13	23	17	16	14
Montenegro	14	13	4	4	2	2	8	7	7	6	0	0	0	0	6	5	3	3	30	31	14	15
North Macedonia	54	47	18	15	11	10	25	22	27	26	2	3	3	4	17	16	11	9	34	31	21	22
Serbia	73	67	15	6	12	23	46	38	73	67	2	3	6	22	39	36	9	7	20	10	16	35
Ukraine	457	319	155	88	85	58	217	173	192	177	6	11	10	19	142	135	16	12	34	28	18	18
Unspecified by region	2,677	2,177	1,338	963	404	337	936	878	2,670	2,176	861	595	165	152	697	693	9	9	49	47	22	21
Low income	4,131	3,489	2,018	1,671	959	807	1,154	1,011	2,878	2,771	1041	984	471	464	666	668	10	11	46	46	21	22
Lower middle income	8,578	8,307	3,197	3,021	1,907	1,880	3,474	3,407	6,679	6,601	1,530	1,437	1,074	1,087	2,640	2,614	13	14	38	37	24	25
Upper middle income	3,418	3,395	1,053	1,097	608	611	1,757	1,688	3,033	3,062	561	513	362	319	1,512	1,396	13	13	30	28	19	21
High income	6	5	2	2	2	1	3	2	6	4	1	1	2	0	2	2	4	3	16	25	34	27
Unspecified by income	3,123	2,646	1,500	1,119	544	473	1,079	1,054	3,083	2,620	934	696	260	261	796	842	10	9	39	37	30	28
TOTAL	**19,256**	**17,842**	**7,769**	**6,909**	**4,020**	**3,771**	**7,466**	**7,162**	**15,680**	**15,058**	**4,067**	**3,631**	**2,169**	**2,132**	**5,615**	**5,523**	10	10	40	39	21	21

Source: OECD (2023).
Note: The country groupings by level of income are as defined by the World Bank but include only countries shown in the table.
They are based on the list of countries by income group as revised in July 2022.
All data represent gross disbursements.
Sector allocable official development assistance (ODA) does not include budget support.

TABLE 4: Development assistance to education by donor – top 3 recipients, annual average 2019–2021

		EDUCATION			BASIC EDUCATION		
	Donor	Recipient	Constant 2021 USD millions	Recipient %	Recipient	Constant 2021 USD millions	Recipient %
Bilateral	Australia	Oceania, unallocated	25.4	13.1	Unspecified by region	10.3	14.8
		Papua N. Guinea	21.1	10.9	Indonesia	10.2	14.7
		Indonesia	14.4	7.4	Philippines	6.7	9.6
	Austria	Bosnia/Herzeg.	21.3	11.9	Mexico	2.2	68.4
		Türkiye	20.5	11.4	Serbia	0.1	1.8
		Ukraine	13.4	7.5	Pakistan	0.1	1.8
	Belgium	Unspecified by region	28.5	23.5	Unspecified by region	8.5	50.2
		D. R. Congo	16.9	13.9	Viet Nam	1.7	9.8
		Uganda	14.8	12.2	South Africa	1.4	8.1
	Canada	Unspecified by region	47.5	15.1	Unspecified by region	21.6	18.0
		Jordan	18.2	5.8	Burkina Faso	10.7	8.9
		Mozambique	14.6	4.7	Mozambique	7.6	6.3
	Denmark	Unspecified by region	81.5	84.4	Northern Africa and Western Asia, unallocated	3.8	32.2
		Northern Africa and Western Asia, unallocated	3.8	4.0	Myanmar	2.6	22.0
		Myanmar	2.7	2.8	Afghanistan	2.5	21.4
	Estonia	Europe and Northern America, unallocated	0.7	27.5	Belarus	0.0	40.9
		Ukraine	0.5	17.7	Kenya	0.0	28.1
		Georgia	0.4	15.7	Unspecified by region	0.0	24.5
	Finland	Unspecified by region	14.7	19.3	Mozambique	6.9	22.9
		Mozambique	12.5	16.5	Unspecified by region	5.0	16.6
		Nepal	8.0	10.5	Ethiopia	4.4	14.5
	France	Morocco	192.4	12.6	Lebanon	22.8	15.4
		Algeria	128.6	8.4	Madagascar	7.2	4.9
		Unspecified by region	97.4	6.4	Morocco	6.9	4.7
	Germany	China	513.7	15.7	Jordan	50.8	16.1
		Unspecified by region	251.4	7.7	Lebanon	47.8	15.1
		India	240.1	7.3	Iraq	23.9	7.6
	Hungary	Jordan	10.1	8.4	Ukraine	2.2	82.6
		Syrian Arab Republic	9.6	8.0	Serbia	0.2	5.6
		Ukraine	6.5	5.4	Unspecified by region	0.1	1.9
	Iceland	Uganda	4.0	68.5	Malawi	1.1	74.5
		Malawi	1.3	21.8	Afghanistan	0.3	19.3
		Afghanistan	0.3	4.9	Uganda	0.1	3.5
	Ireland	Unspecified by region	14.6	32.7	Unspecified by region	9.9	40.4
		Mozambique	6.9	15.4	Mozambique	6.6	26.8
		Palestine	4.5	10.0	Uganda	1.6	6.7
	Italy	Unspecified by region	33.1	19.7	Jordan	13.5	43.2
		Jordan	14.7	8.7	Senegal	2.4	7.6
		India	10.0	6.0	India	1.6	5.1
	Japan	Unspecified by region	173.9	27.4	Syrian Arab Republic	9.8	10.9
		Egypt	56.1	8.8	Burkina Faso	5.1	5.6
		India	30.4	4.8	Myanmar	5.0	5.5
	Kuwait	Jordan	9.1	29.9			
		Ghana	3.9	12.8			
		Sri Lanka	3.9	12.7			
	Luxembourg	Burkina Faso	10.7	21.2	Niger	2.9	32.6
		Senegal	8.0	15.8	Northern Africa and Western Asia, unallocated	2.1	23.9
		Niger	7.4	14.5	Central African Republic	0.6	7.1
	Netherlands	Unspecified by region	89.6	87.0	Unspecified by region	24.3	85.1
		Ethiopia	2.3	2.3	Burundi	2.1	7.5
		Burkina Faso	2.2	2.2	Burkina Faso	1.0	3.4
	New Zealand	Oceania, unallocated	9.0	12.6	Timor-Leste	3.2	33.2
		Solomon Is	7.2	10.1	Solomon Is	2.5	25.6
		Samoa	6.8	9.6	Oceania, unallocated	1.7	17.9
	Norway	Unspecified by region	189.5	48.3	Unspecified by region	166.1	61.3
		Malawi	24.0	6.1	Malawi	16.6	6.1
		Ethiopia	19.8	5.0	Ethiopia	10.0	3.7
	Poland	Ukraine	57.6	41.1	Ukraine	0.9	78.3
		Belarus	33.6	24.0	Unspecified by region	0.1	5.1
		India	7.5	5.4	Lebanon	0.0	3.4
	Portugal	Timor-Leste	13.3	19.9	S. Tome/Principe	1.4	93.3
		Mozambique	12.7	19.0	Mozambique	0.1	4.8
		Guinea-Bissau	12.1	18.1	Guinea-Bissau	0.0	1.9

TABLE 4: continued

	Donor	EDUCATION			BASIC EDUCATION		
		Recipient	Constant 2021 USD millions	Recipient %	Recipient	Constant 2021 USD millions	Recipient %
	Qatar	Türkiye	8.9	11.6	Syrian Arab Republic	1.7	48.5
		Unspecified by region	7.6	10.0	Albania	1.4	40.0
		Palestine	6.4	8.4	Bangladesh	0.4	10.7
	Rep. of Korea	Uzbekistan	16.2	7.1	Cambodia	3.0	7.4
		Viet Nam	15.3	6.7	Jordan	2.8	6.9
		Myanmar	10.7	4.7	Sri Lanka	2.2	5.5
	Romania	Moldova	49.9	80.3	Moldova	0.0	69.5
		Serbia	2.8	4.6	Georgia	0.0	20.3
		Ukraine	2.0	3.3	North Macedonia	0.0	10.2
	Saudi Arabia	Yemen	65.4	22.4	Yemen	6.3	72.8
		Egypt	44.4	15.2	Morocco	1.6	18.8
		Indonesia	17.0	5.8	Somalia	0.2	2.4
	Slovakia	Serbia	0.9	29.6	Kenya	0.1	28.7
		Kenya	0.6	21.2	Lebanon	0.0	16.8
		Afghanistan	0.2	8.1	Georgia	0.0	12.5
	Slovenia	Bosnia/Herzeg.	5.6	32.9	Gambia	0.0	100.0
		North Macedonia	5.3	30.8			
		Serbia	4.6	26.6			
	Spain	Unspecified by region	5.7	8.6	Haiti	1.6	12.1
		Morocco	6.5	9.7	Northern Africa and Western Asia, unallocated	1.5	11.5
		Haiti	3.1	4.6	Morocco	1.0	7.7
	Sweden	Unspecified by region	37.8	25.3	Unspecified by region	35.5	47.3
		U. R. Tanzania	24.7	16.6	Afghanistan	14.2	18.9
		Afghanistan	20.1	13.5	Sub-Saharan Africa, unallocated	8.8	11.7
	Switzerland	Unspecified by region	36.7	23.3	Unspecified by region	7.5	18.1
		Burkina Faso	8.2	5.2	Burkina Faso	4.4	10.8
		Chad	6.9	4.4	Mali	4.2	10.2
	Türkiye	Unspecified by region	132.2	32.7	Northern Africa and Western Asia, unallocated	4.6	59.3
		Europe and Northern America, unallocated within the region	64.1	15.9	Unspecified by region	0.8	9.9
		Kazakhstan	24.3	6.0	Syrian Arab Republic	0.5	5.9
	U. A. Emirates	Unspecified by region	31.3	38.0	Colombia	1.6	31.7
		Jordan	7.5	9.0	Uganda	0.5	9.0
		Sudan	6.7	8.1	India	0.4	8.0
	United Kingdom	Unspecified by region	359.1	42.2	Unspecified by region	130.4	47.8
		Pakistan	92.7	10.9	Pakistan	36.9	13.5
		Nigeria	29.8	3.5	Lebanon	20.1	7.4
	United States	Unspecified by region	251.6	18.3	Unspecified by region	224.0	21.0
		Jordan	99.4	7.3	Jordan	91.9	8.6
		Afghanistan	86.3	6.3	Afghanistan	48.0	4.5
Multilateral	African Development Fund	Kenya	8.8	19.0	Chad	0.2	100.0
		Uganda	8.7	18.8			
		Ghana	5.2	11.2			
	Asian Development Bank	Bangladesh	146.4	41.8	Bangladesh	69.1	92.5
		Nepal	55.2	15.8	Nepal	4.4	5.8
		Viet Nam	39.7	11.3	Marshall Is	0.6	0.8
	EU institutions	Unspecified by region	353.5	28.8	Unspecified by region	69.4	36.0
		Türkiye	157.9	12.9	Morocco	32.7	16.9
		Morocco	68.9	5.6	Nepal	22.0	11.4
	UN Relief and Works Agency for Palestine Refugees	Palestine	292.5	61.9	Jordan	102.4	21.7
		Jordan	102.4	21.7	Lebanon	50.8	10.7
		Lebanon	50.8	10.7	Palestine	292.5	61.9
	UNICEF	D. R. Congo	7.3	9.6	India	3.2	12.3
		India	6.3	8.2	Ethiopia	1.3	5.2
		Pakistan	4.4	5.8	D. R. Congo	1.1	4.1
	World Bank (International Development Association)	Bangladesh	200.1	11.2	Ethiopia	56.8	14.1
		Pakistan	141.0	7.9	Bangladesh	56.4	14.0
		India	138.4	7.8	Nigeria	40.7	10.1

Source: OECD (2023).

Technology in education:

A TOOL ON WHOSE TERMS?

Technology's role in education has been sparking intense debate for a long time. Does it democratize knowledge or threaten democracy by allowing a select few to control information? Does it offer boundless opportunities or lead towards a technology-dependent future with no return? Does it level the playing field or exacerbate inequality? Should it be used in teaching young children or is there a risk to their development? The debate has been fuelled by the COVID-19 school closures and the emergence of generative artificial intelligence.

But as developers are often a step ahead of decision makers, research on education technology is complex. Robust, impartial evidence is scarce. Are societies even asking the right questions about education before turning to technology as a solution? Are they recognizing its risks as they seek out its benefits?

Information and communication technology has potential to support equity and inclusion in terms of reaching disadvantaged learners and diffusing more knowledge in engaging and affordable formats. In certain contexts, and for some types of learning, it can improve the quality of teaching and learning basic skills. In any case, digital skills have become part of a basic skills package. Digital technology can also support management and increase efficiency, helping handle bigger volumes of education data.

But technology can also exclude and be irrelevant and burdensome, if not outright harmful. Governments need to ensure the right conditions to enable equitable access to education for all, to regulate technology use so as to protect learners from its negative influences, and to prepare teachers.

This report recommends that technology should be introduced into education on the basis of evidence showing that it would be appropriate, equitable, scalable and sustainable. In other words, its use should be in learners' best interests and should complement face-to-face interaction with teachers. It should be seen as a tool to be used on these terms.

Midway to the deadline, the 2023 Global Education Monitoring Report assesses the distance still to go to reach the 2030 education targets. Education is the key to unlocking the achievement of other development objectives, not least the goal of technological progress.

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