GLOBAL EDUCATION MONITORING REPORT

2023

Southeast Asia

Technology in education:

A TOOL ON WHOSE TERMS?

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Sustainable Development Goals

Global Education Monitoring Report

Southeast Asian Ministers of Education Organization

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SOUTHEAST ASIA

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Photography caption: On 24 July 2020 in Phnom Penh, Cambodia, Nha Nha helps her little sister Sopheap with her homework using a live streaming lesson. The school has been using streaming apps to provide essential teacher-student interaction and creating a series of physical training exercises. Using Google Classroom, Telegram and Facebook Groups, as well as Messenger, students are allowed to continue their studies from the safety of their home. To ensure students have suitable equipment to learn online, Indochina Starfish Foundation loans tablet computers to those that need them. Subsidies are also available for students who struggle to afford an internet connection.

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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.

The *Global Education Monitoring Report* team is responsible for the choice and the presentation of the facts contained in this book and for the opinions expressed therein, which are not necessarily those of UNESCO and do not commit the Organization. Overall responsibility for the views and opinions expressed in the report is taken by its Director.

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SHORT SUMMARY

Can technology solve the most important challenges in education?

Digital technology is rapidly transforming many aspects of society and the economy in Southeast Asia and is beginning to leave its stamp on education. This edition accompanies the *2023 Global Education Monitoring Report*, which acknowledges technology as a useful tool but invites the education community to question on whose terms it is deployed.

The richest students in Southeast Asia are almost 8x as likely to be connected at home as the poorest students

Three main challenges are considered:

In terms of **equity and inclusion**, while technology helps lower costs to access education, internet connectivity at home is highly unequal by wealth and location, and less than half of rural schools in the region have internet.

In terms of **quality**, digital technology can enliven student experiences and facilitate learner collaboration. Yet rigorous evidence of its impact is rare. While new technology may overcome some constraints, it brings its own problems, including increased screen time and risks to children's privacy.

Improvements to **efficiency** may be the most promising, whether by freeing up time for more meaningful education activities or by generating large volumes of valuable data. However, each tool has major implications in terms of regulation and capacity development.

Three conditions need to be met for technology's potential to be fulfilled: equitable access to technology, appropriate governance and regulation, and sufficient teacher capacity.

Supporting this publication is a series of country profiles on PEER, a policy dialogue resource describing policies and regulations related to technology in the region'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

There is a digital revolution sweeping the world. It is affecting every area of our lives, and no less education. The arrival of COVID-19 made the use of digital technology to ensure the continuity of education obligatory overnight. The recent emergence of artificial intelligence is yet again pointing to new potentials, new limitations and, critically, new risks to learners that may come from change happening at such a fast pace.

Accompanying the 2023 *Global Education Monitoring Report*, this regional edition analyses the ways that these developments are playing out in education in Southeast Asia, where they add value and where they add complications. Reflecting global trends, learners, teachers and institutions in Southeast Asia, a region of some 400 million internet users, have embraced digital technology at a sprint. Learning management platforms have multiplied. Micro-credentials are fast changing higher education.

Yet this report points out how little is known about whether and how technology impacts learning, even though mobile and online technology is widely used for learning purposes. Moreover, the report highlights how technology often leaves marginalized learners behind with a lack of skills to fully benefit from it. In short, the blanket assumption that technology improves teaching and learning still needs to be proven.

This report calls for education stakeholders to pause and reflect before investing in technology solutions. The digital transformation can benefit education but must be appropriate for the context. It must be equitable and with the right governance and regulations in place. Teachers need to be given the support and training they need to make the most of the digital tools they can access.

Decisions on technology do not need to move as fast as the development of technology itself. The time must be taken to ensure that technology enables a human-centred vision of learning, focusing on the needs, experiences and potential of each individual learner. Then, and only then, can it be ensured that technology is being used to help us achieve our education goals.

Stefania Giannini
Assistant Director-General for Education, UNESCO

Foreword

It is with great enthusiasm that we present the 2023 GEM Southeast Asia report on Technology in Education, a collaborative effort between the Southeast Asian Ministers of Education Organization (SEAMEO) and the UNESCO Global Education Monitoring (GEM) Report team. This report delves into the transformative influence of technology on education in Southeast Asia, offering a comprehensive overview of both gains and challenges in the region.

In the evolving landscape of education, impacted by the COVID-19 pandemic, technology has emerged as a catalyst for change and as a key tool for learning continuity. This report aims to provide a detailed account of the current state of affairs on technology in education, emphasizing the strides made and the obstacles encountered in integrating technology into education systems across Southeast Asia.

The report highlights the significant gains made in leveraging technology to enhance learning outcomes. From urban centres to remote communities, technology has facilitated broader access to educational resources, fostering inclusivity and dynamism in the learning process. Mobile technologies, online platforms and interactive learning tools have played vital roles in reshaping the educational landscape. Beyond providing an overview of the current state of technology in education, the report also delves into the policies and practices that have shaped country approaches to educational technology. Through insightful case studies, we can see the impact of education technology policies and programmes and their on-the-ground implementation.

However, amidst these gains, we recognize that challenges still persist. The report highlights the variances among and within countries in the region in terms of access, equity, governance, and other enabling factors to technology in education. The report underscores the imperative to address these gaps, both implementation and policy challenges.

Most importantly, this report offers forward-looking recommendations for policymakers and stakeholders. These recommendations, grounded in the practical realities of the region and the world, advocate for curriculum reforms, evidence-informed education technology interventions, inclusion and equity, scalability, and sustainability, with our learners and teachers at the heart of these policy recommendations.

We hope that this report serves as a resource for policymakers, educators and stakeholders invested in the future of education in Southeast Asia. It is our collective hope that the insights and recommendations well-articulated in this report will contribute to the realization of a learner-centred, digitally inclusive and equitable education in the region.

Datuk Dr Habibah Abdul Rahim
Director
SEAMEO Secretariat

Foreword

Throughout the year 2023, the global education technology landscape has been evolving rapidly, and nowhere more so than in Southeast Asia. In this fast-moving context, the 2023 Southeast Asia Report on technology in education provides a timely contribution to the sector, and a valuable resource for all decision makers seeking to make effective use of technology to help address the learning crisis.

As you read the report, you will find it to be rigorous, robust and full of practical examples. The report makes two critical contributions in relation to technology in education in the region. First, it provides context-specific insight into the opportunities and challenges that different countries are facing, documenting the lessons learned. Second, it provides a clear route forward – with the 'four-point compass' – for how countries in Southeast Asia can navigate to an evidence-driven and high-impact future in the use of technology in education.

There is huge diversity across education systems in the region, and a wide range of ways in which technology is being used. As the report notes, significant progress has been made in recent years with increased access to technology and the development of associated infrastructure. While this provides a strong foundation, it does not, on its own, inevitably lead to meaningful progress in education. Indeed, at present, there are relatively few examples of how education technology has been used to improve learning outcomes at scale within the region.

In light of this, it is clear that Southeast Asia is at a pivotal moment. In the years ahead, significant financial investments will continue to be made in education technology: the priority now is to ensure that the investments made are high-impact ones, based on the best evidence available. One example of how we are already seeing the region's commitment to evidence-driven decision making and the pursuit of equitable learning outcomes is through its development of the Southeast Asia Primary Learning Metrics (SEA-PLM), a regional assessment and capacity-building programme designed by and for Southeast Asian countries.

The report's 'four-point compass' is a simple and powerful tool to help achieve this and is worthy of our close attention. It highlights the importance of education technology which is: 1) appropriate for national and local contexts, 2) focused on equity and ensuring learners are not left behind, 3) scalable and cost-effective, and 4) focused on sustainable education futures. Everyone involved in education technology can start to apply this tool in their work: governments, developers, implementers, researchers, funders, and teachers and school leaders can all benefit from applying this lens.

I encourage everyone to engage deeply with this report, reflect on its findings and consider how you can put its recommendations into practice in your own work. Each one of us has a crucial role to play. There is huge potential for countries in Southeast Asia to be at the forefront of evidence-driven use of education technology, and to serve as examples of good practice for the benefit of the global education community.

The SEAMEO and GEM Report teams should be wholeheartedly commended for the publication of such a high-quality report. It has been a privilege for EdTech Hub to collaborate in its development, and we look forward to ongoing productive partnership with many of you in the years ahead.

Verna Lalbeharie
Executive Director
EdTech Hub

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ABOUT SEAMEO

The Southeast Asian Ministers of Education Organization (SEAMEO) is a regional intergovernmental organization that acts to promote cooperation in education, science and culture in Southeast Asia. Established in 1965 among governments of Southeast Asian countries, its highest policy-making body, the SEAMEO Council, comprises 11 Southeast Asian education ministers. The regional organization also include 9 Associate Member Countries and 8 Affiliate Members. SEAMEO has 26 specialist centres and network located across Southeast Asia that undertake training and research programmes in various fields of education, science, and culture. SEAMEO's vision is to nurture human capacities and explore its peoples' fullest potential, making their lives better through quality and equity in education, and information and communication technology, among others, in Southeast Asia. Its seven priority areas in education include at least four to which information and communication technology can potentially contribute: addressing barriers to inclusion, developing resilience in the face of emergencies, revitalizing teacher education, and adopting a 21st century curriculum.

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The work benefited from consultations with Raman Sidhu (Octava Foundation), Victoria Tinio (Foundation for Information Technology Education and Development) and Noah Yarrow, Lauri Veli Johannes Pynnonen, and Chuyu Song (World Bank), to whom we extend our thanks.

The regional report built on extensive background research. It draws on primary and secondary data and expert analysis conducted in Southeast Asia by researchers and research institutes working in and on the region, SEAMEO specialist institutions, affiliate members and partners that informed country case studies, thematic and input papers. We are grateful to all colleagues who provided these inputs.

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Contents

Reab Song, an indigenous teacher, prepares her lesson plan by listening to a radio teaching programme supported by UNICEF through GPE in Cambodia.

Credit: © UNICEF/UN0371891/Soeum*

CHAPTER

1

Introduction

KEY MESSAGES

The adoption of digital technology is changing education and learning in Southeast Asia.

- The set of basic skills that young people are expected to learn in school has expanded. Southeast Asia stands out for defining frameworks for digital skills in school.
- Technology has made a wide range of learning opportunities accessible. Enrolment in Coursera, a massive open online courses provider, registered the fastest growth globally in Indonesia, the Philippines, and Viet Nam.
- Digital platforms have multiplied to complement traditional learning. Learning management systems have recorded the fastest business volume growth in Malaysia and Singapore.

The rapid surge in the use of internet has vast potential for teaching and learning.

- Southeast Asia experienced a fast growth rate in the use of internet in the last 10 years, with 400 million estimated internet users.
- Southeast Asia also reports a high rate of internet access at home. An average of 57% of students in the region have access to the internet at home, but only 16% do in Cambodia.
- Mobile remains the most accessible form of internet connection but often does not support education applications. Active mobile-broadband subscriptions averaged 101 per 100 people in 2022.

Can technology help address Southeast Asia's education challenges?

- In terms of equity and inclusion, digital technology lowers education access costs for some disadvantaged groups, but the richest students in Southeast Asia are almost eight times more likely to be connected at home than the poorest students.
- In terms of quality, digital technology encourages engagement but brings risks for privacy and well-being: 70% of adolescents in Cambodia, Indonesia, Malaysia and Thailand reported upsetting experiences associated with online activities.
- In terms of efficiency, digital technology reduces the time teachers and students spend on menial tasks, time that can be used for other, educationally more meaningful activities.

What aspects of digital technology do countries in Southeast Asia focus on?

- Digital technology in education is seen as leverage for skills-based development. Brunei Darussalam's Digital Economy Masterplan 2025 has identified ICT in education as one of the clusters to become a 'smart' nation.
- The adoption of technology in teaching and learning in schools is growing. Malaysia aims to integrate ICT across all 10,000 schools to provide individualized learning experiences.
- Digital transformation and rapid change adoption is one of four strategic themes in SEAMEO's Strategic Plan 2021–2030. The 2022 Declaration on the Digital Transformation of Educational Systems in ASEAN lists 35 elements that 'should be considered in any national strategic plan or framework for digital transformation of education'.

Southeast Asia has experienced rapid growth in the use of digital technology, which has already shaped several economic sectors, such as delivery services and telecommunications (World Bank, 2019). In education, information and communication technology (ICT) has been applied for decades, ever since radio programmes were introduced for distance learning in the 1950s in Indonesia and the Philippines. In the past few years, Southeast Asian education systems have concentrated on digital learning (SEAMEO INNOTECH, 2023).

Learners, educators and institutions have adopted digital technology tools, which are no longer only accessible by the wealthiest. It is estimated that there are some 400 million internet users in Southeast Asia and that in 2020 alone, 40 million people went online for the first time (OECD, 2023a). Enrolment in MOOCs of Coursera, a well-known provider, increased the fastest in Indonesia, the Philippines and Viet Nam (Coursera, 2021). More than four in five 12- to 17-year-olds in Indonesia, Malaysia and Viet Nam engage in online activities at least once a day (ECPAT et al., 2022a, 2022b, 2022c). An average of at least 50% of school-age children and youth in the region have access to the internet at home (OECD, 2018; SEA-PLM, 2019; UNICEF, 2021). According to data from the 2018 Programme for International Student Assessment (PISA), more than 50% of 15-year-old students in five out of seven participating Southeast Asian countries were in schools whose principals reported that an effective online learning support platform was available (OECD, 2020b); this is believed to have increased during the COVID-19 pandemic. More than 80% of secondary schools are equipped with computers for pedagogical purposes in seven countries of the region (UIS, 2023).

An education technology industry has emerged in Southeast Asia, in particular in personalized tutoring and testing, learning management systems, language learning, and skills development. It is estimated that two thirds of sales are for services directly purchased by final users, such as learners, teachers and schools (HolonIQ, 2022). With more than 40 million users, Indonesia-based Ruangguru is one of the most innovative global start-ups in education technology (Fast company, 2021). During COVID-19, Ruangguru expanded its services to Thailand and Viet Nam, becoming the largest education technology company in Southeast Asia (UNESCO, 2023a). Purchases of learning management systems have grown the fastest in Malaysia and Singapore (Fortune Business Insights, 2022). The region is projected to be one of the fastest-growing data centre markets, while business for artificial intelligence (AI) is expected to increase by about 8% per year in the coming years (**Box 1.1**) (OECD, 2023a).

Despite these observations, it can be argued that technology has arguably not yet truly transformed education. Change resulting from the use of digital technology is incremental, uneven and bigger in some contexts than others. The application of digital technology varies between and within countries. It varies by community, socioeconomic level, teacher willingness and preparedness, education level, and country income. Evidence is mixed on its impact and depends on the type of technology and the kinds of learning (Hamilton and Hattie, 2021; Selwyn, 2022). Evidence is not tailored to the Southeast Asian context (Asian Development Bank, 2020). Implementing digital technology applications comes with considerable short- and long-term costs, which are often underestimated.

BOX 1.1:

Few Southeast Asian countries use artificial intelligence to transform education

Southeast Asian countries are looking at the potential of artificial intelligence (AI) to drive innovation and stimulate development in teaching and learning. Algorithms could help automate grading, provide learning support and generate learning materials. Other AI applications could help with writing assignments, enhance learning experiences and personalize as well as diversify learning (Cao, 2023; Cepeda, 2023).

Many countries in the region have developed national strategies to advance AI with a focus on capacity development. Thailand's National AI Strategy and Action Plan 2022–2027 promotes an effective ecosystem for the development and application of AI, which includes the promotion of AI education through dedicated scholarships (OECD, 2023b; Thailand Ministry of Digital Economy and Society, 2022). Indonesia's National AI Strategy to 2045 focuses on the identification and promotion of relevant competencies and talents (Indonesia Ministry of Research and Technology, 2020). Fostering AI talent is also one of the six strategic objectives of Malaysia's National Artificial Intelligence Roadmap 2021–2025, which aims to promote the comprehensive and inclusive understanding and knowledge of AI principles in schools and to provide opportunities for skilling and reskilling (Malaysia Ministry of Science Technology and Innovation, 2021).

While AI is mostly seen as an outcome, in a few cases it is also seen as a tool to be integrated into teaching and learning. 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). All school leaders, teachers and students have access to them to help track student progress (Singapore Ministry of Education, 2022). Viet Nam's National Strategy on Research and Development and Application of Artificial Intelligence aims to apply AI to personalize learning, identify and assess learning outcomes, improve learning efficiency through virtual tutoring and career guidance, and support the teaching profession (Viet Nam Government, 2021a).

There is common recognition of the need to regulate the use of AI, including in education. Malaysia is considering the possibility of regulating AI and first educating individuals on its use (digwatch, 2023). The Philippines has warned about uncertainties linked to integrating AI in education (Marcelo, 2023). Regulation of artificial intelligence is still at an early stage in Southeast Asia. There are calls to put it into context and to hold an inclusive debate (Sahoo, 2023). Timor-Leste is one of 50 countries that will implement the UNESCO AI readiness assessment methodology, a diagnostic tool for the development and deployment of artificial intelligence in line with the UNESCO Recommendation on the Ethics of Artificial Intelligence (UNESCO, 2023b). The Association of Southeast Asian Nations (ASEAN) is working on developing regional guidance on artificial intelligence governance and ethics by 2024 (Trajano, 2023).

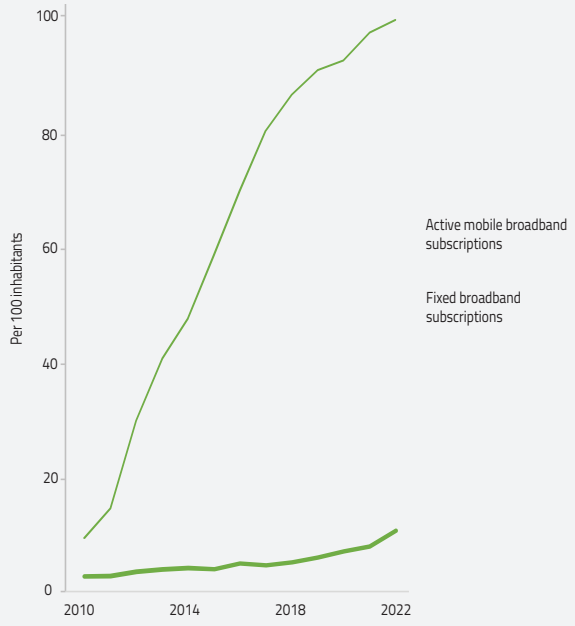
At the same time, without digital technology education risks irrelevance. The right to education is increasingly synonymous with the right to meaningful connectivity. An expanded definition of the right to education could include effective support by technology for all learners to fulfil their potential, regardless of context or circumstance. Moreover, as digital technology is shaping labour markets, demand for qualified professionals with technology skills is increasing (Tobing, 2022).

This regional report covers 11 countries: Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste and Viet Nam. This chapter examines the region's distinct experiences of ICT in education, introduces discourses on ICT and education, and considers future priorities for the use of technology put forward by Southeast Asian countries and regional organizations.

DIGITAL INFRASTRUCTURE HAS EXPANDED IN SOUTHEAST ASIA BUT THE PACE VARIES BY COUNTRY

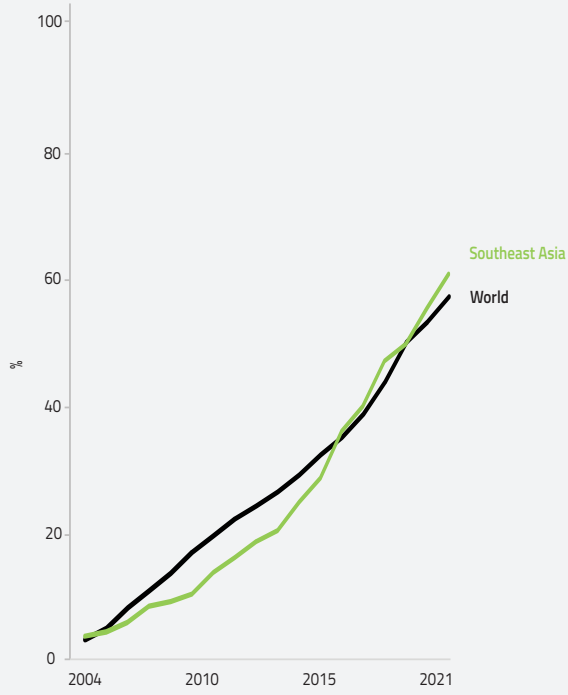
Southeast Asia is a highly diverse region in terms of economic development but also in terms of its demography. Yet its countries share a recent history of economic growth and rapid digital technology penetration (Octava Foundation, 2021; SEAMEO INNOTECH, 2023). There were 132 mobile phone subscriptions, including active pre-paid accounts, per 100 people across 10 Southeast Asian countries in 2022, ranging from 107 in Myanmar to 176 in Thailand (ITU, 2022f). In 2022, at least four in five individuals in Malaysia, Singapore and Thailand owned a mobile or smart phone for personal use (ITU, 2022e).

FIGURE 1.1:
Mobile connectivity has grown rapidly in Southeast Asia
Active mobile and fixed broadband subscriptions per 100 inhabitants, Southeast Asia, 2010–22



Note: Fixed broadband subscriptions refer to fixed subscriptions to high-speed access to the public internet at downstream speeds equal to or greater than 256 kilobits per second (kbit/s) and include cable modems, digital subscriber lines, fibre-to-the-home/building, other fixed (wired)-broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband. Active mobile broadband subscriptions refer to the sum of active handset-based and computer-based mobile broadband subscriptions to the public internet.
Source: ITU database.

FIGURE 1.2:
The use of the internet has surged in Southeast Asia
Individuals using the internet in the last three months via a fixed or mobile network, Southeast Asia and world, 2004–21



Source: ITU dataset.

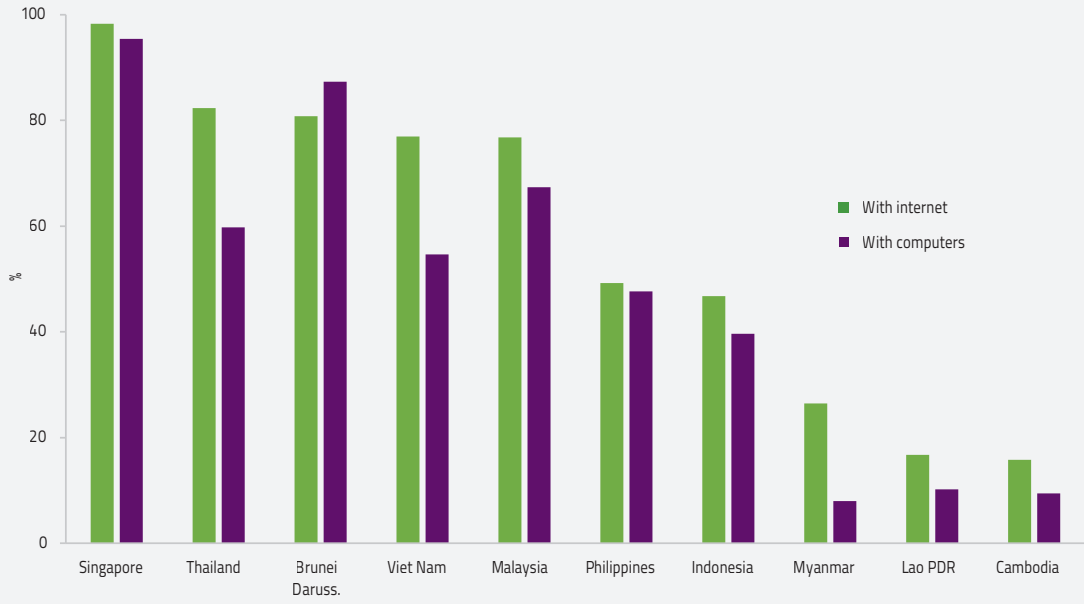
Of all the world's regions, Southeast Asia has registered large increases in mobile connectivity (GSMA, 2022). Mobile broadband is the main, and in some cases the only, form of internet connection in the region. There were 101 active mobile broadband subscriptions per 100 people in 2022 (ITU, 2022a) but only 13 fixed broadband subscriptions (**Figure 1.1**), ranging from 0.01 in Timor-Leste to 22 in Viet Nam (ITU, 2022b).

Although connectivity costs are falling (GSMA, 2022), the cheapest plan providing at least 2 gigabytes (GB) of high-speed data using mobile broadband in Timor-Leste was estimated to cost 4.5% of the average monthly income in 2021, almost four times the regional average and significantly above the 2% affordability target. In Cambodia and the Lao People's Democratic Republic, the costs are around 2.5% of the average monthly income. Expenses for a 5 GB fixed broadband basket are even higher (ITU, 2022c).

Regardless of the type of network, Southeast Asia also reports one of the fastest global growth rates in internet use in the past 10 years. While internet use in Southeast Asia equalled the global average at 16% in 2004, it reached 70% in 2021, outpacing the global average at 66% (**Figure 1.2**). From 2004 to 2020, internet use increased from 11% to 78% in Thailand, one of the largest increases in the world, and from 8% to 70% in Viet Nam. However, only 40% of individuals in Timor-Leste and 44% in Myanmar used the internet in 2021 (ITU, 2022d).

Internet access at home is high in Southeast Asia, which increases the potential for learning opportunities. According to the 2019 Southeast Asia Primary Learning Metrics (SEA-PLM) and 2018 PISA data, 48% of students reported having a desktop computer, portable laptop or netbook at home to study, although the share is less than 10% of students in Cambodia and Myanmar. Likewise, a regional average of 57% of students could access the

FIGURE 1.3:
Three in five students in Southeast Asian have some form of internet at home
Share of households with an internet connection and a desktop computer, portable laptop or netbook at home, selected Southeast Asian countries, 2018–19



Source: Data from the 2018 PISA and the 2019 SEA-PLM surveys.

internet from home, ranging from 16% in Cambodia to 98% in Singapore. More than four in five students cannot connect online from home in Cambodia and the Lao People's Democratic Republic, about three in four in Myanmar cannot do so, and almost one in two cannot in Indonesia and the Philippines (**Figure 1.3**) (OECD, 2018; SEA-PLM, 2019).

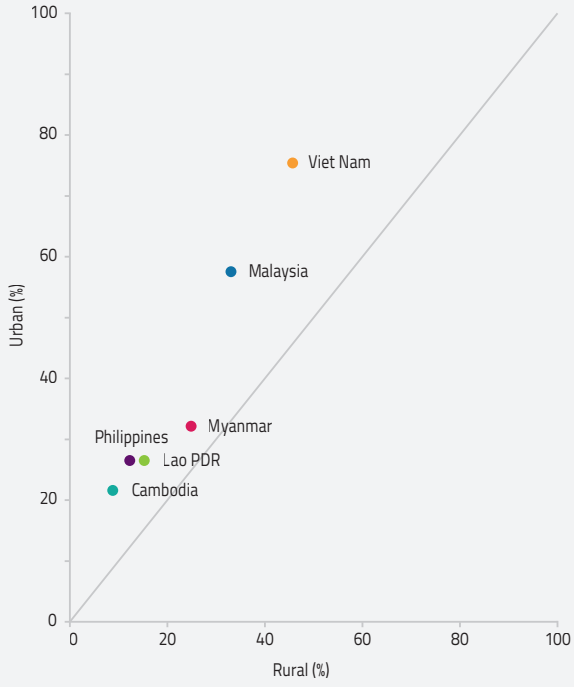
Disadvantaged groups have fewer resources at home, own fewer devices and are less connected to the internet (**Figure 1.4**). According to the 2019 SEA-PLM, primary students attending urban schools in the Lao People's Democratic Republic and Myanmar are at least twice as likely to study using a computer as children in rural schools. Students from the richest households are almost eight times more likely to be connected to the internet than their peers from the poorest quintile. Viet Nam reported the widest divide: 94.5% of the richest children benefit from internet at home compared with 17.5% of the poorest. People from the bottom quintile in East Asia and the Pacific need to spend more than 50% of their average monthly income to purchase an entry-level internet-enabled handset (GSMA, 2021).

Connection quality might not always be good. 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. Bandwidth usage per internet user in Southeast Asia is estimated to have dramatically increased from a median of 0.44 to 147 kilobits per second between 2003 and 2021. Download speed varies from 0.026 megabits per second (Mpbs) in the Lao People's Democratic Republic to 7 Mpbs in Singapore (ITU, 2021).

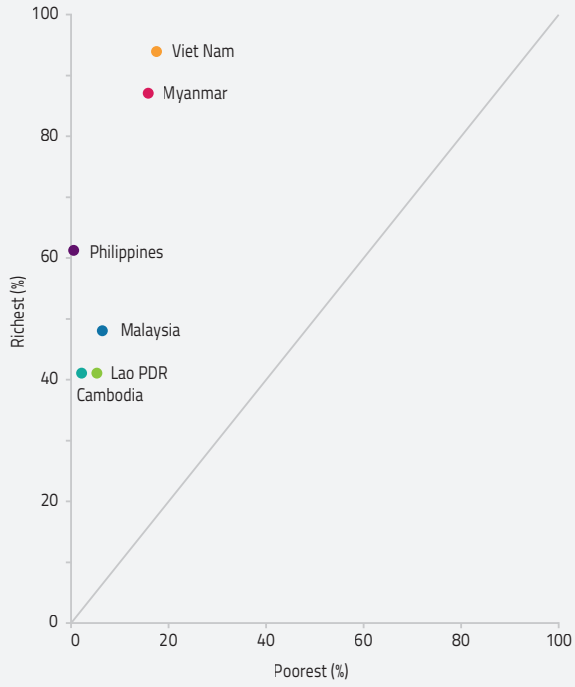
Access to digital technology in schools is expected to be more equitable (OECD, 2020a) to compensate for disadvantages experienced at home (SEAMEO INNOTECH, 2023). According to the UNESCO Institute for Statistics, 62% of primary and 78% of secondary schools in the region have computers for pedagogical purposes. The share of schools connected to the internet was 64% in primary and 75% in secondary education in 2018–22, ranging from 6% in Myanmar to 100% of secondary schools in Brunei Darussalam and Singapore (UIS, 2023). Inequality persists between schools. In the Lao People's Democratic Republic, urban schools are twice as likely to have a computer than rural schools. Schools in the Philippines registered the widest absolute gap in internet access by location (**Figure 1.5**).

FIGURE 1.4:
Internet connectivity at home is highly unequal by wealth and location
Households with an internet connection at home, selected Southeast Asian countries, 2019

a. By location



b. By wealth



Source: Data from the 2019 SEA-PLM survey.

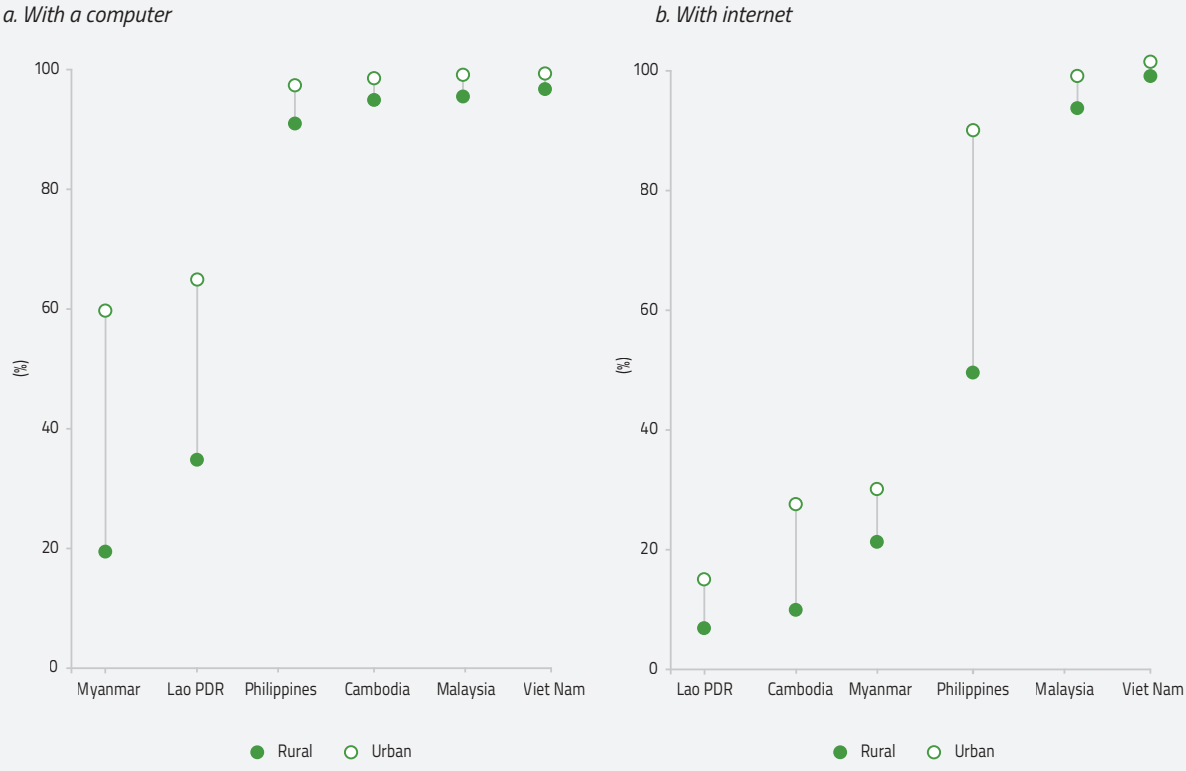
CAN TECHNOLOGY HELP ADDRESS SOUTHEAST ASIA'S EDUCATION CHALLENGES?

Given rapid digitalization trends, there is a temptation to present education technology as a solution without considering what is the problem to be solved. The first question should therefore always be: What are the most important challenges in education? Decision makers are likely to resort to multiple solutions from their policy toolbox, of which technology is only one, to address these challenges. Consider the following three education system 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 the need to individualize instruction and socialize learners?

On the question of **equity and inclusion,** ICT – and digital technology in particular – may help lower the education access cost for some disadvantaged groups: those who live in remote areas, face learning difficulties, lack time or have missed out on past education opportunities. But while access to digital technology has expanded rapidly, inequality in access to technology raises concerns about ICT's actual contribution to equity and inclusion in education.

FIGURE 1.5:
Less than half of rural schools have internet for learning activities
Primary schools with selected ICT facilities, selected Southeast Asian countries, by location, 2019



Source: Data from the 2019 SEA-PLM survey.

In the context of digitalization and increased promotion of hybrid learning, not having access to devices and the internet at home prevents students from having equal educational opportunities, with negative implications for their well-being and learning outcomes (Gottschalk and Weise, 2023). Households that are better off can buy technology earlier, giving children and youth more advantages and compounding disparity.

Education **quality** is a multifaceted concept, and it is difficult to demonstrate whether education technology can help enhance it. There are high expectations that the integration of digital technology can improve learning outcomes (SEAMEO INNOTECH, 2023). Digital technology creates engaging learning environments, enlivens student experiences, simulates situations, facilitates collaboration and expands connections. Yet 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, the effective integration of ICT and the impact of technology use on students' learning outcomes is not systematically measured (SEAMEO INNOTECH, 2023), which means decision making is not based on evidence (Rodrigo, 2018).

New technology may bring solutions but also brings its own problems. Increased screen time has been associated with adverse impacts on physical and mental health. Insufficient regulation has led to unauthorized use of personal data for commercial purposes. About 70% of adolescents in Cambodia, Indonesia, Malaysia and Thailand reported having been upset by their online experiences over the past year. Negative experiences were associated with violent and inappropriate content (UNICEF East Asia and the Pacific Regional Office and the Centre for Justice and Crime Prevention, 2020).

Digital technology has also helped spread misinformation and hate speech, including through education.

Improvements in **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, the way that education technology is used is more complex than just a substitution of resources and there are conflicting views on what is considered educationally meaningful.

When considering education system challenges and how technology might address them, one needs to be mindful of technology's complexity. It is not any one thing. 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.

WHAT ASPECTS OF DIGITAL TECHNOLOGY DO COUNTRIES IN SOUTHEAST ASIA FOCUS ON?

In Southeast Asia, the extent to which governments invest in education technology varies by resource availability, digital infrastructure readiness and development agendas (Machmud et al., 2021). Discussions on technology are mostly skewed towards economic priorities (Noor and Manantan, 2022). Southeast Asian countries have supported the adoption of digital technology in education as leverage for socioeconomic and technological development (Octava Foundation, 2021). Education is seen as one of the sectors that can contribute to making countries 'innovative' and 'smart', two terms used recurrently. Singapore's Smart Nation aims at 'transforming Singapore through technology' (Singapore Smart Nation and Digital Government Office, 2023). Brunei Darussalam's Digital Economy Masterplan 2025 has identified ICT in education as one of the clusters to become a 'smart' nation (Brunei Darussalam Ministry of Transport and Infocommunications, 2020).

In national and regional education strategy and policy documents (**Box 1.2**), there is a strong focus on technology for skills development. Technological innovation is mostly associated with knowledge in science, technology, engineering and mathematics (STEM). Foundational STEM knowledge as well as digital literacy are seen as key to preparing students for understanding and advancing technology (Lestari and Santoso, 2019). According to the PEER country profiles, 9 of 11 Southeast Asian countries promote STEM and digital literacy in their policies, plans and strategies.

Cambodia focuses on the promotion of digital skills and STEM education to 'meet 21st century skills' in its Education Strategic Plan 2019–23 (Cambodia Ministry of Education, 2019). It aims to enrol one third of higher education students in STEM programmes by 2023. Likewise, the Education and Sports Sector Development Plan 2021–25 of the Lao People's Democratic Republic sets a target of 20,000 STEM graduates by 2025 (Lao PDR Ministry of Education and Sports, 2020). Viet Nam's Youth Development Strategy 2021–30 aims to build a generation that masters science and technology and has developed 'digital transformation' skills (Viet Nam Government, 2021b). In line with the National Strategy for Development of the Digital Economy and Society to 2025, 70% of working-age people are expected to have been trained in basic digital skills (Viet Nam Government, 2022). Indonesia's Strategic Plan for Acceleration of National Digital Transformation intends to increase quality ICT education in primary and secondary education through targeted initiatives for disadvantaged students and for teachers to ensure that at least 50% of the workforce has intermediate or advanced digital skills by 2024 (Indonesia Ministry of Ministry of Communications and Informatics, 2020).

Countries have so far focused on the development of digital infrastructure to enable universal access. Almost all countries have policies targeted at improving school and learner connectivity. Universal service funds have been established to address gaps. In strategy documents, most Southeast Asian countries aim to build or improve digital infrastructure for pedagogical purposes. Malaysia aims to address the urban and rural divide in higher education in the 2013–25 Education Blueprint Plan (Malaysia Ministry of Education, 2015).

Some plans consider ICT as conducive to equity and inclusive education. The 2022–2030 Basic Education Development Plan in the Philippines aims to equip platforms with accessibility features to promote inclusive education (Philippines Ministry of Education, 2022). Some Southeast Asian countries integrate ICT, and mostly digital

BOX 1.2:

SEAMEO and ASEAN embrace the digital transformation of national education systems

Digitalization and artificial intelligence are 2 of the 12 global trends that have shaped the education pillar of SEAMEO's Strategic Plan 2021–2030, while references to divides in digital literacy feature strongly in a third global trend, ageing. Further, technology-related issues, such as augmented reality, coding, data analytics, computational thinking and STEM education, are among the global trends shaping the science pillar of the plan. Its development was heavily influenced by the impact of COVID-19 on education systems, which 'pushed the education sector to digitise, automate, and become more flexible'. As a result, the plan places the preparation of learners for technological advancements and disruptions and the development of diverse, context-specific and flexible education platforms high on its agenda. Accordingly, digital transformation and rapid change adoption is one of the plan's four strategic themes.

On the one hand, the plan warns that 'education is already falling behind the digitalisation curve' and that 'education systems continue to fail to equip the youth with the skills they need to keep up with a changing job market'. On the other, it cautions against the potential misuses of technology in education, such as cyberbullying, excessive time spent online, privacy invasion and cybersecurity breaches. Overall, none of the seven education priority areas explicitly features digital technology, with two slight exceptions. Under the fifth area on teacher development, one of the two indicators refers to continuous professional development in areas including digital skills. Under the seventh area on the integration of 21st-century skills in national curricula, digital skills are also implicit. Although there is no explicit definition of 21st-century skills in the plan, the use of open educational resources and ICT can be inferred, even if current activities mainly focus on issues such as sustainable development, shared history, global citizenship, culture-based education and school networks.

One of five strategic goals in SEAMEO's plan is to work with ASEAN to ensure successful alignment of their respective strategies and programmes. ASEAN's Member States are in the process of developing the ASEAN Community's Post-2025 Vision and, eventually, an ASEAN Education 2050 Roadmap. Two documents already describe how digital technology is seen as an essential component of education development in the region.

First, the 2020 ASEAN Declaration on Human Resource Development for the Changing World of Work covers a wide range of activities, including some focusing on digital technology: (1.1.1) the role of employers in developing digital literacy; (1.2.1) investment in digital infrastructure development, online platforms, open educational resources and technology in basic education; (2.1.2) accessibility and inclusivity of online learning opportunities and open educational resources; (2.1.3) training to promote safe, responsible and appropriate use of ICT for teaching and learning; and (3.1.2) professional development for teachers on a range of '21st-century' skills, including digital literacy.

Second, the 2022 Declaration on the Digital Transformation of Educational Systems in ASEAN was an offshoot of both an Education Ministers' Joint Statement on the digital transformation of education and a Leaders' Statement on digital transformation in 2021. It lists 35 elements that 'should be considered in any national strategic plan or framework for digital transformation of education'. These can be grouped to match the chapter structure of this report, with the exception of the chapter on higher education: universal participation in digital learning, including through offline solutions **(Chapter 2)**; open-access, free-to-use digital learning resources with clear entry points and shared repositories, respecting intellectual property **(Chapter 3)**; implementation of pedagogical practices needed for online teaching **(Chapter 4)**; development of a full range of digital skills for life, work and sustainable development **(Chapter 6)**; digital technology for formative assessments and management information systems, ensuring interoperability **(Chapter 7)**; monitoring and evaluation to improve the environment that supports the development and financing of policies, including through partnerships for affordable connectivity **(Chapter 8)**; the participation and engagement of all actors in digital transformation and measures to address safety and privacy, notably of children, but also environmental consequences **(Chapter 9)**; and teacher training on pedagogical practices for online teaching **(Chapter 10)**.

technology, in teaching and learning to enhance quality education. Malaysia aims to integrate ICT across all its 10,000 schools to provide individualized and meaningful learning experiences (Malaysia Ministry of Education, 2015). Singapore's Education Technology Plan highlights that education technology has the potential to make education more self-directed, personalized, connected and human-centred (Singapore Ministry of Education, 2020). In its National Education Strategic Plan by 2030,

Timor-Leste plans to use ICT to improve assessment management (Timor-Leste Ministry of Education, 2011).

GUIDE TO THE REPORT

Based on the approach of the 2023 *Global Education Monitoring Report*, this regional edition recognizes that Southeast Asia is characterized by a variety of contexts and levels of resources. Each country will integrate technology in education in their own specific context. This report first investigates the equity, inclusion, quality and efficiency challenges facing education systems and examines the processes through which technology can contribute to improved education outcomes. It then examines the essential conditions that need to be met for technology's potential to be realized, with a focus on the equitable distribution of ICT infrastructure, evidence-driven decision making, regulatory frameworks and human resources.

Following **Chapter 1's i**ntroduction, **Chapter 2** focuses on how technology can promote equitable and inclusive access to education for disadvantaged groups: populations living in remote areas, people with a disability and communities affected by emergencies. Radio, television, mobile phones and online learning are potential tools. The COVID-19 pandemic was a natural experiment, which tested the capacity of distance education, especially to serve 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 the commercialization of previously free content and platforms. Resources can be remixed, redistributed, repurposed, translated and localized. Despite the advantages of open resources, there are obstacles to their large-scale adoption.

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

Chapter 5 examines how education technology has been introduced in universities and other higher education institutions to improve access, equity, inclusion and quality. It also describes the challenges that these institutions are facing in using education technology. It then focuses on skills development and the potential of massive open online courses.

Chapter 6 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 7 reviews technology's contribution to making education management more efficient and effective. Education systems continually require more data, which technology can help handle. 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 explored.

Having examined the potential of education technology to address major education challenges, Chapters 8 to 10 then ask what conditions will ensure that this potential will be fulfilled.

Chapter 8 asks how education systems ensure that all learners have access to technology resources. It reviews access to electricity, hardware, software and the internet. It then explores the type of evidence that governments use to take decisions on investment in technology solutions.

Chapter 9 addresses how education systems can protect learners from the adverse consequences of technology use. Learners encounter 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 10 deals with the question of how education systems can support all teachers to teach, use and deal with technology effectively. Teachers face 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 improve teacher training and the opportunities teachers have to interact with peers.

A NOTE ON METHODOLOGY

The development of this report's content has significantly benefited from the expertise of SEAMEO and the EdTech Hub. The report has been informed by extensive data collection and expert analysis from collaboration with several institutional and individual researchers in the region that have contributed multiple perspectives on the theme.

Background research consisted of country case studies that analysed different aspects of education technology and its conditions from primary to higher education. Country case studies provided a comprehensive and up-to-date overview of education technology issues through research reviews, analysis of policy and legislative documents, descriptive analysis using secondary data sets or reports, and administrators' and teachers' perspectives through interviews or surveys.

RECOMMENDATIONS

The 2023 Southeast Asia regional report provides a four-point compass to ensure that technology is used on our terms in education.

Is this use of education technology appropriate for the national and local contexts? Education technology should strengthen education systems and align with learning objectives.

- Reform curricula and education programmes to target skill development best suited to digital tools that have been proven to improve learning and are underpinned by a clear theory of how children and youth learn, without assuming either that pedagogy can remain the same or that digital technology is suitable for all types of learning.
- Design, monitor and evaluate education technology policies with the participation of teachers and learners to draw on their experiences and learn from other contexts. 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 flexible, are accessible in multiple 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 and to skills development opportunities 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.

- 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 and act in line with 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 EPUB formats, adaptable open education resources, learning platforms and teacher support applications, all designed so as to leave no one 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.

- 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. Aim to achieve evidence-based policy decisions on education technology and to share that evidence with other countries.
- 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 and from experiences conducted in similar contexts, 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.

- Establish a curriculum and assessment framework of digital competences for children, youth and adults that is broad, not attached to a 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, implement and comply with 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, avoiding applications that are unsustainable in terms of their energy and material requirements.

Syaiful studies at home with his mother Nurhidayah in Indonesia. Syaiful cannot freely move his lower body or his right hand.

Credit: © UNICEF/UNI358823/Ijazah*

CHAPTER

2

Equity and inclusion: Access to education

KEY MESSAGES

Technology supports open and distance learning in Southeast Asia.

- Broadcast media has traditionally expanded access to hard-to-reach learners in Southeast Asia. Educational television programmes in Thailand have compensated for teacher shortages in remote and underserved areas, reaching over a million students.
- Paper-based materials support distance learning when access to other tools is limited. More than four in five students in the Alternative Learning System in the Philippines, one of the largest second chance education programmes, use printed materials for learning.
- More than 90% of 16- to 24-year-olds in Indonesia, Malaysia and Thailand have a mobile phone, including those from disadvantaged backgrounds. Yet, despite the widespread use of mobile and online technology for learning purposes, little is known about it.

Inclusive technology supports access for students with disabilities.

- Many Southeast Asian countries have developed guidelines and regulations on assistive technology to remove barriers to education for students with disabilities.
- Assistive devices are not available for all those in need. Implementation is mostly project-based and limited in scope. A lack of availability, affordability and teacher preparation remain the main barriers.
- Accessibility features are rarely embedded in technology platforms and devices. In the Philippines, non-assistive technologies compensate for the lack of assistive devices in schools.

Technology supports learning continuity and system resilience in emergencies.

- Even before COVID-19, online learning had been used during the SARS and H1N1 outbreaks in Singapore.
- Radio and television have been used to support education disrupted by ethnic and political conflicts in Myanmar, while radio and self-instructional materials have provided learning during typhoons in the Philippines.

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

- During school closures, Southeast Asian countries adopted multiple technologies to support learning. Radio was used by the Lao People's Democratic Republic, Myanmar, the Philippines and Timor-Leste. Television instruction was adopted by all countries except Singapore. Over 2,000 lessons were developed, broadcast and watched by more than 70% of students in Viet Nam.
- Despite these initiatives, the most disadvantaged learners were left out. More than half of the countries in Southeast Asia did not adopt any distance learning measures for students with disabilities. In the Lao People's Democratic Republic, 87.5% of rural children were unable to access distance learning.
- Analysis of countries' COVID-19 response plans shows that Cambodia, Myanmar, Singapore and Timor-Leste developed resilience strategies. Myanmar's COVID-19 response plan aims to increase investment in distance learning and develop system resilience to future crises.

Southeast Asia has been using technology to enable distance learning for those living in remote areas and to facilitate access to education for those with disabilities. This chapter explores these technology-enabled solutions. It seeks to understand whether and how technology has helped increase enrolment and participation rates for marginalized learners. It then discusses how technology has been harnessed to support the education of learners with disabilities. Finally, it examines education disrupted by emergencies and how technology has ensured learning continuity and education system resilience during natural disasters, conflicts and pandemics.

TECHNOLOGY SUPPORTS OPEN AND DISTANCE LEARNING IN SOUTHEAST ASIA

Open and distance learning allows instructors and learners to interact from different locations and beyond a traditional classroom setting, drawing on a wide range of technologies to help learners who face barriers to attend school and access instructional content due to remote locations, resource and time constraints, emergency situations, and functional difficulties.

Open and distance education has a long tradition in the region. Study by correspondence dates back to the 1950s in Indonesia. It was complemented by printed material and radio to educate students from remote areas and those joining student brigades during the Indonesian national revolution (SEAMEO SEAMOLEC, 2023). In the same period, radio was used to support English language learning in the Philippines through the School Broadcast Programme, and to educate farmers in the Iloilo Province. The first on-air school, consisting of 30-minute radio lectures and discussions, institutionalized rural educational broadcasting in the 1970s. Printed materials complemented recorded radio lectures. It is estimated that at least 1.65 million farmers benefited from this form of education (Librero, 2015).

Every country has policies, plans, strategies and laws on distance education that identify technology to promote access to education for all learners and for those who are hard to reach (**Table 2.1**). Cambodia recognizes the potential of open and distance learning to improve access to education for marginalized and underserved communities (SEAMEO SEAMOLEC, 2023). The 2019 National Policy on Lifelong Learning identified the need to use information and communications technology (ICT) to expand access to formal and non-formal learning (Cambodia Ministry of Education, Youth and Sport, 2019). Timor-Leste's National Education Strategic Plan 2011–2030 identified both broadcast media and e-learning as technologies on which to base flexible and distance learning. An educational TV channel was used to reach out to illiterate groups through broadcasting literacy programmes (SEAMEO QITEP in Science, 2023; Timor-Leste Ministry of Education, 2011).

TABLE 2.1:
Selected policy documents promoting access to education through technology

Country	Selected key documents	Description
Brunei Darussalam	- AITI [Authority for Info-communications Technology Industry] Strategic Plan 2020–2025	To improve access to education through digital technologies.
Cambodia	- National Policy on Lifelong Learning (2019) - Master Plan for ICT in Education 2009–13 (2010) - Policy and Strategies on Information and Communication Technology in Education in Cambodia (2004) - Education for All: National Plan 2003–15	To expand access to quality education for marginalized and underserved communities through ICT, alternative education platforms and distance learning.
Indonesia	- Education Ministerial Degree (2014)	To address the shortage of teachers, inequality of education access and uneven distribution of educational resources across the archipelago through distance learning.
Lao PDR	- Education Strategic Vision up to the Year 2020 (2000)	To expand distance learning for disadvantaged or minority groups, and to improve access to higher education through technology.
Malaysia	- Malaysia Education Blueprint Higher Education 2015–25 - Malaysia Education Blueprint Plan 2013–25 - Policy on ICT in Education (2010)	To maximize the use of ICT for distance and self-paced learning to expand access to high-quality teaching regardless of location or student skill level, and to widen access to higher education by making it easily available to all segments of society.
Myanmar	- National Education Strategic Plan 2016–21 - National Education Law (2014)	Alternative Education Programme and distance learning to increase access to education for children facing difficulty accessing formal education, including those living in remote areas, conflict- and disaster-affected areas, on the move, or with disabilities and chronic health problems.
Philippines	- Alternative Learning System 2.0: Information and Communications Technology Strategic Plan 2022–2026 - Basic Education Development Plan 2030 - Open Distance Learning Act (2014) - Basic Education Act of 2001 – Alternative Learning System	To provide education and training to those unable to attend traditional schools, such as working adults, out-of-school youth and those living in remote areas using a mix of modular instruction; online, digital or mobile learning; radio or television-based instruction; and blended learning.
Singapore	- EdTech Plan (2020) - EdTech Masterplan 2030 - ICT in Education Master Plans (1997–2019)	To provide students with seamless access and a technology-enhanced learning environment to learn anytime, anywhere, and to make blended learning a regular feature of the schooling experience and develop digital platforms for e-learning in school education.
Thailand	- National Economic and Social Development Plan 2023–27 - National Education Plan 2017–36 - National Economic and Social Development Plan 2012–16 - Second Thailand ICT Master Plan 2009–13 - ICT Master Plan 2002–06 - IT Policy Framework 2001–10	To increase equal access to quality education through distance learning via satellite and the internet, and to encourage alternative education to promote flexibility, variety and accessibility of education.
Timor-Leste	- National Statement of Commitment to Transform Education in the Democratic Republic of Timor-Leste (2022) - National Education Strategic Plan 2011–2030 - Education System Framework Law (2008)	To organize distance education supported by multimedia and ICT as a complementary or alternative education method for out-of-school children; to establish flexible and distance learning systems to increase student participation and completion; and to expand the use of television for distance learning to enable those who are illiterate to learn regardless of time and space.

Continued on next page

TABLE 2.1 CONTINUED:

Country	Selected key documents	Description
Viet Nam	- Plan to strengthen the application of information technology and digital transformation in education and training for the period 2022–2025 - National Digital Transformation Programme to 2025 (2021) - Education Law (2005, 2019) - National Education for All Action Plan 2003–15	To extend education opportunities for adults and out-of-school youth through distance learning, media and continuing education centres.

Note: This table does not include COVID-19 and other emergency response plans.
Source: GEM Report team based on the Profiles Enhancing Education Reviews (PEER).

BROADCAST MEDIA HAS EXPANDED ACCESS TO HARD-TO-REACH LEARNERS

Traditional and interactive broadcast media, including radio, audio recordings and television, have made education available to hard-to-reach learners in Southeast Asia (SEAMEO SEAMOLEC, 2023). Radio has been historically used to provide education to remote and out-of-school learners in the region. Considered a cost-effective and sustainable technology, traditional radio and audio broadcasts are delivered in one direction (i.e. from the source to the learner) and require synchronous participation, engaging learners through questions and exercises. Interactive radio and audio instruction combines audio recordings, via compact disc or MP3 players, printed materials, and the active participation of both teachers and students (Burns, 2021; Damani and Mitchell, 2020).

Interactive radio instruction is one of the media used in the Philippines to deliver education to students living in remote and underserved areas (**Box 2.1**). Since 2008, the Department of Education in Malaybalay City has delivered a radio instruction programme based on real-time and on-demand broadcasts. Based on two-way interaction mediated by mobile text messages and social media, the programme has reached some 3,000 students facing obstacles in accessing education, including out-of-school youth and adults, inmates, children with disabilities, farmers, and indigenous and remote students. Interactive radio has been a cost-effective and efficient solution despite the limited personalization of learning materials (Philippine Normal University, 2023).

BOX 2.1:

The Philippines' Alternative Learning System relies on printed material

Established through the Governance of Basic Education Act in 2001 and expanded in 2020, the Philippines' Alternative Learning System aims to 'provide all Filipinos the chance to have access to and complete basic education in a mode that fits their distinct situation and needs' (Philippines Department of Education, 2023; Philippines Republic, 2001, 2020). It is one of the world's largest second-chance education programmes and is estimated to have reached 5.5 million learners aged 15 years and older between 2010 and 2020 (Igarashi et al., 2020). In 2016–21 alone, more than 4 million out-of-school youth and adults enrolled in the programme (Philippines Department of Education, 2022b).

The Alternative Learning System uses a combination of face-to-face instruction with printed materials, broadcast media, and online and blended learning through non-formal and informal education approaches. Paper-based materials were used by 83% of participating students, followed by blended learning (14%). Only 1% of the learners expressed a preference for online learning and digital modules, and less than 1% for radio-based instruction and television (Philippines Department of Education, 2021).

Continued on next page

BOX 2.1 CONTINUED:

The reliance on paper-based materials is likely to reflect the lack of access to other distance learning technologies and devices. An evaluation of the programme found that financial restrictions are the main cause of dropping out of formal education for students participating in the Alternative Learning System. Moreover, financial problems were consistently the main reason for students failing to complete the second chance programme (Osawa, 2021); just 1.5% of children from the poorest quintile live in a house with a computer, and less than 1% have an internet connection at home (SEA-PLM, 2019).

Printed material also remained the most popular distance learning modality during the COVID-19 pandemic, reaching over 20 million (75%) pre-primary, primary and secondary school students in the Philippines (Philippines Department of Education, 2022a). At the same time, printed material poses some limitations, including outdated content, sustainability issues and lack of interactivity (Philippines Department of Education, 2021). Despite the challenges, the Alternative Learning System 2.0 Information and Communications Technology Strategic Plan 2022–2026 aims to strengthen the use of digital technology in programme implementation, and to bring the remaining out-of-school population, which amounts to 15% of youth, to either formal or alternative education (Osawa, 2021; Philippines Department of Education, 2021).

Source: Philippine Normal University (2023).

Global evidence shows that the effectiveness of broadcast media for teaching and learning ultimately depends on the policy environment, specific education needs and goals, and available resources. In the Lao People's Democratic Republic, only 18% of school-aged children – and only 10% of children from the poorest households – have access to a radio at home (Lao PDR Statistics Bureau, 2018).

Indonesia relies on both radio and television to deliver education to address unequal education access in remote and underserved areas (Rui and Upadhyay, 2022). Radio has historically provided educational news and programmes to children and youth who could not attend formal education due to economic conditions and conflict (United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development, 2014). In the 1980s, the Educational Media Development Centre at the Ministry of Education and Culture launched Radio Edukasi (Prahmana et al., 2021). To complement this programme, Suara Edukasi provides educational podcasts. Distance education was then expanded through television broadcasts: TV Edukasi aired in 2004 on a public television channel (Machmud et al., 2021; UNICEF, 2021c).

Thailand has been using television as a form of distance learning since 1995 to compensate for teacher shortages in remote and underserved areas. Over the years, broadcasts have become available on-demand, and facilities and television definition have improved. Distance learning television is estimated to have reached over 1 million students – about 15% of the total student population, most of whom are from rural areas – and 50% of small-sized schools in the country. Shortages of learning materials, outdated content and limited teacher preparedness are reported as major challenges. Notwithstanding, the programme is found to contribute positively to learning outcomes (Dipendra, 2023).

Educational television has been found to be effective for learning. In the Lao People's Democratic Republic, My Village TV, a television programme broadcast on public channels since 2012, helps children prepare for school. Television broadcasts are complemented by multimedia and social media materials. In the poorest households, access to My Village TV was predominantly through television (66%) or DVD (64%) (Australian Council for Educational Research, 2023). One of the largest studies on this medium conducted with more than 32,700 grade 3 to 5 students in 516 schools shows that children who watched the Knowledge Channel, a Philippines-based educational channel, performed better than their peers in five subjects (Burns, 2021; Lapinid et al., 2017).

LITTLE IS KNOWN ABOUT MOBILE LEARNING DESPITE THE WIDESPREAD USE OF MOBILE TECHNOLOGY

Cellular phones and mobile technology are used widely in the region. Around 90% of 16- to 24-year-olds in Indonesia, Malaysia and Thailand and 48% of their peers in Cambodia use social media. Most of them reported using mobile technology for interaction and entertainment, but also for accessing learning content. Mobile applications and social media are used for accessing videos and information (UNICEF East Asia and Pacific Regional Office and the

Centre for Justice and Crime Prevention, 2020), and for language learning, including for the most marginalized (Maliphol, 2023).

However, despite the widespread use of mobile technology, little is known about mobile learning initiatives in schools in Southeast Asia (Farley and Song, 2015). Mobile technology supported the Empowering Women and Girls through Mobile Technology project in Myanmar. Part of the Connect to Learn project, it helped marginalized girls in rural schools develop English language skills and life skills as a means of empowerment and a pathway to increased secondary school retention (UNESCO, 2015). In the Philippines, the government provides informal mobile learning to those with limited access to education through partnerships with the private sector. Specific laws and policies support the use of mobile learning in the Alternative Learning System. The government has also partnered with the private sector to deliver digitized learning resources through mobile technologies to poor and underserved public schools (Churchill et al., 2018).

Online learning, which relies on student access to devices and the internet, is only used in selected countries at the primary and secondary level to increase access to education. Launched in 1997, the Smart School (Sekolah Bestari) project in Malaysia has increased access to education for students in rural areas through virtual classrooms and distance learning programmes (Subramaniam, 2023).

Flexible online learning is promoted as part of the Basic Education Equivalency Programme targeting out-of-school youth in Cambodia (Moodle, 2019). With the support of UNESCO, free online courses allow students to complete lower secondary education while being in full-time employment. Learning centres are equipped with internet access, tablets, computers and two trained facilitators. They provide students with government-accredited certificates which enable them to enrol in upper secondary or vocational education. Since its launch in 2019, the programme has reached over 1,500 early school leavers (UNESCO, 2023).

Digital technology also supports multilingualism in the region (Maliphol, 2023). In Southeast Asia, countries make use of technology-assisted language learning tools to support the education of ethnic minorities. Cambodia aims to reach 5,000 students in ethnic minority communities through a range of online and offline multimedia bilingual resources. The Ministry of Education, Youth and Sports provided a range of digital technologies to multilingual education schools to support the quality of teaching and learning in remote ethnic minority areas and help ethnic minority learners recover from the learning losses precipitated by school closures due to COVID-19 (Brehm et al., 2023).

INCLUSIVE TECHNOLOGY SUPPORTS ACCESSIBILITY FOR STUDENTS WITH DISABILITIES

Students with disabilities are one of the most disadvantaged groups in accessing quality education. Children with disabilities account for 5% of the student population in Cambodia and Malaysia, and 3% in the Lao People's Democratic Republic and Viet Nam (SEAMEO SEN, 2023). Children with disabilities tend to be excluded from education, and accessibility remains a major issue (UNESCO, 2020). Children with disabilities of primary and lower secondary school age in Cambodia are eight times less likely to be in education than their peers without disabilities, the largest gap between countries reporting data (United Nations, 2019). Only 6% of schools in Cambodia were fully accessible to children with disabilities, according to the Cambodian Disabled People's Organization (SEAMEO SEN, 2023).

Technology can promote inclusive education through multiple means of representing information, expressing knowledge and engaging in learning. Technology can support students with disabilities through fair and optimized access to the curriculum, contributing to the development of their independence, agency and social inclusion (UNESCO, 2020; UNICEF, 2021b). While inclusive technology is designed for all learners, assistive technology is specifically designed for individuals with disabilities and helps them perform functions that they might otherwise find difficult or impossible (Burns, 2021; Masitry et al., 2013).

All Southeast Asian countries have ratified the Convention on the Rights of Persons with Disabilities, which endorses 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). However, in the absence of good guidance on how to operationalize inclusive technology (**Box 2.2**), many countries continue to rely on assistive devices where available (Banes et al., 2020; World Bank, 2022).

BOX 2.2:

Accessibility features are rarely embedded in technology platforms and devices

Globally, 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, immersive readers and voice control (Dinechin and Boutard, 2021). However, evidence of benefits in Southeast Asia is scarce and implementation at schools is very limited, particularly due to the cost and lack of internet accessibility (SEAMEO SEN, 2023).

In the Philippines, special school teachers indicated that non-assistive technologies, including laptops, tablets, computers, radios, speakers and recorders, are used to support students with disabilities and are considered beneficial to learning and student motivation. They can be used to compensate for the unavailability of assistive devices (Campado et al., 2023). Alternative Learning System programmes require accessibility features in the design of learning resources (Philippines Republic, 2020) and provide tablets and laptops to students with disabilities (SEAMEO SEN, 2023). In Malaysia, the use of educational multimedia software for teaching deaf preschool students enhanced knowledge retention, increased engagement and reduced student learning time by more than 80% compared to traditional learning approaches (Masitry et al., 2013).

In Thailand, the Accessible Online Teaching Platform for Students with Disabilities project, organized by the Office of the Basic Education Commission, trains teachers on developing websites that contain accessible digital learning materials that all types of students with disabilities can access. In Viet Nam, the e-learning system follows the Web Content Accessibility Guidelines (WCAG 2.0) (SEAMEO SEN, 2023).

Indonesia regulated education for students with disabilities in 2020 to ensure they could access quality education. But despite some small-scale projects, including Sekokah Enuma, an application with flexible and inclusive basic numeracy and literacy activities, learning platforms rarely have accessibility features. As a result, students with disabilities were the most excluded group from education during COVID-19 (Asian Development Bank, 2022a; UNICEF, 2021c).

Regulations and policies in the region promote the use of inclusive and assistive technologies, such as screen readers, text-to-speech software and tablets (SEAMEO SEN, 2023). The Philippines' Inclusive Education Act requires all schools to provide reasonable accommodations and support services, including sign language interpreters and assistive technology, to ensure that students with disabilities have equal access to educational opportunities (Philippines Republic, 2021). In Thailand, the Persons with Disabilities Education Act similarly requires assistive technology to be provided to students with disabilities (Thailand Kingdom, 2008). The Lao People's Democratic Republic and Viet Nam support the provision of assistive technology to students with disabilities in their national strategies, while Cambodia has developed guidelines for the use of assistive technology in education (SEAMEO SEN, 2023). The Ministry of Education of Malaysia has adopted guidelines outlining the types of technology that should support the education of children with disabilities in special schools. These include screen reader software for the blind to enable access to digital content, voice-to-text software that enables communication and participation in learning activities for students with speech impairments, tablets with accessibility features, and interactive whiteboards to cater to different learning styles and abilities (Subramaniam, 2023).

ASSISTIVE TECHNOLOGY REMOVES BARRIERS TO LEARNING BUT CHALLENGES PERSIST

Assistive technology is used in education 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 range from high-tech devices to low-tech devices that do not involve complex electronics and specialized software, including long canes, tablets, magnifying glasses and large print books (Lynch et al., 2022; SEAMEO SEN, 2023). The Ministry of Education of Singapore provides assistive technology devices, such as frequency modulation equipment, text-to-speech software and magnifiers to support students with hearing, visual or physical impairments to successfully integrate into the mainstream school environment (Disabled People's Association, 2016; Singapore Ministry of Education, 2023).

However, many interventions tend to be limited in scope, are mostly applied on a project basis and encounter significant implementation challenges. According to a mapping of programmes targeted to pre-primary and primary school age children with disabilities in Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Thailand, Timor-Leste and Viet Nam, most countries had limited to no available assistive devices and accessible

learning resources in general and special education systems. Assistive devices were usually only available for a limited number of schools, mostly only special schools, and for certain types of impairments, such as visual impairments (UNICEF, 2020b). Moreover, there is a lack of clear guidelines on the procurement, distribution and maintenance of assistive devices, as well as on the training of teachers and support staff (SEAMEO SEN, 2023).

According to a survey of special school students in Chiang Mai, Thailand, many considered that assistive technology facilitated their education and students with hearing impairments needed it for communication (Lersilp et al., 2018). The Total Communication with Animation Dictionary software was developed to teach deaf learners sign language in pre-primary and primary schools, with results indicating improved learning performance for students using the programme compared to traditional learning methods (SEAMEO SEN, 2023). The Thai government has invested in the development of assistive technology, including screen readers and speech recognition software, in tertiary education. Disability Support Services, overseen by the Department of Empowerment of Persons with Disabilities, provides Braille translation (68%), equipment and assistive technology or software rental services (55%) and audio books (29%) to university students with disabilities. However, students reported dissatisfaction with equipment or software provision (19%) and skills training on equipment or software (17%). Sign language interpreting was not considered to be adequately provided, while notetaking services were only provided by 26% of universities (Nuchpongsai et al., 2020). In the Philippines, inclusive education community resource centres provide assistive equipment, including Braille translation software, screen reader software and portable electronic magnifiers, to support blind learners or those with visual impairments (SEAMEO SEN, 2023). Malaysia has developed a digital Braille textbook.

A lack of availability and affordability hinders access to assistive technology for many people with disabilities in Southeast Asia. It is estimated that only 5% to 15% of people who need assistive technology in Viet Nam have access to it; and only 10% in Cambodia and the Lao People's Democratic Republic. Similarly, only some 20% and 30% of people with disabilities have access to assistive technology in Thailand and Malaysia, respectively (SEAMEO SEN, 2023). Financial support is available in some richer countries. People with disabilities in Malaysia can apply for the Financial Assistance for Artificial Aids and Assistive Devices programme to enjoy fully subsidized access to assistive technology (Malaysia Department of Social Welfare, 2022; UN Women, 2020). In Singapore, the Assistive Technology Fund covers up to 90% of the cost of assistive equipment for people with disabilities to use for education purposes (Enabling Guide, 2023; Singapore Ministry of Social and Family Development, 2021), while the Special Education Needs Fund helps students purchase assistive devices and support services, such as alternative keyboards, text-to-speech devices and Braille displays (Singapore Institute of Technical Education, 2021).

Inadequate teacher training can result in the ineffective use or inappropriate selection of technologies for specific children (Banes et al., 2020). In the Philippines and Thailand, governments provide training to teachers on how to use technology to support students with disabilities (SEAMEO SEN, 2023). But many teachers lack training and awareness on the use of assistive technology in the classroom. A situational analysis on ICT readiness by the Ministry of Education and Sports in the Lao People's Democratic Republic found that while almost half of the teachers surveyed reported having students with disabilities in the classroom, only 9% used technology on a regular basis to assist students to learn (Lao PDR Ministry of Education and Sports, 2021a). In Viet Nam, despite compulsory pre-service teacher training in inclusive education (SEAMEO SEN, 2023), many teachers reported never (23%) or rarely (19%) receiving any in-service training courses on technology use and pedagogical skills for teaching students with disabilities (Vinh et al, 2023).

Language differences also pose significant challenges in the use of assistive technology, with many assistive technology solutions only available in English or other major languages, such as Mandarin and Arabic, which are not suitable for the local contexts (SEAMEO SEN, 2023).

TECHNOLOGY SUPPORTS LEARNING CONTINUITY AND SYSTEM RESILIENCE IN EMERGENCIES

Technology has long been used to support distance learning and increase the resilience of education systems during emergencies in Southeast Asia (Tauson and Stannard, 2018). Online learning supported learning continuity in Singapore during the Severe Acute Respiratory Syndrome (SARS) and Swine Flu outbreaks in the 2000s (Barbour, 2021). E-learning was practised quarterly to ensure emergency preparedness across the country. In the event of full school closures, the Ministry of Education disseminated the Curriculum Continuity Plan checklist, home-based learning lesson guides and schedules for educational broadcasts (SEAMEO INNOTECH, 2014).

Due to their location and physical features, Southeast Asian countries are particularly vulnerable to natural

hazards, including typhoons, earthquakes, tsunamis and floods (ASEAN, 2016; UNICEF, 2021a). With an average of 20 typhoons per year (Ramirez, 2022), and 74% of its population vulnerable to natural disasters, the Philippines is considered to be at a particularly high risk of learning disruption (David et al., 2018). In 2020, when schools closed due to COVID-19 (Trinidad and Osawa, 2023), 8 typhoons struck (Lagmay and Rodrigo, 2022), one of which destroyed 4,000 classrooms and further disrupted learning for 2 million children (Angrist et al., 2023). To ensure learning continuity, the Department of Education offers flexible learning options, such as self-instructional materials and radio-based instruction through collaborations with local radio stations, local government units and other stakeholders (Philippines Department of Education, 2020; SEAMEO INNOTECH, 2014).

Tablets with preloaded materials, satellite television and internet-enabled devices have been used as part of the Mobile Literacy for Out-of-School Children initiative in 60 schools and migrant learning centres in the Tak, Chiang Rai, Kanchanaburi, Ranong and Samut Sakhon provinces of Thailand. Tablets were preloaded with over 1,000 books and learning materials in Thai, Burmese and Karen languages through the LearnBig app. Teachers were trained to develop ICT-integrated lesson plans and enhance the learning experience of disadvantaged children through mobile learning and ICT devices. Since 2015, the project has reached more than 6,200 migrant and marginalized Thai children and teachers across 89 migrant learning centres and enhanced the literacy and numeracy skills of over 5,500 migrant, ethnic minority, stateless and marginalized children along the Thailand–Myanmar border (Dipendra, 2023). Radio, television and, to a limited extent, online learning were used to deliver distance education in Myanmar, while broadcast media has supported a parallel education system for students not attending government schools (GCPEA, 2022; Nanthakorn et al., 2023).

To increase the resilience of education systems in the region, the ASEAN Safe Schools Initiative developed a set of School Disaster Risk Management Guidelines for Southeast Asia in partnership with the SEAMEO Regional Center for Educational Innovation and Technology (INNOTECH). To complement SEAMEO INNOTECH's Toolkit for Building Disaster-Resilient School Communities in Southeast Asia, the guidelines promote ICT-supported alternative modes of instruction during emergencies, including homeschooling, open and distance learning, and radio-based instruction (ASEAN, 2016).

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

The COVID-19 pandemic created the most severe disruption to education systems in history and the longest sustained period of school closures. In Southeast Asia, the duration of school closures varied widely. In the Philippines, schools remined closed for over two years (Trinidad and Osawa, 2023). Brunei Darussalam, the Lao People's Democratic Republic and Timor-Leste reopened schools and educational institutions between June and August 2020 (UNICEF and UNESCO, 2021b).

All countries in Southeast Asia quickly responded to the pandemic by developing education continuity plans. They launched or strengthened online platforms and take-home packages. Radio was used by the Lao People's Democratic Republic, Myanmar, the Philippines and Timor-Leste (UNICEF and UNESCO, 2021b). A combination of radio and television programmes were broadcast as part of the Eskola Ba Uma (School Goes Home) initiative in Timor-Leste, with the support of UNICEF, targeting 350,000 children (UNICEF Timor-Leste, 2020). The programme Radio Comunidade provided learning continuity in line with the national curriculum with World Bank support.

All countries except Singapore adopted television instruction (UNICEF and UNESCO, 2021b). Due to its near-universal access at the household level and existing distance learning television infrastructure, Thailand expanded its Distance Learning Television channel with 17 additional channels, with an estimated reach of over 1 million students and teachers (Dipendra, 2023). To expand the existing TV Edukasi channel, Indonesia launched Belajar dari Rumah (Study from Home), a series of TV programmes, to ensure learning continuity for those who could not learn online (UNICEF, 2021c). Cambodia and Viet Nam used broadcasting stations that reached 96% and 90% of the school-age audience, respectively (SEAMEO INNOTECH, 2023). In Viet Nam, over 2,000 lessons were developed, broadcast and watched by more than 70% of students throughout the country (Hoang et al., 2022). In Malaysia, satellite TV ensured learning continuity in areas not covered by the internet. DidikTV, a dedicated educational TV channel, and EduWeb TV, an educational videos portal, provided educational resources during the pandemic.

Building on an existing emergency distance learning system and a long history of technology integration in education, Singapore succeeded in shifting to online

learning (World Bank et al., 2021). At the end of one full month of online distance learning, the government reported a near universal student participation rate of 96% (NCEE, 2020), arguably the reason why Singapore did not adopt television instruction, as it did not need to.

Social media and communication channels were among the most widely used platforms for teaching, learning and support in Indonesia. A small-scale teacher survey suggested that 72% had used WhatsApp to provide distance learning (Azhari and Fajri, 2022). The instant messaging application was also used for official information dissemination, covering more than 5 million teachers from pre-primary to tertiary education (UNHCR, 2021). However, social media and communication channels were mostly used to send homework assessments and parents expressed concerns over the lack of student support and interaction (Putra et al., 2020). Mobile messaging applications were similarly promoted as the key tool for interaction among schools, students and teachers in Cambodia, where 78% of households and 86% of teachers had access to smartphones (Cambodia Ministry of Education Youth and Sport, 2021). Almost two in three teachers reported using messaging applications at least once a week for distance learning, with almost half of them using them daily (Brehm et al., 2023).

Despite these measures, millions of children in Southeast Asia were not reached by remote learning due to uneven access to services and resources and a lack of preparedness for the widespread adoption of distance learning. Online platforms, adopted as a form of distance learning by almost all countries, failed to reach children in rural and remote areas and those with a disability (UNICEF and UNESCO, 2021b). Of the 70% of students who engaged in distance learning in Cambodia, only 35% were estimated to have access to online learning materials (Brehm et al., 2023). Meanwhile, a lack of devices and full access to digital resources prevented access to education. In Myanmar, less than half of the student population had access to a computer or a laptop, while access to internet and mobile data networks was limited (Nanthakorn et al., 2023).

Location and income were the key factors affecting the reach of remote learning policies. In Viet Nam, students from the poorest and less-educated households were 34% and 21% less likely to experience distance learning, respectively, than those from the richest and more-educated households (Hossain, 2021). Broadcast lessons reached 87% of students in major cities compared to only 40% in remote areas (Hoang et al., 2022). In Timor-Leste, a larger share of students in rural areas (40%) used offline sources such as student workbooks for remote learning than the share of students in urban areas (12%). Students in the highest wealth quintile (42%) mostly used online resources compared to students in the poorest households (7%). Over one third of students in Timor-Leste stopped studying or studied irregularly due to the scarcity of printed learning materials (Timor-Leste Ministry of Finance and UN Timor-Leste, 2021).

In the Lao People's Democratic Republic, where distance learning was implemented through television (Lao PDR Ministry of Education and Sports, 2021b), only 29% of households reported that their school-age children engaged in remote learning activities during school closures, with a disparity between urban (41%) and rural (24%) areas (World Bank, 2021). Meanwhile, 78% of urban children and 88% of rural children were unable to access distance learning due to a lack of digital resources (USAID, 2021). Teachers in remote communities were instructed to meet with small groups of children for face-to-face teaching, but the number of students reached was not monitored (UNICEF and UNESCO, 2021a).

Some countries in the region, including Myanmar, Thailand and Viet Nam, adopted targeted strategies for the learning continuity of children with disabilities. Yet more than half of the 11 countries did not adopt any distance learning measures for these students. Most online platforms were not designed to accommodate students with visual or hearing impairments (UNICEF and UNESCO, 2021b). In Indonesia, teachers received inadequate guidance on how to deliver distance learning to children with disabilities, with 74% of respondents in a home-based learning assessment reporting that it was difficult for children with disabilities to follow online learning (SEAMEO SEN, 2023; UNICEF and UNESCO, 2021b). In Viet Nam, 53% of Mong and 14% of Tay, Thai, Muong and Nung students could not access remote learning during school closures. Learning material in ethnic minority languages was limited (Vinh et al, 2023).

Paper-based materials served as the main distance learning method when access to other tools was limited. In the Lao People's Democratic Republic, 90% of schools engaged in remote learning using take-home packages (Australian Council for Educational Research, 2023). 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). About 90% of grade 6 teachers provided additional school materials to their students to support distance learning (Bhatta et al., 2022). Some 70% of students could access some form of distance learning (UNICEF, 2020), of which

45% used worksheets and other paper-based materials (Cambodia Ministry of Education Youth and Sport, 2021).

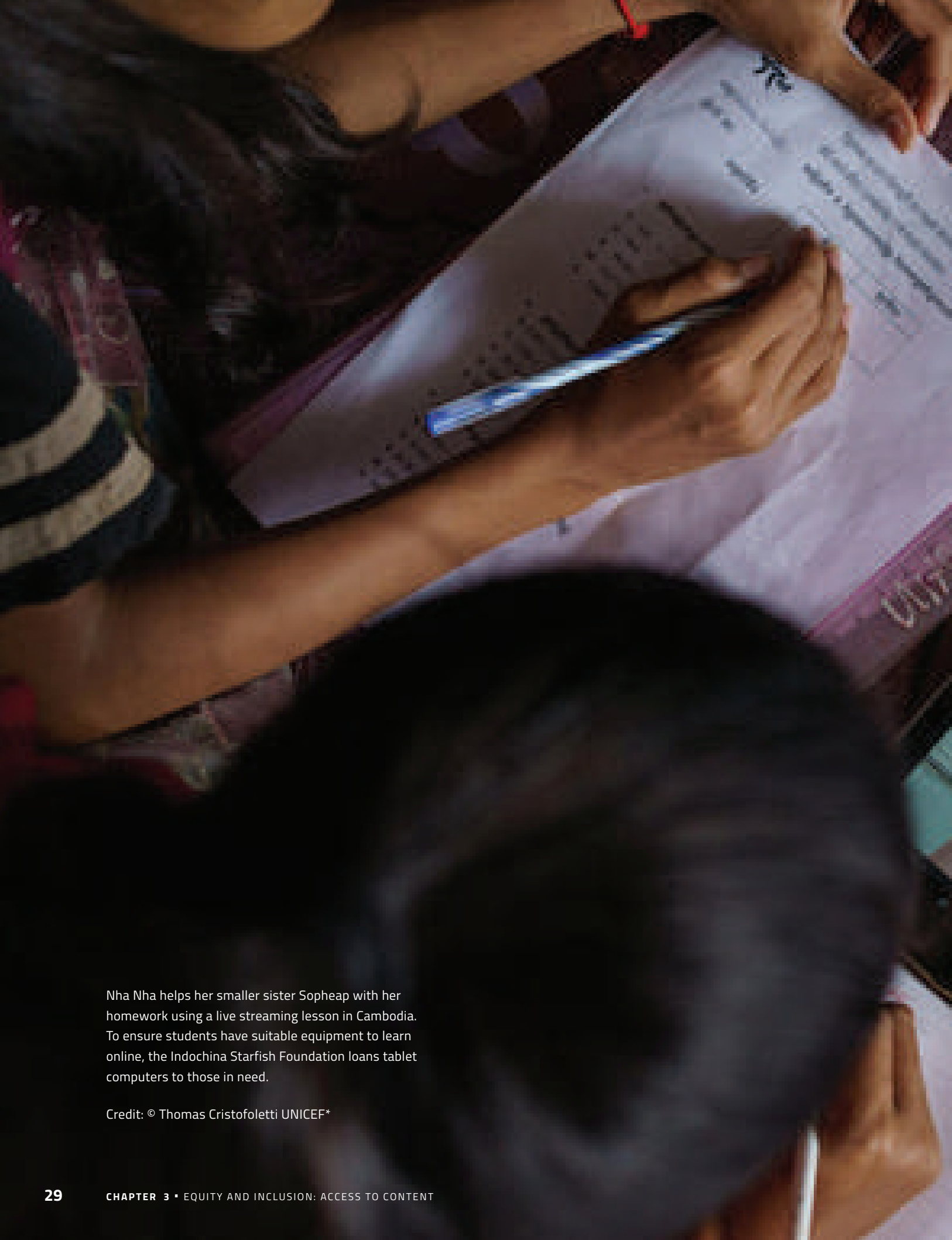
Some countries supported remote learning for disadvantaged groups. Cambodia distributed 1,640 radios to ethnic minority groups in Kratie, Rattanakiri and Mondulkiri provinces to support multilanguage learning (Brehm et al., 2023). Radio broadcasts were available in three of Cambodia's most widely spoken ethnic minority languages (Tumpoun, Kreung and Bunong) (Action Education, 2020), reaching some 7,000 children at pre-primary and primary levels (Khieu, 2021). In the Lao People's Democratic Republic, the Ministry of Education and Sports provided tablets with accessibility options for children with disabilities to access online learning. Videos included subtitles and sign language options for students with hearing impairments, while children's books were translated and adapted to the accessible EPUB format for children who could not access online learning (Australian Council for Educational Research, 2023); this allowed children to read digital resources while offline. Likewise, the Philippines added Filipino Sign Language insets and subtitles to 200 episodes, converted another 200 episodes to radio-based instruction and translated 50 episodes to mother tongue languages, with the support of the United States Agency for International Development (Asian Development Bank, 2022b).

The COVID-19 pandemic accelerated the adoption of open and distance learning in Southeast Asia to increase access to education services and prepare for future emergencies (SEAMEO SEAMOLEC, 2023). New distance learning policies and regulations were adopted in Malaysia and Viet Nam that led to the institutionalization of online teaching (SEAMEO SEAMOLEC, 2023; Subramaniam, 2023). Guidelines, directives and measures for the use of distance learning were issued in Cambodia (Brehm et al., 2023).

Education response systems implemented during the pandemic aimed to accelerate system resilience, enabled by technology, in a region that is at high risk of climate change disasters (ASEAN, 2016; UNICEF, 2021a). Analysis of national COVID-19 response plans shows that Cambodia, Myanmar, Singapore and Timor-Leste 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 and recovery, as well as existing distance learning programmes (Cambodia Ministry of Education, Youth and Sport, 2020). The COVID-19 response plan in Myanmar aims to increase investments in distance learning and develop system resilience to future crises, given the country's high exposure to hazards (Myanmar Ministry of Education, 2020).

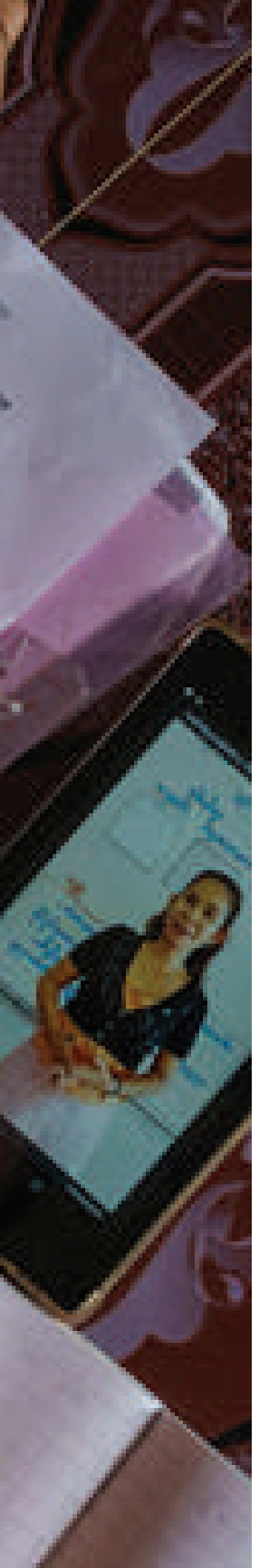
CONCLUSION

Technology is offering alternative education solutions for hard-to-reach learners in Southeast Asia. More recently, technology-supported education delivery has also been used as a response to natural disasters and pandemics. National policy and regulatory frameworks enable the use of technology for access to education. But implementation is hindered by limited infrastructure, the limited availability and lack of affordability of devices, and low teacher capacity. There is a risk that the use of technology may exacerbate existing inequalities, particularly for learners from more disadvantaged backgrounds, as happened during COVID-19. Following the experience of the pandemic, some countries in Southeast Asia have made efforts to further integrate distance learning into their education systems to increase access to education and build education system resilience to future crises.



Nha Nha helps her smaller sister Sopheap with her homework using a live streaming lesson in Cambodia. To ensure students have suitable equipment to learn online, the Indochina Starfish Foundation loans tablet computers to those in need.

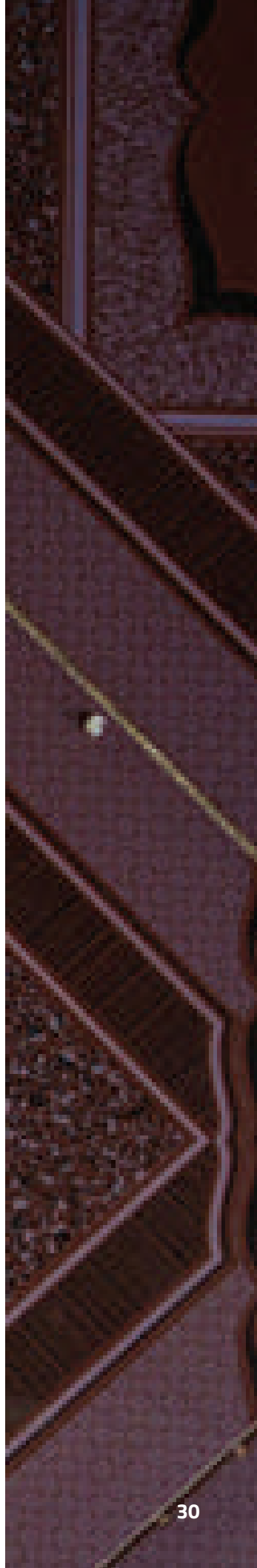
Credit: © Thomas Cristofoletti UNICEF*



CHAPTER

3

Equity and inclusion: Access to content



KEY MESSAGES

Technology facilitates content creation in Southeast Asia.

- Open educational resources (OERs) facilitate affordable, efficient and more inclusive content creation. In Malaysia, the replacement of university textbooks and courseware with OERs led to estimated savings of MYR 1.4 million (USD 300,000) within four years.
- Awareness and positive attitudes toward OERs have traditionally been high in the region; the uptake of OERs is catching up. Since 2018, OERs and free and open courseware have been made available through the Southeast Asian Massive Open Online Courses Network.
- Social media is widely used to access and share educational content. The Violet e-library, a social network system for teachers in Viet Nam, counts nearly 14.6 million members.

Digitization simplifies content distribution and increases access.

- Digital and open textbooks help address the problem of shortages, especially in local languages. Since 2008, Indonesia has made e-books available as part of the Electronic School Textbook Programme.
- Digital libraries and educational content repositories are mostly centralized. In Viet Nam, the Law on Libraries unifies a diverse set of digital resources and content.
- Learning management platforms have multiplied in Southeast Asia: 96% of students in Singapore, 77% in Thailand and 59% in Indonesia went to schools that had an online learning platform. Yet most teachers do not have incentives to use them.
- Offline and mobile learning platforms are key when access to internet is low but the use of mobile phones is high. The Philippines promotes an offline OER library for 'last-mile' schools.
- Social media applications are used as learning management systems in low-resource areas. In Indonesia, 70% of respondents in primary schools use WhatsApp groups instead of learning platforms.

Technology increases content availability but raises quality and equity challenges.

- The quality of digital education content is ensured through strong government oversight. Malaysia has aligned learning materials, such as digital textbooks and educational videos, with the curriculum. However, in the Philippines, the centralized quality process is highly resource-intensive and is time consuming.
- Technology increases access to content but mostly to those who already have it. Less than 20% of 10- to 14-year-old learners across Southeast Asia reported having access to digital education platforms.
- Technology can reinforce language discrimination in content production. Over 60% of open access journals in Malaysia, the Philippines and Viet Nam only accept English submissions.

Access to quality education resources remains one of the main challenges of education systems worldwide. Southeast Asian countries have made significant efforts to expand access to content through digital technology. Some countries and institutions in the region have used technology to make the creation, adaptation and sharing of content easier, advocating for and fostering open educational resources (OERs). Governments have strongly promoted the creation of digital resources, including digital textbooks, digital libraries, online repositories and learning management systems. The COVID-19 pandemic accelerated this trend. However, several challenges remain before technology can achieve its full potential of increasing access to education materials. The questions of who produces digital content and who benefits from it is affected by inequality in access to technology.

This chapter first focuses on content creation and Southeast Asia's experience with OERs in compulsory education and beyond. It investigates how content is created, adapted and shared in the region, including by teachers. The chapter then looks at how Southeast Asian countries distribute, store and manage content in light of the increase in digital libraries and learning platforms. Finally, it examines challenges that prevent learners and teachers from fully benefiting from the growing number of digital education resources in terms of quality and equal participation in creation and access.

TECHNOLOGY FACILITATES CONTENT CREATION IN SOUTHEAST ASIA

Content development is characterized by its initial development and subsequent adaptations, modifications and edits. Digital technologies can help content to be produced and shared efficiently through a more participatory process. Technology is also particularly useful in fostering co-creation and adaptation through the open education movement, which can be framed along two dimensions: the right to access content without restrictions and the right to adapt or modify content due to open licenses (Janssen et al., 2023).

OERs, a term coined by UNESCO in 2002, are 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 license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others' (UNESCO, 2019b, p. 5). OERs are primarily associated with online and digital educational technologies but can also refer to printed materials (Butcher et al., 2023).

OERs are based on five freedoms – to retain, reuse, revise, remix and redistribute resources – which can contribute to education by improving the quantity of relevant learning materials in a cost-effective way (Miao et al., 2019). By reusing and repurposing resources, it is possible to cut development time and avoid duplication of work. This contributes to reducing spending on materials by both students and institutions. In Malaysia, an initiative by Wawasan Open University to replace textbooks and courseware with OERs is estimated to have reduced the cost of course development by MYR 1.4 million (USD 300,000) within four years of its implementation (Arumugam, 2016).

OERs can also improve content quality and inclusiveness. The open sharing of resources increases peer review and fosters continuous improvement of materials and greater inclusion in education. The possibility of modifying materials makes it easier to make them accessible to different learners (Janssen et al., 2023). In Indonesia, teachers have developed Inibudi.org, an OER platform that engages communities and the general public in raising awareness and sharing learning resources in remote areas. Curriculum-aligned printed materials and videos are distributed through DVDs and USB drives to educators and students (Omidyar Network, 2019).

Linked to the OER movement, technology has increased opportunities to create content collaboratively. The Association of Southeast Asian Nations (ASEAN) launched a global cyber university in 2009 with the goal of sharing learning management systems and OER platforms in Southeast Asia, involving a growing number of countries and higher education institutions over the years. Since 2018, the ASEAN Cyber University ACU-OER project has been collecting and combining free e-learning content from different platforms based in the region (ACU Project, 2022).

THE UPTAKE OF OERS IS CATCHING UP WITH INCREASING AWARENESS AND INCENTIVES

In Southeast Asia, awareness and positive attitudes towards OERs have traditionally been high. A decade ago, three quarters of higher education decision makers interviewed in Indonesia, Malaysia, the Philippines and Viet Nam had already reported familiarity with and awareness of OERs (Dhanarajan and Abeywardena, 2013, p. 15). However, the uptake of OERs has been hampered by the inability to search for and locate resources effectively (Otto, 2019).

In Asia, OERs are more widespread in higher education than at the lower levels (Lim et al., 2017). Over the past decade, initiatives to raise awareness of OERs have multiplied, sponsored by leading higher education institutions and regional organizations. Wawasan Open University, a contributor to the UNESCO 2012 Paris OER Declaration, has been promoting OERs through an OER repository and awareness raising. With the support of Canada's International Development Research Centre, it launched OERAsia, a forum which aimed to facilitate Asian stakeholders to share information, research and guidelines, knowledge resources, and practices in OERs in Asia (Liew, 2016). In 2014–17, it jointly hosted with the University of Cape Town an international research project – Researching Open Educational Resources for Development (ROER4D) – focusing on the use, creation and impact of OERs in the Global South with the involvement of researchers from Indonesia, Malaysia and the Philippines (DataFirst, 2023; Janssen et al., 2023).

Based on its Strategic Plan 2021–2030, SEAMEO implements programmes and projects that facilitate knowledge exchange and enhance access to education resources. Since 2018, OERs and free and open courseware have been made available through the Southeast Asian Massive Open Online Courses Network (SEAMEO Secretariat, 2021b, 2021a). The OER hub platform was launched in 2019 to collect and freely share education resources produced by SEAMEO centres and partners, and educational institutions based in Southeast Asia. Resources are accessible through Rumah Belajar, Indonesia's national learning platform (SEAMEO SEAMOLEC, 2020).

The COVID-19 pandemic accelerated the adoption of OERs in Cambodia, the Philippines and Viet Nam (SEAMEO INNOTECH, 2023). At the level of higher education, the Commission on Higher Education of the Philippines financed the PHL CHED Connect Platform, an open education resources platform that provides educators and students with free teaching, learning and research materials. Based on a partnership with Globe Telecom, a telecommunications service provider, PHL CHED Connect is accessible for free to customers worldwide (World Bank, 2022). Overall, 18 higher education institutions have uploaded nearly 1,500 items of content materials and about 350 videos. As of January 2022, the OER platform counted close to 200,000 subscribers, and 65% of its users have accessed it through mobile phones (PHL Connect Platform, 2020; World Bank, 2022).

OERs have also proliferated in compulsory education. Cambodia has developed several portals, including Open Educational Resources Cambodia, that contain teaching and learning materials organized by level, grade and topic in order to improve searchability (Brehm et al., 2023; Cambodia Ministry of Education Youth and Sports, 2022). In the Philippines, since 2020, there has been a surge in the use of the government's Learning Resource Portal, an OER platform that serves as a repository of downloadable teaching and professional development resources (Philippine Normal University, 2023).

SOCIAL MEDIA IS WIDELY USED TO ACCESS AND SHARE EDUCATIONAL CONTENT

Social media allows users to generate and share content and to engage in social networking. The number of studies analysing the role of social media in education has skyrocketed (Barrot, 2021; Greenhow et al., 2019). While Indonesia and the Philippines, the most populous countries in the region, record the highest numbers of active social media users, Brunei Darussalam and Malaysia have the highest penetration rates (Statista, 2023). Southeast Asia is also one of the regions where users spend the most time on social media (Hedges, 2023).

Social media can be an important educational resource through user-generated content. Teachers often consider social media as a more reliable and curated source of updated practices and strategies than the internet because of the user-generated content from fellow educators (Greenhow et al., 2019; Trust et al., 2016). In Timor-Leste, teachers have widely reported using social media for learning and improving teaching materials, particularly through YouTube (SEAMEO QITEP in Science, 2023). On Telegram and Facebook, Cambodian teachers share resources through groups and channels organized by school disciplines (Asian Development Bank, 2022c). Teachers in the Philippines also use Facebook to collaborate and share resources. The Department of Education is working on institutionalizing Facebook Workplace as a communication method (Asian Development Bank, 2022b). In the Lao People's Democratic Republic, the Faculty of Agriculture of the National University of Laos relies on social media, in particular Facebook, to upload materials, exchange notes and mediate communication between lecturers and students, mostly through mobile phones (Australian Council for Educational Research, 2023; Starasts et al., 2017).

In Viet Nam, the Violet e-library is a social network system for teachers that allows them to learn from their peers. Teachers share lesson plans and video recordings and can easily receive feedback and advice from colleagues nationwide. In May 2023, there were nearly 14.6 million members, with over 500 million visits to the platform (Vinh et al, 2023).

DIGITIZATION SIMPLIFIES CONTENT DISTRIBUTION AND INCREASES ACCESS

Digitized education materials help systems overcome barriers associated with distribution and storage. Despite significant upfront costs, including infrastructure and training, the digitization of textbooks greatly reduces the production and distribution unit cost (Brown and Heavner, 2018; Lee et al., 2013). To address the issues of increasing costs and school textbook shortages, Indonesia launched the Electronic School Textbook Programme in 2008. The ministry buys the copyright of selected books to be shared with the education community via a dedicated portal. The number of e-books made available for free has increased every year (Asian Development Bank, 2022a).

Digital and open textbooks help address the problem of shortages, especially in local languages, often caused by stringent procurement policies and challenging supply systems (Arinto and Cantada, 2013). Since 2008, the Vietnam Open Educational Resources programme, supported by the Vietnam Foundation and many scholars, has been engaged in digitizing learning materials and has made more than 20,000 modules available for free under the Creative Commons Attribution licence (Do, 2013; Vietnam Foundation, 2023). The Ministry of Education and Training has also digitized all textbooks and exercise books in grades 1 to 12 and made them freely available to teachers and students (Vinh et al., 2023).

Digital textbooks support the integration of online and distance learning and help expand access to online content (**Box 3.1**). In Singapore, e-books in textbook and workbook formats enable hybrid education to be included as a permanent teaching and learning mode. Most digital textbooks include multimedia resources, visualizations and interactive content (Centre for Evidence and Implementation, 2023). However, digital textbooks do not substitute for printed books. Print and digital materials provide diverse advantages and often complement each other (Jang et al., 2016; Loh and Sun, 2018; Millar and Schrier, 2018). International assessments found that students in Singapore have benefited from digital materials but a survey of 6,000 students and a focus group with students across 6 secondary schools in Singapore showed that students still used printed books for reading (Loh and Sun, 2018).

Southeast Asia has promoted the development of digital textbooks, particularly since the COVID-19 pandemic. In the Philippines, the government is piloting a new Learning Resource Portal for Kids, where textbooks for basic education will be digitally available, along with other learning materials (Philippine Normal University, 2023). In Malaysia, the government launched the Digital Textbook Initiative during the COVID-19 pandemic, aimed at providing digital textbooks to all students in the country.

BOX 3.1:

Digital textbooks have contributed to increasing Korean students' motivation

The Republic of Korea has introduced digital textbooks in schools. Initially piloted at grade 5 and in four subjects, digital textbooks were progressively developed and distributed to cover all subjects and grades starting from 2018. The reform of the national curriculum in 2015 paved the way to their introduction and further development. The Korea Education and Research Information Service, a government-sponsored institute, has overseen their development in partnership with private companies (Jang et al., 2016; Jeong and Kim, 2015).

Digital textbooks have several other potential benefits in addition to increasing access to digital content, including enhancing engagement and collaboration and promoting personalized and self-directed learning (Chapter 4). Digital textbooks include textbook content, multimedia content, and dictionaries and hyperlinks, and also serve as learning management tools, monitoring progress and collecting information, and as a repository for external and supplementary resources (Jeong and Kim, 2015). A meta-analysis on the effects of the introduction of digital textbooks in primary and lower secondary schools in the Republic of Korea showed that digital textbooks can increase students' external motivation, as they are intrigued by their interactive functions. However, the motivational effects have not directly led to changes in learning attitude and performance (Jang et al., 2016). Still, a study conducted in a sample of Korean schools before and after the introduction of digital textbooks showed that both students and teachers benefited from the digital resources. Students reported the highest improvements in critical thinking and the ability to use information (UNESCO, 2019a).

During and in the aftermath of the COVID-19 pandemic, the number and use of digital textbooks has increased in the Republic of Korea. Building on the country's past experience, immersive content, such as virtual and augmented reality, has been integrated into existing digital material, and artificial intelligence (AI) applications have been embedded in new textbooks. In 2023/24, the Ministry of Education plans to scale up AI-embedded textbooks to expand personalized learning opportunities in the country.

Source: Korea Education and Research Information Service (2023).

Over 750 digital textbooks have been uploaded to the Ministry of Education's Digital Educational Learning Initiative Malaysia (DELIMa) platform, introduced in 2019. At first, textbooks were uploaded only in static formats, but interactive sections are gradually being added. The Malaysia Digital Economy Blueprint encourages education publishers to transition to e-books and interactive formats by 2030 (Subramaniam, 2023). As of October 2023, it was accessed by 4.1 million students (85%) and 420,000 teachers (99%).

GOVERNMENTS SUPPORT DIGITAL LIBRARIES AND EDUCATION CONTENT REPOSITORIES

The overwhelming amount of digital education resources has increased the need to develop mechanisms to store resources efficiently, as well as to manage and organize them. Digital repositories can help improve information retrieval and increase access to content (**Box 3.2**).

In Southeast Asia, governments play an important role in developing education content repositories. In Thailand, the Office of the Basic Education Commission has operated an education content portal since 2014 that contains books, videos, images and teaching materials that can be used by both students and teachers in primary and secondary education (Dipendra, 2023). In 2020, the Department of Education of the Philippines launched DepEd Commons, an online learning platform through which public school teachers can download OER created by other teachers and which are aligned with the national curriculum (Philippines Department of Education, 2020). However, content is reviewed, accepted and shared outside of the platform (RTI International, 2022). Accessible via mobile phone, it had reached more than 10.5 million unique users by 2021, with over 4,500 updated resources (Philippines Department of Education, 2021).

In Viet Nam, the Digitalized Vietnamese Knowledge directive was implemented nationally in 2017 and has led over 60 education and training institutions and over 700 bureaux of education and training to develop their own education resource databases. The Ministry of Education and Training has also developed its own portal, Kho học liệu số, that connects all educational institutions and allows them to share resources with each other (Vinh et al, 2023). In 2019, the government passed a Law on Libraries, which specifies the creation of a shared digital library that will act as a unified portal to allow users to access a diverse set of resources and contents (Vinh et al., 2023).

BOX 3.2:

Open access publishing increases access to scientific content

The open access movement aims to make publications available to everyone free of charge. Applied to academic publishing in the early 1990s, when the first open access journals and free repositories were created, it experienced a great push from international initiatives, including the Budapest Open Access Initiative in 2002, the Bethesda Statement on Open Access Publishing in 2003, and the 2003 Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (Queen Mary University of London, 2023; Sciendo, 2022). The number of open access articles has since skyrocketed. It is estimated that the number increased nearly ten fold between 2000 and 2009, from 19,500 to over 191,000 (Laakso, 2011). By 2019, there were over 18.5 million open access articles published and some 31% of all journal articles were freely accessible online (Piwowar et al., 2018, 2019).

Countries in Southeast Asia, Latin America and Africa lead the way in supplying freely available articles online. Indonesia is the world leader both in the absolute number of open access journals published and in the total research output: 81% of all journal articles published by an Indonesia-affiliated author in 2017 are freely available to read online – the highest rate in the world – and 74% of them are published with open access licenses (Noorden, 2019). This is in line with the country's surge in open access journals published by universities and in pre-print repositories that host manuscripts from multiple disciplines (Noorden, 2019; Shih, 2018).

LEARNING MANAGEMENT SYSTEMS HAVE MULTIPLIED IN SOUTHEAST ASIA

A learning platform, also known as a learning management system, is an integrated set of resources, tools and online services for teachers and learners within a course structure. 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.

In recent years, most countries in Southeast Asia have developed and encouraged the use of learning management systems in compulsory education. The Ministry of Education and Culture of Indonesia initiated the Rumah Belajar (House of Learning) digital platform in 2011. Initially conceived as support for home learning for disadvantaged youth, the portal has expanded to include materials from pre-primary to technical and vocational education and training, facilities for online classes, collaboration, and teacher training on information and communications technology (ICT) and OER aligned with the Indonesian curriculum. The portal was particularly relevant during the COVID-19 pandemic (Asian Development Bank, 2022a; UNICEF, 2021). Introduced in 2017 in Singapore, the digital portal Student Learning Space facilitates access to curriculum-aligned teaching and learning materials, the administration of learning assessments, and monitoring of student progress (NCEE, 2023; Singapore Ministry of Education, 2023b).

Governments often partner with private companies to develop learning management systems. In Malaysia, the Ministry of Education partnered with Google, Microsoft and Apple to launch its digital learning platform DELIMa in 2020. The platform is used by 370,000 teachers and 2.5 million students (Subramaniam, 2023). In Thailand, the Ministry of Education launched the Digital Education Excellence Platform in collaboration with Google, Microsoft and other private companies. The platform integrates learning tools intended for students and teachers, as well as classroom and school management tools to help monitor school budgets and resources. Despite the high public investment, however, the platform is estimated to be used by only 13% of schools and is criticized for serving as an access point for Google and Microsoft systems (Dipendra, 2023).

UNICEF has supported platform development in some countries. UNICEF and Microsoft have implemented the Learning Passport, a digital platform launched in over 30 countries and territories that can serve as a national learning management system or to complement existing learning platforms (McCarthy, 2023). The Lao People's Democratic Republic, in collaboration with UNICEF, launched the country's first digital learning platform, Khang Panya Lao, or the 'Lao Wisdom Warehouse', based on the Learning Passport project (UNICEF, 2022). The platform can be accessed both online and offline via an application and hosts learning resources for students and training resources for teachers' professional development. It is also an interactive learning space that can be paired with other messaging and video-calling applications to improve engagement between students and teachers. Nevertheless, lack of awareness, training and access to the internet still hinder its adoption (Australian Council for Educational Research, 2023). Timor-Leste has also developed its first learning platform within the Eskola Ba Uma (School Goes Home) initiative with the support of UNICEF. A telecommunications company hosts learning materials on a platform, which include television and

radio programmes and electronic books, which can be downloaded by subscribers without an internet connection (UNICEF Timor-Leste, 2020).

Mobile and offline learning platforms are important when access to internet is low but the use of mobile phones is high. In Indonesia, the Ministry of Education and Culture developed the Merdeka Mengajar platform to support teachers in delivering the new Merdeka Curriculum (**Chapter 6**) through online and offline methods. Teachers organize learning materials aligned with the curriculum, assess students' literacy and numeracy, and share best practices with their peers, including through an application for mobile phones (SEAMEO RECSAM, 2023). Within the Digital Rise programme aimed at expanding ICT in education, the Philippines has promoted a large offline OER library combining over 7,000 resources from the Learning Resource Management and Development System, 20,000 interactive exercises from Khan Academy, and 5.8 million articles from Wikimedia resources. The library is aimed to specifically be used for last-mile schools that are located in hard-to-reach areas and often do not have an internet connection (RTI International, 2020).

Social media applications are commonly used as learning management systems in low-resource areas due to their ubiquity, mobile accessibility and user friendliness (Cavus et al., 2021). In Cambodia, the Ministry of Education, Youth and Sports created educational content for Facebook and Telegram to help learners continue their education during the COVID-19 pandemic. Teachers also use instant messaging applications to send students papers or assignments (Brehm et al., 2023). Similarly, teachers reported having used social media such as Facebook, WhatsApp and Telegram to provide virtual learning during school closures in Malaysia and Thailand (Dipendra, 2023; SEAMEO RECSAM, 2023). A survey conducted by the Ministry of Education, Culture, Research, and Technology in Indonesia in 2020 among almost 15,000 respondents in primary schools found that 70% of them used WhatsApp groups instead of learning platforms. Teachers reported being unprepared and students are often not aware of existing website and digital resources (Asian Development Bank, 2022a; UNICEF, 2021). Social media was also preferred over learning platforms due to low internet speed, affordability and easiness (UNICEF, 2021).

Learning management systems can also promote non-formal education programmes. In Indonesia, the Setara Daring platform allows users to create and manage courses, develop student learning assessments, track student attendance, and participate in discussion forums. Its use spiked during the COVID-19 pandemic: the number of learners increased from about 2,000 in 2019 to over 100,000 in 2022. The number of institutions and tutor users also increased tenfold each during this period (SEAMEO SEAMOLEC, 2023).

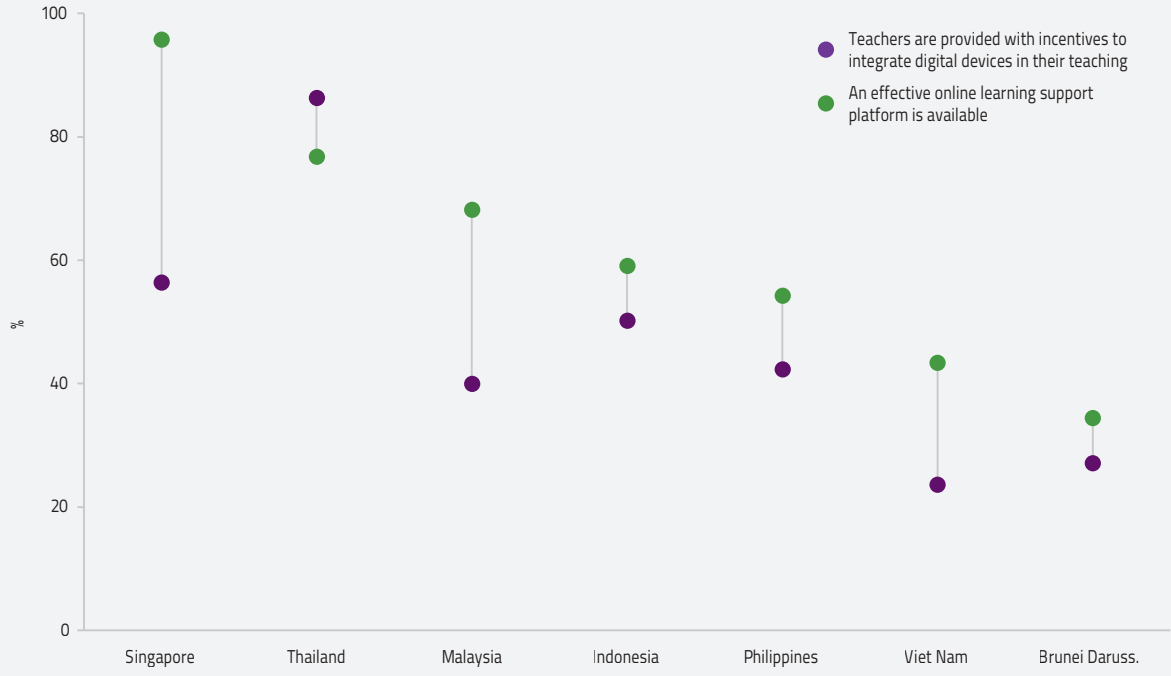
Despite governments' efforts to develop learning management systems, teachers may not have incentives to use them. In 2018, 96% of students in Singapore went to schools whose principal reported that an effective online learning support platform was available. The same was true for 77% of students in Thailand and 59% in Indonesia (OECD, 2020). Yet, in six out of seven Southeast Asian countries with available data from the OECD's Programme for International Student Assessment (PISA), the share of students going to schools where teachers received incentives to integrate digital devices in their teaching was considerably lower (**Figure 3.1**); Thailand was the exception. In Malaysia, while 68% of students reportedly had access to an online learning platform, only 40% went to schools where teachers were provided with incentives to integrate digital devices in their teaching.

TECHNOLOGY INCREASES CONTENT AVAILABILITY BUT RAISES QUALITY AND EQUITY CHALLENGES

Digital educational content has grown exponentially. It comes from an increasingly diverse group of providers. The content aims to fulfil very different needs. Concerns have therefore been raised about how to ensure minimum quality standards (Mulla et al., 2023).

Strong government oversight over the content and its producers has been a common approach in the region to ensure quality. In Cambodia and Viet Nam, the governments set up committees to evaluate all education materials before they are made available on education platforms (SEAMEO INNOTECH, 2023). In the Philippines, experts and subject teacher experts develop content for the Learning Resource Portal – a repository of teaching resources – and submit it to the Department of Education, which assesses its quality, sometimes through an independent evaluation, before uploading (Philippine Normal University, 2023). The Malaysia Education Blueprint 2013–2025 set a goal to improve the quality of the videos uploaded to the EduwebTV channel on YouTube. The Ministry of Education requires school inspectorates to curate all submissions and then the ministry aligns them to the curriculum so that students can find materials more easily (Subramaniam, 2023).

FIGURE 3.1:
Even if there are digital platforms, teachers may not have incentives to use them
Percentage of students in schools whose principal agreed or strongly agreed with the statements 'An effective online learning support platform is available' and 'Teachers are provided with incentives to integrate digital devices in their teaching', 2018



Source: OECD (2020).

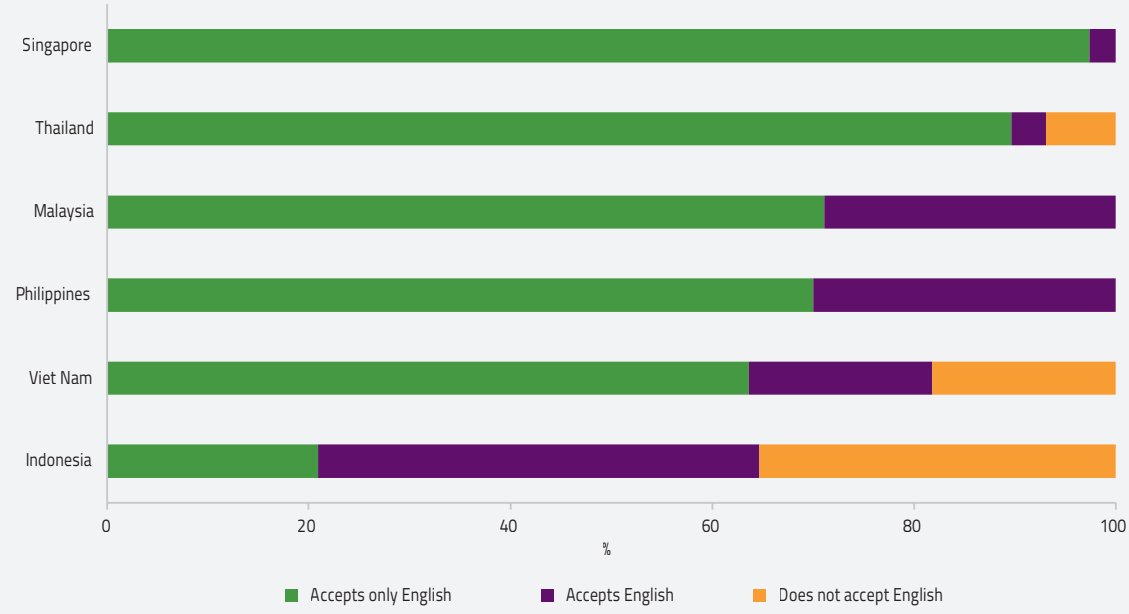
However, regional studies describe operational challenges faced by ministries of education, including lack of capacity of employees, lack of ICT infrastructure, and inadequate or fragmented policies on digital content, including those regarding copyright issues (**Chapter 9**). These can hinder quality control processes (SEAMEO INNOTECH, 2023).

Teacher participation is key to the creation of high-quality content, but incentives are limited. In the Philippines, the centralized quality assurance process takes time and is highly resource-intensive, which may prevent teachers from getting involved (RTI International, 2020). Indonesian teachers who have completed their training in ICT and have been particularly active in creating and sharing content through the digital platform, Rumah Belajar, become ambassadors of the national portal and enter the Guru Penggerak, Teachers as Agents of Change programme. The objective is to involve 400,000 teachers in the programme by 2024 (Asian Development Bank, 2022a).

Another challenge technology poses is that it can reinforce inequalities in content production. OER production and use are 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, but only 20% are from Asia. Moreover, most OERs available worldwide are in English (Janssen et al., 2023).

Open access to research may reinforce biases in who is published. Many open access journals – some 30% of those registered in the Directory of Open Access Journals – charge an article processing fee to authors. This share is nearly 40% for Directory of Open Access Journals from Indonesia and Singapore, potentially restricting access from poorly funded authors or institutions (Directory of Open Access Journals, 2022). Research indexes can be another source of inequity in publishing. In addition to being accused of favouring commercially published journals, they require journals to systematically publish

FIGURE 3.2:
Most open access journals in the region only accept English submissions
Share of open access journals registered in the Directory of Open Access Journals by languages accepted, selected Southeast Asian countries, 2022



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

English abstracts as well as a given percentage of English articles (sometimes over 50%), effectively contributing to global inequality in content production (Aguado-López and Becerril-Garcia, 2019; Bosman et al., 2021). Over 60% of open access journals in Malaysia, the Philippines and Viet Nam only accept English submissions. The share reaches 90% in Thailand and 97% in Singapore (**Figure 3.2**).

The lack of production of digital resources in students' mother tongues is a challenge (Farley, 2023). Myanmar's distance education programme, promoted through the Transformation by Innovation in Distance Education project, relied on English materials, only partially translated in Burmese. Driven by the increase in mobile internet, the project aimed to combine face-to-face instruction with online and distance learning, but the lack of resources in local languages and the need to create ad hoc material for the courses was a problem for its effective implementation (Brown and Hung, 2023; Gregson and Fawssett, 2020).

Several initiatives in the region focus on producing locally relevant content. Thailand launched Thai Open Educational Resources in 2015, a project supported by the National Science and Technology Development Agency to promote the creation and sharing of Thai local and indigenous knowledge among institutions, teachers and learners (ITU, 2018). As of July 2023, more than 5,000 users had contributed to producing and uploading materials (Open Education Resource Library, 2023). The Vietnam OER programme is conceived of as a resource repository 'of Vietnamese people and for Vietnamese people'. It aims to promote Viet Nam's history, literature and culture through OERs (Vietnam Foundation, 2023). The Ministry of Religious Affairs, in collaboration with the Ministry of Communication and Information of Indonesia, has developed an e-learning portal with resources for madrasahs (SEAMEO SEAMOLEC, 2023).

Finally, technology can also reinforce inequality by increasing access to content mostly to those who already have it. 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. In 2021, less than 20% of 10- to 14-year-old learners across Southeast Asia reported having access to digital education platforms (UNICEF and ASEAN, 2021). But students

FIGURE 3.3:
Students in privileged schools have more access to online learning platforms
Percentage of students in schools whose principal agreed or strongly agreed that an effective online learning support platform is available, 2018

Source: OECD (2020).

from advantaged schools are more likely to have access to learning platforms than those from disadvantaged schools: in Thailand, while 88% of 15-year-old students in advantaged schools reportedly have access to an effective online learning support platform, the same is true for only 61% of students in disadvantaged schools. The gap is even wider in the Philippines: 75% of students in advantaged schools versus 39% of students in disadvantaged schools (**Figure 3.3**).

In Viet Nam, poor digital skills, a lack of training opportunities and language barriers have widened the gap in access to content between teachers of different socioeconomic backgrounds, in particular between those from the Kinh ethnicity and those from ethnic minorities. Nearly 40% of schools in Viet Nam, most of which are in disadvantaged areas, have not developed digital education resources (Vinh et al., 2023). In Indonesia, digital resources tend to be mostly used by urban users and direct consumers. Low internet speed and lack of affordability prevent both learners and educators from accessing them (Asian Development Bank, 2022a).

CONCLUSION

Technology has improved access to content in Southeast Asia. Open education resources have helped make content creation more affordable, efficient and inclusive. Digital libraries and repositories improve storage and distribution channels, and learning management systems help organize the contemporary learning environment. Governments in the region have played an important role in ensuring minimum standards and have led the digitization of resources and their dissemination.

Yet ensuring the quality, relevance and accessibility of an overwhelming amount of digital educational content is difficult. The development of digital public goods and the use of free and open educational resources are important steps in that direction. Making content production more inclusive remains challenging, as educational resources are often not available in different languages, seldom adapted to different contexts and realities, and not accessible by all learners and teachers.

Nong Van Duong, 15, and Nong Van Thanh are students in Viet Nam. Duong and Thanh faced difficulties during the COVID-19 pandemic while other students were able to use smartphones or laptops to continue their education. Duong and Thanh tried to copy the recording from the online class and played it on an old red radio.

Credit: © UNICEF/UN0610388/Le Vu*

CHAPTER

4

Teaching and learning in basic education

KEY MESSAGES

Technology's potential to improve teaching and learning needs to be proven.

- Technology continues to be taught as a subject. In many Southeast Asian classrooms, its integration into teaching and learning remains centred on teachers.
- The limited evidence of technology's impact on learning shows a small positive effect, but studies are often restricted in scope to geography, subject or duration. Many surveys gather perceptions rather than evidence on impact.

ICT use in classrooms is low, even in the region's high-income countries.

- About 8% of 15-year-old students in Brunei Darussalam, Singapore and Thailand used digital devices for more than one hour per week in mathematics and science, according to the 2018 Programme for International Student Assessment.
- 90% of teachers in Cambodia and the Lao People's Democratic Republic reported 'never' or 'hardly ever' using computer-based resources for teaching mathematics in the 2019 Southeast Asia Primary Learning Metrics.

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

- Pre-recorded lessons accompanied by teaching guides can be effective. In the Philippines, the Text-2-Teach project led to learning improvements across subjects and grades in about 900 schools.
- Devices with preloaded content do not improve learning without the content being integrated into the curriculum and contextualized. In Thailand, the One Tablet Per Child programme distributed over 800,000 tablets to primary schools but was later discontinued due to a lack of integration into classroom practices.

Technology can improve instruction quality through personalization.

- Due to its affordability, portability and low data usage, mobile learning is increasingly used to supplement in-school instruction. Digital personalization may have a positive impact on learning outcomes. The computer-assisted personalized learning software, Think!Think!, improved mathematics achievement in a study of primary school students in Cambodia.

With appropriate pedagogical integration, digital technology can improve student engagement in some contexts.

- Digital game-based learning applications are widely used. In Malaysia, Kahoot!, a digital game-based platform was found to be effective in improving primary student lesson engagement due to quiz-like features that promoted competitive and interactive learning.

But technology use also carries the risk of increasing distraction and lowering student engagement.

- About 30% of students in Viet Nam reported increasing non-academic distractions, such as browsing social media and playing video games, while using technology to study.
- The switch to online learning during COVID-19 affected student engagement. Students in Cambodia reported lower scores in the national learning assessment in Khmer and mathematics.

The rapid increase in the uptake of digital technology in Southeast Asia has made digital skills an essential part of learners' basic skill set. However, while students need to be taught *about* digital technology, to acquire digital literacy (**Chapter 6**), 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. This chapter focuses on the use of digital technology for teaching and learning. It analyses the potential and challenges of technology integration. It then reviews the two main ways in which digital technology is used to improve education quality: by improving teaching (through distributing resources more equitably, personalizing and increasing practice opportunities); and by better engaging learners.

TECHNOLOGY IS USED BUT NOT EXTENSIVELY IN TEACHING AND LEARNING

Technology can be used in many ways to improve teaching and learning (Escueta et al., 2020; Ganimian et al., 2020; Major et al., 2021). It can personalize instruction and supplement instructional time. It can enhance engagement by varying how content is represented, for instance using multimedia, digital games and collaborative tools (Praheto et al., 2020). It can stimulate interaction and promote collaboration. But it can also allow learners to learn wherever they are, switch between formal and non-formal contexts and promote self-directed learning (Boticki et al., 2015; Farley and Song, 2015).

Personalization and adaptive learning technologies have been integrated in some cases in national educational platforms and commercial applications used in Southeast Asia (Octava Foundation et al., 2022). Yet, teaching and learning processes have not yet been transformed.

In many Southeast Asian education systems, technology is still taught as a subject and its integration into teaching remains centred on teachers (Rodrigo, 2018). Teachers report being inadequately prepared to use technology in their pedagogy (SEAMEO INNOTECH, 2023a). For instance, teachers in the Philippines encountered difficulties in adapting to new technologies and software (Philippine Normal University, 2023). Moreover, learners tend to be distracted by technology as they associate it with leisure activities instead of study (Vinh et al, 2023).

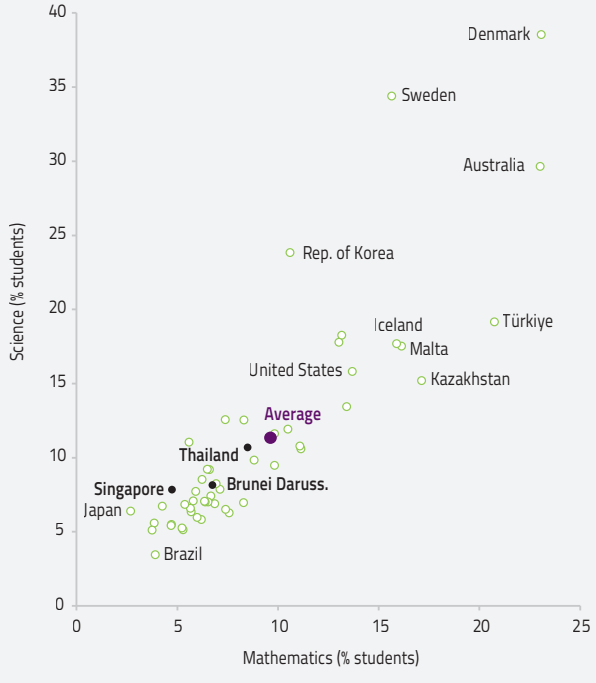
The proliferation of commercial education technology companies in Southeast Asia, often acting as both salespeople and government partners, poses different challenges. Microsoft has partnered with several governments in the region to support ambitious national technology integration plans. In Brunei Darussalam, the Microsoft Partners in Learning Programme, in partnership with the Ministry of Education, supports the inclusion of digital tools in primary and secondary education (Othman, 2019). Microsoft has developed localized versions of its e-learning platforms, provided devices, and trained teachers and students in using Microsoft 365 software, for instance in Indonesia (Courtois, 2023; Indonesia News Center, 2022). In the Lao People's Democratic Republic, Microsoft worked with the Ministry of Education and Sport under the Education Transformation Agreement to integrate technology in learning and pedagogical practices (Microsoft, 2015). However, private companies are more likely to target the most affluent schools and users, with implications on equitable quality teaching and learning. In the Philippines, private schools extensively use commercial software, such as those provided by Google and Microsoft. Public schools are less likely to use education technology in teaching and learning processes (Octava Foundation et al., 2022).

National policies and plans are gradually shifting to enable teaching through the medium of technology (SEAMEO INNOTECH, 2023a). Singapore's Transforming Education through Technology Masterplan 2030 supports technology-enriched environments for self-directed, personalized, connected and student-centred teaching and learning (Singapore Ministry of Education, 2023b). Thailand's and Viet Nam's information and communications technology (ICT) plans aim to integrate technology to improve pedagogy. Timor-Leste prioritizes ICT infrastructure through its National Strategic Development Plan 2011–2030 and aims to equip schools and staff with devices to further integrate digital technology in education (SEAMEO INNOTECH, 2023a; SEAMEO QITEP in Science, 2023).

A few countries in Southeast Asia are also integrating artificial intelligence in their education systems with the goal of improving teaching and learning processes. In Singapore, the National Artificial Intelligence Strategy and the EdTech Plan promote artificial intelligence for personalizing teaching and learning (Schiff, 2022) through national learning platforms (Singapore Ministry of Education, 2022a; Singapore Smart Nation and Digital Government Office, 2019). The Lao People's Democratic Republic developed a Machine Learning Education Framework in 2020 and adopted a Use-Modify-Create approach, according to which students engage with and modify software to create new software (UNESCO, 2022).

But despite policies encouraging ICT integration, technology use was low in classrooms before COVID-19, even in richer countries. According to the 2018 Programme for International Student Assessment (PISA), only about 8% of 15-year-old students in Brunei Darussalam, Singapore and Thailand used digital devices on average for more than one hour per week in mathematics and science lessons (**Figure 4.1**). In the 2019 Southeast Asia Primary Learning Metrics (SEA-PLM), technology was not used extensively for teaching and learning, with 90% of teachers in Cambodia and the Lao People's Democratic Republic reporting 'never' or 'hardly ever' using ICT for teaching mathematics (**Figure 4.2**).

FIGURE 4.1:
Technology is not used extensively in secondary science and mathematics lessons
Percentage of 15-year-old students using digital devices for at least one hour per week in mathematics and science classroom lessons, selected countries, 2018



Source: 2018 PISA database

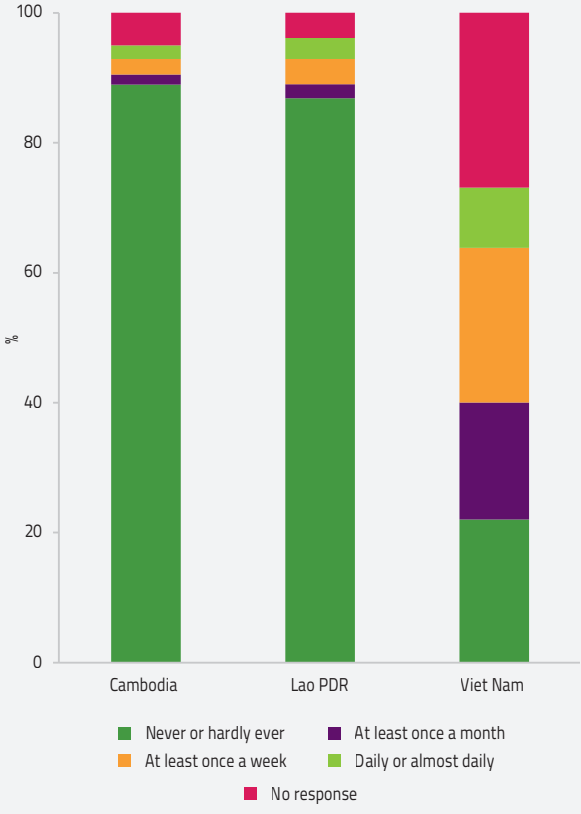
TECHNOLOGY'S POTENTIAL TO IMPROVE TEACHING AND LEARNING NEEDS TO BE PROVEN

Evidence on how technology interventions affect learning should inform the adoption and scaling up of technology use in education settings. Yet such evidence is not systematically collected (SEAMEO INNOTECH, 2023a) and is therefore lacking (Asian Development Bank, 2022), making it difficult to make informed decisions (Rodrigo, 2018). The limited evidence that exists in the region suggests small positive effects from the integration of specific technologies on learning. However, as is the case globally, studies on education technology effectiveness do not always include a control group and are often based on perceptions, making it difficult to assess impact. Attributing any positive effects to technology rather than other factors, such as added instruction, time, resources or teacher support, remains difficult (Mayer, 2019).

PRE-RECORDED AND BROADCAST LESSONS CAN SUPPORT DISADVANTAGED LEARNERS

Some countries have used pre-recorded and live broadcasting of lessons to reduce gaps in access and instructional quality. Evidence on how live and pre-recorded lectures help improve learning outcomes remains limited in the region but it is assumed they improve the quality of instruction available to disadvantaged learners if contextualized to local needs and supported by extensive teacher training.

FIGURE 4.2:
Technology is not often used in Cambodian and Laotian primary mathematics lessons
Percentage of teachers who reported using computer-based resources for teaching mathematics in primary classrooms, selected Southeast Asian countries, 2019



Source: SEA-PLM 2019.

Even before the advent of digital technology, radio- and television-based instruction was found to have positive effects. In Indonesia, a study conducted among kindergarten students showed that interactive audio instruction improved linguistic, cognitive, physical and psychomotor development. An evaluation of Radio Math, an international programme implemented in Thailand in the 1980s, also showed a positive impact on learning (Ho and Thukral, 2009).

Since 1995, Distance Learning Television in Thailand has provided nationwide broadcasted pre-recorded lessons, aligned to the national curriculum, to some 15,000 small schools in remote areas. Promoted and implemented by the Office of Basic Education, the programme registered a slight increase in the average scores in schools taking part in the 2014 Ordinary National Educational Test. Capitalizing on this initiative, since 2015, experienced teachers from better-served schools have delivered live classes and educational content to under-resourced schools as part of the Distance Learning Information Technology Classroom. Surveys highlighted that more than 90% of all respondents – including parents, teachers and students – were satisfied with this expanded project and considered it to be highly beneficial. The success of this broadcasting intervention can be traced to the quality of integration and added support. The project was supported by a significant teacher professional development programme, regular supervision from school administrators and the high engagement of teachers and parents (Dipendra, 2023; Kraiubon, 2021).

Pre-recorded lessons accompanied by teaching guides can improve the quality of instruction and improve learning in areas with limited teaching resources. Introduced in 2004, the Text-2-Teach project was launched in the Philippines as a public–private partnership including Nokia, the SEAMEO Regional Center for Educational Innovation and Technology (INNOTECH), local government units and the Department of Education to improve the quality of teaching and learning resources in underserved public schools through mobile technology. Mobile phones with preloaded educational content, teacher guides and other mobile learning resources were provided in English, mathematics and science. Teachers could send text message requests for educational resources to be delivered via satellite to a school television (Farley and Song, 2015; Roble, 2018). Scaled up to about 900 schools by 2014, the project led to significant learning improvements across subjects and grades, according to a quasi-experimental study of grade 5 and 6 pupils from 12 schools in 3 provinces. Positive results were also recorded in minority and 'last mile' schools. However, the impact differed by province and by teaching experience (SEAMEO INNOTECH, 2014, 2023b). Moreover, providing devices to students with pre-recorded lessons has not always been successful. It is not enough to just deliver inputs without contextualizing them and providing support (**Box 4.1**).

BOX 4.1:

Preloaded content requires that it be integrated into teaching and contextualized

In the early 2000s, large-scale programmes providing devices to every child, such as the One Laptop Per Child (OLPC) project, were implemented in some countries in Southeast Asia, including in the Philippines, Singapore and Thailand. The project provided low-cost, low-maintenance laptops with low connectivity requirements and loaded with free open source learning materials. The laptops aimed to promote learning by doing, encouraging students to share their experiences and learn together. In the Philippines, OLPC was piloted in 2010 when digital devices were distributed to primary school students (Philippines Congress, 2011). However, the programme outcomes varied by context, depending on the availability of teacher support and training and the contextualization of learning resources.

Thailand's One Tablet Per Child project was the largest globally, with 800,000 devices distributed to primary schools. Launched in 2012, the project led to the development and distribution of about 300 preloaded multimedia learning resources, including e-books, videos, and interactive content for mathematics, science, Thai, social studies and English. Despite the significant investment, the project faced challenges related to developing contextualized content, ensuring hardware usability, providing teacher training to enable pedagogical integration, and assessing learning impact. Teachers were not able to integrate the tablets into classroom practice and students used them to play games. The project was eventually phased out (Tubplee, 2019; Viriyapong, 2013), although its revival was recently announced (Bangkok Post, 2023).

As part of the National Digital Literacy Programme, all secondary school students in Singapore are provided with digital devices. The programme has been supported by technical assistance and guidance to school administrators, teachers and parents. Personal learning devices are used with the national e-learning platform, the Singapore Student Learning Space, and specific education technology applications to personalize learning. In 2020, 9 in 10 students reported having access to personal learning devices (Singapore Ministry of Education, 2020, 2023b). In 2021, the Ministry of Education decided to ensure the provision of subsidized and free device ownership to all secondary school students, a decision accelerated by the COVID-19 pandemic (Lee and Ho, 2021).

SUPPLEMENTING INSTRUCTIONAL TIME WITH TECHNOLOGY CAN IMPROVE LEARNING

Video lessons, online libraries and mobile learning platforms provide supplemental instruction, often after school and without time and space barriers. Asynchronous video lessons can supplement school teaching and promote self-directed learning at learners' own pace. In the Philippines, public secondary school teachers developed video lessons to support online distance learning in 2020/21. Students attended an hour of synchronous classes per week and engaged in three hours of asynchronous video lessons via Google Classroom. A quasi-experimental evaluation of the impact of these video lessons on a purposely selected sample of 50 students, including low-performing learners, found improvements in examination scores and understanding of concepts (Insorio et al., 2023).

Public–private partnerships have promoted technology-based supplementary learning initiatives to promote specific objectives. With United States Agency for International Development support, the Department of Education in the Philippines has been implementing ABC+ Reading, a five-year early grade literacy project. As part of this project, the free digital libraries, Bloom and Let's Read, have been developed with reading materials adapted to support children's proficiency in local languages, such as Miraya Bikol and Southern Sorsogon (Education Development Center, 2018).

In Malaysia, a private after-school initiative, E-Kelas, provides access to educational content aligned to the syllabus. The platform includes live tutorials provided through video-conferencing software by experienced teachers based in Kuala Lumpur. E-Kelas was delivered in more than 70 internet centres and reached more than 13,000 students, especially in remote areas (Maxis, 2019). Available in Indonesia, Malaysia and Singapore, the Khan Academy, an international learning platform, provides instructional videos in science, mathematics and language. Its personalized, adaptive features enable tailored practice sessions, while its tracking software allows teachers and parents to monitor student progress (Abidin and Baharin, 2017).

Mobile learning has been used to supplement in-school instruction, mostly with private partners. In Myanmar, the Ministry of Education collaborated with Ericsson, UNESCO and other partners on the Connect to Learn project, which promoted mobile-based learning in 31 schools and to more than 33,000 students (Qualcomm, 2021). In the Philippines, the Department

of Education teamed up with the Ayala Foundation, Nokia, Globe Telecom, Pearson Foundation, Toshiba and Microsoft to support the Global Bridge IT programme and make digital resources available through mobile technology (Churchill et al., 2018). In Indonesia, a review of mobile learning studies found that various commercially developed applications and national platforms were used to supplement language learning at home (Bhardwaj et al., 2020). According to primary data collected for this report, educators in the Philippines integrate commercial applications, such as Quizizz and Mentimeter, in their lessons for practising and drilling concepts in reading in both English and national languages (Philippine Normal University, 2023). In Thailand, learners are encouraged in classrooms to use commercial applications on tablets to supplement instruction and support independent learning (Dipendra, 2023).

Mobile learning has also supported the expansion of commercial online tutoring platforms (HolonIQ, 2022). Private tutoring is widespread in Southeast Asia, for example, 4 in 10 families interviewed in a survey reported that their children were engaged in private tutoring sessions in Singapore. Similar shares have been estimated in Cambodia and Myanmar (OECD, 2023). Mobile technology has made private tutoring accessible for those who do not have access to face-to-face extra classes. Despite efforts to limit private tutoring, students in the New Generational Schools of Cambodia continued to subscribe to paid online tutoring enabled by video-conferencing software. The use of online tutoring surged during COVID-19. Digital tutoring lowers the cost of remedial support compared to face-to-face tutoring, but in practice only wealthier households can afford digital tutoring, which is expected to maintain inequality in student achievement (Brehm et al., 2023).

STUDENTS CAN RECEIVE TARGETED SUPPORT THROUGH PERSONALIZATION AND SOFTWARE ADAPTATION

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). Singapore's ICT Masterplan and Ed-Tech Plan promotes personalized teaching and learning in primary and secondary education. The national learning platform, Student Learning Space, uses artificial intelligence to generate learning analytics to help teachers track student progress and address specific gaps in student learning (Singapore Ministry of Education, 2022b; Singapore Smart Nation and Digital Government Office, 2019). All school leaders, teachers and students have access to the platform. Integrated with personalized adaptive software, personal learning devices provided to all secondary students are meant to help them adjust their learning experience to their own time and pace (Singapore Ministry of Education, 2022b). In Malaysia, the Education Blueprint 2013–2025 encourages the delivery of personalized adaptive learning through different modes, such as blended and online learning as well as interactive online tutoring, with a focus on language learning (Malaysia Ministry of Education, 2013).

Personalization may be having a positive impact on learning outcomes according to small-scale studies. In Thailand, students showed positive perceptions towards learning science with the support of a personalized e-learning system for a month, with younger students responding more positively. They also reported slightly improved academic performance (Dipendra, 2023). Think!Think!, a computer-assisted personalized learning software application supported by the Japanese International Cooperation Agency, aims to improve foundational mathematics and critical thinking skills in Cambodia. The application, which includes games and puzzles, has reached over 100,000 downloads (Asian Development Bank, 2022). A randomized controlled trial over three months involving grade 1 and 5 students from five public primary schools near Phnom Penh found significant positive effects on mathematics achievement (Ito et al., 2021).

Commercial actors have developed and managed a large number of personalized adaptive digital tools and platforms. However, these products often lack evidence on their effectiveness, and tend not to cover curriculum subjects. In Indonesia, mapping of 60 education technology firms, some of which integrate personalization in their products, found that less than 15% offered a specific content focus on reading, mathematics and science. Instead, most provide technology-related skills, such as programming and coding (Bhardwaj et al., 2020).

DIGITAL TECHNOLOGY APPEARS TO IMPROVE STUDENT ENGAGEMENT

Digital technology, such as games, multimedia, simulators and collaboration tools, is increasingly used in Southeast Asia. When appropriately designed and effectively integrated in pedagogy by teachers, these applications can help engage students and parents and indirectly affect student outcomes.

DIGITAL GAMES FOSTER KNOWLEDGE ACQUISITION IN INTERACTIVE WAYS

Digital educational games and gamification, i.e. the integration of game features, such as challenges, scores and ranking, in digital learning, can improve academic and non-academic skills by increasing engagement (Schindler et al., 2017; SEAMEO RECSAM, 2023) and motivation (Mayer et al., 2019).

Game-based learning applications are widely used in Southeast Asia. In Viet Nam, a survey of primary and secondary school students conducted for this report found that more than one in two students used game-based learning applications and websites for developing literacy and numeracy skills (Vinh et al, 2023). Research for this report also confirmed that teachers from the Lao People's Democratic Republic, Malaysia and Viet Nam used commercially developed interactive game-based learning applications, websites and platforms – such as Kahoot! Quizizz, Quizlet, Padlet and Canvas – mostly employed during warm-up and sum-up classroom activities (Vinh et al, 2023).

Evaluations of the effectiveness of commercially developed game-based applications have mostly been conducted in higher education settings and are often based on perceptions rather than test results. As part of gamification functions of the Digital Educational Learning Initiative Malaysia, Kahoot! was found to be effective in improving primary student lesson engagement due to quiz-like features that promoted competitive and interactive learning (Pavitra and Tan, 2023). A randomized control trial of Quizlet, a game-based application for learning English, showed that the application was effective in vocabulary retention among students of a private school in Viet Nam. Most participants wanted to continue using Quizlet to review their vocabulary (Nguyen and Le, 2022).

Large-scale longitudinal studies on the effectiveness of gamification are limited to a few countries. A review of 22 empirical and theoretical studies on game-based learning in Asian primary and secondary schools, of which 7 were in Singapore, showed positive cognitive and non-cognitive effects. Combined with supporting pedagogical approaches, games were found to improve cognitive and affective dimensions of learning (So and Seo, 2018). Statecraft X, a multiplayer simulation game, supplements Singapore's formal social studies curriculum for 15-year-old students. An evaluation of secondary school students who used Statecraft X to supplement their regular classroom instruction for three weeks found that it had improved subject knowledge. These benefits were possible as a result of adequate teacher preparation, students' willingness to play games and engagement in classroom dialogue (Gaydos, 2021). Analysis of the results of the 2015 PISA ICT usage and achievement data from more than 8,000 students from 237 schools in Thailand found that students who played single-player games almost every day had better scores in reading, mathematics and science than their peers who never or almost never played. However, playing multiplayer games often negatively impacted learning achievement, especially in reading and science (Srijamdee and Pholphirul, 2020).

Game-based applications are also used in low-resource settings to practise literacy and mathematics skills. In Cambodia, a game-based application developed under World Education's All Children Reading initiative was used by more than 100 schools across 5 provinces (World Education, 2023). It promoted early-grade reading in the Khmer language with pedagogy that focused on practising the Khmer alphabet, vocabulary and phonetics. The pedagogy complements the Cambodian government's new early-grade reading curriculum. A study found that grade 2 and 3 children who often used the application reported high scores in reading. Interactive game-based activities, a user-friendly interface and instructional support were some design features that helped improve student engagement, although the design needed further alignment to users' needs and capabilities (Oakley et al., 2022).

REPRESENTING CONTENT IN VARIOUS WAYS FACILITATES LEARNING

Commercial applications are widely used to develop and deliver multimedia-based teaching content. In Cambodia and the Philippines, interviews conducted for this report highlighted the use of Facebook, Instagram, TikTok and YouTube to supplement teaching and learning (Brehm et al., 2023; Philippine Normal University, 2023). A systematic review of how YouTube is used to support classroom teaching in the Philippines found positive impacts on student comprehension, motivation and academic performance in English and mathematics (Dagohoy, 2023). In Brunei Darussalam, embedding videos into classroom teaching was found to have a positive impact on students' conceptual understanding of biology (Fan et al., 2018). In Timor-Leste, teachers reported that incorporating animations and learning videos into teaching supported student engagement by making the learning process visually attractive, interactive and easier for students (SEAMEO QITEP in Science, 2023).

According to the 2019 SEA-PLM, less than 20% of teachers reported having interactive whiteboards in their

classrooms in five countries, ranging from 1% in Cambodia to 18% in the Philippines and Viet Nam and 50% in Malaysia (SEA-PLM, 2019). Brunei Darussalam has invested in interactive whiteboards since 2005, along with teacher professional development. The use of such whiteboards to teach chemistry to grade 11 students was found to have a positive impact on learning achievement (Emron and Dhindhsa, 2010).

Evidence is limited on the effectiveness of investments in smart classrooms with enhanced interactivity features. Smart schools have been expanding in Viet Nam, after the first such primary school was inaugurated in Hanoi in 2013. A trial of the smart classroom model in 2018/19 in another primary school, where it was used to teach mathematics, science and social studies in grades 3 to 5, reported positive perceptions but the impact on learning was not evaluated (Tran and Tran, 2023).

Simulations facilitate practical and visual learning and can promote learners' engagement (SEAMEO RECSAM, 2023). Delivery of educational content through virtual and augmented reality as pedagogical tools in mathematics and science is increasing in Southeast Asia (Pillay and Pant, 2022). In Singapore, a study on the use of immersive technology for teaching socioemotional learning to secondary students found that such virtual environments were not necessarily more effective than using traditional teaching or videos, but students reported higher levels of engagement (Tan et al., 2022). Virtual laboratories can help develop students' practical science skills by allowing unlimited repetition of experiments in a safe and cost-efficient manner. Indonesia's online learning platform, Rumah Belajar, uses simulations to provide virtual classes and laboratories and promote collaboration among more than 600,000 users. The Laboratorium Maya feature (Virtual Laboratory) simulates laboratory equipment and offers an interactive and engaging learning experience to practise experiments (SEAMEO SEAMOLEC, 2023).

DIGITAL TECHNOLOGY CAN SUPPORT COLLABORATIVE LEARNING AND COMMUNICATION

Digital technology can help students collaborate, facilitate asynchronous group work and promote knowledge co-creation (Wang and Shen, 2023). In Singapore, teachers have been using a variety of tools with social media features, such as LinoIT, Wallwisher, MindMeister, Google Sites and Edmodo (now discontinued), to support collaborative learning. A review of 126 studies published between 2010 and 2019 by Singapore's National Institute of Education found that ICT was used to support collaborative pedagogical practices in classrooms. Real-time chat tools and online forums enable peers to collaborate on group projects asynchronously. Structured communications platforms, such as SMILE and Newsroom, encourage students to express their opinions, answer questions and debate (Seow et al., 2020).

Such collaborative tools can have positive impacts if combined with teacher support. In Malaysia, 1BestariNet initiative aims to connect 10,000 primary and secondary schools to the internet and has promoted a cloud-based teaching and learning environment through FrogLearn, an online learning platform. An experimental study exploring the role of using the platform in improving English language teaching and learning reported positive outcomes. The experimental group that assessed their peers' writing using the materials uploaded on the FrogLearn virtual learning environment for eight lessons reported improvements in their descriptive writing tests compared to the control group receiving regular instruction. However, the results cannot be attributed to the use of the platform alone, as the intervention involved significant teacher support and guidance (Zainal and Zainuddin, 2020).

Audio and video conferencing tools can facilitate collaborative learning by reducing time and space barriers (Wang and Shen, 2023). The flipped classroom allows students to follow lectures at home and spend classroom time collaborating with each other and with teachers (Bredow et al., 2021; Kushairi and Ahmi, 2021). Evidence on the impact of this approach tends to focus on higher education settings (Jdaitawi, 2019). Small-scale studies highlight that flipped classrooms may improve learning outcomes in schools. In Brunei Darussalam, grade 9 students using flipped learning registered gains in mathematics and reported a positive perception of this pedagogical approach (Ali et al., 2022).

Technology also provides teachers several low-cost and convenient ways to communicate up-to-date information about their child's learning progress (**Box 4.2**). ICT can improve parental knowledge and practices through training and information (Nicolai et al., 2023a).

TECHNOLOGY INCREASES DISRUPTION AND DISENGAGEMENT RISKS

In contrast to digital technology's potential to improve education, the use of devices for teaching and learning is accompanied by growing concerns of increased classroom disruptions and lower student engagement. In addition

BOX 4.2:

Digital technology helps parents engage with their children's learning

Parents' familiarity with common online communication tools and social media platforms has been leveraged by teachers to enhance parental engagement. Email, messaging applications and discussion forums allow teachers to share course materials, provide regular updates and communicate with parents. In Thailand, the Ministry of Higher Education, Science, Research and Innovation promoted the use of online teaching, learning management systems and social media and messaging platforms to improve communication with parents. Teachers reported using Line and Facebook messaging applications for instant communication with parents (Dipendra, 2023). In the Total Reading Approach for Children Plus programme, parents in Cambodia were trained on how to install Aan Khmer, a mobile learning application, and were guided on choosing appropriate learning materials from the toolkit to use with their children (Nicolai et al., 2023b).

During the COVID-19 pandemic, governments used ICT to communicate with parents and engage them in their children's learning. The transition to digital learning has been overwhelming for many students and parents, especially younger students and those from marginalized communities. Parents, particularly in rural areas or from lower socioeconomic backgrounds, needed guidance on how to manage home-based learning. Lack of classroom interaction shifted much of the burden of teaching from teachers to parents (UNICEF and UNESCO, 2021).

In Viet Nam, the Ministry of Education and Training issued specific guidelines on providing broadcast teaching and learning. Communication between schools and parents was strengthened by parent–teacher meetings and question and answer sessions online and by telephone (Hoang et al., 2020). Singapore introduced Parent Kits that cover multiple areas of how parents can support their children's home-based learning (Singapore Ministry of Education, 2023a). In the Lao People's Democratic Republic, the Ministry of Education and Sports developed the Teaching and Learning Platform, Khang Panya Lao, which facilitated regular communication with parents (Australian Council for Educational Research, 2023).

to the 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. For example, a meta-analysis of research on internet use among students in Southeast Asia indicated that internet and gaming addiction was prevalent among students (Balhara et al., 2018).

Education systems have adopted varied approaches, ranging from restricting use of devices to banning them completely from the classroom (**Chapter 9**). Malaysia and Viet Nam have banned the use of mobile phones in classrooms. In Viet Nam, primary data collected for this report found that 30% of the surveyed students reported increasing non-academic distractions while using technology to study, such as browsing social media and playing video games. Distractions and feelings of anxiety were higher among secondary students. In classrooms, the use of mobile phones was found to be disruptive during study hours, making it difficult for teachers to manage the class (Vinh et al, 2023).

The use of tablets and phones can make classroom management a challenge for teachers. In Indonesia, mathematics teachers in secondary schools were reluctant to use mobile technologies for teaching. They reported being concerned about the improper use of mobile phones, increased distraction and the negative impact on students' mental well-being (Abidin et al., 2017).

Online learning during the COVID-19 pandemic relied on teachers' ability to design lessons suited for online delivery and on students' ability to self-regulate learning; in the absence of these two factors, online delivery may increase the risk of disengagement and learning losses (Bergdahl et al., 2020; UNICEF and UNESCO, 2021). In disadvantaged areas of Viet Nam, teachers were unprepared to facilitate online learning. According to a 2020 survey, 93% of teachers in remote provinces reported never having used modern technologies prior to COVID-19. The switch to online learning made it difficult to interact, engage and assess learners remotely (UNICEF and UNESCO, 2021). In Thailand, online distractions and the poor quality of teaching and learning decreased students' motivation and engagement (Aroonsrimarakot et al., 2023). In Indonesia, a survey of some 160 secondary school mathematics teachers highlighted several barriers to e-learning during COVID-19, such as a lack of online content aligned to curricula, teachers' inability to teach using ICT and students' lack of knowledge and skills to engage in learning using ICT applications (Mailizar et al., 2020).

CONCLUSION

Many Southeast Asian countries have been trying to integrate technology into teaching and learning processes, albeit to a limited extent so far. Successful integration of technology needs to be supported by strong pedagogical alignment, contextualization and teacher support. It has various benefits including supplementing and personalizing instruction and stimulating student engagement through multiple media. But despite its potential for improving teaching and learning, the use of technology is accompanied by the risk of increasing student distraction and disengagement. Many technology products and platforms are developed by commercial education technology actors, which brings specific challenges. And the evidence of impact on learning outcomes is limited. Particularly needed is large-scale research that systematically explores how technology can facilitate learning in a sustained way and in diverse contexts.

Teacher Ko Phyo Thet Tun teaches a course on computers during the evening NFMSE class in Loikaw, Myanmar.

Credit: © UNICEF/UN0324870/Oo*
Released to everyone

CHAPTER

5

Teaching and learning in higher education

KEY MESSAGES

Southeast Asian countries are promoting the digital transformation of their higher education systems.

- Regulations are conducive to digital transformation in higher education in Southeast Asia. Malaysia expects private higher education institutions to integrate experiential learning through, for instance, virtual and augmented reality by 2025.

Open and distance learning has expanded access to higher education.

- The University of the Philippines Open University accounted for 17% of the university's graduate student population in 2021/2.
- Flexible entry regulations at Universitas Terbuka in Indonesia have led to 320,000 students enrolled, of which 40% are aged over 30.
- Massive open online courses (MOOCs) promote access to learning. Thailand Cyber University provided official MOOCs to over 800,000 students in 2021.

Open and distance learning strives to provide equitable education opportunities of good quality.

- In Myanmar, distance education provides access to 500,000 students, about 60% of the country's undergraduates, who could not have moved locations to be full-time students.
- Internal and external quality assurance mechanisms are being deployed. At Wawasan Open University in Malaysia, online counselling helped increase retention in online learning courses.

Micro-credentials complement higher education in Southeast Asia.

- One in four students in the Philippines are estimated to use online and micro-credential courses to complement their university studies. With almost 3 million enrolments, Indonesia, the Philippines and Viet Nam had the highest growth rate of new learners in Coursera in 2021.
- Malaysia's transferrable credits system enables the use of micro-credentials to obtain formal qualifications.

Digital technologies support teaching and learning in higher education.

- An ASEAN survey of 183 higher education educators in Cambodia, the Lao People's Democratic Republic and Viet Nam found that around one third were engaged in blended teaching practices.
- Immersive virtual environments have the potential for improving technical and vocational education. Yet in 2019, fewer than one in three of 239 training institutions surveyed in Cambodia, Indonesia, the Philippines and Viet Nam used simulators and fewer than one in four integrated virtual and augmented reality.
- Videos, interactive exercises, gaming and collaborative features have been found to improve student engagement and motivation but evidence on the impact of these tools on learning practice and outcomes is lacking.
- A lack of educator capacity and infrastructure is an obstacle to applying digital technology. About two in three university students in Viet Nam consider that lecturers' low ICT competence levels negatively affect the integration of digital technology in teaching. In Cambodia, most lecturers use their own laptops and self-financed internet services.

Worldwide, higher education institutions have adopted education technology earlier and to a larger extent than institutions at other education levels. In Southeast Asia, technology-based approaches have expanded access to post-secondary education, facilitating alternative paths for many learners. Massive online open courses (MOOCs) and micro-credentials have boomed in the region, as a form of skills development that complements formal education.

This chapter provides an overview of the application of digital technology in higher education in Southeast Asia. It focuses on regulations enabling the adoption of technology to expand access to education, including for hard-to-reach groups. It explores the integration of formal and non-formal learning through MOOCs and micro-credentials. Finally, it describes the integration of digital technologies in teaching and learning, and the challenges higher education institutions have faced.

SOUTHEAST ASIA PROMOTES THE DIGITALIZATION OF HIGHER EDUCATION

Regulations in the region are considered particularly conducive to digital transformation in higher education. An open global consultation, conducted by the International Association of Universities, found laws and policies regulating higher education, accreditation, quality assurance systems and financial frameworks in Asian and Pacific countries to be highly supportive of technology (Jensen, 2019). Southeast Asian countries, in particular, promoted digital technologies for access to and provision of higher education programmes.

Most Southeast Asian countries promote open and distance learning approaches, which are often being applied in higher education (SEAMEO SEAMOLEC, 2023). In 2016, the Thailand 4.0 initiative institutionalized distance education for skills and economic development (Farley, 2023; SEAMEO RECSAM, 2023). In this favourable context, higher education institutions set up open courses on dedicated platforms to further expand such opportunities (Dipendra, 2023). Drawing on a long history, Indonesia institutionalized distance learning at the turn of the century, extending it to the entire education sector with the intent to widen access for hard-to-reach students through financial mechanisms and the accreditation of diverse providers (SEAMEO SEAMOLEC, 2023).

Some countries aim to set up open and distance learning, or expand it further, in their strategic plans. The Malaysian Higher Education Blueprint 2015–2025 makes online learning an integral component of higher education. The strategic document aims to increase tertiary enrolment rates from 36% currently to 53%, and overall higher education enrolment rates from 48% to 70%, including through online learning, with 70% of programmes required to use blended learning models by 2025 (Malaysia Ministry of Education, 2015). Indonesia aims to increase access to tertiary education to 50% through online learning by 2026 (Garcia et al., 2021). In Viet Nam, the National Digital Transformation Program toward 2025 aims for at least 20% of programme content to be delivered through online classes, laying the foundation for universities to become digital (Vinh et al, 2023). Cambodia aims to establish its first open university as part of the Cambodian Cyber University Network (Eam and Song, 2022).

In addition to improving access, some regulations have focused on the integration of digital technology in teaching and learning. Cambodia's Higher Education Roadmap 2030 and Beyond outlines its plan to integrate technology into teaching and learning by 2032 (Phyrom and Song, 2022). Malaysia's strategy on private higher education institutions, which enrol more than 50% of students in the country, expects them to integrate experiential learning by 2025 through virtual reality, augmented reality, mixed

reality, artificial intelligence, the Internet of Things and learning about advanced digital media and robotics (Malaysia Ministry of Education, 2020; UNESCO IBE, 2021).

Technology is also being integrated into higher education management systems (**Chapter 7**). Brunei Darussalam's Digital Transformation Plan 2023–2027 aims to create a centralized digital platform to facilitate student admissions and manage learning processes (Brunei Darussalam Ministry of Education, 2022; SEAMEO VOCTECH, 2023). Cambodia's Higher Education Masterplan 2010 aimed to use ICT to improve student data management and progress monitoring (Cambodia Ministry of Post and Telecommunications, 2020). In September 2020, the Philippines encouraged institutions to establish and support learning management systems. A dedicated office for tertiary online learning and distance education was set up in the Commission on Higher Education to monitor and report on open and distance learning (Philippines Commission on Higher Education, 2020; World Bank, 2022).

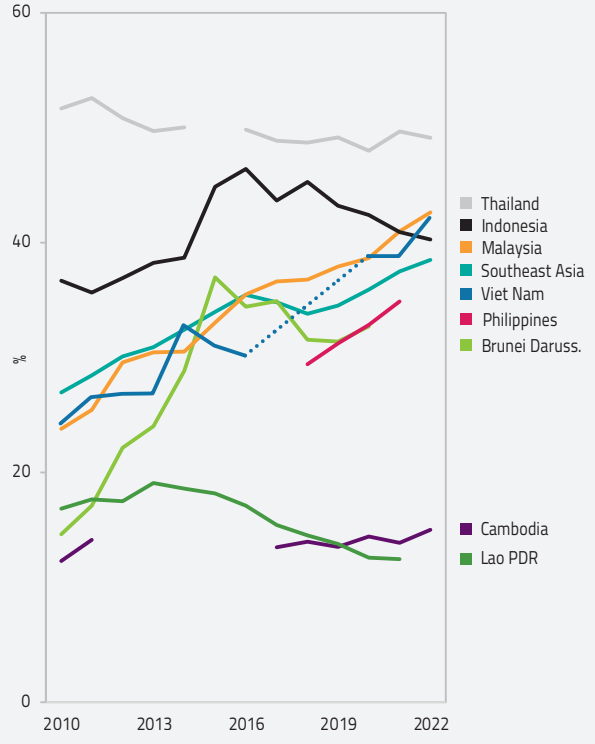
The COVID-19 pandemic and the forced closure of education institutions prompted many countries to regulate the sector more systematically and provide guidance on digital technology (Nagarajan and Tozsa, 2021). In 2021, Viet Nam regulated online tertiary teaching and learning more comprehensively (Circular No. 08/ 2021/TT-BGDĐT). The National Digital Transformation Programme through 2025 with orientations toward 2030 includes digital technology in education starting with a pilot in the five main public universities (Vinh et al, 2023). In the Lao People's Democratic Republic, online learning had developed through projects, but the Ministry of Education and Sport made the first attempt to regulate the practice in 2020. Higher education institutions, such as the National University of Laos, have developed their own guidelines concerning content development, teaching practices and assessment (ACU Secretariat, 2021; Australian Council for Educational Research, 2023).

OPEN AND DISTANCE LEARNING HAS SUPPORTED ACCESS TO HIGHER EDUCATION

Tertiary education participation in Southeast Asia quadrupled between 1990 and 2010 and has continued to grow since, albeit more slowly, with the gross enrolment ratio reaching 38.5% in 2022, driven mainly by fast progress in Indonesia (from 24% to 43%) and Viet Nam (from 24% to 42%) between 2010 and 2022 (**Figure 5.1**).

Technology, among other factors, has helped increase access to tertiary education (Hong and Songan, 2011; UNESCO-IESALC, 2020). In Southeast Asia, distance higher education has a long tradition, originally through printed learning materials, radio and television programmes (**Chapter 2**). The first initiatives – correspondence teacher training in Indonesia and radio farmers' school in the Philippines – date back to the 1950s. Distance education expanded in science teaching and learning. In Malaysia, the Science University of Malaysia established the first Centre of Distance Education (Pusat Pendidikan Jarak Jauh) in the 1970s. The programme used a mix of distance education modalities, based on recorded lectures and combined with face-to-face engagement and self-learning (Sirat and Wan, 2023). Launched by the University of the Philippines Los Baños in 1984, the Science Teaching Using Distance Instruction programme led to the establishment of the first open university of the country (Asian Association of Open Universities, 2022).

FIGURE 5.1:
Tertiary education participation has grown unevenly in Southeast Asia since 2010
Tertiary education gross enrolment ratio, Southeast Asian countries, 2010–22



Source: UIS database.

Open and distance initiatives in higher education have evolved with the establishment of open universities (Bandalaria, 2018). Open universities offer flexible access, with minimal or no entry requirements, and typically use technology to offer distance education opportunities, exclusively or in combination with conventional programmes (Stein, 2020).

Established in 1984, Indonesia's Universitas Terbuka (literally meaning 'Open University') is one of the leading public open universities in the region and in the world (Universitas Terbuka, 2023a). Distance education is promoted through different media, from printed materials to MOOCs (Padmo et al., 2017). Universitas Terbuka is considered an example of flexible and accessible learning (Mizal et al., 2021), with an adaptable calendar and open registration process. Students can choose the number of courses and the amount of hours of study. Since 2017, new entry regulations allow students to register at any time of the academic year, which has led to a further increase in enrolments (Darojat and Li, 2023; Welch and Aziz, 2023). Enrolments at Universitas Terbuka are steadily increasing, reaching more than 400,000 students from more than 50 countries in 2023 (Universitas Terbuka, 2023b, 2023a).

There are four open universities in Malaysia, while at least seven other universities provide open and distance programmes (Malaysia Ministry of Education, 2020). The University of the Philippines Open University was established in 1995, evolving out of a distance education programme. It moved its programmes fully online in 2004 and has been providing MOOCs since 2013, further expanding access (Philippine Normal University, 2023). In 2021/22, the Open University accounted for about 17% of the University of the Philippines' graduate student population (UPS Budget Office, 2021).

MOOCS EXPAND ACCESS AND INTEGRATE FORMAL AND NON-FORMAL LEARNING

Higher education institutions in Asia have turned to MOOCs, leveraging their ability to reach a potentially unlimited number of participants at a relatively low cost (Farley, 2023). MOOCs have spread, encouraged by supportive national policies (Kato et al., 2020; Zhang et al., 2020).

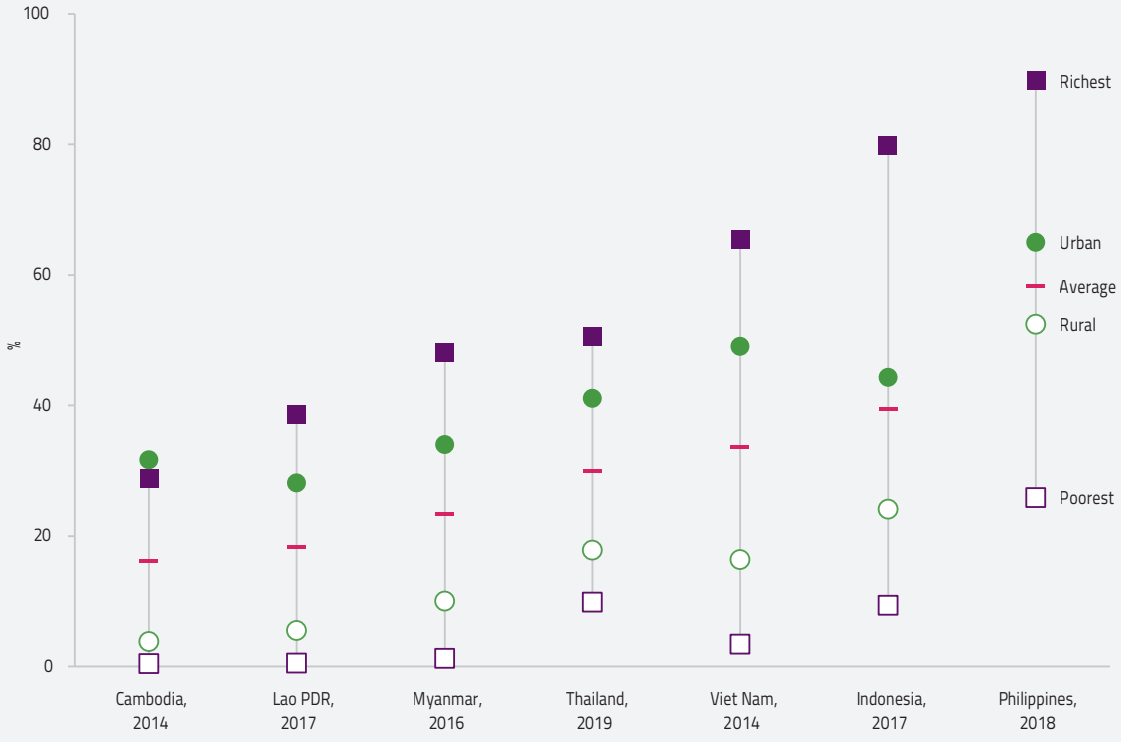
Thailand's Office of the Higher Education Commission launched the Thailand Cyber University in 2016 to offer official MOOCs and on-demand skills development through its platform. As of March 2021, over 800,000 students were estimated to have enrolled in its online courses (Crocco and Pitiyanuwat, 2023), following a doubling of its user base during the COVID-19 pandemic (Shah, 2020). In Thailand, diverse partners contribute to designing and providing online courses, including international universities and organizations, private companies, government agencies, and public and private universities. About 46% of higher education institutions in Thailand offer courses through the platform, blurring the boundaries between formal and non-formal education. Several other universities in Thailand have also set up MOOC platforms, integrated with their programmes. Sukhothai Thammathirat Open University was one of the leaders offering MOOCs as part of its formal education provision (Farley, 2023). Among traditional universities, Chulalongkorn University's Chula MOOC and Thammasat University's GenNext MOOC provide online courses to their students (Dipendra, 2023).

Both public and private universities in the Philippines, including the Polytechnic University of the Philippines, Central Luzon State University and Benguet State University, provide online courses leading to formal degrees (Philippine Normal University, 2023). All 20 Malaysian public universities made MOOCs available to students, internal and external (Subramaniam, 2023). At the regional level, the SEAMEO Regional Open Learning Centre set up a Southeast Asia MOOCs Network in 2020 to promote the capacity of MOOCs providers in the region and share practices (Farley, 2023).

OPEN AND DISTANCE LEARNING CAN IMPROVE EQUITY IN EDUCATION OPPORTUNITIES

Access to and participation in higher education is determined by individual characteristics, such as wealth and location (OECD, 2023). In Indonesia, 80% of the richest attended tertiary education in 2017 compared with less than 10% of the poorest. In Viet Nam, urban youth are three times more likely to attend tertiary education than their rural peers. Less than 5% of the poorest youth and less than 10% of rural youth in Cambodia are estimated to attend tertiary education (**Figure 5.2**).

FIGURE 5.2:
Very few poor young people attend tertiary education in Southeast Asia
Gross attendance rates in tertiary education, by location and wealth quintile, selected Southeast Asian countries, 2014–19



Note: Household survey-based attendance rates differ from administrative data-based enrolment ratios due to differences in the methodology used to collect the information. A key advantage of household surveys is that they allow attendance rates to be disaggregated by individual characteristics, such as location and wealth.
Source: UIS (2021).

Open and distance education can help overcome traditional obstacles to accessing higher education (Bandalaria, 2018; Lim et al., 2020). In Myanmar, distance education provides access to those who cannot afford to move to study and be full-time students. Distance learning allows them to combine part-time jobs with education. A distance education programme, which is offered by 35 learning centres at Yangon University of Distance Education for Lower Myanmar and at Mandalay University of Distance Education for Upper Myanmar, is estimated to reach about 60% of undergraduate students in Myanmar, or around 500,000 students (Howson and Lall, 2020). In-presence training is still required for examination preparation and for practical sessions for science students, but is often not attended (Gregson and Fawssett, 2020; Lall, 2021).

Open and distance courses, and in particular MOOCs, have enabled access to tertiary education for those living in remote areas and those who do not follow a continuous educational path from secondary school. In Indonesia, MOOCs have helped reach students in remote islands, unlike what is often observed globally. It has been estimated that 95% of students in Indonesian MOOCs are working adults (Belawati, 2019). At Universitas Terbuka, 40% of students are aged over 30 (ACU Secretariat, 2021). Moreover, affordability is ensured through diverse fee mechanisms depending on study programmes and learning modalities, and through dedicated scholarships (Counselor Corporation, 2023; Welch and Aziz, 2023; Zuhairi, 2019).

At the same time, open and distance education opportunities require affordable and suitable technology and connectivity, which may perpetuate existing inequality by economic, social and cultural characteristics. In Viet Nam, analysis conducted for this report shows that 11% of students from ethnic minorities are more likely to use broadband cellular network technology to learn online than fixed broadband, as Wi-Fi is not or is poorly available in their houses, which impacts their chances to experience

BOX 5.1:

Open universities have instituted quality assurance and support mechanisms

Open universities have put quality assurance mechanisms in place (Zuhairi et al., 2020). Quality assurance at Universitas Terbuka is based on a system of internal and external reviews and adjustments. In 2004, a Quality Assurance Centre was set up to define quality guidelines, monitor and report on the quality of university programmes, and coordinate external evaluations. The internal system is based on preventive actions and evaluation processes aimed to establish a quality work culture (Zuhairi, 2019). Learners and staff participate in quality oversight and implementation, in which faculty members receive training. External quality reviews are conducted every three years by the International Council for Open and Distance Education (Darojat and Li, 2023; Welch and Aziz, 2023).

Supranational agencies have developed public accountability and transparency frameworks for higher education programmes. The Asian Association of Open Universities, a non-profit organization which aims to promote quality (Asian Association of Open Universities, 2020b), covers more than 10 million students across 20 countries (Asian Association of Open Universities, 2022). As of 2020, 12 of its 44 full members are Southeast Asian universities (Asian Association of Open Universities, 2020a). It has proposed guidelines and developed a quality assurance framework that includes the promotion of tutoring and counselling services and peer support structures (Darojat et al., 2015).

At Wawasan Open University, a private tertiary institution in Malaysia, the introduction of online counselling in 2017 targeted at distance education students helped increase the retention of those at risk of dropping out (Chuah and Lim, 2018). The Sukhothai Thammathirat Open University in Thailand provides a combination of online and in-person learning services on a group and individual basis throughout the country. Educational and professional counselling helps students adjust to the distance education environment (Asian Association of Open Universities, 2022; International Affairs Unit Sukhothai Thammathirat Open University, 2010).

Clear accreditation rules are another means for a tertiary education system to achieve good quality (Zuhairi et al., 2020). The Malaysian Qualifications Agency has developed accreditation criteria for distance programmes in line with international standards. The open and distance learning code of good practice covers many dimensions, including curriculum development, learning assessment and programme monitoring (Sirat and Wan, 2023). Within this framework, Open University Malaysia carries out student evaluations to measure the level of satisfaction with courses and services and ensure recurrent monitoring and review (Jung, 2023). The ASEAN University Network has also outlined guidelines to promote consistent quality assurance of qualification systems in the region, which was finalized in 2020 and extended to online learning (ASEAN, 2021a).

an effective distance learning experience (Vinh et al, 2023). The expansion of the Vietnam National Open University has been challenged by shortcomings in the ICT infrastructure (SEAMEO SEAMOLEC, 2023).

In addition to equity concerns, quality is often at the centre of debates about distance education. Various approaches have been followed in Southeast Asia to ensure the relevance and quality of higher education provision (**Box 5.1**) (Zuhairi et al., 2020).

MICRO-CREDENTIALS COMPLEMENT HIGHER EDUCATION IN SOUTHEAST ASIA

Rapid economic expansion and the increasing digitalization of some sectors mean that Southeast Asia's economies and labour markets are undergoing deep transformations. It is estimated that more than 60% of workers in electronics in Indonesia, Philippines, Thailand and Viet Nam and over 80% of workers in the textile and clothing industry in Cambodia and Viet Nam will be affected in the next decades (ILO, 2021). Education and training systems need to respond to such transformations (**Box 5.2**).

One response has been the growth of micro-credentials, which provide a wide range of opportunities for on-demand skills development (West and Cheng, 2022). Micro-credentials refer 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 qualifications (Oliver, 2022, p. 6). One in four students in the Philippines are estimated to use online and micro-credential courses from national and international platforms to complement their learning experience (World Bank, 2022). In 2021, Indonesia, the Philippines and Viet Nam with almost 3 million enrolments combined, all ranked among the top 10 countries with the highest learner growth, measured by enrolment increases, on Coursera, an international MOOC provider (Coursera, 2021).

BOX 5.2:

Higher education programmes do not always keep up with technological development

Enrolment in science, technology, engineering and mathematics (STEM) fields has risen across the region in the last decades. STEM graduates have more than doubled in some cases. In Cambodia, the share of STEM graduates rose from 10.5% in 2000 to 23% in 2019. In Brunei Darussalam, 38% of graduates completed a STEM programme in 2020, compared with 11% in 2000. Two in five graduates in Malaysia had specialized in STEM in 2022 (UIS, 2023). Countries have encouraged this trend through expanding programmes and funding mechanisms, including scholarships. However, the readiness and quality of programmes is not always ensured (OECD, 2023).

Outdated and non-interdisciplinary curricula hamper workers' readiness to apply digital technologies. In Indonesia, curricula are revised every five years, which means not keeping pace with changes in the technology sector. In Thailand, formal curricula are not updated regularly and do not provide the necessary knowledge in coding and advanced mathematics (ILO, 2019; OECD, 2021). A survey of 239 training providers and institutions in Cambodia, Indonesia, the Philippines and Viet Nam found that almost half did not review and update their curricula annually, while more than 40% did not include digital skills in their programmes (Asian Development Bank, 2021).

Some countries in Southeast Asia have partnered with external actors to review their education programmes. Malaysia's universities have established university–industry advisory panels to provide guidance on educational content and skill needs by sector (OECD, 2023). Where no centralized monitoring of skill needs exists, interventions are promoted by individual institutions. In Thailand, universities including the Panyapiwat Institute of Management, Nation University, Vidyasirimedhi Institute of Science and Technology and Thai-Nichi Institute of Technology have aligned their programmes with industry demands through partnerships with private companies (Crocco and Pitiyanuwat, 2023). Thammasat University has partnered with True Digital Group, a communications company, for training on business data analytics combining industry and education expertise (Dipendra, 2023).

Singapore has turned to digital platforms to strengthen its lifelong learning programme and encourage independent learning (Nguyen et al., 2022). MySkillsFuture is an online platform that provides learning opportunities and resources as part of Singapore's SkillsFuture lifelong learning initiative. Citizens aged 25 and older can spend Skills Future Credit they receive from the government on the platform to continue learning. In 2021, about 250,000 individuals used credits. Among them, more than 22,000 participated in training to acquire relevant skills for digital jobs. With the goal of widening these opportunities, the SkillsFuture Singapore Agency collaborated with NTUC LearningHub, Gnowbe and ZilLearn, online training providers, on a two-year pilot starting in 2021 to spend SkillsFuture credits for micro-credentials on digital platforms (Centre for Evidence and Implementation, 2023; Skills Future Singapore, 2021).

Some countries have developed minimum quality standards frameworks for micro-credentials to link them to formal learning (Oliver, 2019). Malaysia was one of the first countries to create a system of transferrable credits (Shahar, 2016). In 2019, the Malaysian Qualifications Agency implemented an accreditation strategy for online courses that enable the collection of credits to obtain formal qualifications. Its guidelines outline secure and interoperable digital verification and outcome-based and personalized learning achievements, which lead to credentials that are recognized and transferrable across sectors, universities and countries. Drawing on the OpenCreds Australia of Open Universities of Australia, Malaysia's OpenLearning platform awards fixed credits based on defined learning per hour that can be used to meet the requirements of higher education and professional development programmes (Ahmat et al., 2021; Kumar et al., 2022).

Blockchain technology refers to a 'distributed database that stores transactions in sealed blocks and records them securely'. Applied to education, this technology supports the decentralized management, storage and authentication of academic qualifications and course completions issued by diverse providers. Blockchain technology attests them over time and across education systems, overcoming traditional time-consuming processes of validation (Alsobhi et al., 2023). In Southeast Asia, some countries have invested in blockchain education programmes (Caporale, 2021). Indonesia has recognized creditable online courses since 2018. Updated in 2020, regulations allow students to transfer credits for up to 40% of the programme for the courses they have completed online. Digital credentials are accredited by a centralized system that operates through blockchain technology to ensure transparency and trust (Garcia et al., 2021). Viet Nam's Ministry of Education and Training has partnered with TomoChain, a blockchain platform,

in the National Qualifications Archive initiative to transfer and store certification and diplomas. Starting from the academic year 2020/21, the system aims to increase transparency and address document falsification (Daily Hodl, 2020; Nguyen et al., 2020).

DIGITAL TECHNOLOGY CAN SUPPORT TEACHING AND LEARNING

Digital technology has been increasingly integrated into higher education's pedagogies and practices worldwide, promising to foster adaptive and personalized learning (Henderson et al., 2017; UNESCO-IESALC, 2023). However, knowledge and understanding of the actual impact remains limited. In higher education, digital technologies have been largely used as a tool to deliver classes. Learning management systems and platforms have moved many campuses online (Williamson, 2021). The experiences of high-income countries may offer lessons for other regions (**Box 5.3**).

During the COVID-19 emergency, many universities in Indonesia, the Philippines, and Viet Nam purchased an external learning management system or developed their own (Joaquin et al., 2020). Analysis conducted for this report shows that almost 95% of a sample of 200 university students surveyed in Viet Nam used learning management systems, such as Moodle and Google Classroom (Vinh et al, 2023).

Blended learning, a combination of online and in-campus learning, tends to be a more common practice than learning that is exclusively online (ASEAN, 2021b). A survey conducted by the Association of Southeast Asian Nations (ASEAN) in Cambodia, the Lao People's Democratic Republic and Viet Nam found that around one third of 183 higher education educators surveyed followed blended teaching (ASEAN, 2021b). Several higher education institutions in Brunei Darussalam, Cambodia and Malaysia have institutionalized blended learning since the COVID-19 pandemic (Asian Association of Open Universities, 2022; Heng and Doeur, 2022; Noorashid et al., 2020).

Universities in Malaysia have been encouraged to apply blended learning. In 2023/24, 95 bachelor's degree programmes from 19 public universities in Malaysia are applying this learning modality (Kasinathan, 2023). Most of them apply e-learning for delivering classes; others employ the approach for delivering tutorials, supporting

BOX 5.3:

Digital technology's disruption of higher education in high-income countries has lessons for Southeast Asia

Technology has been steadily changing the way higher education operates. The transformation has only accelerated with COVID-19 (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 have been 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 are 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).

self-managed learning or offering new textbooks. A meta-analysis of 45 studies on Malaysian universities' experience with blended learning reports overall positive feedback by students. However, their effectiveness depends on educators' guidance and readiness and students' approaches (Mustapha et al., 2022). This is consistent with findings on flipped classrooms, a type of blended pedagogical approach, which has mostly been employed in higher education. Based on the flipped classroom model, students watch online lectures or pre-recorded videos at their own pace and get familiar with the learning material before the class. In the classroom, they can apply what they have learned and shift to a learning experience that is learner-centred (Bredow et al., 2021; Strelan et al., 2020).

In Southeast Asia, evaluations of flipped classrooms in higher education settings have been conducted in Indonesia, Malaysia, Thailand and Singapore (Kushairi and Ahmi, 2021). A meta-analysis of 19 studies conducted in Malaysia confirmed that in line with global evaluations flipped classrooms lead to positive learning achievements across disciplines, from information technology to engineering and performing arts (Rahman et al., 2019). A 14-week evaluation of flipped classroom pedagogy among 24 first-year students at the School of Applied Sciences and Mathematics of the Universiti Teknologi Brunei also reported positive feedback. Students found the approach more engaging and interactive than traditional classes, appreciating the independent and collaborative learning style (Yueh and Hassell, 2022).

The effective use of the flipped mode is contingent on students' learning approach. A study conducted among 58 university students in Indonesia on writing achievement found that the experimental group who accessed learning materials beforehand outperformed the control group. However, it is students who are already used to studying independently and applying an adequate learning strategy who benefit the most from this pedagogical model (Mubarok et al., 2019). Flipped learning also needs appropriate guidance. Clear explanations and directions were found to be a key element contributing to a positive learning experience and outcomes among 69 second-year students at the ICT programme at Prince of Songkla University in Thailand (Pattanaphanchai, 2019). The specific instructional design, tools and learning activities selected by the instructor for the flipped classroom were identified as central for both active and collaborative learning experiences among postgraduate students in Malaysia (Zain and Sailin, 2020).

Smartphones and mobile applications are used to overcome connectivity and accessibility issues. At four departments of Silang Campus of Cavite State University in the Philippines, 39% of students who used smartphones to access and support e-learning reported that more communication and exchange helped them create a sense of community (Santiago Jr. et al., 2021). A study of 176 university students of the Universiti Tun Hussein Onn Malaysia confirmed that students choose mobile applications as a supportive pedagogical tool because of their perceived relevance and added value (Al-Rahmi et al., 2022). However, the use of mobile applications is generally driven by personal motivation rather than institutional planning (Hinze et al., 2023).

As well as delivering education, digital technology can be used as a pedagogical tool. Videos, interactive exercises, gaming and collaborative features are found to increase students' engagement and motivation (Martin and Bolliger, 2018; Nacke and Deterding, 2017). A study of 127 students at the mathematics and statistics department of the De La Salle University – Dasmariñas, in the Philippines, found that a tool used to administer online exercises and modules led to overall positive perceptions and higher motivation towards the proposed activities (Valdez and Maderal, 2017). A study of 32 teachers undergoing pre-service training at the Universitas Negeri Surabaya in Indonesia showed that broadcasting instructional videos was effective in supporting inquiry-based teaching. Videos showing teachers giving chemistry and biology classes were used to raise student teachers' awareness of scientific approaches in teaching practice (Susantini et al., 2018). However, beyond self-reporting, evidence on the impact of these tools on actual practice and on learning outcomes is lacking.

Digital technology offers the opportunity to engage with real-life, complex situations through simulations, such as virtual reality and role play. Simulation-based learning is beginning to be applied in tertiary education settings (**Box 5.4**). Virtual reality helps reduce design and implementation costs as well as overcome technical issues (Habibah et al., 2021). Immersive three-dimensional environments foster motivation and experiential learning increases students' skills (Kustandi et al., 2020). A meta-analysis on 145 empirical studies on the effectiveness of virtual reality in higher education found that simulations lead to large positive effects on all skills investigated, and medium positive effects on teamwork, including among students without prior knowledge (Chernikova et al., 2020).

BOX 5.4:

The use of virtual reality in technical institutes in Southeast Asia is in its early stages

In technical and vocational education and training (TVET), immersive virtual environments help overcome safety concerns and practical constraints (UNESCO-UNEVOC, 2020; World Bank, 2021). Used as a pedagogical tool, they can increase student skills in sectors such as health and engineering (Angel-Urdinola et al., 2021). The Health Professionals Education and Training for Health System Reforms project in Viet Nam has introduced clinical simulations into nursing education programmes. The establishment of virtual learning rooms, computer laboratories, clinical skills laboratories and clinical simulation areas have integrated virtual reality as a permanent clinical method. As a result, students have improved in multiple-choice tests and clinical examinations (Lê, 2021; Tran et al., 2022).

In Indonesia, MilleaLab, a software platform used to create virtual reality–based educational content, was developed in 2019 by a partnership between the SEAMEO Regional Open Learning Centre and the Indonesian TVET provider Shinta Virtual Reality. Millealab has enabled access to virtual learning courses for 1,500 schools and has trained 5,200 teachers who do not have advanced digital skills (UNESCO-UNEVOC, 2021a).

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).

Despite these initiatives, the deployment of technologies in TVET remains limited in Southeast Asia. In 2019, fewer than 1 in 3 of the 239 training institutions surveyed in Cambodia, Indonesia, the Philippines and Viet Nam used simulators and fewer than 1 in 4 integrated virtual and augmented reality. In over 70% of assessed training programmes, technologies are mostly used as tools for self-learning (Asian Development Bank, 2021).

Simulation-based learning has been applied in medicine and other science and technology fields (Chernikova et al., 2020). However, the high costs of virtual reality applications may prevent their widespread implementation in some contexts. In Indonesia, virtual reality has been used as a learning tool, mostly in selected industries including gaming, entertainment and tourism. Low-cost solutions are prevalent, including Google Cardboard and head-mounted displays (Habibah et al., 2021). Interviews conducted with 19 lecturers at two English departments of a private university in East Kalimantan province of Indonesia confirmed that limited implementation of this mode of learning can be traced to poor infrastructure and financial resources. Nevertheless, teachers acknowledge the potential benefits of stimulating interest and personalizing learning (Nur, 2023).

More advanced in its processes, 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 an experimental programme involving first-year students at the same university, video and voice analytics were used to analyse students' engagement, while virtual reality and data analytics were used to encourage and monitor interactions with peers attending a programme from China. While the programme is expected to be further monitored (Singapore Ministry of Education, 2022), students' self-assessments reported positive experiences linked to the exchange programme and new partnerships were established in the academic year 2023/4 with other universities in the region (SUDT, 2023). Analysis for this report found that most technology applications are not being scaled up in Brunei Darussalam. Educators also reported limited understanding and exposure to advanced digital technology (SEAMEO VOCTECH, 2023).

VARIOUS BARRIERS PREVENT THE EFFECTIVE INTEGRATION OF DIGITAL TECHNOLOGY

The capacity of instructors and lecturers affects the extent and degree of success in integrating digital technology in higher education in the region. Consistent with previous studies (Nhu et al., 2018), a survey carried out for this report among 200 university students in Viet Nam found that about two in three consider that poor ICT competencies of lecturers negatively affect the integration of ICT into teaching practices (Vinh et al, 2023). Even in countries that have a long e-learning tradition, such as Singapore, educators report challenges in ensuring an engaging learning experience in classes mediated by technologies and in catering to diverse students' needs (Müller et al., 2021; Nguyen et al., 2022).

Educator beliefs and dispositions towards technologies may also impede their use (**Chapter 10**). In the Philippines, older educators were resistant to adapting to digital technologies when they were forced to move to online learning during the COVID-19 pandemic (Philippine Normal University, 2023). Likewise, a study in Viet Nam exploring differences in competencies based on higher education teachers' age found that older teachers were less confident in using digital technology (Nghia and Tran, 2021). A study conducted in Malaysia among higher education educators found that self-efficacy affects the perceived usefulness of technologies, and as a result, their intention to use them in their teaching practices (Islam et al., 2019). Higher education instructors also show resistance to sharing teaching content online (Farley, 2023).

Functional ICT infrastructure of good quality is necessary but not always consistently ensured, especially in lower-middle income countries of the region (**Chapter 7**). Financed by the Republic of Korea, the Korean Language Department of the National University of Laos is well equipped with digital devices to facilitate teaching and learning, such as projectors, desktop computers and high-speed internet. In this context, lecturers reported using Google Classroom, a free blended learning platform, to manage student assignments and assessments. Some instructors also report effectively integrating Google Form ¬– survey administration software – and Kahoot – game-based software – for developing quizzes and assessments and enhancing students' engagement (Australian Council for Educational Research, 2023).

Even if available, the low quality of digital resources and services may hamper their effective use. Most lecturers in Cambodia report having access to hardware in higher education institutions, such as projectors and computers; however, they prefer to use their own laptops for teaching (Phyrom and Song, 2022). Respondents interviewed for this report confirmed that both teachers and students tend to rely on their own devices, mostly mobile phones, and on self-financed pre-paid internet services. Some locations are particularly at a disadvantage. Higher education institutions in Odaar Meanchey, a remote northwest province, are more likely to experience poor internet connection and support services; this has implications for the effectiveness of ICT integration (Brehm et al., 2023).

Some Southeast Asian countries have worked to strengthen higher education ICT infrastructure. As part of its second higher education plan 2008–22, Thailand has set up the University Network (UniNet) to connect higher education institutions to high-speed internet and provide them with digital resources (Crocco and Pitiyanuwat, 2023). The system supports resource and knowledge exchange and collaboration among researchers and educational institutions across Southeast Asia (Dipendra, 2023). The Philippine Research, Education and Government Information Network (PREGINET) connects the country's main universities with international research networks and provides a digital platform for research exchange and communication; it was upgraded during the COVID-19 pandemic (World Bank, 2022).

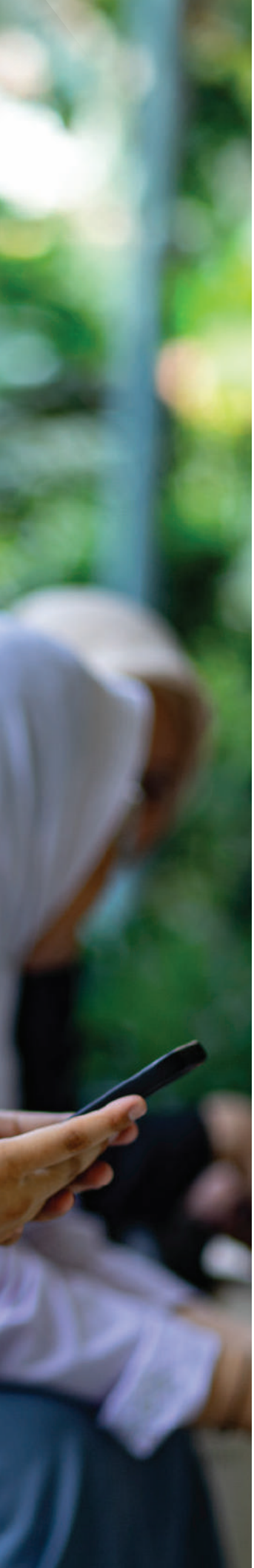
CONCLUSION

Southeast Asian countries have promoted the digital transformation of their higher education systems in various ways, from the establishment of open universities to the formal recognition of micro-credentials. Drawing on a tradition of online and distance learning, digital technology has been used to progressively expand access to post-secondary education and to promote new pedagogies and provision modalities, especially in response to the COVID-19 pandemic.

Digital technology has provided alternative pathways to tertiary education for hard-to-reach learners and for students who would have not participated in traditional formal education. Open universities promote a more flexible and inclusive learning experience and have made efforts to promote quality standards. The surge in MOOCs and micro-credentials in the region is a sign of the high demand for learning. Their gradual recognition and integration in formal learning settings shows that higher education institutions in the region are receptive to transformation. But obstacles remain, including weak instructor capacity, negative beliefs and dispositions, and a lack of functional infrastructure and quality connection and services. Moreover, evidence on the effectiveness of technology on changing teaching practices and improving learning outcomes, beyond just facilitating access to learning, remains limited.

The Digital Innovation Challenge 2023: Generasi Terampil programme, launched by UNICEF and partners in Indonesia, aims to provide adolescent girls and boys aged 12-18 years old, particularly the most disadvantaged, with the skills they need to fulfil their potential through increased access to high-quality learning opportunities.

Credit: © UNICEF/UNI471950/*



CHAPTER

6

Digital skills

KEY MESSAGES

There are contrasting visions of digital skills in Southeast Asia.

- Almost all countries define digital skills standards and competencies. But while regional and multilateral organizations have embraced a broad, critical approach, often related to the concept of citizenship, many countries rely on digital skills frameworks developed by commercial actors.

Measuring digital skills remains challenging.

- Digital skills are not assessed separately in formative assessments. International and regional skills assessments only cover certain aspects of digital skills and some countries.

Current measures suggest low digital skills levels and large gaps.

- Among youth and adults in seven countries, 34% can transfer files between devices, 19% can use basic arithmetic formulas in a spreadsheet, and less than 3% have coding and programming skills.
- The gender gap is more evident when considering advanced digital skills, such as writing a computer programme. In Singapore, 4 women for every 10 men can do so.
- Digital skills vary by socioeconomic background. In the Philippines, students from private and urban schools have significantly higher scores in digital skills than their peers.

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

- In 2021, 61% of 10- to 24-year-old youth had not received any formal digital skills education at school, ranging from 24% in Viet Nam to 75% in Myanmar.
- Data from the 2018 Programme for International Student Assessment show that 48% of 15-year-olds in Thailand, 34% in Singapore, and 31% in Brunei Darussalam regularly use their devices for activities outside schools.
- Formal education remains important for the safe and effective use of devices. About 30% of children in the Philippines and 50% of children in the Lao People's Democratic Republic reported having learned from teachers how to use computers, according to Digital Kids Asia-Pacific national surveys.

Southeast Asia has developed various ways to build digital skills.

- Media literacy is not always mainstreamed in in school curricula. The Philippines includes media and information literacy as a core subject in grades 11 and 12.
- Brunei Darussalam integrates communication and collaboration skills across various subjects such as science, languages, social science and humanities.
- Southeast Asian countries have developed various responses to the development of content creation skills. Indonesia organizes intellectual property rights webinars for young content creators through Siberkreasi, the National Digital Literacy Movement.
- Data privacy and security skills are mostly taught through targeted initiatives. Since 2010, the CyberSAFE in Schools programme has focused on cyberbullying, cyberstalking and grooming in Malaysia.
- Problem-solving skills are conceived of predominantly in relation to coding and programming. In Singapore, the O-level Computing syllabus includes a dedicated 'Abstraction and Algorithms' module on problem analysis and algorithm design.

Technology is transforming the way people study, work, access and interpret information, communicate and interact with others, and participate as citizens. As economies and labour markets are being transformed by digital technology, one projection estimated that 80% of jobs in Southeast Asia will necessitate a basic level of digital skills by 2030 (Asian Development Bank, 2022). Digital skills have therefore become part of the basic skill set which everyone needs.

Keeping up with the pace of change is costly and time consuming. It also poses a challenge for formal education systems to find entry points which take into account that children and youth acquire digital skills outside formal settings. Southeast Asian countries are endorsing definitions of digital skills, adopting standards and adjusting curricula. Yet efforts are still required to prioritize the needs of marginalized populations and ensure the implementation of education programmes that aim to build digital skills (ASEAN, 2022).

This chapter provides an overview of digital skills in Southeast Asia. It focuses on national digital skills definitions, frameworks and standards. It examines approaches to measure these skills and available evidence. Finally, it explores how digital skills are acquired in formal and non-formal settings and across areas of digital competence.

ORGANIZATIONS AND COMMERCIAL ACTORS OFFER CONTRASTING VISIONS OF DIGITAL SKILLS

Definitions of digital skills have been evolving, as digital technology continues to advance. Regional and multilateral organizations in Southeast Asia have embraced a broad, critical approach to defining digital literacy, often related to the concept of citizenship. Digital skills are thought of as empowering individuals to confidently use digital technology, enhance their personal and professional lives, use and create content, protect themselves from potential risks, and engage online with the responsibility of not harming others (**Table 6.1**).

Almost all Southeast Asian countries have explicitly identified digital skills standards and competencies for learners in a policy, plan or strategy document, adopting a variety of approaches to defining digital skills. In its 2022 Digital Workforce Competitiveness Act, the Philippines endorsed a broad definition considering digital skills as a 'combination of behaviours, expertise, know-how, work habits, character traits, dispositions, and critical understanding' of digital technology (Philippines Congress, 2022). By contrast, in its 2022 EduTech Roadmap, Cambodia sees digital literacy as a way to 'search for, access, manage, manipulate and create information' (Cambodia Ministry of Industry, Science, Technology and Innovation, 2022); its approach draws upon the Digital Capacity Framework developed by the United Kingdom Joint Information Systems Committee (Cambodia Ministry of Industry, Science, Technology and Innovation, 2022). Analysis for this report shows that at least five countries' national plans have an emphasis on gender.

TABLE 6.1:
Definitions of digital skills by intergovernmental organizations

	Association of Southeast Asian Nations (ASEAN)	UNESCO Bangkok	SEAMEO/UNESCO Digital Kids Asia-Pacific
	Digital literacy	Digital citizenship	Digital literacy
Definition	'knowledge, skills and attitudes…'	'being able to find, access, use and create information effectively; engage with other users and with content in an active, critical, sensitive and ethical manner; and navigate the online and ICT environment safely and responsibly, while being aware of one's own rights'	'ability to seek, critically evaluate and use digital tools and information effectively'
Purpose	'…that allow learners and teachers to be both safe and empowered in an increasingly digital world' 'encompasses their play, participation, socializing, searching and learning through digital technologies'	'to benefit from the fullest exercise, enjoyment and participation in society through the use of ICT'	'to make informed decisions'

Sources: UNESCO Bangkok and Regional Bureau for Education in Asia and the Pacific (2016) and UNESCO Bangkok (2019).

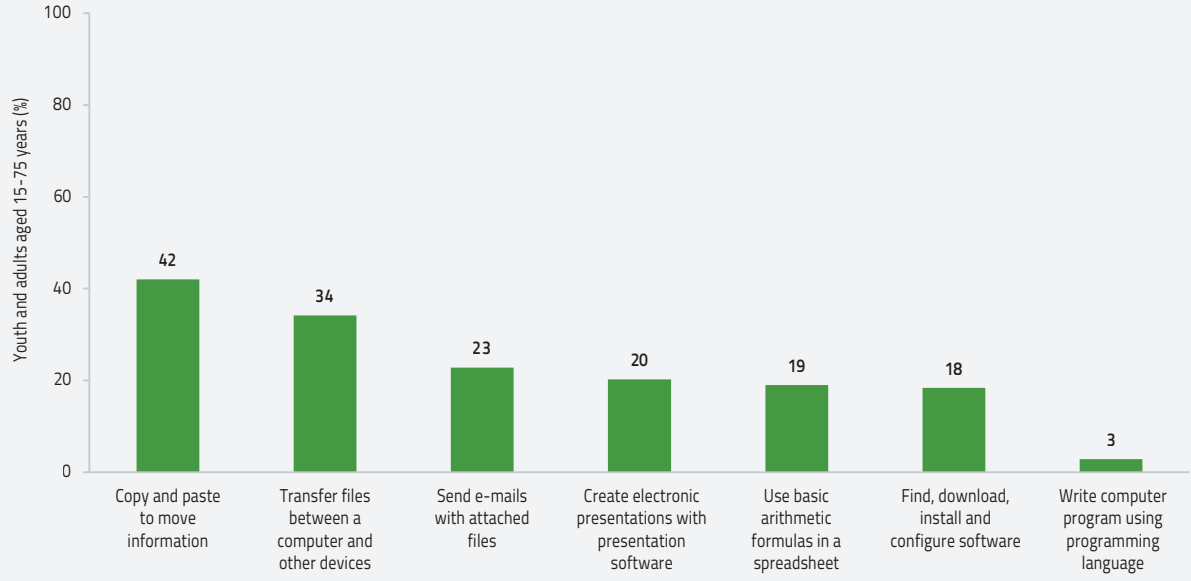
The Ministry of Communications and Informatics of Indonesia has developed a national digital literacy framework with Siberkreasi, a multi-stakeholder initiative involving more than 60 national-level institutions and communities. The framework covers digital skills, digital safety, digital ethics and digital culture, and includes learning modules and curriculum (Azzahra and Amanta, 2022; UNESCO-UNEVOC, 2021). In Singapore, the Ministry of Communications and Information refers to a digital society where individuals have technology access and confidently and effectively utilize it to engage with the global community. This entails fostering skills in areas such as digital security and cybersecurity (Centre for Evidence and Implementation, 2023).

Several countries use digital skills frameworks developed by commercial actors. These tend to be narrower, operational and related to the world of work. Indonesia, Malaysia, Thailand and Viet Nam rely on the International Computer Driving Licence (ICDL). ICDL has been promoted as a 'digital skills standard' but is primarily associated with Microsoft applications, as is the Microsoft Digital Literacy Standard Curriculum (UIS, 2018). Thailand has officially recognized and endorsed ICDL as the only digital literacy standard for use in schools, universities and training institutes (World Bank, 2020). In 2007, Malaysia adopted the Certiport Internet and Computing Core Certification, a testing arm of the multinational publishing and education company Pearson (Certiport, 2023; UIS, 2018). Based in Singapore, the DQ Institute has developed a digital intelligence framework that was piloted in Thailand (Jackman et al., 2021).

MEASURING DIGITAL SKILLS IS CHALLENGING

Digital skills are difficult to measure, especially when a broad definition is adopted. The coverage of digital skills in national assessments remains limited in Southeast Asia. They are not explicitly mentioned in Cambodia and the Lao People's Democratic Republic, even though information communication and technology (ICT) is integrated in parts of the curriculum (Australian Council for Educational Research, 2023; Brehm et al., 2023). In the Philippines, national assessments at grades 3, 6 and 10 focus on English, mathematics and science but not on digital skills (Philippine Normal University, 2023). Viet Nam has an assessment that engages students in creating digital products (Vinh et al., 2023). The education ministry in the Lao People's Democratic Republic has provided comprehensive guidelines on student assessment across all subjects, including on digital skills, but the adoption of technology-based assessment practices among teachers varies (UNDP, 2022).

FIGURE 6.1:
One in five adults in Southeast Asia can use formulas in a spreadsheet
Percentage of youth and adults aged 15 to 75 with ICT skills, by type of skill, selected Southeast Asian countries, 2017–19



Source: SDG indicators database.

In 2015, Malaysia developed the Digital Competency Score in partnership with the Malaysia Digital Economy Corporation. Schools in Singapore assess digital skills through the National Digital Explorer initiative, targeting students aged 10 to 18. Upon completion of each module, students can undergo ICDL certification tests. As of 2023, the National Digital Explorer initiative has registered 17,000 students from 64 schools (Centre for Evidence and Implementation, 2023).

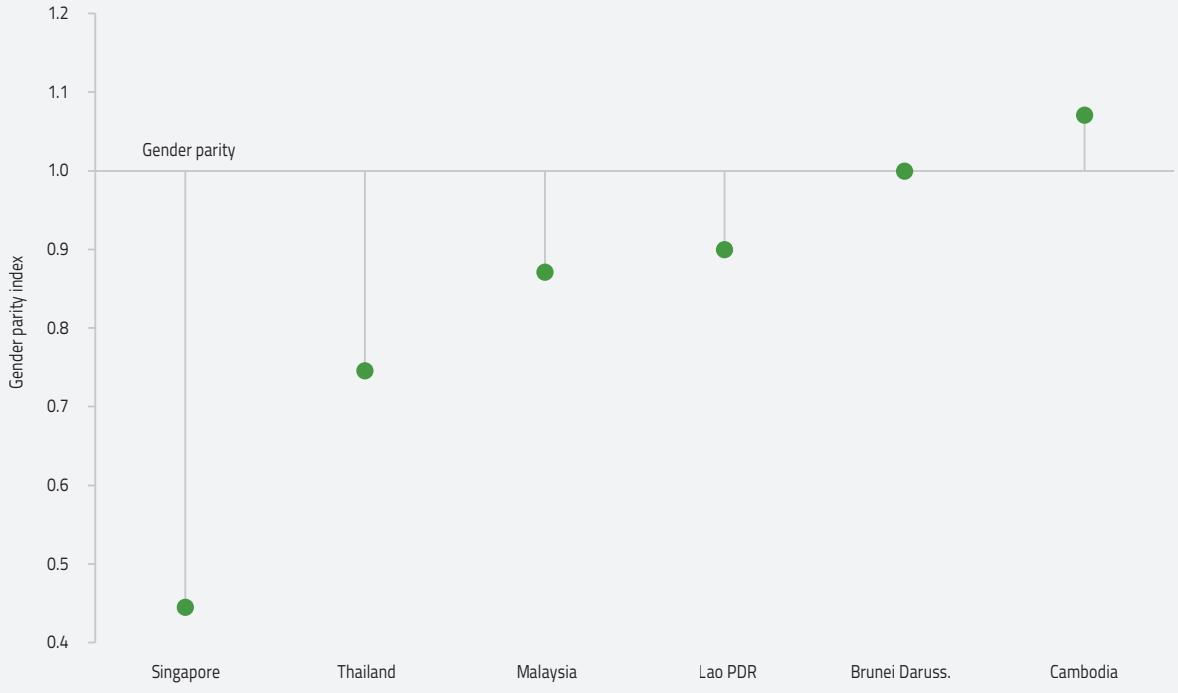
Relying on proxy measures or self-assessments, some cross-national assessments try to capture aspects of digital skills. The International Telecommunication Union (ITU) and the UNESCO Institute for Statistics (UIS), which are the custodian agencies of SDG global indicator 4.4.1, rely on national household surveys which measure the percentage of adults who self-report possessing nine ICT skills. The UNESCO Digital Kids Asia-Pacific project, which aims to assess ICT literacy, attitudes and behaviours among 15-year-old students, has been carried out in Indonesia, the Lao People's Democratic Republic, the Philippines and Thailand (UNESCO Bangkok, 2019). But the survey acknowledges that responses suffer from social desirability bias, for instance in the Philippines (SEAMEO, 2021b).

CURRENT MEASURES SUGGEST LOW DIGITAL SKILLS LEVELS AND LARGE GAPS

In 2017–19, eight countries reported on the SDG global indicator 4.4.1: Brunei Darussalam, Cambodia, Indonesia, Malaysia, the Philippines, Singapore Thailand and Viet Nam. Among youth and adults in these countries, 34% can transfer files between devices, 19% can use basic arithmetic formulas in a spreadsheet, and less than 3% have coding and programming skills (**Figure 6.1**).

There is large inequality in self-reported basic ICT skills by age, such as communicating by email. In Thailand, the percentage of 15- to 24-year-olds who could send e-mails with an attachment was 40% but less than 5% among adults over 75 years old. Gender is not a major determinant of digital skills in general but plays a major role in advanced skills. Women and men tend to have the same level of basic digital skills, such as creating electronic presentations. But the gender gap is large in the use of programming languages. For instance, in Singapore, 44 women can write a computer program for every 100 men who can do so (**Figure 6.2**).

FIGURE 6.2:
Women are much less likely than men to have programming skills
Gender parity index in the reported ability to write a computer programme using a specialized programming language, selected Southeast Asian countries, 2016–21



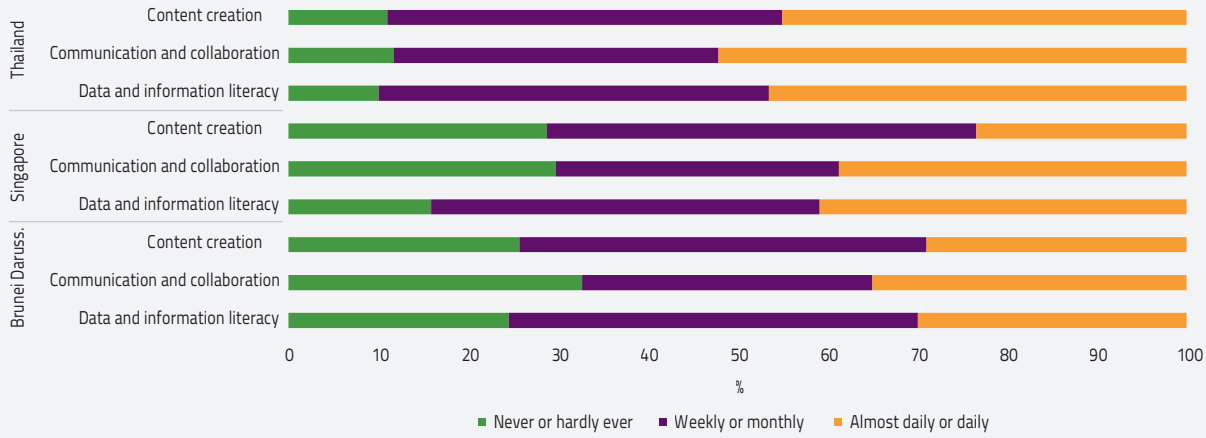
Source: SDG indicators database.

Significant gaps are also evident by socioeconomic background. In the Philippines, a survey of grade 10 students found that those from private and urban schools had significantly higher digital skills than their peers from public and rural schools (Philippine Normal University, 2023). Based on responses to nine computer-related activities, youth aged 15 to 24 from the wealthiest quintile in Viet Nam were nearly seven times as likely to have digital skills as youth from the poorest quintile. Likewise, 1% of ethnic Hmong but 44% of Kinh, the dominant ethnic group in Viet Nam, were reported as having digital skills (Vinh et al., 2023). Insufficient familiarity with the language in which digital content is available is another barrier for digital learning. In Cambodia, 72% of secondary school students identified poor English language skills as their primary challenge in online learning, given that most instructional materials were available in English (UNICEF East Asia and Pacific Regional Office, 2023).

DIGITAL SKILLS ARE ACQUIRED IN FORMAL EDUCATION BUT OFTEN OUTSIDE IT

There is little evidence on how digital skills are acquired, as there are both multiple pathways and outcomes. Formal skills training is a key way to acquire digital skills, as suggested by the correlation between education qualifications and digital skills. In Thailand according to a 2019 national household survey, 46% of upper secondary and early undergraduate students – but only 16% of lower secondary students – reported being proficient in digital content creation, for instance in creating electronic presentations (Dipendra, 2023). In Viet Nam, 54% of youth with higher education qualification have digital skills compared with 5% of youth with lower secondary education (Vinh et al., 2023). Findings from the 2017 Lao Social Indicator Survey show a remarkable disparity in computer-related engagement between 15- to 24-year-olds without a lower secondary qualification and their peers with tertiary education (Australian Council for Educational Research, 2023; UNICEF, 2020).

FIGURE 6.3:
Children in Southeast Asia use digital devices outside school almost daily
Percentage of 15-year-olds using digital devices outside school to perform different activities, selected Southeast Asian countries, 2018



Note: Questions included in the survey are categorized into three different types of skills. For each skill category, the average of the respondents' responses is calculated. The questions included in the survey were on:

a) Data and information literacy: Using email. Browsing the internet for fun (such as watching videos). Browsing the internet for schoolwork (e.g. for preparing an essay or presentation). Browsing the internet to follow up lessons, e.g. for finding explanations. Checking the school's website for announcements, e.g. absence of teachers. Reading news on the internet (e.g. current affairs). Obtaining practical information from the internet (e.g. locations, dates of events).

b) Communication and collaboration: Playing one-player games. Playing collaborative online games. Chatting online. Participating in social networks. Playing online games via social networks. Using email for communication with other students about schoolwork. Using email for communication with teachers and submission of homework or other schoolwork. Using social networks for communication with other students about schoolwork (e.g. Facebook). Using social networks for communication with teachers (e.g. Facebook).

c) Content creation: Downloading music, films, games or software from the internet. Uploading their own created contents for sharing (e.g. music, poetry, videos, computer, programs). Downloading new apps on a mobile device. Downloading, uploading or browsing material from a school's website (e.g. timetable or course materials).

Source: GEM Report team analysis based on the 2018 PISA ICT survey data.

But digital skills are also acquired in non-formal settings (Helsper and Eynon, 2013). According to a survey conducted by the UNICEF East Asia and Pacific Regional Office, 61% of 10- to 24-year-olds reported not receiving any formal digital skills education at school, ranging from 24% in Viet Nam to 75% in Myanmar. Students who did receive digital skills education in their formal education rated their learning experience on average as moderate, in a range from poor to excellent (UNICEF East Asia and Pacific Regional Office, 2021).

According to the ICT survey component of the 2018 Programme for International Student Assessment (PISA), 48% of 15-year-olds in Thailand, 34% in Singapore and 31% in Brunei Darussalam reported using their digital devices outside school for content creation, communication and collaboration activities almost daily or daily (**Figure 6.3**).

Southeast Asia stands out as a region with a remarkably dynamic social media landscape. Countries consistently exhibit some of the highest levels of daily time spent on social media (Statista, 2023). Among 16- to 64-year-old internet users in Indonesia, Malaysia, the Philippines, Thailand, Singapore and Viet Nam, an average of about three hours is spent on social media platforms every day. It is estimated that 64% of 16- to 64-year-olds in the Philippines and 60% in Indonesia engage with online videos, tutorials and educational videos every week (GWI, 2022; wearesocial, 2023).

The COVID-19 pandemic accelerated the shift towards digital learning through social media. It is estimated that 48% of 16- to 24-year-old internet users in Cambodia and 91% in Indonesia use social media. Adolescents reported creating their own content through social media. In Indonesia and Malaysia, children use Wattpad,

a free online platform, to upload and exchange stories. Others reported creating and posting videos on YouTube. In a primary school survey conducted by the Indonesia Ministry of Education and Culture in April 2020, 70% of almost 15,000 respondents indicated that they engaged in learning activities primarily via WhatsApp groups. Conversely, less than 0.1% of respondents reported utilizing websites or school-specific online platforms as their primary means of learning (UNESCO Bangkok and Regional Bureau for Education in Asia and the Pacific, 2020).

Learners can develop coding and programming skills through online courses, digital games, commercially available robotic kits and puzzle-style digital applications (UNESCO, 2023). A Microsoft Asia-Pacific study conducted in 2015 showed that 39% of students under age 24 in the Philippines had engaged in coding through online video tutorials (Microsoft, 2015).

Results from the UNESCO Digital Kids Asia-Pacific Online Survey show that the use of digital devices was strongly correlated with digital safety and resilience and, in the Lao People's Democratic Republic, also with digital creativity and innovation. With adequate support, formal education can guide students in the safe and effective use of technology: about 30% of children in the Philippines and 50% of children in the Lao People's Democratic Republic reported having learned from teachers how to use computers (SEAMEO, 2021a, 2021b).

This does not suggest that formal education is not important. But formal education systems face various challenges, including a lack of material resources, as well as enhancing awareness and allocating sufficient time for learners to practise digital skills (UNICEF East Asia and Pacific Regional Office, 2021), and determining the appropriate content, pedagogy and desired outcomes that effectively foster the development of digital skills. These considerations become even more critical in light of the rapid evolution of technology (OECD, 2019b).

SOUTHEAST ASIA HAS DEVELOPED VARIOUS WAYS TO BUILD DIGITAL SKILLS

Digital skills policies, plans and strategies are developing rapidly. Some adopt a broad view of digital skills, while others focus on a narrow set; some take an intergenerational approach, while others specifically target children, parents (**Box 6.1**) and public officers (**Box 6.2**).

Many countries in the region provide digital skills education through standalone subjects, with a focus on ICT and computer science subjects. At the primary level, primary students in Malaysia learn to create documents, basic coding and computer programming through the subjects 'ICT' and the 'World of Science and Technology' (UNESCO Bangkok and Regional Bureau for Education in Asia and the Pacific, 2020). In the Philippines, digital skills are taught to students from grades 4 to 6 within the subject 'ICT and Entrepreneurship'. The pedagogical strategy includes regular reviews and building on prior knowledge to enhance understanding and retention (Philippine Normal University, 2023).

At the secondary level, countries emphasize distinct aspects of digital skills in ICT and computer science curricula. Through the secondary school computer

BOX 6.1:

Parents are partners in digital skills development

Parents' understanding and awareness of technology plays a critical role in ensuring that children can benefit from and not be harmed by their experiences online. Findings from the Disrupting Harm household survey show that more than 80% of 12- to 17-year-olds in Indonesia, Malaysia, the Philippines and Viet Nam, and almost 80% of their caregivers, engage in online activities at least once a day (ECPAT et al., 2022a, 2022b, 2022c, 2022d).

However, limited ICT skills of caregivers (33%) and insufficient knowledge to support learning (28%) were identified as main barriers to implementing distance learning programmes in Cambodia (Cambodia Ministry of Education, Youth and Sport, 2021). This might prevent parents from encouraging their children to explore and learn through the internet, suggesting methods for safe internet usage and engaging in shared online activities. Instead, some parents prioritize restricting their children's internet access if they have concerns about them being online (ECPAT et al., 2022a, 2022b, 2022c, 2022d).

In response to the lack of parents' digital skills, low engagement and overprotective and technologically moderated parenting, countries have launched targeted initiatives, including training and guidance. In Malaysia, the National Population and Family Development Board, in partnership with University Putra Malaysia, Maestral International and UNICEF, has revised and strengthened several training modules to guide parenting support interventions on child online protection (UNICEF Malaysia, 2019). Singapore offers parents guides and kits on cyber wellness, setting parental controls and navigation (Singapore Ministry of Education, 2023a).

BOX 6.2:

It is crucial that administrators and public officers have digital skills

The acquisition of digital skills is not solely limited to learners, teachers and parents; it is also imperative for central and local administrators. Competency development is a high priority in most countries within the region. Singapore and Thailand have explicitly acknowledged the importance of digital skills for senior civil servants, as their capacity is key to the successful implementation of national policies and programmes (OECD, 2019a).

However, there are obstacles to this. An assessment conducted by the Lao People's Democratic Republic's Ministry of Education and Sports shows that the teaching of digital skills is hampered by ICT staff's limited capacity to administer, maintain and build software and associated systems across departments (Australian Council for Educational Research, 2023). Another study confirmed that the digital maturity of central and local administrators was only an average of 1.7 on a scale from 'digitally nascent' (1) to 'innovative' (5) (Australian Council for Educational Research, 2023; UNDP, 2022). A 2019 Asia-Pacific Economic Cooperation survey highlights that over 50% of 3,000 respondents from six countries in Asia and the Pacific, including Indonesia and Singapore, believed that governments and educational institutions had a limited understanding of the digital skills landscape in their countries (AlphaBeta, 2021). To address these challenges effectively, the Ministry of Technology and Communications in the Lao People's Democratic Republic regularly organizes ICT training programmes, seminars and educational sessions for government personnel (World Bank, 2022). Indonesia has developed the digital capabilities of its civil servants through the Government Transformation Academy training (Santhika, 2023). The education ministry in Timor-Leste has recruited local mentors to assist municipal education leaders on the use of technology.

Public–private partnerships can also enhance system capacity. Malaysia has introduced the MyDIGITAL initiative to strengthen civil servants' digital skills (Malaysia Ministry of Economy, 2023). To effectively implement this nationwide campaign, two digital technology companies, Cloud Connect and TM One, the enterprise and public sector business arms of Telekom Malaysia Berhad, have joined forces to establish the Cloud Connect Academy and equip government officials with the necessary opportunities for upskilling (TM One, 2021).

In the Philippines, Globe, a telecommunications company, has established a strategic partnership with the American Bar Association Rule of Law Initiative to provide extensive training to representatives from civil society, academia and the Integrated Bar, the organization of lawyers of the Philippines. The primary goal is to provide digital knowledge and skills to enable capacity-building workshops under the Digital Thumbprint Programme (Globe Telecom, 2021).

science syllabus, Malaysia's national curriculum discusses privacy, cyberbullying, hacking and ethics to raise awareness among students regarding the implications of using computers (UNESCO Bangkok and Regional Bureau for Education in Asia and the Pacific, 2020). In the Philippines, the ICT curriculum for grades 11 and 12 has been designed to align with the demands of the labour market. As part of the Technical Vocational Livelihood Track, students can specialize in animation, computer programming and computer systems servicing, enabling them to obtain national certifications from the Technical Education and Skills Development Authority (Philippine Normal University, 2023).

An alternative approach is to incorporating digital skills transversally into several subjects. In Viet Nam, teaching students to combat misinformation and address internet and video game addiction cuts across subjects like English, Mathematics and Vietnamese (Vinh et al., 2023). Indonesia recognized this approach's value and eliminated ICT as a standalone compulsory subject in 2014. The revised primary and secondary curriculum now emphasizes high order thinking skills, including analysis, evaluation and creation, by integrating ICT across other subjects (The SMERU Research Institute, 2022; UNICEF, 2021a).

This section reviews national efforts to develop digital skills, within the school system and beyond. It is organized along the lines of the five competence areas (information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving) of the Digital Competence Framework for Citizens (DigComp) developed by the European Commission in consultation with the European Union's member states and since adopted as part of the Digital Literacy Global Framework (UIS, 2018; Vuorikari et al., 2022).

DATA AND INFORMATION LITERACY

Data and information literacy skills enable people to effectively browse, search, filter, evaluate and manage data and information available in digital environments. A survey conducted among individuals aged 18 and older in the region shows that more than three in five respondents

in Malaysia, Singapore and Thailand are concerned about misinformation online (Newman et al, 2022; wearesocial, 2023).

Some countries take a protectionist approach to media literacy which prioritizes information control over education (UNESCO Bangkok and Regional Bureau for Education in Asia and the Pacific, 2020). As a result, such education 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 and Regional Bureau for Education in Asia and the Pacific, 2020). The Association for Media and Information Literacy advocated for the incorporation of media and information literacy in the curriculum of the Philippines, which has now become a core subject in grades 11 and 12. This subject offers students an introductory understanding of media and information as vital communication channels and tools (Frau-Meigs, 2023). With UNESCO support, Myanmar developed the Media and Information Literacy Competency Framework based on a collaborative approach, involving students, teachers, teacher trainers and coordinators from the Myanmar Literacy Resource Centre (UNESCO Myanmar, 2020).

Children and youth who are traditionally excluded from education may have limited access to experts and to reliable data and information sources that can help with the acquisition and external validation of knowledge. Thailand's 4.0 Policy aims to provide data and information skills programmes specifically to young people who are not in education and employment (Thailand Ministry of Labor, 2017). These initiatives focus on data analytics, visualization, using data for decision-making, aiming to increase employability opportunities and enhancing critical thinking. The programme Media, Information, and Digital Literacy for Democratic Citizenship of Thai Elderly Thailand provides media and digital technology competencies and performance indicators for older adults (Thisaphak et al., 2019).

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 in the region have adopted varied strategies to promote communication and collaboration skills in schools. The education system in Brunei Darussalam follows a holistic approach to developing student ability to communicate and collaborate effectively. It embeds these skills across various learning areas including science, languages, social science, humanities and digital literacy (Brunei Darussalam Ministry of Education, 2013; UNESCO-NEQMAP, 2019).

The Philippines has implemented a mandatory curriculum component known as 'empowerment technologies' in grades 11 and 12, which focuses on ICT as a tool for curating, contextualizing and collaborating (Philippine Normal University, 2023). Singapore has implemented the 'Find, Think, Apply, Create' framework in schools to cultivate and strengthen communication and collaboration skills among students as a foundation for the National Digital Literacy Programme, which was launched in 2020 (Singapore Ministry of Education, 2020).

DIGITAL CONTENT CREATION

Competences under digital content creation include selecting appropriate delivery formats and creating copy, audio, video or visual assets; integrating and re-elaborating digital content; and copyright and licences. Countries have developed various responses to the development of content creation skills.

Indonesia's updated primary and secondary curriculum has been designed in collaboration with corporations, academics, non-governmental organizations, and public figures such as artists to inspire students and foster wider community cooperation in producing and disseminating cultural and ethical digital content (Indonesia Ministry of Communication and Informatics, 2020; SEAMOLEC, 2023). Siberkreasi, the National Digital Literacy Movement, organizes intellectual property rights webinars for young content creators (Siberkreasi, 2023). An initiative between Siberkreasi and the government, Makin Cakap Digital (Raising Indonesia's Digital Capability), involves literacy activist institutions and communities and aims to improve creativity skills in content creation (Literasi Digital, 2023).

In Malaysia, the Ministry of Education launched the #mydigitalmaker movement through a collaborative effort between the public sector, private sector and academia, spearheaded by the Malaysia Digital Economy Corporation (Malaysia Digital Economy Corporation, 2023b), with the objective of establishing the country as a leading digital content creator and provider in the regional market by 2030 (Malaysia Economic Planning Unit, 2021). This initiative encourages students to acquire digital content

creation skills, focusing on programming, robotics and digital design. It has reached more than 2 million students. As part of the #mydigitalmaker movement, the Digital Ninja programme offers bootcamps for high school students to gain industry experience and work alongside digital technology professionals in content creation and has certified more than 500 students (Malaysia Digital Economy Corporation, 2023a).

Singaporean primary and secondary schools have placed a growing emphasis on 'digital making', which includes utilizing digital technology for artefact creation, coding applications, digital art and music production, and digital fabrication methods, including 3D printing. Students are actively encouraged to apply design thinking methodologies using Tinkercad, an online 3D modelling programme, and Adobe Creative Cloud – a platform used for graphic design, video and photo editing – to facilitate the design of 3D prototypes (Centre for Evidence and Implementation, 2023). In Timor-Leste, multimedia courses for high school students focus on creating presentations and producing videos (SEAMEO QITEP in Science, 2023).

SAFETY

As the use of digital technologies increases so do the risks related to exposure to digital technologies. The frequent violation of privacy through data misuse means preventive measures are needed to strengthen cybersecurity and address the mental and physical health implications of lengthy screen time, cyberbullying and harmful content with its potential long-term impact on addictive behaviour, violence and sexual exploitation (**Chapter 9**) (UNESCO Bangkok and Regional Bureau for Education in Asia and the Pacific, 2020).

Since 2001, Singapore has implemented a cyber wellness education programme in schools. The curriculum has been constantly updated to address emerging issues, such as introducing a module on fake news in 2018. Starting from 2022, the time allocated to cyber wellness doubled, up to four hours a week (Teng, 2020). The Cyber Wellness curriculum is organized into five main topics – cyber use, cyber identity, cyber relationships, cyber citizenship and cyber ethics – which cover various issues, from cyberbullying and awareness of distress symptoms to responsibility over online content and copyright (Singapore Ministry of Education, 2023b).

The Department of Education of the Philippines has prioritized online safety and integrated the Digital Thumbprint Programme into the primary and secondary curriculum with the support of Globe Telecom since 2016. Organized around four modules, the programme focuses on internet addiction, digital safety, cyberbullying, understanding passwords and terms of services, and online piracy. The programme has reached more than 4,000 schools nationwide, and about 116,000 teachers. Some 2 million students have benefited from the content offered by the Digital Thumbprint Programme e-modules (Globe Telecom, 2023).

Digital safety elements are not explicitly addressed within the curriculum of other countries in Southeast Asia. However, countries plan to raise awareness in schools through targeted interventions. Thailand has implemented strategic frameworks to facilitate skills development and encourage the secure and innovative utilization of online media among children and adolescents (Dipendra, 2023). Cambodia through its 2020 ICT Master Plan aims to execute awareness education and promotion for cybersecurity (Cambodia Ministry of Post and Telecommunications, 2020). The Ministry of Education, Youth and Sport plans to enhance user privacy and raise the issues of the ethics of ICT use and unsafe technology use (Brehm et al., 2023).

As part of the broader Cyber Security Awareness for Everyone initiative, Malaysia has implemented the CyberSAFE in Schools programme since 2010. The programme focuses on cyberbullying, cyberstalking and grooming through contests, games and informative videos (DiGi Telecommunications, 2015). The Klik Dengan Bijak (Click Wisely) module, introduced by the Malaysian Communication and Multimedia Commission, also aims to foster online safety and awareness (Malaysian Communication and Multimedia Commission, 2023). The module covers cyberbullying, hacking and online grooming, online fraud, oversharing, phishing, spam and the rights and responsibilities of online citizens and uses a combination of printed and digital material as teaching resources (Omar et al. 2022; UNESCO Bangkok and Regional Bureau for Education in Asia and the Pacific, 2020).

As learners started spending more time online during COVID-19, countries have begun promoting programmes on digital safety. Viet Nam approved the first National Programme on Child Online Protection for 2021–2025 to provide children with age-appropriate digital knowledge and skills to safeguard themselves and navigate the cyber environment securely. In the Lao People's Democratic Republic, the Digital Literacy Camp has introduced topics like online safety for children and teachers for the first time through the national e-learning platform, Khang Panya Lao (UNICEF, 2021b; McCarthy, 2023).

PROBLEM-SOLVING

Problem-solving skills are defined in multiple ways, and predominantly in relation to coding and programming. Brunei Darussalam and Singapore have adopted a broader perspective to define such skills. In Brunei Darussalam, problem-solving skills have been incorporated within the mathematics, science and technology learning domains of the primary and secondary curriculum. They encompass acquiring knowledge, dispositions, and cognitive and meta-cognitive operations and are linked to thinking, hypothesis formation, investigating, analysing and decision-making (Brunei Darussalam Ministry of Education, 2013; UNESCO-NEQMAP, 2019).

In Singapore, problem-solving skills involve breaking down complex problems into smaller, more manageable components and designing algorithms to solve them. The 2021 O-level Computing syllabus includes a dedicated 'Abstraction and Algorithms' module divided into problem analysis and algorithm design (Singapore Ministry of Education, 2021). Initiated in 2016, a 10-hour enrichment programme on coding, Code for Fun, has been used to develop problem-solving skills through visual block-based programming (e.g. Scratch) and robotics kits (e.g. Arduino, Raspberry Pi) in primary schools (Laguarda et al. 2022). Building on the progress made, the Code for Fun programme was officially mandated for students in grades 4 to 6 in 2020 (Laguarda et al. 2022; Singapore Infocom Media Development Authority, 2020).

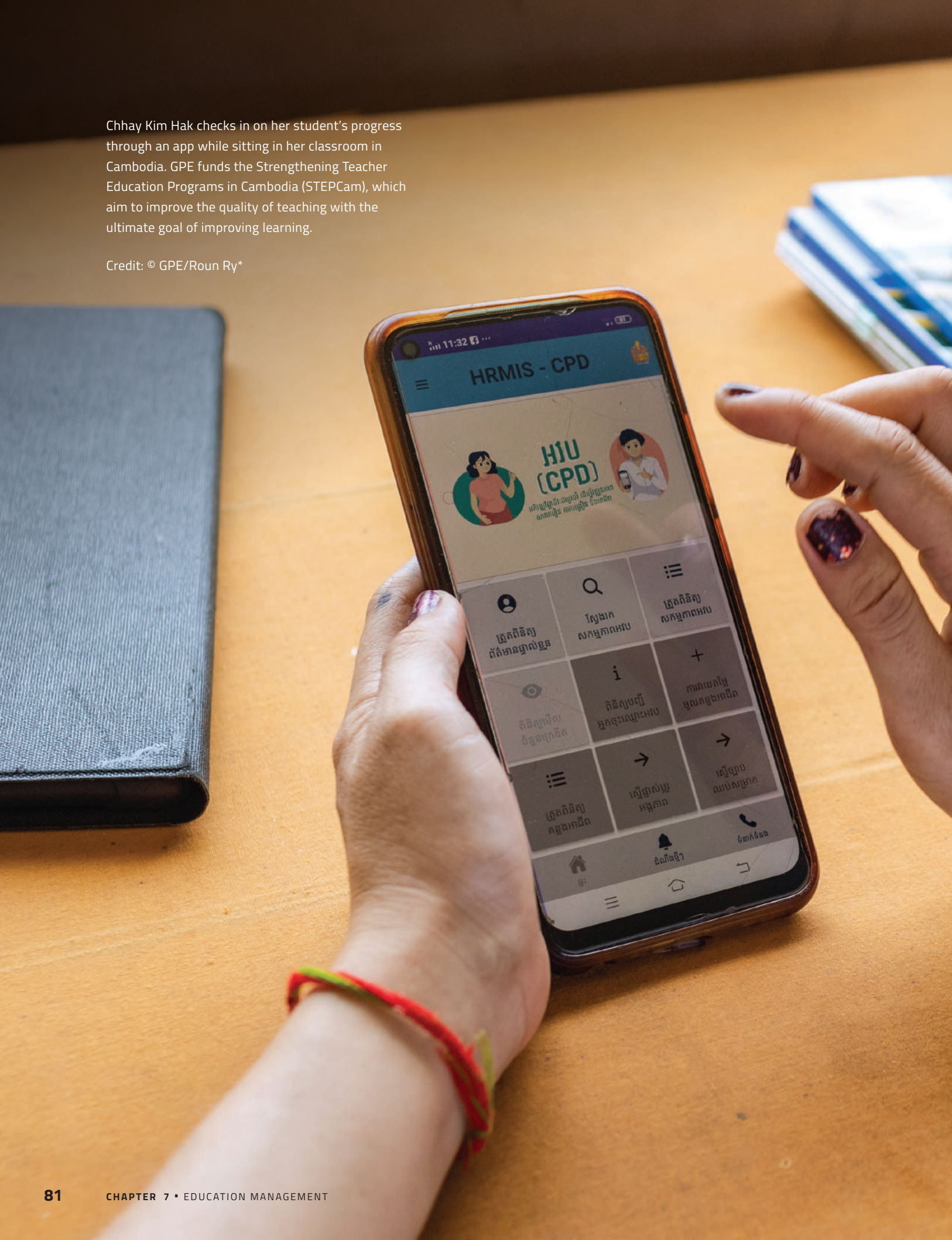
Other countries are following the global trend of associating problem-solving with coding and programming and as part of computer science in the curriculum. Thailand's curriculum has integrated project-based learning to cultivate problem-solving skills within the framework of computer science education. In grades 4 to 6, students engage in computer-based activities to explore various aspects of daily life, including employing logical thinking for problem-solving, conducting data searches, assessing data accuracy and utilizing block coding platforms like Scratch. Students in grades 7 to 9 concentrate on acquiring proficiency in primary data handling through objectives encompassing problem-solving through programming, data collection, analysis, presentation and evaluation, as well as textual programming languages such as Python. Grade 10 to 12 students focus on applying advanced computing technologies and programming techniques to tackle real-world situations by integrating knowledge from other disciplines and leveraging external data sources (Vegas et al., 2021).

Southeast Asian countries have partnered with private companies to advance coding skills through targeted outreach programmes. Microsoft has launched the collaborative YouthSpark Programme in the Philippines with a local non-governmental organization to promote coding and programming skills, specifically among visually impaired youth (Philippine Normal University, 2023; Siew, 2016). Microsoft Thailand provides free coding classes, the Hour of Code, to traditionally marginalized students, in collaboration with non-profit organizations (Vegas et al., 2021).

The Youth Coding Initiative, an initiative launched by UNESCO and China's Codemao, aims to train young people from rural areas and teachers in Thailand on coding skills and artificial intelligence. Teachers are provided with comprehensive lesson plans and other teaching materials, which they can adapt and use in their classrooms (UNESCO-IITE, 2022). Launched in 2022, the public–private initiative, Let's Code Thailand, is also targeted at individuals traditionally marginalized from education. The programme aims to reach out to 1,000 people and is centred around e-learning and self-study approaches to coding, supported by mentoring provided by local software associations and developer organizations (Digital Makers Asia Pacific, 2022).

CONCLUSION

Digital skills have become part of the basic skills' set that formal education is expected to provide. Southeast Asian countries are faced with critical decisions over how to define digital skills, which skills to integrate and package in subjects and how, at what level, and how to leverage learner experience, which often surpasses that of their teachers. Challenges also persist concerning how to assess and measure different dimensions of digital skills. The current level of digital skills in Southeast Asia does not yet match the region's ambitions. Countries are called to address this gap and in the face of the ever-increasing complexity of the digital world, they need to urgently define digital skills and decide how best to increase them among their citizens.



Chhay Kim Hak checks in on her student's progress through an app while sitting in her classroom in Cambodia. GPE funds the Strengthening Teacher Education Programs in Cambodia (STEPCam), which aim to improve the quality of teaching with the ultimate goal of improving learning.

Credit: © GPE/Roun Ry*

CHAPTER

7

Education management

KEY MESSAGES

Southeast Asia leverages technology to support education management.

- Most Southeast Asian countries have adopted technology solutions to optimize their information systems. Viet Nam built a shared database that serves more than 60 provincial departments, over 700 districts and some 53,000 schools.
- Nine Southeast Asian countries rely on standardized administrative data records on the public workforce's composition and performance. E-Operation for Teachers, e-Operasi, monitors teachers' capacity and shortages in Malaysia.

Unique student identification makes public services more efficient but may exclude some.

- Most countries in Southeast Asia have unique student identification mechanisms. In 2020, Cambodia piloted a system of student tracking in Pouk district, Siem Reap province.
- But access to education may be conditional on having national identification. In Malaysia, children and youth without the necessary documents are required to apply for an identification number and pay a tax at the District Education Office.

Geospatial data help identify those in need and inform information systems.

- Geospatial data help address equity and efficiency in infrastructure. Web-based school mapping in Indonesia has been used to identify schools in disaster-prone areas to prioritize risk reduction interventions.
- Such data are often limited in scope and led by development agencies or researchers. In Myanmar, the population data of selected mapped areas are used to estimate the number of internally displaced students at risk of being excluded from education.

Information systems often do not communicate with each other.

- The E-Governance Act in the Philippines, under discussion in the Congress, aims to establish interconnected and interoperable national and local services for data sharing and communication networks.

Technology is underutilized in learning assessments in Southeast Asia.

- Computer-based assessments can make test administration more time- and cost-efficient. In 2021, Indonesia extended its computer-based national assessment to more than 6.5 million students.
- Computer-based assessments and computer-adaptive testing provide rapid scoring. Candidates who took part in the online entrance examinations at the Hanoi National University received results in a fortnight.
- Technology-enabled assessments can reduce cheating, but their effectiveness should be weighed against fairness and psychological effects. Engineering students in the Philippines reported experiencing an increase in stress during proctored online exams.

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

- In Cambodia, some teachers asked students for assistance with filling in digital forms; others used paper-based forms. In the 2021/22 academic year, 18% of higher education institutions entered data into the education management system.
- The use and acceptance of an online education management information system is influenced by its perceived usability. Secondary school teachers in Malaysia responsible for data entry tend to have positive attitudes and higher satisfaction levels towards technology.

The use of digital technology in education has been producing enormous amounts of data. The volume of the data produced expands management tasks and functions accumulate and, as systems grow in size and complexity, actors multiply. There are more and more demands on actors, from central administrators to teachers, to monitor education targets (Abdul-Hamid, 2017); using digital technology to do this will be a necessity. By facilitating data processing and exchange, it is assumed that technology can improve the effectiveness and efficiency of education system management to help realize policy objectives.

Most Southeast Asian countries have adopted technology solutions to optimize their information systems (SEAMEO INNOTECH, 2023), establishing conducive regulatory frameworks and focusing on strengthening their information and communications technology (ICT) infrastructure. However, while handling and leveraging these data becomes increasingly important (Howard et al., 2022), this ability to use and monitor the data is often absent (Custer et al., 2016; Rodrigo, 2018).

This chapter discusses how technology supports education management in Southeast Asia. It first examines how countries in the region have set up the conditions for integrating technology into their national information systems. It then looks at school and classroom experiences in leveraging technology for generating meaningful data. Finally, it investigates the perspectives of the final users – teachers and administrators – towards technology in education management.

SOUTHEAST ASIA LEVERAGES TECHNOLOGY TO SUPPORT EDUCATION MANAGEMENT

An education management information system 'collects, monitors, manages, analyzes, and disseminates information about education inputs, processes, and outcomes', notably related to student learning (Abdul-Hamid, 2017, p. 7). Critical functions include keeping track of flows and stocks of learners and their performance, as well as human and infrastructural resources (**Box 7.1**), to ensure that commensurate and equitable funds 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. This trend is also evident in Southeast Asia, where some countries have embarked on reforms of their education management systems with the goal of improving data for monitoring and for education development.

Successful rollout of education management information systems depends on the interplay of appropriate governance, policies, budgets and resources (Abdul-Hamid, 2017). Since 2000, it is estimated that Southeast Asian countries have adopted some 20 policies which include a focus on data, statistics and information systems (Bromley et al., 2023). For instance, Cambodia introduced efforts to support its capacity for planning and monitoring, as part of the Education Management Information System's Master Plan 2014–2018. In 2018, the Policy and Strategy for ICT in Education identified digital technology as a tool to improve education management (SEAMEO INNOTECH, 2023). The 2022 Education Technology Roadmap recognizes the importance of an education data ecosystem that integrates existing information databases to make the process more efficient and accurate (Brehm et al., 2023; Cambodia Ministry of Industry, Science, Technology and Innovation, 2022).

In some contexts, development strategies on education management information systems focus on data integration. Data integration involves processes and standards to unify access to data from multiple and autonomous sources, even from sources outside education. Data integration ensures information is compatible and the systems are sustainably and functionally utilized (Abdul-Hamid, 2014; Dong and Srivastava, 2015). Brunei Darussalam's Integrated National Education Information System aimed to use a common platform for data on admission, attendance, curricula, 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 from pre-primary to post-secondary education. In 2017, the country introduced its Education Data Repository, as part of the ICT Transformation Plan 2019–2023. As of 2019, it had integrated 12 of its main data systems, including information on students, learning assessments, institutions, and human and financial resources, aiming for full integration through a single data platform by the end of 2023 (UNICEF, 2019).

Data integration may involve multiple actors and government levels. In 2022, the Philippines defined rules and standards, roles and responsibilities for the institutionalization of a results-based and consistent basic education monitoring system across government levels. Operating units at the school, school division, regional and national levels (SEAMEO INNOTECH, 2023) were identified to inform a unified platform managed by the Department of Education (Philippines Department of Education, 2022). Viet Nam also integrated data systems across government levels. Piloted in 2003, the information systems of all provincial departments of education and training have gradually been integrated into a central education management information system. The project was completed in 2021 with the Circular on Digital Database Management of Education and Training (Asian Development Bank, 2022a). The current system, built on a shared database, serves more than 60 provincial departments, over 700 districts and some 53,000 schools (Vinh and Hanh, 2023).

Most monitoring and evaluation systems in Southeast Asia rely on technology solutions to collect data and generate reports. However, the lack of standardized guidelines may hamper efficient data collection and reporting (SEAMEO INNOTECH, 2023). In Timor-Leste, no specific policies or guidelines have been developed since the

BOX 7.1:

Technology facilitates the management of school infrastructure and the teacher workforce

In Southeast Asia, technology supports monitoring systems in collecting information on school infrastructure and reporting on it (SEAMEO INNOTECH, 2023). Technology has enabled the better identification of infrastructure gaps between schools. With UNICEF support, the Lao People's Democratic Republic is piloting a technology-based education management information system: schools input information into a centralized database through tablets. The dashboard assigns a red, yellow or green code according to the inputted data, and district and provincial educational institutions can prioritize support accordingly (Australian Council for Educational Research, 2023). Managed by the Office of Basic Education Commission, Thailand's education management information system collects information on basic school infrastructure, including access to electricity and internet connectivity. Technology supports the collection and monitoring of information for about 30,000 educational institutions spread across the country, which account for about 80% of the total (Dipendra, 2023; ITU, 2022).

Technology can also help monitor public sector human resources, including education. Nine Southeast Asian countries rely on standardized administrative data records on the composition and performance of the public workforce (OECD and Asian Development Bank, 2019). Linked to the Human Resource Management Information System, E-Operation for Teachers, or e-Operasi, managed by the Public Service Department, collects information related to the teaching workforce in Malaysia's education system. Based online, it replaced the previous systems based on Microsoft Excel and manual forms. It allows teachers to verify and update their data throughout the year and administrators to monitor teachers' capacity and shortages in relation to subjects in every school of the country (UNICEF, 2019).

Integrated information on teaching staff helps identify competency gaps and inform training programmes (Subosa and West, 2018). Since 2018, Viet Nam has been working on creating an education and training database across education levels. The Teacher Education Management Information System monitors information on teachers' competencies and professional development (Vinh et al, 2023), integrating teachers' feedback and evaluations of learning plans (Vo, 2022).

adoption of the National Education Strategic Plan 2011–2030, which aims to develop a national education management information system. Instructions for data collection remain inefficient (UNICEF, 2020). The World Bank Basic Education Strengthening and Transformation project aims to develop a centralized and technology-enabled information systems through an online and offline platform. Respondents interviewed for this report stated that schools have not received adequate guidance on the maintenance and sustainability of the system (SEAMEO QITEP in Science, 2023).

UNIQUE STUDENT IDENTIFIERS MAKE PUBLIC SERVICES MORE EFFICIENT BUT MAY ALSO EXCLUDE SOME

Guaranteeing that each school and student are uniquely identified within the education management information system is key to the effective and efficient use of information. It enables tracing students, for instance, in school registers, examination records and national scholarship databases throughout their education journey, from administrative routine follow-ups to analytical insights into their learning trajectories. Unique student identifiers have benefits beyond education. For example, student identification can be linked to civil registry official digital identification, which can then link students to other social services.

School identification is almost universal. A global mapping of education management information systems found that all Southeast Asian countries surveyed used school identification in primary and secondary education. However, identification was somewhat lower for early childhood education and for technical and vocational education centres. The Philippines has been using school identifiers for both public and private secondary vocational education institutes since the academic year 2016/17 (UIS, 2020).

Student identification enables the monitoring of learning progress throughout students' educational journeys. While globally 52% of countries had unique student identifiers, all surveyed Southeast Asian countries already had student identification numbers in place or planned to introduce them (UIS, 2020). In 2020, Cambodia piloted a student tracking system in Pouk district, Siem Reap province, with the support of UNESCO. Each student was provided with identifiers to collect personal information and learning data that informed education planning and monitoring (UNESCO, 2023). With the goal of improving school-based management and accountability, the Philippines introduced unique student identification and a process of third-party verification, which has reduced data manipulation and misreporting (Read and Atinc, 2017). Each student, including those enrolled in the Alternative Learning System, is provided with a 12-digit identifier that tracks information throughout the education system. Based on the aggregated data, the system generates reports for teachers and the Department of Education (Abdul-Hamid, 2017). In 2018, Viet Nam integrated student identification into the national education management information system. All students are assigned an identification code that enables their learning progress to be monitored throughout the school year (Vinh et al, 2023).

Student identifiers can also be issued and managed outside the Ministry of Education and be associated with a national identification system. Children under 12 in Malaysia can apply for the MyKid card, and then for the compulsory Malaysia's MyKad card, a contactless smart card that provides access to multiple public services (World Bank, 2018; World Bank and Digital Impact Alliance, 2018). In 2018, the National Registration Department's MyIdentity system was integrated with the Student Information System that tracks school attendance electronically (UNICEF, 2019). In Singapore, the national identification is also used as a student identifier (UIS, 2020).

Student identification systems should be developed carefully to avoid excluding people. Digital national identification systems are key to accelerating progress to universal legal identification by 2030, which is also Sustainable Development Goal target 16.9. In 2021, more than 96% of individuals aged 15 and above 15 owned an identification card in Indonesia, Malaysia, Singapore, Thailand and Viet Nam but only 41% of 15- to 24-year-olds did in the Lao People's Democratic Republic and 68% in Cambodia (World Bank, 2023).

Access to educational services may be conditional on having national identification (World Bank and Digital Impact Alliance, 2018). In Indonesia, Malaysia and Thailand, children are provided with an identification card that collects demographic information (World Bank and Digital Impact Alliance, 2018). Since 2016, Indonesia has established the Child Identity Card (Kartu Identitas Anak), which is integrated with the population administration information system. The identity card is issued to 5- to 17-year-old children to simplify school registration (Ardyati et al., 2022; World Bank, 2018). Thai citizens registered in the national civil registration office are issued a 13-digit identifier at birth and an identification card at the age of 7 (Abdul-Hamid, 2017), which is required to be enrolled in public schools (Kijsanayotin, 2018).

In Malaysia, children and youth who are not citizens and those who do not have the necessary documents are required to apply for an identification number at the Immigration Department or National Registration Department and pay a tax at the District Education Office (UNICEF, 2019). In Singapore, Singpass, a system based on multifactor authentication, provides access to public services to all citizens and residents, but only citizens can benefit through it from Singapore's Edusave programme, which allocates financial assistance based on the monitored students' academic achievements and socioeconomic status (Centre for Evidence and Implementation, 2023).

GEOSPATIAL DATA IDENTIFY THOSE IN NEED AND SUPPORT INFORMATION SYSTEMS

Geospatial data and the use of geographic information systems (GIS) are key tools to improving monitoring. They can support decision makers as they attempt to address equity and efficiency in infrastructure and resource distribution in their education systems (UNESCO IIEP, 2023). Geospatial data also help identify schools and child populations vulnerable to specific risks (Gagnon and Mesa, 2022).

School identification supported by GIS has been used in various projects in Southeast Asia. In Indonesia, web-based school mapping was used to identify schools in disaster-prone areas to prioritize risk reduction interventions, and to identify travel routes to and from school (Ariyanti et al., 2018). In Myanmar, population data of selected mapped areas were used to estimate the school-age populations at risk of being excluded from education because of displacement due to conflict (Global Education Cluster, 2016). Geographic data from the Philippines' Department of Education school profiling database are used to monitor the conditions of school facilities across 75 provinces and to understand if the funding allocation is equitable (Figueroa et al., 2016). Geographical information for some schools is also recorded in the national education information system (UIS, 2020).

Geographical data may inform education management systems. Geographic data visualization and aggregation are used to develop the Lao Education and Sports management information system, currently being piloted in five districts of the country (Australian Council for Educational Research, 2023). In its National Education Strategic Plan 2011–2030, Timor-Leste plans to record the geographical coordinates of each school to inform its education management information system (UNICEF, 2020).

INFORMATION SYSTEMS DO NOT ALWAYS COMMUNICATE WITH EACH OTHER

Interoperability, the ability of databases to communicate and work with one another, is becoming a necessary condition to unlock the full potential of technology for effective management (UNESCO Office Santiago and Regional Bureau for Education in Latin America and the Caribbean, 2021). Almost all Southeast Asian countries promote open government in their digital strategies to facilitate data sharing and make public services more citizen-oriented. Yet, collaboration and integration across sectors and government levels remains limited.

Some Southeast Asian countries have started to develop an e-government architecture, which involves regulations that define a common framework for the use and exchange of digitalized data. Indonesia and the Philippines were among the eight founding member states of the Open Government Partnership that promotes transparency and accountability in open government (Read and Atinc, 2017). Along these lines, Indonesia adopted regulations on e-government and on integrated data in 2018 and 2019. The whole-of-government approach defined in the One Data policy aims to promote the use of the same information technology system and a common data management among government agencies to ensure data sharing and utilization; however, implementation challenges and sectoral fragmentation persist (World Bank, 2021).

The E-Governance Act in the Philippines, approved in 2023, aims to establish an interconnected and interoperable environment for data sharing and communications networks that integrates national and local government public services, including education. The E-Government Masterplan 2022 intends to launch One Digitized Government that integrates public services through interoperable and digital systems (Philippine Normal University, 2023). With the support of the UNDP, the Lao People's Democratic Republic has developed an e-government interoperability framework to centralize the delivery of online public services and improve their efficiency (Australian Council for Educational Research, 2023).

Common standards enable the interoperability of databases and education information (Chen, 2021). Based on joint operating protocols and standards, Singapore launched APEX in 2017, a centralized platform that enables government agencies and private enterprises to exchange data and systems in a secure environment to incentivize collaboration and effectiveness across sectors (OECD, 2018). The definition of technical standards for data on individuals ensures that Malaysia's education management

information system communicates with other systems to some extent; however, the partial alignment may cause data duplication and inconsistency (UNICEF, 2019). In Timor-Leste, the lack of interoperability between the education management information system and other data systems undermines the potential use of available data (UNICEF, 2020).

TECHNOLOGY IS UNDERUTILIZED IN LEARNING ASSESSMENTS IN SOUTHEAST ASIA

Countries aim to replace traditional educational assessments with computer-based and computer-adaptive testing. Their popularity has grown as technology has expanded their potential to improve traditional ways of conducting learning assessments (Wise, 2018). It is claimed that technology-supported assessments increase efficiency and measurement precision, ease administration and communication, and reduce cheating (Dandan, 2023). However, comparing written and computer-based assessments remains challenging, and is mostly based on small and targeted studies (Flowers et al. 2020).

Since 2014/15, Indonesia has been one of the few countries in the region to administer national examinations (Ujian Nasional) through a computer-based system in selected 9- and 12-grade secondary schools (SEAMEO RECSAM, 2023). Initially piloted in fewer than 600 schools, it was scaled up and administered in some 4,500 institutions by 2016. The computer-based assessment consisted of an online set of questions to which students could reply offline. An evaluation of the experience of selected schools in Jakarta showed a reduction in administration time and printing costs (Handoko et al., 2019; Megarani and Ghofari, 2016). Based on the positive experience, the method was replaced by the National Assessment of Minimum Competencies (Asesmen Nasional) in 2021, coordinated by the Data and Information Center (Asian Development Bank, 2022c). Extended to all public educational institutions, and reaching more than 6.5 million students, the new assessment moved completely online and included interactive features to increase accuracy and efficiency (Indonesia Office of Assistant to Deputy Cabinet Secretary, 2022). In 2021, Malaysia implemented LPSkor system to make marking national examination (Sijil Pelajaran Malaysia) answer scripts more efficient (Bernama, 2021).

Some higher education institutions in Viet Nam, including the two national universities – Vietnam National University, Hanoi and Viet Nam National University, Ho Chi Minh City – have introduced online entrance examinations. Managers interviewed for this report reported positive feedback about the computer-based multiple-choice test administered by the Hanoi National University in terms of speed. Candidates receive results in a fortnight (Vinh et al, 2023). Primary school teachers in Malaysia using Padlet, a cloud-based platform, to assess writing skills found the tool effective for providing feedback outside classroom settings (Jong and Tan, 2021).

However, perceptions of effectiveness from the use of results generated by technology-mediated assessments depend on follow-up actions. In Myanmar, students from five high schools in Yangon region who took part in a pilot of computer-based assessment and could discuss the results of their mathematics test immediately reported higher achievement compared to their peers tested through traditional methods (Tun, 2022). In Singapore, outcomes from formative assessments were considered to be conducive to deeper feedback, despite the delays in generating results. In-person discussions provide learners with the opportunity to reflect on the assessment experience (Chan, 2021).

Artificial intelligence has been applied to, fully or partially, automate some traditional assessments. Such techniques allow, for example, adjusting the assessment's level of complexity to the examinees' proficiency (Swiecki et al., 2022), such as in computerized adaptive testing (Luecht, 2018). A computerized adaptive test, CAT-PhysCriTS, administered to grade 11 students in Kulonprogo regency, Indonesia, was found to be precise in its measurement of critical thinking in physics (Abidin et al., 2019). The Hanoi National University of Education in Viet Nam has experimented with an adaptive test, UEd-CAT 1.0, that adjusts multiple choice questions to learners' previous responses to ensure their knowledge level is more accurately monitored (Vinh et al, 2023). Computerized adaptive testing may reduce the possibility of cheating (Dandan, 2023). An evaluation conducted in a vocational school in North Sangatta in East Kalimantan province of Indonesia found that computerized adaptive testing reduced opportunities for cheating by easily generating multiple test versions (Dwiyono et al., 2021). Singapore has planned to introduce computerized adaptive tests in the assessment of the secondary school mother tongue language curriculum by 2024 (Centre for Evidence and Implementation, 2023).

As more examinations shifted online, especially as a result of COVID-19 (Deneen, 2022), higher education teaching staff interviewed for this report reported concerns about maintaining academic integrity and avoiding cheating (Australian Council for Educational Research, 2023; Philippine Normal University, 2023). As is the case

globally, the need to implement online cheating detection and proctoring tools and methods has increased. These systems record student computer activity through webcam video and audio to detect potential fraud during examinations (Andreou et al., 2021; Kharbat and Daabes, 2021). Some higher education institutions in Southeast Asia introduced proctoring methods during COVID-19. The Faculty of Law at the National University of Singapore reported combining surveillance through live video and investigating students' screen recordings for the duration of the examination (Tan, 2020). The University of Education of Vietnam National University relied on simultaneous access to the integrated digital platform (Moodle) and the web-conferencing application (Zoom). Candidates had to connect to the web-conference room before taking the examination and get their identity checked and set their video and audio. The exam location was also verified to ensure it met the necessary conditions (Lam et al., 2022).

While they can reduce cheating (Milone et al., 2017), the effectiveness of technology-based solutions should be weighed against fairness and psychological effects (Lee and Fanguy, 2022). A high degree of scrutiny and intrusiveness increases students' anxiety. In the Philippines, a study among engineering students showed a large preference for non-proctored online exams. Students raised concerns about the environment and psychological factors linked to proctored online exams, as they reported an increase in stress during examinations (Gumasing et al., 2022; Yandug et al., 2023). As the use of proctored online assessment tools will continue to increase, the intersection of artificial intelligence use and ethics will also be an important consideration (Coghlan et al., 2021).

Technology-enabled assessments are not yet commonly used for national scale testing in Southeast Asia (SEAMEO INNOTECH, 2015; SEAMEO RECSAM, 2023), as most of them remain based on paper and pencil (Rodrigo, 2018). Data generated from large-scale assessments remain largely underutilized to inform student tracking and decision making.

LEARNING ANALYTICS CAN SUPPORT FEEDBACK AND MONITOR STUDENT PERFORMANCE

Learners' use of education hardware and software generates a massive volume of data. When curated and analysed appropriately, learning analytics can help teachers to understand student progress and system administrators to take better management

BOX 7.2:

The Education University of Hong Kong has introduced data analytics tools

Beyond Southeast Asian countries, the Education University of Hong Kong, China, a SEAMEO Affiliate Member, has systematically introduced learning analytics using data on both platform use and learning behaviours. Aiming to improve quality assurance, a learning analytics tool has collected performance data from students enrolled in selected courses in the psychology track. Information on course grades, Moodle activity and course assessment results during the first seven learning weeks is compared with statistics from previous cohorts of students. In addition to predicting students' final grades, the tool helps identify those who have learning difficulties and guides instructors in follow-up actions and tailored learning support, including individual consultations.

Other analytical tools are applied in individual courses and serve pedagogical purposes. BookRoll, for example, is an e-book system used in the Selected Readings in Classical Chinese course that enables learning behaviour visualization and access to reading and learning materials (Flanagan and Ogata, 2018). The BookRoll dashboard facilitates reading by highlighting key sentences and adding personalized notes. Based on the number and type of highlights made, the tool enables teachers to identify common questions and to plan interventions. It also generates data on reading frequency and speed and allows students and teachers to monitor progress. A study of 109 students from one university in Taiwan, Province of China, showed that the e-book reading system can lead to effective learning experiences. The experimental student group exhibited improvement in their performance and learning approaches, including independence and self-efficacy, compared with the control group (Chen and Su, 2019).

Technology has also made it possible to understand how students learn and engage with learning materials and analytics dashboards (Sedrakyan et al., 2020). Behaviour Analytics is another learning analytics tool used in the Theory and Practice of Classroom Language course. Behaviour Analytics tracks access patterns from student activity on the Moodle learning platform and identifies common behaviours in using learning materials. Instructors make learning materials more relevant and targeted to their needs based on student engagement.

Source: The Education University of Hong Kong (2023).

decisions (OECD, 2021). Learning analytics refers to the 'measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs' (Siemens et al., 2011, p. 1).

Learning analytics has been extensively used in higher education (**Box 7.2**) (Lang et al., 2022). Data on student characteristics can be combined with use patterns of learning management systems to predict student trajectories and to design supportive interventions (Ifenthaler, 2021). Some schools and higher education institutions in Southeast Asia have experimented with and benefited from digitalized data. In the Philippines, De La Salle University Dasmariñas, for example, has been using a learning management system since 2010 that collects analytics and provides educators with a detailed report on student progress. Based on student assessment, the system identifies student strengths and weaknesses automatically. It also suggests grading, feedback and personalized learning strategies. This tool has been claimed to reduce educators' tracking and evaluating efforts (ACU Secretariat, 2023).

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, a study on computer-adaptive testing in a private school showed that artificial intelligence techniques helped teachers monitor students' progress in reading skills for English as a second language. The tool generated learning analytics that allowed educators to tailor their teaching strategies (Aristizábal, 2018).

Even when digitized data are available, other conditions need to be met to translate data into meaningful information. An analysis conducted across Southeast Asian countries shows that a culture of evaluation and research and the capacity to interpret a high volume of data are lacking. In addition, digitized data generated by computer-based learning and assessments might not be detailed enough to inform learning analytics (Rodrigo, 2018). In the Philippines, teacher training focuses on ICT literacy and integration and lacks training on monitoring and the effective use of digitized data (Rodrigo, 2019).

LACK OF CAPACITY AND CONFIDENCE CONSTRAIN TECHNOLOGY USE IN EDUCATION MANAGEMENT

Various conditions may hamper the effective implementation of technology-enabled education management in Southeast Asia. Infrastructure often may not be available or adequate (SEAMEO INNOTECH, 2023). Under Timor-Leste's technology-enabled education information system, schools were provided with notebooks connected to the internet to input data to the centralized system. However, analysis conducted for this report shows that an unreliable network has interfered with its implementation. Schools are left with the financial and operational burden of system upgrades and notebook maintenance (SEAMEO QITEP in Science, 2023).

Administrators and teachers are the main users of education technology for management purposes. Yet they are often unprepared (SEAMEO INNOTECH, 2023). Analysis conducted for this report in Cambodia found that some teachers had difficulty filling in student data in digital forms as required by the district and provincial office of education, due to their limited command of technology. As a result, they turned to students for assistance (Brehm et al., 2023). Alternatively, teachers collect data through paper-based forms, which is then entered into the system by the school administration office (Asian Development Bank, 2022b). Limited administrator skills in programming and networking impeded the timely and effective update of the higher education management database. In 2021/22, only 18% of higher education institutions entered data into the system (Eam and Song, 2022). Meanwhile, school personnel in the Lao People's Democratic Republic are less likely than district and provincial staff to be prepared to collect and upload data and information onto the new education management information system (Australian Council for Educational Research, 2023).

Beliefs and attitudes towards technology may hinder technology adoption. Self-efficacy and confidence in performing management tasks that require the integration of technology also determine its use by teachers and administrators. In the Philippines, the resistance of middle-tier officials at the school and local government levels in implementing the enhanced basic education information system was listed as one of the main constraints of the information-based reform of the country's education system (Read and Atinc, 2017). Positive administrator attitudes are a strong predictor of the adoption of technology for school management and, eventually, of school management improvements (Villa and Lorenzo, 2019). Compared to other colleagues, secondary school teachers in Malaysia responsible for data entry, who are more exposed to and more knowledgeable about the system's potential and limitations, have developed positive attitudes and higher satisfaction levels towards the relevant technology. The use and acceptance of an online education management information system is influenced by its perceived usability (Saad and Daud, 2020).

Finally, education institutions vary in their capacity to absorb technological change and use it for the intended purposes. Educational institutions' readiness to adopt technology for management depends on their resources and their ability to integrate technology into daily practices. 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). Location is likely to be a condition for assessing technology-enabled information management systems in Southeast Asia. In the Philippines, public primary schools in the southern regions face more challenges in assessing and benefiting from the national education monitoring system. Remoteness is identified as the main obstacle to the effective use of data (Cuartero and Role, 2018; Philippine Normal University, 2023).

CONCLUSION

Technology offers various opportunities to improve education system management. Southeast Asian countries have been working to expand the range of data collected on schools and students and generating fine-grained analyses that integrate different data sources. Such data can be used to personalize learning, track children left behind, and develop improved strategies to prevent disengagement and early school leaving. Some institutions in the region have been exploring technology's potential to support continuous assessment for learning, as well as to expand the range of skills and outcomes assessed. However, questions and challenges arise concerning the use of such a potentially high volume of digital data, notably related to teacher and administrator capacity.

Millah, 12, a girl with an intellectual disability, receives a video call from her teacher, Mintarsih, while studying at home in Indonesia. Millah dreams of becoming a doctor.

Credit: © UNICEF/UNI358753/Ijazah*

CHAPTER

8

Access to technology: Equity efficiency and sustainability

KEY MESSAGES

Countries use various policies to improve access to technology.

- Eight countries have committed to enhance electricity in schools. Cambodia has regulated and promoted mini-grids and stand-alone systems to expand off-grid solutions, especially in remote areas, which has rapidly improved services in rural areas. In 2018, 72% of public schools in Cambodia had access to electricity, compared to 44% in Myanmar.
- All countries are trying to expand internet connectivity. In Thailand, the Village Broadband Internet, or Net Pracharat, has linked 24,700 rural villages to a fibre optic cable network, while the Universal Service Obligation Fund has provided internet connectivity to more than 6,000 schools. Giga project mapping suggests 84% of schools have internet connections that are good enough for learning.
- At one time, the Philippines, Singapore and Thailand had established programmes where schools provided each student with a personal learning device. Today, richer countries are targeting poor students, assuming that the others can afford a digital device. In Singapore, some 12,500 devices were loaned out during COVID-19 to ensure all secondary students were connected.
- Bring Your Own Device policies have been used in the region, such as in Malaysia, where the Ministry of Education has issued guidelines, including a list of permitted devices. But such policies bring challenges related to teacher capacity, privacy and security.
- 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. Cambodia promotes the use of open source software and Khmer language applications for teaching and learning.

There is a lack of clear evidence on education technology solutions.

- The impact of technology is not often assessed when taking investment decisions. Fewer than 10% of education technology companies operating in Indonesia produced evidence of the effectiveness of their products.
- In the Philippines, 41% of 205 ICT coordinators participating in a survey said they never conducted impact evaluations of information and communication technology (ICT).

Good procurement promotes equitable, efficient and sustainable technology solutions.

- Malaysia, Singapore and Viet Nam evaluate ICT projects in terms of financial benefits for businesses and citizens.
- The decentralization of public procurement can help balance corruption risks. Indonesia has used its SIPLah e-commerce platform to support procurement processes at the school level.
- Civil society can help improve transparency in public spending. Non-state actors have participated in monitoring public procurement in the Philippines since 1991.
- Technology leads to excess e-waste. E-waste reached 35.3 million metric tons in Southeast Asia, with significant social, health, environmental and economic consequences. Four countries have national policies or legislation regulating e-waste. Adopting digital technology that is environmentally sustainable is high on the agenda in Singapore.

Access to technology, and especially internet connectivity, is increasingly being considered a part of the right to education. The Special Rapporteur on the right to education has 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). Equitable access has, therefore, become a key issue, including in Southeast Asia, a region where the integration of technology in education varies between and within countries according to socioeconomic characteristics (SEAMEO INNOTECH, 2023).

Schools, teachers and students need good quality context-appropriate devices, accessible platforms and relevant software aligned with national curricula. Governments need to pay affordable prices and ensure the 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.

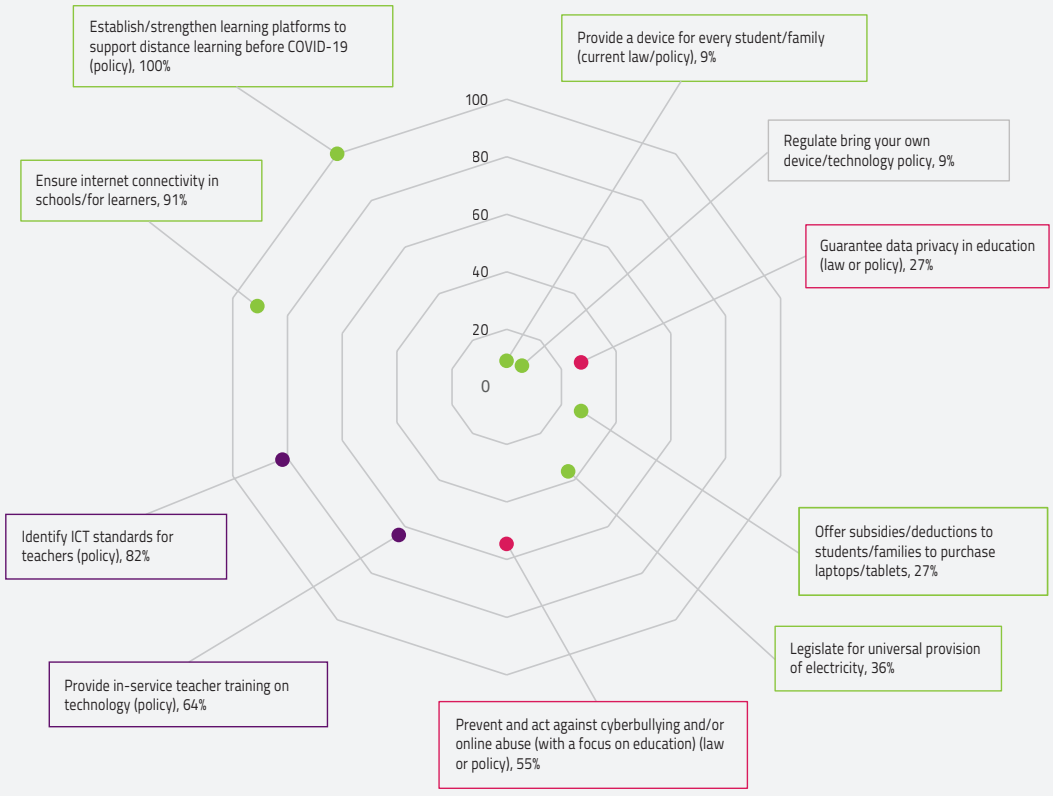
The cost of much of that investment is high and beyond many countries' budgets. Education technology must compete with other education priorities. Access to technology is often unequally distributed, both between and within countries. Evidence on the impact of products and services on learning is limited. Providers are a step ahead of government officials. Some engage in misleading marketing practices. Waste and obsolescence are high, adding to the growing environmental cost of digitalization.

This chapter describes efforts to ensure that access to infrastructure, hardware and software is equitable and affordable. It also describes cases that support evidence-based public procurement of education technology, which leads to equitable, efficient and sustainable solutions.

COUNTRIES USE VARIOUS POLICIES TO IMPROVE ACCESS TO TECHNOLOGY

The rapid expansion and high relevance of digital technology in Southeast Asia led SEAMEO to examine the application of ICT in education in 2010. A framework was developed to highlight ICT practices and experiences in all countries based on self-assessment and across 10 ICT-related education dimensions. At the time, findings showed that countries positioned themselves on a wide spectrum in terms of ICT integration in education (SEAMEO, 2010). According to this framework, Brunei Darussalam, Malaysia and Singapore appeared to be

FIGURE 8.1:
Countries have developed a variety of education technology laws and policies
Percentage of countries with specific education technology–related policies, Southeast Asia, 2023



Source: GEM Report team analysis of PEER country profiles.

transforming, in the sense that they had developed advanced ICT-based teaching and learning practices and administrative systems; Indonesia, the Philippines, Thailand and Viet Nam were in the middle; and Cambodia, the Lao People's Democratic Republic, Myanmar and Timor-Leste were emerging (SEAMEO INNOTECH, 2023).

Countries have been developing laws and policies to strengthen ICT infrastructure. Four countries have a law on universal access to electricity, while eight have also committed to enhancing electricity in school (**Figure 8.1**). Electrification in Southeast Asia is nearly universal, yet challenges remain, especially for those in rural and remote areas.

Cambodia established the Rural Electrification Fund with the objective of fostering access to electricity infrastructure and providing a secure, reliable, environmentally safe and sustainable energy supply at reasonable and affordable prices (IEA, 2023; IRENA, 2016). Since 2010, it has regulated and promoted mini-grids and stand-alone systems to expand off-grid solutions, especially in remote areas, which has rapidly improved services in rural areas. The 2018 Multi-Tier Framework survey found that 72% of public schools in Cambodia had access to electricity, compared to 44% in Myanmar (IEA et al., 2020).

In the Lao People's Democratic Republic, the Rural Electrification Master Plan set the national electrification target of 94.7% of households by 2020 using both grid and off-grid systems (Al-Saffar, 2017), while Indonesia's 2014 National Energy Policy set that target at 100% (Asian Development Bank, 2016). Timor-Leste's National Education Strategic Plan 2011–2030 includes the improvement of the national electricity grid among its priorities (Timor-Leste Ministry of Education, 2011). Access to electricity increased from 38% in 2010 to 100% in 2021 (World Bank, 2023a). Yet power outages are common and the voltage remains low in rural areas (SEAMEO QITEP in Science, 2023).

COUNTRIES ARE COMMITTED TO UNIVERSAL INTERNET PROVISION AT HOME AND IN SCHOOLS

The commitment to universal internet provision is the foundation for equitable access. One estimate suggests that a 10% increase in school connectivity could contribute to an increase of 1.1% of gross domestic product per capita and 0.6% to effective years of schooling (The Economist Intelligence Unit, 2021). According to the GEM Report's PEER profiles, almost all countries in the region have national plans or strategies to improve school and learner connectivity.

All 11 countries except for Timor-Leste have a law on universal internet provision, and are also rolling out supportive policies. Cambodia is developing the ROAMX framework on internet universality in line with UNESCO's framework launched in 2013 (UNESCO, 2019). In Myanmar, the Ministry of Education has collaborated with multiple public and private stakeholders to provide schools with mobile technology (Oxford Business Group, 2019). In Timor-Leste, the 2017–19 national ICT policy encourages the provision of broadband internet capacity throughout the country (Ribeiro Cardoso de Barros, 2019).

Most countries in the region target underserved areas or users through specific initiatives. In the Philippines, two initiatives have facilitated the provision of internet services and connectivity in rural and remote areas. The National Broadband Plan includes the deployment of fibre optic cables, the establishment of government-owned internet infrastructure and the promotion of public–private partnerships (Philippines Department of Information and Communications Technology, 2017). The Free Wi-Fi for All programme provides free internet access in public places, including parks and schools. A midterm evaluation showed that the programme was successful in providing internet services in geographically isolated and disadvantaged areas, reaching out to marginalized groups and ethnic minorities, despite delays in deployment, poor coordination and communication, and a lack of competition (Flor, 2021; Philippine Normal University, 2023). The Tech4ED is another national digital inclusion initiative establishing centres that provide critical services in communities (Philippine Normal University, 2023).

Thailand promotes social equity in its 20-Year National Strategy and Digital Economy and Society Development Plan. One of the principles is to guarantee inclusive access to digital technology through equal public access to digital technology and media to every citizen, especially underprivileged learners (UN ESCAP, 2017). To achieve this goal, the Village Broadband Internet, also known as Net Pracharat, was launched in 2017 as a nationwide initiative to enhance the national broadband network through digital infrastructure. At the end of 2017, the Ministry of Digital Economy and Society and Telephone of Thailand Public Company Limited linked 24,700 rural villages to a fibre optic cable network and provided free public Wi-Fi hotspots at speeds of 30 and 10 megabits per second to download and upload, respectively. As of July 2019, over 6.6 million users had been connected. Over 1,200 schools that previously lacked broadband internet access have also been connected (Dipendra, 2023). Yet some concerns have emerged in relation to the location usability and maintenance of access points (Dipendra, 2023). In Timor-Leste, 144 primary and 45 secondary schools have been connected to the internet in 2023.

In Malaysia, the government prioritized high-speed internet access and a virtual learning environment for all Malaysian schools through the 1BestariNet project, which aimed for every student to access a 4G network in school. This project was further boosted with the National Digital Connectivity Plan launched in 2020 (Subramaniam, 2023).

Regional collaboration and international support also help promote connectivity. The Association of Southeast Asian Nations, ICT Masterplan 2020 addresses connectivity, alongside other priorities, with a strong equity focus (ASEAN, 2015). The Digital Masterplan 2025 aims to increase the quality and coverage of fixed and mobile broadband 'for a digitally inclusive society' (ASEAN, 2021).

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. 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. For instance, according to its mapping, 84% of schools in Thailand have an average internet speed that is good enough for learning (Giga et al., 2023).

GOVERNMENTS AND PROVIDERS ARE TRYING TO LOWER INTERNET CONNECTION COSTS

The Affordability Drivers Index is a policy tool of the Alliance for Affordable Internet that calculates composite scores to be used to assess the extent to which the policy, regulatory and supply-side environment helps lower costs and improve broadband affordability. While most countries have national broadband plans, investment per user varies widely between countries and remains low in many. Among the eight Southeast Asian countries analysed in 2021,

BOX 8.1:

Universal service funds could help equitable access but challenges exist

Universal service funds are collected from telecommunications providers by the government, with the aim of supporting the governments, goals to provide universal ICT service while addressing relevant issues relating to the access, price and quality of ICT services and products (Trucano, 2015). The funds can be used for 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 the frequent lack of a gender-specific focus have raised concerns on their use and effectiveness (Thakur and Potter, 2018; Bleeker, 2019), including in Asia (Roddis et al., 2021b; UN ESCAP, 2020).

In Indonesia, the Universal Service Obligation (USO Fund included ICT and broadband services in 2007. Telecommunications providers have to contribute 1.25% of their gross profits to the fund. Malaysia's Universal Service Provision Fund included broadband in 2008 (GSMA, 2013). In Myanmar, the 2013 Telecommunications Law established a Universal Service Fund to be financed through a 2% tax on mobile operators' income to ensure universal mobile coverage in underserved areas. Programme 2 of the Universal Service Strategy connects education institutions to broadband internet (Myanmar Ministry of Transport and Communications Post and Telecom Department, 2018; Oxford Business Group, 2019). Cambodia and Myanmar also have made USOs aiming to support broadband internet (ITU, 2019).

Thailand and Viet Nam have 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). In Thailand, as part of the Net Pracharat initiative, the National Broadcasting and Telecommunication Commission, through its USO Fund, has established internet connectivity for more than 6,000 schools, providing Wi-Fi and creating computer centres in schools and in villages (Dipendra, 2023).

Malaysia is the most affordable. Viet Nam is in the middle of the scale. It is making sustained efforts to modernize and expand its telecommunication system (Alliance for Affordable Internet, 2021) but has the third-highest high-speed internet cost in the region at USD 2.41 per megabit per month (Octava Foundation, 2022).

Governments can increase affordability through direct public investment (Roddis et al., 2021a) as well as through taxes, subsidies and loans for families, and licensing and authorization frameworks for providers (World Bank, 2023b). Another channel that governments can use to increase affordability is universal service funds (**Box 8.1**).

Taxes on digital services can be used to help regulate the sector but can also increase the cost for end users and negatively affect affordability. Grants, subsidies and loans to poor families and disadvantaged schools are another way to reduce connectivity costs. In Singapore, the DigitalAccess@Home programme subsidizes broadband, as well as laptops or tablets, for poor families (Singapore Infocomm Media Development Authority, 2023). If there is a primary school student or a learner with a disability in the household, the income ceiling for eligibility is raised (Tham, 2023).

Zero-rating is the practice of providing free internet access under certain conditions. Some mobile network operators offer to not charge for data used for educational purposes (Bayat et al., 2022; Eisenach, 2015), a practice which received attention during the COVID-19 pandemic. In the Lao People's Democratic Republic, the Ministry of Education and Sports negotiated an agreement with private telecommunication companies, such as UNITEL and Lao Telecom, to subsidize internet subscriptions and provide unlimited data for education-related applications. Discounts of up to 50% were offered to district and provincial education officers and teachers to access educational content. Conversations have continued for private service providers to take a more prominent role in the digitalization of education. However, this approach is raising questions about fair competition (Australian Council for Educational Research, 2023).

SOUTHEAST ASIAN COUNTRIES ARE SHIFTING THEIR POLICIES ON DEVICES

One-to-one technology models have long been used to provide each student with a laptop or tablet. Such approaches are costlier than most interventions. The One Laptop Per Child initiative is probably the most famous intervention (**Chapter 4**), with more than 3 million Linux-based educational computers distributed worldwide (OLPC, 2023).

At one time, the Philippines, Singapore and Thailand had established one-to-one technology programmes where schools provided each student with a personal learning device. However, Thailand phased out the One Laptop Per Child initiative started in 2011 and the One Tablet Per Child project launched in 2012. Introduced to increase digital literacy, One Tablet Per Child was the biggest individual tablet procurement programme in Thailand and the largest tablet experiment in the world at the time. The tablets were preloaded with educational content, including e-books, videos and interactive learning materials. Yet shortcomings in tablet quality, lack of technical support, issues in the supply chain, corruption allegations and political instability led to the programme being dismantled. More recently, Thailand has introduced the Smart Thailand programme, which aims to distribute 13 million laptops to underprivileged students across the country (Dipendra, 2023).

Richer countries are targeting poor students, assuming that the other students can afford a digital device, In Singapore, schools can purchase devices based on a given list (Ang, 2020). But during COVID-19, about 12,500 devices and 1,200 mobile internet–enabled systems, including dongles, were loaned out to ensure all students were connected. This policy ensured that secondary students had a personal learning device on which to study from home on a regular basis, bringing the target date to the end of 2021, instead of 2028 as originally planned (Tan and Chua, 2023). In Malaysia, the Ministry of Education recommended a Bring Your Own Device approach and a memorandum in March 2018 outlined the policy and guidelines for implementation, including the list of permitted devices (Yeop et al., 2018).

Bring Your Own Device approaches can reduce the financial burden for schools and governments, but they raise other challenges. First, they risk widening divides, as wealthier students are more likely to access good digital learning resources (Stock, 2019). Second, teachers may not have the skills or may find it very difficult to organize and manage learning and teaching activities in a classroom with different devices and platforms (Ginley, 2021). 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 and for using platforms. Concerns include theft, cybersafety, virus protection and the costs of working with multiple operating systems (Poggi, 2021).

SOME COUNTRIES CHAMPION FREE AND OPEN SOURCE 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 (FOSS), 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. Using FOSS rather than proprietary software results in cost savings estimated at between 15% and 35% because of lower licensing, personnel and hardware costs (Philippines House of Representatives, 2006). FOSS includes software used in tutorials, textbooks, wikis, professional training, online learning, GitHub, discussion forums and member portals. It supports education systems by facilitating the sharing of data and libraries.

Education institutions with complex infrastructure, such as universities, can benefit from open source software and its flexibility for adding new solutions and functionalities. By contrast, proprietary software does not permit sharing. Proprietary file formats are locked by vendors, which hinders interoperability, exchange and updates. However, awareness about free and open source software is still low and the required skills to use it are not widely available. There are also deployment and maintenance costs. The University of the Philippines has prioritized FOSS over commercial software. In 2011, its Linux Users' Group set up introductory training to FOSS and LINUX to raise awareness among students (UnPLUG, 2012). In Thailand, open source applications in some public services helped reduce costs. Marginalized areas that are not served by commercial services may benefit the most; however, the uptake is slow (UNESCO Bangkok and the Regional Bureau for Education in Asia and the Pacific, 2021).

Some countries are turning to open sources for public services, including education. X-Road, an open source data exchange used as the backbone of government e-services in Estonia (Nordic Institute for Interoperability Solutions, 2023), has been exported to Cambodia and Viet Nam (Guadagnoli, 2021). In Viet Nam, the Ministry of Information and Communication issued a directive in 2009 including a list of open source software products that state agencies and organizations should prioritize for investment, procurement and use when using state budget capital (Vietnam Ministry of Information and Communication, 2009).

FOSS is being fostered through policies, legislation and other initiatives in several Southeast Asian countries. In 2019, FOSSASIA, a non-governmental organization developing open hardware and software applications, launched a hackathon with UNESCO to develop innovative

ideas and prototypes for open source technology solutions and to raise awareness among young developers and FOSS communities on the importance of indigenous languages and the use of technology to protect them (UNESCO Bangkok, 2019).

Cambodia's 2018 Policy and Strategy on ICT in Education promotes the use of open source software and Khmer language applications for teaching and learning in compliance with Cambodian copyright laws (Cambodia Ministry of Education Youth and Sports, 2018). In 2008, Indonesia's Ministry of Research and Technology established the Center for Open Source Technology Awakening to disseminate open source technology and legal software. The Ministry of National Education, along with the Ministry of Industry and the Ministry of Communication and Information, were involved in the effective implementation of open source technology (Kompas.com, 2008). In Viet Nam, the Ministry of Information and Communication released a plan in 2012 to develop and apply open source software through training, funding, and enterprise and product development (Viet Nam Ministry of Information and Communication, 2012).

TECHNOLOGY SOLUTIONS ARE OFTEN NOT SUPPORTED BY GOOD EVIDENCE

Achieving universal provision of technology for schools, teachers and students involves substantial resources and requires good investment decisions supported by effective procurement processes. Evidence is critical to determine good investments (Hennessy et al., 2021). Value for money should be a key decision criterion, as several education technology products are underused, if used at all. The quality and reliability of vendors also needs to be assessed alongside the relevance of solutions. Only 15% of education technology companies are publicly funded in Southeast Asia, carrying sustainability risks for education systems (Kaizenvest and EdTech Asia, 2022).

But rigorous evidence is rarely used to take decisions on technology. Teachers, administrators and schools need to know the product features best suited to their education priorities. People are often attracted to the latest education technology but technology may not be the best or only solution (UNESCO, 2022). Purchasing technology for reasons other than pedagogical ones is a common mistake. In Thailand, the One Laptop Per Child and One Tablet Per Child programmes faced significant procurement challenges. A complex procurement process led to delays, inflated costs and compromised device quality. In the case of the Village Broadband Project, maintaining reliable internet connectivity in remote areas proved challenging, resulting in limited access and educational opportunities for residents. Moreover, political turnovers and changes in leadership disrupted the continuity of digital infrastructure initiatives, leading to discontinuation, redirection and insufficient support (Dipendra, 2023).

Research cannot keep up with the speed at which new education technologies emerge. Rigorous evaluation is often lacking, even for high-profile programmes (Hennessy et al., 2021). National policies and programmes are rarely informed by evidence, even in the richest countries (Jameson, 2019; Slavin, 2020). Less than 10% of education technology companies operating in Indonesia produced evidence of the effectiveness of their products (World Bank, 2020). In a survey of 205 division ICT coordinators in the Philippines, 41% said they never conducted impact evaluations of ICT (RTI International, 2020). This is not to suggest that only such evidence should be used, but a portfolio of evidence can help answer different questions (Kucirkova, 2023) and account for diverse real-world settings (Joyce and Cartwright, 2019).

A technology needs to prove it has an impact on teaching and learning, but accessing impartial advice can be challenging. When evidence of effectiveness is unavailable, decisions tend to rely on referrals and anecdotal knowledge (Morrison et al., 2019). But evidence exists which could be put to use. In Southeast Asia, ministries of education often collect data on devices and their use. Thailand monitors the use of technology, the number of training hours and student competencies. Singapore conducts e-formative assessments, e-school-based assessments and national e-examinations that generate a wealth of data (SEAMEO INNOTECH, 2023).

Yet considerable challenges exist, both for finding evidence and in the use of data. In Cambodia, a lack of monitoring and evaluation has made it difficult to understand whether a USD 75 million loan from the Asian Infrastructure Development Bank in 2019 to install fibre optic technology infrastructure has been effective (Brehm et al., 2023). In the Philippines, the lack of standardized monitoring and evaluation guidelines makes it difficult to compare and learn from the results of different studies. In Viet Nam, school data contain sensitive information about children. There are limitations in decentralizing data access and use, especially for the subnational education governance levels; this means the question of regulating who can access information still needs to be tackled (SEAMEO INNOTECH, 2023).

Evidence is also needed on the implementation of education technologies that may have proven their potential in principle (Steeves and Kwami, 2017). In the Philippines, a recent landmark decision by the Supreme Court, the Mandanas-Garcia ruling or Executive Order No. 138, could have implications on the sourcing and allocation

of education technology resources at the local government level. In line with the implementation of the ruling, the national government must establish key performance indicators and the minimum required investment for the devolution of educational functions to local government units so that the quality of education will not be diminished (Philippine Normal University, 2023).

MULTIPLE ACTORS CAN HELP INFORM CHOICES IN EDUCATION TECHNOLOGY PROCUREMENT

Adopting the right products and the right implementation model is crucial to improve teaching and learning. But it requires support. Findings from a survey of 205 division ICT coordinators in the Philippines suggested that 1 in 3 choose products based on the Department of Education's recommendations, over half get recommendations from funding partners and teachers directly, consulting with suppliers and searching reviews on the internet; while just over 1 in 10 said they do not make purchases at all. Fewer than one in four get information from one source of information (often the Department of Education), while the majority of ICT officers indicated multiple sources of information (RTI International, 2020). The Indonesian EdTech Association is a non-profit consortium aiming to connect local providers, the government and schools. It has been argued that independent consortia such as this one could have a positive impact on the education technology ecosystem because they could influence education regulations and policies to be more efficient (Omidyar Network, 2019).

International partnerships have also supported decision making. The United Kingdom Foreign and Commonwealth Office, the World Bank, and the Bill & Melinda Gates Foundation fund the EdTech Hub, a partnership that supports low- and middle-income countries to take informed decisions about technology in education through research (EdTech Hub, 2023). In Southeast Asia, the EdTech Hub has offered technical advice to develop a national education technology strategy in Cambodia with UNICEF (Thinley, 2023). The Asian Development Bank is supporting Cambodia, Indonesia, the Philippines and Viet Nam to identify technology solutions that are appropriate to each country's readiness and then test the interventions accordingly (Asian Development Bank, 2020).

PROCUREMENT DECISIONS OFTEN DO NOT TAKE SUSTAINABILITY INTO ACCOUNT

One of the most important issues in decisions on education technology procurement is sustainability. Education technology has economic, social and environmental impacts that need to be considered (Selwyn, 2021, 2023).

The lifespan of products and services is critical. In Cambodia, the United Nations Development Programme complemented the efforts of the Rural Electrification Fund in installing solar mini-grids to help address the short lifespan of batteries, while meeting varying power demands (UNDP, 2022). As part of the technology solutions for 'last-mile' schools during the COVID-19 pandemic, the Philippines has piloted the use of low-cost tablets connected to a local area network powered through a solar-panel battery to ensure learning continuity (Asian Development Bank, 2022).

The so-called total cost of ownership, which is the total cost of a product during its life cycle, should incorporate both the initial investment and the operational and support cost (Chuang et al., 2021; Morrison et al., 2019). Initial investment in education technology has been estimated at up to only 25% of the total cost (UNESCO, 2022). Recurrent and hidden costs include compatibility and interoperability with the existing information technology environment, depreciation, replacement needs, and even training (Mitchell and D'Rozario, 2022; UNCTAD, 2013). Malaysia, Singapore and Thailand are assessing the financial sustainability of their ICT projects, while Malaysia, Singapore and Viet Nam also assess the financial benefits for businesses and citizens (OECD and Asian Development Bank, 2019). In Cambodia, the 2018 Policy and Strategy on ICT in Education states that all ICT intervention proposals must include an analysis of the total cost of ownership for the Ministry of Education, Youth and Sports to ensure the availability of an operational budget. It also highlights that the use of evidence-based planning and resourcing should be promoted by providing easy access to data, information and analysis (Cambodia Ministry of Education Youth and Sports, 2018).

Buying devices for schools implies additional electricity needs, replacing of equipment when it is broken or outdated, purchasing cables and printers, security, user training and support, and maintenance. Manufacturers tend to base warranties for devices on an average 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 lifespans, tighter budgets and the ongoing semiconductor shortage, which has impacted supply chains, are increasing the risk of education technology disruption. Analysis conducted for this report estimates that it would cost USD 18 billion of capital expenditure to connect all schools in lower-middle-income countries in the region to the internet.

In Thailand, the Office of the Auditor General found that about 30% of the 860,000 tablets distributed to students in the first year of One Tablet Per Child were broken or needed repair. The supplier had signed an agreement with a local firm to maintain and repair the tablets for two years, but failed to do so (Dipendra, 2023). The long-term maintenance of the Net Pracharat initiative also remains a question. Complaints about the network being down for several weeks and not being fixed were reflected in the 'moderate' level of satisfaction of residents of a district in North Eastern Nakhon Ratchasima province (Nuchapat, 2019). The Office of the Auditor General indicated that the THB 13 billion (USD 370 million) of investment in the project may not have met its objectives (Thai PBS News, 2020).

The biggest concern about the costs of education technology relates to how giant technology firms 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). In Indonesia, the Competition Commission announced the start of an investigation for the alleged violations by Google of Law No. 5/1999 related to a potential abuse of dominant position, by conducting conditional sales and discriminatory practices in the distribution of digital applications (Chen et al., 2023).

REGULATION HELPS 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, 2022; Titl et al., 2021; Titl and Geys, 2019). Globally, even the most conservative estimate of the cost of corruption to the value of procurement contracts is 8%, which in 2019 would have been some USD 880 billion (Bosio, 2021).

Education technology procurement is not immune to these risks. Despite Indonesia being largely compliant to Article 9 of the United Nations Convention against Corruption and praised for its use of integrity pacts and e-procurement, the majority of corruption cases in Indonesia relate to public procurement. As much as USD 4 billion are lost per year through this form of corruption alone (UNODC, 2020). Decentralizing public procurement to local governments is often part of an effort 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 (OECD, 2023). However, this has been found to add other risks related to weak governance mechanisms and organizational capacity.

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). In Indonesia, the United Nations Office on Drugs and Crime's second review cycle included suggestions for improving the procurement process, such as the introduction of a comprehensive procurement law, greater transparency surrounding direct appointment and direct procurement practices, the establishment of specific external audits of procurement, and the issuance of clear regulations on the handling of complaints procedures, including through an independent appeal mechanism (UNODC, 2020).

The Malaysian government follows a competitive bidding process to procure software and hardware for education technology before awarding the contract to the selected vendor. It evaluates proposals based on criteria such as cost, technical capabilities and the ability to meet the required specifications. Additionally, the government may negotiate bulk purchasing agreements with suppliers to acquire software and hardware at discounted rates, reducing procurement costs and ensuring affordable access to resources for schools. The procurement process for public–private partnerships is regulated through a combination of general public finance legislation (e.g. the Financial Procedure Act 1957) and policies and guidelines which need to be followed in practice (Subramaniam, 2023).

Sustainability clauses are starting to be used, although or adoption [or uptake] has been slow. Analysis of the World Bank Global Public Procurement Database for this report found that Indonesia, Malaysia and the Philippines have sustainability clauses in their procurement laws. This compares to seven countries which have domestic preference clauses (World Bank, 2023a).

Civil society organizations have set up mechanisms to monitor public spending to increase the transparency

and accountability of public procurement. In the Philippines, the participation of non-state actors in monitoring public procurement has been in place for decades. The presence of non-governmental organizations as voting members of the special body for local government unit procurement was already required by the Local Government Code of 1991 (Transparency and Accountability Network Philippines, 2012). An Anti-Corruption Platform for Southeast Asia has been set up to showcase civil society organizations working on anti-corruption, in particular through activities around the UN Convention against Corruption and its review process (UNCAC Civil Society Coalition, 2021).

EDUCATION TECHNOLOGY USE HAS ENVIRONMENTAL CONSEQUENCES

Water, energy and material resources consumed to create education technology contribute considerably to environmental damage and the climate crisis. Distributing devices to each student, rather than students sharing devices, leads to a surplus of e-waste when outdated products are discarded (Selwyn, 2021, 2023). In Southeast Asia, e-waste is estimated to have reached 35.3 million metric tons, with significant social, health, environmental and economic consequences (Forti et al., 2020).

Only four countries currently have a national policy or legislation regulating e-waste. In Cambodia, the 2016 Sub-decree on Electrical and Electronic Equipment Waste Management covers all activities regarding the disposal, storage, collection, transport, recycling and dumping of electronic waste (Cambodia Ministry of Environment, 2016). In Myanmar, the National Waste Management Strategy and Master Plan, which also covers hazardous and e-waste, was issued in 2018. It calls for appropriate legislation and associated regulatory requirements to be adopted by the Ministry of Natural Resources and Environmental Conservation in cooperation with relevant stakeholders to guide the execution of the National Waste Management Strategy (Myanmar Ministry of Natural Resources and Environmental Conservation, 2018). Malaysia has set up an Integrated E-Waste Management System through which government agencies and private sector stakeholders collaborate to streamline and standardize e-waste recycling processes (Hill, 2023).

In Singapore, environmentally sustainable ICT technology is high on the agenda. This includes consolidating data centres to improve efficiency, evaluating devices for carbon emissions, reusing devices to minimize wastage and embedding sustainability criteria in procurement processes. A monitoring and reporting platform tracks sustainability performance across government (Hirdaramani, 2023). The Extended Producer Responsibility programme introduced in 2021 by the National Environmental Agency requires producers to take responsibility for disposing of their products at the end of their life cycle (Singapore National Environment Agency, 2023).

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. The use of small and low-maintenance solar panels to power digital devices is becoming more prominent in low-income countries and offers a cost-effective option for school communities in rural and remote areas. It is estimated that a small, low-cost solar panel with a battery that can supply 10 watts is sufficient to charge a smartphone for one day (Mooney, 2022).

CONCLUSION

Access to and the use of education technology is characterized by inequality. The costs of electricity, internet connection, hardware and software are high and often underestimated. Sustainability concerns go beyond economic dimensions and extend to social and environmental aspects. As technology is constantly changing, taking decisions that promote equity and quality requires expert guidance from trusted sources. However, the very sources of such expertise 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 required.

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 common good. When developing a comprehensive digital education system that truly enhances teaching and learning experiences, countries must address access to technology, while committing to inclusivity and putting learners' interest at the centre.

Giang A Sang and his grandfather are using artificial reality technology on a tablet supported by UNICEF in Viet Nam.

Credit: © UNICEF/UN0589432/Hoang*

CHAPTER

9

Governance and regulation

KEY MESSAGES

Governance of education technology is often a shared responsibility.

- In Southeast Asia, 10 countries have a government department or agency in charge of information and communication technology (ICT) or education technology; 4 are led by the education ministry.
- Concerns have been raised about the lack of oversight of private actors. Seven Southeast Asian countries have a unit responsible for public–private partnerships, but only five countries assess the partnerships' effectiveness. Myanmar and Singapore do it for the most expensive projects.

Learners often face risks in online learning environments.

- Many technology providers collect and store user data. Education technology products in Indonesia collect personal information from an estimated 14 million users.
- Individuals or their caregivers are expected to take responsibility for data privacy. About one in four 12- to 17-year-olds surveyed in Cambodia, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam reported that their online activities were restricted by caregivers.
- Seven Southeast Asian countries have a data protection framework. Based on the European Union's General Data Protection Regulation, Indonesia's 2022 Personal Data Protection Law sets out that children's consent must be obtained from the child's parents or guardians to process the child's personal data.
- Education is increasingly targeted by cyberattacks but there is insufficient capacity to address them. In April 2020, Singapore's educational institutions experienced an increase of cyberattacks by 68% in one month.
- Cyberbullying and online abuse are addressed in more than half of countries primarily with policies, strategies or plans. A 2023 Ministry of Education, Culture, Research and Technology regulation in Indonesia mandated schools to establish violence prevention teams to address cyberbullying.
- Online sexual exploitation and abuse of children is a growing concern in Southeast Asia, highlighting the need for digital and critical thinking skills. In 2017, Malaysia adopted comprehensive and progressive regulations on this issue.
- Artificial intelligence (AI) opens opportunities in education but introduces bias and privacy violation risks. The University of the Philippines published guidelines on the responsible and ethical use of AI, calling for meaningful human control.

The increasing use of education technology impacts children's well-being.

- Children are being exposed to a large amount of screen time, with negative impacts. In Singapore, high use of screens at lower ages was related to language delays and social communication deficits.
- Some regulations and guidelines relate to screen time. The Malaysian Dietary Guidelines for Children and Adolescents recommend less than two hours of screen time for children.
- Brunei Darussalam, Malaysia and Viet Nam have introduced some forms of restrictions on the use of smartphones in schools. In Viet Nam, several schools have adopted a more restrictive approach: more than 60% of students surveyed for this report reported they are not allowed to use smartphones in classrooms, even for studying.

As governments seek to integrate digital technology into education, they need to balance the opportunities and potential risks through governance mechanisms and regulations. Government goals for equity, inclusion, quality and efficiency are not necessarily aligned with those of the education technology industry, whose profit orientation can easily lead to practices which reduce well-being, breach security, abuse personal information and even violate human rights. 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).

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 human rights and the rule of law needs collaboration, partnerships and stakeholders aligning their goals.

EDUCATION TECHNOLOGY PRESENTS GOVERNANCE CHALLENGES

Education ministries need to collaborate with their peers in charge of economic development, infrastructure, energy and telecommunications 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. The role of private actors, notably through public–private partnerships, needs to be clear, which requires transparency and accountability mechanisms (Hillman, 2022; Lingard and Sellar, 2013).

GOVERNANCE OF EDUCATION TECHNOLOGY IS OFTEN A SHARED RESPONSIBILITY

When considering integrating technology into education, it is important to clarify which body steers the process. Ministries of education need to lead such decisions and pedagogical decisions need to take precedence over commercial considerations. The best interest of learners may be at risk where education technology companies do not come under the jurisdiction of education legislation and are seen purely through commercial law. In Southeast Asia, 10 countries have a government department or agency in charge of ICT or education technology.

In four countries, the education ministry is leading. In Cambodia, the Department of Information Technology led by the Ministry of Education, Youth and Sports oversees ICT policy and strategy implementation in the education sector, including teacher training, procurement, equipment, systems design, accountability mechanisms and educational programmes. In Singapore, the Educational Technology Division leads on educational technology, including the Student Learning Space platform. The Information Technology Division promotes the digitalization of ministerial services, management and infrastructure.

In six countries, responsibilities are shared between different ministries or agencies. In Malaysia, the Ministry of Education shares responsibility with other relevant government agencies for overseeing the implementation of education technology initiatives (Subramaniam, 2023). For example, the Government IT and Internet Committee is responsible for determining the direction, policy and strategy of ICT development, as well as for monitoring all public sector ICT programmes (Malaysia Government, 2023). In Thailand, the Ministry of Digital Economy and Society and its agencies lead on technology use and digital innovation. However, the Institute for the Promotion of Teaching Science and Technology under the Ministry of Education has responsibilities in most areas of teaching and learning related to science and technology (Thailand IPST, 2023; Thailand ONDE, 2017). In Viet Nam, the Ministry of Education and Training leads on educational programmes concerning information technology, whereas the Ministry of Information and Communications regulates the national ICT infrastructure (Viet Nam Ministry of Education and Training, 2023; Viet Nam Ministry of Information and Communications, 2023).

In the Philippines, the Department of Information and Communication Technology, is mandated to 'provide every Filipino access to vital ICT infrastructure and services' in line with the national digital agenda (Philippines Department of Information and Communications Technology, 2023). It promotes digital technology in education, including leading on nationwide initiatives, such as the National Broadband Plan, Free-Wi-Fi for All and digital literacy programmes. The department also supports the Department of Education, the Commission on Higher Education, and the Technical Education and Skills Development Agency, providing technical assistance and ensuring alignment with national and international standards (Philippine Normal University, 2023).

Mechanisms have also emerged to strengthen the governance of digital education and the representation of various stakeholders in policy design, implementation and monitoring. In 2019, the Digital Council of Thailand was established to act as a collaborative initiative between government and industry. In Malaysia, the Digital Education Policy aims to involve government agencies, communities, non-governmental organizations, government-linked companies and the private sector (Subramaniam, 2023).

PARTNERSHIPS WITH PRIVATE ACTORS ARE WIDESPREAD BUT RARELY REGULATED

Connectivity, devices, software and content are expensive to acquire and maintain. Governments that want to expand their supply often engage private companies in partnerships covering technical expertise, leasing and contracting services, training, software licences, and in-kind contributions of equipment. But lack of clear governance and regulations can confuse the question of who owns the processes. As learning software and applications offer services in exchange for data, it is important to address the issues of violation of privacy and safety (SEAMEO INNOTECH, 2023).

The use of replacing essential pedagogical functions can challenge teachers' autonomy (Zeide, 2017). Cambodia and the Philippines raised concerns over the sustainability of projects if they are not aligned with existing ICT programmes in education and if the process owners are not involved in their implementation (SEAMEO INNOTECH, 2023). In Indonesia, despite many efforts to create an open access digital education ecosystem, there are challenges, including about content quality (UNICEF, 2021).

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. Consumers could be misled, requiring more traditional market governance. But governments find it challenging to assure the quality of services provided by education technology companies (Patel et al., 2021). 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 the users pay a fee for accessing the platforms (Razquin et al., 2023).

Specific units responsible for public–private partnerships have been found to foster partnership and project delivery effectiveness. Seven countries have such dedicated units, four of which sit within the Ministry of Finance. Only five countries assess partnership effectiveness. Myanmar and Singapore do it for the most expensive projects (OECD and Asian Development Bank, 2019).

Some countries have made attempts to streamline the participation of non-state actors. In Indonesia, a non-profit consortium, the EdTech Association, was set up to bridge the gap between providers and the government (Omidyar Network, 2019). In Malaysia, UKAS, a public–private partnership unit, was specifically set up in 2009 under the Prime Minister's Department

to act as a central coordinating agency. It has issued Public–Private Partnership Guidelines as a reference for potential investors (Subramaniam, 2023). In Singapore, a dedicated industry-led coalition, Together Alliances for Action, works with the government to promote growth opportunities (Singapore Ministry of Trade and Industry, 2023). The Alliance for Action on EduTech aims to link industry stakeholders and governments 'for quick action and mutual benefit' (Emerging Stronger Taskforce, 2021).

Limited oversight capacity is another concern. In Malaysia, despite UKAS' work, existing guidelines and procedures have not been sufficient to prevent delays in negotiation and the implementation of ICT services, at the expense of the direct users (Subramaniam, 2023). One response of the education technology industry was self-regulation. In Singapore, already in 2010, mobile service providers M1, SingTel Mobile and StarHub Mobile developed a voluntary code on mobile content to regulate the exposure of non-appropriate content to minors and address growing concerns for children's safety (M1 et al., 2010).

DIGITAL PRIVACY, SAFETY AND WELL-BEING ARE NOT WELL REGULATED

While digital technology offers excellent opportunities for teaching and learning, it also carries risks related to privacy, safety, well-being and even with intellectual property (**Box 9.1**). The internet exposes users to the 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 have grown as education technology companies and products target children (SEAMEO INNOTECH, 2023). Clear standards on data security are often lacking (World Bank, 2020).

PRIVACY PROTECTION IN EDUCATION SETTINGS IS NOT YET PRIORITIZED

Digital technology providers collect and store data on their users, including information that is sensitive, compromising learners' privacy (United Nations Human Rights Council, 2022). In some countries, education technology installed on learning platforms recommended for learning during the COVID-19 pandemic came with tracking technologies that collected and sent data to third-party companies, usually advertising technology companies. In most cases, such surveillance took place without parents or children having the opportunity to opt out or consent (Human Rights Watch, 2022).
In Indonesia, private technology companies, such as Quipper, Ruangguru and Kelas Pintar, and the education ministry–owned Rumah Belajar collected data from an

BOX 9.1:

Teachers' intellectual property rights are disregarded

Digital technology has expanded educational content in Southeast Asia. However, expectations about equal access have been dampened **(Chapter 3)**. Schools and teachers are encouraged to participate in digital content creation and use. Yet questions arise over ownership and restrictions on the reuse and sharing of student and teacher work due to intellectual property rights (Nobre, 2019). In 7 of 11 countries (Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam), governments have signed the World Intellectual Property Organization's Copyright Treaty that regulates the rights of authors in digital environments (WIPO, 2023a). Some countries have also adopted related legislation on teaching and learning (WIPO, 2023b).

In the Philippines, Section 185 of the Intellectual Property Code defines the 'fair use' of a copyrighted work for criticism, comment, news reporting and teaching, including a limited number of copies for classroom use, scholarship, research and similar purposes (Philippines Congress, 1997). The move to online delivery during the COVID-19 pandemic raised a new issue of intellectual property. Teachers played a key role in creating digital content in local languages and tailored to local culture. However, Section 176 of the Code in effect explicitly excludes government employees' work (Intellectual Property Office of the Philippines, 2020; Philippines Congress, 1997), while teaching materials created by the private sector are protected by copyright upon creation (Chan et al., 2022). In practice, public school teachers are not acknowledged and protected as authors.

In Malaysia, the online sharing of copyrighted materials can present specific challenges, although exceptions exist for education (InfoJustice Eds, 2019). Singapore's 2021 Copyright Act acknowledges the impact of technology on the creation, distribution, access and use of copyrighted works. It devotes a section to education, exceptionally permitting schools and students of non-profit educational institutions to use internet resources for educational purposes only and under certain conditions (Singapore Parliament, 2021).
The Ministry of Education launched the eMedia channel for educators to provide 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 (Intellectual Property Office of Singapore, 2021).
Amendments to Thailand's 1994 Copyright Law extend coverage to digital content reproduction and privacy. For instance, exceptions are embedded in Section 32 concerning the reproduction and use of copyrighted material for teaching (Supasiripongchai, 2013, 2014).

estimated 14 million users. Applications, including the Digital Education Excellence Platform in Thailand and OLM in Viet Nam, were found to be collecting and transmitting children's data to third-party companies that tailor advertising and services to the user profile (Human Rights Watch, 2021a, 2021b, 2022). A Joint Submission to the High Commissioner for Human Rights on the Right to Privacy in the Digital Age under the #StopDigitalDictatorship campaign highlights privacy threats and challenges well beyond education (ASEAN Regional Coalition to #StopDigitalDictatorship, 2022).

Legal protection from arbitrary or unlawful interference with privacy, family, home or correspondence and from unlawful attacks on honour and reputation is recognized as a human right through international legal 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 violations of privacy is harder to define. It is not a single occurrence but extends into the future. Its negative consequences are spread across many people, even if they may be minimal for a single individual. The act may cause only an inconvenience for an individual but bring large benefits to companies. These factors are a challenge to courts' traditional understandings of harm (Citron and Solove, 2022).

The privacy of education technology users must be protected

Education technology users' privacy must be protected, while allowing the appropriate use of data to personalize learning, understand student progress and advance research. Schools should be aware of who can access student data and should disclose to families the type of data collected when students use technology. Schools also need to ensure that 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 inadequacies in how privacy concerns over education technology choices are addressed. 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 (United Nations Human Rights Council, 2021).

In 2022, a report of the UN Special Rapporteur on the right to education highlighted that the digitalization of education should not 'lead to violations of other human rights within education, in particular the right to privacy'. It raised concerns about the 'massive imbalance in power, awareness and knowledge between those who decide on the technologies and the users'. It 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).

In Viet Nam, Article 20 of a 2023 decree on personal data protection stipulates that children's personal data should be processed protecting their rights and respecting the principles of the best interests of children and no discrimination against children (The Legal Library, 2023).

AI is heightening some privacy concerns (**Box 9.2**). Countries are increasingly looking at its implications in specific domains. An ASEAN guide on AI Governance and Ethics is to be released in early 2024 (Potki and Wongcha-um, 2023). The Malaysian National AI Roadmap for 2021–2025 incorporates principles for the responsible use of AI, including fairness, reliability, safety and control, privacy and security, inclusiveness, transparency, accountability, and the pursuit of human benefit and happiness. In 2022, Thailand approved a draft National AI Strategy and Action Plan (2022–2027) to 'enhance the economy and quality of life within 2027'. Viet Nam's draft Standard on AI aims to establish quality assurance and transparency and proposes quality requirements for safety, privacy and ethics (Sandpiper, 2023).

Data protection legislation targeting children and education is only nascent

Seven Southeast Asian countries have a data protection framework and at least four of them have adopted, updated or clarified their related legislation after COVID-19, in light of the increased exposure of personal data to multiple security risks. Analysis of PEER country profiles for this report shows that only 3 of 11 countries have either a law or a policy on privacy with a focus on education.

BOX 9.2:

Artificial intelligence presents additional risks for privacy

The use of artificial intelligence (AI) in education is expanding, from the automation of administrative processes and tasks to curriculum and content development, teaching, and learning. 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 take 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). Thailand developed Ethics Guidelines which include principles for the development and utilization of AI such as transparency, accountability, security, privacy and fairness (Sharon, 2019). AI should consider diversity, avoid bias, minimize segregation and prevent discrimination. In relation to fairness, the guidelines state that the results of AI processing might be unfair if the datasets used for training, testing, and validation are biased and do not represent those who will be impacted by its usage in a comprehensive and equitable manner.

Algorithms applied in education relate to student admissions (Engler, 2021) and predictions of dropout (Sybol et al., 2023) and grades (Yağcı, 2022). Many countries have much hope in AI for reskilling and upskilling (Marsan, 2022). However, AI does not consider real experiences and contexts, exhibiting gender, racial and other biases (Baker and Hawn, 2022; Borgesius, 2018; Buolamwini and Gebru, 2018). Given that 70% of scientists working on AI are white, algorithmic biases could emerge with, for example, skin colour becoming a criterion (Hằng, 2023).

Guidelines may be needed. Singapore's Ministry of Education recognized the potential of ChatGPT, a language model–based chatbot developed by AI, and reported relying on students and teachers' capacity to use it effectively (Singapore Ministry of Education, 2020). More positively, in July 2023, the University of the Philippines published principles on the responsible and ethical use of AI, calling for meaningful human control, accountability and transparency (University of the Philippines, 2023). UNESCO has launched the first-ever guidance on generative artificial intelligence in education and research. Among the Southeast Asian countries surveyed, only Thailand reported that it was developing frameworks or training programmes on AI for teachers.

Repositories may also be useful to allow researchers to compare and analyse different uses of AI. The Ministry of Education of Singapore was the only Southeast Asian country to have set up an online repository centred on the use of ChatGPT in teaching and learning. Singapore has also established a platform to develop education institution capacity through its AI Government Cloud Cluster, which includes a dedicated repository of GPT models (UNESCO, 2023).

At the regional level, the Asia-Pacific Economic Cooperation Privacy Framework, adopted in 2015, defines principles and implementation guidelines for effective privacy protection that avoids barriers to information flows for economic purposes. The non-legally binding document provides a flexible approach to information privacy protection across Asia-Pacific Economic Cooperation member economies, including Brunei Darussalam, Indonesia, the Philippines, Singapore, Thailand and Viet Nam. Targeting businesses which operate across borders, it calls for age-appropriate information about personal data collection, use and disclosure to be made available (APEC, 2015; Wall, 2017).

The framework has informed the adoption of similar regulations in several Southeast Asian countries (Rodrigo, 2018), some of which cover children and minors and others that do not. The 2017 Law on Electronic Data Protection in the Lao People's Democratic Republic does not specifically regulate the processing of children's data (OneTrust DataGuidance, 2022). Singapore's 2012 Personal Data Protection Act does not specify the age of consent from minors (Allen et al., 2022). However, in 2022, the Personal Data Protection Commission clarified in an advisory guideline that children aged at least 13 can be considered to have sufficient understanding to be able to consent on their own behalf (OneTrust DataGuidance and Rajah & Tann Asia, 2020). Thailand's 2019 Personal Data Protection Act, which came into effect in 2022, regulates data collection, use and disclosure as well as restrictions on data transfers. It set the age of consent at 10 years and does not outline specific control requirements about information from and to children for marketing and services offered directly to a child (OneTrust DataGuidance

and Blumenthal Richter & Sumet, 2021).
Viet Nam's 2023 decree on personal data protection stipulates that the processing of children's personal data must have the consent of children at least 7 years of age or older and the consent of the parent or guardian, except where the school has given consent (Viet Nam Government, 2023).

The General Data Protection Regulation, issued in 2016 and entered into force in 2018, has changed the legal landscape for child protection in the European Union. 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'. The regulation has led to the adoption of compliant norms in countries outside the European Union. In Indonesia, the 2022 Personal Data Protection Law is closely based on the General Data Protection Regulation. While it does not specify a minimum age for data privacy purposes, it sets out that children's consent must be obtained from the child's parents or guardians to process personal data belonging to children, i.e. those under 18 (Indonesia Presidency of the Republic, 2022).

Data protection standards, consumer protection laws and privacy regulations are still fragmented and opaque, hampering the coherence of privacy policies for students and teachers (Right to Education Initiative, 2023). 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. In the Philippines, an exception to the consent rule is contained in Opinion No. 2017-049, which stipulates that 'the teacher may search through a minor student's cellphone in order to protect vitally important interests of the student, including his life and health or probably to respond to [a] national emergency' (Chao, 2022). During COVID-19, the National Privacy Commission clarified the lawful nature of recording and uploading online classes though a series of advisory opinions on online learning (Philippines National Privacy Commission, 2021). In Singapore, specific exceptions for consent are set out in advisory guidelines for the education sector, for example, when disclosure of data is needed for admission, scholarship or evaluation purposes (Personal Data Protection Commission Singapore, 2018).

There may be confusion over whether existing standards of consent apply to schools, raising concerns about the consistent protection of personal data and the potential for data misuse through loopholes. In Malaysia, education is under the scope of the 2010 Personal Data Protection Act, which, however, excludes from its application federal and state governments, covering instead private universities and private schools. Singapore's guidelines on the implementation of 'relevant precautions' in case of data collection, use and disclosure about minors also exempts government and public authorities (OneTrust DataGuidance and Rajah & Tann Asia, 2020). Section 4(1)c of Singapore's data protection law exempts public agencies. However, education institutions, such as government-aided schools, specialized schools, specialized independent schools and autonomous universities, are required to comply with the 2012 Personal Data Protection Act provisions. In most cases, those institutions have also adopted personal data protection policies which allow families to access those data and ask for correction (Singapore American School, 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. But the extent to which they can investigate, impose civil liability and issue remedies varies. In the region, Singapore has entrusted a regulatory authority with the power to bring administrative actions against parties who have committed data law breaches.

Governments are expected to intervene when data privacy is infringed upon by technology companies. In Singapore, following a ransomware attack, personal data from a learning management platform managed by Marshall Cavendish Education were disclosed without authorization. The result was that the Ministry of Education of Singapore's service provider was fined USD 30,000 in 2019 by the Personal Data Protection Commission of Singapore's Data Protection Authority for violating the 2012 Personal Data Protection Act (UNESCO, 2022). Following amendments of the Personal Data Protection Act adopted in 2020, the financial penalty cap for breaches has been amended from SGD 1 million to whichever is the higher amount: SGD 1 million or 10% of the organization's annual turnover in Singapore for organizations with an annual local turnover exceeding SGD 10 million (Singapore Republic, 2023). In the Philippines, fines range from 0.5% to 3% of the gross annual income of the controller or processor handling the personal data. The severity of the fines depends on several factors, including the number of subjects affected; whether or not the subjects were notified of data breaches; and the intent, character and severity of the offence (Nagashima Ohno & Tsunematsu, 2023).

Education technology companies can contribute to addressing the problem by applying sound privacy and data protection to their products, services and systems. They can set privacy filters by default on applications and devices without requiring manual input from users (UNESCO, 2022). Often, however, individuals or their caregivers are expected to take responsibility for their own data privacy. In Viet Nam, over half of caregivers restricted online activities for children aged 12 to 17 (ECPAT et al., 2022f). In Cambodia (ECPAT et al., 2022a) and Malaysia (ECPAT et al., 2022c), just over one quarter did so, although at a higher frequency for younger children. In Singapore, the Personal Data Protection Commission considered data privacy impact assessments as a key component of a 'data protection by design' approach (Personal Data Protection Commission Singapore, 2021).

Various civil society initiatives have developed guidance and frameworks to regulate technology and address ethical and social considerations (Shackelford et al., 2015; Shackelford and Dockery, 2020). Recent investigations by Human Rights Watch have also generated some responses. The Ministry of Education of Indonesia has removed advertising tracking from the national learning platform, Rumah Belajar (Human Rights Watch, 2023). In 2020, Singapore suspended the video-conferencing platform Zoom, used for online learning during COVID-19. Its use was resumed following the disabling of screen annotation and sharing and the consolidation of security settings (Ang, 2020). In response to data breaches during online learning, representatives of higher education institutions in the Philippines volunteered to define common guidelines on data treatment and privacy. Moreover, a data privacy council was established to increase data privacy effectiveness and accountability (Philippines National Privacy Commission, 2022; World Bank, 2022).

ONLINE SAFETY RISKS ARE OFTEN DISMISSED DESPITE THEIR INCREASE IN NUMBER

Education, like all sectors, is increasingly targeted by cyberattacks. Schools possess confidential data about students and parents ranging from sociodemographic records to health and financial data. More attacks on education systems means more exposure to identity and other personal data thefts. While the education sector was particularly targeted during COVID-19, as it was considered the most vulnerable of all public services, this trend has since continued (SOPHOS, 2023). Globally, in 2022, the education sector accounted for 5% of all ransomware attacks (APWG, 2022). Among incidents reported globally in 2023, 48% took place with confirmed data disclosure (Verizon, 2023). Globally, education is the sector with the highest number of attacks (Leesa-Nguansuk, 2023).

From March to April 2020, Singapore's education institutions experienced a 68% increase of cyberattacks (Teng, 2020b). A 2021 survey of 450 information technology decision makers in Malaysia, the Philippines and Singapore, including from the education sector, showed that at least one in three were hit by ransomware in 2020. Organizations were forced to incur restoration costs ranging from USD 770,000 in Malaysia to USD 3.4 million in Singapore. The costs and risks of poor cybersecurity in schools are large, even though ransoms are often not paid; the restoration of systems and resources can cost more than the average ransom payment (SOPHOS, 2021).

In the Philippines, education institutions were more likely to experience losses from ransomware attacks than other sectors (Bautista, 2022). However, the country was one of the most prepared to respond to malware incidents. In response to frequent environmental emergencies, 83% of respondents in the Philippines reported having a malware incident recovery plan (SOPHOS, 2021).

Some Southeast Asian countries have developed legal and policy frameworks to protect and safeguard digital infrastructure and data from cyberattacks. Thailand and Singapore adopted Cybersecurity Acts in 2019 and 2018, respectively, to regulate, prevent and mitigate cybersecurity threats. Singapore's Public Sector Committee conducted a review of data security policies and practices across the public sector and required public schools to comply with the regulation in the aftermath of increasing attacks. An employee cybersecurity toolkit was developed to educate and inform employees about cybersecurity risks (Singapore Cyber Security Agency, 2022).

Cyberbullying is common and likely to grow as children spend more time online

Cyberbullying is a new form of bullying behaviour that has been fuelled by access to smartphones and the use of social media (Ortega-Ruipérez et al., 2021). It has been estimated that 16- to 64-year-old internet users in Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam spend on average about three hours on social media platforms every day (Hedges, 2023).

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). More than half of the countries in Southeast Asia

BOX 9.3:

Online child grooming is a growing concern in Southeast Asia

Child grooming is a growing concern among parents and teachers. In Singapore, 3 in 10 parents reported being concerned about their children's online safety (Low, 2022). Crime detection agencies have reported a significant increase in demand for child sexual abuse and exploitation livestreams from traffickers in Cambodia, the Philippines and Thailand (Sullivan, 2020). In Cambodia, boys reported having experienced child grooming at almost twice the rate of girls (ECPAT et al., 2022a). COVID-19 multiplied the risk: the Philippines Department of Justice reported a fourfold increase in cases from March to May 2020 compared to the same period in 2019 (Buan, 2020).

Regulation varies in its ambition. Cambodia's 2008 Law on Suppression of Human Trafficking and Sexual Exploitation includes a narrow definition of child sexual abuse material, criminalizing certain conduct associated with it (ECPAT et al., 2022a). Malaysia adopted a comprehensive Sexual Offences against Children Act in 2017, which includes the protection of children from sexual exploitation and abuse conducted online by criminalizing the production, distribution, access and possession of a wide range of child sexual abuse materials (ECPAT et al., 2022c). In the Philippines, the 2009 Anti-Child Pornography Act prohibits grooming (Philippines Congress, 2009). To reinforce the implementation of the 2012 Child Protection Policy, it established a Child Protection Unit and a Child Rights in Education Desk in 2021 (Philippines Department of Education, 2021). Singapore criminalizes sexual grooming in its 2020 Penal Code (Mohan and Lee, 2020).

Countries have also started addressing this issue in curricula and teacher training. In Cambodia, the Ministry of Education, Youth and Sports has developed a resource for primary and secondary schools on child abuse, including online sexual violence against children. Viet Nam has made classes on the prevention of sexual abuse mandatory in primary schools and developed manuals for staff (ECPAT International, 2022). The Philippines Department of Education launched an e-learning course to train school-based Child Protection Committees and strengthen child protection, in partnership with the Stairway Foundation Inc (Philippines Department of Education, 2023b). Activities also extend beyond school. In the Philippines, SaferKidsPH works with children, their families, the government, civil society and the private sector to ensure child online safety and protection (#SaferKidsPh, 2023). The Philippines Department of Education collaborates with Stairway Foundation, Inc., and the Internet and Mobile Marketers Association to increase awareness of online risks with the #BeCyberSafe project (Philippines Department of Education, 2023a).

have adopted either a law or, more usually, a policy to prevent and act on cyberbullying with a focus on education. Only the 2013 Anti-Bullying Act in the Philippines explicitly refers to cyberbullying as an act of bullying exerted using technology or any electronic means. It mandates schools to adopt policies to prevent and address this practice in a timely and effective manner through reporting, investigation and disciplinary interventions (Philippines Congress, 2013).

In Indonesia, protection against cyberbullying is indirectly provided under the Personal Data Protection Act, while the amended 2008 Electronic Information and Transactions Law considers cyberbullying to be a form of harassment and prohibits the dissemination of defamatory or slanderous material through electronic media, including social media and messaging applications (Indonesia House of Representatives, 2008). Regulation 46 issued by the Minister of Education, Culture, Research and Technology in 2023 aims 'to firmly handle and prevent sexual violence, bullying, discrimination, and intolerance, as well as to assist education units in handling cases of violence, covering online, psychological, and other forms of violence with a victim perspective'. The regulation mandated schools to establish violence prevention teams and local governments to establish task forces (Indonesia Cabinet Secretariat of the Republic, 2023).

In Brunei Darussalam, the 2015 Child Online Protection National Strategy Framework strengthens the coordination of procedures and protocols on child online protection, covering cyberbullying and harassment (Brunei Darussalam Ministry of Culture Youth and Sports, 2015). In Cambodia, the Minister of Youth, Education and Sport strengthens preventive strategies for security and against online abuse and incorporates awareness on cyberbullying in digital education (Brehm et al., 2023). In the Lao People's Democratic Republic, a 2020 regulation authorizes the Laos Computer Emergency Response Team to receive complaints from those affected by cyberbullying (Lao PDR Ministry of Post and Telecommunications, 2020). In Singapore, the Harassment Protection Act, dating from

2014 and last amended in 2023, criminalizes cyberbullying and stalking and prohibits cyber harassment and the bullying of children (Singapore Parliament, 2014). Thailand has drafted, but not yet approved, a law covering cyberbullying, cyberstalking and grooming (**Box 9.3**), as part of measures against online child sexual exploitation and abuse to be added to the Penal Code (ECPAT et al., 2022d).

PHYSICAL AND MENTAL WELL-BEING ARE AT RISK FROM EXCESSIVE TECHNOLOGY USE

The use of technology involves prolonged periods of time handling devices and in front of screens. Education is particularly vulnerable to excesses in both respects, as risks to health and general well-being are exacerbated by requiring learners to use digital technology. Governments are only now beginning to consider how to respond to these risks. In Singapore, the probability of being overweight is about twice as much among adolescents with insufficient sleep (less than 7 hours on school nights) relative to those who sleep 8 to 10 hours a night. Insufficient sleep has also been associated with higher cardiovascular diseases when these adolescents become adults (Lewis and Yap, 2023). In a survey of caregivers of 12- to 17-year-old internet users in Indonesia, Malaysia, the Philippines and Viet Nam, 64% reported being concerned about their children being contacted by strangers and exposed to sexual images while using the internet (ECPAT et al., 2022b, 2022c, 2022e, 2022f).

Excessive exposure to screens affects children's well-being and development

Three in five parents in Singapore confirmed that they allow their children to spend more time on screens since the pandemic. One in three reported that their children spent between three and six hours online per day on average (Low, 2022). A cohort study showed that even children under 2 are exposed to nearly two hours per day of digital media via electronic screen-based devices (CHILD, 2021). A study of children under 5 in Malaysia showed that 90% spent 3 hours in front of screens (Raj et al., 2022).

Concerns about screen time were discussed well before the advent of computers and screen-based digital devices, in relation to television. But earlier studies' results were often inconclusive because screen time was self-reported and might have been affected by recall errors and biases (Wong et al., 2021). More recent studies, which capture screen time more accurately, tend to report negative impacts in various domains, including sleep and eating disorders (Trott et al., 2022). A study among 15- to 18-year-old students in Indonesia during COVID-19 found that nearly one in three suffered from sleep disorders (Windiani et al., 2021). Parents in Singapore reported that their children aged 3 to 16 doubled the time spent in front of screens for pleasure, which impacted their sleep habits (Law et al., 2023). In a 2020 survey, about 80% of parents were concerned about screen addiction, poor sleep and access to inappropriate content. More than half were concerned about eyesight problems, a lack of physical activity or a lack of parent–child interactions (Chia et al., 2020).

Excessive screen time can have health and development implications. A study of 437 children in Singapore followed from 2010 to 2020 found that infant screen use was associated with variations in neurological activities and had an impact on the development of high-order cognitive skills (Law et al., 2023). High use of screens at lower ages is found to be related to language delays and social communication deficits. A study conducted among 62 children who had been referred for speech and language delay in Malaysia found that 90% of them had been exposed to excessive screen time and at an early age (Kai et al. 2022). In Singapore, the association between the amount of time (or number of hours) watching television and cognitive and language skills at age 4.5 years was negative. Screen time between ages 1 and 2 was associated with deficits in executive functions at age 8.5 (CHILD, 2021).

Youth can become addicted to the internet, social media and screen time. A study conducted in Thailand in 2018 among 245 lower secondary students highlighted the risk of addictive behaviours; students reported spending an average of five hours per day during the week and seven hours per day during the weekend on social media (Manwong et al., 2018). One in five adolescents in Indonesia developed an addiction to the internet during the COVID-19 pandemic. Longer screen time was considered one of the risk factors (Siste et al., 2021).

Experts are calling for public interventions and limits to screen time (Nagata et al., 2022). At the international level, guidelines and recommended screen time limits exist, most often under the purview of health authorities, but it is up to parents to follow them (Lewis and Yap, 2023). The World Health Organization's Guidelines on Physical Activity, Sedentary Behaviours and Sleep recommend less than one hour of sedentary screen time for children aged between 1 and 5 years (WHO, 2019). Yet one 2019 survey in Singapore showed that only 27% of children under 5 met these guidelines (Chia et al., 2020).

The Family Physicians of Malaysia and Family Medicine Specialist Association of Malaysia have called for guidelines for the 'mindful usage of screen-based media' for children under 5 years (Arumugam et al., 2021). The Malaysian Dietary Guidelines for Children and Adolescents had already recommended in 2013 less than two hours of screen time for children (Raj et al., 2022). The Philippines Society of Paediatric Ophthalmology and Strabismus recommends avoiding screen exposure for infants under 1, less than one hour for children aged 2 to 5, and guided screen time for those above 5 (UNILAB, 2020). In 2021, the Singapore College of Paediatrics and Child Health and the Academy of Medicine drafted 24-hour activity guidelines for children aged 7 to 18 and recommend less than 2 hours a day screen exposure for this age group (Singapore College of Paediatrics and Child Health and Academy of Medicine, 2021).

Apart from health advice, countries are trying to make education interventions on the issue. The latest curriculum review in Singapore, which started in 2022, doubled the time allocated to cyber wellness to four hours a week (Teng, 2020a). During 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, 2021a). Students are directed to take responsibility for their online well-being and parents are recommended to schedule screen time to make it predictable, especially during home-based learning (Singapore Ministry of Education, 2018, 2021b). Malaysia adopted the National Cyber Ethics Module to raise awareness of ethical use of digital technology among students.

Some countries are banning phones or other technology from schools

Concerns over data privacy, safety and well-being also underpin debates about the use of technology in schools, especially by students of young ages. The use of smartphones in schools is contentious. In Indonesia, a study of 11- to 12-year-old primary students found an association between the problematic use of smartphones and anxiety disorder symptoms (Dhamayanti et al., 2019). Studies from high-income countries show that banning mobile phones from schools improves academic performance, especially for low-performing students.

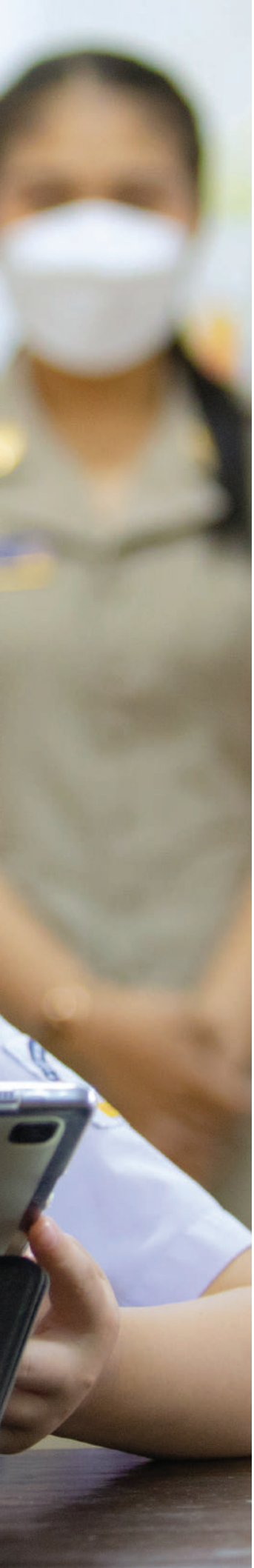
Analysis for this report shows that Brunei Darussalam, Malaysia and Viet Nam have introduced bans in laws or policies. Schools ban the use of smartphones in schools in Cambodia (Bunthoeurn, 2023) and Indonesia (Suseno et al., 2022). Malaysia banned the use of smartphones in schools in 2009 and issued guidelines in 2018 on the use of digital devices for learning purposes. While schools have their own responsibilities to set rules concerning the use of smartphones in classrooms (Kan, 2021), the Ministry of Education aims to limit playing games on them (Ridzaimi, 2022). In 2020, Viet Nam allowed the use of smartphones in secondary schools only for educational purposes (Nhat et al., 2020). In line with the directive, some schools adopted a more restrictive approach: more than 60% of students surveyed for this report reported they are not allowed to use smartphones in classrooms, even for studying (Vinh et al., 2023). Besides smartphones, Singapore has regulated the use of TikTok, a video hosting service, and other social media applications for public officers. TikTok can be used on government-provided devices, only if needed (Kit, 2023).

CONCLUSION

Under certain conditions, the use of technology in education can enhance children's opportunities to learn, but technology can also be harmful to the physical and mental integrity, privacy, and dignity of users. Intellectual property, data privacy and online safety are critical challenges that countries need to address. In response, some Southeast Asian countries have issued data protection laws and regulated online safety. Despite progress, it is evident that this is a major new challenge for regulators in the region, especially in the wake of emerging new risks for children in relation to online safety and security, including in education settings.

A girl uses tablet to access the teaching and learning platform "Khang Panya Lao" developed with UNICEF's support in a school in Vientiane.

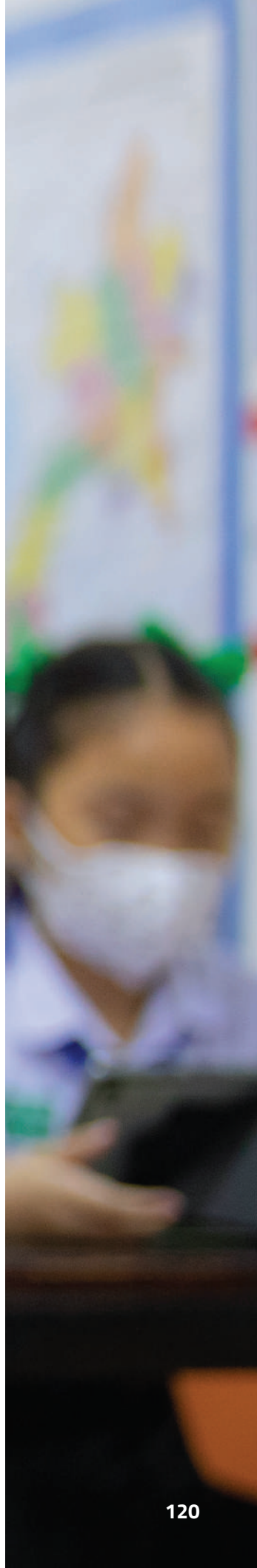
Credit: © UNICEF/UN0671248/Karki
Released to everyone



CHAPTER

10

Teachers



KEY MESSAGES

Technology is changing the teaching profession in Southeast Asia.

- During COVID-19, options for working with multiple teaching and assessment resources and for interacting with students accelerated. Digital applications were often used to communicate with students, parents and colleagues. However, teachers in Southeast Asia reported difficulties in carrying out technology-based assessment.

Various barriers prevent teachers from making the most of what technology offers.

- Lack of infrastructure remains a barrier to technology integration. According to the 2019 Southeast Asia Primary Learning Metrics (SEA-PLM) survey, only 22% of children attended classrooms where teachers had access to a computer. In 2018, 63% of teachers in Viet Nam indicated that digital infrastructure hindered their capacity at least 'quite a bit' to provide quality instruction.
- Some teachers lack confidence in using technology. Nearly one third of primary teachers in the region, and almost one half in Cambodia and the Lao People's Democratic Republic, felt 'not very' or 'not at all' confident in using information and communication technology (ICT) in the classroom.

Education systems do support teachers in using technology.

- In Southeast Asia, 9 out of 11 countries define ICT standards for teachers. At the regional level, the Southeast Asia Teaching Competency Framework identifies the use of ICT as a teaching strategy to support learning.
- Teacher training remains limited in certain contexts. For instance, 40% of primary teachers in the region reported having received neither pre- nor in-service training on ICT, ranging from 3% in Viet Nam to about 65% in Cambodia and the Lao People's Democratic Republic.
- COVID-19 school closures led to an increase in teacher training on ICT, with 44% of primary and lower secondary teachers in Indonesia receiving online training during the pandemic, of which three quarters had never participated in such training before.

Technology is transforming teacher training provision in Southeast Asia.

- Technology can make training opportunities more accessible, overcoming location and time barriers. The Faculty of Education and Teacher Training was among the first departments established at Universitas Terbuka, the open university in Indonesia, to address teacher shortages. In 2022, it counted about 21,500 graduates.
- Technology helps teachers learn from each other through platforms. Guru Berbagi, a teacher-sharing platform, has connected about 30% of Indonesian teachers, creating a virtual community.
- Many actors support teachers' professional development in ICT. Since 2013, the Teaching and Learning Centre at Universiti Brunei Darussalam has played a pivotal role in providing training on digital teaching and pedagogies and then did so during the COVID-19 pandemic.
- In the Philippines, each school appoints ICT coordinators to assist teachers in their professional development.

Teachers are increasingly expected to integrate digital technology into various aspects of their work, including their teaching practices, student assessment, interactions with students and parents, and ongoing professional development. Most countries in Southeast Asia have established ICT standards for educators. However, there is stillnot consistent support for effectively using digital technology in classrooms. In many instances, teachers report feeling unconfident about the integration of ICT into their teaching practice. The COVID-19 pandemic further heightened demands on teachers, increasing their workload and learning requirements. However, while professional development opportunities for ICT support and integration have increased, it remains a challenge to ensure training is consistent and sustainable.

This chapter explores Southeast Asia's responses to support teachers in the use of technology. Teachers play a unique role in the classroom as motivators, socializers and facilitators of critical thinking and autonomy. Professional development can empower teachers to make informed choices about technology to meet diverse learner needs and contexts. Finally, the chapter examines how technology can be used to provide distance training to teachers.

TECHNOLOGY IS CHANGING THE TEACHING PROFESSION IN SOUTHEAST ASIA

The teaching profession is evolving in response to changes brought about by the integration of new applications and technologies into classrooms. In Southeast Asia, opportunities for learning engagement, access to multiple resources, and direct interactions with students and parents are increasing. The COVID-19 pandemic accelerated some of these developments, forcing teachers to consider the implications of technology for their teaching methods.

Teachers are being provided with more teaching resources that they can adapt to their instructional methods. The development of national platforms has increased, often prompted by the pandemic (UNESCO et al., 2021). Malaysia's Ministry of Education launched DELIMa in 2020. Indonesia's Ministry of Education and Culture introduced Merdeka Mengajar in 2022. Both platforms provide teachers with multiple resources, including modules, videos and digital textbooks aligned with the national curricula. They also enable educators to personalize teaching by allowing them to upload their own materials (SEAMEO SEAMOLEC, 2023; Subramaniam, 2023). With the support of the Research Institute for Educational Sciences and UNICEF, the Lao People's Democratic Republic adopted the Khang Panya Lao

platform, which provides access to relevant digital resources for 10,000 teachers across all 18 provinces (Australian Council for Educational Research, 2023).

The Department of Education in the Philippines introduced DepEd Commons, a platform designed for teachers and students to access and exchange online open educational resources, including via mobile phones (Philippine Normal University, 2023). In a 2021 survey, 44% of respondents said they used technology to find instructional materials. However, 87% printed resources were originally in digital formats (Vikas et al., 2021). To improve teachers' familiarity with the platform and its resources, the Department of Education conducts training sessions for teaching and non-teaching staff (Philippines Learning Management System, 2023).

The effective use of education technology can facilitate student-centred learning through project-based activities. Platforms equipped with algorithms and adaptive learning capabilities can offer personalized experiences for students, enabling teachers to tailor instruction, identify areas needing support and adjust teaching strategies accordingly (Walkington and Bernacki, 2020). In richer countries across Southeast Asia, teachers are exploring these tools. Launched in 2022, Malaysia's Reading Progress initiative aims to improve students' English proficiency through customized instruction and progress tracking. Integrated into DELIMa, it collects data on student learning and provides valuable insights on a dashboard. The tool enables teachers to monitor assignments and track learning development while adapting their teaching strategies. To date, about 1,200 teachers in more than 550 schools have used this technology (Subramaniam, 2023). In Singapore, Student Learning Space Community Gallery, a dashboard feature of the national learning platform, empowers teachers to monitor student performance and plan lessons effectively. Teachers are encouraged to share lessons with their peers, fostering collaboration through forums like the Singapore Learning Designers Community, which counts 20,000 members (Singapore Ministry of Education, 2022b).

Some teachers also have the opportunity to use virtual and augmented reality technologies to explain concepts through immersive experiences, offering game-based learning and simulating real-world scenarios such as virtual field trips (Pellas et al., 2019). Selected schools in Thailand employ augmented reality as an educational tool. A study of 60 grade 9 students found that using augmented reality for feedback during instruction led to improvements in information and knowledge retention and analytical thinking abilities (Nasongkhla et al., 2019).

In northern Thailand, pre-service teachers have expressed favourable opinions on augmented reality to teach astronomy in secondary schools. They noted the approach increased student engagement and enjoyment (Putiorn et al., 2018).

Technology provides a wide range of tools to support teachers in student assessment. These tools provide immediate feedback to students and valuable insights into their learning progress. Prior to the pandemic, ICT integration in assessment was limited. Teachers primarily used ICT for preparing assessment materials and recording results (SEAMEO INNOTECH, 2015). Starting from the academic year 2014/15, Indonesia began conducting the national examinations using computers. English teachers interviewed about their experiences reported a positive view of this testing method. They found the administration and evaluation processes to be effective and efficient. However, this transition required teaching methods and materials to be adjusted to align with the new assessment format (Mardjuki and Lubis, 2020).

During the COVID-19 pandemic, teachers had to incorporate technology into assessment to adapt to remote and online learning. They were given the opportunity to choose and customize assessment tools, including computer-based tests, and initiate group projects and presentations through features integrated into national learning platforms (SEAMEO INNOTECH, 2023). Overall, it was found that teachers in Southeast Asia encountered challenges when making the transition to technology-based assessment during the shift to distance learning (UNICEF, 2021a). This aligned with the T4 online survey of over 20,000 teachers in 165 countries, who identified assessments as the pedagogical area in which they were least likely to receive technological support (Vikas et al., 2021).

Technology provides teachers with tools and platforms to enhance interactions with students, parents and the community. In the Philippines, 70% of teachers interviewed used messaging services to communicate with students (Vikas et al., 2021). In Vietnamese universities, lecturers often employ digital technologies, such as social media platforms, including Facebook Messenger; messaging applications like Zalo; and videoconferencing tools like Zoom, to stay connected with students (Nghia and Tran, 2021). This type of interaction became popular due to students' and parents' familiarity with these applications, as in Thailand (Dipendra, 2023).

VARIOUS BARRIERS PREVENT TEACHERS FROM MAKING THE MOST OF WHAT TECHNOLOGY OFFERS

Teachers often encounter difficulties when integrating technology into professional tasks. One significant obstacle is limited access to digital infrastructure. According to the 2019 SEA-PLM survey conducted in 6 countries (Cambodia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines and Viet Nam), more than 75% of primary schools had computers but only 22% of children were in a classroom where teachers indicated having access to a computer to support their teaching activities. In Myanmar, only 8% of children had access to a personal computer or laptop in their classroom for teaching purposes (UNICEF, 2022). Data from the 2018 Teaching and Learning International Survey (TALIS) showed that teachers in schools with inadequate digital infrastructure were less likely to believe that they could effectively support student learning; 63% of teachers in Viet Nam reported that their school's digital infrastructure hindered their capacity at least 'quite a bit' to provide quality instruction (OECD, 2022).

Teachers in poorer countries struggle to access necessary devices and software for teaching. As a result, they often have to use their own devices or invest personal funds for teaching and learning materials, a situation that was exacerbated during the COVID-19 pandemic. More than two thirds of teachers in the Philippines reported using their own devices to facilitate remote learning during this period (Vikas et al., 2021). In Timor-Leste, teachers often resort to their digital devices and spending out of pocket to access information for teaching (SEAMEO QITEP in Science, 2023). In Myanmar, educators routinely took on the cost of repairing computers when they malfunctioned (Lall, 2021).

Access to digital resources is also unequal within countries. In the Lao People's Democratic Republic, schools in rural areas are less likely to have computers, devices and other hardware, such as printers. During the pandemic, they had to copy exercises from textbooks on paper and distribute them to students to facilitate home learning. Teachers in remote areas often lack personal computers or smartphones, so their access to online digital resources is limited (Australian Council for Educational Research, 2023).

In Cambodia, only 22% of schools had computers in satisfactory working condition, according to a national review in 2022 (Cambodia Ministry of Industry, Science, Technology and Innovation, 2022). Moreover, teachers in disadvantaged areas interviewed for this report were less likely to access adequate digital resources in their schools (Brehm et al., 2023). Teachers' access to resources is also limited by restricted schedules on the use of ICT laboratories (SEAMEO INNOTECH, 2023).

Meanwhile, teachers are often excluded from ICT decision-making processes. In a study conducted by Education International, 42% of teachers from countries in Asia and the Pacific reported that their unions had not been consulted at all about the introduction of digital technology. Moreover, 43% indicated that their unions had not been consulted on the digital technology the teachers wanted (Colclough, 2020).

Teachers expect to receive support to use school digital equipment effectively. However, despite the availability of digital devices, only about one in four 15-year-old students in Brunei Darussalam and Viet Nam attended schools in 2018 where teachers received incentives to integrate them in teaching practices, according to data from the Programme for International Student Assessment (OECD, 2020). Even when schools invest in costly software licences, teachers may not receive adequate support for implementation. In Indonesia, 67% of teachers reported not feeling confident in effectively using digital devices and online learning systems, such as the open education resource platform Rumah Belajar (Asian Development Bank, 2022).

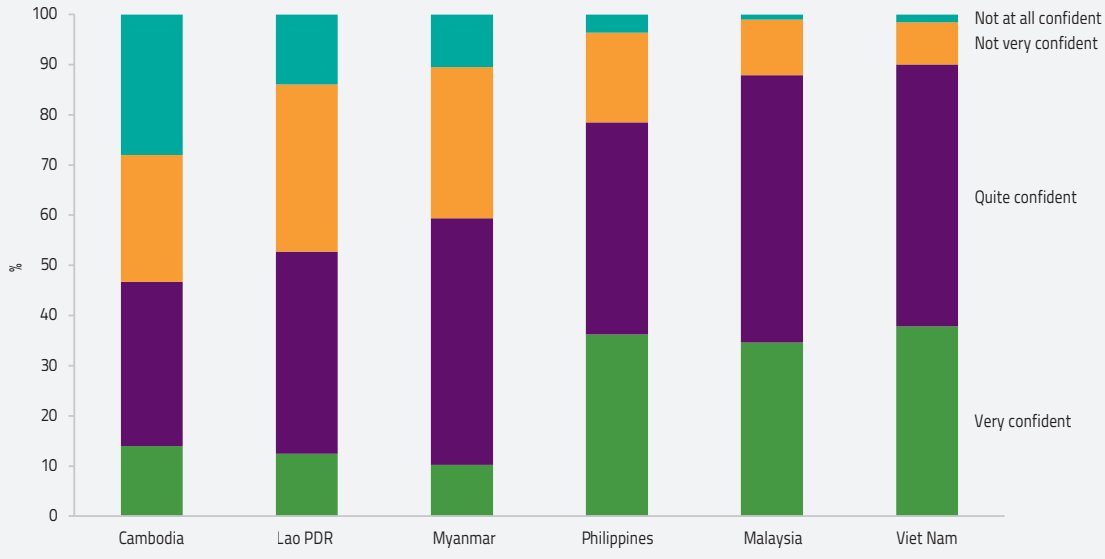
SOME TEACHERS ARE HESITANT OR LACK CONFIDENCE IN USING TECHNOLOGY

Regardless of age and skill levels, teachers recognize the significance of digital technology in education. In Viet Nam, more than 95% of teachers acknowledge the positive impact of integrating technology into their teaching. They believe that technology enhances student learning outcomes, increases their interest and motivation, fosters greater autonomy in learning, and effectively bridges content gaps (Vinh et al, 2023).

Despite recognizing its overall value, teachers may view using technology negatively, for example, as less suitable for certain subjects or educational levels. In the Philippines, the adoption of ICT-based instruction greatly depends on teachers' perceptions of its usefulness and ease of use (Kim and Lee, 2020). Negative attitudes towards technology can occasionally arise from safety concerns, such as the use of unsecured public Wi-Fi, which poses risks to data security. In Indonesia, for example, teachers expressed concerns about using free public Wi-Fi (Purwanto et al., 2020).

Teachers may also lack confidence in using technology for teaching purposes. According to the 2019 SEA-PLM, nearly one third of primary teachers, on average, reported

FIGURE 10.1:
Primary teachers in Southeast Asia vary in their confidence in using ICT
Distribution of primary school teachers in terms of confidence in using ICT as a teaching method, selected Southeast Asian countries, 2019



Source: 2019 SEA-PLM data.

feeling 'not very' or 'not at all' confident in using ICT in the classroom. About half of teachers in Cambodia and the Lao People's Democratic Republic, but only about one in ten in Malaysia and Viet Nam, felt 'not very' or 'not at all' confident in using ICT in teaching **(Figure 10.1)**.

A survey of 58,000 educators in the region shows that they generally have low competencies in the use of software, search engines, digital platforms for communication and online collaboration, and digital resource creation tools (Bin Assanarkutty, 2023). Teachers in Cambodia reported lacking proficiency in knowledge to use technology (Brehm et al., 2023; Phal et al., 2022). Teachers in the Philippines encounter difficulties in integrating education technology into their lesson planning, such as creating materials using online applications, developing evaluation tools and procedures with digital content and platforms, and adapting to new technologies and software (Philippine Normal University, 2023). But more than four in five teachers interviewed in Viet Nam expressed at least some confidence in their organizational skills to teach online (Vinh et al, 2023). Timor-Leste reported that 75% of teachers do not have enough skills to use digital platforms.

Lack of knowledge is significantly influenced by lack of training. Although schools provide some form of ICT training, 55% of lower secondary school teachers in Viet Nam who participated in the 2018 TALIS expressed a high need for professional development in ICT skills for teaching (OECD, 2019). Among grade 4 mathematics and science teachers in the Philippines who participated in the 2019 Trends in International Mathematics and Science Study, 56% and 61%, respectively, reported participating in professional development in ICT, making it the least common area of focus in the survey (Mullis et al., 2020). Training must also be tailored to specific teaching practices. In Myanmar, teachers receiving pre-service training on ICT were taught basic Microsoft programmes with outdated handbooks. And the teachers in training often had to share computers, hindering their practical training opportunities (Lall, 2021).

Analysis of countries' policies, plans, strategies and laws on teacher education for this report, captured in the PEER country profiles, shows that key areas of ICT are sometimes overlooked. For example, only 3 of the 11 countries mention online safety in their training programmes. Teachers and counsellors in Brunei Darussalam are expected to receive training on child online protection and cybercrime in line

with e-Hijrah, the ICT in Education Strategic Blueprint initiative (Brunei Darussalam Ministry of Culture, Youth and Sports, 2015).

AGE AND ETHNICITY CAN IMPACT TEACHERS' SKILLS AND PRACTICES

It is widely assumed that older teachers may be less proficient and ready to use technology for teaching purposes. In the Philippines, older teachers tend to be less enthusiastic about ICT, whereas younger teachers embrace it more readily (Philippine Normal University, 2023). In Islamic religious schools in Indonesia, older teachers also struggle to keep pace with the rapid developments in ICT, which hinders their ability to effectively leverage various tools to enhance their teaching methods (Miskiah et al., 2019). In the Lao People's Democratic Republic, junior teachers tend to have higher levels of ICT skills than their older or more experienced colleagues. And secondary school teachers are more likely than pre-primary and primary school teachers to possess ICT skills (Australian Council for Educational Research, 2023; Lao PDR Ministry of Education and Sports, 2021).

However, background qualitative research for the 2023 *Global Education Monitoring Report*, involving 70 teachers from 17 countries including the Philippines, found that resistance to technology among teachers is mainly due to inadequate preparation rather than age. Although younger teachers may be skilled in using technology, they often face challenges in seamlessly incorporating it into their teaching practice (Burns, 2023). In Singapore, experts interviewed for this report reported that resistance is most likely linked to a lack of appropriate school management support and to teachers' heavy workloads (Centre for Evidence and Implementation, 2023).

Along with age, ethnicity can also influence teachers' technological skills and practices. In Viet Nam, there is significant disparity in access to open educational resources between Kinh teachers and their peers from ethnic minorities who face language barriers and fewer training opportunities (Vinh et al, 2023).

EDUCATION SYSTEMS DO SUPPORT TEACHERS IN USING TECHNOLOGY

Education systems in the region are actively supporting teachers in enhancing their professional competence in technology. Southeast Asia is recognized as one of the leading regions globally in establishing ICT standards for teachers. There is also a strong commitment to equip teachers with the necessary tools and resources to effectively integrate technology into their teaching practices. These efforts have become more organized and structured in response to the COVID-19 pandemic. Head teachers, school ICT coordinators, teacher unions and regional organizations each play a role in ensuring the success of these initiatives, which aim to enhance flexibility, collaboration, coaching effectiveness, reflection and subject knowledge among teachers.

ALMOST ALL COUNTRIES IN SOUTHEAST ASIA HAVE ICT STANDARDS FOR TEACHERS

In Southeast Asia, 9 of 11 education systems have ICT standards for teachers in a competency framework, teacher training framework, development plan or strategy (**Table 10.1**).

Compared to other regions, Southeast Asia has been proactive in establishing ICT standards and enhancing teachers' ICT skills, particularly in response to the COVID-19 pandemic. Singapore introduced the SkillsFuture for Educators Professional Development Roadmap for teachers as part of its latest Educational Technology Plan (Singapore Ministry of Education, 2020). However, some countries, such as Viet Nam, do not have teacher competency frameworks on technology (VInh et al., 2023).

Initiated by the Teachers' Council of Thailand, and in partnership with the SEAMEO Secretariat and the SEAMEO Regional Center for Educational Innovation and Technology (SEAMEO INNOTECH), the Southeast Asian Teachers Competency Framework (SEA-TCF) was developed with input from teacher education experts and adopted in 2017. It encompasses four core competencies: 1) knowing and understanding what to teach, 2) facilitating student learning, 3) engaging the community, and 4) becoming a better teacher every day. These are further divided into 12 general and 31 enabling competencies, which include the use of ICT as a strategy for supporting learning. One of the criteria for assessing general competence in utilizing the most effective teaching and learning strategies pertains to the use of ICT tools to enhance student learning. SEA-TCF also includes a self-rating competency checklist along with guidance for how teachers should interpret the results (Thailand Teachers' Council, 2018).

TRAINING INITIATIVES HAVE INCREASED SINCE COVID-19

Analysis of the GEM Report's PEER profiles on the 11 education systems in the region shows that 6 have a policy, plan or strategy for pre-service teacher education in technology, while 7 have one for in-service

TABLE 10.1:
Selected Southeast Asian countries with ICT standards for teachers

Country	Key documents	Description
Cambodia	- Teacher Professional Standards (2010) - Teacher Education Provider Standards (2016)	The Teacher Professional Standards promote the use of ICT whenever possible to enhance the effectiveness of teaching and learning. They also encourage teachers to describe how they can use ICT to motivate student learning and help students learn more effectively.
Malaysia	- National Policy on ICT in Education (2010)	The Policy mandates that teachers meet minimum ICT skill standards as determined and periodically adjusted by the Ministry of Education and schools to align with students' needs and school conditions.
Myanmar	- Teacher Competency Standards Framework (2017)	The Framework supports the quality of teacher education in four critical domains: professional knowledge and understanding, skills (including ICT) and practice, values and dispositions, and professional learning and development.
Philippines	- National ICT Competency Standards (2017) - Philippines Professional National Standards for Teachers (2017)	The ICT Competency Standards are organized into three proficiency levels – basic, proficient and advanced – across six domains: ICT; pedagogy; organization and administration; teacher professional development; social, ethical, legal and human issues; and evaluation and assessment. The Professional National Standards promote the positive use of ICT and emphasize its integration into teaching and learning.
Singapore	- Singapore Teaching Practice (2017) - SkillsFuture for Educators (SFEd) (2020)	SkillsFuture for Educators serves as a professional development roadmap for teachers, with a focus on enhancing digital competencies through its e-Pedagogy strategy. It emphasizes the importance of teachers harnessing digital technology to enhance learning by making it more active and personalized, creating new learning opportunities.
Thailand	- 21st Century Skills Education Teacher Manual (2017)	ICT competency is part of teachers' basic competency standards. The manual is part of the Ministry of Education's project to integrate life skills, including through the use of ICT in classrooms, and to enhance learning efficiency.

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

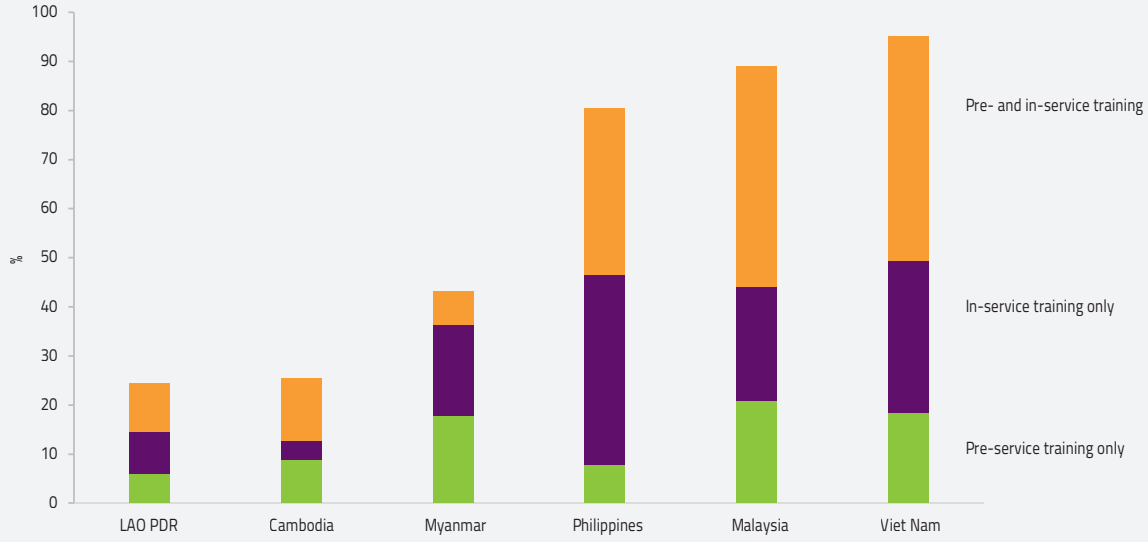
teacher professional development. Brunei Darussalam, Cambodia, the Lao People's Democratic Republic, Malaysia, Singapore and Thailand have defined policies, plans or strategies to provide teacher training on ICT at both pre- and in-service levels.

Despite the recognized need for training, training opportunities on ICT vary significantly in Southeast Asia. On average, 60% of primary teachers receive some form of training on ICT in Cambodia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines and Viet Nam. This breaks down to 13% of primary teachers being trained during their formal training and education, 21% as part of their professional development, and 26% in both settings. Meanwhile, the percentage of primary teachers not receiving any ICT training at all ranges from 3% in Viet Nam to about 65% in Cambodia and the Lao People's Democratic Republic (**Figure 10.2**).

Integrating digital pedagogy into pre-service training programmes can increase teachers' digital skills. A study of 24 final-year student teachers in Malaysia showed that introducing them to digital pedagogy as part of their preparation encouraged their technological knowledge, skills and capability to include technology in future teaching practices (Sailin and Mahmor, 2018).

The COVID-19–related school closures prompted an increase in ICT teacher training, including online initiatives. In Indonesia, 44% of primary and lower secondary teachers surveyed by the World Bank received online training during the pandemic, of which three quarters participated in online training for the first time (Yarrow et al., 2022).

FIGURE 10.2:
One in three teachers in Southeast Asia are not trained in ICT
Percentage of teachers who received pre-service and/or in-service training in ICT, selected Southeast Asian countries, 2019



Source: 2019 SEA-PLM data.

In Timor-Leste, with UNICEF support, the National Institute for Teacher Training provided training opportunities through the Learning Passport portal to familiarize teachers with distance learning tools and engage them during the school closures (UNICEF, 2020).

In 2021 in the Philippines, the National Educators Academy organized a Virtual In-Service Training course to address the ICT training needs of teachers across the country. On the first day, more than 260,000 participants joined in. The Advancing Basic Education in the Philippines project conducted a teacher training programme to help 5,000 participants adapt to the shift towards modular home-based learning (Robledo, 2021). In contrast, Cambodia and the Lao People's Democratic Republic organized small, local cluster-based in-person trainings to reach both teachers and learners, even in the most remote areas (UNICEF, 2021a).

TECHNOLOGY IS TRANSFORMING TEACHER TRAINING IN SOUTHEAST ASIA

Teachers in Southeast Asia are not only being trained in the use of technology, but technology is also being used as a tool for their training, fundamentally changing how they can learn. This transformation includes creating flexible learning experiences, facilitating collaborative online learning, providing support for coaching and mentoring processes and reflective practices, and enhancing subject and pedagogical knowledge.

Technology-driven training offers greater accessibility, effectively overcoming location and time constraints. This flexibility empowers teachers to select their own learning pace, location and format, and even sometimes customize the content and teaching methods. Distance learning models, including massive open online courses, and self-study options, cater to teachers in remote and rural areas. For example, Indonesia's correspondence teacher training, one of the region's pioneering open and distance learning initiatives, has been providing in-service training to teachers and educators through distance learning since the establishment of Universitas Terbuka, an open university, in 1984 (**Chapter 5**). In 2022, about 21,500 individuals graduated from its Faculty of Education and Teacher Training (Asian Association of Open Universities, 2022; Universitas Terbuka, 2022).

Blending traditional classroom instruction with virtual learning and peer reflection has also proven effective in enhancing teaching practices in the region. In the Lao People's Democratic Republic, teachers and pedagogical advisors who attended workshops under the Australia-funded ASPIRE programme reported a

better understanding of collaborative learning. They found the workshops flexible, immersive and beneficial for learning through collaboration. They also used different technologies to engage family members and the community in the learning process (Phanhlack, 2021). The BEQUAL Programme, also funded by Australia, promoted teacher training in digital and online learning during the pandemic. The Blended Learning Pilot, which combines face-to-face and online learning, was initially tested in three provinces and later expanded nationwide (Australian Council for Educational Research, 2023).

Teachers highly value hands-on, personalized and collaborative learning experiences. They seek opportunities to explore technology tools, experiment with different software and devices, and learn about the practical applications of technology in classrooms and its benefits for students. As they often find the use of technology in pre-service programmes too theoretical (Burns, 2021), they can leverage technology in their day-to-day work to learn from their peers, share best practices and collaborate on projects (Burns, 2023).

Community learning offers an effective way for teachers to learn from and share resources with colleagues (Sumaryanta et al., 2019). Virtual communities of practice are especially valuable when face-to-face communication or specialized subject specialists are not readily available. In the Philippines, the Learning Action Cells (LACs) system has established itself as a valuable platform for sharing knowledge and enhancing teacher skills at the school level. Since 2016, LACs have been serving as local communities of practice through which teachers learn from one another and actively contribute to the advancement of technology use in the teaching and learning process. LAC sessions have played a crucial role in fostering collaboration among teachers and promoting the effective integration of technology in education (SEAMEO INNOTECH, 2023), including during the COVID-19 pandemic and forced distance learning practices (Culajara, 2022).

Social networking services also serve as a platform for social interaction and community support. A study conducted among English student teachers in Indonesia shows that social networking services facilitated communication and collaboration among student teachers and promoted peer support and a sense of belonging to the learning community (Habibi et al., 2018).

Virtual communities have emerged within learning management systems, offering platforms for teachers to connect and collaborate. One such platform is Guru Berbagi, launched by Indonesia's Ministry of Education in 2020. This platform encourages teachers to collaborate, exchange practices and share teaching methods, including lesson plans provided by the ministry. As of 2021, 30% of teachers were estimated to have access to it (UNICEF, 2021b). Introduced in 2015 by the Thailand Office of Basic Education Commission, the professional learning community of the Distance Learning Information Technology platform also serves as an online community where teachers can enhance their professional development. It consists of three sections: 1) good practices, showcasing successful teaching approaches; 2) share and learn, facilitating knowledge exchange among teachers; and 3) coaching and mentoring, providing guidance and support for educators (Dipendra, 2023).

Technology can also empower experienced teachers to support the professional development of their colleagues by offering feedback and sharing their own experiences. Virtual mentoring is a component of a software platform promoted by the Ministry of Education, Youth and Sport of Cambodia, in collaboration with the non-governmental organization Kampuchean Action for Primary Education. This platform aims to train teachers for the New Generation School programme, a government school model introduced in 2015 and inspired by charter schools (Donager and Wu, 2020). Online mentoring and coaching have been identified as a key strategy to help teachers familiarize themselves with technology. The Singapore Teachers' Network, Singapore Teaching Practice from the National Institute of Education and the Ministry of Education's eLearning portal all support teachers in sharing experiences and expertise with their peers (Centre for Evidence and Implementation, 2023).

MANY ACTORS SUPPORT TEACHERS' PROFESSIONAL DEVELOPMENT IN ICT

School leaders, ICT coordinators, universities, teacher unions, non-profit and for-profit organizations and multilaterals are all involved in supporting teachers in their professional development in ICT.

Head teachers have a crucial role in establishing the conditions for technology integration in schools. They facilitate the rollout of digital tools and strategies in line with national plans and expectations. 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 home (Singapore Ministry of Education, 2022a). Head teachers also supervise teachers in ensuring the effective integration of technology. In Viet Nam, the use of school management software enables principals to access objective school performance information.

The software includes detailed profiles of teachers, students and classes, providing comprehensive data for effective management and technology integration (Vinh et al, 2023).

ICT coordinators also support teachers with technical assistance and professional development, although their specific responsibilities can differ widely between schools. In the Philippines, each school has designated an ICT point person responsible for training teachers, with support from Microsoft and the Department of Information Communications Technology. Cascading has effectively reached remote schools. However, a limited budget raises concerns about the long-term effectiveness of the current cascade training model and ICT coordinators' ability to train colleagues effectively (Philippine Normal University, 2023).

Universities, teacher training centres and research institutes provide specialized training, promote research and innovation, and collaborate with teachers to improve their ICT skills. The Centre of Instructional Design and Technology of Open University Malaysia provides training for tutors and facilitators (Asian Association of Open Universities, 2022; Malaysia Ministry of Education, 2015). The Teaching and Learning Centre at Universiti Brunei Darussalam has been providing training on digital teaching and pedagogies since 2013. During the forced transition to online learning in 2020, it developed guidelines for using Canva, a design tool for creating graphics and presentations. It also provided guidance on conducting assessments and creating videos using Microsoft PowerPoint (Shahrill et al., 2021).

Teacher unions and professional organizations prioritize safeguarding teachers' rights in the context of technology and advocate for policies that support teachers facing challenges related to technology implementation.

Civil society organizations help fill gaps in training provision. The Ayala Foundation's Training Institute focuses on teacher training in the Philippines. Through its Center of Excellence in Public Elementary Education programme, it has directly reached about 220 educators through virtual sessions (Ayala Foundation, 2021; RTI International, 2020). Countries also collaborate with private companies. As part of the Digital Talent Cluster initiative, Malaysia's Ministry of Education partners with the Malaysia Digital Economy Corporation and companies, such as Google, Apple and Microsoft, to develop educators' digital skills.

Regional organizations provide resources and technical assistance for teacher professional development in ICT. Among SEAMEO centres, the Regional Open Learning Centre (SEAMOLEC) is mandated to conduct training programmes for trainers. Since 2016, it has provided ICT learning materials and massive open online courses (Ratih, 2022). The Regional Center for Education Innovation and Technology (INNOTECH) focuses on helping educators meet evolving technology demands in education through courses, digital resources, and research and development activities (SEAMEO INNOTECH, 2020). In 2023, the Regional Training Center (SEAMEO RETRAC) provided professional development opportunities by launching in-person training sessions for higher education staff and lecturers, which covered ICT application in gaming and teaching assessment (SEAMEO RETRAC, 2023a, 2023b).

CONCLUSION

Technology is gradually changing the teaching profession in Southeast Asia, requiring teachers to adapt their pedagogy and interact more with students and parents. The COVID-19 pandemic has further accelerated this transformation. However, many teachers still lack access to technology and infrastructure and do not feel confident in using ICT in their teaching. Southeast Asia has made significant progress in developing ICT teacher competence frameworks and complementary tools to facilitate teachers' professional development. This achievement highlights the region's commitment to equipping teachers with the necessary skills and resources to integrate technology into their educational practices.

Effective education technology policies in the region rely on collaboration between teachers and other educational practitioners. By involving teachers from the beginning and considering their experiences, policies can be better tailored to meet their needs and increase their acceptance of technology. Continuous teacher professional development in schools is also essential for building their skills and confidence in using digital technologies. Ideally, these programmes should offer hands-on experience and encourage teachers to share their experiences and best practices with their peers.

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CHAPTER 9

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Southeast Asia

Technology in education:

A TOOL ON WHOSE TERMS?

Southeast Asia has experienced rapid growth in the adoption of digital technology. There are an estimated 400 million internet users in the region. In 2020 alone, 40 million people went online for the first time. The potential of this expansion has been identified to transform education and meet the region's development aspirations, for example, through personalized tutoring and testing, learning management systems, language learning, and skills development.

But before rushing to deploy the latest technology, the report asks policy makers to consider the main education challenges, those related to equity and inclusion, quality, and efficiency. Technology is one of many potential tools that can be deployed to improve education outcomes – but it can also exacerbate some of these challenges. In any case, for technology's potential to be realized, essential conditions need to be met related to the equitable distribution of digital technology infrastructure, evidence-driven decision making, good regulatory frameworks and sustained investment in teachers.

Produced by the Global Education Monitoring (GEM) Report team, in partnership with the Southeast Asian Ministers of Education Organization (SEAMEO), and with the contribution of the EdTech Hub, the report covers 11 countries: Brunei Darussalam, Cambodia, the Lao People's Democratic Republic, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste and Viet Nam. It is informed by nine country case studies, five thematic studies, and inputs by SEAMEO affiliate members and partners.

Building on the 2023 *Global Education Monitoring Report*, this regional edition recognizes the emphasis given to technology in Southeast Asia for socioeconomic development, which is being reflected in a focus on digital skills development and investment in connectivity. It urges governments to ask whether the application of technology in education is: appropriate, helping improve learning; equitable, not leaving any one behind; scalable, based on evidence and a solid assessment of costs; and sustainable, in terms not only of its economic value but also of its social and environmental consequences.

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