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Education and the development of digital competences in Latin America and the Caribbean

Pablo Herrera
Mariana Huepe
Daniela Trucco

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This document was prepared by Pablo Herrera, consultant, Mariana Huepe, Social Affairs Officer, and Daniela Trucco, Senior Social Affairs Officer, all of the Social Development Division of the Economic Commission for Latin America and the Caribbean (ECLAC), under the component on strengthening of the linkages between education and the labour market through digital inclusion of the cooperation programme between ECLAC and the Republic of Korea in 2024. Amalia Palma, Senior Research Assistant, and Magdalena Claro, Antony Rossi and Isabel Walker, consultants, all of the Social Development Division of ECLAC, contributed inputs for the preparation of the document.

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Introduction

We live in an increasingly digitalized world where new technologies are progressively transforming people's daily lives and productive, social and cultural opportunities (Velázquez, Martínez and Palma, 2020). Artificial intelligence, big data, blockchain, cloud data and platforms are among these digital technologies (Palma, 2024). Their potential impacts can be seen in the transformation of occupations and the creation of new ones, mainly related to the rise of the technology industry and information management tasks, and in the disappearance of certain types of jobs because of automation (Huepe, 2024).

Although Latin America and the Caribbean has made major progress in expanding access to digital media and Internet connectivity, this has been driven mainly by mobile connectivity (Trucco and Palma, 2020), which had reached 96% in the region by 2022, compared to 17.2% for high-speed fixed Internet penetration that same year (ECLAC, 2024c). This means that the opportunities to reap the full benefits of digitalization are quite limited for a large percentage of the population. For connectivity to be meaningful, Internet connections must be fast, reliable and stable, so that all daily and productive activities can be carried out and different services accessed without interruption. Moreover, this connectivity must be accessible to everyone, regardless of their socioeconomic or territorial situation, and cannot be restricted to a basic telephone. Also considered essential in this comprehensive approach to meaningful connectivity proposed by ECLAC and the Regional Centre for Studies on the Development of the Information Society (Cetic.br) is for people to have digital competences that enable them to take advantage of online tools and services and for them to have access to a variety of technological equipment (ECLAC, 2024a).

People need to understand these new languages and take advantage of the potential that digital tools offer them to learn, work and socialize and to incorporate new knowledge and innovate in the production processes they are engaged in, thereby contributing to the socioeconomic development of their communities and countries. Thus, where labour inclusion opportunities are concerned, as digital technology increasingly becomes an integral part of the daily operations of businesses in a wide range of industries, the demand for skilled personnel is growing, and digital competences are becoming essential for a considerable percentage of workers. The evidence suggests that higher levels of digital competences are linked to higher levels of labour inclusion, as they increase job stability and improve pay and employment prospects (ILO, 2021).

These competences are also essential for successful participation in different areas of society. The coronavirus disease (COVID-19) pandemic highlighted the opportunities provided by technology to cope with its health, employment and educational effects. However, the high levels of vulnerability and inequality that characterize Latin America and the Caribbean pose particular challenges for this digitalization process, since the transformations under way may be a source of even greater inequality and social exclusion than currently prevail.

In a framework of inclusive social development, digital inclusion, understood as the opportunity for people to participate fully in the digital world, including both protection of their rights and reduction of the risk to them in an increasingly digitalized society, has thus become a pillar to be included in policy design. Digital inclusion requires consideration of all the dimensions necessary for effective participation in the digital space, as described by the concept of meaningful connectivity (Palma, 2024).

To move towards digital inclusion, it is essential to strengthen skills training in everything from basic cognitive skills (reading, writing and mathematics) to the ability to solve information management problems such as searching, evaluating, synthesizing, analysing and representing information in a digital environment, as well as having the ability to share and collaborate safely and ethically with others in these new settings (Levy and Murnane, 2007; Fraillon and others, 2020; ECLAC/OEI, 2020). Another requirement is for technology specialists capable of programming and developing applications, operating complex digital networks and managing large volumes of data, among other tasks. Such skills are increasingly needed to strengthen trade, businesses and governments in a digital economy. These challenges are being heightened by the rapid development of artificial intelligence and the potential increase in inequality between the economies of developed and developing countries (ECLAC, 2024a).

In short, technological transformations lead to changes in society and the labour market. The new generations thus need to be prepared for these transformations, which are creating a need for new occupations and skills linked to digital technologies, and to be given opportunities to renew their skills throughout their life cycle. The characteristics of the digital transformation are a critical factor in the development of policies and programmes to allow better use to be made of the opportunities created by this change and reduce its negative impacts.

In the context of the digital transformation, this document focuses on training in digital competences for the new generations and the role played by the education system in this. Quality access to technology and connectivity is not enough for these skills to develop; rather, education needs to be explicitly geared towards them, with schools having primary responsibility for inculcating them in children and adolescents (Pedró, 2012). Because the development of these skills relies significantly on the cognitive resources of individuals (such as reading literacy), which are not only difficult to develop but are closely associated with the social and cultural context and unevenly distributed in society, this is a major challenge for technology policies in education (Van Dijk, 2005).

Much of the current discussion about the use of digital devices by children and adolescents relates to the risks to their well-being and development. Major concerns include the negative and distracting effects that social media can have on learning processes, potentially risky or addictive behaviours and the increased possibility of being exposed to violent situations. The latest measurements of the Programme for International Student Assessment (PISA 2022), conducted by the Organisation for Economic Co-operation and Development (OECD), show that using digital media too intensively (more than seven hours a day) can have a negative impact on the learning of basic cognitive skills. However, moderate digital device use of up to 1 hour per day at school for learning activities and similarly moderate use for leisure activities are linked to better academic performance (OECD, 2023a). In other words, among the demands being made of the education system when it comes to training in digital competences is that it should address these concerns and include in its efforts the development of socioemotional skills such as self-regulation, self-care and ethical behaviour in the digital age.

Training in digital competences is a long-term process that requires consistent support from education policy and involves clearly identifying the skills to be taught, measuring progress with them and implementing strategies to develop them. The development of digital competences is something relatively new and very dynamic for school systems when compared to the centuries of experience they have built up in traditional areas of the curriculum. There are as yet no undisputed definitions or proven teaching strategies, and nor has systematic work been done with teachers to determine how these competences should be incorporated into the teaching process. In this context, implementing an assessment of such skills is a first step that can contribute in various ways to their development in schools.

Assessment is, in the first instance, a way of reaching agreement on what these new skills entail and making the different stakeholders (managers, teachers, students, families, policymakers and social actors) aware of the need to address them in the school system, thus guiding them, like a beacon, towards a common goal. Assessment also provides information on learning attainments to inform educational policy decisions, while providing an account of the progress made. By using complementary information about students and their schools and homes, skills assessment also makes it possible to investigate the possible factors, such as conditions, modes of access, types of use and educational experiences, that may influence their development, while providing important clues about the strategies that might be most effective in promoting them.

The first chapter of this document organizes and systematizes the main internationally developed reference frameworks for understanding digital competences. Some of these are already being used in Latin American and Caribbean countries to understand and assess the development of digital competences in schools so that the new generations are better equipped to face and adapt to the rapid technological changes they will encounter in the world they live in. The second chapter reviews the opportunities for developing technological competences in students on the basis of statistical information drawn from the PISA 2022 measurement carried out by OECD, which is limited but comparable across several countries of the region. The document closes with some reflections on how training in digital competences can be strengthened in the region's schools.

I. What is meant by digital competences in schools and how are they measured?

The development of the digital competences of children, adolescents and youth is a central issue in contemporary education. Although the new generations interact with technology from an earlier age than previous ones, this does not ensure that they are developing critical skills for its use (Hargittai and Micheli, 2019). For this reason, the notion of children and adolescents as "digital natives", referring to the almost automatic development of digital competences as a result of early familiarity with technology, has been significantly challenged in recent years (Boyd, 2014; AGESIC and others, 2023). Although there is no hard and fast consensus on the definition of digital competences or digital literacy, many studies agree that both are multidimensional concepts combining technical skills with cognitive and metacognitive processes, as well as civic engagement and ethical awareness (Calvani, Fini and Rainieri, 2010).

The incorporation of digital technologies into the region's education systems began in the late 1980s with the aim of promoting digital inclusion and narrowing divides and with an interest in improving learning and educational management through this medium. The prolonged disruption of face-to-face classes during the coronavirus disease (COVID-19) pandemic (from 2020 to 2022) and the rapid development and expansion of these technologies pushed this component of education policy back up the public agenda.

Digitalization has the potential to foster greater educational inclusion and strengthen students' skills development processes. For one thing, digitally mediated education can lower barriers to entry, for example by providing more learning opportunities for students with disabilities and for those living in isolated areas, and help to maintain engagement during periods of school closure. Furthermore, digital education can also facilitate the adaptation of teaching and learning processes to the diversity of learning levels in the classroom; foster commitment and motivation through interaction with multimedia resources and personalized learning; and change the way content is taught and assessed, expanding opportunities for students to learn in different environments (ECLAC/OEI, 2020; Huepe, Palma and Trucco, 2023). But unregulated and unsupervised use also presents potential risks to learning processes and students' socioemotional well-being.

Using digital media to strengthen teaching and learning processes in the region is not just a matter of reducing the large gaps in quality Internet access and appropriate devices for using it; there is also a need to tackle the digital divide in the type of use made of technologies and people's ability to benefit from them (Claro and others, 2011; Sunkel, Trucco and Espejo, 2014). The benefits that children and adolescents can perceive when they incorporate digital technologies into their learning processes depend not only on their access opportunities and technical handling of the technologies, but also on the type of activities carried out in educational institutions and at home, to develop the knowledge, skills and attitudes required to participate effectively in an increasingly digital world.

Students' opportunities to appropriate learning through the use of digital technologies shape the role of new technologies as instruments to enhance learning and the development of core cognitive competences (Sunkel, Trucco and Espejo, 2014). The complexity of this appropriation phenomenon is reflected in the difficulty of clearly establishing how technologies relate to learning and the development of competences. Various studies over time have shown that the relationship between the use of information and communications technologies (ICTs) and the development of competences is not linear and that more complex models of study incorporating the different dimensions of this relationship are required (Sunkel, Trucco and Espejo, 2014). In general, it has been found that good results in standardized tests are associated with specific uses of technology, and it is therefore important for assessments to investigate the ways students use ICTs, the school and teaching conditions in which new technologies are used, and the social and personal characteristics of students that determine how well equipped they are to use technologies in a way that is beneficial to their learning (Sunkel, Trucco and Espejo, 2014).

Where the development of digital competences is concerned, there are additional challenges involved in doing this in a school setting, related in part to their multidimensional and dynamic nature (UNESCO, 2023; Misra, 2022). The digital competences that children, adolescents and youth are expected to learn at school are constantly evolving and expanding as the available technologies change, which makes it difficult to conceptualize them and to implement measurement approaches that provide comparability over time (UNESCO, 2023; Vuorikari, Kluzer and Punie, 2022).

As regards their definition, digital competences were originally understood mainly from an instrumental perspective, i.e. definitions focused on the ability to use different devices and applications, incorporating, for example, skills related to Internet searching and the use of email, equipment and specific applications or software ("digital literacy"). More recently, the definition has been expanding to include the ability to engage critically with content, guard against risks and act responsibly in the virtual environment, while having the knowledge, skills and attitudes to use technologies to add value to one's personal and professional life (UNESCO, 2023). In other words, while there is no consensus on an exact definition of digital competences, there has generally been an evolution from more instrumental approaches to more holistic ones involving more complex cognitive skills (such as critical thinking, problem-solving and programming) and socioemotional skills (such as communication, collaboration and autonomy) (ECLAC/OEI, 2020).

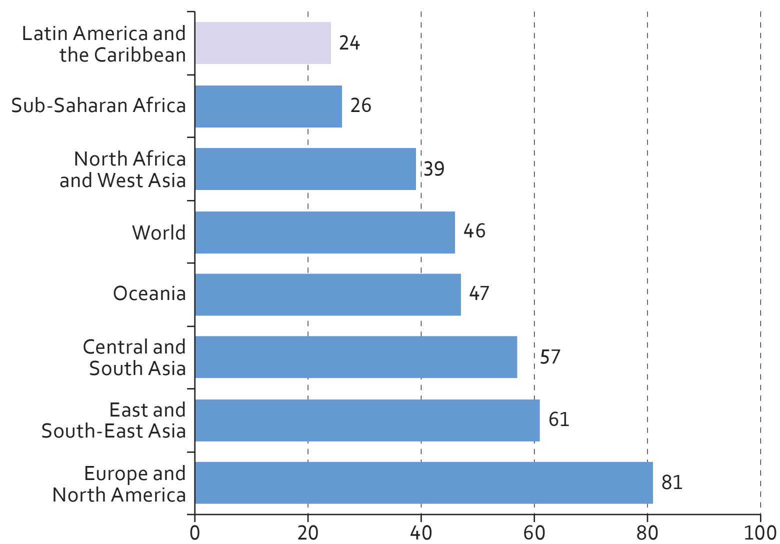
When it comes to evaluating digital competences, broadly speaking, attempts have been made to measure them through direct assessments, in which people demonstrate that they can perform certain tasks; knowledge-based assessments of how people would perform certain tasks; subjective assessments, whereby people report self-perceived effectiveness; and secondary data that can provide some information about the level of competences of a population group, but not of individuals (Law and others 2018). While subjective assessments are the most commonly used method for measuring digital competences because of their relative simplicity and ability to probe a broader range of skills in a short period of time (Van Deursen, Helsper and Eynon, 2014), there is no consensus about the correlation of these types of assessments with actual levels of digital competences.

Different studies have posited that self-reporting does not adequately reflect people's level of competences (Aesaert and others, 2014; Reichert, Pan and Chen, 2023; Rohatgi, Scherer and Hatlevik, 2016), arguing that it reflects perceptions which correlate only moderately with the actual level of development of the skills surveyed (Fraillon and others, 2020; Pan and others, 2022) and that people tend to overestimate their knowledge and skills (Porat, Blau and Barak, 2018; Spisak, 2022). Moreover, some authors argue that this overestimation is not free of bias, with boys reporting higher levels of digital competences than their female counterparts even when direct assessments show differences in outcomes that favour women in some dimensions (Gebhardt and others, 2019; Lau and Yuen, 2015; Reichert, Pan and Chen, 2023).

Direct assessments of competences are the instrument of choice as regards external validity (Aesaert and others, 2014); however, these tests are more time-consuming and labour-intensive and involve some operational challenges relating, among other things, to the setting in which they are administered (real or simulated software, the device used and its characteristics, such as screen size and resolution) (UNESCO, 2023). In particular, it may happen that the results do not adequately reflect the general competence that is supposed to be measured, but rather familiarity with the software and the device used (Reichert and others, 2020). Since assessments are generally computer-based, they tend to be computer-centric, and the digital competences needed when employing other types of devices, such as smartphones (which require different skills if they are to be used well), are not generally included in such assessments (Clark, Coward and Rothschild, 2017; Misra, 2022; Law and others, 2018).

OECD (2023b) points out that while most countries have integrated national guidelines for the development of digital competences into their educational curricula, the lack of formal assessments to measure the skills developed reduces the effectiveness of these policies. Digital competence frameworks can guide education and training systems in identifying, measuring and developing the competences, knowledge and attitudes learners need to participate effectively, critically and safely in the digital environment (UNESCO, 2023). However, the development of these is only incipient in the region. According to data published by UNESCO (2023), about a quarter of Latin American and Caribbean countries have standards for identifying digital competences, which is 20 percentage points lower than the average percentage of countries globally (see figure 1).

Figure 1
Countries with established standards for digital competences, 2022
(Percentages)



Source: United Nations Educational, Scientific and Cultural Organization (UNESCO), *Global Education Monitoring Report 2023. Technology in Education: A Tool on Whose Terms?*, Paris, 2023.

Without attempting an exhaustive review, this chapter presents some of the main theoretical and empirical frameworks that are being used globally and regionally to define digital competences in education, together with the types of measurements that have been implemented for children and adolescents. The aim is to show how these competences are currently understood, conceptualized and operationalized, before going on to analyse which skills are most frequently identified as essential to teach in educational settings and then present the differences between the various frameworks and the ways these have changed over time.

A. Main theoretical and empirical frameworks for digital competences

1. The DigComp framework

The Digital Competence Framework for Citizens (DigComp) is a European Commission initiative proposing a reference framework for understanding the core digital competences that all citizens need to live and work in the digital society. Various institutions, such as UNESCO, UNICEF and the World Bank (Law and others, 2018; Nascimbeni and Vosloo, 2019; Bashir and Miyamoto, 2020), have identified it as the most comprehensive framework for analysing general digital competences today. DigComp sets out five areas of digital competence (see table 1), and for each competence it establishes 8 levels of proficiency, from beginner to expert, in order to assess and certify citizens' competences, providing examples of knowledge, skills and attitudes associated with each competence and level (Redecker, 2017).

Table 1
Areas of digital competence in the DigComp framework

Area of digital competence	Description
Information and digital literacy	Identify, locate, retrieve, store, organize and analyse digital information, judging its relevance and purpose.
Communication and collaboration	Communicate in digital environments, share resources through online tools, link with others and collaborate through digital tools, interact with and participate in communities and networks.
Digital content creation	Create and edit new content, integrate and re-elaborate previous knowledge and content, produce creative expressions, media outputs and programming, deal with and apply intellectual property rights and licences.
Safety	Personal protection, data protection, digital identity protection, security measures, safe and sustainable use.
Problem-solving	Identify digital needs and resources, make informed decisions as to which are the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital means, creatively use technologies, solve technical problems, update one's own and others' competences.

Source: C. Redecker, *European Framework for the Digital Competence of Educators: DigCompEdu*, Y. Punie (ed.), Luxembourg, Publications Office of the European Union, 2017.

DigComp has been used in education to structure and develop the digital competences of students and teachers. It has also served as a basis for curriculum development in education and vocational training and for education systems to assess the level of digital competences of different actors in the community (students, teachers and managers, among others), identifying strengths and areas for improvement, and providing recommendations for courses and learning opportunities.

(a) DigCompEdu

In particular, DigComp has been used as the basis for the Digital Competence Framework for Educators (DigCompEdu), a framework that helps teachers to assess and optimize their own digital competences, enabling them to better integrate these into their teaching and foster more effective learning among their students (Redecker, 2017). The purpose of DigCompEdu is to detail how digital technologies can be used to innovate and bring about improvements in education and training. To answer the question of what is meant by being digitally competent, it offers a model that assists in understanding, developing and assessing the specific competences of educators. DigCompEdu includes six dimensions, of which the last relates directly to the development of students' digital competences (see table 2) (Redecker, 2017).

Table 2
Dimensions of digital competence in the DigCompEdu framework

Dimension	Description	Sub-area
Professional engagement	How teachers use digital technologies for professional development and communication with students, parents and colleagues.	No sub-areas
Digital resources	Sourcing, creating and managing digital resources.	No sub-areas
Teaching and learning	How digital technologies are integrated into the design and implementation of teaching and learning strategies.	No sub-areas
Assessment	Using digital technologies to assess student learning.	No sub-areas
Empowering learners	Using technologies to support and empower students in their learning.	No sub-areas
Facilitating learners' digital competence	Strategies for teaching students to use digital technologies critically, collaboratively and creatively.	Information and literacy
		Communication
		Content creation
		Responsible use
		Problem-solving

Source: C. Redecker, *European Framework for the Digital Competence of Educators: DigCompEdu*, Y. Punie (ed.), Luxembourg, Publications Office of the European Union, 2017.

(b) The DigComp framework in Spain

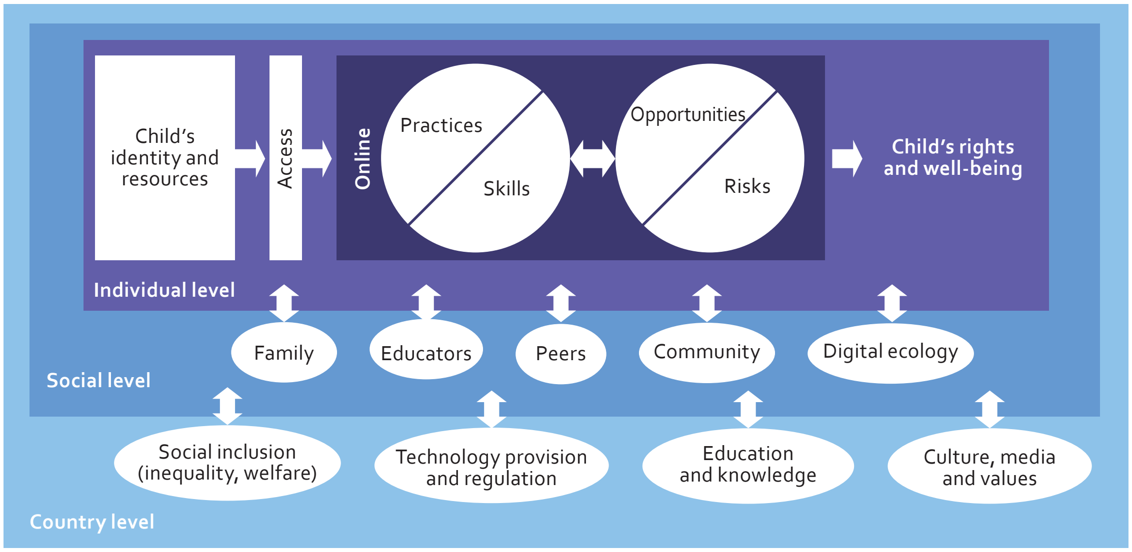
Another example of the DigComp framework being adapted to the educational environment is Spain's adaptation of it to the school curriculum. "Digital competence" is considered cross-cutting and integrative in the Spanish education system, and the country's national curriculum provides operational descriptors that establish the level of proficiency students are expected to achieve in each of the areas at different levels of education. Moreover, the Student Digital Competence Evaluation Test (ECODIES), which is applied to primary school pupils, asks how children would perform certain tasks and actions and includes questions related to the five areas of the DigComp framework, with indicators for knowledge, skills and attitudes (García-Valcárcel and others, 2021; Regueira and Alonso-Ferreiro, 2022).

2. Global Kids Online

Global Kids Online, launched in 2015 by the UNICEF Innocenti Research Centre, the London School of Economics and the EU Kids Online network, is a global network of researchers and specialists whose purpose is to help gather evidence for a deeper understanding of the digital experiences of children and adolescents, taking into account their individual and contextual diversity.

The Global Kids Online research framework gauges the balance between online participation opportunities for children and adolescents and the risks of harm to their well-being. The framework includes three levels of analysis: (i) the macrosocial situation in the country, i.e. the structural factors and cultural values that determine access to and appropriation of digital technologies; (ii) the social environment that mediates the child's or adolescent's relationship with the Internet and includes family, teachers (whether in formal or informal settings), peers, the wider community (considering, among other factors, local customs and norms and other authority figures outside the family and educational environment) and the digital ecology (the specific set of digital devices, platforms and services used); and (iii) the individual level, recognizing that online agency and experiences are also shaped by children's and adolescents' identity characteristics, such as their age, sex and ethnicity or race, as well as aspects of their personality and level of competences (Livingstone, 2016) (see diagram 1).

Diagram 1
Global Kids Online framework: individual, societal and national influences on children's well-being and rights in the digital age



Source: Prepared by the authors, on the basis of S. Livingstone, G. Mascheroni and E. Staksrud, "Developing a framework for researching children's online risks and opportunities in Europe", London, London School of Economics and Political Science (LSE), 2015 [online] http://eprints.lse.ac.uk/64470/1/__lse.ac.uk_storage_LIBRARY_Secondary_libfile_shared_repository_Content_EU%20Kids%20Online_EU%20Kids%20Online_Developing%20framework%20for%20researching_2015.pdf.

A number of countries in Latin America and the Caribbean have applied this framework in studies on digital experiences in childhood and adolescence. The first country to adopt this international methodological framework was Brazil, where Cetic.br began conducting an annual study in 2012. It was followed by Argentina, Chile, Costa Rica and Uruguay and, during 2020, by the Dominican Republic and Jamaica. In addition to the annual measurement in Brazil, several of these countries (Argentina, Chile, Costa Rica and Uruguay) conducted a second measurement between 2022 and 2024 to research children's online experience in the aftermath of the COVID-19 pandemic.

These studies provide information on the individual, identity and sociocultural characteristics of children and adolescents and on the following dimensions of their online experience:

(i) Access, uses and opportunities: information on children's and adolescents' access to the Internet and digital devices, places of use, social networking behaviour and online activities.

(ii) Digital skills: information on children's and adolescents' self-perceived proficiency in performing online tasks, including self-care, social, technical, creative and information skills.

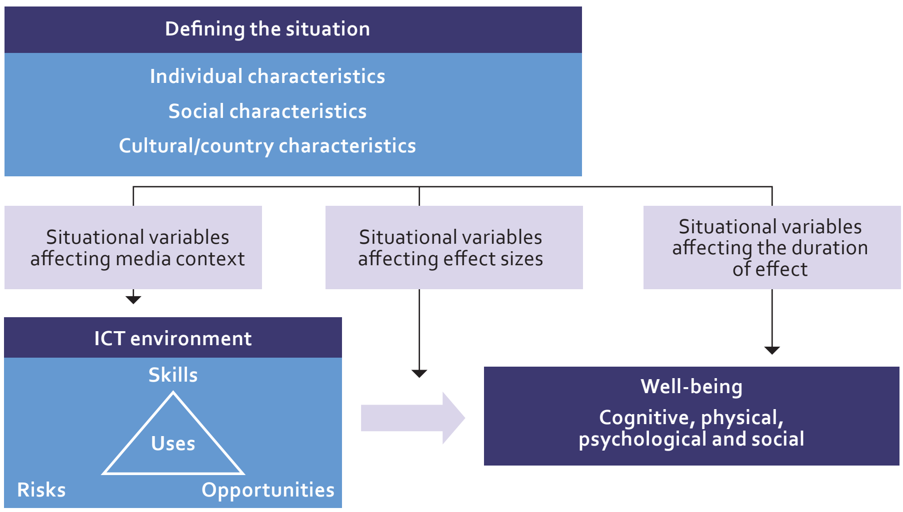
(iii) Mediation: information on how Internet use is mediated by significant adults at home and at school.

(iv) Risks: information about risky Internet behaviours and experiences among children and adolescents.

3. The ySKILLS project

The ySKILLS (Youth Skills) project is funded by the European Union's Horizon 2020 programme and involves 16 research centres in 13 countries of the region. The aim of the project is to enhance the long-term positive impacts of ICTs on the well-being of children, adolescents and youth by stimulating their resilience through the development of digital competences. ySKILLS proposes a conceptual framework inspired by various theories and models, including the Global Kids Online framework, and positions digital competences as mediators of risks and opportunities in online contexts, recognizing individual and social characteristics and the cultural context of the country as important factors in the development of these skills and the well-being of individuals. In this framework, the digital environment is understood as patterns of technology use (time, frequency, type of use, devices used) and their relationship with the digital competences of children and adolescents and with the risks and opportunities they face in the virtual environment. The main output of the framework is the well-being of children, adolescents and youth, which is classified into cognitive well-being (related to functions such as attention span), physical well-being (such as their emotional state, life satisfaction and self-efficacy) and social well-being (such as family and peer support) (see diagram 2) (Šmahel and others, 2023).

Diagram 2
Conceptual model of ySKILLS



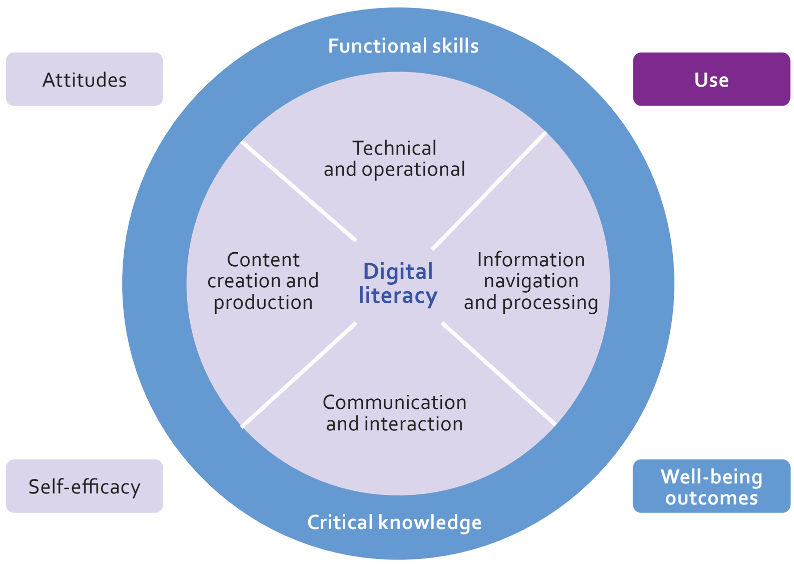
Source: Prepared by the authors, on the basis of D. Šmahel and others, *Theoretical Integration of ySKILLS: Towards a New Model of Digital Literacy*, Leuven, Youth Skills (ySKILLS), 2023.

ySKILLS recognizes four dimensions of digital literacy, incorporating into each of them both functional skills (understanding how ICTs and devices work, and being able to use them) and critical knowledge (understanding how and why devices and content are produced in certain ways). Although the ySKILLS theoretical model treats attitudes, self-efficacy and technology use as important in determining effective engagement with digital technologies and the Internet, it posits that they do not allow conclusions to be drawn about what specific digital competences and knowledge are needed to improve levels of well-being in digital societies, and so does not consider them to be factors directly related to digital literacy (Šmahel and others, 2023) (see diagram 3).

In particular, the theoretical model underpinning the ySKILLS framework posits that self-efficacy relates more to people's characteristics (gender and ethnicity or race, among others) than to their actual level of skills; that attitudes are more associated with social discourses around digital media than with knowledge about how the digital world works; and that the fact of using ICTs does not mean that children, adolescents and youth know how to perform these activities properly. The framework also assumes that digital literacy is not directly related to well-being outcomes, but that well-being is the outcome of interactions between digital competences and patterns of ICT use and with the risks and opportunities of participation in the digital society (see diagram 2) (Šmahel and others, 2023).

The latest ySKILLS assessment was conducted in six European countries (Estonia, Finland, Germany, Italy, Poland and Portugal) in 2022 and consisted of a computer-based test that directly measured the digital competences of children, adolescents and youth aged between 12 and 17 in real-life situations. The test consisted of two modules, one focused on information navigation and processing skills and content creation skills, and the second on communication and interaction skills (Van Laar and others, 2022).

Diagram 3
ySKILLS theoretical model of digital literacy



Source: Prepared by the authors, on the basis of D. Šmahel and others, *Theoretical Integration of ySKILLS: Towards a New Model of Digital Literacy*, Leuven, Youth Skills (ySKILLS), 2023.

4. The Digital Literacy Global Framework

Drawing on a review of more than 40 digital literacy frameworks worldwide and the results of online consultations and in-depth interviews in countries with diverse economies, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has proposed the Digital Literacy Global Framework to monitor SDG indicator 4.4.2 (percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills). In particular, the Framework is intended to complement the DigComp framework and facilitate its implementation in developing countries with two additional competence domains related to the operation of devices and software and to vocational skills (Law and others, 2018) (see table 3).

Table 3
Competence areas and digital competences of the Digital Literacy Global Framework

Competence areas	Competences
Devices and software operations[a]	Physical operation of digital devices
	Software operations on digital devices
Information and data literacy	Browsing, searching and filtering data, information and digital content
	Evaluating data, information and digital content
	Managing data, information and digital content
Communication and collaboration	Interacting through digital technologies
	Sharing through digital technologies
	Engaging in citizenship through digital technologies
	Collaborating through digital technologies
	Netiquette[b]
	Managing digital identity
Digital content creation	Developing digital content
	Integrating and re-elaborating digital content
	Copyright and licences
	Programming

Competence areas	Competences
Safety	Protecting devices
	Protecting personal data and privacy
	Protecting health and well-being
	Protecting the environment
Problem-solving	Solving technical problems
	Identifying needs and technological responses
	Creatively using digital technologies
	Identifying digital competence gaps
	Computational thinking
Career-related competences[a]	Operating digital technologies for a particular field
	Interpreting and manipulating data, information and digital content for a particular field

Source: N. Law and others, "A global framework of reference on digital literacy skills for indicator 4.4.2", *Information Paper*, No. 51, Montreal, UNESCO Institute for Statistics (UIS), 2018.
[a] This area is complementary to the DigComp framework.
[b] Netiquette means the set of standards of courtesy governing user behaviour and communications on the Internet.

The inclusion of competences related to the physical operation of digital devices and to the operation of software reflects the relative consensus that emerged in the consultation process about the importance of studying the development of these, especially in the context of developing countries. Meanwhile, the intention in including the broad category of career-related competences within the framework, was to explore the development of competences in the adult population while allowing knowledge, skills and attitudes related to specific careers (such as technology use in engineering and education) to be made dependent on the socioeconomic context and change over time, thus giving countries the flexibility to identify the competences they require in specific fields for their economic development strategies (Law and others, 2018).

5. The International Computer and Information Literacy Study

The International Computer and Information Literacy Study (ICILS) framework, developed by the International Association for the Evaluation of Educational Achievement, assesses the digital competences of eighth grade students, seeking to gather comparable information across different education systems internationally. In 2018, the ICILS assessment included two Latin American countries (Chile and Uruguay) and covered both digital literacy and computational thinking skills, defining digital literacy as the ability to use computer technologies to collect, manage, produce and exchange digital information, and digital thinking as the type of thinking used when programming a computer or developing an application (see table 4).

Table 4
Constructs, strands and aspects of the International Computer and Information Literacy Study framework

Construct	Strand	Aspect
Digital literacy	Understanding computer use	Foundations of computer use
		Computer use conventions
	Gathering information	Accessing and evaluating information
		Managing information
	Producing information	Transforming information
		Creating information
	Digital communication	Sharing information
		Using information responsibly and safely
Computational thinking	Conceptualizing problems	Knowing about and understanding digital systems
		Formulating and analysing problems
		Collecting and representing relevant data
	Operationalizing solutions	Planning and evaluating solutions
		Developing algorithms, programs and interfaces

Source: J. Fraillon and M. Rožman (eds.), *IEA International Computer and Information Literacy Study 2023: Assessment Framework*, Cham, Springer, 2024.

The ICILS test is standardized and computer-based and includes multiple-choice questions, short text responses, skills-based activities and tasks set in authentic contexts. These tasks are executed within specialized productivity applications such as document editors, design software and web browsers specifically developed for the assessment. In addition, the web content accessed is exclusively developed for the test, serving as the sole source of web-based material accessible to students (Fraillon and Rožman, 2024).

6. The National Assessment of Educational Progress Technology and Engineering Literacy assessment

The National Assessment of Educational Progress (NAEP) Technology and Engineering Literacy (TEL) assessment, implemented in the United States, is entirely computer-based and uses interactive, scenario-based tasks and short-answer and multiple-choice questions to measure whether eighth grade students have the ability to implement technology and engineering skills in real-life situations[1] (NAGB, 2018). The position taken in the framework is that technology and engineering literacy requires students to be able to recognize the technologies around them and to apply what they know to problems and projects involving specific technologies in the context of important social problems and real-life problems that people commonly have to solve.

The NAEP-TEL assessment measures three interconnected areas of technology and engineering expertise inside and outside the classroom:

(i) Technology and Society, involving the effects that technology has on society and on the natural world and the ethical questions that arise from those effects.

(ii) Design and systems, covering the nature of technology, the engineering design process by which technologies are developed, and basic principles of dealing with everyday technologies, including maintenance and troubleshooting.

(iii) Information and communication technology, including computers and software learning tools, networking systems and protocols, hand-held digital devices and other technologies for accessing, creating, and communicating information and for facilitating creative expression.

In each of the three areas of literacy, learners are expected to be able to implement certain "practices", i.e. certain types of thinking and reasoning. The framework specifies three:

(i) Understanding technological principles, which focuses on how well students are able to make use of their knowledge about technology.

(ii) Developing solutions and achieving goals, which refers to students' systematic use of technological knowledge, tools and skills to solve problems and achieve goals presented in realistic contexts.

(iii) Communicating and collaborating, which concerns how well students are able to use contemporary technologies to communicate for a variety of purposes and in a variety of ways, working individually or in teams, with peers and experts.

Lastly, the framework also describes what technology and engineering literacy knowledge and skills students need to have in order to attain the basic, proficient and advanced levels (NAGB, 2018).

7. The National Assessment Program: ICT Literacy framework

The National Assessment Program: ICT Literacy (NAP-ICTL) framework is intended to keep pace with rapid technological growth and establish sound connections with the Australian curriculum. Drawing on the ICILS framework and the NAEP-TEL framework, it is organized around four strands, each representing a category of knowledge, skills, processes, understanding and actions (see table 5) (ACARA, 2023).

[1] The framework defines technology as "any modification of the natural world done to fulfill human needs or desires" and engineering as a "systematic and often iterative approach to designing objects, processes, and systems to meet human needs and wants" (NAGB, 2018).

Table 5
Strands and aspects of the National Assessment Program: ICT Literacy framework

Strand	Aspect
Understanding ICT and digital systems	Managing information and operating ICTs
	Understanding digital systems
Investigating and planning solutions with ICTs	Accessing and evaluating information
	Collecting and representing data
	Formulating problems and planning solutions
Implementing and evaluating digital solutions	Communicating with digital information products
	Developing algorithms, programs and interfaces
Applying safe and ethical protocols and practices when using ICTs	Safe and responsible information consumption with ICTs
	Responsible digital solutions and information production with ICTs

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA), *National Assessment Program - ICT Literacy 2025 Years 6 and 10: Assessment Framework*, Sydney, 2024.

The NAP-ICTL assessment tool requires students to apply digital literacy processes in real-world contexts that represent the four strands of the assessment framework. Specifically, it consists of computer-based task modules that simulate real-world use of ICTs in academic and personal contexts. In almost all cases, the modules comprise a sequence of 8 to 10 tasks that culminate in a larger task. All tasks are completed using software designed specifically for this purpose (ACARA, 2024).

8. ICT literacy

Led by the Korea Education and Research Information Service (KERIS), Korea has measured the digital literacy of primary and secondary school students annually since 2007. The measurement initially focused on ICT literacy, with computational thinking skills added in 2016. In 2018, the concept of ICT literacy was extended to digital literacy, and from 2019 to 2021 this was measured in seven areas distributed across two main categories (see table 6). Specifically, digital literacy is included in the revised 2022 curriculum and defined as "the ability to understand and use digital knowledge and technology on a basis of ethical awareness, to collect, analyse, critically understand and evaluate information, and to produce and use new information and knowledge" (Jeon and others, 2023). Assessment frameworks and items have been updated annually to systematically measure the trend of change in students' literacy levels (Kim and others, 2021).

Table 6
Categories and areas of the ICT Literacy framework

Category	Area	Sub-area
Literacy in ICTs	Information search	No sub-areas
	Analysis and evaluation of information	No sub-areas
	Organization and creation of information	No sub-areas
	Utilization and management of information	No sub-areas
	Information and communication	No sub-areas
Computational thinking	Abstraction	Problem-solving
		Pattern analysis
		Design of algorithms
	Automation	Implementation of algorithms
		Structural programming
		Debugging

Source: Korea Education and Research Information Service (KERIS), *2022 White Paper on ICT in Education in Korea*, Daegu, 2022.

In 2021, the assessment was conducted in a computer laboratory, with a computer and Internet access for each student. The results were given to each student immediately after completion of the test so that they could identify their strengths and weaknesses in the dimensions assessed.

9. International Society for Technology in Education Standards

The International Society for Technology in Education (ISTE) is an organization based in the United States that brings together educators from around the world. The ISTE Standards have been developed over two decades, are frequently updated and are segmented according to the needs of four different target groups: students, educators, educational leaders and trainers. The student section is specifically designed to prepare students to thrive in an ever-evolving technological environment, emphasizing student-driven learning and student voice in the educational process. The ISTE Standards can meet local goals, needs and priorities, while being flexible enough to take different forms according to the characteristics of the school, district, State/province or country. For students, seven areas with four standards each are proposed (see table 7) (ISTE, 2024).

Table 7
International Society for Technology in Education areas and standards for learners

Area	Description	Standards
Empowered learner	Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals.	Learning goals
		Customized learning environments
		Feedback to improve practice
		Technology fundamentals
Digital citizen	Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical.	Digital footprint
		Online interactions
		Safeguard well-being
		Digital privacy
Knowledge constructor	Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.	Effective research strategies
		Evaluate information
		Curate information
		Explore real-world issues
Innovative designer	Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.	Design process
		Design constraints
		Prototypes
		Open-ended problems
Computational thinker	Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.	Problem definitions
		Data sets
		Decompose problems
		Algorithmic thinking
Creative communicator	Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.	Choose platforms or tools
		Original and remixed works
		Communicate complex ideas
		Customize the message
Global collaborator	Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.	Global connections
		Multiple viewpoints
		Project teams
		Local and global issues

Source: International Society for Technology in Education (ISTE), *ISTE Standards*, Washington, D.C., 2024.

The ISTE Standards are a comprehensive road map for the effective use of technology in schools around the world. In essence, they are about learning rather than tools and emphasize actionability and ways to transform teaching and learning (ISTE, 2024).

10. Some national frameworks in Latin America and the Caribbean

Chile developed a conceptual framework of ICT Skills for Learning (HTPA), defining these as "the ability to solve information, communication and knowledge problems and legal, social and ethical dilemmas in a digital environment". It divided digital competences into four main dimensions, namely information, communication, digital living and technology, with several subdimensions (Ministry of Education of Chile, 2013). Between 2008 and 2009, the Education and Technology Centre (Enlaces) of the Ministry of Education of Chile, as part of a joint project with the Pontifical Catholic University of Chile and the OECD Centre for Educational Research and Innovation (CERI), constructed a measurement instrument relevant to its educational context. This instrument, targeted at students aged 15 or 16 and forming the ICT component of the System for Measuring the Quality of Education (SIMCE), was called SIMCE TIC and applied by the Ministry of Education to a national sample in 2011 and 2013.

Building on the SIMCE TIC experience, Chile developed a second version of the HTPA test between 2014 and 2016. The development of this second version also benefited from the advice of the Australian Council for Educational Research (ACER) and the services of the technology platform of the Australian company SoNET Systems (the same company that ICILS uses). Aside from these technical improvements, the second version of the Chilean instrument did not uniformly assess all the skills of the HTPA conceptual framework, but focused on measuring learners' ability to solve information problems on the Internet and to communicate an information outcome, these being considered strategic skills for students' learning processes. Instead of continuing to develop this measurement, however, the country has moved to the internationally comparable ICILS measurements.

In Peru, the Office of Quality Measurement of Learning (UMC) designs and implements the National Assessments of Educational Achievement. In 2022, it included a module in the measurements for the second grade of secondary school which measures the ability of students to use technology to solve problems in their environment. This revealed large gaps between State and private schools and between schools in urban and rural areas, with private and urban schools obtaining the best results (MINEDU, 2023).

In Colombia, the Colombian Institute for the Promotion of Higher Education (ICFES), acting on a mandate from the Ministry of National Education, is designing a Saber test for the area of technology and information technology to assess the digital competences of children in the Colombian school system. The Saber tests, which are standardized external assessments applied by ICFES (*saber* means "know"), evaluate the Basic Standards of Competence formulated by the Ministry of National Education. The new test will seek to contribute to the development of children's and adolescents' competences in the technology and information technology area of the national curriculum. The assessment, which was being designed and piloted as of 2024, focuses on a combination of theoretical and practical knowledge, testing both learners' understanding of technological concepts and the practical application of these in specific settings. The tool deals with understanding, handling of concepts and problem-solving in relation to the role and use of technology in general and of information technology in particular in society; however, it includes virtually no digital competences associated with the use, evaluation and communication of digital information.

B. Summary

For all children, adolescents and youth to be able to benefit from new technologies, the region needs to implement actions to reduce the divides affecting them in the digital sphere. This involves, first, dealing with the differences in connectivity that can be observed in the region as per the axes of the social inequality matrix (ECLAC, 2016) and, second, helping people acquire a greater capacity to make beneficial use of new technologies, i.e. benefit from the new opportunities that are emerging in the context of technological transformation, while at the same time reducing the risks of digital participation. The ability to take advantage of new technologies partly depends on patterns of ICT use and people's level of digital competences, making it essential to address both these dimensions in educational settings and learners' homes alike.

In line with the notion that digital competences are a multifaceted set of knowledge and skills, the different frameworks and standardized assessments reviewed adopt multidimensional approaches. In general, these share a focus on competences related to finding, storing, organizing, analysing, evaluating and creating information; communicating in digital media; using digital technologies safely and responsibly; and formulating and solving problems. They also present certain differences when it comes to the inclusion of competences related to the physical operation of digital devices and more complex digital competences, such as the creation of content in different formats, consideration of copyright and licensing, the development of algorithms, software and interfaces, and career-related competences, as well as the inclusion of socioemotional skills such as creativity in technology use, the ability to update competences and enrich learning, and the capacity to work collaboratively and use digital tools to exercise active citizenship.

Nonetheless, the definition of digital competences has expanded over the last few decades from more instrumental approaches to more holistic conceptualizations that take a broader view of the importance to individuals of participating as active citizens in the digital society. In addition, a number of theoretical approaches have incorporated the relationship between learners' contextual and personal characteristics and patterns of ICT use, levels of digital competences and the levels of well-being that result from engagement with the digital world.

The next chapter analyses the empirical results of the PISA 2022 test in the population of 15-year-old students in 14 countries of Latin America and the Caribbean, using the DigComp framework as a frame of reference and exploring how certain characteristics of the students themselves and their context, whether the home or the school, influence their patterns of technology use and development of digital competences.

II. What do recent data tell us?

Latin America and the Caribbean has undergone a rapid digital transformation in recent decades, driven by growing access to the Internet, technological devices and other digital resources (software, online resources and learning applications, among others). However, this transformation has not been homogeneous in the region, with significant disparities between and within countries on the axes of the social inequality matrix (socioeconomic status, territory, ethnicity or race, migration and disability status) (ECLAC, 2016). Characterizing inequalities in access to digital technologies in the region makes it possible to generate inclusive education and technology policies. However, access alone does not imply effective use of technological and digital resources. To move towards universal digital inclusion, it is essential to understand inequalities in patterns of ICT use and in the ability to benefit from these technologies.

For comparative purposes, OECD figures are used as a benchmark throughout this chapter, leaving out the countries of the region that belong to the organization, since Chile, Colombia, Costa Rica and Mexico share more similarities with the rest of Latin America and the Caribbean in terms of development in general and the challenges associated with the use of and inclusive access to ICTs in particular. Excluding them prevents their figures from skewing OECD averages and ensures that comparisons are with the advanced OECD countries, bringing out the peculiarities of the region.

Access to an Internet connection has increased steadily in the region over the last 20 years. According to data from the ECLAC Digital Development Observatory (ODD), 5% of households in 18 countries of Latin America and the Caribbean had some way of connecting to the Internet at home in 2002, whereas 61% of households could do so by 2021. In more developed countries, however, access is almost universal. In OECD (32 countries), on average, 92% of households could connect to the Internet in 2021. Within the region, moreover, there are gaps both between countries and between groups of people within countries.

More than 90% of households in Argentina and Chile can connect to the Internet, while in El Salvador, Guatemala and Honduras the proportion is below 40% of all households. In 14 Latin American countries, the gap in access to an Internet connection between urban and rural areas averages 29 percentage points in favour of urban areas, which shows the scale of the challenge involved in increasing coverage of rural areas. Home Internet access is only one aspect of digital inclusion, however, and it is also necessary to look at the type of usage, competences for coping with the digital world and time spent using digital technologies. These aspects will now be discussed from the point of view of the education of the region's young learners.

The OECD Programme for International Student Assessment (PISA) is a crucial input for analysing patterns of new technology use and the digital competences developed by the youth participating in it. In addition to assessing students' academic performance in reading, mathematics and science, PISA collects data on access to digital technologies and the use of these tools at home, at school and elsewhere, and on young learners' self-perceived digital competences.

This chapter mainly analyses PISA 2022[2] data and explores, first, trends and gaps in access to and use of digital devices among 15-year-old students in the region and, second, self-reported levels of digital competences, examining inter- and intra-country differences and their relationship with personal and contextual factors, including students' economic, social and cultural status and gender, among others. Analysing PISA data yields a better understanding of the region's progress and challenges with technology access, usage patterns for different devices and the level of development of different digital competences, providing an initial overview that can contribute to the design of education and digital inclusion policies aimed at reducing gaps.

A. Digital device availability and access in the region's schools has increased greatly

The number of desktop and laptop computers available for student learning in schools has increased significantly over recent decades. In the six countries of the region that participated in the 2006 and 2022 PISA rounds, the average number of schools without computers available for use by young learners fell from 35% to 16% between the two measurements. However, despite the progress with computer availability in the region's schools, there is still a large gap relative to more developed economies. In the OECD countries, for example, only 3% of schools had neither desktop nor laptop computers for student learning in 2022 (see table 8).

Table 8
Latin America and the Caribbean (14 countries):[a] schools without computers available for student learning, by country, 2006 and 2022
(Percentages)

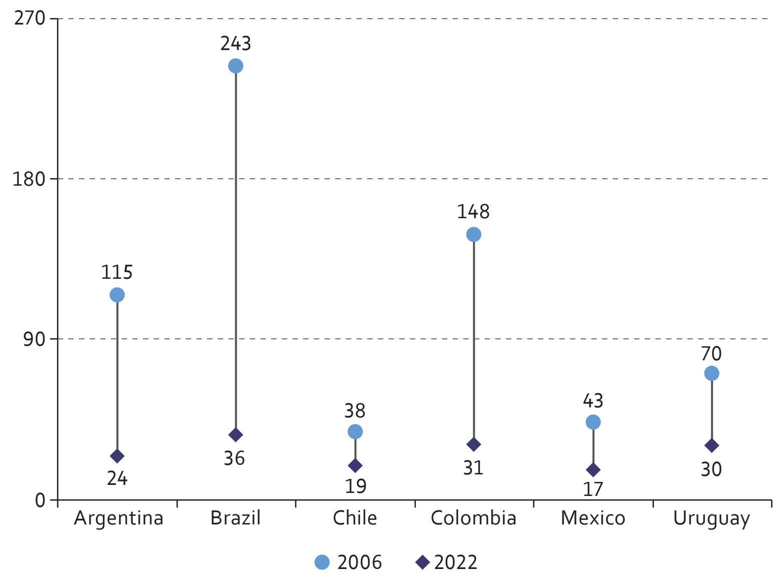
Country	2006	2022
Argentina	48	16
Brazil	44	34
Chile	9	10
Colombia	18	12
Costa Rica		5
Dominican Republic		42
El Salvador		3
Guatemala		23
Jamaica		4
Mexico	60	21
Panama		34
Paraguay		48
Peru		29
Uruguay	27	5
Latin America (6 countries)[b]	35	16
Latin America and the Caribbean (14 countries)		20

Source: Prepared by the authors, on the basis of Organisation for Economic Co-operation and Development (OECD), Programme for International Student Assessment (PISA) 2022.
[a] The figures for Latin America and for Latin America and the Caribbean are simple averages.
[b] Argentina, Brazil, Chile, Colombia, Mexico, and Uruguay.

[2] PISA 2022 focused on 15-year-old students and included 14 countries of Latin America and the Caribbean (Argentina, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Jamaica, Mexico, Panama, Peru, Paraguay and Uruguay), although the ICT familiarity questionnaire was administered in only 7, namely Argentina, Brazil, Chile, Costa Rica, the Dominican Republic, Panama and Uruguay.

Another aspect that shows the increase in access to ICTs in the region is the number of devices available to students in schools. In the countries of the region with information available for 2006 and 2022, the number of computers for educational use increased significantly. In Brazil, for example, there was one computer for every 243 students in 2006, then one for every 36 in 2022, and there were similar reductions in Argentina and Colombia. Chile and Mexico had one device for every 38 and 43 students, respectively, in 2006, while in 2022 they had one device for every 19 and 17 students, respectively (see figure 2).

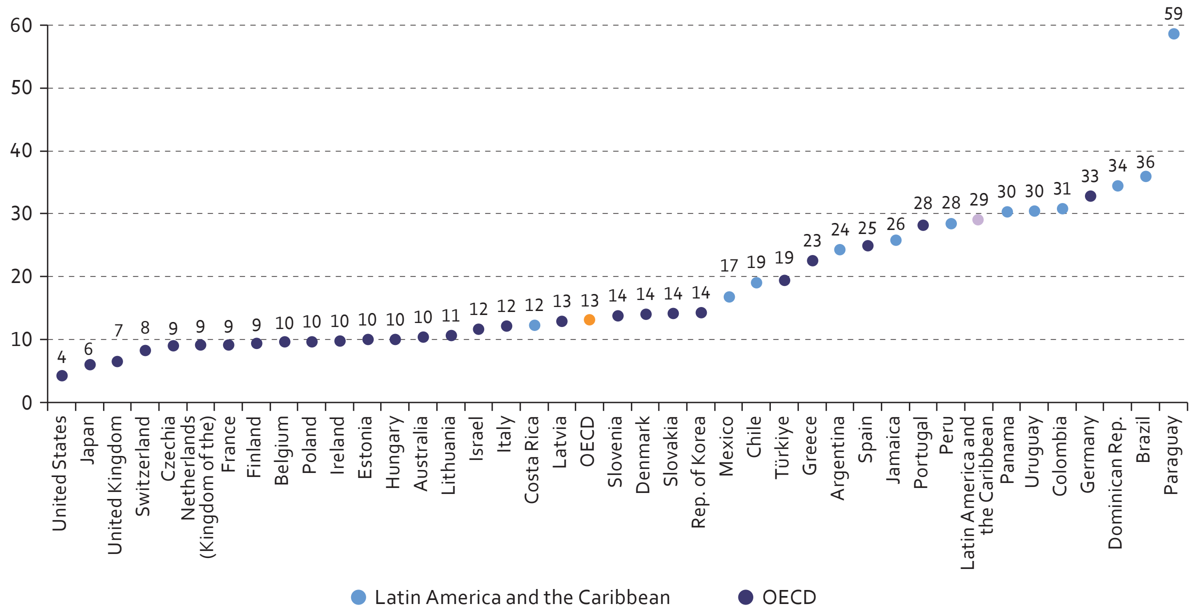
Figure 2
Latin America (6 countries): students per computer available in schools for student learning, by country, 2006 and 2022
(Numbers of students)



Source: Prepared by the authors, on the basis of Organisation for Economic Co-operation and Development (OECD), Programme for International Student Assessment (PISA) 2022.
Note: Includes only schools with computers available for teaching.

Despite the increased availability of devices for students in the region's schools, however, the number of children, adolescents and youth per computer or laptop is still considerably higher than in more developed countries. In OECD, the average student-to-device ratio is 13 to 1, while in Latin America and the Caribbean it is 29 to 1. At the extremes, schools in Costa Rica report having one computer for every 12 students, while in Paraguay they report one for every 59 (see figure 3).

Figure 3
OECD (27 countries) and Latin America and the Caribbean (12 countries): students per computer available in schools for student learning, by country, 2022
(Numbers of students)



Source: Prepared by the authors, on the basis of Organisation for Economic Co-operation and Development (OECD), Programme for International Student Assessment (PISA) 2022.
Note: Latin America and the Caribbean includes Argentina, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Jamaica, Mexico, Panama, Peru, Paraguay and Uruguay. OECD includes Australia, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, the Kingdom of the Netherlands, Latvia, Lithuania, Poland, Portugal, the Republic of Korea, Slovakia, Slovenia, Spain, Switzerland, Türkiye, the United Kingdom and the United States.

1. Teachers have technical skills but no incentives to integrate digital tools into their teaching

The increase in digital devices in the region's schools does not imply, a priori, that they are being used regularly and effectively for teaching and learning. In-school use of digital resources by students largely depends on the ability of teachers to integrate them effectively into their teaching and learning processes.

On average, 87% of the school leaders in the countries of the region that participated in PISA 2022 said that teachers had the technical and pedagogical skills to integrate digital devices into their classes, and 88% of school leaders in OECD said the same. Similarly, 66% thought that teachers had enough time to prepare their lessons in a way that integrated digital resources, compared to 60% in OECD. However, while most school leaders thought that teachers had the skills and time to integrate digital devices into their lessons, only 32% thought they had incentives to do so, compared to 60% in the OECD countries.

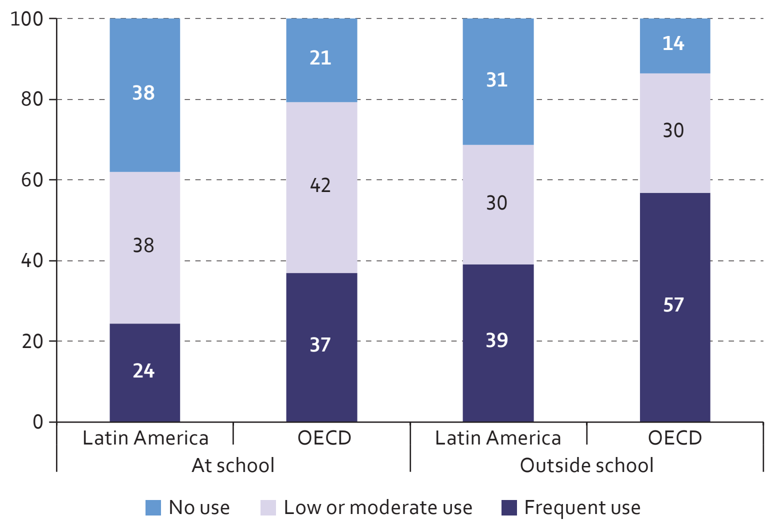
A questionnaire was administered to teachers of 15-year-olds in six countries of the region that took part in PISA 2022. While the small number of teachers included in the study means that it is not possible to generalize the results, it is possible to use their responses in an exploratory way. Among the questions included, teachers were asked to say how much emphasis they placed on teaching certain digital competences related to those described in the European Commission's DigComp framework (see chapter I). Most teachers in the region replied that they placed at least some emphasis in their teaching on all the digital competences asked about. Likewise, 3 in every 5 teachers stated that they had learned how to use ICTs for teaching during their professional training, which reinforces the perception of school leaders in the region, who considered for the most part that teachers had the skills to incorporate ICT use into the education of the region's youth.

B. Patterns of digital device use by students in the region

1. Low relative frequency of computer use for educational purposes

The increased availability of digital resources in the region's schools has not meant frequent use of technological tools by youth for school activities. An analysis comparing Latin American countries (Argentina, Brazil, Chile, Costa Rica, the Dominican Republic, Panama and Uruguay) and OECD countries reveals a striking difference in the frequency of desktop and laptop computer use by 15-year-old students. In Latin America, 38% of youth report that they never or almost never use these devices at school, while in the OECD countries the figure is significantly lower, at only 21%. This gap is also observed in out-of-school use, with 31% of Latin American youth reporting no computer use outside school, compared to 14% in the OECD countries (see figure 4).

Figure 4
Latin America (7 countries) and OECD (27 countries): 15-year-old students using desktop or laptop computers for school activities, in and out of school, by frequency of use, 2022
(Percentages)



Source: Prepared by the authors, on the basis of Organisation for Economic Co-operation and Development (OECD), Programme for International Student Assessment (PISA) 2022.
Note: Latin America includes Argentina, Brazil, Chile, Costa Rica, the Dominican Republic, Panama and Uruguay. OECD includes Australia, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, the Kingdom of the Netherlands, Latvia, Lithuania, Poland, Portugal, the Republic of Korea, Slovakia, Slovenia, Spain, Switzerland, Türkiye, the United Kingdom and the United States.

The relatively low use of computers does not imply, however, that youth do not have access to them. In Latin American countries, an average of only 4.8% of youth assessed in PISA 2022 reported not having access to a desktop or laptop computer outside school, compared with 2.7% in the OECD countries, although there were differences depending on economic, social and cultural status.[3] In the region, the proportion of youth in the first economic, social and cultural status quartile lacking access to a computer outside school was 5.9%, compared with 3.4% in the top quartile. As for the proportion of students using digital devices frequently, the data show that one in four youth in Latin America used computers almost every day at school, compared to two in five in OECD. Outside school, three in five youth in OECD used computers daily, while two in five did so in Latin America.[4]

[3] PISA incorporates an index of economic, social and cultural status constructed from the educational and employment characteristics of students' families and the material and cultural resources available in the household.

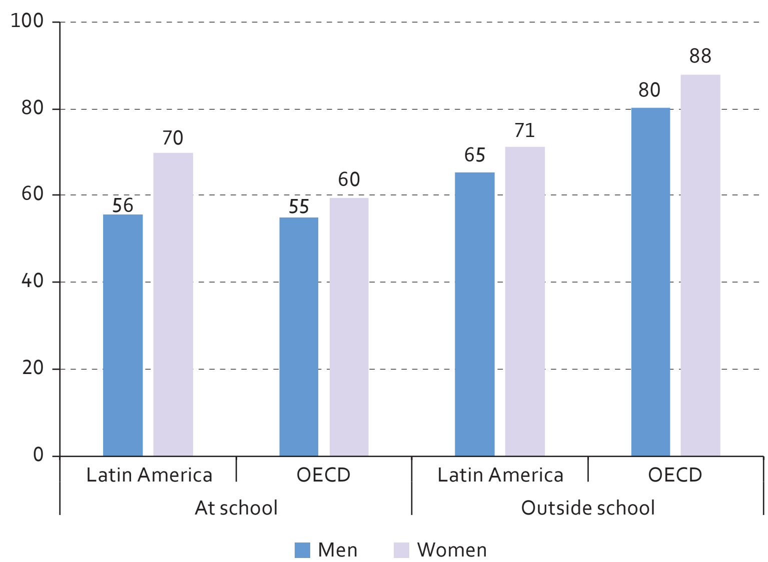
[4] Desktop and laptop computer use outside school encompasses personally owned own-use, personally owned shared-use and public computers, reflecting access to devices anywhere outside school, and not just the household.

2. Large-scale use of smartphones, particularly outside school

The difference in frequency of use narrows when other devices, such as smartphones with Internet access, are analysed. These devices were used on a large scale in both Latin America and OECD. In both cases, 3 in every 5 youth used Internet-enabled mobile phones daily at school, while daily use outside school was even higher, at 7 out of 10 in Latin America and 8 out of 10 in the OECD countries. This suggests that, although computer use was more limited in Latin America, youth in the region compensated for this with more frequent (days per week) and intensive (daily hours) use of smartphones.

While there were no major differences in smartphone availability between youth of different economic, social and cultural status, there were considerable gaps when the frequency of use by sex was considered. In both Latin America and OECD, girls reported more regular use of Internet-enabled mobile phones than their male counterparts, with the gender gap within schools being particularly marked in the region: while the share of boys in Latin America who constantly used smartphones at school was similar to that in the OECD countries (56% and 55%, respectively), girls did so to a greater extent in the region (70% in Latin America and 60% in OECD). In OECD, both boys' and girls' usage time was greater outside school, while in Latin America this was only true of boys, and to a lesser extent. The percentage of 15-year-old girls in the region who used a smartphone intensively was the same both inside and outside school (see figure 5).

Figure 5
Latin America (7 countries) and OECD (27 countries): 15-year-old students using an Internet-enabled smartphone every day or several times a day at and outside school, by sex, 2022
(Percentages)



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Greater access to and use of smartphones than of desktop and laptop computers came to play an important role during the school closures caused by the COVID-19 pandemic, a period in which many of the region's students had to continue their education remotely. During the health emergency, access to and use of ICTs was essential for children and adolescents to carry on their education, but not everyone had access to the same devices. According to the PISA 2022 data, most youth in Latin America and the Caribbean used a smartphone of their own (48.2%), followed by a PC, laptop or tablet of their own (34.2%), to continue their studies, while in the OECD countries most used a PC, laptop or tablet of their own (57.6%), followed by a phone of their own (26.4%).

3. Technological devices used mainly for recreational activities

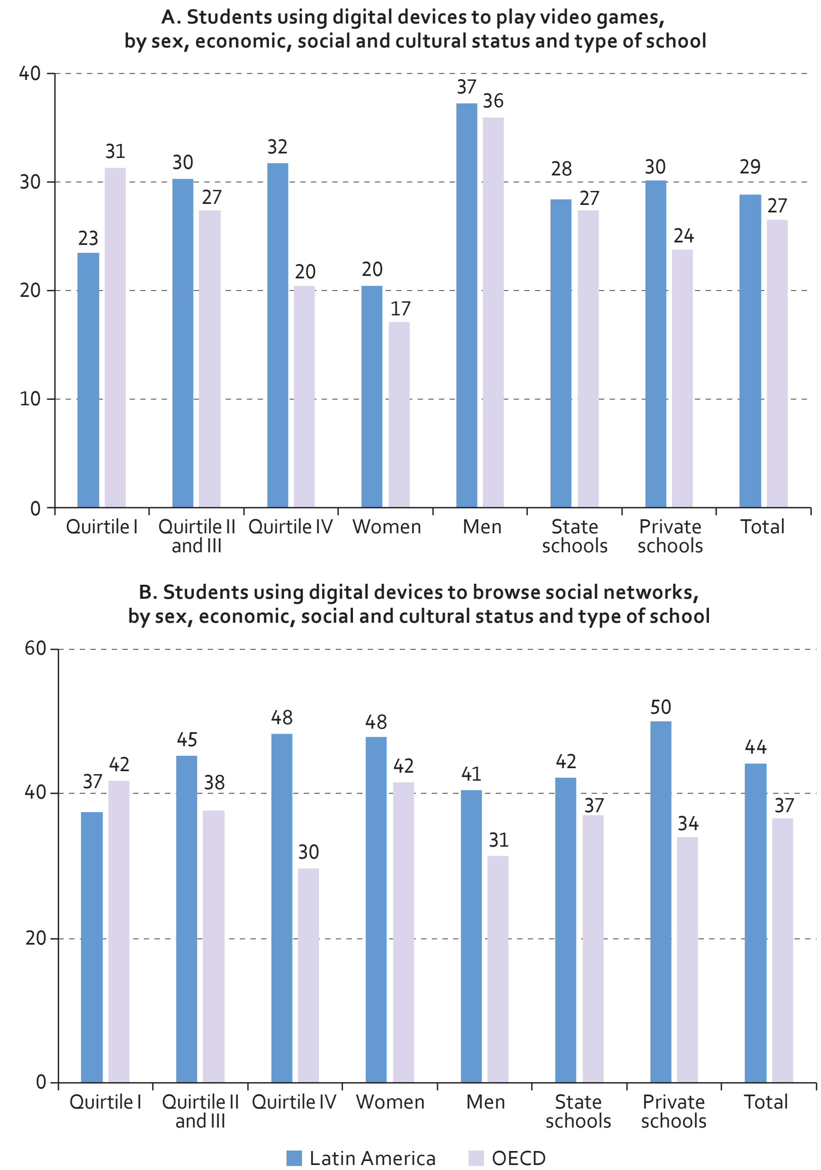
The type of device used determines the range of activities that can be carried out. While the large-scale use of smartphones has enabled more people to have an Internet connection, the relative dearth of access to and use of laptop and desktop computers has been a factor limiting the use of tools specific to these devices. About a third of youth in the region, on average, reported writing or editing text using some kind of software at least once a week, while the same proportion reported collaborating frequently with other students to create digital content related to school activities, and just one in five of those surveyed reported using software to collect and record data for school purposes, these figures being similar to those in OECD countries.

Nevertheless, it is important to note that activities for school purposes that can be done with other devices, such as tablets or smartphones, were not performed frequently in the region either. Browsing the Internet for information on real-world problems or phenomena for school purposes was only done at least once a week by an average of 36% of youth in Latin America and 35% in OECD.

At this point it is worth noting the difference in the way the figures are interpreted. Frequency of use refers to the number of times a task is performed, and throughout this document it is considered frequent when a task is performed at least once a week. In contrast, intensiveness of use refers to the amount of time spent on a certain activity on an average day, with three hours or more of use per day being considered intensive. With this in mind, whereas digital devices were used infrequently for school activities, this was not true of other types of use. On average, 29% of all youth in the region reported playing video games for three or more hours per day on a smartphone, computer or video game console, a percentage similar to that reported by youth in OECD (27%). However, analysis by sex and by economic, social and cultural group reveals dissimilar trends. In Latin America, on a typical weekday, youth of higher economic, social and cultural status spent more hours playing video games than the lowest quartile, while in OECD countries the relationship was the reverse: the lower people's economic, social and cultural status, the more time they spent on these activities. In both Latin America and OECD, the proportion of boys spending more than three hours a day playing video games was twice the proportion of girls spending the same amount of time on that activity (see figure 6A).

Social media usage also took up a large share of the device time of the youth assessed in PISA 2022, with 44% of students in the region spending at least 3 hours a day on this on a typical weekday. As with video games, the proportion of youth spending large amounts of time on social networking rose with economic, social and cultural status in Latin America, whereas it decreased in OECD. Girls using social networking sites intensively outnumbered boys by 8 percentage points (see figure 6B). Figures 6A and 6B show the strong correlation between the results by economic, social and cultural status and by type of school in the region, illustrating the clear concentration of youth with higher economic, social and cultural status in private schools in the region.

Figure 6
Latin America (7 countries) and OECD (27 countries): 15-year-old students using digital devices for recreational activities for at least 3 hours per day on a weekday, by activity, 2022
(Percentages)



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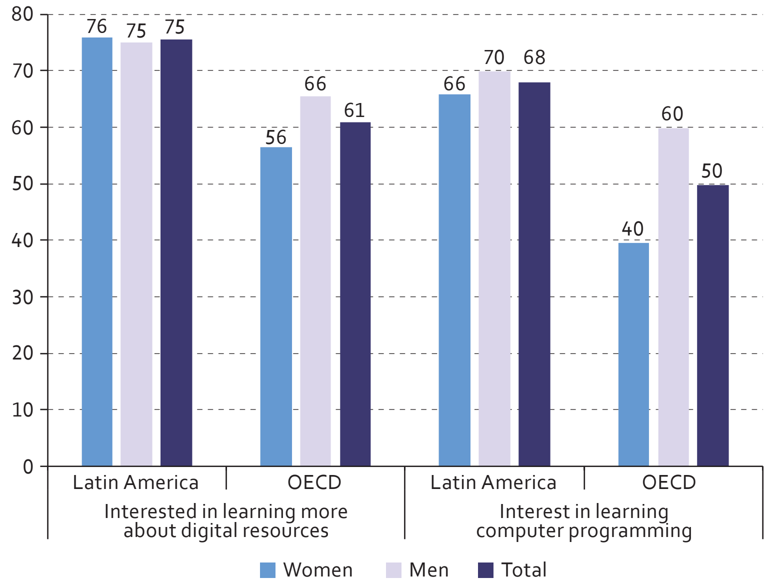
4. Youth in the region show a strong interest in learning more about the use of digital resources

The large amount of time given over to recreational activities on digital devices, whether smartphones, computers or video game consoles, did not extend to school or learning activities. Youth in the region used the available technological equipment for recreational activities for several hours a day but only for short periods per month or week for educational purposes, even though Latin American youth expressed more interest in learning about ICT use than OECD youth. On average, 75% of 15-year-old students in seven Latin American countries expressed interest in learning more about digital resources and 68% in learning computer programming (see figure 7).

Figure 7
Latin America (7 countries) and OECD (27 countries): 15-year-old students interested in learning about digital tools, by interest and sex
(Percentages)



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Both boys and girls expressed interest in learning more about digital resources, with shares of 75% and 76%, respectively, while in OECD there was a gap of 10 percentage points in favour of boys, giving an average of 66%. As regards students interested in learning digital programming, boys outnumbered girls in both groups of countries. The gap was 4 percentage points in the Latin American countries (70% for boys and 66% for girls), while in OECD it was wider, at 20 percentage points (60% versus 40%).

The strong interest on the part of the region's youth could be linked to the heavy use made of technology for recreational rather than educational purposes. PISA 2022 asked a number of questions about different operational tasks and how difficult it was for youth to perform them. The following section shows how 15-year-olds perceived their competences for carrying out different tasks using ICTs.

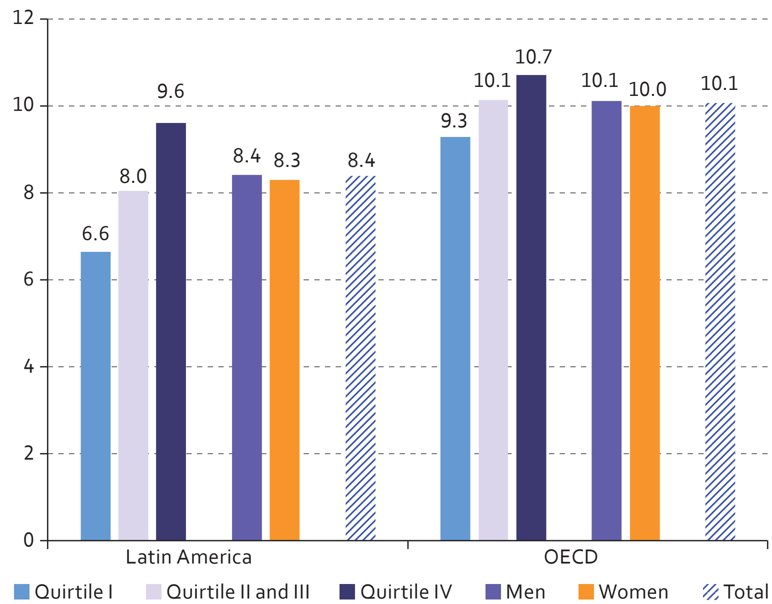
C. Youth and self-perceived digital competences in Latin America

1. Students in the region perceive themselves as having strong digital competences

PISA 2022 asked 15-year-olds to say how much effort they had to make to perform a number of tasks related to the use of ICTs. Students were asked to choose one of the following categories for each of the 14 tasks surveyed: "I can easily do this, "I can do this with a bit of effort", "I struggle to do this on my own", "I cannot do this" or "I don't know what this is".

To obtain an overview of the number of activities young people in the region reported being able to do, an aggregate index covering all the tasks in the questionnaire was constructed. This index is summative across activities, i.e. one point is added to the index for each task that a student could perform easily or with a bit of effort. An index score of 0 indicates that the assessed learner did not consider that he or she could perform any of the tasks alone, while an index value of 14 means that the learner could perform all the tasks alone with little or no effort. Figure 8 shows the average index values for Latin America and OECD, by sex and economic, social and cultural status quartile. Average reported self-efficacy was higher for all groups in OECD countries than in the countries of the region. Within each set of countries, youth of a higher economic, social and cultural status consistently rated themselves higher for their ability to carry out tasks by themselves with digital tools.

Figure 8
Latin America (7 countries) and OECD (27 countries):[a] summative index of tasks that 15-year-old students reported being able to perform with a bit of effort or none, by economic, social and cultural status and sex
(Index values)



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[a] Simple averages.

The increase in self-efficacy progressing through the quartiles was more pronounced in the region than in more developed countries. Thus, youth in the fourth quartile reported being able to perform an average of 3 more tasks than those in the first quartile in Latin America, while the gap was only 1.4 tasks in the OECD countries. Table A1.1 of the annex shows mean difference tests for scores by sex and economic, social and cultural status quartiles in each country.

The summative index of self-perceived digital competences provides a useful initial approach to the skills reported by the youth assessed in PISA 2022, as well as to general differences between the socioeconomic groups and sexes, both within and outside Latin America. To consider the different digital competences within the theoretical and empirical frameworks described in chapter I, however, it is preferable to analyse the tasks in a disaggregated way.[5] The tasks included in the PISA 2022 self-perception questions are shown below by area of digital competence in the DigComp framework.

2. Youth of high economic, social and cultural status rate their ability to carry out tasks in digital environments by themselves higher

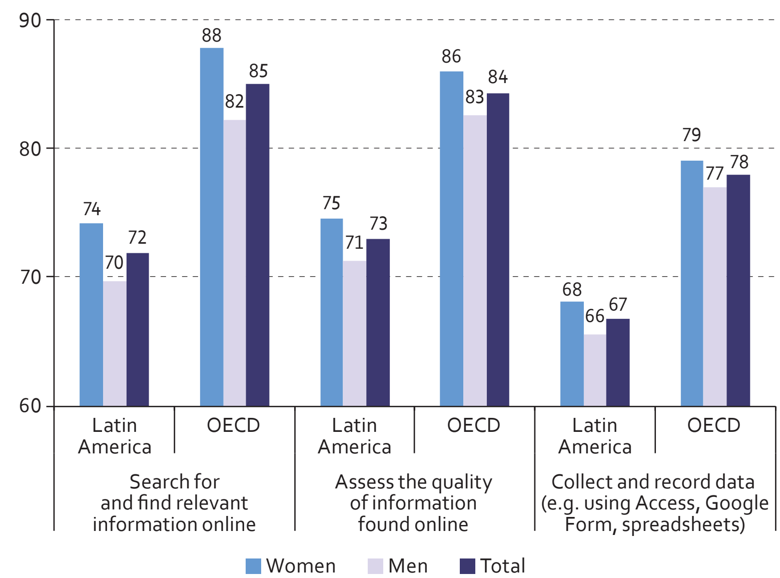
(a) Information and digital literacy

This area covers all digital competences whose goal is to identify, locate, retrieve, store, organize and analyse digital information, judging its relevance and purpose. In the region, an average of 72% of youth assessed by PISA stated that they could search for and find relevant information on their own with digital tools, and the same percentage reported that they could evaluate the quality of information easily or with a bit of effort, while 67% of 15-year-old students reported that they could collect and record data using digital spreadsheets or the like (see figure 9). Smaller proportions of students reported being able to do each activity in Latin America than in the more developed countries, with gaps of over 10 percentage points.

In both Latin America and the OECD countries, there were gender gaps favouring girls in this area of competences, as well as economic, social and cultural gaps favouring more privileged students. While gender gaps were similar between the two groups of countries (between 2 and 6 percentage points, depending on the task), differences by economic, social and cultural status were considerably greater in Latin America, with gaps of more than 20 percentage points in the region and about 12 percentage points in OECD.

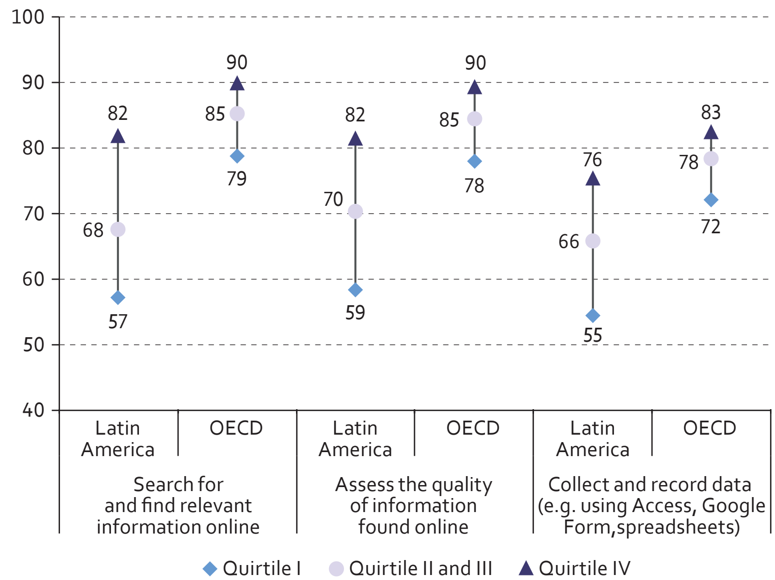
Figure 9
Latin America (7 countries) and OECD (27 countries): students reporting that they could complete tasks associated with digital literacy competence easily or with a bit of effort, by task and group
(Percentages)

A. Youth stating they could do tasks, by sex



5 See table A1.2 in the annex for details of statistical differences by sex for each type of activity.

B. Youth stating they could do tasks, by economic, social and cultural status



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(b) Communication and collaboration

This area covers competences related to communicating in digital environments, sharing resources through online tools, linking with others and collaborating through digital tools, and interacting with and participating in communities and networks.

Across the Latin American countries assessed in PISA 2022, three out of every four 15-year-olds reported being able to share information easily with a group of students using digital tools, and the same proportion of students reported being able to easily explain to their peers how to share content online or via a digital platform. Nearly 8 in every 10 youth reported being able to collaborate with other students on a group task using ICTs (see figure 10).

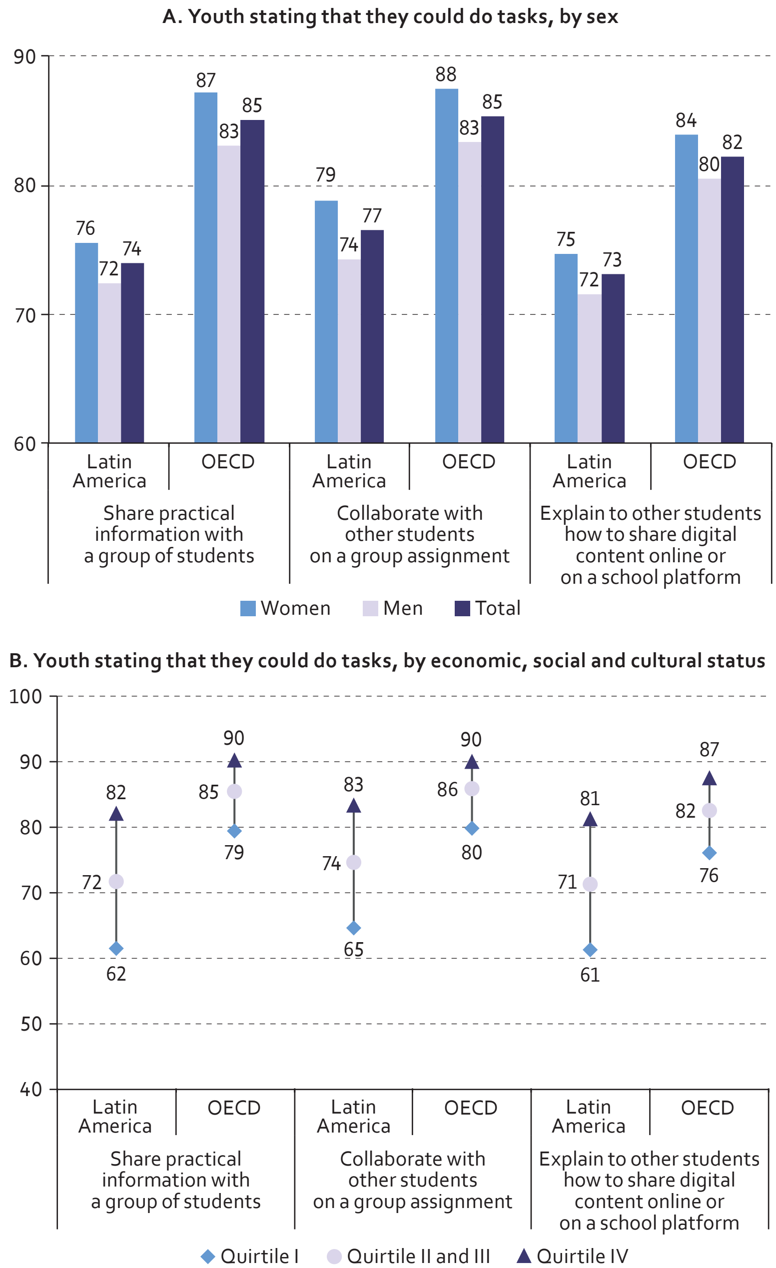
Much as with the competences observed in the area of digital literacy, activities related to the communication and collaboration competence are performed easily by a higher proportion of girls in both Latin America and OECD, but a larger proportion of students report being able to perform the tasks easily or with a bit of effort in the OECD countries than in the region.

The gaps between youth from different economic, social and cultural status quartiles are larger in Latin America than in OECD at around 20 percentage points in the region for each of the competences in this area, which is double the gap in the OECD countries.

Figure 10

Latin America (7 countries) and OECD (27 countries): youth stating that they could do tasks related to communication and collaboration competence easily or with a bit of effort, by task and group

(Percentages)



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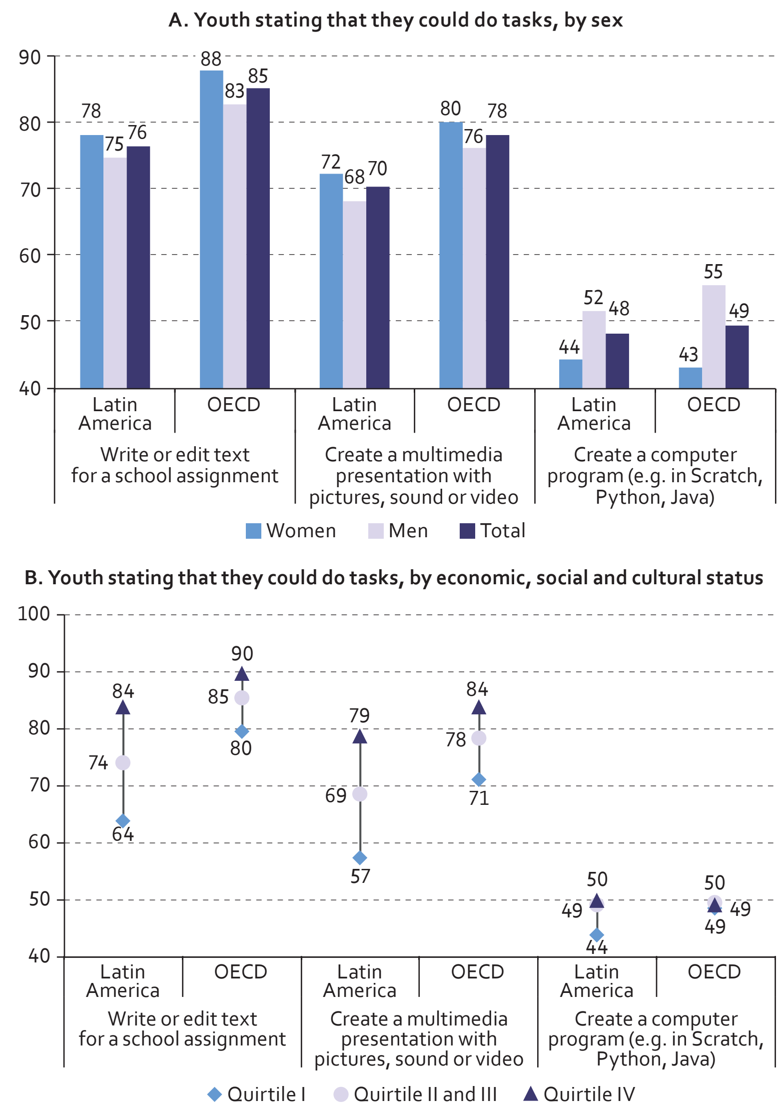
(c) Digital content creation

The competences associated with this area include the ability to create and edit new digital content, integrate and re-elaborate previous knowledge and content, produce creative expressions, media outputs and programming and deal with and apply intellectual property rights and licences.

Three quarters of the 15-year-olds assessed by PISA 2022 in the region said they could write or edit text for a school assignment easily or with a bit of effort, and 7 out of 10 said they could create a multimedia presentation by themselves. When they were asked about their ability to create a computer program, a very different picture emerged, with only 48% of the students participating in the assessment saying they could carry out this task (see figure 11).

Figure 11
Latin America (7 countries) and OECD (27 countries): youth stating that they could do tasks associated with digital content creation competence easily or with a bit of effort, by task and group
(Percentages)



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When it came to tasks associated with the digital content creation competence, a larger proportion of youth in OECD than in the region could easily perform office computing tasks such as writing text or creating presentations, but this difference narrowed when it came to computer programming. In both sets of countries, girls reported higher levels of proficiency in writing and in the creation of presentations using digital devices, with similar gaps relative to boys. In contrast, boys were more likely to report proficiency in computer programming, with gaps of 8 and 12 percentage points in Latin America and OECD, respectively.

Gaps by economic, social and cultural status quartile in the tasks of writing and creating presentations followed the trends described for the competences shown above. On average, the proportion of youth who were proficient in these tasks was 20 percentage points higher in the top quartile than in the bottom quartile in the region. The gap between the top and bottom quartiles in OECD was narrower.

The situation was different for the creation of computer programs, since the gap between the first and last quartiles in Latin America was 6 percentage points in favour of the latter, with a smaller difference between the intermediate groups and the fourth quartile. In OECD, there were no substantial differences between groups of different economic, social and cultural status. Looking at the variations for this task by sex and economic, social and cultural status quartile, both in the region and in OECD, the more economic, social and cultural capital boys have, the greater their self-perceived ability to carry out this activity autonomously, with differences of less than 1 percentage point between the intermediate and top quartiles. The situation of girls, meanwhile, differed between the country groups. In Latin America, the higher their economic, social and cultural status, the larger the proportion reporting being able to program easily or with a bit of effort, whereas in OECD this proportion decreased up the quartiles.

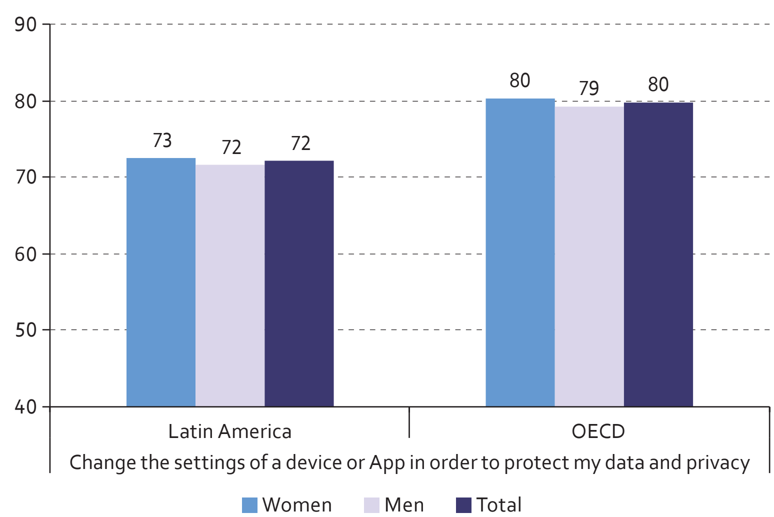
(d) Safety

The tasks associated with the safety competence include personal protection in digital environments, data protection, digital identity protection, security measures and safe and sustainable use of digital resources.

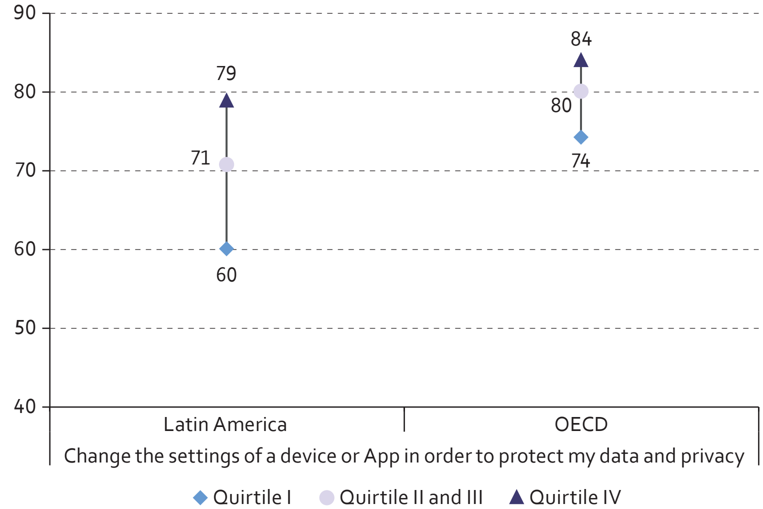
Among the 15-year-old students assessed by PISA 2022 in Latin America, 7 in every 10 reported being able to change the settings of an application or digital device to protect their personal data and privacy (see figure 12).

Figure 12
Latin America (7 countries) and OECD (27 countries): youth stating that they could do tasks associated with safety competence easily or with a bit of effort, by task and group
(Percentages)

A. Youth stating that they could do tasks, by sex



B. Youth stating they could do tasks, by economic, social and cultural status



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Analysis by gender shows that a slightly higher proportion of girls than of boys reported being able to carry out this task on their own in both Latin America and OECD. There was a gap between the region and the more developed countries that favoured OECD students, both in total and by sex. Where economic, social and cultural status quartiles are concerned, the gap between the bottom and top groups was around 20 percentage points in the region and around 10 percentage points in the OECD countries.

(e) Problem-solving

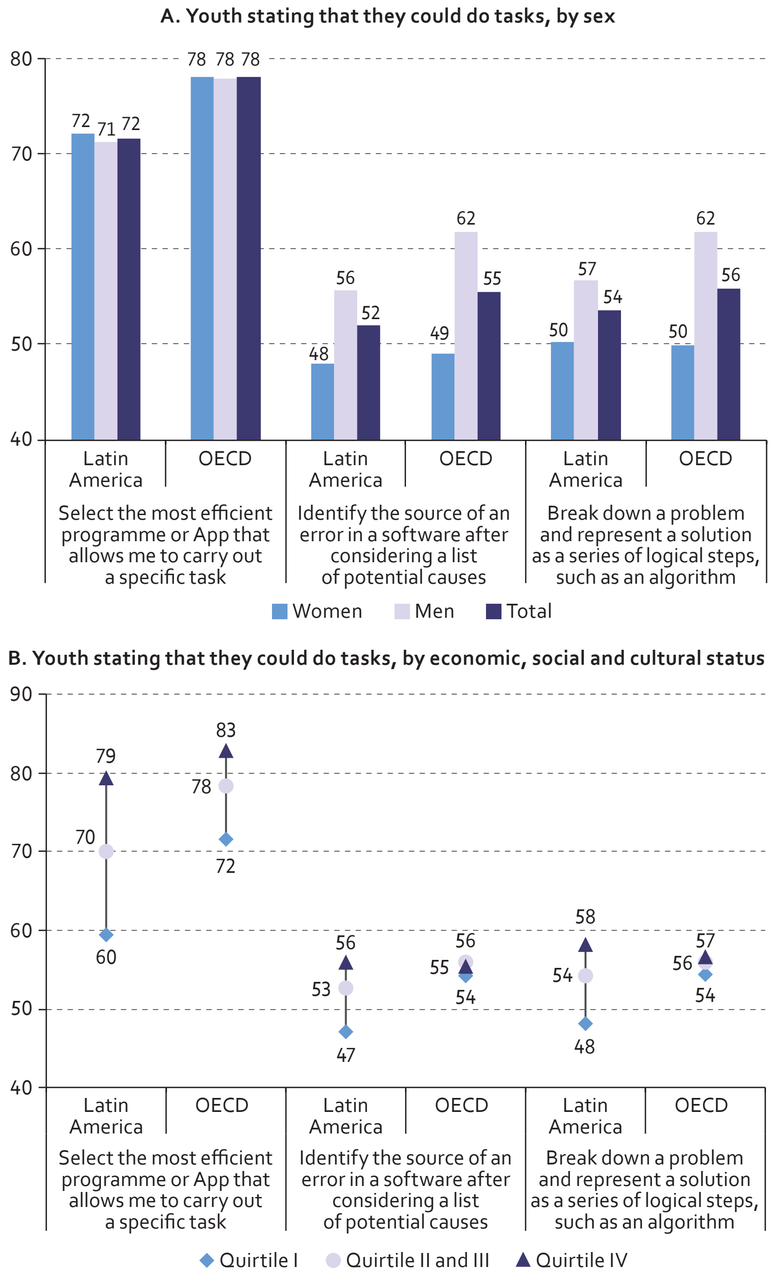
This competence entails the ability to identify digital needs and resources, make informed decisions as to which are the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital means, creatively use technologies, solve technical problems and update one's own and others' competences.

In Latin America, an average of 72% of youth assessed in PISA 2022 reported being able to easily select the most efficient software or application to carry out a specific task, but only 52% reported being able to identify the source of an error in a software by themselves. Similarly, 54% reported being able to autonomously break down a problem and represent a solution as a series of steps (see figure 13).

By sex, the proportion of students who reported being able to choose the right program or application was similar for boys and girls in both Latin America and OECD, with a consistent gap in favour of more developed countries of around 6 percentage points. When it comes to identifying errors in computer programs and planning solutions, however, different relationships are observed. The proportion of girls who could easily perform these tasks was very similar in OECD and Latin America, and in both cases was below the proportion of boys who could do so. Meanwhile, there was a gap of about 5 percentage points in favour of boys from more developed countries.

In terms of the ability to select the right applications or software there were economic, social and cultural status gaps favouring the fourth quartile over the first of around 20 percentage points in Latin America and 10 percentage points in OECD. When it came to identifying software problems and representing solutions in logical steps, the gap favouring the highest quartile over the first was around 10 percentage points in Latin America, while in OECD the difference did not exceed 3 points.

Figure 13
Latin America (7 countries) and OECD (27 countries): youth stating that they could do tasks associated with problem-solving competence easily or with a bit of effort, by task and group
(Percentages)



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D. Summary

Over the last two decades, both the availability of and access to the Internet and digital devices in educational institutions and students' personal access to devices have increased significantly in the countries of the region. However, a further effort is needed to review other factors that determine people's real opportunities for connectivity and ability to take advantage of the benefits of digital technologies for learning activities. Accordingly, ECLAC (2024a) has proposed moving towards meaningful connectivity measurements that include issues related to connection quality, device types and skills. The findings of this chapter illustrate that youth in the region do not make frequent use of digital tools for education activities to the same extent that they do for recreational activities, such as video games and social networks. This could be associated, first, with the fact that the increase in access in the region has been driven mainly by the growth of smartphone use, which has determined the patterns of use of new technologies. Second, limited use of digital devices for school activities may also be due to the fact that teachers receive few incentives from educational institutions to integrate digital tools into their teaching processes.

Notwithstanding, teachers participating in the PISA 2022 study reported prioritizing the development of their students' digital competences, and school leaders stated that teachers had the time and the technical and pedagogical tools to incorporate digital tools into their teaching. However, the tools used in teaching did not seem to be aligned with the interests of youth, who mainly chose to use digital devices for recreational activities.

Students in the region showed greater interest in learning about digital resources and computer programming than their OECD peers. However, problem-solving competences in digital environments seem to have been relatively underdeveloped in the region's young population, as evidenced by the low relative perception of self-efficacy reported by 15-year-old students in the PISA test. Although gender gaps in favour of boys were larger in OECD countries, it is still worrying that female students in the region reported lower motivation to learn programming than their male peers, something that subsequently translates into higher male representation in vocational programmes in the areas of science, technology, engineering and mathematics, and into persistent gender biases in the labour market.

As regards gaps by economic, social and cultural status, the persistent divides in access to and use of devices between different groups, which were wider in Latin America than in the more developed countries, meant that youth with the lowest status tended to have a poorer perception of their ability to carry out activities with digital tools on their own than their peers in more privileged households.

The next section presents policy recommendations for narrowing digital access and competences development gaps in the region, with a view to moving towards greater digital inclusion.

III. Final reflections on how to enhance the development of digital competences among students in the region

ECLAC has included the digital divide among the structural gaps in the development models of Latin America and the Caribbean, since it has become one of the critical problems exacerbating the exclusion of large portions of the population from the benefits of development. Digitalization, however, has the potential to increase the productivity of the region's countries, enhance access to information and knowledge, facilitate access to social services and make public policy implementation more efficient and effective, among numerous other benefits that can help countries to escape the traps of the development crisis (ECLAC, 2024b). Hence, it is important to invest in people and their education from childhood onward as a fundamental strategy for dealing with this gap.

New technologies are increasingly transforming people's daily lives and their opportunities in the productive, social and cultural spheres. For the new generations to be able to perform effectively in this context, they need to develop and strengthen their digital competences from school and through their life cycle, since although they interact with technology from an earlier age than previous generations, they are not necessarily developing the critical skills needed. The role of school as a primary socializer is crucial for fostering the development of these competences in children and adolescents through educational experiences explicitly geared towards this.

The availability of and access to digital devices for school-age students has increased significantly in the region over the last two decades, both inside and outside schools, although still with a lag relative to developed countries. However, this expansion has taken place mainly through mobile connectivity, which suffers from major constraints when it comes to developing certain skills. Access to quality Internet and appropriate devices for using it should be available to all, regardless of their socioeconomic or territorial context or the educational establishment they attend.

The development of digital competences requires the involvement of teachers and responsible adults at home. In the region, although teachers receive few incentives from educational institutions to integrate new technologies into their teaching, they report having professional training in the use of information technologies and state that they treat the development of their students' digital competences as a matter of priority. However, this does not translate into frequent use of digital tools for school activities by adolescents, whereas there is evidence of digital devices being intensively used for recreational activities such as video games and social networking, particularly by those with higher economic, social and cultural status in the countries of the region (with all the risks this entails for their development and well-being).

The data show persistent gaps in device use and self-perceived efficacy in digital environments across different economic, social and cultural groups, which are wider in Latin America than in the more developed OECD countries. Students with lower economic, social and cultural status tend to perceive themselves as less skilled in performing activities with digital tools, while gender differences vary according to the competence assessed. They seem to be more closely linked to the type of activity performed than to the frequency with which digital tools are used. Girls rate themselves higher than boys in digital literacy, their ability to operate safely in digital environments and their skills to use communication and collaboration tools. They also tend to perceive themselves as more skilled at creating digital content with office computing tools, although their self-perceived autonomy in computer programming is lower.

In line with the lesser emphasis given to it by teachers, problem-solving seems to be the least developed competence in the region, as evidenced by the low perception of self-efficacy reported by 15-year-old students in this area. Boys report a greater ability to identify problems in software and break down solutions into logical steps, while girls excel in selecting the most efficient tool to carry out a specific task. This difference also coincides with the motivation to learn programming, where girls show less interest than boys.

Children and adolescents require mediation at home, and for this their parents and caregivers need competences to foster appropriation processes that go beyond technology use, monitoring their online activities to guide and provide tools for safe and critical use. Evidence shows that rather than restricting use, it is advisable for adults both at school and at home to accompany them with active mediation (Trucco, Cabello and Claro, 2022), engaging and guiding their purposes.

Lastly, it is essential to have mechanisms for clearly identifying the competences to be nurtured, measuring progress with them and implementing strategies for their development. For this it is necessary to have nationally agreed competence frameworks to guide teaching processes and the skills to be assessed. However, development of these is only incipient in the region.

The following lines of action for strengthening children's and adolescents' training in digital competences in the education system, with a view to reducing gaps and moving towards universal digital inclusion in the region, are proposed.

A. Narrowing access and connectivity gaps

In Latin America and the Caribbean, the expansion of digitalization has occurred in a context of profound inequalities manifested, among other areas, by considerable gaps in access to both high-quality Internet and appropriate devices for its use. These significant connectivity deficits limit the development of digital competences among children, adolescents and adults, particularly those located at the intersections of the axes of the region's social inequality matrix (ECLAC, 2016), who face major obstacles to digital inclusion.

Thus, the minimum that needs to be achieved in order to foster the development of digital competences in the region's children, adolescents and youth is to even out the conditions of connectivity with a multidimensional and multisectoral approach. This implies involving private and public actors to respond comprehensively to the different needs of the various territories and population groups, implementing inclusion mechanisms and tools, and supporting the work of ministries of technology from the various sectors involved. The digital transformation of education requires greater investment in equipment and connectivity in the educational community and better coordination between education and the digital strategies of each country (Huepe, Palma and Trucco, 2023).

B. Strengthening the development of students' digital competences in teaching and learning processes

Besides ensuring connectivity in education systems and implementing public policies to increase the frequency with which new technologies are used in schools, the development of students' digital competences requires policies for integrating technologies into teaching and learning processes (Katz and others, 2023; Huepe, Palma and Trucco, 2023). Digital education does not merely mean an instrumental use of digital tools in educational environments, but involves a transformation of the way content is taught and assessed and the implementation of a system focused on the different needs, circumstances and contexts of students (Huepe, Palma and Trucco, 2023).

Accordingly, school leaders and teachers need to have clear guidelines that set realistic goals for which digital competences are to be developed in the school environment and how this can be done. That means providing guidelines based on effective practices to foster healthy and meaningful usage patterns from an early age (European Commission, 2020 and 2022) and determining which skills can be effectively incorporated into the curricula of technology or computing classes and which can be nested in other subjects (ITU, 2018). The acceleration of digitalization means that training in digital competences needs to be cross-cutting and implemented through the teaching of other disciplines, e.g. via multimodality in language, representational skills in science, or the development of critical thinking by evaluating information sources in research, among many other possibilities.

Curriculum changes generally take time to be adopted in the education sector, and the speed of technological change means that this has a particularly negative impact on the development of digital competences. Thus, it is also important for educational curricula and syllabuses to be flexible in nature so that they can be updated as new technologies emerge and new competences are required, if they are to fully engage with today's societies and economies (ITU, 2018).

To facilitate the development of digital competences both outside and inside the classroom, greater efforts are needed to ensure that high-quality educational content and resources are available to teachers and students free of charge both in and out of school, are easy to access and use and are aligned with formal curricula (Huepe, Palma and Trucco, 2023). The availability of these digital learning resources and tools could also help create the conditions necessary to sustain teaching and learning processes during periods of school closure, like the one that occurred during the COVID-19 pandemic, and other emergencies (OECD, 2023b).

C. Adopting a digital competences framework to guide training

This document has presented the main digital competences frameworks being used internationally. It recommends the adoption of a specific framework to identify, guide, develop and assess the digital competences of learners, teachers and the wider educational community. The DigComp framework has been adapted to the educational environment in the form of DigCompEdu and has been identified as one of the most comprehensive frameworks for analysing general digital competences at present. Countries could therefore use it and adapt it to their own contexts so that they can go on to identify and assess the competences they consider essential. In any event, the recommendation is to choose a framework that suits the particular characteristics of each country, with a view to guiding and assessing its application in schools. It is particularly important for the framework to be flexible so that it can adapt to changing competence needs in a context of constant technological change, while preserving comparability, as far as possible, between different measures.

D. Developing the digital competences of teachers and caregivers

The development of digital competences in childhood and adolescence requires the mediation of adults with the necessary skills to promote appropriation processes that go beyond the use of technology, providing tools for its safe and critical use in both academic and recreational settings. A number of studies over time have shown that the relationship between ICT use and the development of competences is not linear. Research findings have described that good results in standardized tests are associated with specific uses of technology, highlighting the importance of the mediation received by children and adolescents. However, the evidence suggests that rather than restricting the use of technology, it is advisable for the responsible adults at home and at school to provide support through active mediation, regulating and setting limits, but especially supervising and guiding use (Trucco, Cabello and Claro, 2022).

To begin with, this means strengthening initial and continuing teacher training so that educators develop their own digital competences and are able to integrate new technologies into different teaching modalities and formats, editing, enriching and adapting digital resources to the particular needs of their students (Katz and others, 2023). Ideally, all initial training courses should incorporate the use of digital technologies, with specific courses to deepen particular competences. In addition, mediation that encourages appropriation processes at home requires the implementation of actions to develop the digital competences of parents and caregivers (Trucco and Palma, 2020). The education system can also play a role in supporting the training of parents and caregivers by providing them with guidelines to strengthen their role as mediators.

Competence frameworks can serve as starting points for designing both initial teacher training courses and continuous learning options, including short training courses (European Commission, 2020 and 2022). For in-service training courses to be most effective, support from school administrators is needed to ensure that teachers have time to acquire new skills outside working hours, and to provide incentives for teachers who undergo training, such as extra pay (ITU, 2018).

E. Ensuring protection of children's rights and online data protection

The great technological advances of recent decades and the fact that people are increasingly sharing their information on the Internet has meant that a great deal of personal data are online and highly digitalized. The experience of children and adolescents in the digital world is especially affected by this situation, which means that steps are needed to safeguard their information and empower them to deal with the associated risks. There is a need for a public policy approach that balances protection and the creation of opportunities so that the younger generations become digital citizens and can cope and function properly in the digital environment. This means treating children and adolescents as subjects of rights, without focusing solely on safety (ITU, 2021; Pavez, 2014).

A fundamental step is for the countries of the region to adapt their regulatory frameworks and national legislation to ensure children's rights are protected in the digital environment. This means developing specific laws to regulate the use of children's personal data and setting clear standards for digital platforms and technology companies. Moving towards an approach that safeguards children's privacy and safety, but at the same time does not stifle opportunities in the digital world, is crucial to progress towards full protection of children's rights in accordance with the Convention on the Rights of the Child.

Lastly, cross-sectoral action that includes non-governmental organizations and private companies is necessary to better protect children. This includes, for example, seeking incentives for technology companies that develop educational platforms or tools to implement parental control tools, ethical algorithms and child- and adolescent-friendly privacy policies. Internationally, changes by platforms to the configuration of a range of functions and services have been crucial in improving children's privacy and safety (Wood, 2024).

F. Preparing students to become responsible and creative citizens in the age of artificial intelligence

The rapid emergence of artificial intelligence (AI), which has become increasingly sophisticated and accessible in recent years, is the clearest example of the speed and transformative impact of technological innovation. AI is now part of the digital environment available to the student population, with all that this implies in terms of learning opportunities and teaching efficiency, and of risks and challenges for the education of the new generations. It is crucial to train people to understand the potential benefits of this new generation of technology, as well as the risks associated with its use. Furthermore, the emergence of this new technological transformation is highlighting the central importance of preparing students and the educational community so that they have the capacity to adapt to unforeseen changes, while learning to be both users of AI and potential creators. Another challenge for the education system is to consider the importance of forming upstanding and responsible digital citizens with an ethical understanding of behaviour in the digital age and the limitations that need to be applied in the use of this tool for knowledge production and academic integrity.

Adapting to this new technological transformation exponentially increases the challenge faced by education systems in addressing digitalization, as outlined in this report: upgrading infrastructure and equipment to equalize opportunities for meaningful connectivity, training teachers to educate both with and through digital technologies, and addressing crucial ethical considerations (Molina and others, 2024), particularly with regard to the care of children and their rights.

G. Strengthening the empirical evidence for and assessments of digital competences

To improve the provision and content of the different educational and vocational training initiatives so that they can respond to the dynamic nature of digital competences in a constantly changing world, it is essential to develop periodic, dynamic and prospective systems for assessing the population's level of digital competences and the competences mismatch between the knowledge and skills being taught and the demands of the labour market. Because the measurement of digital competences is relatively new, more research is needed to design assessment instruments suitable for different types of learners and teachers (ITU, 2018). To identify the competences to be assessed, the adoption of competence frameworks is crucial (see section D of this chapter). Where possible, questions could be included in standardized educational surveys or assessments to collect self-reported information on people's levels of digital competences and their needs in this area. This information could be supplemented with subsamples of direct digital competence assessments, allowing for disaggregation across different population groups.

Not only is evidence on the levels of digital competences among children, adolescents and youth in the region limited, but there is also a need to better understand which practices and interventions are most effective in developing them (partly because of the dearth of assessments of the impact of interventions designed for this purpose) and how their development is related to personal and contextual characteristics. This is crucial for designing and implementing effective strategies to develop digital competences with a particular focus on situations of greater vulnerability and people with different levels of competences (Misra, 2022). Furthermore, because the set of digital competences considered important in an increasingly digitalized society includes the knowledge and skills required to use different types of devices, there is also a need to collect more information about the different skills that need to and can be developed on devices other than personal computers, such as mobile phones or tablets, and their different applications (Misra, 2022).

At the same time, there is a need for information systems that regularly map the technological infrastructure and connectivity needs of both educational establishments and households, with particular attention to the situation of the most vulnerable (Katz and others, 2023). Different patterns of use have different impacts on the development of digital competences, so in-depth data collection is also required to analyse the appropriateness and quality of access to the Internet and devices, for example by asking about connection types and speeds, or about time spent on specific school activities (Claro and others, 2011), and by exploring the impact of different types of use on the development of particular digital competences.

Lastly, for training programmes to be able to adapt to the changing needs of the digital world, programme monitoring systems are required to assess the impact of different educational and training initiatives and update them periodically as required (ITU, 2018). At the same time, developing systems to collect information on and evaluate the results of the training activities implemented will make it possible to apply results-based budgeting mechanisms that ensure budgetary resources are used equitably and efficiently (Katz and others, 2023).

H. Ensuring the financial sustainability of policies to promote the development of digital competences

The digital transformation of education requires financial sustainability to ensure both "hard" investment in infrastructure and access to equipment, and "soft" investment focused on developing the competences of the different stakeholders in the education community.

Ensuring medium- and long-term funding for the development of digital inclusion policies requires allocating specific financial resources within education budgets for the development and maintenance of these policies. These resources must be allocated in a regular and sustained way, considering the strategic importance of digital inclusion for inclusive social development, a fundamental dimension of sustainable development. This can be achieved, among other actions, by establishing strategic partnerships with the private sector and encouraging the participation of companies and organizations that can provide resources for the development of digital inclusion policies (collaboration agreements, donations or investment in digital education projects) (Katz and others, 2023).

Building up the funding necessary for the digital transformation of education systems and the development of students' digital competences requires political will and cross-cutting agreements to sustain initiatives over time, as well as coordination of efforts through an intersectoral policy that involves private actors, academia, civil society, and national and local governments], among other stakeholders (Katz and others, 2023; Misra, 2022). National efforts can be driven by different initiatives, such as socioeconomic development plans, education or technology ministry strategies, digital planning strategies, or a combination of all of these.

As discussed throughout this document, the rapid digital transformation, among other dimensions, will require investment in the training and development of the digital competences of the new generations. This investment and its potential results will shape the strategies that the countries of the region can implement to achieve digital inclusion and advance towards inclusive social development.

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Annex A1

Table A1.1
Mean differences in summative index scores for tasks that 15-year-old students reported being able to perform easily or with a bit of effort in the PISA 2022 test, by economic, social and cultural status, sex and country, 2022

Country	Girls relative to boys	Fourth economic, social and cultural status quartile relative to first	Fourth economic, social and cultural status quartile relative to second and third	Second and third economic, social and cultural status quartiles relative to first
Argentina	-0.1	3.5[a]	1.6[a]	1.9[a]
Brazil	0.6[a]	3.0[a]	1.5[a]	1.5[a]
Chile	0.0	1.3[a]	0.5[a]	0.8[a]
Costa Rica	-0.3[a]			
Dominican Republic	0.8[a]	2.9[a]	1.8[a]	1.1[a]
Panama	-0.1	4.2[a]	2.3[a]	1.9[a]
Uruguay	0.1	2.8[a]	1.6[a]	1.2[a]
Australia	0.1	1.3[a]	0.4[a]	0.9[a]
Austria	0.0	1.6[a]	0.5[a]	1.1[a]
Belgium	-0.1	1.6[a]	0.6[a]	0.9[a]
Czechia	-0.2[a]	1.3[a]	0.4[a]	0.9[a]
Denmark	-0.4[a]	1.1[a]	0.5[a]	0.6[a]
Estonia	-0.2	1.0[a]	0.6[a]	0.4[a]
Finland	-0.3[a]	1.0[a]	0.5[a]	0.6[a]
Germany	-0.3[a]	1.7[a]	0.7[a]	1.0[a]
Greece	0.5[a]	2.1[a]	0.9[a]	1.2[a]
Hungary	-0.3[a]	1.7[a]	0.7[a]	1.0[a]
Iceland	-0.3	1.0[a]	0.3	0.7[a]
Ireland	0.1	0.8[a]	0.2[a]	0.5[a]
Israel	0.7[a]	3.0[a]	1.2[a]	1.8[a]
Italy	0.2[a]	1.1[a]	0.5[a]	0.6[a]
Japan	-0.1	1.4[a]	0.6[a]	0.8[a]
Latvia	-0.1	1.1[a]	0.5[a]	0.6[a]
Lithuania	-0.1	1.0[a]	0.3[a]	0.6[a]
Poland	0.1	1.6[a]	0.7[a]	0.9[a]
Republic of Korea	0.3[a]	1.1[a]	0.2	0.9[a]
Slovakia	0.3[a]	2.8[a]	1.1[a]	1.7[a]
Slovenia	0.2[a]	0.7[a]	0.7[a]	0.0
Spain	0.0	1.1[a]	0.4[a]	0.6[a]
Sweden	0.1	1.9[a]	0.8[a]	1.1[a]
Switzerland	-0.4[a]	1.1[a]	0.2	0.9[a]
Türkiye	0.4[a]	1.9[a]	0.7[a]	1.2[a]
United Kingdom	-0.1	1.2[a]	0.6[a]	0.6[a]
United States	0.1	1.4[a]	0.8[a]	0.6[a]

Source: Prepared by the authors, on the basis of Organisation for Economic Co-operation and Development (OECD), Programme for International Student Assessment (PISA) 2022.
[a] Indicates that the difference is statistically significant at the 0.05 level.

Table A1.2
Differences by sex in the proportion of 15-year-old students reporting being able to complete each task in PISA 2022 easily or with a bit of effort, by country, girls relative to boys
(Percentage points)

	Search for and find relevant information online	Assess the quality of information you found online	Share practical information with a group of students	Collaborate with other students on a group assignment	Explain to other students how to share digital content online or on a school platform	Write or edit text for a school assignment	Collect and record data (e.g. using Access, Google Form, spreadsheets)	Create a multimedia presentation (with sound, pictures or video)	Create, update and maintain a webpage or a blog	Change the settings of a device or App in order to protect my data and privacy	Select the most efficient programme or App that allows me to carry out a specific task	Create a computer program (e.g. in Scratch, Python, Java)	Identify the source of an error in a software after considering a list of potential causes	Break down a problem and represent a solution as a series of logical steps, such as an algorithm
Argentina	1	-1	1	1	0	0	1	3	1	1	-1	-5[a]	-8[a]	-5[a]
Brazil	9[a]	7[a]	8[a]	8[a]	6[a]	6[a]	3[a]	5[a]	6[a]	5[a]	3[a]	-7[a]	-5[a]	-4[a]
Chile	2	0	1	2	3[a]	2	1	4[a]	6[a]	-1	0	-7[a]	-8[a]	-5[a]
Costa Rica	3[a]	1	-1	2	0	2[a]	0	2	0	-3[a]	-1	-10[a]	-13[a]	-13[a]
Dominican Republic	10[a]	9[a]	8[a]	10[a]	10[a]	8[a]	6[a]	8[a]	4[a]	5[a]	5[a]	-4[a]	-2	-3
Panama	3	3	4	7[a]	0	2	3	3	0	0	-2	-9[a]	-9[a]	-9[a]
Uruguay	4[a]	4[a]	2	4[a]	3[a]	3[a]	3[a]	4[a]	-1	-1	1	-9[a]	-10[a]	-7[a]
Australia	7[a]	5[a]	6[a]	6[a]	2[a]	2[a]	2[a]	5[a]	3[a]	1	1	-10[a]	-11[a]	-9[a]
Austria	4[a]	3[a]	3[a]	4[a]	7[a]	6[a]	4[a]	4[a]	-3[a]	2	1	-16[a]	-16[a]	-14[a]
Belgium	2[a]	2[a]	3[a]	3[a]	2	4[a]	3[a]	3[a]	-5[a]	2	0	-10[a]	-13[a]	-11[a]
Czechia	7[a]	5[a]	6[a]	6[a]	3[a]	4[a]	1	4[a]	-4[a]	-1	-2	-17[a]	-15[a]	-15[a]
Denmark	7[a]	5[a]	4[a]	4[a]	2	3[a]	1	5[a]	-4[a]	-3[a]	-3[a]	-21[a]	-19[a]	-14[a]
Estonia	6[a]	3[a]	3[a]	4[a]	2[a]	5[a]	2	0	-4[a]	2[a]	-2	-11[a]	-14[a]	-10[a]
Finland	7[a]	4[a]	4[a]	5[a]	0	4[a]	2	1	-3[a]	1	-1	-20[a]	-10[a]	-17[a]
Germany	7[a]	2[a]	4[a]	4[a]	4[a]	6[a]	1	3[a]	-2	2	-4[a]	-20[a]	-20[a]	-15[a]
Greece	-2[a]	1	0	3[a]	7[a]	6[a]	3[a]	4[a]	2	7[a]	5[a]	-6[a]	-5[a]	-6[a]
Hungary	4[a]	2	1	1	3[a]	3[a]	3[a]	2	-4[a]	-1	-2	-13[a]	-19[a]	-17[a]
Iceland	5[a]	1	4[a]	3[a]	1	3[a]	2	3	-4	-2	-5[a]	-18[a]	-14[a]	-12[a]
Ireland	10[a]	7[a]	7[a]	6[a]	4[a]	5[a]	3[a]	5[a]	2	2[a]	1	-6[a]	-10[a]	-8[a]
Israel	5[a]	4[a]	3[a]	4[a]	5[a]	6[a]	2	5[a]	8[a]	2	3[a]	-13[a]	-11[a]	-12[a]
Italy	2	1	0	2	6[a]	5[a]	2	7[a]	3[a]	1	2	-11[a]	-12[a]	-14[a]

	Search for and find relevant information online	Assess the quality of information you found online	Share practical information with a group of students	Collaborate with other students on a group assignment	Explain to other students how to share digital content online or on a school platform	Write or edit text for a school assignment	Collect and record data (e.g. using Access, Google Form, spreadsheets)	Create a multimedia presentation (with sound, pictures or video)	Create, update and maintain a webpage or a blog	Change the settings of a device or App in order to protect my data and privacy	Select the most efficient programme or App that allows me to carry out a specific task	Create a computer program (e.g. in Scratch, Python, Java)	Identify the source of an error in a software after considering a list of potential causes	Break down a problem and represent a solution as a series of logical steps, such as an algorithm
Japan	9[a]	4[a]	8[a]	6[a]	-1	6[a]	0	5[a]	0	-2	1	-5[a]	-9[a]	-8[a]
Latvia	5[a]	4[a]	6[a]	6[a]	2	5[a]	4[a]	3[a]	2	1	2	-14[a]	-15[a]	-11[a]
Lithuania	2[a]	-2[a]	2	4[a]	2[a]	4[a]	3[a]	1	-1	0	0	-11[a]	-11[a]	-10[a]
Poland	4[a]	3[a]	4[a]	4[a]	3[a]	5[a]	1	7[a]	1	4[a]	1	-10[a]	-9[a]	-10[a]
Republic of Korea	7[a]	5[a]	6[a]	6[a]	6[a]	7[a]	3[a]	6[a]	12[a]	5[a]	3[a]	-11[a]	-15[a]	-11[a]
Slovakia	7[a]	5[a]	4[a]	3[a]	5[a]	9[a]	5[a]	4[a]	-2	4[a]	2	-9[a]	-13[a]	-10[a]
Slovenia	6[a]	5[a]	4[a]	3[a]	7[a]	7[a]	3[a]	3[a]	-4[a]	1	2	-16[a]	-13[a]	-15[a]
Spain	5[a]	1	5[a]	3[a]	6[a]	5[a]	3[a]	7[a]	3[a]	-1	1	-12[a]	-12[a]	-14[a]
Sweden	10[a]	7[a]	6[a]	7[a]	4[a]	6[a]	5[a]	2	1	0	1	-8[a]	-7[a]	-10[a]
Switzerland	5[a]	2[a]	3[a]	4[a]	0	5[a]	-6[a]	2[a]	-7[a]	-3[a]	-3[a]	-16[a]	-22[a]	-20[a]
Türkiye	10[a]	6[a]	7[a]	5[a]	7[a]	8[a]	2	4[a]	3[a]	3[a]	2[a]	-10[a]	-8[a]	-5[a]
United Kingdom	4[a]	1	3[a]	3[a]	1	4[a]	0	4[a]	-1	0	-2	-13[a]	-14[a]	-16[a]
United States	7[a]	6[a]	5[a]	4[a]	3[a]	4[a]	1	5[a]	1	1	1	-8[a]	-10[a]	-7[a]

Source: Prepared by the authors, on the basis of Organisation for Economic Co-operation and Development (OECD), Programme for International Student Assessment (PISA) 2022.

[a] Indicates that the difference is statistically significant at the 0.05 level.

The Economic Commission for Latin America and the Caribbean considers the digital divide to be one of the structural gaps reflected in the development models of Latin America and the Caribbean. Despite the expansion of digital connectivity and equipment, gaps remain with regard to access, use of digital tools and especially competences that would allow the entire population to benefit from the opportunities of the digital age. It is essential to invest in people and their education from childhood to address this gap and advance towards digital inclusion as part of inclusive social development. This document examines the role of the education system in building digital competences among the new generations. First, it systematizes the main internationally developed frameworks for digital competences, then it presents an assessment of the opportunities for developing technological competences on the basis of the information drawn from the PISA 2022 measurement carried out by the Organisation for Economic Co-operation and Development. The document concludes with some reflections on how training in digital competences can be strengthened in the region's schools.

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