OECD Skills Studies

Making the Most of Technology for Learning and Training in Latin America

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BETTER POLICIES FOR BETTER LIVES

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Foreword

The digital transformation is reshaping people's lives, workplaces and economies. It changes what individuals do at work, how they interact with each other, where and when they buy products and how they learn. Skills are crucial to thrive in an increasingly digital and interconnected world. To reap the benefits of the new technological wave, each country relies on the skills of its population and its skills-related policies. Latin American countries are still lagging behind many countries in terms of the skills of their citizens, but the digital transformation provides new opportunities to catch up. New technologies bring countless opportunities for learning at any time, in any place and at all stages of life. From online tutorials to open education resources, online degrees or educational software, new technologies open the door to new forms of developing skills and acquiring knowledge.

This report draws on the OECD Programme for International Student Assessment (PISA), the Teaching and Learning International Survey (TALIS) and the Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), to examine how Latin American countries can make the most of the digital transformation to develop their students and adults' skills. In particular, this report identifies barriers to accessing ICT infrastructure and connectivity limitations in Latin America, and provides recommendations for how they can be overcome to ensure that all students and individuals can benefit from new learning opportunities. It also emphasises the importance of rethinking how ICTs are integrated in initial education in order to seize the benefits of new technologies in Latin American schools and enhance students' skills. Teachers are pivotal for making the most of new technologies in schools. Therefore, this report explores Latin American teachers' use of new technologies, and how policies can best support teachers as digital tools enter their classrooms. Finally, new ways of learning are emerging and this report investigates the potential of open education and MOOCs in reaching those adults who are most in need of training in Latin America.

Supporting the Latin American region in taking advantage of the digital transformation to boost productivity, social inclusion and strengthen institutions and governance is a priority for the OECD's engagement with Latin America. The OECD Regional Programme for Latin America and the Caribbean, founded in 2016 as a space for evidence-based policy dialogue to bring countries in the region closer to OECD standards and best practices, recently explored these issues during its Third Ministerial Summit on Productivity: "Harnessing the Digital Transformation to Boost Productivity in Latin America and the Caribbean", which took place on 25 October 2019 in Bogota, Colombia. The Programme is committed to leveraging the organisation's work on digital transformation in various areas, such as skills, digital infrastructure, measurement, and artificial intelligence, to assist the Latin American region in better shaping and harnessing its digital transformation and potential.

This report was prepared by Andreea Minea-Pic from the OECD Centre for Skills, under the supervision of Fabio Manca (Head of the Skills Analysis team). Montserrat Gomendio (Head of the OECD Centre for Skills) and Andrew Bell (Head of the National Skills Strategy project) provided guidance, oversight and comments. Stefano Scarpetta (OECD Director for Employment, Labour and Social Affairs) ensured strategic oversight for the project. The report has benefitted from helpful comments provided by staff at the Fundación Telefónica.

Three LAC countries are OECD member states: Chile, Colombia and Mexico. The OECD average includes Chile and Mexico. Colombia was not an OECD Member at the time of preparation of this publication. Accordingly, Colombia does not appear in the list of OECD members and is not included in the zone aggregates. Argentina, Brazil and Peru are partner countries to the OECD. On 15 May 2020, the OECD Council invited Costa Rica to become a Member. At the time of preparation of this publication, the deposit of Costa Rica's instrument of accession to the OECD Convention was pending and therefore Costa Rica does not appear in the list of OECD Members and is not included in the OECD averages reported.

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Andreea Minea-Pic and Jennifer Cannon co-ordinated production. Jennifer Cannon also provided valuable support in the editorial process, while Rasa Silyte-Niavas provided administrative support.

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Executive summary

The COVID-19 pandemic has dramatically altered the lives of all individuals around the globe and changed the way people work and learn. As a response to the COVID-19 health crisis, for instance, many countries have decided to close schools, colleges and universities. Online and digital learning have become key for students to continue developing their skills and schools around the world have implemented digital solutions to face the crisis. Similarly, lockdowns around the globe have impeded many adults from physically going to work, making the use of digital technologies and smart working arrangements, whenever possible, more important than ever. Strengthening the digital skills of populations and improving access to online learning opportunities is critical to face the challenges of the future, and its importance will be heightened in the turbulent post COVID-19 world. This report provides valuable information on the specific challenges Latin American countries face in making the most of digital technologies for learning.

From initial to higher education and adult training, new technologies open the door to innumerable learning activities, available at any time, from anywhere and to anyone. In schools, the use of new technologies can support the development of 21st century skills, facilitate the deployment of innovative learning practices and personalise learning to engage students who are at risk of being left behind. For adults, digital resources expand opportunities to acquire knowledge and develop skills flexibly, at any point in life, for job-related purposes or just for the pleasure of learning.

This report shows that countries in Latin America need to help individuals strengthen their skills to thrive in a rapidly changing world of work and societies, as all Latin American countries for which information is available display high shares of low-performing students and adults. Technology can be part of the solution to foster the skills individuals need to engage in societies and in an increasingly digital-intensive future. However, in Latin American countries, the use of technology for learning and skills development has not reached its full potential yet. Different challenges emerge.

Boosting connectivity and Internet adoption is an essential first step in making the most of all the new learning and training opportunities brought about by new technologies. Digital divides are, however, still an obstacle for learning with new technologies in Latin America. Socio-economic background, for instance, plays an important role in Latin American students' access to technology. Around 18% of Latin American 15-year-olds from socio-economically disadvantaged backgrounds lack an Internet connection at home and at school, in contrast to less than 2% on average across OECD countries. Some 24% of them do not have access to a computer (desktop, laptop or tablet) neither at home, nor at school. These are challenges that policy makers should address urgently to provide equal opportunities to all students. Public institutions and in particular schools in Latin America can play a leading role in bringing individuals and young people on line.

In initial education, more should be done to integrate technology innovatively in teaching and learning practices as this is crucial to boost every student's performance and the ability to develop skills. To be successful, digital technologies need to be introduced into schools as part of a comprehensive approach that aligns technology use with curricular needs, and includes teacher training and ICT support. This sort of comprehensive approach is essential to ensure that innovative uses of new technologies support teaching and learning practices. Gamification, flipped instruction or blended learning are some examples of innovative practices that can rely on digital technologies and show great potential for improved learning.

In this context, Latin American teachers play a pivotal role in realising the untapped potential of new technologies in initial education. Teachers in Latin American countries with available data report high levels of openness to innovation in their school, similar to those observed among OECD countries, and hence of potential readiness to adopt new technologies in schools.

Accounting for curricular needs and teachers' objectives is key when introducing digital technologies in schools. Similarly, providing ICT support and high-quality training to teachers on both 'when' and 'how' to integrate technology in their teaching are essential to ensure that technology is used at its best potential in the classroom. Those digital tools that reach schools and classrooms need to be of high quality, carefully designed and tailored to benefit teaching and improve student learning. In many Latin American countries, there is still scope for a more efficient and innovative integration of digital technologies in teaching and learning practices to allow everyone to reap the benefits stemming from the digital revolution.

Digitalisation is also transforming the world of work, making lifelong learning of paramount importance. Against this backdrop, Latin American countries need to foster high quality, flexible options for learning at all stages of life. In Latin American countries with available data, however, participation in formal and non-formal job-related adult learning is far from being widespread. New technologies can contribute to finding a solution to this problem by providing new opportunities for developing skills and engaging individuals who may find standard forms of adult training to be of difficult access, ineffective or of insufficient quality.

Those individuals who engage in open or distance education for job-related reasons tend to find it useful. Around 55% of Latin American adults who engage in open or distance education do so in order to perform better at their jobs and to improve their career prospects. Personal interests or desire to enhance one's knowledge or skills in a specific area come second among reasons for participation. This pattern holds in OECD and Latin American countries alike. Individuals who combine work and education are the most numerous to engage in open education.

That being said, in Latin American and OECD countries alike, participation levels in open and distance education increase with the level of skills (whether in literacy or problem solving in technology-rich environments) and with educational attainment. Conversely, workers who lack a contract in their current job are less likely to engage in open or distance education.

Policy makers should be careful when leveraging these tools as patterns of participation in open and distance education tend to reproduce or even amplify patterns of participation in standard forms of adult learning and therefore, potential inequalities. Tailored policy intervention is, therefore, needed to engage low-skilled workers in adult learning and make them part of the digital revolution.

1 Overview

Societies around the globe are rapidly changing and digitalisation is bringing challenges as well as opportunities for learning and skills development. In Latin America, reducing digital divides and boosting Internet adoption is a first step to making the most of learning opportunities brought about by new technologies. That is not enough: new technologies should be integrated more efficiently in initial education by, for instance, providing high quality and comprehensive training to teachers. In turbulent post COVID-19 times, in Latin America as in other countries, there is also scope to further harness the potential of open education and MOOCs in reaching adults most in need of training.

Digitalisation transforms the world of work and societies, while it also brings many opportunities for learning and skills development. Latin American countries are lagging behind OECD economies with respect to the skills of their populations but digital technologies can be part of the solution. From initial to higher education and adult training, new technologies open the door to innumerable learning activities, available at any time, from anywhere and to anyone. In schools, the use of new technologies can support the development of 21st century skills, facilitate the deployment of innovative learning practices and personalise learning to engage students who are at risk of being left behind. For adults, digital resources expand opportunities to acquire knowledge and develop skills flexibly, at any point in life, for job-related purposes or just for the pleasure of learning.

Boosting connectivity and Internet adoption is a first step to make the most of learning opportunities brought about by new technologies in Latin America

Although the lack of connectivity is an obstacle for technology-driven learning in Latin America, this is not the only factor. The lack of skills and digital competence, as well as security and affordability-related challenges remain Latin America's most relevant barriers for Internet adoption. To ensure that Latin American individuals have the possibility to make the most of new technologies for learning and training, enhancing connectivity is only the first step.

Countries in the region need to help individuals strengthen their skills to engage in rapidly changing world of work and societies.

- Only less than 10% of individuals in Chile, Ecuador, Mexico and Peru have a well-rounded level of literacy, numeracy and problem-solving skills in technology-rich environments and around 42% of Latin American 15-year-olds who participated in the Programme for International Student Assessment (PISA) in 2018 are low performers in science, reading and mathematics. In the Dominican Republic, this share goes up to 75%.

Digital divides or inequalities in the access, use or benefits derived from the use of information and communication technologies (ICT) are still obstacles for learning with new technologies in Latin America.

- Penetration of broadband services is low relative to levels observed in OECD countries. In 2017, penetration of mobile broadband was, on average, of 64.9% in Latin American countries in contrast to 102% for OECD countries. Penetration of fixed broadband was just above 12% in contrast to more than double (30%) in OECD countries. Some Latin American countries, together with Asia and Africa, also fare poorly in terms of average Internet connection speed relative to OECD countries. Inequalities also persist across and within countries in the region in individuals' access and use of digital technologies by socio-economic status, gender, age and territory.

Public institutions and in particular schools can play a leading role in bringing individuals and young people on line.

- Connectivity remains a challenge for the overall population in Latin America, but this is less so for students as public institutions and, in particular, schools are helping to bridge this divide. Around 75% of students in the region reported having access to a computer, desktop or laptop in their school and a similar share to have an Internet connection.
- Schools in many Latin American countries play an important role in bringing connectivity to ICT to many disadvantaged students who would otherwise be left disconnected. Around 25% of socio-economically disadvantaged students in Latin American countries have access to a computer only when at school and 16% of them are able to go on line exclusively when at school, lacking the chance to connect when at home. In Peru, almost two-thirds have access to a computer solely in the school premises and more than one-third of students have Internet access only at school.
- In Colombia, Mexico and Peru, schools act as Internet providers for more than 20% of rural students who lack access at home but who can go on line at school. Schools, more generally, also play an important role in making computers, and not only connection to the Internet, available for rural students in those same countries. For instance, more than 41% of rural students in Peru have access to a desktop/computer/tablet only at school. In Colombia, this is the case for 20% of rural students and in Mexico for 27% of them.

Socio-economic background plays an important role in students' access to technology in Latin America, leading to divides that policy makers should address.

- Around 18% of Latin American 15-year-olds from socio-economically disadvantaged backgrounds lack an Internet connection at home and at school, in contrast to less than 2% on average in OECD countries. Some 24% of them, in addition, do not have access to a computer (desktop, laptop or tablet) neither at home, nor at school. In contrast, computer access of socio-economically advantaged students in Latin American countries is comparable to that of students in OECD countries: in Latin American and OECD countries alike, less than 1% of socio-economically advantaged students lack access to a desktop, laptop or tablet. Important divides persist between advantaged and disadvantaged students and need urgent policy intervention to make the digital revolution truly inclusive across the countries of the region.
- The extent to which disadvantaged and advantaged students are able to connect varies widely across countries in the region. Among countries with available data, the digital divide between advantaged and disadvantaged students is especially large in the Dominican Republican, Mexico and Peru. One-third of disadvantaged students in the Dominican Republic are not able to connect to the Internet and 40% of them lack access to a computer.

Relative to other potential barriers, shortage or inadequacy of digital technology for instruction (e.g. software, tablets, computers, smart boards) and insufficient Internet access are very often reported to be important challenges hindering instruction in Latin America schools.

- Much needs to be done to put teachers and schools in a position to make the most of the digital revolution for learning and teaching activities. In particular, some 51% of principals, on average in the region, report insufficient Internet access as a barrier and around 43% of principals in the region complain about the shortage or inadequacy of digital technology for instruction.

In Latin America, new technologies should be integrated more efficiently in initial education

All Latin American countries display shares of low-performing students well above the OECD average and new technologies can bring opportunities to enhance student outcomes.

Addressing connectivity is crucial, but it is not enough to improve learning or academic outcomes and in Latin America, the use of technology for learning and skills development has not reached its full potential yet. Integrating technology innovatively in teaching and learning practices is crucial and Latin American teachers play a pivotal role in realising the untapped potential of new technologies in initial education.

When technology is blended into innovative teaching and learning practices, it can enhance student performance. To be successful, however, digital technologies need to be introduced into schools as part of a comprehensive approach that aligns technology use with curricular needs, and includes teacher training and ICT support. This sort of comprehensive approach is essential to ensure that innovative uses of new technologies support teaching and learning practices.

- Technology use should not be the objective but rather a tool to leverage more innovative pedagogies. Simply delivering content through technology, substituting teaching by using computers or reproducing traditional pedagogies using ICT is unlikely to result in better outcomes. The way technology is integrated in teaching and learning activities is crucial to enhance student outcomes, and when these pre-conditions are missing, students' performance may not improve or even be hindered. Gamification, flipped instruction or blended learning are some examples of innovative practices that can rely on digital technologies and show great potential for improved learning. Teachers in Latin American countries with available data report high levels of openness to innovation in their school, similar to those observed among OECD countries, and hence of readiness to adopt new technologies in schools. Most teachers, in between 71% in Chile and up to 80% in Brazil, report being open to change and similar shares also declare to search for new ways to solve problems in the classroom.
- A comprehensive approach is needed to make the most of new technologies in initial education in Latin America. Teachers are a cornerstone of this approach. Accounting for curricular needs and teachers' objectives is key when introducing digital technologies in schools. Similarly, providing ICT support and high-quality training to teachers on both 'when' and 'how' to integrate technology in their teaching are essential to ensure that technology is used at its best potential in the classroom. Those digital tools that reach schools and classrooms need to be of high quality, carefully designed and tailored to benefit teaching and improve student learning. In many Latin American countries, there is still scope for a more efficient and innovative integration of digital technologies in teaching and learning practices to allow everyone to reap the benefits stemming from the digital revolution.

Providing high quality and comprehensive training to teachers is crucial to make the best out of new technologies for teaching and learning

Integrating technology in innovative teaching and learning practices is crucial and Latin American teachers play a pivotal role in realising the untapped potential of new technologies in initial education.

Training in ICT skills for teaching, teacher self-efficacy and collaboration with other teachers matter for teachers' use of ICT in class and their self-efficacy in supporting student learning using digital technologies.

- Whether in Latin American or OECD countries, teachers' use of ICT in class and self-efficacy in supporting student learning using ICT relate strongly to their training in ICT skills for teaching. Merely receiving training in the use ICT for teaching in their initial education is not sufficient to enable teachers' use of ICT in their classroom and their self-confidence in supporting student learning through digital technologies. What drives Latin American teachers' use of ICT is how well prepared they actually felt after receiving training. Participation in professional development in ICT skills for teaching seems, also, to be very important.
- Teachers who feel more efficient about their instruction are more likely to let their students use ICT frequently for learning activities and feel more confident about their capacity to support learning using new technologies. In addition, the likelihood that teachers let their students use ICT frequently also increases with teachers' degree of collaboration with other teachers.

Many Latin American teachers use technologies in the classroom and receive training in ICT skills for teaching.

- In Latin American countries with available data in TALIS (2018), many teachers frequently use technology in the classroom and feel quite confident about their capacity to support student learning through ICT use. Latin American teachers seem to use ICT in class with relatively higher frequency than their OECD counterparts. However, these data do not allow knowing how technology is integrated in teaching practices. In addition, teachers' self-efficacy in ICT use for student learning is based on self-evaluative questions and replies may reflect the opinion of teachers about what they think it is expected from them rather than an objective assessment of their capacity to effectively integrate digital technologies in the classroom.
- More than 70% of teachers in Latin America let their students use ICT frequently or always for projects or class work. Aggregate results hide, however, large disparities within the region. In Brazil, only 41% of lower secondary teachers display a high frequency use of ICT in class and one in five teachers never relies on ICT for class work.
- Many Latin American teachers report having received training in the use of ICT for teaching as part of their initial teacher education or training. In Chile, Colombia and Mexico, more than 70% of lower-secondary teachers report having trained in the use of ICT for teaching during their initial teacher education. Similarly, many report having engaged in professional development activities to develop their ICT skills for teaching. Colombia displays one of the largest shares of teachers who have engaged in professional development in ICT skills for teaching in the year prior to the survey (78%).
- In addition, a relatively high share of teachers in Latin American countries train through technology. On average, around 40% of Latin American lower-secondary teachers have participated in online courses or seminars as part of their professional development activities.

Teachers' training needs in ICT skills for teaching remain high, raising the need to revisit how teachers are trained for teaching with new technologies.

- As many as 60% of Latin American teachers report the need for further professional development in ICT skills for teaching and for 22% the need is substantial. Even when they already received training in ICT skills for teaching in the year prior to the survey, a relatively large share of Latin American teachers still report high levels of need in professional development.
- In Colombia, the level of self-reported need for further training in ICT is much larger than in the majority of OECD countries, irrespective of whether teachers have already participated or not in professional development activities in ICT skills for teaching. In Brazil and Buenos Aires (Argentina), more than 30% of lower-secondary teachers did not participate in ICT-related professional development activities and report a high level of need in this area.
- Spending on high-quality professional development for teachers is considered a highly important spending priority for many more Latin American teachers than for OECD ones, pointing to the need to reinforce quality, more than quantity of teachers' training. In particular, in a scenario where the education budget were to increase, 86% of Latin American teachers consider that spending on the provision of high-quality professional development would be of high importance. Evidence suggests that in many Latin American countries, the accessibility and quality of professional development programmes should be a major focus for policy intervention.
- Teachers in Latin American countries with available data in the OECD Survey of Adult Skills (PIAAC) perform poorly in problem solving in technology-rich environments. Across the countries participating in the OECD Survey of Adult Skills (PIAAC), the share of teachers with low problem solving skills in technology-rich environments varies from less than 5% in Australia to around 54% in Ecuador. Teachers' skills relate to student performance. Substantial gains in students' performance could be obtained by strengthening teachers' skills and this should become a priority for Latin American governments.

There is scope to further harness the potential of open education and MOOCs in reaching adults most in need of training

Digitalisation transforms workplaces and Latin American countries need to foster high quality, flexible options for learning at all stages of life.

- Latin American countries are lagging behind in terms of exposure to digitalisation, but as technologies progressively permeate every aspect of work and societies, this situation is expected to change rapidly in the future. Latin American individuals and workers will need to be equipped with a well-rounded set of skills to be able to adapt to these changes.
- Skills are crucial to thrive in an increasingly digital and interconnected world, but Latin American countries perform poorly in terms of their populations' skills. Latin American countries display particularly large shares of young people lacking basic skills. In Ecuador and Peru, almost half of young people aged 16-24 perform poorly in literacy, numeracy and problem solving in technology-rich environments. The same holds for prime-age individuals: more than 60% of them lack basic skills.

- In Latin American countries, participation in formal and non-formal job-related adult learning is not widespread. Around 24% of adults in Latin American countries who wanted to participate (more) in training, did not do so because training was too expensive. In contrast, this is the case for only 16% of adults in OECD countries. More worryingly, a large share of adults in OECD (50%) and Latin American countries (57%), do not participate and do not want to participate in training.
- New technologies can contribute to finding a solution to these problems by providing new opportunities for developing skills and engaging individuals who may find standard forms of adult training to be of difficult access, ineffective or of insufficient quality.

The COVID-19 crisis has shown the importance and potential of online learning for adults. Open or distance education tends to reproduce inequalities in participation observed also in 'standard' adult learning.

- Latin American countries with available data in the OECD Survey of Adult Skills (PIAAC) display, on average, larger levels of participation in open or distance education than the average of OECD countries. Shares of adults engaging in such courses in Latin America range from 8% in Peru to 13% in Chile.
- Many individuals engage in open or distance education for job-related reasons and tend to find it useful. Around 55% of Latin American adults who engage in open or distance education do so in order to perform better at their jobs and to improve their career prospects. Personal interests or desire to enhance one's knowledge or skills in a specific area come second among reasons for participation. This pattern holds in OECD and Latin American countries alike. Individuals who combine work and education are the most numerous to engage in open education.
- In Latin American and OECD countries alike, participation levels in open and distance education increase with the level of skills (whether in literacy or problem solving in technology-rich environments) and with educational attainment. Conversely, workers who lack a contract in their current job are less likely to engage in open or distance education.
- Age plays an important role in explaining participation in open or distance education in Latin America. Around 58% of adults who engage in open and distance education are aged 20-40 years old in Latin American countries. They represent 52% of participants in OECD countries.
- Patterns of participation in open and distance education tend to reproduce or even amplify patterns of participation in standard forms of adult learning. Engaging low-skilled workers in adult learning remains a challenge that does not seem to improve when looking at the participation in open and distance education.

There is scope to further harness the potential of massive open online courses (MOOCs).

- MOOC enrolments have disproportionately come from very developed countries (scoring very high on the Human Development Index). A large number of Latin American countries, including Brazil, Colombia, Costa Rica and Mexico, score 'high' in the Human Development Index whereas only Argentina and Chile are rated as 'very high'.

- In a similar vein to open education and standard forms of adult training, participation in MOOCs has tended to be higher among the highly skilled, highly educated and among individuals with higher socio-economic status. Latin American countries display a similar pattern of participation in MOOCs. Data from edX MOOC participants in 2012-2013 showed that in Latin America, most MOOC participants were very young (the median age of participants was 26 years old), mostly men (76%), and holding a Bachelor or a Master's degree (more than 60% of participants).

2 Enhancing connectivity to develop skills in Latin America

Digitalisation brings many opportunities for learning and developing skills, in initial education and throughout life. This chapter examines the extent to which digital divides (gaps or inequalities in the access, use or benefits derived from the use of information and communication technologies) in Latin American countries are likely to hinder individuals' ability to make the most of new technologies for learning. Schools can help bridge connectivity gaps by providing access to ICT infrastructure to a large number of children, but many digital divides remain in Latin American countries.

Summary of the main insights

> Latin American countries are lagging behind OECD countries with respect to the skills of their populations but digital technologies can be part of the solution. However, countries in the region lack the basic skills to engage in the rapidly changing world of work and societies.

- Only less than 10% of individuals in Chile, Ecuador, Mexico and Peru have a well-rounded level of literacy, numeracy and problem-solving skills in technology-rich environments and around 42% of Latin American 15-year-olds who participated in the Programme for International Student Assessment (PISA) in 2018 are low performers in science, reading and mathematics. In the Dominican Republic, this share goes up to 75%.

> Although the lack of connectivity is an obstacle for technology-driven learning in Latin America, it is not the only factor. The lack of skills and digital competence, as well as security and affordability-related issues are Latin America's most relevant barriers for Internet adoption.

- Penetration of broadband services is low relative to levels observed in OECD countries. In 2017, penetration of mobile broadband was, on average, of 64.9% in Latin American countries in contrast to 102% for OECD countries. Penetration of fixed broadband was just above 12% in contrast to more than double (30%) in OECD countries. Some Latin American countries, together with Asia and Africa, also fare poorly in terms of average Internet connection speed relative to OECD countries. In addition, many inequalities persist across and within countries in the region in individuals' access and use of digital technologies by socio-economic status, gender, age and territory.

> Public institutions and in particular schools can play a leading role in bringing individuals and young people on line.

- Connectivity remains a challenge for the overall population in Latin America, but this is less so for students as public institutions and, in particular, schools are helping to bridge this divide. Around 75% of students in the region reported having access to a computer, desktop or laptop in their school and a similar share to have an Internet connection.
- Schools in many Latin American countries play an important role in bringing connectivity to ICT to many disadvantaged students who would otherwise be left disconnected. Around 25% of socio-economically disadvantaged students in Latin American countries have access to a computer only when at school and 16% of them are able to go on line exclusively when at school, lacking the chance to connect when at home. In Peru, almost two-thirds have access to a computer solely on the school premises and more than one-third of students have Internet access only at school.
- In Colombia, Peru and Mexico, schools act as Internet providers for more than 20% of rural students who lack access at home but who can go on line at school. Schools, more generally, also play an important role in making computers, and not only connection to the Internet, available for

rural students in those same countries. For instance, more than 41% of rural students in Peru have access to a desktop/laptop/tablet only at school. In Colombia, this is the case for 20% of rural students and in Mexico for 27% of them.

Socio-economic background plays an important role in students' access to technology in Latin America, leading to divides that policy makers should address.

- Around 18% of Latin American 15-year-olds from socio-economically disadvantaged backgrounds lack an Internet connection at home and at school, in contrast to less than 2% on average in OECD countries. Some 24% of them, in addition, do not have access to a computer (desktop, laptop or tablet) neither at home, nor at school. In contrast, computer access of socio-economically advantaged students in Latin American countries is comparable to that of students in OECD countries. In Latin American and OECD countries alike, less than 1% of socio-economically advantaged students lack access to a desktop, laptop or tablet. Important divides persist between advantaged and disadvantaged students and need urgent policy intervention to make the digital revolution truly inclusive across the countries of the region.
- The extent to which disadvantaged and advantaged students are able to connect varies widely across countries in the region. Among countries with available data, the digital divide between advantaged and disadvantaged students is especially large in the Dominican Republican, Mexico and Peru. One-third of disadvantaged students in the Dominican Republic are not able to connect to the Internet and 40% of them lack access to a computer.

Relative to other potential barriers, shortage or inadequacy of digital technology for instruction (e.g. software, tablets, computers, smart boards) and insufficient Internet access are very often reported to be important challenges hindering instruction in Latin America schools.

- Much needs to be done to put teachers and schools in a position to make the most of the digital revolution for learning and teaching activities. Around 51% of principals, on average in the region, report insufficient Internet access as a barrier to the provision of quality instruction, in contrast to 17% on average in OECD countries. This share goes up to 73% in Colombia. Around 43% of principals also complain about the shortage or inadequacy of digital technology for instruction.

New technologies bring opportunities for skills development

Digitalisation profoundly transforms the world of work and societies, and individuals need a mix of skills to thrive in an increasingly digital environment (OECD, 2019[1]). Without a well-rounded level of cognitive, socio-emotional and digital skills, individuals are locked out of all the benefits new technologies can provide, whether at home, in society, or at work. At the same time, digitalisation brings many new opportunities for developing skills. People go on line to learn from tutorials; they can attend massive open online courses (MOOCs) from leading universities outside of their country, exchange in online communities with other professionals about their practice, or access a vast amount of knowledge and information through open resources. A digital device and Internet connection open the door to countless learning opportunities available at any time, from anywhere and to anyone.

Latin American countries are lagging behind OECD countries with respect to the skills of their populations but digital technologies can be part of the solution. Data from the OECD Survey of Adult Skills, a product of the Programme for the International Assessment of Adult Competencies (PIAAC) (Figure 2.1) show that in Chile, Ecuador, Mexico and Peru, a large share of individuals lack the basic skills to engage in the rapidly changing world of work and societies. This is the case for around 60% of 16-65 year-olds in Ecuador and Peru in contrast to an average of 14% in OECD countries. Less than 10% of individuals in Chile, Ecuador, Mexico and Peru have a well-rounded level of literacy, numeracy and problem-solving skills in technology-rich environments.[1]

While school enrolment has improved in the last decades in Latin American countries, the quality of education remains a major challenge in the region (OECD, 2015[2]): many young people leave school without having acquired the necessary foundation skills. Around 42% of Latin American 15-year-olds who participated in PISA in 2018 are low performers in science, reading and mathematics (Figure 2.2). In the Dominican Republic, this share goes up to 75%.

A good level of cognitive and socio-emotional skills, developed early in life, provides a strong basis for the development of further skills (Heckman, 2006[3]) and the impact of unfavourable conditions (e.g. socio-economic disadvantage) on skills development is better tackled early in life than later (Cunha, Heckman and Schennach, 2010[4]).

This is particularly important for Latin American countries as analyses based on PISA show that socio-economic status decreases the chances of disadvantaged students performing well, to a larger extent than it shields advantaged ones from being low performers (OECD, 2015[2]) (Box 2.1). Equity of outcomes is yet another challenge that many Latin American countries need to address in order to equip their populations with the necessary skills to thrive at work and in life.

Box 2.1. Equity in education in Latin American countries

OECD (2015[2]) examines the relationship between socio-economic status and student performance in PISA (2015) in Latin American countries, including Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Mexico, Peru and Uruguay.

In Brazil, the Dominican Republic and Peru, student performance is below that of students in OECD countries, irrespective of whether students come from advantaged or disadvantaged backgrounds. In contrast, in a number of Latin American countries (Chile, Colombia, Costa Rica, Mexico and Uruguay), the mean performance of socio-economically disadvantaged students is on a par with that of disadvantaged students in other OECD countries. However, advantaged students in all Latin American countries with available data perform less well than advantaged students in OECD countries.

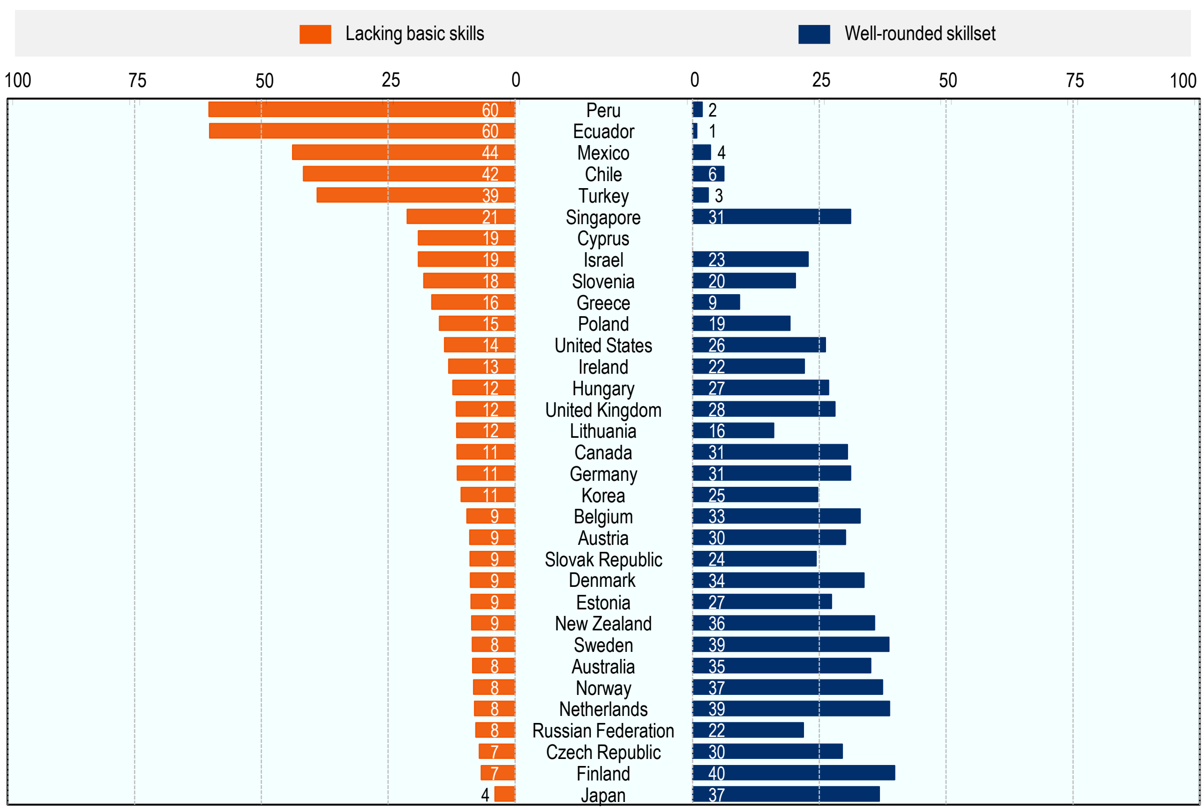
Comparing the performance of socio-economically advantaged and disadvantaged students in Latin American countries shows that the latter have lower chances to perform well in the assessment. Disadvantaged students have a higher likelihood than non-disadvantaged ones of reaching a baseline level, whether in science, reading or mathematics. In Peru, for example, disadvantaged students are almost 16 times more likely to be low performers in reading than non-disadvantaged ones. Additional analyses show that in most Latin American countries (excluding Chile), socio-economic status is more detrimental for disadvantaged students' likelihood to be top performers than it shields their more advantaged peers from poor performance (OECD, 2016[5]).

Source: OECD (2015[2]), *Skills in Ibero-America: Insights from PISA 2015*, www.oecd.org/pisa/sitedocument/Skills-in-Ibero-America-Insights-from-PISA-2015.pdf; OECD (2016[5]). *PISA 2015 Results (Volume I): Excellence and Equity in Education*, https://dx.doi.org/10.1787/9789264266490-en.

New technologies, including mobile devices, can help bridge gaps between individuals and foster the skills they need to engage in societies and in an increasingly digital-intensive future. In schools, the use of digital tools can potentially support the development of digital and cognitive skills, enhance student engagement and enable innovative teaching methods that personalise instruction and allow all students to thrive. In the case of adults, MOOCs and open education resources open the possibility of engaging in learning at all stages in life. For workers who lack time, resources, or are in informal employment with little opportunities for training, new technologies open the path for alternative ways of acquiring knowledge and developing skills.

Figure 2.1. Skills mix of countries' populations

Share of 16-65 year-olds lacking basic skills or having a well-rounded skill set, by country (%)



Note: Indicators are based on the *OECD Skills Outlook 2019* (OECD, 2019[1]). Individuals lacking basic skills score at most level 1 (inclusive) in literacy and numeracy and at most below level 1 (inclusive) in problem solving (including failing ICT core and having no computer experience). Individuals with a well-rounded skill set score at least level 3 (inclusive) in literacy and numeracy and at least level 2 (inclusive) in problem solving. Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey: Year of reference 2015. Ecuador, Hungary, Mexico, Peru and the United States: Year of reference 2017. All other countries: Year of reference 2012. Data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly.
Source: OECD calculations based on OECD (2017[6]), Survey of Adult Skills (PIAAC) (2012, 2015, 2017) (database), http://www.oecd.org/skills/piaac/.

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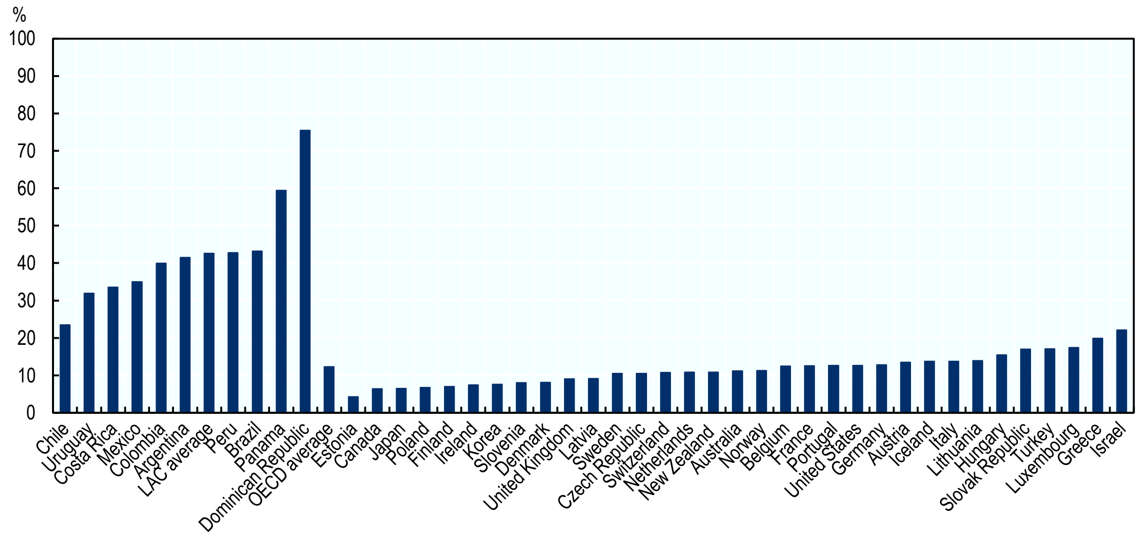
Figure 2.2. Low-performing students in science, reading and mathematics

Share of 15-year-old students



Note: Students who are low performers are students who score at less than level 2 in the reading, mathematics and science assessments. Level 2 is considered the baseline level of proficiency in reading, mathematics and science.
Source: OECD calculations based on OECD (2018[7]), PISA 2018 Database, https://www.oecd.org/pisa/data/2018database/.

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Boosting connectivity and Internet adoption is a first step in making the most of all the new learning and training opportunities brought about by new technologies. Without accessible, good quality and affordable Internet connection, individuals are completely locked-out of the potential benefits of digital transformation. In Latin American countries, around 237 million people were still offline in 2017 and a digital divide in access persists both across countries but also within Latin American countries between individuals coming from different socio-economic backgrounds or between urban and rural areas. Against this backdrop, effective intervention should be implemented in key policy areas to address challenges of connectivity and Internet in the region (OECD, 2019[8]).

Enhancing access, connectivity and quality of ICT infrastructure is a prerequisite for learning with new technologies in Latin America

Latin American countries are lagging behind OECD countries in their citizens' exposure to digitalisation. In 2017, 38% of individuals in Latin American countries made no use of the Internet (Figure 2.3) though large variations between countries persist. While Chile is on par with the OECD average, Haiti has made almost no progress in the last two decades and in seven other Latin American and Caribbean countries[2] more than half of individuals still do not go on line.

In the last decade, however, the region has made progress and expanded connectivity: the gap between OECD and Latin American countries in terms of Internet penetration and use has progressively narrowed (Fernando Rojas and Poveda, 2018[9]). For Internet penetration at the household level (households with Internet connection) the gap decreased from 50.8 percentage points in 2010 to 40.8 percentage points in 2016, while for Internet use it decreased from 40 percentage points in 2007 to 25 percentage points in 2017. Despite these advances, at the end of 2018, still 48% of the population had not subscribed to mobile Internet networks. Nevertheless the coverage gap did not represent a barrier since 94% of the Latin American population has access to mobile Internet services (GSMA, 2019[10]).

Latin American countries still need to make substantial efforts to enhance the digital competence of their citizens, strengthen safety and security online, and reduce affordability barriers. This requires a holistic approach to the challenges stemming from the digital transformation. Policy intervention needs to foster both demand and supply simultaneously to ensure that countries in the region harness the benefits stemming from digitalisation (OECD, 2019[8]). The mix of different challenges faced by Latin American countries raises concerns about the extent to which individuals are (and will be) able to take advantage of the opportunities brought by digitalisation. Penetration of broadband services, for instance, is low relative to levels observed in OECD countries (OECD, 2019[8]): in 2017, penetration of mobile broadband[3] was on average of 64.9% in Latin American countries in contrast to 102% for OECD countries; penetration of fixed broadband was over 12% in contrast to 30% in OECD countries.

The rise in mobile-cellular telephone subscriptions opens new possibilities for higher-quality connectivity in many Latin American countries (Figure 2.4). In the last decade, mobile-cellular telephone subscriptions in Costa Rica increased by more than four times and in Nicaragua they tripled. Nevertheless, some Latin American countries, together with Asia and Africa, fare poorly in terms of average Internet connection speed relative to OECD countries (Broadband Commission for Sustainable Development, 2018[11]).

In addition, inequalities in connectivity are pervasive within Latin American countries. the divide in access to digital technologies has not been closed in many countries of the region: individuals from rural areas, disadvantaged backgrounds or with low education levels are less likely to have access and hence to use Internet (Fernando Rojas and Poveda, 2018[9]; OECD, 2019[12]; UNESCO, 2017[13]). Among the countries with available data on Internet access by income distribution, Uruguay displays the greatest degree of equality in contrast to Brazil where the distribution of Internet access has become more unequal (Fernando Rojas and Poveda, 2018[9]). Nevertheless, the rural gap in mobile Internet use in low- and middle-income countries for the Latin American and Caribbean region, at 29% in 2018, is smaller than the global average of 40%, and similar to Europe and Central Asia region, at 26% in 2018 (ITU/UNESCO Broadband Commission for Sustainable Development, 2019[14]). Closing the gap in rural areas remains an open challenge. More efforts should be put in spurring public-private co-operation as the private sector intervention alone may be insufficient and firms may lack incentives to develop businesses there. A successful example of such public-private initiatives is "*Internet para Todos in Perú*" which provides digital access in remote areas (IDB, n.d.[15]).

A gender-based digital divide is also still present in the region. Girls in Latin American countries are exposed to new technologies later in life relative to boys (OECD, 2015[16]), display lower levels of self-perceived autonomy related to ICT use and self-perceived ICT competence (OECD et al., forthcoming[17]). Girls also exhibit less interest in ICT-related and science careers except for health sciences (OECD, 2019[18]).

Public institutions and in particular schools, can play a leading role in bringing individuals and young people on line. Data from several Latin American countries (Brazil, Colombia, Ecuador, Honduras, Paraguay and Peru) show that Internet access is not limited to home access and individuals use other locations to go on line (UNESCO, 2017[13]). In Honduras for instance, access to the Internet from public centres is more widespread than access from home.

Investments in ICT infrastructure for schools have been extensive, across many OECD and Latin American countries (Box 2.2). In Latin American countries with available data from PISA (2015), around 75% of students reported having access to a computer, desktop or laptop in their school and a similar share have Internet connection (Figure 2.5). A relatively high share of Latin American students thus has access to ICT infrastructure in schools, although rates remain below the OECD average and hide both between and within-country inequalities. Students in Chile, Colombia and Uruguay, for instance, have levels of access that are very similar to those of OECD countries, but connectivity in schools remains an issue in other countries such in the Dominican Republic where more than one-third of students are unable to access the Internet or computers. Internet connection refers both to connection through school computers and to connection through wireless. In some countries (e.g. Colombia), the proportion of school computers connected to the Internet is in fact much lower than the OECD average.

Box 2.2. Programmes to expand connectivity for Latin American schoolchildren

Launched in 1997 and reformulated in 2007, ProInfo is the main national policy in Brazil promoting the use of ICT technologies in primary and secondary public schools. The programme provides equipment, digital content and media, and training of professors and students. In 2017, the Ministry of Education also launched the Connected Education Innovation Programme (Programa de Inovação Educação Conectada) which aims to ensure universal access to high-speed Internet and the use of technology in all Brazilian (primary and secondary) public schools by 2024, in line with the National Plan for Education. The programme is designed around four complementary dimensions: vision, competencies, digital educational resources and infrastructure, all considered crucial to ensure ICTs are effective in improving education. The programme promotes actions such as helping schools to be prepared to receive Internet connection, as well as teacher training through a virtual learning environment (OECD, forthcoming[19]).

In Chile, the programmes “Yo elijo mi PC” and “Me conecto para aprender” seek to reduce divides in access to new technologies and support student learning by providing a laptop computer to students in seventh grade (Ministerio de Educacion, 2019[20]). The laptops also provide access to digital resources and portals for learning activities. In 2019, around 130 000 laptops were provided to students. “Me conecto par aprender” targets students enrolled in the 7th grade in public schools (ChileAtiende, n.d.[21]). “Yo elijo mi PC” targets socio-economically disadvantaged students, with an average grade greater than or equal to 5.8 and enrolled in a subsidised private school.

Since 2000, Colombia has unfolded the programme “Computadores para Educar”. The programme has focused on the provision of schools with computers and of training for teachers in order to support them in integrating ICT in their pedagogies (Radinger et al., 2018[22]). Data from PISA 2015 showed that Colombia displayed one of the highest computer-student ratios in schools among countries with available data (Radinger et al., 2018[22]).

Peru introduced the programme “Un Laptop por Niño” in 2007, targeting students from public primary schools in poor rural areas (OECD, 2015[2]). The programme also included a training component for teachers, supporting them in the use of the type of laptops (XO portable computers) distributed in schools.

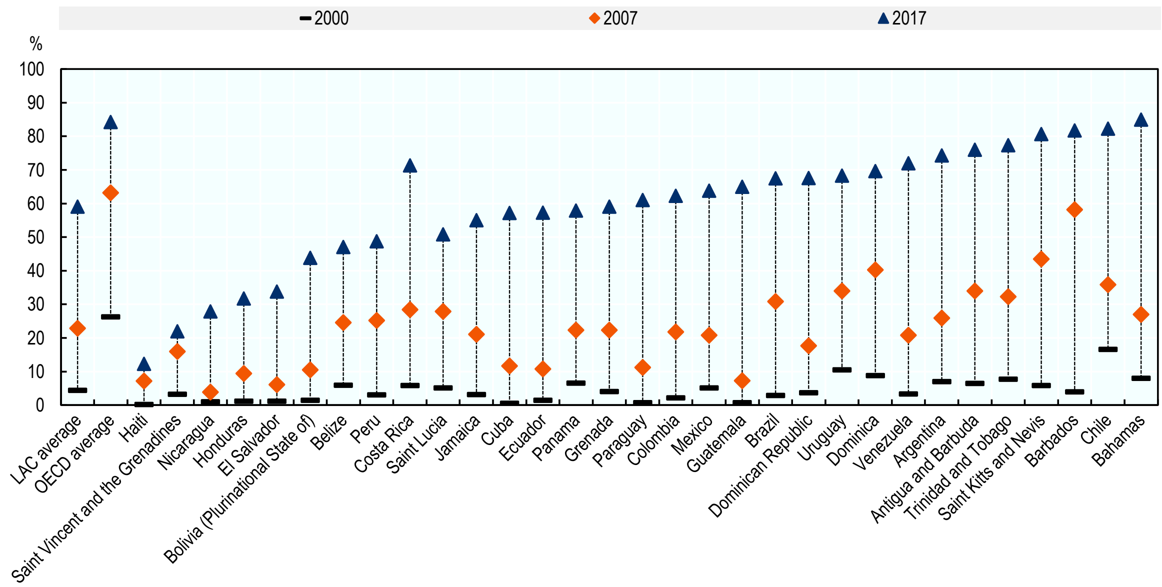
Created in 2007, the Plan Ceibal in Uruguay relied on the distribution of laptops to students and teachers in public schools (primary and lower secondary), together with the provision of free Internet connection (Santiago et al., 2016[23]). The plan also covers students and teachers from private schools in low-income areas (Plan Ceibal, 2017[24]). After the first step of the programme that revolved around expanding connectivity, the focus was put on professional development for teachers, introduction of educational software and digitalisation of textbooks (Plan Ceibal, 2017[24]). Since 2013, the plan has shifted towards the development of an approach related to “New Pedagogies for Deep Learning” by “implementing student-cantered methodologies, extending teaching beyond the classroom, and using technology to achieve specific goals” (Plan Ceibal, 2017[24]).

Source: ChileAtiende (n.d.[21]), *ChileAtiende - Me conecto para aprender*, www.chileatiende.gob.cl/fichas/41874-me-conecto-para-aprender; Ministerio de Educacion (2019[20]), *Me Conecto para Aprender*, http://meconecto.mineduc.cl/; OECD (2015[2]), *Skills in Ibero-America: Insights from PISA 2015*, www.oecd.org/pisa/sitedocument/Skills-in-Ibero-America-Insights-from-PISA-2015.pdf; Plan Ceibal (2017[24]), *Hicimos historia haciendo future*, www.ceibal.edu.uy; Radinger et al (2018[22]), *OECD Reviews of School Resources: Colombia 2018*, https://dx.doi.org/10.1787/9789264303751-en; Santiago et al. (2016[23]), *OECD Reviews of School Resources: Uruguay 2016*, https://dx.doi.org/10.1787/9789264265530-en.

As in OECD countries, all students in Latin America countries (for which information is available) who have access to computers in schools do not necessarily use them. With the exception of Colombia, where most students who have access to computers, laptops or tablets in schools also report using them, around 25% of students in the other Latin American countries have access to ICT infrastructure but do not use it.

Figure 2.3. Internet use in Latin America and Caribbean countries

Share of individuals



Source: Based on data from ITU (2019[25]), ITU World Telecommunication/ICT Indicators database, https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

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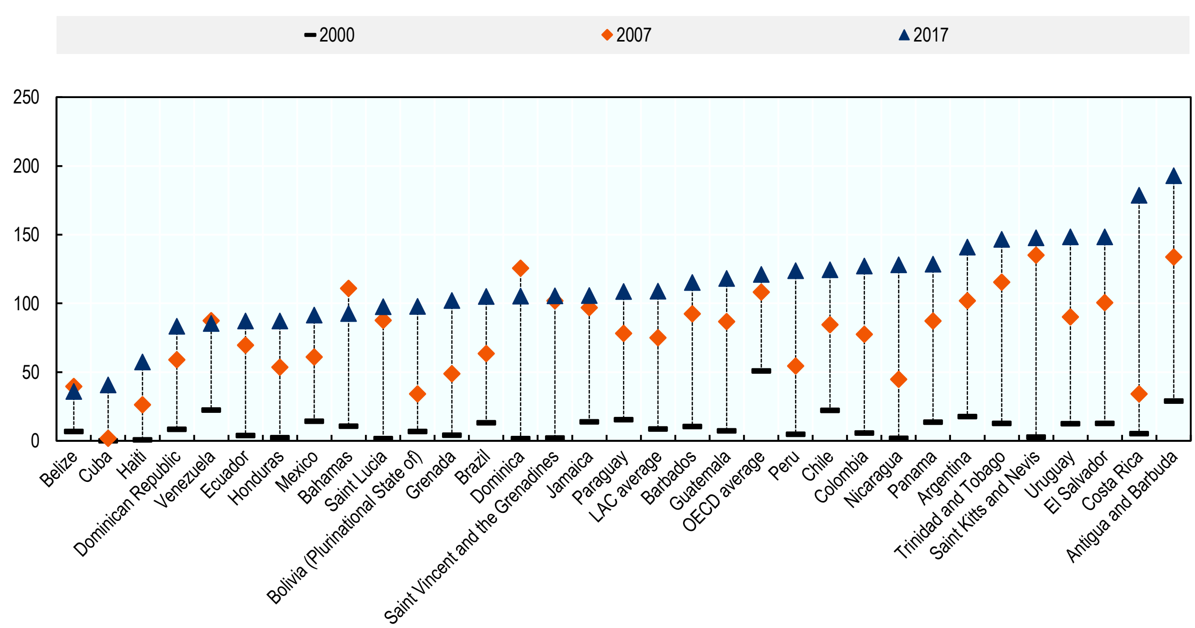
Figure 2.4. Mobile-cellular telephone subscriptions, per 100 inhabitants



Source: Based on data from ITU (2019[25]), ITU World Telecommunication/ICT Indicators database, https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

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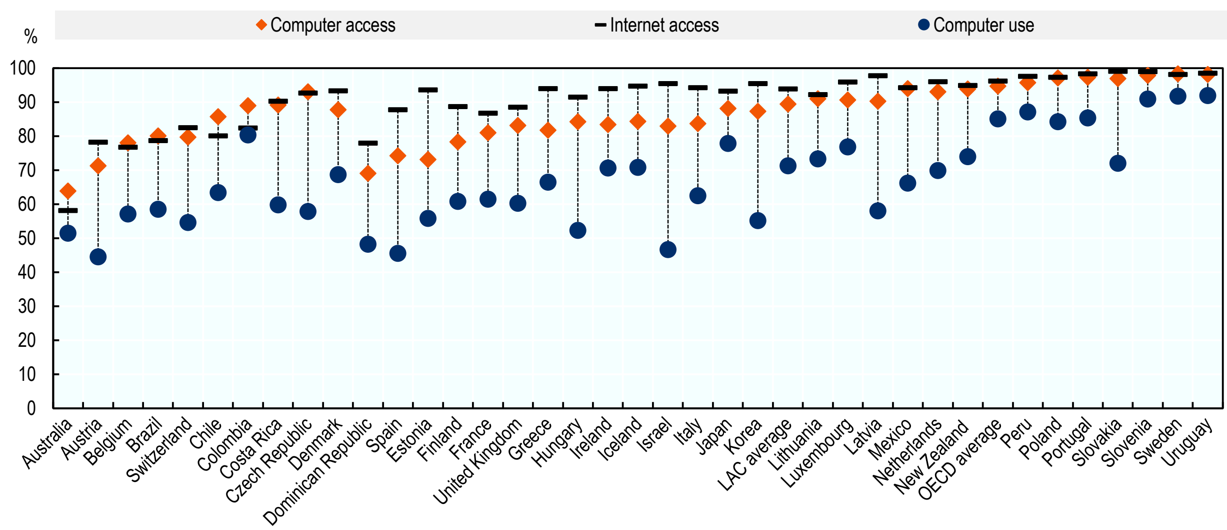
Many reasons may lie behind the limited use of school computers and ICT infrastructure in schools. On the one hand, students may be using their own digital devices within schools, bringing either mobile phones or laptops, especially as schoolchildren in several Latin American countries have benefited from one laptop per child type of programmes (One Laptop per Child, n.d.[26]; Bulman and Fairlie, 2016[27]). On the other hand, the quality of the ICT infrastructure available in schools may be poor or teachers may find the devices not useful or appropriate for their teaching practices or activities. In a similar vein, while Latin American students may have access to computers in schools, they may have to share them if there are not enough computers for all students. For instance, in Brazil more than five students share each Internet connected computer (OECD et al., forthcoming[17]).

Figure 2.5. Access and use of computers available in schools

Share of 15-year-old students



Note: Students with computer access at school are students for whom a desktop computer, a portable laptop/notebook or a tablet computer is available to use at school, whether they use it or not. Students with Internet access at school are students who have access to Internet connected school computers or to Internet connection via wireless network. Students who use computers at school are students for whom a desktop computer, a portable laptop/notebook or a tablet computer is available to use at school and who use it.
Source: Calculations based on OECD (2015[28]), PISA 2015 Database, http://www.oecd.org/pisa/data/2015database/.

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While data from PISA (Figure 2.5) quantify the availability of ICT infrastructure in schools, principals' perception on shortages of resources hindering instruction can shed light on an equally important issue: the quality of ICT resources. Data from the Teaching and Learning International Survey (TALIS) show that in Latin American countries, around half of principals report that shortages or inadequacy of ICT hinder the school's capacity to provide quality instruction (Figure 2.6).[4]

Relative to other potential barriers, shortages of digital technology for instruction (software, tablets, computers and smart boards) and the insufficiency of Internet connection are very often reported to be important challenges hindering instruction in Latin America schools, being those factors mentioned by the highest share of principals in most Latin American countries.

On the contrary, principals in OECD countries report more frequently other types of barriers to instruction, unrelated to digital technologies, such as shortages of teachers with competence in teaching students with special needs, shortages of support personnel and shortages or inadequacy of time for instructional leadership (OECD, 2018[29]).

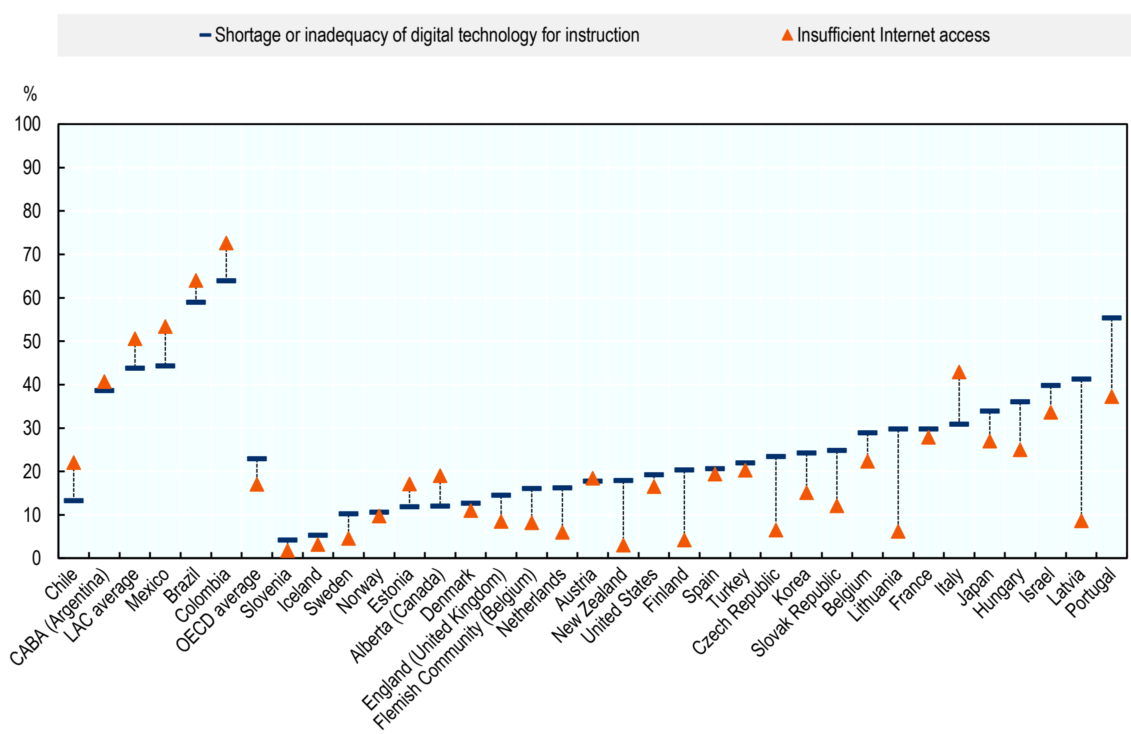
Investment in ICT infrastructure is often associated with an increase in the time students actually spend using ICT and government programmes in the LAC region have tried to encourage the use of ICT in schools and classrooms (Bulman and Fairlie, 2016[27]; Escueta et al., 2017[30]) hoping that this would boost learning and skill development. While providing an adequate number of digital devices is fundamental to expand access, the quality and relevance of available digital technologies is key in ensuring that technologies can be used effectively, paving the way towards enhanced teaching and learning activities.

However, if digital devices are of low quality or the educational software available is inadequate for instruction, then mere use of ICT for simple tasks may substitute for more efficient instructional activities (see Chapter 3) and eventually worsen student outcomes instead of providing true learning opportunities.

All in all, results seems to suggest that digital technologies in Latin American schools may be insufficient (e.g. Internet connection) or inadequate (e.g. educational software) for instruction. Perceived shortages and inadequacies in terms of digital technology in schools are large in Latin American countries. These perceptions may reflect that computers may be malfunctioning, not adequate for pedagogical needs; software may be of little use for teaching or Internet connection too slow. In order to the make the most out of digital opportunities, governments should strike the right balance between expanding access to digital devices and enhancing the quality and relevance of ICT investments made in Latin American schools, making them more aligned to teaching and learning needs.

Figure 2.6. Perceived shortages or inadequacy of digital technology and Internet for instruction

Percentage of principals reporting that the following shortages of resources hinder the school's capacity to provide quality instruction "quite a bit" or "a lot"



Note: Digital technology refers to software, computers, tablets, smart boards, etc. CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: Adapted from Table I.3.63, OECD (2018[29]), *TALIS 2018 Database*, http://www.oecd.org/education/talis/.

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Schools help narrow connectivity and access-related gaps, but many digital divides remain

In OECD countries, the divide in access to digital technologies has been shrinking, although urban-rural disparities in broadband penetration remain somewhat a challenge (OECD, 2019[12]). Similarly, the digital divide in terms of access to ICT infrastructure in schools has generally been bridged (OECD, 2019[1]).

In most Latin American countries, instead, connectivity gaps are still pervasive at many levels. Around 18% of Latin American 15-year-olds from socio-economically disadvantaged backgrounds lack Internet connection at home and at school. Moreover, 24% of them do not have access to a computer (desktop, laptop or tablet) (Figure 2.7) neither at home, nor at school. Strikingly, instead, computer access of socio-economically advantaged students in Latin American countries is comparable to that of students in OECD countries. The same holds for access to an Internet connection: almost all Latin American students from high socio-economic background report having Internet access either at home and at school, or at home only.

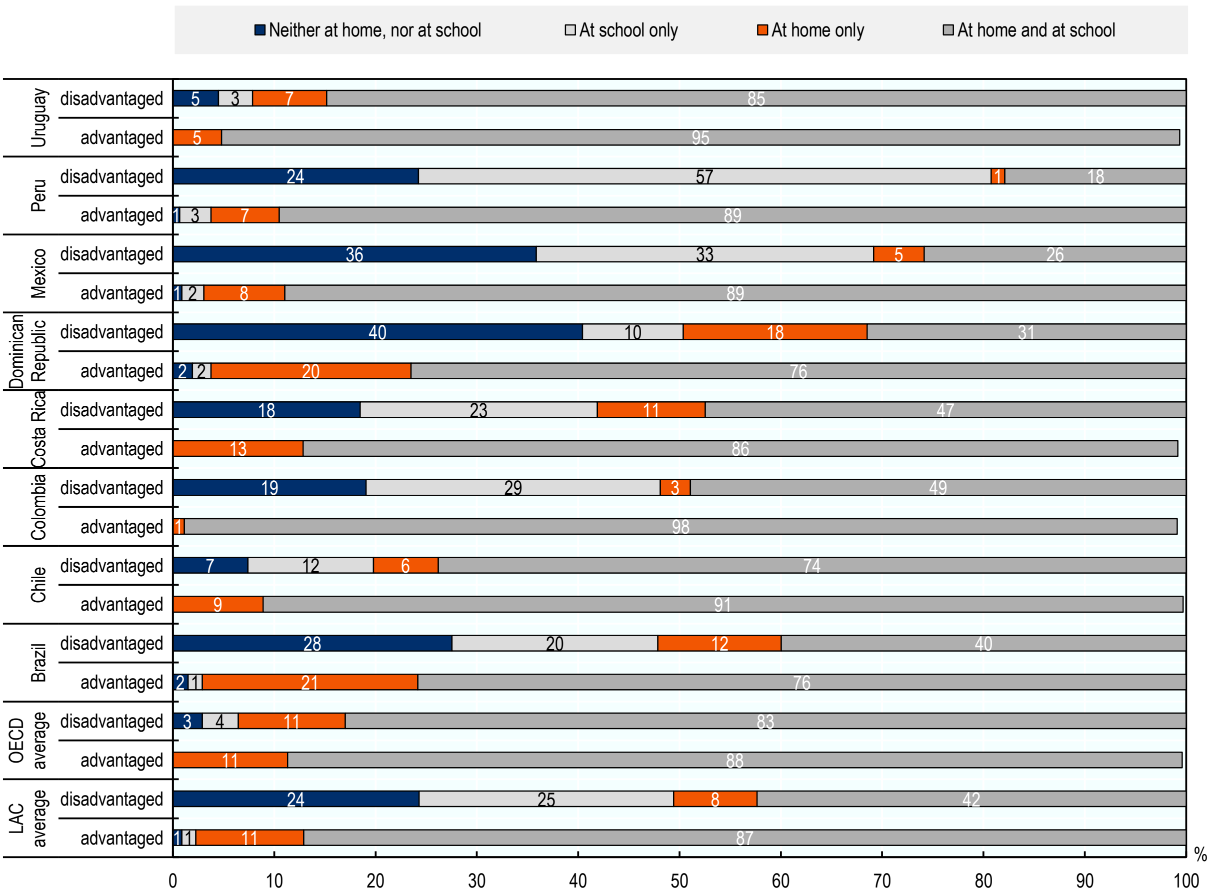
If many disadvantaged students lack ICT access at home, schools and/or local community centres as well as government offices (OECD/IDB, 2016[31]) can act as ICT providers and bridge the gap between students who do not have ICT at home and those who do, thus increasing connectivity for young disadvantaged people.

De facto, schools in many Latin American countries play an important role in bringing connectivity to ICT to a large share of students who would otherwise be left unconnected. Around 25% of socio-economically disadvantaged students in Latin American countries have access to a computer only when at school and 16% of them are able to go on line exclusively when at school, lacking the chance to connect when at home (Figure 2.7). In Peru, almost two-thirds have access to a computer in the school premises and more than one-third of students have Internet access only at school.

With the spread of mobile phones, students may more easily connect to Internet at home as well through personal or family phones. Owning a mobile phone, however, does not seem to be sufficient to ensure connectivity to all students at home as Internet connection may be too expensive or, in remote rural areas, not even available.

Figure 2.7. Access to computers (desktop/laptop/tablet), by socio-economic background

Share of 15-year-old students



Note: Students are considered to be socio-economically advantaged if they are among the 25% of students with the highest values on the PISA ESCS index in their country or economy. Students are considered to be socio-economically disadvantaged if their values on the PISA ESCS index are among the bottom 25% within their country or economy.
Source: OECD calculations based on OECD. (2015[28]), *PISA 2015 Database*, http://www.oecd.org/pisa/data/2015database/.

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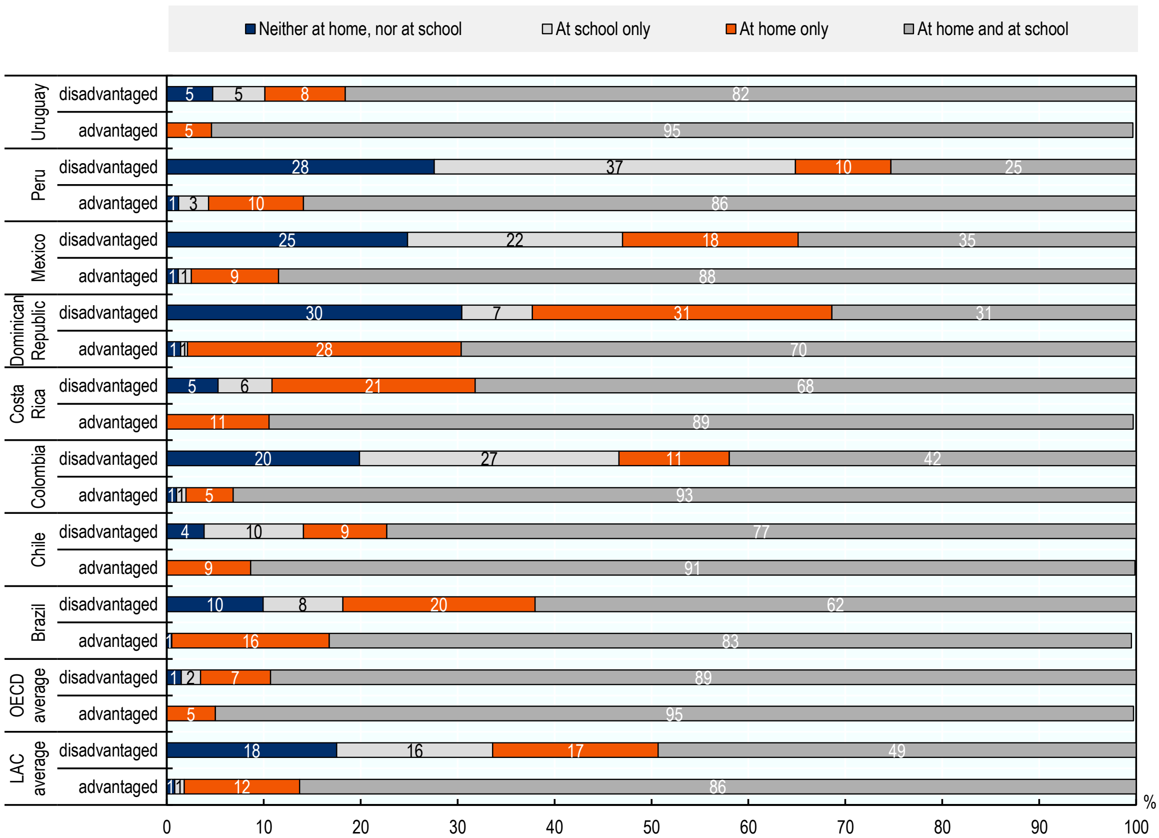
Figure 2.8 Access to Internet, by socio-economic background

Share of 15-year-old students



Note: Students are considered to be socio-economically advantaged if they are among the 25% of students with the highest values on the PISA ESCS index in their country or economy. Students are considered to be socio-economically disadvantaged if their values on the PISA ESCS index are among the bottom 25% within their country or economy.
Source: OECD calculations based on OECD. (2015[28]), *PISA 2015 Database*, http://www.oecd.org/pisa/data/2015database/.

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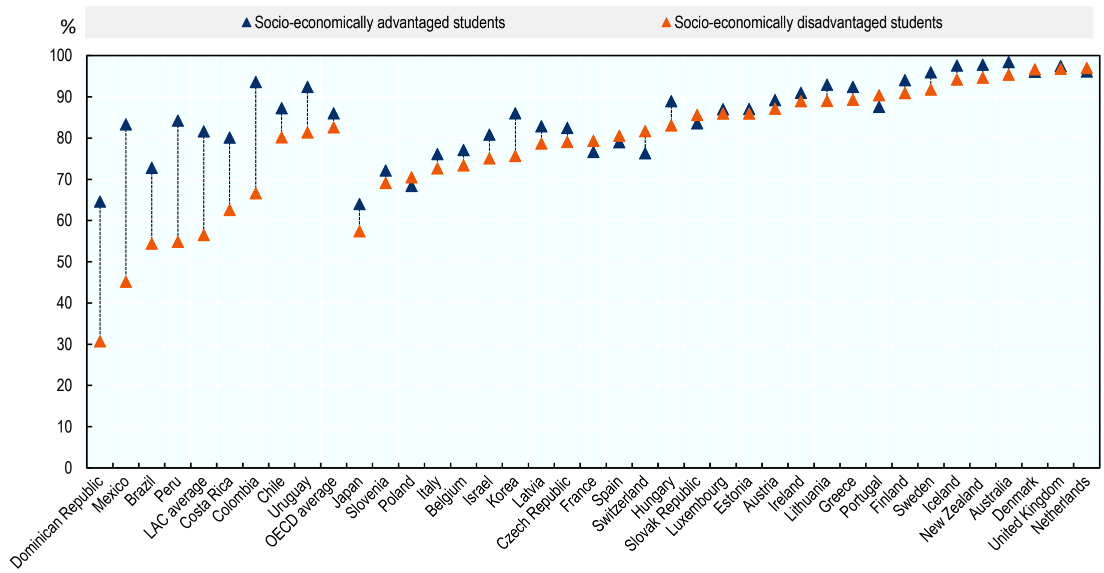
The extent to which disadvantaged and advantaged students are able to connect varies widely across countries in the region. Among countries with available data, the digital divide in access to Internet between advantaged and disadvantaged students is especially large in the Dominican Republican, Mexico and Peru. One-third of disadvantaged students in the Dominican Republic are not able to connect to the Internet and 40% of them lack access to a computer. They also benefit less from connectivity at school than 15-year-olds in other countries and are thus at high risk of being unprepared for an increasingly digitalised society and work environment. While Mexico or Peru equally display a large share of disadvantaged students deprived of access to the Internet or computers at home, they also provide access to ICT through schools to a larger extent.

Figure 2.9. Divide in access to ICT at school, by students' socio-economic status

Share of 15-year-old students who have access to a desktop computer/laptop/tablet and Internet at school



Note: Students are considered to be socio-economically advantaged if they are among the 25% of students with the highest values on the PISA ESCS index in their country or economy. Students are considered to be socioeconomically disadvantaged if their values on the PISA ESCS index are among the bottom 25% within their country or economy.
Source: OECD calculations based on OECD (2015[28]), *PISA 2015 Database*, http://www.oecd.org/pisa/data/2015database/.

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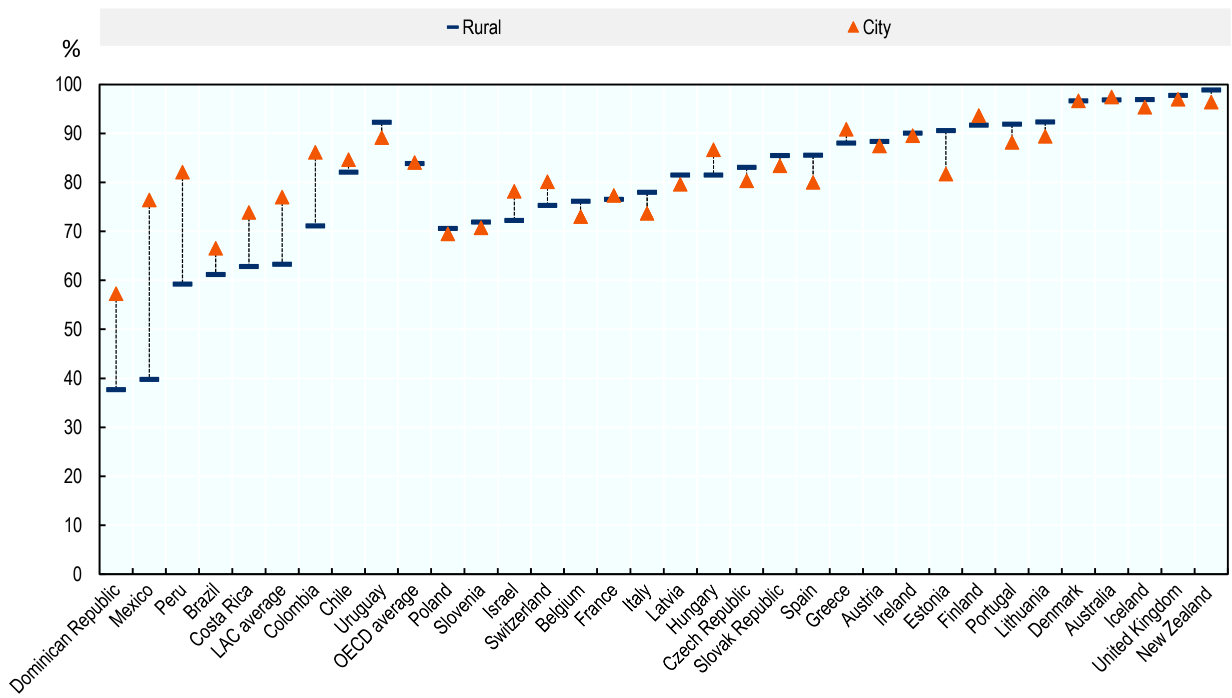
While Latin American schools do provide some ICT access to disadvantaged students, they have not managed to close the digital divide in access related to students' socio-economic status (Figure 2.9). The average divide in access between disadvantaged and advantaged students is more than 30 percentage points larger in Latin American countries with available data than in the OECD average. In a similar vein, the urban-rural digital divide is still largely present in Latin American countries (Figure 2.10). In Mexico, the connectivity gap at school between rural and urban students goes up to 35 percentage points. In the Dominican Republic, Mexico and Peru, one in four students in rural areas has no Internet access, while on average, less than 8% of advantaged students in the three countries cannot connect to the Internet (Figure 2.11). In Brazil, national statistics show a higher rural-urban divide: only 43% of schools in rural areas have desktop computers, compared to 96% in urban areas (CGI, 2019[32]). The gap is larger when considering connectivity: on average only 36% of schools in rural areas are on line, as compared to nearly all schools in urban areas. In addition, connection speeds also differ widely between rural and urban schools (CGI, 2019[32]).

Figure 2.10. Rural-urban divide in access to ICT at school

Share of 15-year-old students who have access to a desktop computer/laptop/tablet and Internet at school



Note: Students in rural schools are students whose school is located in "a village, hamlet or rural area with fewer than 3 000 people" while students in urban schools are students whose school is located in a city of over 100 000 people.
Source: OECD calculations based on OECD (2015[28]), *PISA 2015 Database*, http://www.oecd.org/pisa/data/2015database/.

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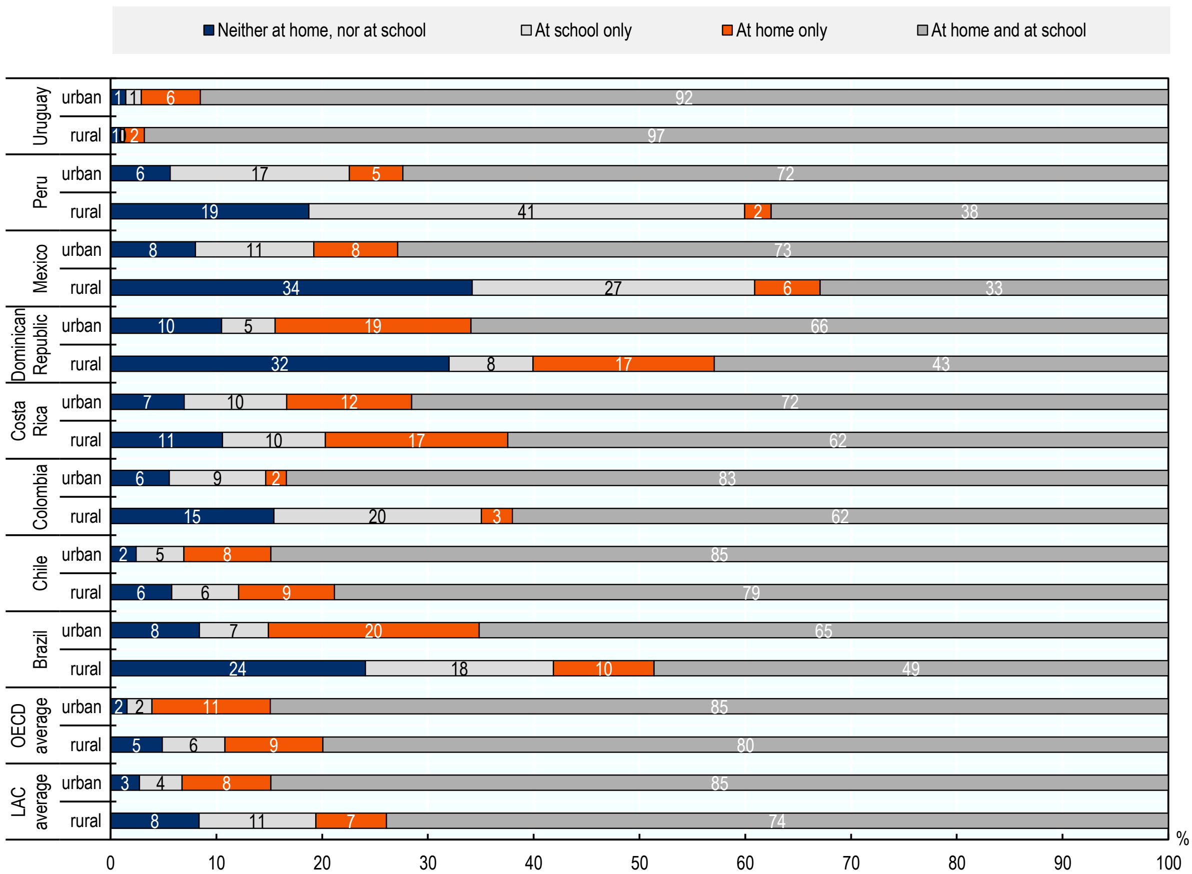
In Colombia, Peru and Mexico, schools act as Internet providers for more than 20% of rural students who lack access at home but who can go on line at school. Schools, more generally, also play an important role in making computers available for rural students in those same countries. For instance, more than 41% of rural students in Peru have access to a desktop/laptop/tablet only at school. In Colombia, this is the case for 20% of rural students and in Mexico for 27% of them.

Other LAC countries such as Uruguay, and to a lesser extent Chile, seem to have bridged the urban-rural divide with students from rural contexts being able to access the Internet and computers widely, both at home and at school.

Figure 2.11. Access to computers (desktop/laptop/tablet), by school location

Share of 15-year-old students

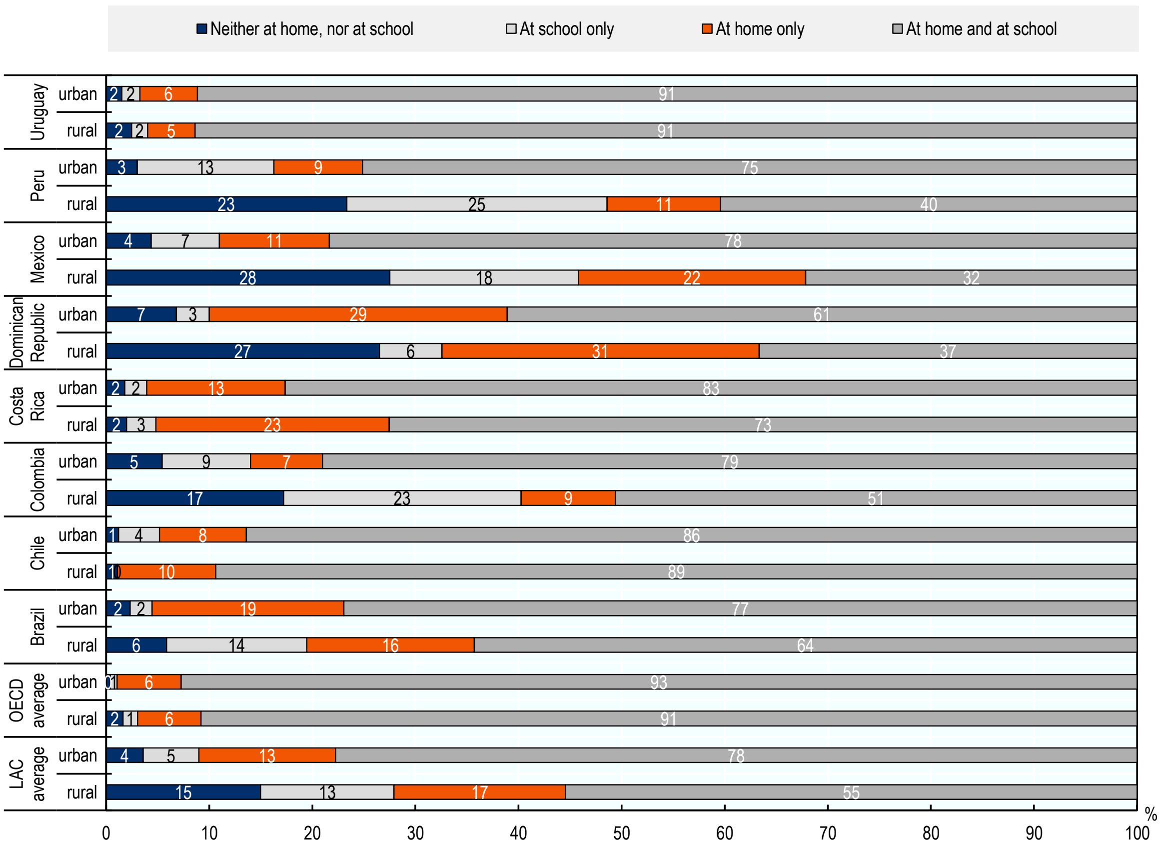


Note: Students in rural schools are students whose school is located in "a village, hamlet or rural area with fewer than 3 000 people" while students in urban schools are students whose school located in a city of over 100 000 people.
Source: OECD calculations based on OECD (2015[28]), *PISA 2015 Database*, http://www.oecd.org/pisa/data/2015database/.

StatLink https://doi.org/10.1787/888934135433

Figure 2.12. Access to Internet, by school location

Share of 15-year-old students

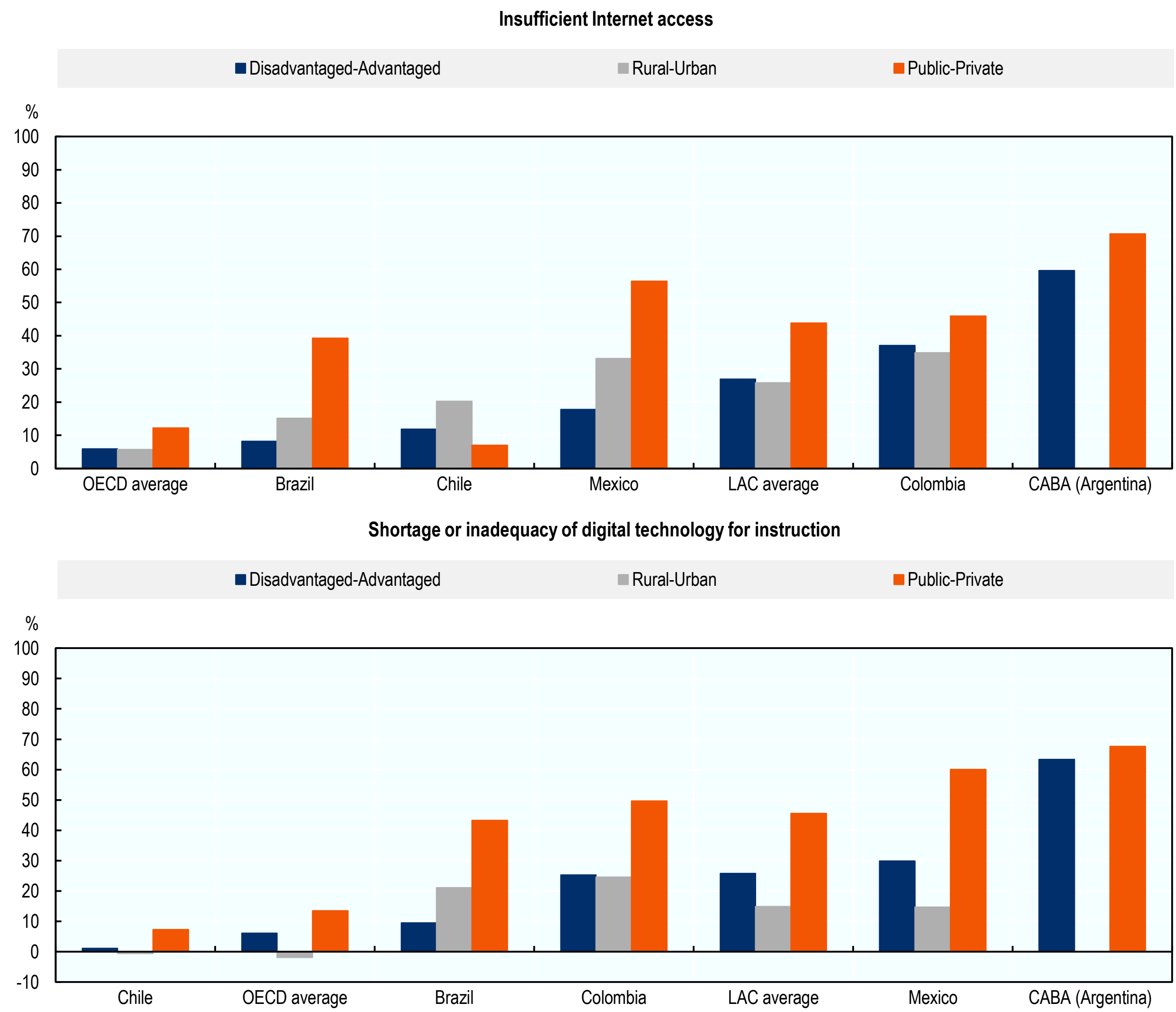


Note: Students in rural schools are students whose school is located in "a village, hamlet or rural area with fewer than 3 000 people" while students in urban schools are students whose school located in a city of over 100 000 people.
Source: OECD calculations based on OECD (2015[28]), *PISA 2015 Database*, http://www.oecd.org/pisa/data/2015database/.

StatLink https://doi.org/10.1787/888934135452

Figure 2.13. Gaps in perceived shortages or inadequacy of digital technology and Internet for instruction, by school profile

Difference in the percentage of principals reporting that the following shortages of resources hinder the school's capacity to provide quality instruction "quite a bit" or "a lot"



Note: "Disadvantaged" refers to a school with more than 30% of students from socio-economically disadvantaged homes. "Advantaged" refers to a school with fewer than 30% of students from socio-economically advantaged homes. Digital technology refers to software, computers, tablets, smart boards, etc. CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD. (2018[29]), *TALIS 2018 Database*, http://www.oecd.org/education/talis/.

StatLink https://doi.org/10.1787/888934135471

In many Latin American countries, students from socio-economically disadvantaged backgrounds and students who live in rural areas and students who attend public schools are penalised twice. They are less likely to have Internet and computer access at home but also at school. Moreover, the quality of ICT infrastructure available in their schools is also poorer than the average of their country: principals in schools with more disadvantaged students, from rural areas and that are publicly managed are more numerous to report that shortages or inadequacy of new technologies are major obstacles to the provision of quality instruction (Figure 2.13).

Providing high-quality Internet connection and access to digital tools is not enough though to help develop skills. What individuals do when they go on line is equally crucial. The digital divide increasingly relates to how individuals use the Internet and the extent to which they are able to seize the opportunities and benefits of their engagement in online activities (OECD, 2019[1]). For young people in Latin America, connectivity in schools is a way to narrow gaps in connectivity at home. Nevertheless, access to and use of technology do not automatically translate into better learning outcomes. Integrating technology in innovative teaching and learning practices is crucial and Latin American teachers play a pivotal role in realising the untapped potential of new technologies in initial education.

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Notes

[1] Individuals with a well-rounded skill set score at least level 3 (inclusive) in literacy and numeracy and at least level 2 (inclusive) in problem solving in technology-rich environments in the OECD Survey of Adults Skills (PIAAC).

[2] Saint Vincent and the Grenadines, Nicaragua, Honduras, El Salvador, Bolivia, Peru, Belize.

[3] Penetration of mobile broadband is computed as subscriptions per 100 inhabitants. This statistics can therefore exceed 100%, as it is the case for the OECD average.

[4] Principals are asked to indicate the extent to which shortages of various resources hinder the school's capacity to provide quality instruction. TALIS data used for this analysis are based on self-reported information provided by principals and teachers and, therefore, subjective in nature. Data from TALIS provide insights into how teachers and school principals “perceive the learning environments in which they work” (OECD, 2019[33]). There is no imputation of data from administrative sources.

3 Making the most of new technologies in initial education in Latin America

This chapter investigates Latin American students' use of digital devices and how technology use relates to students' performance. Results show that the way technology is embedded in teaching and learning practices is crucial to raise student outcomes. In this context, teachers in Latin American countries report high levels of openness to innovation in their school, similar to those observed among OECD countries. Yet Latin American countries still show margin for improvement in the integration of ICTs in initial education.

Summary of the main insights

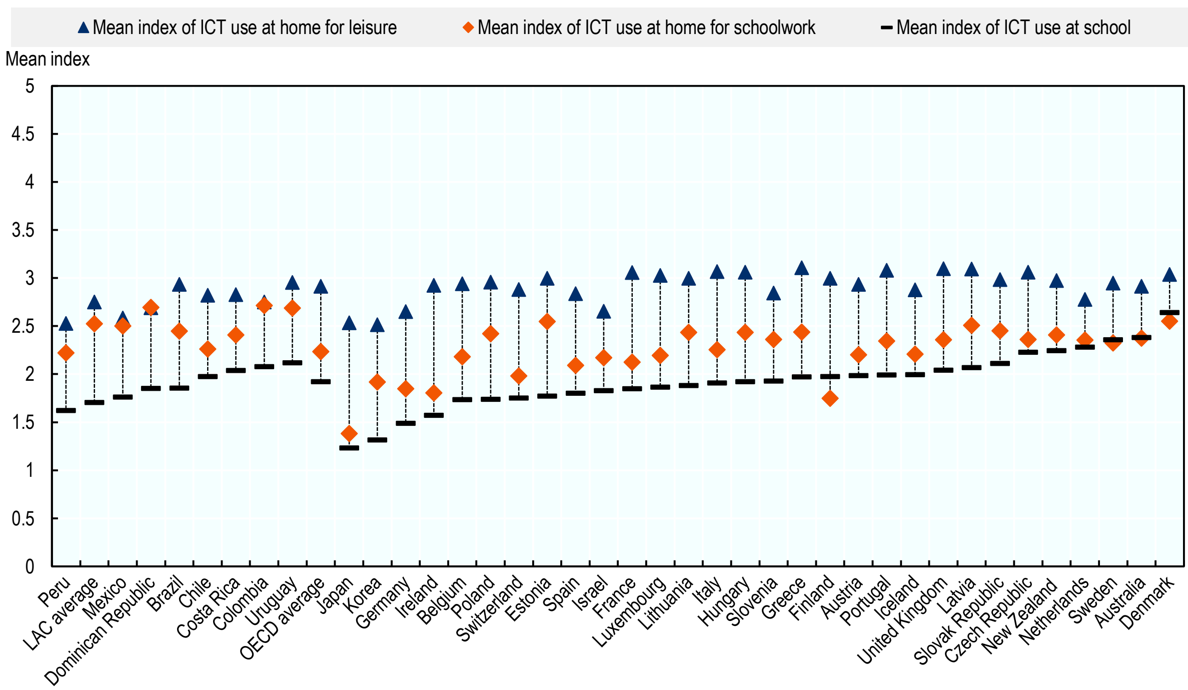
- Whether in science, reading or mathematics, the mean performance of Latin American 15-year-olds in the Programme for International Student Assessment (PISA) assessments is below that of OECD countries. Data from PISA (2015) show that all Latin American countries display shares of low-performing students (below the baseline level of proficiency) well above the OECD average. In science, the share of low performers in Latin American countries ranges from 35% of students in Chile to 86% in the Dominican Republic, in contrast to 21% on average across OECD countries. Shares of low performers are equally high for the reading and mathematics assessments.
- When technology is blended into innovative teaching and learning practices, it can enhance student performance. To be successful, however, digital technologies need to be introduced into schools as part of a comprehensive approach that aligns technology use with curricular needs, and includes teacher training and information and communications technology (ICT) support. This sort of comprehensive approach is essential to ensure that innovative uses of new technologies support teaching and learning practices. High-quality digital tools need to be in line with teacher and curricular needs. Teacher training and ICT support are also essential to enable innovative uses of new technologies that support teaching and learning practices.
- Technology use should not be the objective but rather a tool to leverage more innovative pedagogies. Simply delivering content through technology, substituting teaching by using computers or reproducing traditional pedagogies using ICT is unlikely to result in better outcomes. The way technology is integrated in teaching and learning activities is crucial to enhance student outcomes, and when these pre-conditions are missing, students' performance may not improve or even be hindered. Gamification, flipped instruction or blended learning are some examples of innovative practices that can rely on digital technologies and show great potential for improved learning.
- Teachers in Latin American countries with available data report high levels of openness to innovation in their school, similar to those observed among OECD countries, and hence of readiness to adopt new technologies in schools. Most teachers, in between 71% in Chile and up to 80% in Brazil, report being open to change and similar shares also declare to search for new ways to solve problems in the classroom.
- A comprehensive approach is needed to make the most of new technologies in initial education in Latin America. Teachers are a cornerstone of this approach. Accounting for curricular needs and teachers' objectives is key when introducing digital technologies in schools. Similarly, providing ICT support and high-quality training to teachers on both 'when' and 'how' to integrate technology in their teaching are essential to ensure that technology is used at its best potential in the classroom. Those digital tools that reach schools and classrooms need to be of high quality, carefully designed and tailored to benefit teaching and improve student learning. In many Latin American countries, there is still scope for a more efficient and innovative integration of digital technologies in teaching and learning practices to allow everyone to reap the benefits stemming from the digital revolution.

How do Latin American students use digital devices?

New technologies hold great potential for skills development in initial education. They open up the opportunity of more personalised instruction and student feedback in school, enhanced access to learning resources and materials available on line at any time or better student engagement using innovative methods such as gamification. The use of digital devices and tools in schools can also foster the development of digital skills and thereby prepare students for the skills requirements of digital societies.

Figure 3.1. Students' frequency of digital devices uses

Mean index



Note: The figure displays the mean index of ICT use at school, at home for schoolwork and at home for leisure, by country and year.
The index of ICT use at school measures how frequently students make a variety of digital device uses at school: playing simulations; posting one's work on the school website; practicing and drilling (such as for foreign languages or mathematics); downloading, uploading or browsing material from the school's website or intranet; chatting online at school; using email at school; doing homework on a school computer; using school computers for group work and communication with other students; browsing the Internet for schoolwork. The frequency of use goes from never or hardly ever (1), once or twice a month (2), -once or twice a week (3), almost every day (4), every day (5).
The index of ICT use at home for schoolwork measures how frequently students make a variety of digital device uses at home: doing homework on a computer or digital device, browsing the Internet for schoolwork, downloading learning apps on a device, communicating with students or teachers about schoolwork, etc. The frequency of use goes from never or hardly ever (1,) once or twice a month (2), once or twice a week (3), almost every day (4), every day (5).
The index of ICT use at home for leisure measures how frequently students make a variety of digital devices uses at home for: playing one-player or collaborative games, participating in social networks, browsing the Internet for fun, downloading music, etc. The frequency of use goes from never or hardly ever (1), once or twice a month (2), once or twice a week (3), almost every day (4), every day (5).
Source: OECD calculations based on OECD (2015[1]), PISA 2015 database, http://www.oecd.org/pisa/data/2015database/.

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Chapter 2 showed that connectivity remains an issue in many Latin American schools and homes. In spite of a more difficult access to digital technologies, data on the frequency with which digital devices are used show that Latin American students use digital devices with similar frequency as their OECD peers do (Figure 3.1). The index of ICT use summarises the frequency in the use of digital devices, irrespective of the digital device on which 15-year-olds perform each activity. Students may use their own mobile phone or the phone of a colleague, the school infrastructure or a laptop they bring from home, especially as many programmes in Latin America have sought to address connectivity gaps by providing laptops for schoolchildren. At school, for instance, Latin American students use digital devices as frequently as OECD students do and tend to use them even more frequently at home for schoolwork. Latin American students who have access to and use digital devices are likely to use them with relatively higher frequency.

In addition, Latin American students who use digital devices with a rather regular frequency (at least weekly) often use digital devices in a similar way (Figure 3.2) and for comparable purposes as OECD students do. One notable difference is in the use of digital devices at home for schoolwork and in particular for doing homework, which is more widespread across students in Latin America than among their OECD peers. Investments in the provision of ICT infrastructure to schoolchildren have been extensive in many Latin American countries, with one laptop per child type of programmes allowing students to take their computers home. Such laptops often provide access to digital learning resources, activities or textbooks that students are likely to be required to use for their homework, or as additional learning materials.

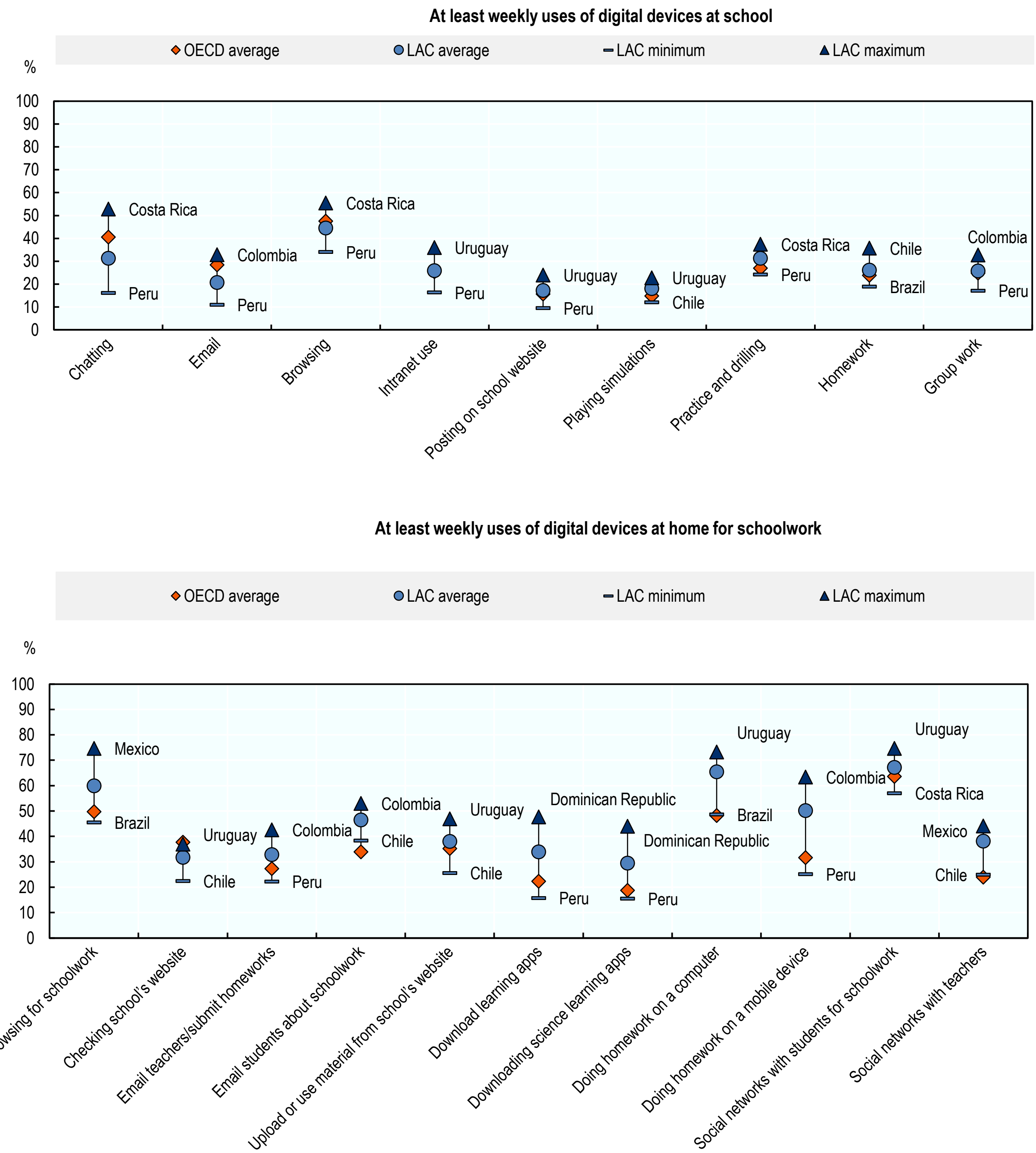
While the average intensity in the use of digital devices is comparable between Latin American and OECD countries, the digital divide between those who can access and use digital technologies and those who are excluded from them is considerably more pronounced in Latin American countries. The digital divide in access to ICT infrastructure in Latin American countries (Chapter 2) appears to be paired by a digital divide in use. Students who have access to and use digital devices in Latin American countries use them with relatively high frequency, which further amplifies existing digital inequalities.

Contrary to evidence in several OECD countries, students from low socio-economic backgrounds in Latin America make a substantially less frequent uses of digital devices at school, at home for schoolwork or for leisure (Figure 3.3) than those from more advantaged backgrounds. At home, disadvantaged students are less likely to have access to digital devices or Internet connection in the first place (Chapter 2) or maybe have digital devices of a lower quality (older mobile phones or computers). In addition, even if many investments have been made in Latin American countries to bridge divides in access between advantaged and disadvantaged students, differences may remain in how students use ICT at home. Disadvantaged students may use their digital devices for fewer activities, while advantaged students can go online for recreational purposes, to do their homework, read news or obtain practical information. Differences in Internet uses matter because they tend to reproduce non-digital inequalities (Van Deursen et al., 2017[2]). If students from low socio-economic background, less educated or who perform worse in school use digital devices more for entertainment rather than learning, then the use of new technologies may even amplify existing divides.

The socio-economic status gap is less sizeable, however, when it comes to using digital devices at school. This shows that, despite the fact that access to and use of digital devices correlate strongly with students' socio-economic status, schools in Latin America are able to narrow the digital divide to some extent. Effectively integrating new technologies in teaching and learning practices can help all students develop the mix of skills they need to thrive in a digital world.

Figure 3.2. Digital devices uses at school and at home for schoolwork

Share of students



Note: Students who make a given digital device use at least weekly are students who make a specific use once or twice a week, almost every day or every day. "LAC minimum" refers to the minimum value among LAC countries with available data. "LAC maximum" refers to the maximum value among Latin American countries with available data. The name of the country associated with the minimum or the maximum among LAC countries is displayed on the graph.

Source: OECD calculations based on OECD (2015[1]), PISA 2015 database, http://www.oecd.org/pisa/data/2015database/.

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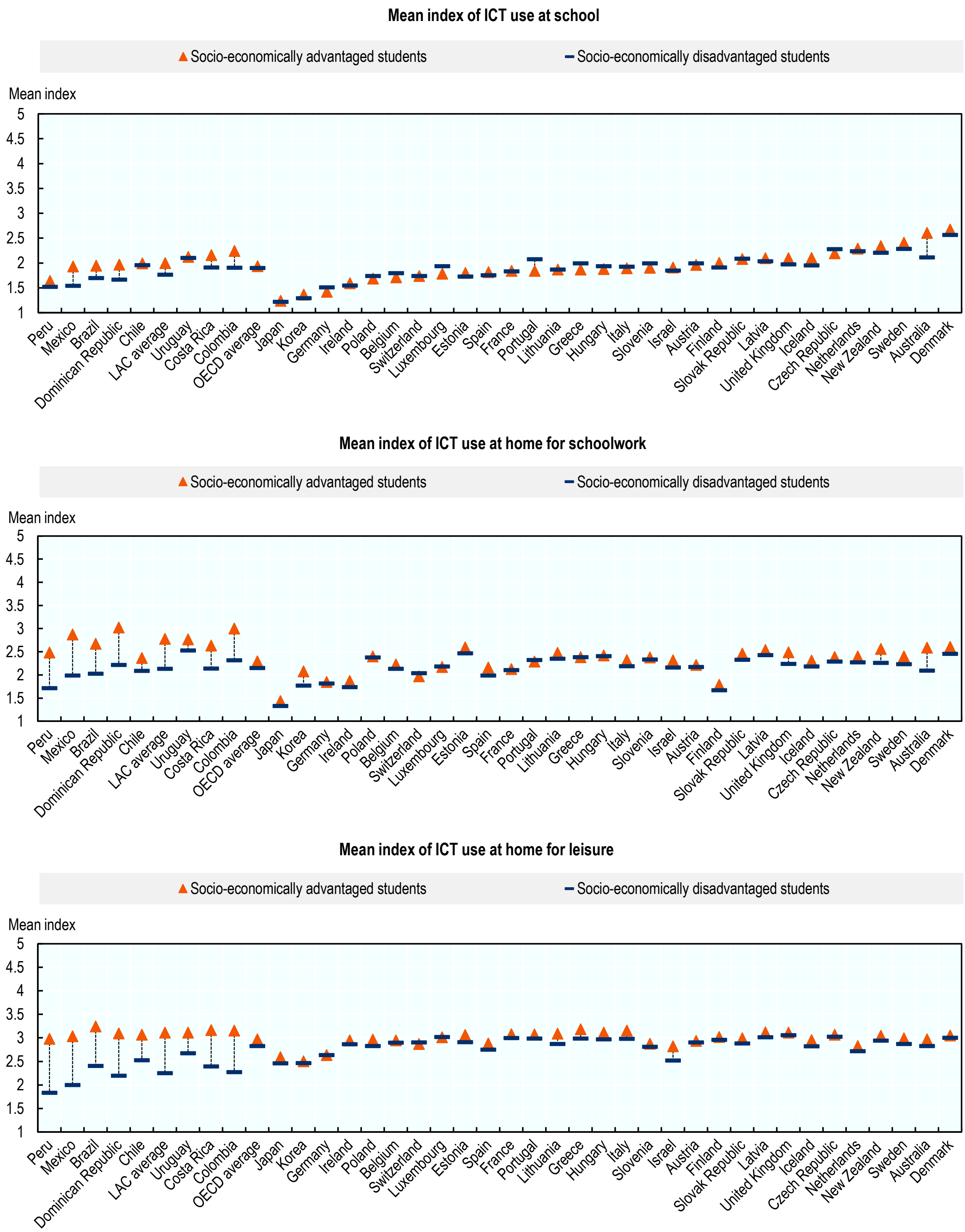
Figure 3.3. Students' frequency of digital devices uses, by students' socio-economic status

Mean index



Note: The mean indices are defined in the note under (Figure 3.1).
Source: OECD calculations based on OECD (2015[1]), PISA 2015 database, http://www.oecd.org/pisa/data/2015database/.

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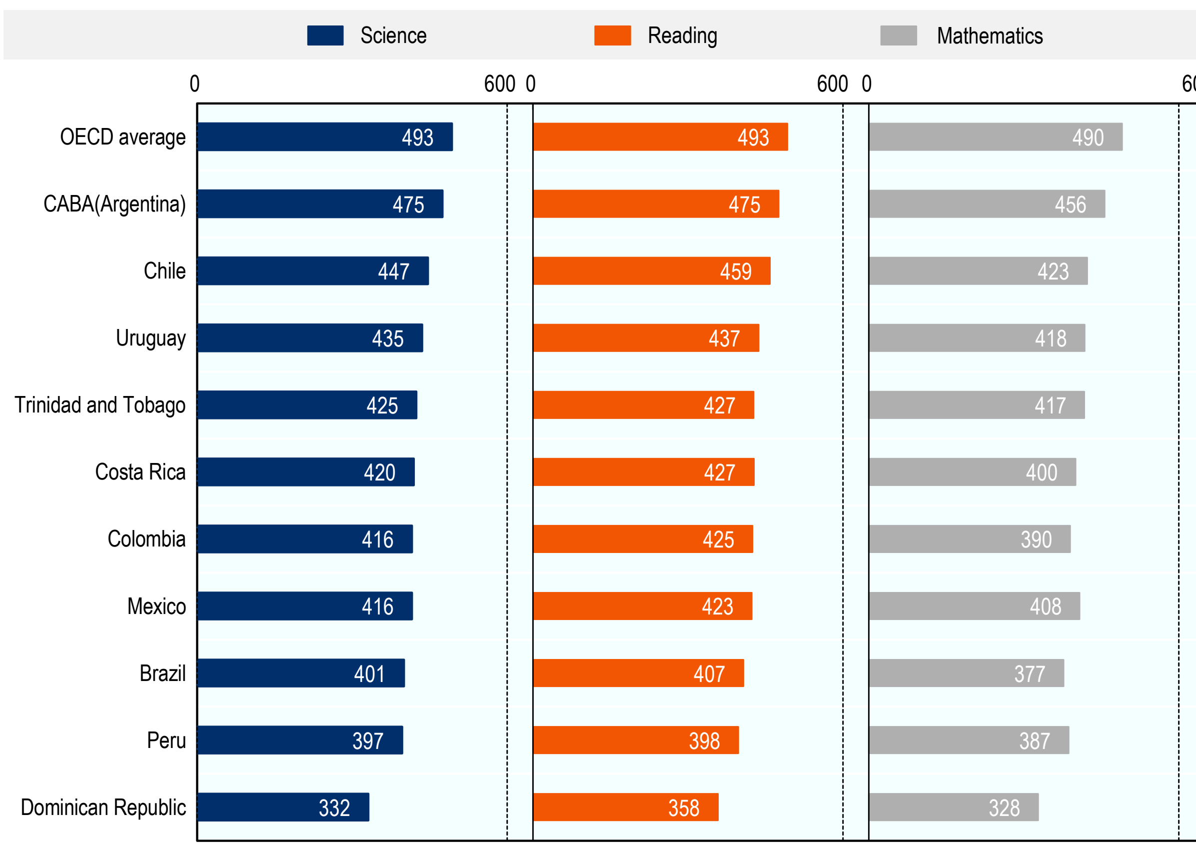
How does technology use relate to student performance in Latin American countries?

Skills are crucial for individuals to thrive in a changing world of work, but also in societies. Without a good level of skills, people are locked out from the benefits of new technologies (OECD, 2019[3]). Latin American countries are lagging behind OECD countries in terms of their population's skills. Whether in science, reading or mathematics, the mean performance of Latin American 15-year-olds in PISA assessments is below that of OECD countries (Figure 3.4). All Latin American countries display shares of low-performing students (below the baseline level of proficiency) well above the OECD average. In science, the share of low performers in Latin American countries ranges from 35% of students in Chile to 86% in the Dominican Republic, in contrast to 21% on average across the OECD countries (Figure 3.5) (OECD, 2015[1]). Shares of low performers are equally high for the reading and mathematics assessments.

Figure 3.4. Student performance in science, reading and mathematics

Mean score in PISA 2015



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2015[1]), PISA 2015 database, http://www.oecd.org/pisa/data/2015database/.

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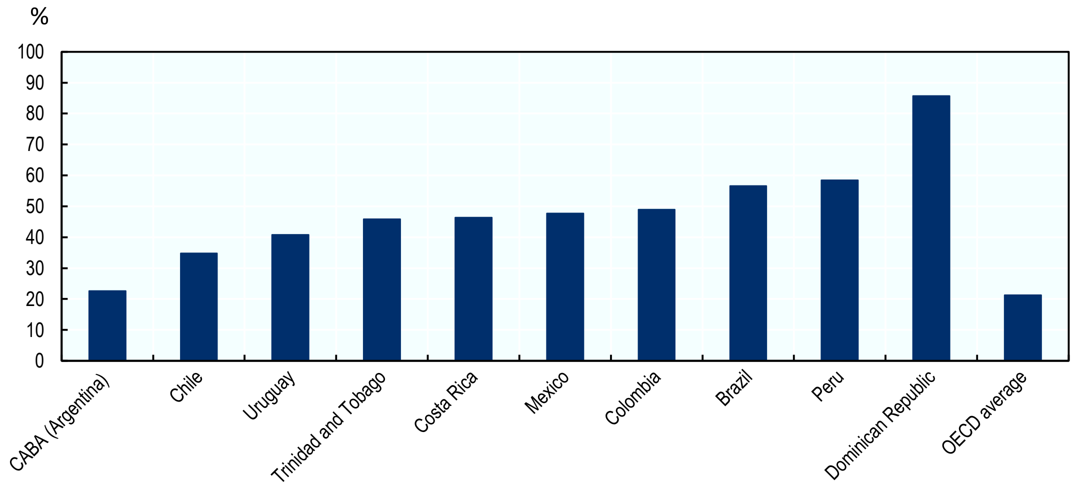
Figure 3.5. Low performers in science

Share of students



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2015[1]), PISA 2015 database, Table I.2.2a, http://www.oecd.org/pisa/data/2015database/.

StatLink https://doi.org/10.1787/888934135566

Box 3.1. Drop- outs and performance: Are we overestimating PISA scores in LAC?

Enrolment in secondary education has been on the rise in many Latin American countries, but school dropout rates remain substantial (Josephson, Francis and Jayaram, 2018[4]). Since PISA covers 15-year-olds who are enrolled in school and have completed at least 6 years of formal schooling (OECD, 2016[5]), students who dropped out or who did not reach level 7 of schooling by the time they were old enough to be eligible for the assessment, are not included in the PISA sample. Many Latin American countries with available data in PISA 2015 display lower coverage rates of their 15-year-old populations (from 62% in Mexico to 75% in Colombia) in comparison to most OECD countries (OECD, 2015[6]). If students excluded from the sample perform less well than those participating in the assessment, then the observed performance levels of students in these countries, already very poor, are likely to be overestimated.

In addition, inequalities due to socio-economic status, immigrant status or living in a rural area are also potentially underestimated in countries with lower coverage if students from such backgrounds are less likely to be included in the sample (OECD, 2016[5]). At the same time, expanding enrolment also means that more low-performing students take the assessment and hence, thereby potentially undervaluing advances made by education systems. Evidence from PISA 2015 shows, however, that in the Latin American countries that have experienced the largest rise in access to schooling, there has not been a trade-off between equity and quality (OECD, 2015[6]).

Source: Josephson, K., R. Francis and S. Jayaram (2018[4]), *Políticas para promover la culminación de la educación media en América Latina y el Caribe. Lecciones desde México y Chile.* http://scioteca.caf.com/handle/123456789/1246; OECD (2015[6]), *Skills in Ibero-America: Insights from PISA 2015,* http://www.oecd.org/pisa/sitedocument/Skills-in-Ibero-America-Insights-from-PISA-2015.pdf

Technology can be part of the solution to developing students' skills as it brings many new and flexible learning opportunities. In particular, technology can complement students and teachers in the performance of educational activities, increasing their efficiency (e.g. for instance, if students find information faster by going on line rather than by searching through a large number of books). Technology use can also substitute more routine or repetitive tasks.

Technology use, however, should not be the objective but rather a tool to leverage more innovative pedagogies. Analyses based on PISA 2015 show that in many OECD and Latin American countries a too frequent use of digital devices at school is associated with lower student performance.[1] Results suggest that simply delivering content through technology, substituting teaching by using computers or reproducing traditional pedagogies using ICT is unlikely to result in better outcomes. The way technology is integrated in teaching and learning activities is crucial to enhance student outcomes, and when these pre-conditions are missing, students' performance may not improve or even be hindered.

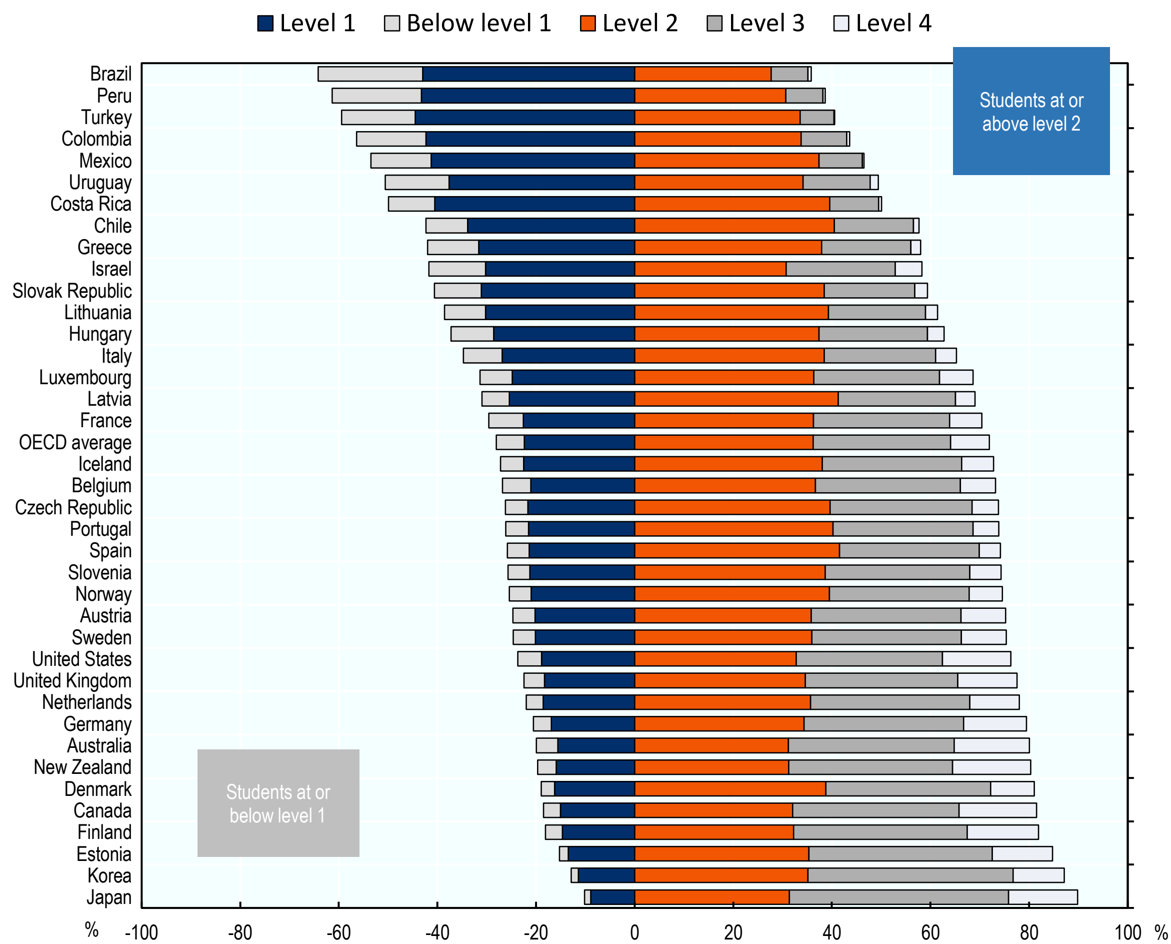
To be successful, the introduction of digital technologies in schools needs to rely on a comprehensive approach. High-quality digital tools need to be in line with teacher and curricular needs. Teacher training and ICT support are also essential to enable innovative uses of new technologies that support teaching and learning practices. Chapter 5 examines in detail Latin American teachers' use of new technologies and self-efficacy in supporting student learning using new technologies.

Beyond cognitive skills and academic performance, the use of new technologies could equally facilitate the development of other types of skills. Labour markets increasingly reward collaboration and socio-emotional skills more generally, as technologies replace workers in the performance of routine and manual tasks and complement them in the performance of other tasks (OECD, 2019[3]; Deming, 2017[7]). The PISA 2015 assessment examined the extent to which 15-year-old students were able to collaborate in order to solve problems (OECD, 2017[8]).

Unfortunately, evidence shows that students in Latin American countries that participated in this assessment performed less well than students in all OECD countries (with the exception of Turkey). In Brazil and Peru, more than 60% of students are low performers in collaborative problem solving (below level 2) and less than 1% are top performers (level 4).

Figure 3.6. Proficiency in collaborative problem solving

Percentage of students at different levels of collaborative problem-solving proficiency



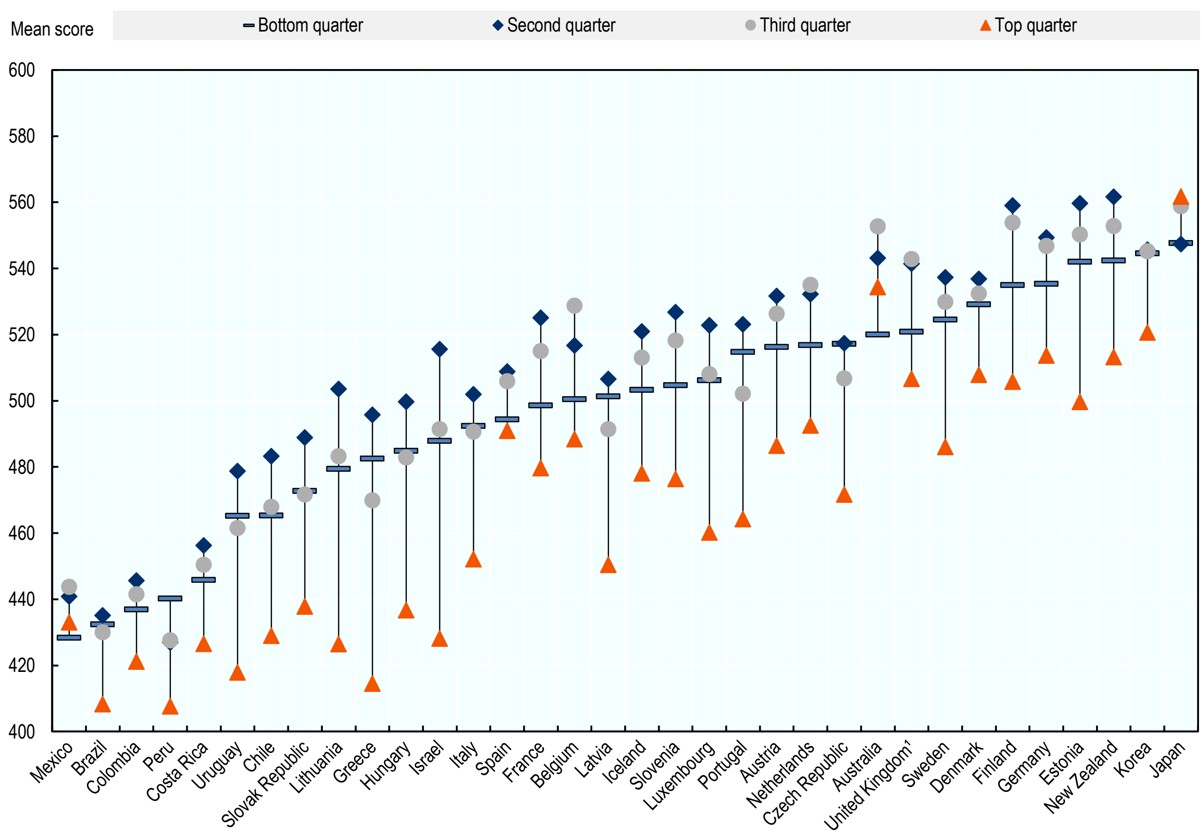
Note: The PISA 2015 assessment and analytical framework (OECD, 2017[9]) describes proficiency levels as follows: "at level 4, students can successfully carry out complicated problem-solving tasks with high collaboration complexity" and "at level 1, students can complete tasks with low problem complexity and limited collaboration complexity". As for students performing at below level 1, "the PISA 2015 collaborative problem-solving assessment was not designed to assess either elementary collaboration skills or elementary problem-solving skills. Hence, there were insufficient items to fully describe performance that fell below level 1 on the collaborative problem-solving scale" (OECD, 2017[8]).
Source: OECD (2017[8]), *PISA 2015 Results (Volume V): Collaborative Problem Solving*, http://dx.doi.org/10.1787/9789264285521-en.

StatLink https://doi.org/10.1787/888934135585

At the same time, new technologies increase the scope of collaboration: they allow individuals, students and teachers to connect from anywhere and at any time, to easily communicate and exchange, and thus work jointly on projects or solve problems. Analyses based on PISA 2015 suggest again that there is little relationship between students' performance in collaborative problem solving and their self-reported ICT competence (Figure 3.7) (OECD, 2017[8]) and exposure to ICT does not seem to be associated with better student performance in collaborative problem solving. Other policies, such as those that increase diversity in classrooms, foster positive relationships at schools (e.g. through teacher training in classroom management or the organisation of social activities at school) or even physical education can be more beneficial to students' collaborative skills (OECD, 2017[8]).

The following section will discuss how Latin American countries can make the most of ICT use in initial education.

Figure 3.7. Index of ICT use at school and performance in collaborative problem solving



Note: Only the United Kingdom subnational entities of England, Northern Ireland and Wales participated in the ICT questionnaire. The index of ICT use at school is defined in the note of Figure 3.1. Countries are ranked by the mean score of students in the bottom quartile of the index of ICT use at school.
Source: OECD (2017[8]), *PISA 2015 Results (Volume V): Collaborative Problem Solving*, http://dx.doi.org/10.1787/9789264285521-en.

StatLink https://doi.org/10.1787/888934135604

In Latin American countries, there is scope for more efficient integration of ICTs in initial education

Access to digital tools for learning is, alone, insufficient to raise student outcomes

Empirical results based on PISA show that in Latin American countries, as in OECD countries, connectivity is not enough for improved academic outcomes. Merely adding and using more computers or educational software in classrooms does not automatically translate into better performance. The same holds for investing in access at home. Evidence on the increase in ICT access at home, though more scarce than evidence related to ICT in schools, indicates that expanding access is unlikely to result in improved educational outcomes (Bulman and Fairlie, 2016[10]). While there is leeway for enhanced connectivity in many Latin American countries and particularly for disadvantaged students (Chapter 2), channelling investments only on expanding access is insufficient to make the most of new technologies for learning.

Even in many OECD countries with almost universal access to ICT in schools and at home, the potential of digital tools for learning has not been reached yet (OECD, 2019[3]).

Indeed, increased access to ICT in schools (and at home) tends to be associated with more time spent using these devices (Leuven et al., 2007[11]; Malamud et al., 2018[12]; Bulman and Fairlie, 2016[10]). By investing in ICT availability, students are provided more opportunities to become acquainted to digital tools, thereby potentially enhancing their digital competence and increasing their awareness of the risks associated with new technologies (e.g. cyberbullying, safety and privacy issues, and excessive use). Few studies measure, however, the direct impact of technology use on students' digital skills, as the focus is generally on academic outcomes. Among those who do, some find positive effects on digital skills (Malamud and Pop-Eleches, 2011[13]; Malamud et al., 2018[12]). Evidence from PISA 2012 indicates the presence of a hill-shaped relationship between computer use at school and student performance in digital reading, quality of students' navigation on line or computer-based mathematics, whereby moderate uses are more positively related to student performance than no or extensive uses (OECD, 2015[14]). Interestingly, contrasting students' performance in digital versus paper-based assessment shows that students' performance is weakly associated to high levels of computer use. The relationship between computer use and digital skills vary, however, by type of use and country. For instance, in Australia, even high frequency browsing is associated with higher skills in digital reading (OECD, 2015[14]).

As technology is constantly changing, the definition of digital competence is also evolving. The availability of digital tools in schools can enable children to learn how to use a computer or specific software. However, when students focus too much on acquiring specialised digital skills, the risk that those skills become quickly outdated can emerge, especially in light of the rapid pace of technological progress (OECD, 2019[3]). Developing digital literacy more broadly, one that enhances students' digital skills, their digital resilience and capacity to make a critical use of new technologies can lead to larger dividends, ensuring that students are not locked up by their narrow knowledge of specific digital technologies (Bell, 2016[15]). Schools can play a leading role in this respect, either through the innovative integration of ICTs in the curricula, or by shifting the focus of ICT classes from developing specific digital skills to broader digital literacy and competence (Box 3.2).

Box 3.2. Digital skills and digital competence

The Broadband Commission for Sustainable Development – a joint initiative of the International Communication Union and UNESCO – regards digital skills as a continuum from basic to advanced skills (Broadband Commission for Sustainable Development, 2017[16]):

- Basic functional digital skills allow people to access and use digital technologies (e.g. understanding basic ICT concepts, being able to manage computer files, use keyboards or touch-screen devices).
- Generic/intermediate digital skills allow people to use technologies in meaningful and beneficial ways (e.g. using work-related software, creating online content, evaluating online risks).
- Advanced skills are those needed by ICT specialists (e.g. programming, app development).

Generic/intermediate digital skills are often at the core of national digital strategies or policies that seek to develop the population's digital literacy or competence. For instance, the digital competence framework of the European Commission defines digital competence as "the confident, critical and creative use of ICT to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society" (Ferrari, 2013[17]).

Source: OECD (2019[3]), *OECD Skills Outlook 2019 : Thriving in a Digital World*, https://dx.doi.org/10.1787/df80bc12-en.

The quality of educational technologies matters

Much focus has been put on expanding and documenting increases in access (e.g. through the number of computers per student in schools), but the quality of digital devices is rarely measured in a systematic way (Bulman and Fairlie, 2016[10]). Shortages or inadequacies of digital instruction are equally likely to shape the extent to which technology use in schools can be associated with better performance. If students waste time because the Internet connection is slow, computers do not function properly, or software is outdated, technology use risks being detrimental to student performance. Perceived shortages or inadequacy of digital technologies are considerable in Latin American countries (Chapter 2), hence the quality of ICT infrastructure or lack thereof could also drive the absence of positive associations between student performance and digital devices use. The availability of technical support staff for ICT who can help maintain digital tools and prepare them for class, so that teachers do not waste time trying to fix computers or wait until they are turned on during class, can also be of consequence. Such support staff can be crucial, especially if teachers themselves are not fully proficient in the use of digital tools and require assistance with newer software or technologies.

The quality of educational technologies also raises the question of their evaluation. Certain types of interventions, such as expanding access to computers or computer-assisted instruction, have been more frequently evaluated through rigorous methods than others, although countless technology-based opportunities for learning have emerged (e.g. interactive whiteboards) (Escueta et al., 2017[18]; Abdul Latif Jameel Poverty Action Lab, 2019[19]). More evidence is needed to identify which components of educational technologies, rather than tools or products, are most beneficial to learning (Escueta et al., 2017[18]; Abdul Latif Jameel Poverty Action Lab, 2019[19]). In addition, it is often easier to invest in hardware or scale up educational technology programmes rapidly than devote time and resources in evaluating them or collecting data to assess their link to student performance. Pilot projects can be run before scaling up programmes and rethinking measurement options could be rethought in order to obtain metrics on the relationship between technology and performance faster. Cost-benefit analyses would also allow understanding whether investments in some technologies crowd out other types of investments, especially as the introduction of technologies in schools is likely to be associated with additional costs related to their maintenance or update (Bulman and Fairlie, 2016[10]).

The way technology is integrated in teaching and learning activities is crucial to enhance student outcomes

Technology use at school

In Latin American and OECD countries alike, if not well developed, the frequent use of digital devices at school may distract students or substitute more efficient instructional practices (OECD, 2019[3]). If technology merely replaces learning or teaching activities that could have been done equally efficiently otherwise, then the use of technology may not have been necessary in the first place and thus, their use will likely result in no impact on performance. More troubling, if technology replaces more efficient educational practices, it can be detrimental to students' outcomes.

The way technology is used and the quality of the instruction it may substitute matter. The overall effect of technology use for learning activities in schools depends on how it complements or substitutes traditional instruction (Bulman and Fairlie, 2016[10]), meaning how technology is integrated into pedagogical practices and whether it substitutes more or less motivated and trained teachers (Banerjee et al., 2007[20]).

Evidence shows that, while ICT investment has very little or no positive effect on student outcomes on its own, educational software or computer-assisted instruction displays more promising results, although more in mathematics than in reading (Bulman and Fairlie, 2016[10]; Escueta et al., 2017[18]; Abdul Latif Jameel Poverty Action Lab, 2019[19]). Unlike broad ICT investments, educational software can be more easily individualised and targeted at the specific needs of students. Some of the programmes that were found to be effective, were so as they provided feedback to students and sent information about students' performance to teachers as well (Abdul Latif Jameel Poverty Action Lab, 2019[19]). In developing countries with lower teacher quality and large heterogeneity in students' skills, computer-assisted instruction can have beneficial effects on student outcomes especially as this can enable to provide instruction at a level adequate to each student (Kremer, Brannen and Glennerster, 2013[21]; Muralidharan, Singh and Ganimian, 2019[22]).

Box 3.3. Technology use and student outcomes- some research evidence from Latin America

Technology at school

In Colombia, an evaluation of the "Computadores para Educar" programme found that the programme only increased the time spent by students on computers, with no statistically significant effect on students' test scores and other outcomes (Barrera-Osorio and Linden, 2009[23]). The programme, initiated in 2002, was based on refurbishing computers from the private sector in order to give them to public schools and training teachers, thanks to a partnership between schools and a local university. Using a randomised experiment involving a sample of schools associated with the University of Antioquia, the evaluation shows that there is no effect of the programme on students' test scores, grades, probability to like school or to talk to a teacher outside of class. A follow-up questionnaire unveiled that students' computer use at school had increased for computer science classes but not for Spanish classes, although the latter were the focus of the programme. Outside of ICT classes, the programme failed at supporting the integration of computers into pedagogical practices.

Assessments that are more recent have provided more positive evidence on the effectiveness of "Computadores para Educar" (OECD, 2019[24]). In particular, participation in the programme appeared to be associated with lower dropout and reduced repetition rates, as well as with higher transition rates to tertiary education. These effects were nevertheless dependent on a satisfactory level of training for teachers. Teacher training, but also training of parents, has been one of the important features of the programme. By 2016, around 50 000 teachers and more than 150 000 parents had benefitted from training (OECD, 2019[24]) in ICT-skills and the use of digital technologies for educational purposes.

In Chile, the programme "ConectaIdeas" was developed to support learning in mathematics among students from disadvantaged backgrounds. The novelty of the programme relied on several gamification strategies in order to enhance student motivation. Based on a randomised experiment in public primary schools attended by low-income, low-skilled students in Santiago, an evaluation of the programme found positive effects on students' maths achievement (Araya et al., 2019[25]). Observed effects were four times larger than the effects of two other interventions related to: (i) the extension of the school day from four to seven hours, and (ii) the provision of lesson plans and materials to teachers. While the programme had a positive effect on students' preference to rely on computers for maths, it also led to higher anxiety associated with the field and made students less willing to collaborate.

Technology at home

A randomised experiment examined the short-term impact of One Laptop Per Child (OLPC) XO laptops provided at home in Peru (Beuermann et al., 2015[26]). Around 1 000 primary school children from Lima received laptops to use at home. The intervention successfully increased children's exposure to and use of computers at home. The largest increases in time spent on the laptop were due to playing games, although OLPC designed these games with educational purposes. Students' proficiency in using OLPC XO also increased. However, no effect was found on self-reported skills for Windows or Internet use, on maths and reading grades or cognitive skills measured by the Raven's Progressive Matrices Test.

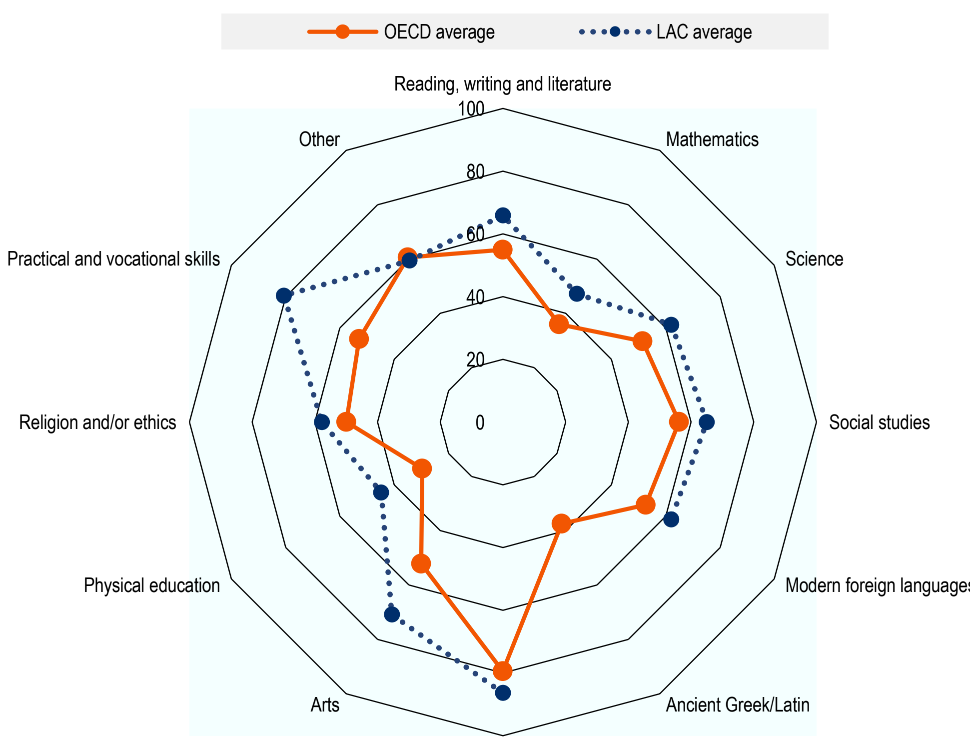
Moreover, using information on teachers' perceptions, the evaluation provided evidence that students who benefitted from the programme made fewer efforts at school.

A further evaluation of the same OLPC XO provision in Peru focused on the effects of increased Internet access at home on a range of student outcomes (Malamud et al., 2018[12]). In contrast to Beuermann et al. (2015[26]) who examined short-term effects, this secondary evaluation, conducted using follow-up data collected after a longer time, found positive effects on students' computer literacy as reflected by their proficiency in a Windows-based test. Internet and computer proficiency of children improved following the intervention. There were no effects, however, on maths and reading achievement, school grades or cognitive skills measured by the Raven's Progressive Matrices Test. In addition, using log data, the evaluation showed that students were using the computer and the Internet more for entertainment rather than for learning activities.

Source: Araya, R. et al. (2019[25]), *Does Gamification in Education Work?: Experimental Evidence from Chile*, http://dx.doi.org/10.18235/0001777; Barrera-Osorio, F. and L. Linden (2009[23]), "The use and misuse of computers in education: Evidence from a randomized experiment in Colombia", *Impact Evaluation Series No. 29, Policy Research Working Paper* No. 4836; Beuermann, D. et al. (2015[26]), "One laptop per child at home: Short-term impacts from a randomized experiment in Peru", *American Economic Journal: Applied Economics*, http://dx.doi.org/10.1257/app.20130267; Malamud, O. and C. Pop-Eleches (2011[13]), "Home computer use and the development of human capital", *The Quarterly Journal of Economics*, http://dx.doi.org/10.1093/qje/qjr008.

Figure 3.8. Use of ICT with high frequency, by subject

Share of lower-secondary teachers with high ICT frequency, by subject in target class



Note: High ICT frequency use occurs when ICTs are used frequently or nearly in all lessons for students' class work or projects. The sample for LAC includes: Buenos Aires (Argentina), Brazil, Chile, Colombia and Mexico.
Source: OECD calculations based on OECD (2018[27]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

StatLink https://doi.org/10.1787/888934135623

Indeed, while new technologies hold great potential for innovative uses across many subjects, they continue to be used mostly in areas where they are expected to be present, such as technology or ICT classes (OECD, 2019[3]). In a similar vein to in OECD countries, Latin American teachers use ICTs with higher frequency in subjects that are already traditionally associated with the use of new technologies (Figure 3.8). The share of lower-secondary teachers who let their students use ICT frequently (or always) is highest in subjects such as technology, science, practical and vocational skills. Evidence on the effectiveness of ICT use for student learning shows, however, that innovative uses of technology in mathematics can lead to enhanced student performance (Bulman and Fairlie, 2016[10]). Yet, less than half of mathematics teachers let their students use ICT for projects or class work (Figure 3.8).

When technology is integrated into innovative teaching and learning practices, it can enhance student performance and engagement (OECD, 2015[14]; Paniagua and Istance, 2018[28]; Peterson et al., 2018[29]). Simply delivering content through technology, substituting teaching by using computers or reproducing traditional pedagogies is unlikely to result in better outcomes. Technology use should not be the objective, but rather a tool or a complement for more innovative pedagogies. Gamification, flipped instruction or blended learning are some examples of innovative uses that can be performed with the use of digital technologies and show great potential for improved learning (Peterson et al., 2018[29]; Araya et al., 2019[25]; Abdul Latif Jameel Poverty Action Lab, 2019[19]).

Teachers and their pedagogies are essential to ensure that technology is used at its best potential in the classroom. Pedagogies can rely on technology to encourage active learning and collaboration, while also supporting students' digital literacy and ensuring that they have the prerequisite skills to use digital tools (Paniagua and Istance, 2018[28]). Many children are passive consumers of new technologies and pedagogies are key to support children in developing their critical thinking with respect to new technologies and taking an active role in relation to digital content (e.g. by analysing or creating content rather than simply using what is available) (Burns and Gottschalk, 2019[30]).

Technology use at home

At home, making the most of opportunities brought by new technologies for learning depends heavily on parents' involvement and digital competence. Many children first enter into contact with technology in the parental household, whether through the presence of a computer or parents' smartphones. Parents and families have a crucial role in how children interact with technology outside of the school premises. For instance, digitally proficient parents are also more likely to encourage their children to explore and learn using new technologies, while also building their digital resilience (Livingstone et al., 2017[31]). Apart from policies to develop adults' digital competence, technology-based nudges, such as text messages, can also have positive effects on parental involvement and behaviour related to their children's digital activity (Abdul Latif Jameel Poverty Action Lab, 2019[19]). In Chile, a randomised intervention sent more than 7 000 parents weekly SMS messages informing them about their children's Internet use and/or encouraging and assisting them to install parental control software (Gallego, Malamud and Pop-Eleches, 2018[32]). Messages were effective at influencing parents' behaviour and reducing children's Internet use.

The role of schools and teachers

Latin American countries perform poorly in terms of their population's skills and inequalities are pervasive, with respect to both the access and use of new technologies for learning at home. This enhances the role of schools and teachers in helping bridge digital divides and ensuring that students, irrespective of their background, are able to make the most of new technologies to develop their skills. In turn, schools and especially teachers need to be able to integrate technology in their activities.

Box 3.4. Computer-assisted instruction in mathematics - two promising programmes

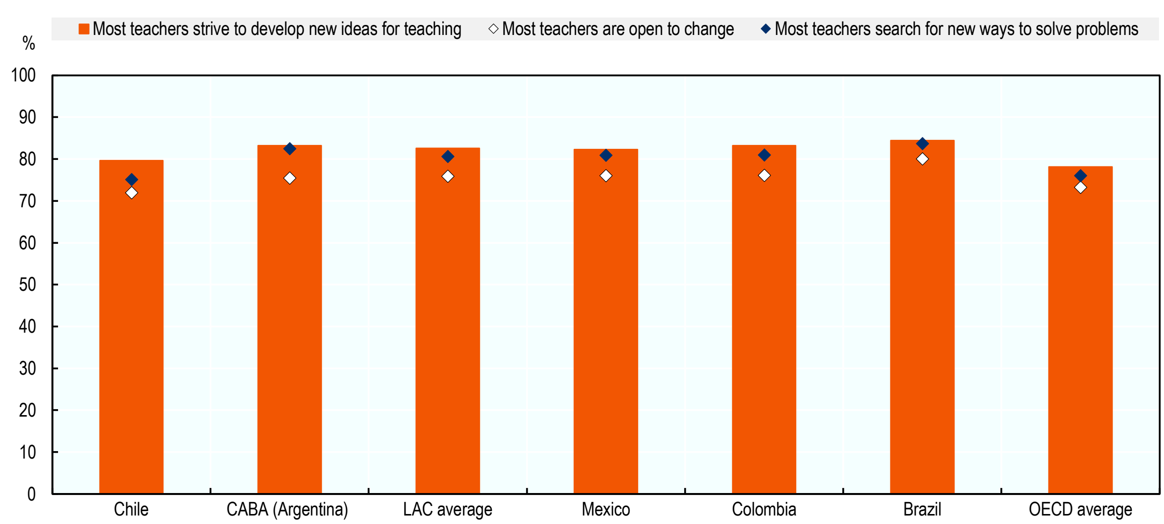
Several evaluations of the ASSISTments web-based homework support have found large positive effects on students' performance in mathematics (Escueta et al., 2017[18]). Among these evaluations, Roschelle et al (2016[33]) perform a large-scale randomised experiment with seventh-grade mathematics students in Maine. ASSISTments is a platform for maths homework that relies on "formative assessments". Based on data derived from students' work, it provides feedback, guidance and allows teachers to rely on the data to adapt their own instruction methods to the specific needs of their students. (Roschelle et al., 2016[33]; Escueta et al., 2017[18]). Roschelle et al. (2016[33]) found that the use of ASSISTments was associated with a large increase in students' maths scores. The estimated improvement in learning outcomes is significant considering the limited amount of time (a few minutes per day) devoted by students to its use.

Muralidharan, Singh and Ganimian (2019[22]) examine the effect of a personalised computer-aided after-school programme in India. Through a lottery, middle-school students from low socio-economic backgrounds in urban areas can enter the programme and attend after-school centres where they use the Mindspark software. They benefit from a blended learning experience that combines individual activities using the software and instructional support from an assistant. One of the key features of the software is that it allows personalising the material proposed to students based on their initial level and rate of progress. The evaluation of the programme finds strong positive effects on students' mathematics and Hindi score. Moreover, the programme is associated with absolute gains for all students, irrespective of their baseline scores, gender or socio-economic status, which reflects the effectiveness of its personalised instruction feature that adapts to each student's needs.

Source: Escueta, M. et al. (2017[18]), "Education technology: An evidence-based review", *NBER Working Paper*, No. 23744, http://www.nber.org/papers/w23744; Muralidharan, K., A. Singh and A. Ganimian (2019[22]), "Disrupting education? Experimental evidence on technology-aided instruction in India", *American Economic Review*, http://dx.doi.org/10.1257/aer.20171112; Roschelle, J. et al. (2016[33]), "Online mathematics homework increases student achievement", *AERA Open*, http://dx.doi.org/10.1177/2332858416673968.

Figure 3.9. Teachers' views on their colleagues' openness to innovation

Percentage of lower secondary teachers who "agree" or "strongly agree" with each statement



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2018[27]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

StatLink https://doi.org/10.1787/888934135642

In many cases, educational technology polices or reforms fail to translate into the desired outcomes because too little focus is put on their implementation (Viennet and Pont, 2017[34]). To be successful, the introduction of digital technologies in schools and classrooms needs to properly engage all relevant stakeholders and in particular teachers. Teachers in Latin American countries with available data report high levels of openness to innovation in their school, similar to those observed among OECD countries (Figure 3.9). The teaching profession is at the core of the integration of ICTs in classrooms and its skills, attitudes and beliefs are key determinants of the extent to which new technologies can support better learning outcomes. For innovation to happen, teachers need support.

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Note

[1] The pattern holds for all subjects traditionally assessed in PISA, namely science, reading and mathematics and is consistent across several PISA rounds (OECD, 2015[14]) and holds also when looking at digital devices at home for schoolwork.

4 Teachers' use of new technologies in Latin America

This chapter investigates Latin American teachers' use of new technologies in the classroom. It identifies the main enabling factors for teachers' frequency of ICT use and self-efficacy in supporting student learning using digital technologies. Many Latin American teachers rely on ICTs in the classroom, and many train in and with technology. However, teachers' self-reported training needs in ICT skills for teaching remain high in Latin America.

Summary of the main insights

Training in information and communications technology (ICT) skills for teaching, teacher self-efficacy and collaboration with other teachers matter for teachers' use of ICT in class and their self-efficacy in supporting student learning using digital technologies.

- Whether in Latin American or OECD countries, teachers' use of ICT in class and self-efficacy in supporting student learning using ICT relate strongly to their training in ICT skills for teaching. Merely receiving training in the use ICT for teaching in their initial education is not sufficient to enable teachers' use of ICT in their classroom and their self-confidence in supporting student learning through digital technologies. What drives Latin American teachers' use of ICT is how well-prepared they actually felt after receiving training. Participation in professional development in ICT skills for teaching seems, also, to be very important.
- Teachers who feel more efficient about their instruction are more likely to let their students use ICT frequently for learning activities and feel more confident about their capacity to support learning using new technologies. In addition, the likelihood that teachers let their students use ICT frequently also increases with teachers' degree of collaboration with other teachers.

Many Latin American teachers use technologies in the classroom and receive training in ICT skills for teaching.

- In Latin American countries with available data in the OECD Teaching and Learning International Survey (TALIS) (2018), many teachers frequently use technology in the classroom and feel quite confident about their capacity to support student learning through ICT use. Latin American teachers seem to use ICT in class with relatively higher frequency than their OECD counterparts. However, these data do not allow knowing how technology is integrated in teaching practices. In addition, teachers' self-efficacy in ICT use for student learning is based on self-evaluative questions and replies may reflect the opinion of teachers about what they think is expected from them rather than an objective assessment of their capacity to effectively integrate digital technologies in the classroom.
- More than 70% of teachers in Latin America let their students use ICT frequently or always for projects or class work. Aggregate results hide, however, large disparities within the region. In Brazil, only 41% of lower secondary teachers display a high frequency use of ICT in class and one in five teachers never relies on ICT for class work.
- Many Latin American teachers report having received training in the use of ICT for teaching as part of their initial teacher education or training. In Chile, Colombia and Mexico, more than 70% of lower-secondary teachers report having trained in the use of ICT for teaching during their initial teacher education. Similarly, many report having engaged in professional development activities to develop their ICT skills for teaching. Colombia displays one of the largest shares of teachers who have engaged in professional development in ICT skills for teaching in the year prior to the survey (78%).
- In addition, a relatively high share of teachers in Latin American countries train through technology. On average, around 40% of Latin American lower-secondary teachers have participated in online courses or seminars as part of their professional development activities.

Teachers' training needs in ICT skills for teaching remain high, raising the need to revisit how teachers are trained for teaching with new technologies.

- As many as 60% of Latin American teachers report the need for further professional development in ICT skills for teaching and for 22% the need is substantial. Even when they already received training in ICT skills for teaching in the year prior to the survey, a relatively large share of Latin American teachers still report high levels of need in professional development.
- In Colombia, the level of self-reported need for further training in ICT is much larger than in the majority of OECD countries, irrespective of whether teachers have already participated or not in professional development activities in ICT skills for teaching. In Brazil and Buenos Aires (Argentina), more than 30% of lower-secondary teachers did not participate in ICT-related professional development activities and report a high level of need in this area.
- Spending on high-quality professional development for teachers is considered a highly important spending priority for many more Latin American teachers than for teachers across OECD countries, pointing to the need to reinforce quality, more than quantity of teachers' training. In particular, in a scenario where the education budget were to increase, 86% of Latin American teachers consider that spending on the provision of high-quality professional development would be of high importance. Evidence suggests that in many Latin American countries, the accessibility and quality of professional development programmes should be a major focus for policy intervention.
- Teachers in Latin American countries with available data in the OECD Survey of Adult Skills, a product of the Programme for the International Assessment of Adult Competencies (PIAAC), perform poorly in problem solving in technology-rich environments. Across the countries participating in the Survey of Adult Skills (PIAAC), the share of teachers with low problem solving skills in technology-rich environments varies from less than 5% in Australia to around 54% in Ecuador. Teachers' skills relate to student performance. Substantial gains in students' performance could be obtained by strengthening teachers' skills and this should become a priority for Latin American governments.

What factors enable teachers' use of new technologies and their self-confidence in supporting student learning using ICT?

The teaching profession is pivotal for making the most of new technologies in the classroom. Students' performance relates closely to the quality of their teachers (Chetty, Friedman and Rockoff, 2014[1]; Hanushek, Piopiunik and Wiederhold, 2014[2]) and technology use has the potential to translate into better student outcomes when technology is blended into innovative teaching and learning practices (Chapter 3). This puts teachers, their skills, attitudes and pedagogies at the core of an effective integration of ICT in teaching in initial education.

Teachers' reliance on ICT for student learning activities and their self-confidence regarding the use of new technologies for supporting student learning can be enabled by a variety of factors. The availability and quality of ICT infrastructure in schools, school policies, teachers' commitment, skills and attitudes towards ICT are likely to shape whether and how new technologies enter the classroom. Data from TALIS (2018) allow investigating (Box 4.1) the factors that enable teachers to let their students use ICT frequently for their projects and make teachers feel self-confident about their capacity to support student learning through the use of new technologies.

Training in ICT skills for teaching makes a difference for teachers' ICT use and self-efficacy

Whether in Latin American or OECD countries, teachers' use of ICT in class (Figure 4.1) and self-efficacy (Figure 4.2) in supporting student learning using ICT relate strongly to their training in ICT skills for teaching.

Teachers may feel overwhelmed by the different technological options that are arrive in their classrooms or are available to them for teaching, and feel that they are not sufficiently skilled or supported in order to make the most of the new technologies. The quality of teachers' training in ICT skills becomes, then, a key factor behind the extent to which teachers finally rely on ICT and feel confident about supporting learning through technology use.

What drives Latin American teachers' use of ICT is how well prepared they actually felt after receiving training in the use of ICT for teaching as part of their initial teacher education. Results in Panel B of Figure 4.1 suggest, for instance, that teachers who received training in the use of ICT for teaching in their initial teacher education but felt unprepared display a similar frequency of technology use as teachers who did not receive such training and felt unprepared.

Box 4.1. Enabling factors for teachers' ICT use and self-efficacy in ICT use – empirical analysis

The econometric analysis in this chapter examines the factors that enable teachers' frequency of ICT use in class and their self-efficacy in ICT use. The main results of the analysis are presented in Figure 4.1 and Figure 4.2. Estimation tables with all coefficients are reported in Annex Table 4.A.1 and Annex Table 4.A.4.

Potentially enabling factors

The analysis relies on two research papers aiming to identify a series of factors potentially associated with the use of ICT in the classroom for students' projects and teachers' self-confidence in ICT use for learning.

The first, (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[3]) investigates the role of ICT infrastructure and teacher characteristics in explaining ICT use by Spanish lower-secondary teachers. It relies on data from the Spanish sample of TALIS (2013).

The second, (Le Donné, Fraser and Bousquet, 2016[4]) identifies a series of factors that are most important in explaining differences in teachers' cognitive activation and active learning teaching practices. The analysis relies on the TALIS (2013)–PISA (2012) link database and explores the relationship between teachers' teaching strategies and student performance.

The following variables are therefore included in the analysis of the main enabling factors associated with teachers' ICT use and self-confidence:

School attributes

- Private or public school; school in rural or urban area; whether teacher determines course content, including curricula; whether teacher chooses learning material; organisational and team's innovativeness (OECD, 2019[5]); professional collaboration in lessons among teachers; shortage or inadequacy of digital technology for instruction; insufficiency of Internet access.

The index of professional collaboration among teachers is based on four items related to how often teachers do the following in school: teach jointly as a team in the same class, provide feedback to other teachers about their practice, engage in joint activities across different classes and age groups (e.g. projects) and participate in collaborative professional learning (OECD, 2019[5]).

School composition

- Share of students from disadvantaged homes; percentage of immigrant students.

Classroom composition

- Disciplinary climate; percentage of low academic achievers; percentage of students with special needs; percentage of students from disadvantaged homes; percentage of gifted students.

Teacher characteristics

- Years of teaching experience; age; gender; permanent contract; relationship with students and other teachers; effective professional development; index of job satisfaction; use of ICT for teaching included in teacher's initial education or training; preparedness to use ICT for teaching after initial teacher education or training; ICT skills for teaching part of professional development in the 12 months prior to the survey; need for professional development in ICT; self-efficacy in instruction, classroom management and student engagement.

Self-efficacy indices are based on a series of items derived from teachers' answers to the question "In your teaching, to what extent can you do the following?" (OECD, 2019[6]):

- Self-efficacy in instruction is a composite indicator based on the extent to which teachers can: craft good questions for students, use a variety of assessment strategies, provide an alternative explanation, for example when students are confused, vary instructional strategies in my classroom.
- Self-efficacy in classroom management is a composite indicator based on the extent to which teachers can: control disruptive behaviour in the classroom, make their expectations about student behaviour clear, get students to follow classroom rules, calm students who are disruptive or noisy.
- Self-efficacy in student engagement is a composite indicator based on the extent to which teachers can: get students to believe they can do well in schoolwork, help students value learning, motivate students who show low interest in schoolwork and help students think critically.

Econometric analysis

The analysis is based on a multilevel (teacher and school levels) mixed-effects regression model. Two different estimations are performed, examining:

- Enabling factors for the use of ICT: the dependent variable for this estimation is a dummy for whether the teacher lets students use ICT for projects or class work frequently or in all or nearly all lessons (vs. never/almost never or occasionally).
- Enabling factors for teachers' self-efficacy in ICT use to support student learning: the dependent variable for this estimation is a dummy for whether the teacher perceives he or she can support quite a bit or a lot student learning through the use of new technologies.

Source: Gil-Flores, J., J. Rodríguez-Santero and J. Torres-Gordillo (2017[3]), "Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure", *Computers in Human Behavior*, http://dx.doi.org/10.1016/j.chb.2016.11.057; Le Donné, N., P. Fraser and G. Bousquet (2016[4]),, "Teaching strategies for instructional quality: insights from the TALIS-PISA link data", *OECD Education Working Papers*, No. 148, https://dx.doi.org/10.1787/5jln1hlsr0lr-en; OECD, (2019[6]), *TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners*, https://dx.doi.org/10.1787/1d0bc92a-en.

Simply having had the use of ICT for teaching included in their initial teacher education does not appear to boost teachers' ICT use in classroom and self-confidence if the quality of that training is low and teachers end up feeling unprepared. Participation in professional development in ICT skills for teaching, instead, seem to matter quite a lot. Evidence shows, in fact, that teachers who participated in professional development in this area in the year prior to the survey are significantly more likely to use ICT with high frequency in class.[1] They are also significantly more likely to report they can support student learning quite a bit or a lot using digital technologies. This association is observed in all Latin American countries with available data in TALIS 2018 (Annex Table 4.A.3).

While perceived shortages related to ICT infrastructure are associated with less frequent uses of digital technologies in the classroom and lower teacher self-efficacy in ICT, programmes that focus only on the provision of ICT infrastructure will not be sufficient. To support the integration of ICT in classrooms and teachers' confidence in their capacity to make effective uses of these tools for student learning, investments in ICT infrastructure should come jointly with high-quality training in ICT skills for teaching during teachers' initial teacher education and professional development (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[3]).

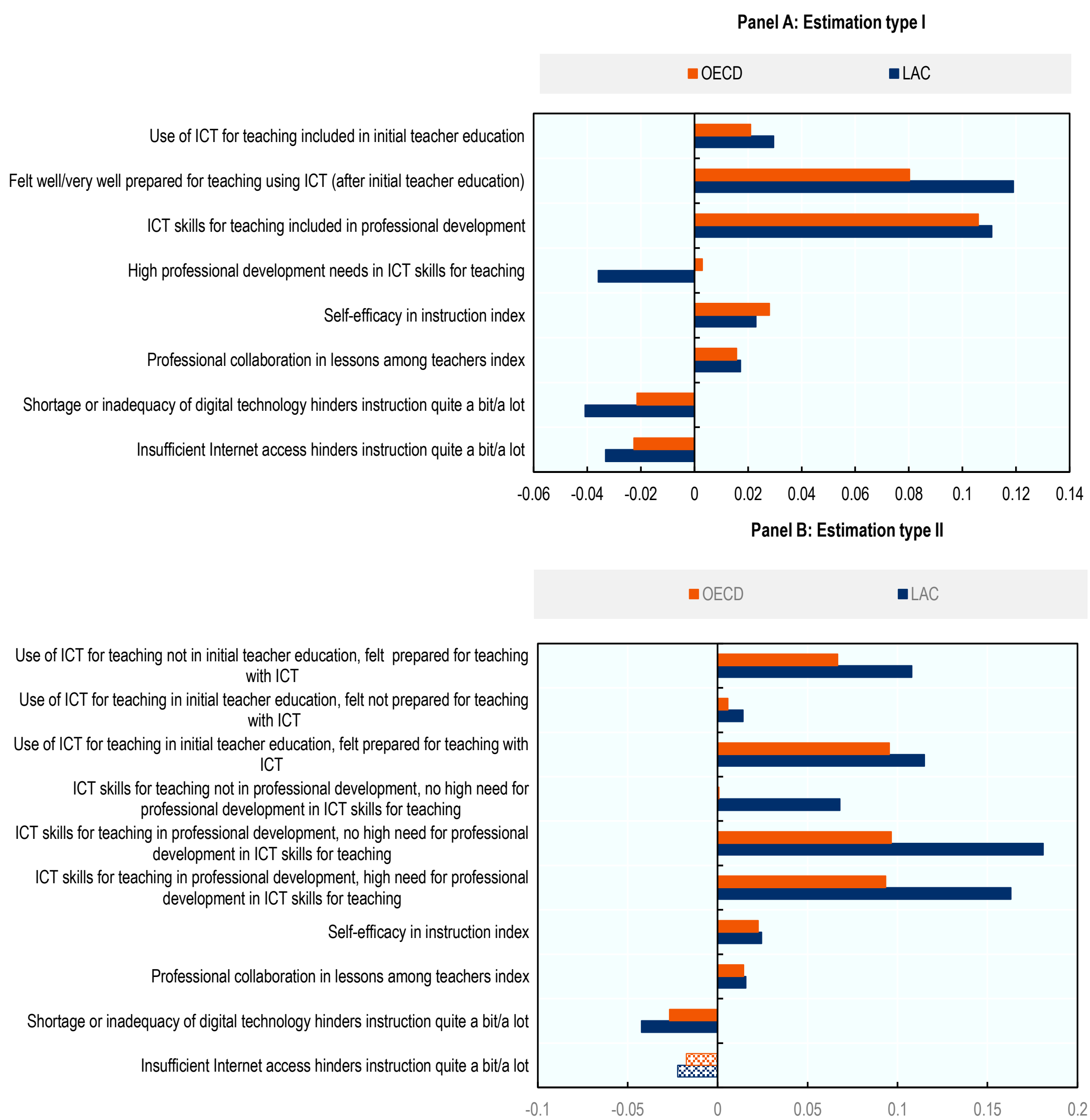
Teacher self-efficacy in instruction and collaboration with other teachers also matter

Teachers who feel more efficient about their instruction are more likely to let their students use ICT frequently for learning activities and feel more confident about their capacity to support learning using new technologies. TALIS examines teachers' perception on their self-efficacy, meaning the extent to which teachers report they can do a series of activities in three dimensions: instruction, classroom management and student engagement (Box 4.1). Teacher self-efficacy is closely related to instructional quality (Holzberger, Philipp and Kunter, 2013[7]). Self-efficacy in instruction reflects teachers' confidence in using diverse instructional and assessment strategies, as well as providing alternative explanations, for instance, when students are confused.

In addition, the likelihood that teachers frequently use ICT also increases with teachers' degree of collaboration with other teachers. Higher levels of collaboration among teachers in a school tend also to be related to higher teacher job satisfaction and teacher self-efficacy (OECD, 2014[8]).[2]

Figure 4.1. Factors related to teachers' frequent use of ICT for students' projects/class work

Effects of each variable on teachers' frequent use of ICT for students' projects/class work



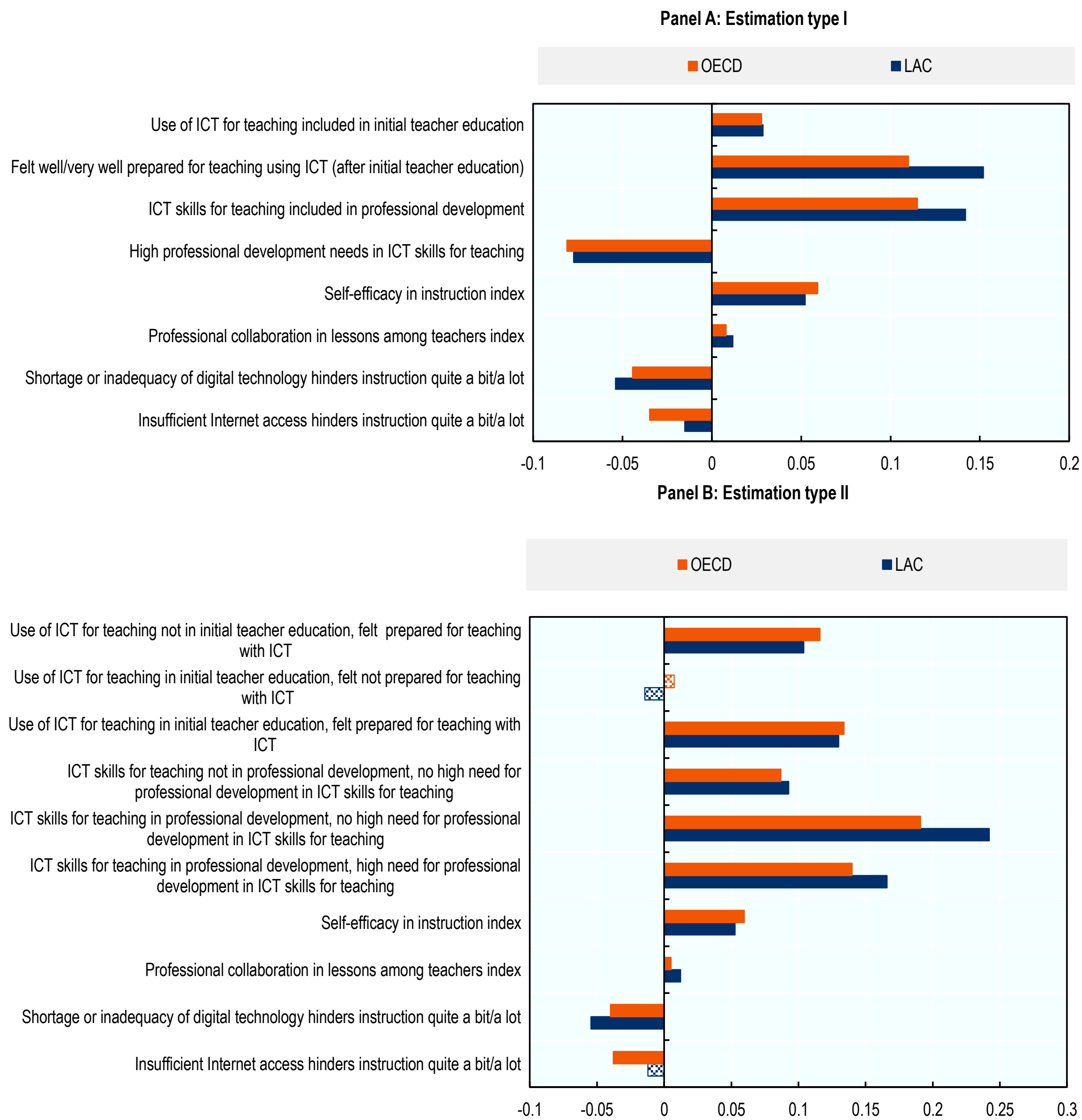
Note: "Frequent ICT use" is a dummy for letting students us ICT for projects or class work frequently or always. Coefficients are obtained through multilevel mixed-effects linear regressions that account for school attributes, school composition, school characteristics, teacher characteristics and country fixed effects. School attributes, school composition, school characteristics and teacher characteristics are detailed in Box 4.1. Effects of "Use of ICT for teaching not in initial teacher education, felt prepared for teaching with ICT", "Use of ICT for teaching in initial teacher education, felt not prepared for teaching with ICT", "Use of ICT for teaching in initial teacher education, felt prepared for teaching with ICT" should be interpreted with respect to the reference category "Use of ICT for teaching not in initial teacher education, felt not prepared for teaching with ICT". Effects of "ICT skills for teaching not in professional development, no high need for professional development", "ICT skills for teaching in professional development, no high need for professional development" and "ICT skills for teaching in professional development, high need for professional development' should be interpreted with respect to the reference category "ICT skills for teaching not in professional development, high need for professional development". Detailed estimation results are presented in Annex Table 4.A.1 for results in Panel A (Estimation type I) and Annex Table 4.A.2 for results in Panel B (Estimation type II). Estimations on OECD countries exclude Chile and Mexico. Bars with patterns indicate coefficients that are not statistically significant.

Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

StatLink https://doi.org/10.1787/888934135661

Figure 4.2. Factors related to teachers' ICT self-efficacy

Effects of each variable on teachers' ICT self-efficacy



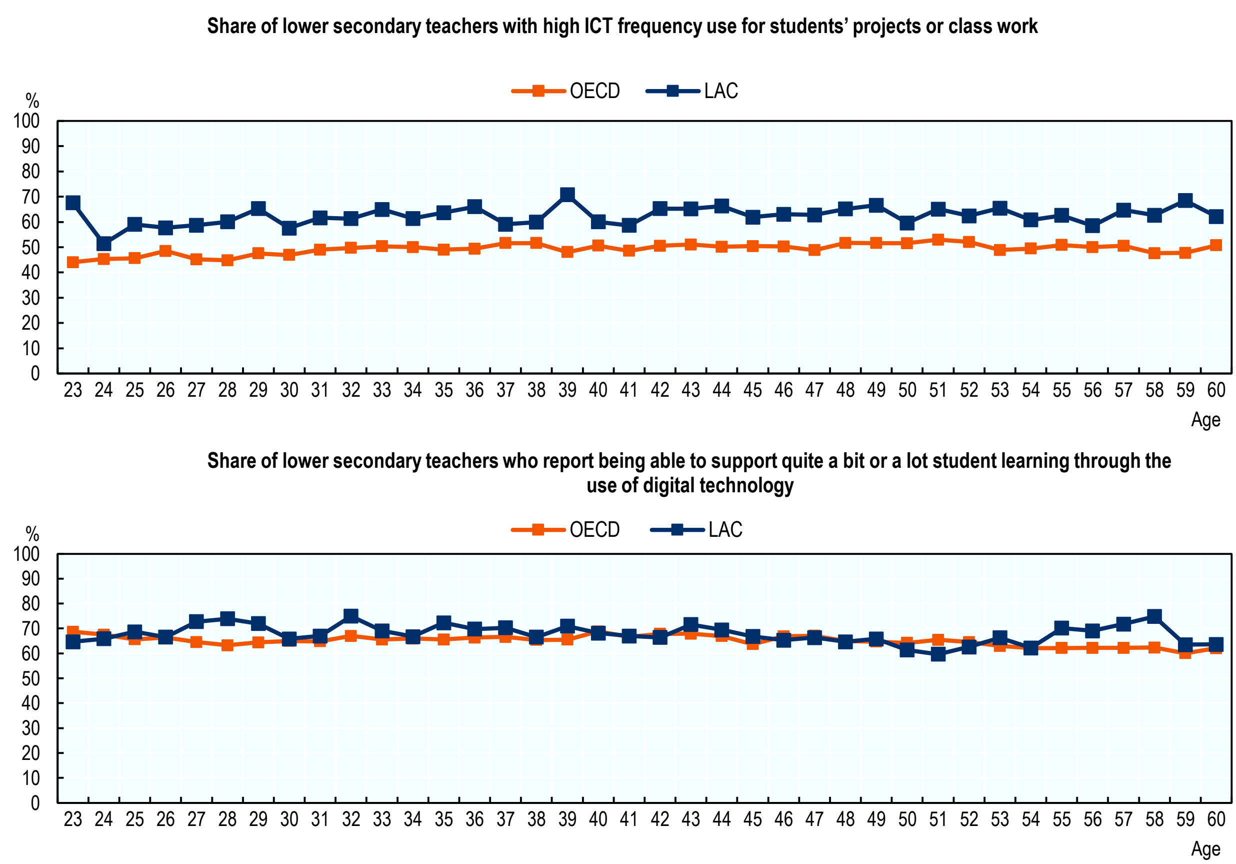
Note: . "ICT self-efficacy" is a dummy variable equal to one if the teacher reports being able to support student learning quite a bit or a lot through the use of digital technology. Coefficients are obtained through multilevel mixed-effects linear regressions that account for school attributes, school composition, school characteristics, teacher characteristics and country fixed effects. School attributes, school composition, school characteristics and teacher characteristics are detailed in Box 4.1. Effects of "Use of ICT for teaching not in initial teacher education, felt prepared for teaching with ICT", "Use of ICT for teaching in initial teacher education, felt not prepared for teaching with ICT", "Use of ICT for teaching in initial teacher education, felt prepared for teaching with ICT" should be interpreted with respect to the reference category "Use of ICTfor teaching not in initial teacher education, felt not prepared for teaching with ICT". Effects of "ICT skills for teaching not in professional development, no high need for professional development", "ICT skills for teaching in professional development, no high need for professional development" and "ICT skills for teaching in professional development, high need for professional development' should be interpreted with respect to the reference category "ICT skills for teaching not in professional development, high need for professional development". Detailed estimation results are presented in Annex Table 4.A.1 for results in Panel A (Estimation type I) and Annex Table 4.A.2 for results in Panel B (Estimation type II). Estimations on OECD countries exclude Chile and Mexico. Bars with patterns indicate coefficients that are not statistically significant.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

StatLink https://doi.org/10.1787/888934135680

Finally, teachers' attitudes towards ICT are also likely to be related to the extent to which ICTs are present in the classroom. Students whose teachers are more positive about the usefulness of new technologies for teaching are more likely to report more frequent technology uses (European Commission, 2013[10]). Teachers who hold constructivist beliefs about how students learn (e.g. "My role as a teacher is to facilitate students' own inquiry") are equally more inclined to let their students use ICT for projects or class work with high frequency (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017[3]). In fact, analyses based on TALIS (2013) showed that in around 16 countries, teachers' frequency of ICT use in classrooms was associated with their constructivist beliefs (OECD, 2014[8]). However, teachers' ICT use in class and ICT-related self-efficacy do not appear to be a question of age (Figure 4.3).

Figure 4.3. Teachers' frequency of ICT use and self-confidence in supporting learning through ICT, by age

Share of lower-secondary teachers, by age



Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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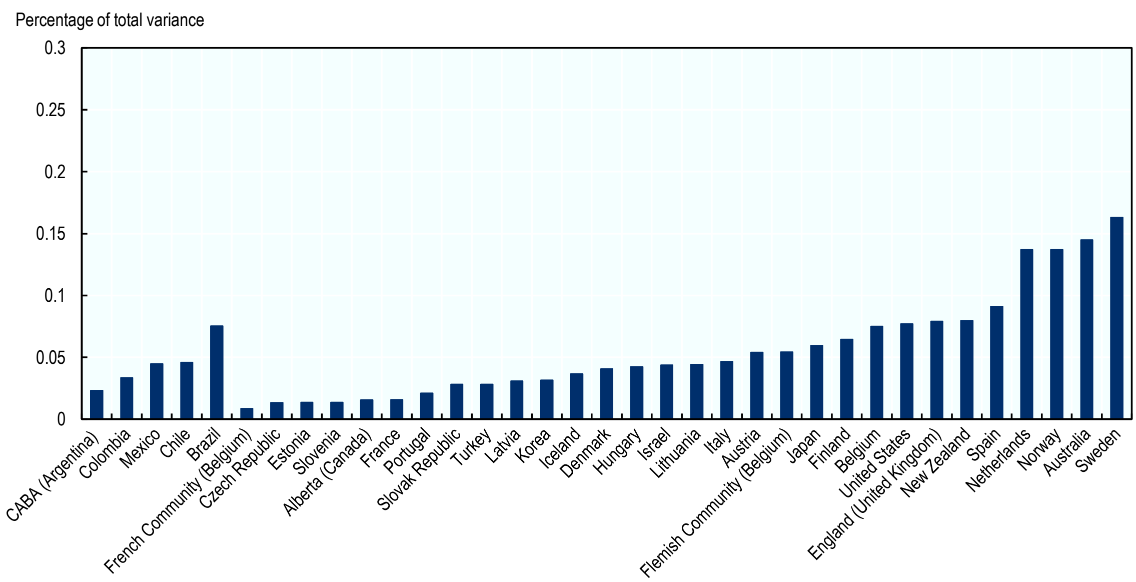
Teacher training, attitudes and collaboration with other teachers matter for ICT use in classrooms. In fact, teacher and potentially student-level factors are relatively more important in explaining the frequency of ICT use for students' projects or class work. In most Latin American and OECD countries, the use of ICT by teachers working in the same school varies greatly (Figure 4.4). On average across Latin American schools, school-level factors seem to play a very limited role in explaining the variation in teachers' frequency of ICT use. High between-school variation would indicate that teachers in the same school approach ICT use in the same way and therefore, that school-level factors are more important in shaping teachers' use of ICT. However, in Latin American countries, the between-school variation in teachers' ICT use with high frequency represents only 4% of the total variation in teachers' ICT use with high frequency.

This pattern also holds for the majority of OECD countries. These figures are in line with findings from the econometric analysis (Annex Table 4.A.1, Annex Table 4.A.2). They are also consistent with evidence based on PISA (2012) showing that the variation in computer use in mathematics is mainly within-schools, rather than between-schools, suggesting a relatively weak association between computer use in class and school-level policies (OECD, 2015[11]).

Figure 4.4. Between-school variation in teachers' frequent use of ICT for students' projects/class work

Intra-class correlation coefficient



Note: The intra-class correlation coefficient reports the between-school variation in teachers' frequent use of ICT for students' projects/class work expressed as a percentage of the total variation in teachers' frequent use of ICT for students' projects/class work. CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

StatLink https://doi.org/10.1787/888934135718

How prepared are Latin American teachers for teaching with new technologies?

Many Latin American teachers rely on technologies in the classroom

In Latin American countries with available data in TALIS (2018), many teachers frequently use technology in the classroom and feel quite confident about their capacity to support student learning through ICT use (Figure 4.5). TALIS data do not provide any information on the specific use teachers and students are making of new technologies, nor on the amount of time devoted to technology use (Box 4.2). As such, these data should be interpreted as providing an indication of teachers and students' exposure to new technologies and of the different factors that enable teaching practices associated with ICT.

Latin American teachers seem to use ICT in class with relatively higher frequency than their OECD counterparts, although the region hides large disparities. Colombian teachers lead the use of ICT for class work. More than 70% of them let their students use ICT frequently or always for projects or class work. In contrast, in Brazil, only 41% of lower secondary teachers display a high frequency use of ICT in class and one in five teachers never relies on ICT for class work.

Interestingly, Latin American teachers report similar levels of confidence in their capacity to support student learning using ICT as teachers across OECD countries do. Around two thirds of teachers report being able to provide such support quite a bit or a lot and Colombian and Chilean teachers appear to be most confident in their capacity to support student learning through ICT. Brazilian teachers are also relatively numerous to report being self-efficient when it comes to ICT for learning, although they use ICT the least frequently among Latin American teachers surveyed in TALIS (2018).

Box 4.2. Some data limitations

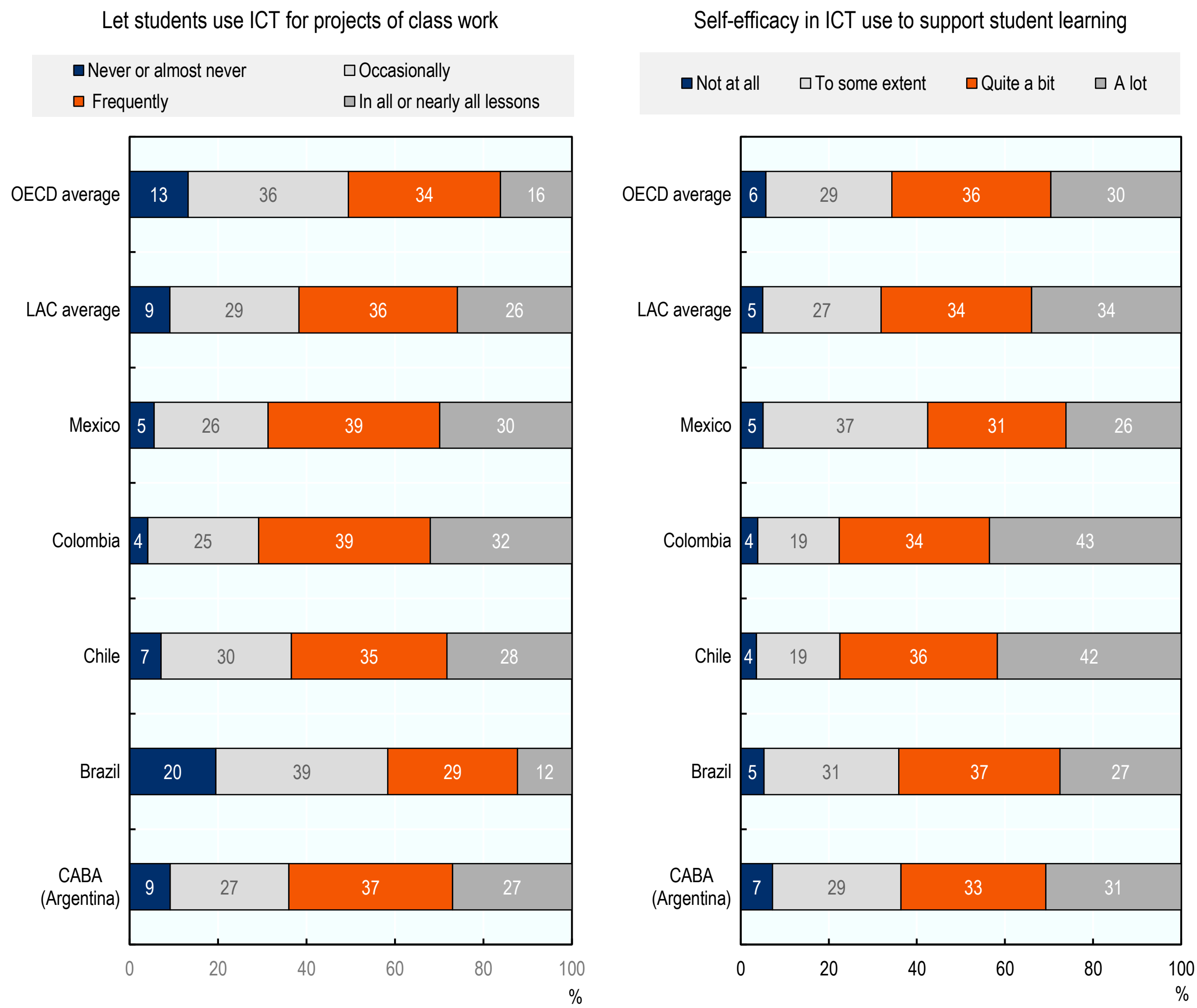
TALIS data do not allow knowing how technology is integrated into teaching practices. For instance, there is no available information on whether teachers are making innovative or simplistic uses of ICT in class. The analyses carried out in this chapter are informative with respect to the exposure of Latin American teachers and students to new technologies, and to the factors associated with more frequent reliance on ICT in the classroom and higher teacher self-confidence. However, given data limitations, it is not possible to derive conclusions on whether Latin American teachers' frequency of technology use translates into better student outcomes Additional data on teachers and students' specific use of new technologies would be needed to make inferences about the extent to which specific uses can support student outcomes.

In addition, TALIS data are based on teachers' self-reports and as such, reflect their own perceptions, opinions and evaluations about the learning environment and their own teaching practices (OECD, 2019[6]; OECD, 2019[5]). Teachers' self-confidence in their capacity to support student learning using new technologies (or ICT-related self-efficacy) is based on self-evaluative questions. This can make cross-country comparison difficult as teachers in different countries could potentially evaluate themselves against different standards of teaching self-efficacy.

Source: OECD (2019[6]), *TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners*, https://dx.doi.org/10.1787/1d0bc92a-en; OECD (2019[5]), *TALIS 2018 Technical Report*.

Figure 4.5. Latin American teachers' use of ICT in the classroom and self-efficacy

Percentage of lower-secondary teachers



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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A relatively high share of teachers receive training in ICT skills for teaching

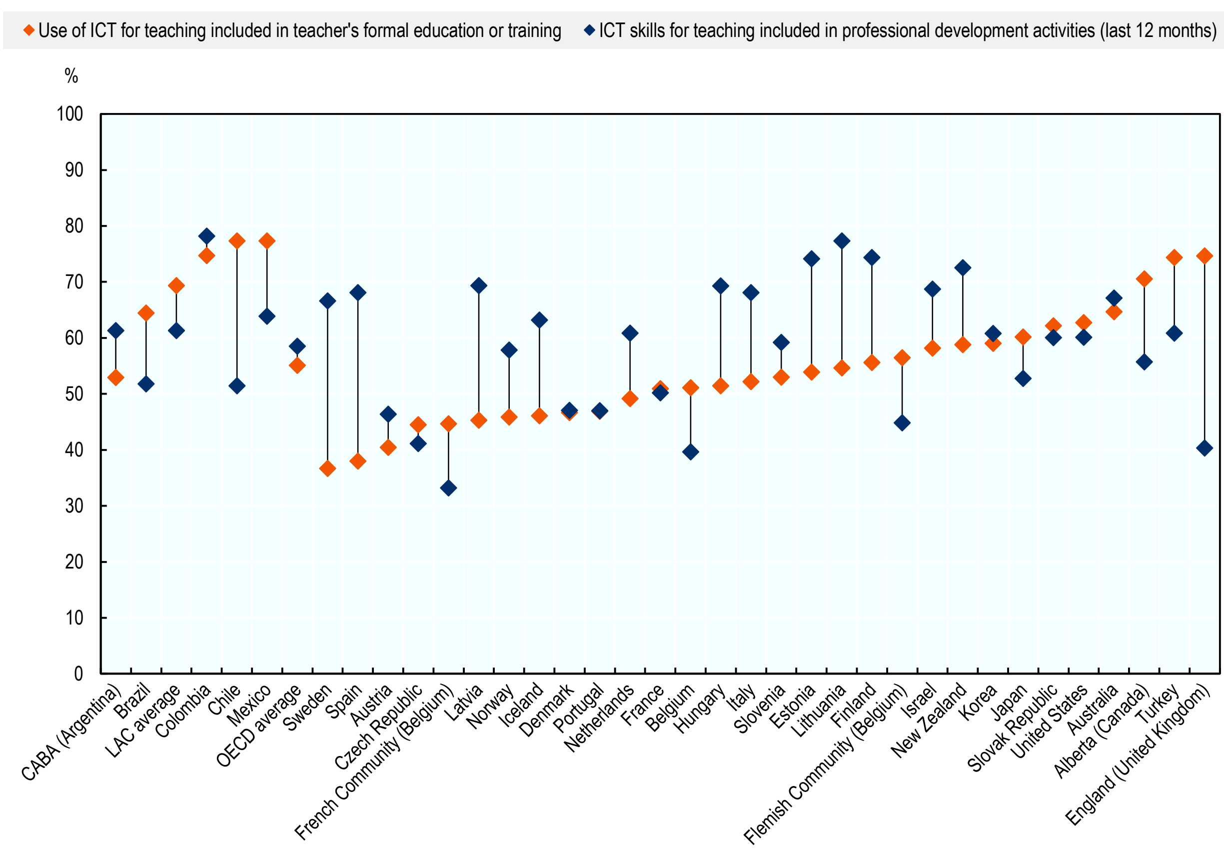
Many Latin American teachers report having received training in the use of ICT for teaching as part of their formal education or training, or professional development in ICT skills for teaching (Figure 4.11). On average, the inclusion of ICT use for teaching in teachers' initial education appears to be more widespread in Latin American countries than across OECD countries. In Chile, Colombia and Mexico, for instance, more than 70% of lower-secondary teachers report having trained in the area of ICT skills for teaching during their initial teacher education or training.

Participation in professional development activities related to ICT skills for teaching is similar in OECD and Latin American regions. Among countries for which data are available in the region, Colombia displays one of the largest shares of teachers who have engaged in professional development in ICT skills for teaching in the year preceding the survey (78%). Latin American countries have also relatively high levels of teacher participation in professional development activities in general (Figure 4.7), although not on a par with OECD countries.

Latin American teachers are numerous to receive training in teaching with ICT as part of their initial teacher education, or professional development activities. However, these figures do not reflect the type or quality of the training they receive. If many Latin American teachers receive, in fact, basic ICT training, such training may not be necessary in many OECD countries, where teachers and adults are likely to be more digitally literate. Differences in the type and quality of training provision may therefore explain the relatively high shares of teachers receiving ICT-related training in their initial teacher education, or professional development activities. That being said, investments made in ICT infrastructure in many Latin American countries have often been accompanied by more training for teachers in this area.

Figure 4.6. Inclusion of the use of ICT for teaching in initial teacher education and of ICT skills for teaching in professional development activities

Share of lower-secondary teachers



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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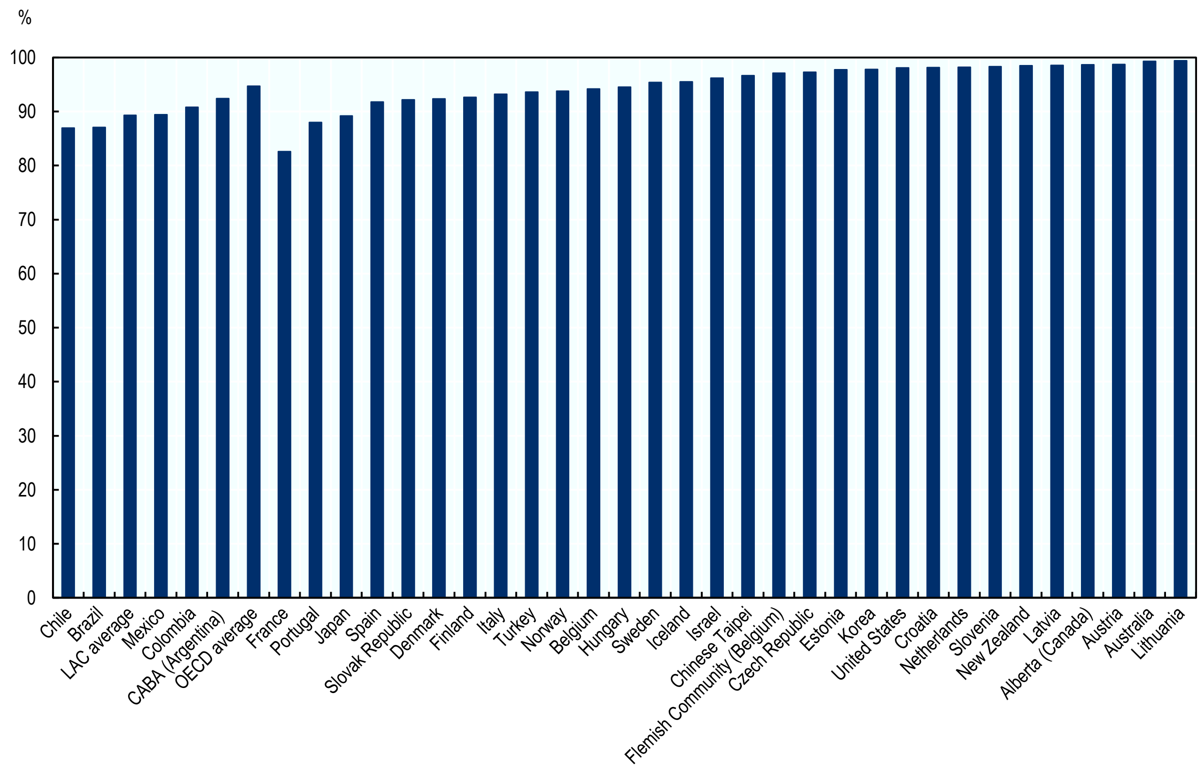
Figure 4.7. Participation in professional development

Share of lower-secondary teachers who participated in professional development activities in the 12 months prior to the survey



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina. Professional development activities include: "Courses/seminars attended in person", "Online courses/seminars", "Education conferences where teachers and/or researchers present their research or discuss educational issues", "Formal qualification programme (e.g. degree programme)", "Observation visits to other schools", "Observation visits to business premises, public organisations or non-governmental organisations", "Peer and/or self-observation and coaching as part of a formal school arrangement", "Participation in a network of teachers formed specifically for the professional development of teachers", "Reading professional literature" or any other activity ("Other").
Source: Adapted from OECD (2018[9]), TALIS 2018 Database, Table I.5.1; http://www.oecd.org/education/talis/.

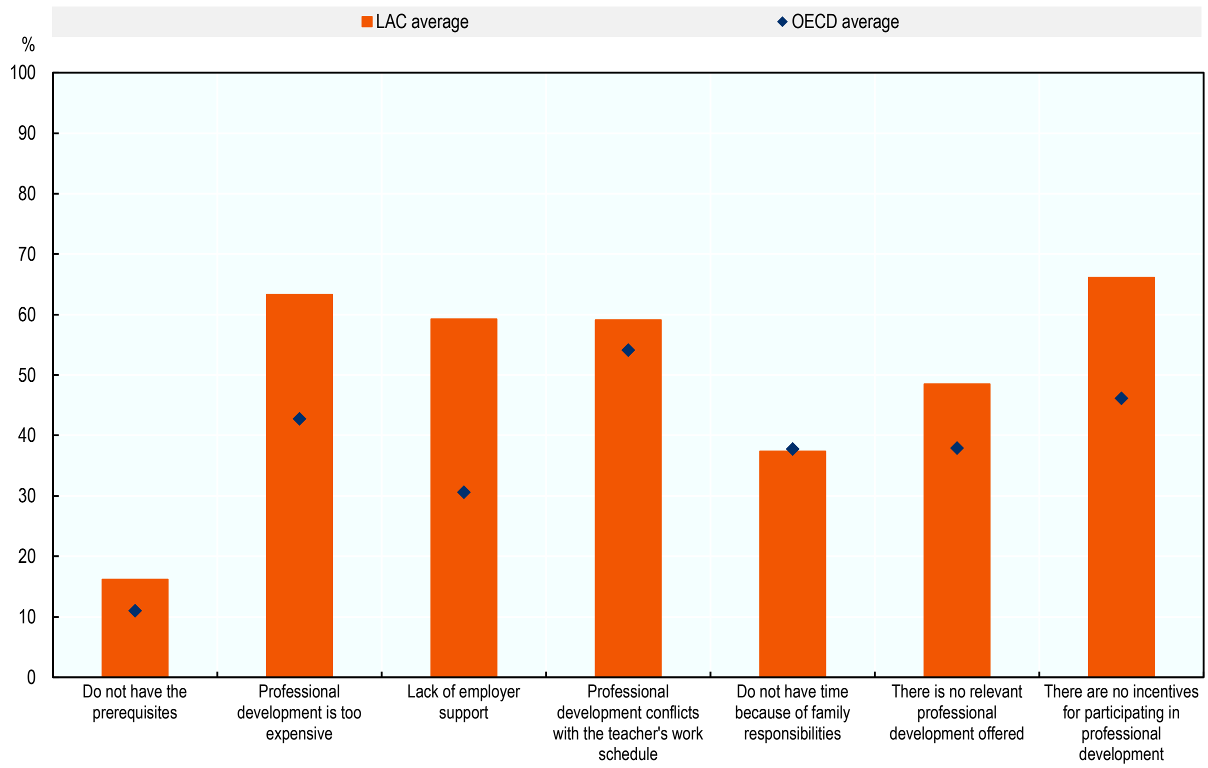
StatLink https://doi.org/10.1787/888934135775

Teachers in Latin America train through technology

In Latin America, teachers are numerous to report costs as a barrier to participation in professional development (Figure 4.8).[3] New technologies can open the door to diverse ways of learning for individuals and teachers. Digital resources, massive open online courses (MOOCs) or other online learning activities, for instance, expand opportunities for developing skills and acquiring knowledge with limited costs and from anywhere, and provide potential alternative sources for skills development for teachers in Latin America.

Figure 4.8. Barriers to teachers' participation in professional development

Share of lower-secondary teachers



Note: The figure displays shares of teachers who agree, or strongly agree, that the following elements present barriers to their participation in professional development.
Source: Adapted from OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/, Table I.5.36.

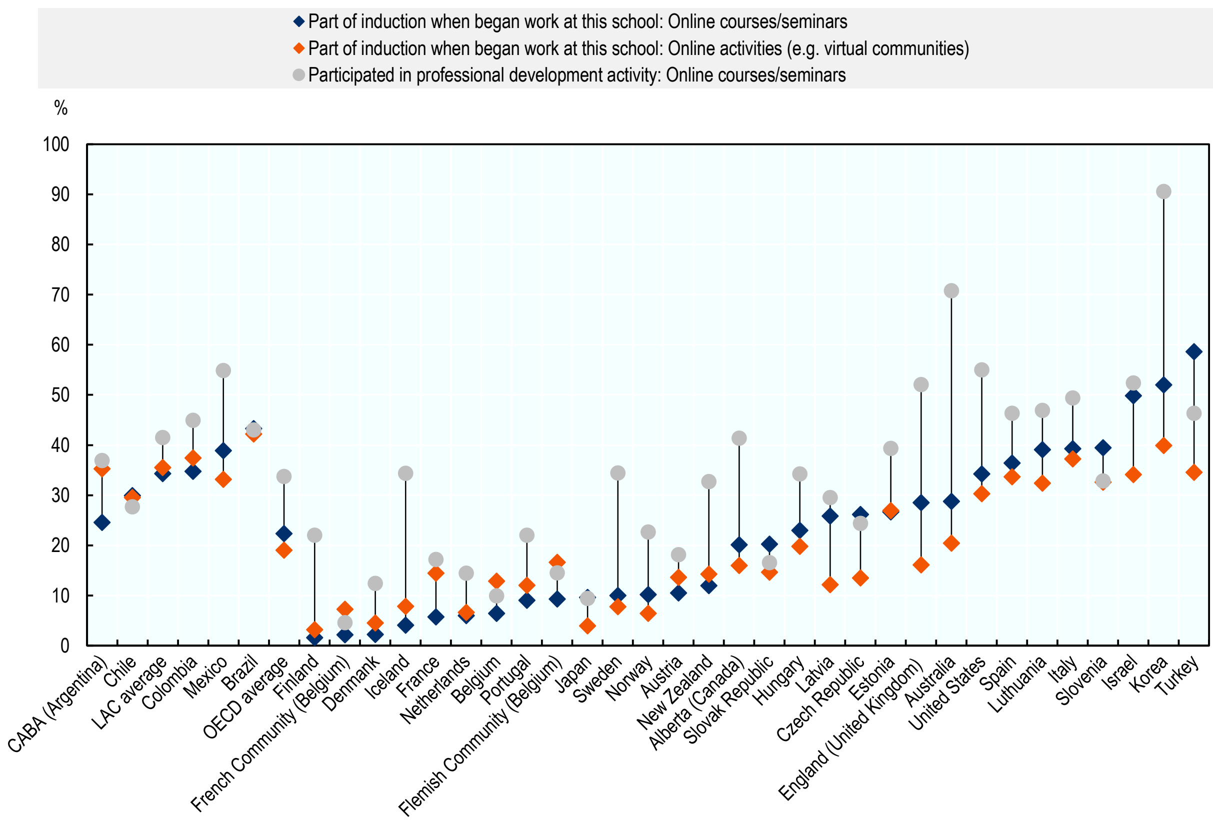
StatLink https://doi.org/10.1787/888934135794

Indeed, enhanced access to online resources for teacher training has often accompanied the extensive investments in ICT infrastructure made in many Latin American countries. A relatively high share of teachers in Latin American countries, in fact, train through technology (Figure 4.9). On average across Latin American countries with available data in TALIS (2018), around 40% of lower-secondary teachers have participated in online courses or seminars as part of their professional development activities. A similar share have engaged in online activities (e.g. virtual communities) or online courses as part of their induction programme at their current school.

MOOCs are also becoming increasingly widespread and provide new sources of knowledge and learning and teachers from Latin American countries are likely to be engaging as well in these new learning opportunities. Early survey data from MITx MOOCs indicated that as many as 28% of survey respondents reported to be past or present teachers and 6% reported to be teaching the topic they were following (Seaton, Coleman and Daries, 2014[12]). Moreover, teachers were actively engaged in MOOC related activities, as they were overrepresented in terms of comments in the MOOC discussion forum. This pattern of teacher participation in MOOCs continued in later years: in 2017, 32% of HarvardX and MITx MOOC survey respondents identified themselves as current or past teachers and 19% reported teaching on the same topic as the MOOC. In addition, less than a third of all surveyed MOOC participants came from the United States (Chuang, 2017[13]), suggesting that Latin American teachers were potentially engaging in these opportunities as well.

Figure 4.9. Participation in online induction and professional development activities

Share of lower-secondary teachers



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

StatLink https://doi.org/10.1787/888934135813

While the use of technology made by teachers in Latin America has the potential to help them get access to professional training opportunities at a low cost this strategy may not be a panacea. Evidence shows, in fact, that fewer teachers engage in similar induction and professional development activities in OECD countries. These patterns of participation suggest that teachers in OECD countries may have access to other types of induction activities that are potentially lacking in Latin American countries and that the use of digital resources has tried to compensate for. Teachers in other OECD countries may have access to better professional development opportunities than those offered by MOOCs, but for teachers in Latin American countries, MOOCs may be a comparatively good quality source of professional development.

Admittedly, the effectiveness of participation in technology-based training activities is largely dependent on the quality of the learning material and on the extent to which these opportunities reach those most in need of training (Chapter 5).

More research is needed to understand how effective digital training activities are relative to more traditional professional development activities. In particular, data are still scarce on the quality of MOOC resources, especially as most experimental evaluations have rather focused on behavioural interventions meant at enhancing completion rates and participation of disadvantaged groups (Escueta et al., 2017[14]).

At the same time, self-reported training needs in ICT skills for teaching remain high

The mere availability of many training opportunities (being these traditional or digital) and the statistics reporting high engagement of teachers may mask severe quality issues with the training received by teachers in Latin America. Despite relatively high levels of engagement of teachers in training geared to the development of ICT skills, in fact, teachers in Latin America still report further training needs (Figure 4.10).

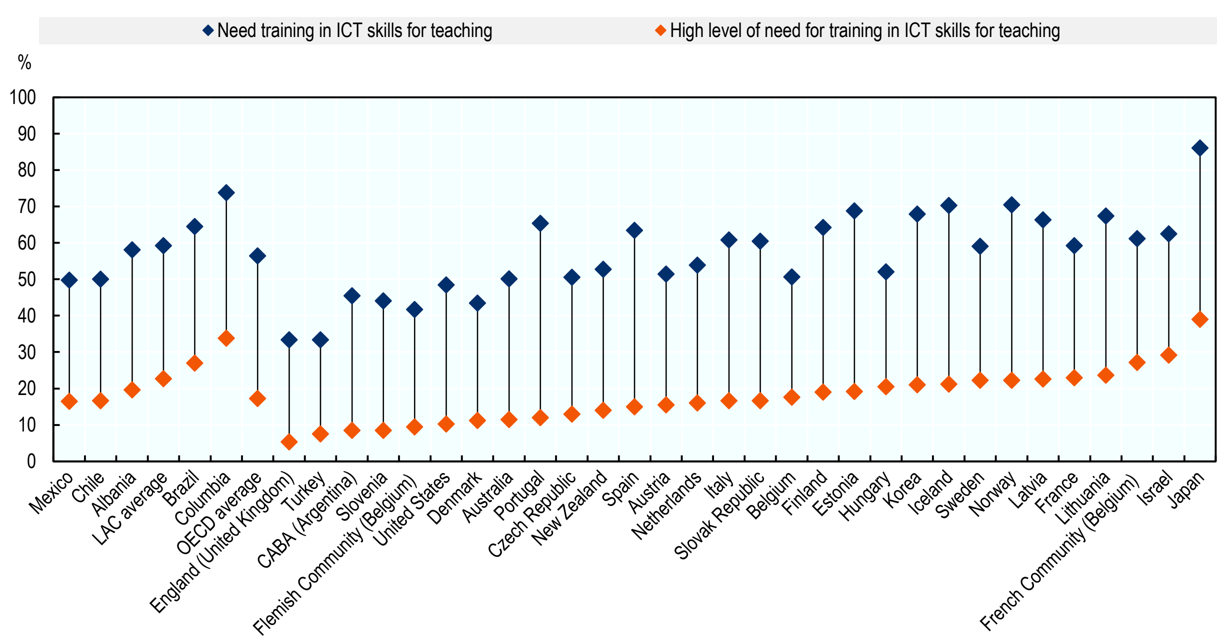
To start with, as many as 60% of Latin American teachers report the need for further professional development in ICT skills for teaching and for 22% the need is substantial. In Colombia, 77% of teachers still need further training and 33% report a high level of need.

The need to reinforce the quality of ICT training to teachers in Latin America is even more evident as TALIS data show that when they already received training in ICT skills for teaching in the year prior to the survey, a relatively large share of Latin American teachers still report high levels of need in professional development (Figure 4.11). In Colombia, the level of self-reported need for further training in this area is much larger than in the majority of OECD countries, irrespective of whether teachers have already participated or not in professional development activities in ICT skills for teaching. In Brazil and Buenos Aires (Argentina), more than 30% of lower-secondary teachers did not participate in ICT-related professional development activities and report a high level of need in this area.

In addition, the share of teachers who engaged in professional development and display a high level of need in Latin American countries (17.4%) is similar to that of teachers who did not engage in professional development in OECD countries (17.2%). This suggests that the quality and content of professional development programmes in ICT skills for teaching in Latin American countries with available data is also likely to be problematic and should become a policy focus.

Figure 4.10. Self-reported training needs in ICT skills for teaching

Share of lower-secondary teachers



Note: Teachers who need training in ICT skills for teachers are teachers who report any need for professional development in ICT skills for teaching, whether low, moderate or high. CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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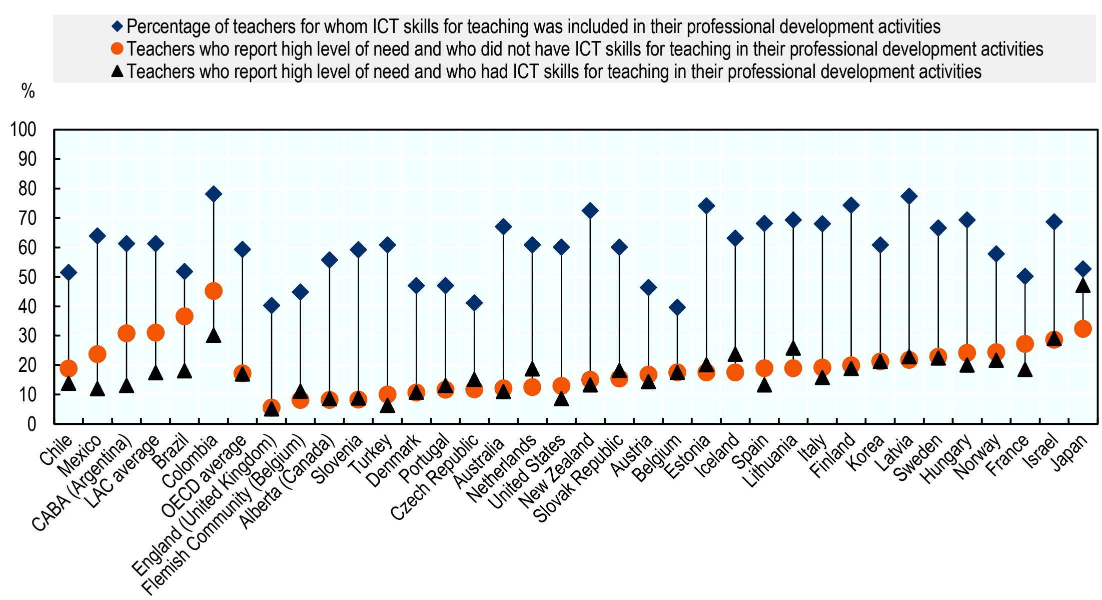
High training needs in ICT skills for teaching may, therefore, reflect that teachers have not received any training or that the training received was insufficient or ineffective. More generally, even if teachers may have already participated in ICT-related training in the past, newer technologies will eventually enter their classroom or new topics such as well-being challenges of technology use or digital citizenship (Burns and Gottschalk, 2019[15]) and teachers will continue needing training. As societies and economies go digital, demands for enhancing teachers' digital competence are also increasing. Lifelong learning and continuous skill development will be of paramount importance for all. This is a key challenge for all countries, and even more so for Latin America as new technologies are expected to rapidly spread in the near future.

Most OECD countries display no difference in teachers' training needs between those who have participated in professional development activities in ICT skills for teaching and those who did not. Instead, in Latin American countries, the average high level of need for professional development in ICT skills for teaching is coupled by a large gap in needs between teachers who participated in professional development and those who did not.

Teachers who have not engaged in professional development in ICT skills for teaching are at high risk of being left behind by the increasing use of new technologies. Strengthening access to professional development activities is therefore crucial.

Figure 4.11. Participation in and need for professional development in ICT skills for teaching

Share of lower-secondary teachers



Note: CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.
Source: Adapted from OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/, Table I.5.24.

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It is clear that uptake of professional development opportunities does not necessarily translate into better skills if the quality of these activities is low or the content is not aligned with teachers' needs. There are other hints of that the quality of professional training received by Latin American teachers should be reinforced. On the one hand, as mentioned above, in Latin American countries, teacher participation in professional development is similar to participation levels in OECD countries (Figure 4.6, Figure 4.7).

On the other hand, spending on high-quality professional development for teachers is considered a highly important spending priority for many more Latin American teachers than for teachers in OECD countries (Figure 4.12), pointing to the need to reinforce quality, more than quantity of teachers' training.

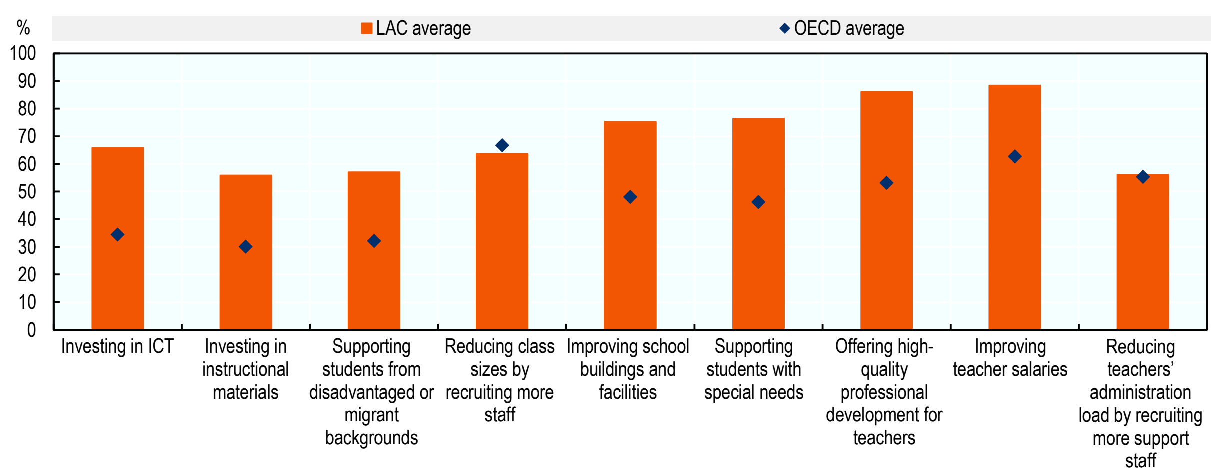
If the education budget were to increase, 86% of Latin American teachers consider that spending on the provision of high-quality professional development is of high importance. The only other spending priority that gathers the assent of a larger number of Latin American teachers relates to improvements in teachers' salaries (88% of teachers).

In addition, in none of the Latin American countries covered in TALIS does investment in ICT appear as a number one spending priority. The share of lower-secondary teachers reporting that investing in ICT is highly important spending priority goes from 48% in Chile to 74% in Colombia. In all Latin American countries, other areas of spending are of greater concern.

To put it differently, evidence suggests that in many Latin American countries, the accessibility and quality of professional development programmes should instead be the a major focus for policy intervention. Investing in ICT only will unlikely result in more effective ICT uses in classrooms, if teachers do not benefit from the appropriate training and support in this area.

Figure 4.12. Spending priorities in education, according to teachers

Share of lower-secondary teachers who reported a specific spending priority to be of high importance



Note: Respondents were able to attribute "high importance" to all spending priorities, they were not asked to prioritise.
Source: Adapted from OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/, Table I.3.66.

StatLink https://doi.org/10.1787/888934135870

There is a need to revisit how teachers are trained for teaching with ICT

In an increasingly digitalised world, teachers will need more than just digital skills in their jobs to be effective. Digitalisation raises the need for children to develop a range of skills in schools, from being able to rely on and make critical uses of digital technologies for specific activities, to being resilient and having a good set of social and emotional skills that allow dealing with well-being challenges[4] on line (Burns and Gottschalk, 2019[15]). To help develop such skills in students, teachers themselves need to be equipped with a relevant range of digital and non-digital skills.

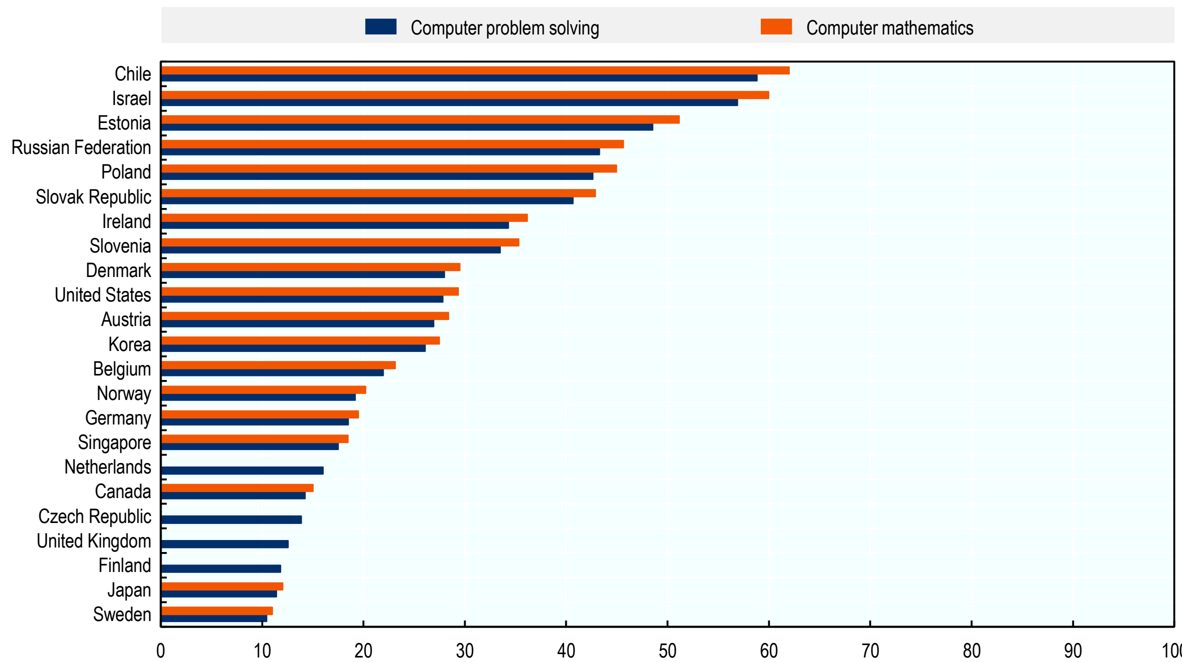
Simply mastering the use of computers in classrooms and enabling students to go on line or use software is not enough. Beyond knowing how to use digital tools, teachers need to be able to know how to use them in innovative ways that serve their teaching purposes and support students when they encounter risks online. Equally important, teachers should be able to assess and determine in which circumstances it may be better not to use technology because technology risks distracting students or replacing activities that are more efficient.

International differences in student performance are strongly related to differences in teacher cognitive skills (Hanushek, Piopiunik and Wiederhold, 2014[2]). In the case of technology use, the better teachers perform in problem solving in technology-rich environments, the better their students' skills in computer problem solving and mathematics will be (Figure 4.13).

Regression analysis shows that substantial gains in student performance can be obtained by strengthening teachers' skills. For example, increasing Chilean teachers' problem-solving skills in technology-rich environments to the level of Australian teachers (the highest performing in the sample), would translate into a substantial increase in students' outcomes.

Figure 4.13. Potential increase in computer problem solving and mathematics student scores linked to an increase in teachers' skills to the level of top performers

Increase in students' test scores (in % of international standard deviation) from an increase in teachers' problem-solving skills in technology-rich environments to the level of teachers from Australia



Note: Each bar displays the increase in student performance (expressed in % of standard deviation across all countries covered) in the respective field if teachers' problem-solving skills in technology-rich environments were raised to the level of Australian teachers (the highest performing teachers in the sample). Computations are based on the estimated coefficients for the relationship between teachers' skills in problem solving in technology-rich environments [from the OECD Survey of Adult Skills (PIAAC)] and students' scores in computer problem solving and computer mathematics (from PISA). The international standard deviation is the mean value of the country-level standard deviations (of student scores) for countries included in the sample in each field (computer problem solving and computer mathematics). It is equal to 96.05 PISA points for computer problem solving and to 89.28 PISA points for computer mathematics. The computer-based assessment of mathematics was offered as an option to countries in PISA (2012): the Czech Republic, Finland, the Netherlands and the United Kingdom do not have data on student performance in computer mathematics. The empirical analysis is based on the methodology of Hanushek, Piopiunik and Wiederhold, (2014[2]). In the Survey of Adult Skills (PIAAC): data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly. Also, in the Survey of Adult Skills (PIAAC): Chile, Israel, Singapore and Slovenia: year of reference 2015; all other countries- year of reference 2012.
Source: OECD (2019[16]), *OECD Skills Outlook 2019 : Thriving in a Digital World*, https://dx.doi.org/10.1787/df80bc12-en.

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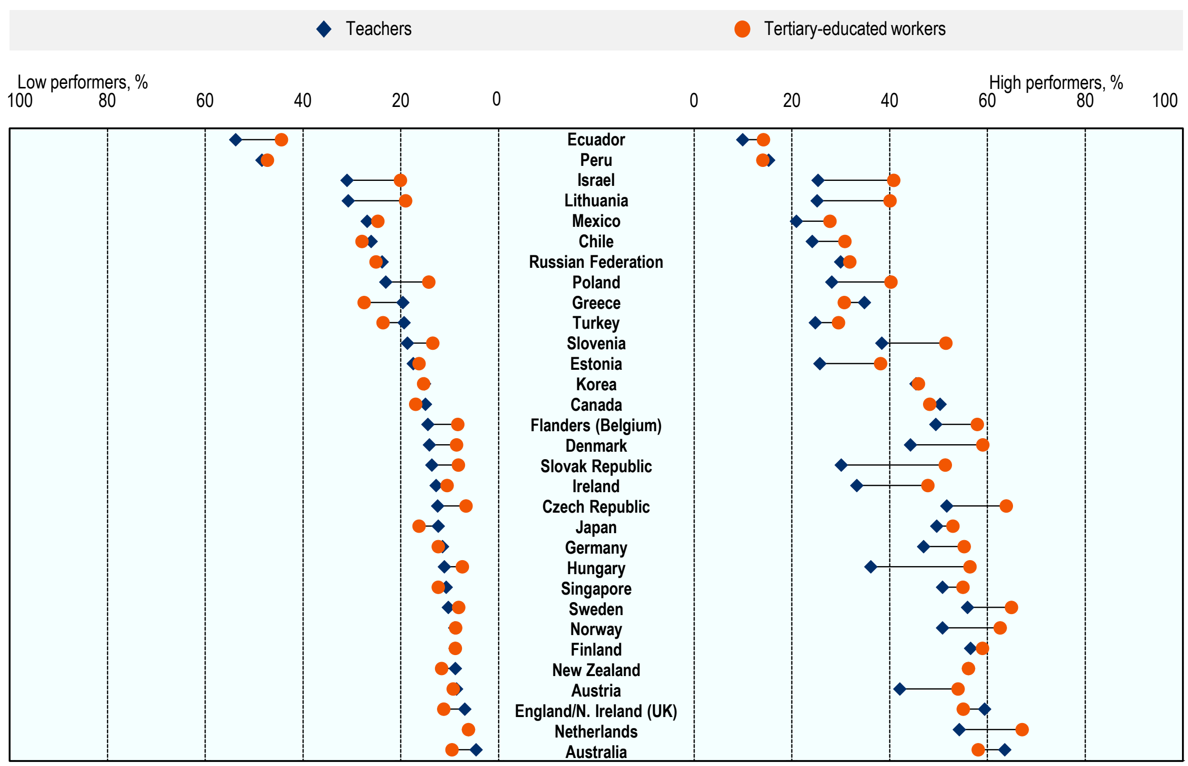
The OECD Survey of Adult Skills (PIAAC) defines problem solving in technology-rich environments as "using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks" (OECD, 2012[17]). Problem-solving skills in technology-rich environments are thus not equivalent to ICT skills for teaching. Yet, the assessment gives an indication of adults', including teachers' "abilities to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, and accessing and making use of information through computers and computer networks" (OECD, 2012[17]).

Figure 4.14. Teachers' problem solving in technology-rich environment proficiency

Share of poor and top performing teachers and tertiary-educated workers in problem solving in technology-rich environments, by country (%)



Note: Indicator developed based on (OECD, 2019[16]). Teachers and tertiary-educated workers are defined based on the population of adults aged 25-65. Teachers are adults self-reporting working in the following two-digit occupations as classified by the International Standard Classification of Occupations (ISCO-08): Teaching Professionals (ISCO 23). Tertiary-educated workers are all adults in employment with a tertiary education as defined by 1997 International Standard Classification of Education (ISCED): Tertiary (ISCED 5B, 5A, 5A/6). Poor performers are defined as scoring at most Below Level 1 (inclusive) in problem solving (including failing ICT core and having no computer experience), while top performers score at least Level 2 (inclusive). Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey: Year of reference 2015. Ecuador, Hungary, Mexico, Peru and United States: Year of reference 2017. All other countries: Year of reference 2012. Data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly.
Source: OECD calculations based on (2017[18]), Survey of Adults Skills (PIAAC) (2012, 2015, 2017), (database), http://www.oecd.org/skills/piaac/.

StatLink https://doi.org/10.1787/888934135908

Teachers in Latin American countries with available data in the OECD Survey of Adult Skills (PIAAC) perform poorly in problem solving in technology-rich environments (Figure 4.14). In Ecuador and Peru, around half of teachers are low performers. The share of teachers with low problem solving skills in technology-rich environments varies across countries from less than 5% in Australia to around 54% in Ecuador. Contrasting teachers with tertiary-educated workers shows that in many countries, teachers are as likely as tertiary-educated workers are to be low performers in this area, but in Ecuador, teachers are more numerous to perform poorly. In addition, few Latin American teachers are top performers in the assessment in comparison to teachers in other OECD countries.

Box 4.3. Providing support to teachers – evidence from Australia

Relative to their OECD peers, Australian teachers are top performers in problem solving in technology-rich environments and in Australia, more extensive uses of ICT at school are associated with enhanced student performance (OECD, 2019[16]). In the Australian curriculum, students develop an ICT capability when they "learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school and in their lives beyond school" (Australian Curriculum, Assessment and Reporting Authority (ACARA), n.d.[19]). ICT capability is developed in all curricular areas, but digital technologies puts the strongest focus on ICT. A number of initiatives aim to support teachers in the implementation of the digital technologies curriculum.

The Computer Science Education Research Group (CSER) at the University of Adelaide provides free online MOOCs, paired with professional learning events for teachers and a national lending library. MOOCs offer "background knowledge about concepts and topics in the curriculum, as well as practical examples that can be tried in the classroom", going from courses on algorithms and data representation to integrating programming into science, English or mathematics or teaching artificial intelligence in class (for primary or lower secondary teachers) (CSER Digital Technologies, 2019[20]).

In September 2019, more than 32 000 teachers were engaged in the MOOC programme, with a large share of teachers coming from remote areas or from schools with many students from low socio-economic backgrounds. Free professional learning that accompanies MOOCs is also provided in person to teachers in order to support them adapt to the requirements of the curriculum in the area of digital technologies and to make the most of the CSER digital learning resources. This in person support is especially targeted at disadvantaged schools. Finally, the national lending library allows teachers to borrow educational equipment that comes jointly with lesson plans, in line with the national curriculum (CSER Digital Technologies, 2019[20]).

The Digital Technologies in Focus project seeks to foster collaboration within and between schools in order to support the implementation of the digital technologies component in the Australian curriculum in socio-economically disadvantaged schools (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2019[21]). The project has reached so far more than 160 schools. Curriculum officers provide support to clusters of schools and lead workshops for school leaders and teachers as each school prepares a research project related to how they intend to implement the digital technologies curriculum. Teachers exchange with the curriculum officer and other teachers from the school cluster they belong to and obtain feedback on the projects and changes occurred in the school. Workshops are also carried out for the teachers participating in the project on topics related to the understanding of the digital technologies curriculum, computational thinking, resources for elaborating teaching and learning plans, or exploration of activities that link digital technologies with other curricular areas (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2019[21]). Workshops are tailored to the needs of each school and are complemented by online mentoring. Between 2018 and 2020, the project is undergoing an external evaluation.

The Digital Technologies Hub (Education Services Australia, 2019[22]), developed for the Australian Department of Education, is another platform offering learning resources related to the implementation of the digital technologies curriculum for teachers, students, parents and school leaders. In this platform, teachers are given ideas for lessons targeted at different age groups and subjects integrating new technologies. Similarly, they examine case studies based on other schools and teachers or obtain advice on professional development in the area. Suggested resources for professional learning include online courses, webinars or online communities in which teachers can engage and exchange with other professionals (Education Services Australia, 2019[22]).

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA) (n.d.[19]), Information and Communication Technology (ICT) Capability, https://www.australiancurriculum.edu.au/f-10-curriculum/general-capabilities/information-and-communication-technology-ict-capability/; Australian Curriculum, Assessment and Reporting Authority (ACARA) (2019[21]), Digital Technologies in Focus, https://www.australiancurriculum.edu.au/resources/digital-technologies-in-focus/; CSER Digital Technologies (2019[20]), Available MOOCs - (Massively Open Online Courses), https://csermoocs.adelaide.edu.au/available-moocs; Education Services Australia (2019[22]), Digital Technologies Hub, https://www.digitaltechnologieshub.edu.au/footer/about-dth; OECD (2019[16]), *OECD Skills Outlook 2019 : Thriving in a Digital World*, https://dx.doi.org/10.1787/df80bc12-en.

Providing high quality, comprehensive and appropriate training to teachers in order to support them integrate digital technologies in classrooms is crucial (Box 4.3). Many Latin American teachers engage in professional development in ICT skills for teaching, but analyses in this chapter show that there is scope for further strengthening the quality and accessibility of training in the area. Moreover, while many teachers in Latin America use ICT in class and are self-confident about it, technology use does not appear to have reached its full potential in initial education. Chapter 3 emphasised that there is still leeway for more efficient integration of ICT in teaching and learning activities. Better-trained teachers, who engage more in collaboration with other teachers in the school, who are more self-confident in their instruction abilities, are indeed more inclined to use technology in their teaching and to feel confident in their capacity to support student learning through technology. However, making the use of technology more widespread is not sufficient to achieve better student outcomes and policies should not aim at simply increasing teachers' use of technology. In Latin American countries, investments in ICT infrastructure have been high, students and teachers tend to use technology frequently, and many teachers train in the use of ICT for teaching. Yet, student performance is lagging behind that of OECD countries and evidence from PISA as well as from the research literature on the relationship between ICT use and student performance remains mixed (Chapter 3). In this context, Latin American governments need to rethink how to embed technology in teaching and learning activities and, very importantly how to support teachers and strengthen their digital competence.

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Annex 4.A. Estimations

Annex Table 4.A.1. Factors related to teachers' frequent use of ICT for students' projects/class work and self-efficacy in supporting student learning through ICT use – estimation type I

	LAC		OECD	
	(1)	(2)	(3)	(4)
DEPENDENT VARIABLE	Frequent ICT use	ICT self-efficacy	Frequent ICT use	ICT self-efficacy
Positive impact of professional development on teaching practice	0.0230	0.00373	0.0272***	0.0299***
	(0.0206)	(0.0202)	(0.00728)	(0.00708)
Job satisfaction index	-0.00383	-0.00569	-0.00154	-0.000159
	(0.00426)	(0.00387)	(0.00145)	(0.00141)
Personal utility value index	0.00152	0.00500**	-0.00392***	-0.000158
	(0.00284)	(0.00246)	(0.00124)	(0.00121)
Social utility value index	-0.00528	-0.0129***	0.00378***	-0.000140
	(0.00469)	(0.00428)	(0.00127)	(0.00140)
Use of ICT for teaching included in initial teacher education or training	0.0296*	0.0286*	0.0210***	0.0279***
	(0.0175)	(0.0153)	(0.00634)	(0.00537)
Felt well/very well prepared for teaching using ICT (after initial teacher education or training)	0.119***	0.152***	0.0803***	0.110***
	(0.0168)	(0.0154)	(0.00705)	(0.00619)
ICT skills for teaching included in professional development	0.111***	0.142***	0.106***	0.115***
	(0.0153)	(0.0144)	(0.00609)	(0.00533)
High professional development needs in ICT skills for teaching	-0.0359**	-0.0774***	0.00295	-0.0811***
	(0.0163)	(0.0156)	(0.00791)	(0.00689)
Self-efficacy in classroom management index	-0.00680	-0.00374	-0.00882***	-0.00522***
	(0.00452)	(0.00441)	(0.00174)	(0.00176)
Self-efficacy in instruction index	0.0230***	0.0523***	0.0280***	0.0593***
	(0.00445)	(0.00406)	(0.00171)	(0.00183)
Self-efficacy in student engagement index	0.00952**	0.00335	0.0130***	0.0102***
	(0.00455)	(0.00447)	(0.00178)	(0.00181)
Professional collaboration in lessons among teachers index	0.0172***	0.0117***	0.0157***	0.00804***
	(0.00286)	(0.00311)	(0.00159)	(0.00147)
Teacher-student relations index	0.00791**	0.0105***	0.00407**	0.00369**
	(0.00332)	(0.00325)	(0.00159)	(0.00149)
Teachers perceived disciplinary climate index	-0.00276	-0.00211	-0.00322**	-0.000713
	(0.00416)	(0.00354)	(0.00153)	(0.00146)
Percentage of students. with first language different from instruction language	0.0117	-0.00446	0.00142	-0.00422
	(0.00980)	(0.00782)	(0.00402)	(0.00398)
Percentage of students with behavioural problems	0.0184**	0.00322	-0.00308	-0.00335
	(0.00931)	(0.00847)	(0.00433)	(0.00402)
Percentage of. students who are low academic achievers	-0.0318***	-0.00925	-0.0105**	-0.00892**
	(0.00862)	(0.00865)	(0.00424)	(0.00394)
Percentage of students with special needs	0.0179*	0.0129	0.0262***	0.0236***
	(0.0102)	(0.00990)	(0.00413)	(0.00369)

	LAC		OECD	
	(1)	(2)	(3)	(4)
DEPENDENT VARIABLE	Frequent ICT use	ICT self-efficacy	Frequent ICT use	ICT self-efficacy
Percentage of students from socio-economically disadvantaged homes	0.00702	-0.0143**	0.00673	0.00397
	(0.00617)	(0.00630)	(0.00433)	(0.00382)
Percentage of academically gifted students	0.0122	0.00675	0.00906**	-0.00368
	(0.00751)	(0.00715)	(0.00359)	(0.00321)
Percentage of. students from socio-economically disadvantaged homes (school level)	-0.000989	0.000946	-0.00438	0.00303
	(0.00695)	(0.00587)	(0.00470)	(0.00448)
Percentage of. students who are immigrants or with migrant background (school level)	-0.00449	-0.00656	-0.00263	-0.00252
	(0.0116)	(0.0107)	(0.00510)	(0.00518)
Experiences as a teacher (in total)	-0.000723	-0.00182*	2.40e-05	-0.000566
	(0.00108)	(0.00109)	(0.000495)	(0.000440)
Teacher age	0.00310***	0.00158	0.00128**	-0.000908**
	(0.00100)	(0.00104)	(0.000505)	(0.000432)
Female	0.0439***	-0.0100	0.0155**	-0.00253
	(0.0128)	(0.0108)	(0.00646)	(0.00639)
Employment status at this school: permanent employment	0.0146	0.00724	0.0121	0.0210***
	(0.0174)	(0.0149)	(0.00857)	(0.00800)
Privately-managed school	-0.00212	0.0244	-0.00379	-0.00716
	(0.0231)	(0.0190)	(0.0100)	(0.00928)
School location: rural	0.0743***	0.0448*	0.0206**	0.0247***
	(0.0275)	(0.0259)	(0.0103)	(0.00949)
Teacher can determine course content, including national. regional curricula	0.00520	-0.0172	-0.0136*	-0.00522
	(0.0201)	(0.0169)	(0.00818)	(0.00754)
Teacher can choose which learning materials are used	-0.0222	0.0140	0.0117	-0.00159
	(0.0182)	(0.0177)	(0.00953)	(0.00894)
Shortage or inadequacy of digital technology hinders instruction quite a bit/a lot	-0.0409*	-0.0539***	-0.0215**	-0.0444***
	(0.0225)	(0.0206)	(0.00939)	(0.00909)
Insufficient Internet access hinders instruction quite a bit/a lot	-0.0332	-0.0152	-0.0226*	-0.0349***
	(0.0223)	(0.0184)	(0.0119)	(0.0111)
Team innovativeness index	-0.00245	-0.00303	-0.00200	0.00349**
	(0.00301)	(0.00314)	(0.00171)	(0.00150)
Organisational innovativeness index	0.00437	0.00249	0.00481***	0.00189
	(0.00385)	(0.00296)	(0.00175)	(0.00144)
Constant	-0.130	-0.224**	-0.161***	-0.393***
	(0.131)	(0.114)	(0.0510)	(0.0476)
Country dummies	Yes	Yes	Yes	Yes
Observations	6 856	6 877	51 921	54 418

Note: "Frequent ICT use" is a dummy for letting students us ICT for projects or class work frequently or always. "ICT self-efficacy" is a dummy variable equal to one if the teacher reports being able to support student learning quite a bit or a lot through the use of digital technology. Estimations obtained through multilevel mixed-effects linear regressions. Estimations on OECD countries exclude Chile and Mexico. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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Annex Table 4.A.2. Factors related to teachers' frequent use of ICT for students' projects/class work and self-efficacy in supporting student learning through ICT use - estimation type II

	LAC		OECD	
	(1)	(2)	(3)	(4)
VARIABLES	Frequent ICT use	ICT self-efficacy	Frequent ICT use	ICT self-efficacy
Positive impact of professional development on teaching practice	0.0242	0.00279	0.00827	0.0116
	(0.0202)	(0.0193)	(0.00834)	(0.00769)
Job satisfaction, overall, teacher / Metric (All)	-0.00298	-0.00461	-0.000159	-0.00168
	(0.00407)	(0.00371)	(0.00159)	(0.00152)
Personal utility value / Metric (All)	0.000841	0.00494**	-0.00324**	0.000470
	(0.00279)	(0.00241)	(0.00143)	(0.00140)
Social utility value / Metric (All)	-0.00396	-0.0119***	0.00186	0.000310
	(0.00438)	(0.00416)	(0.00158)	(0.00144)
Use of ICT for teaching not in initial teacher education or training, felt prepared for teaching with ICT	0.108***	0.104***	0.0667***	0.116***
	(0.0262)	(0.0241)	(0.0129)	(0.0113)
Use of ICT for teaching in initial teacher education or training, felt not prepared for teaching with ICT	0.0141	-0.0143	0.00570	0.00743
	(0.0233)	(0.0208)	(0.00819)	(0.00780)
Use of ICT for teaching in initial teacher education or training, felt prepared for teaching with ICT	0.115***	0.130***	0.0955***	0.134***
	(0.0167)	(0.0144)	(0.00815)	(0.00723)
ICT skills for teaching not in professional development, no high need for professional development in ICT skills for teaching	0.0680***	0.0928***	0.000749	0.0870***
	(0.0263)	(0.0199)	(0.0110)	(0.0132)
ICT skills for teaching in professional development, no high need for professional development in ICT skills for teaching	0.181***	0.242***	0.0965***	0.191***
	(0.0251)	(0.0199)	(0.0105)	(0.0130)
ICT skills for teaching in professional development, high need for professional development in ICT skills for teaching	0.163***	0.166***	0.0935***	0.140***
	(0.0290)	(0.0256)	(0.0136)	(0.0140)
Self-efficacy in classroom management index	-0.00774*	-0.00107	-0.00502***	-0.00200
	(0.00426)	(0.00442)	(0.00183)	(0.00184)
Self-efficacy in instruction index	0.0245***	0.0527***	0.0226***	0.0596***
	(0.00432)	(0.00392)	(0.00185)	(0.00212)
Self-efficacy in student engagement index	0.00924**	0.00263	0.0133***	0.00598***
	(0.00440)	(0.00450)	(0.00214)	(0.00198)
Professional collaboration in lessons among teachers index	0.0157***	0.0122***	0.0145***	0.00518***
	(0.00280)	(0.00295)	(0.00171)	(0.00150)
Teacher-student relations index	0.00837***	0.0120***	0.00330*	0.000578
	(0.00324)	(0.00316)	(0.00182)	(0.00159)
Teachers perceived disciplinary climate index	-0.00236	-0.00137	-0.000365	0.00201
	(0.00390)	(0.00340)	(0.00174)	(0.00146)
Percentage of students with first language different from instruction language	0.00586	-0.00631	0.00359	-0.00136
	(0.00990)	(0.00771)	(0.00438)	(0.00400)
Percentage of students with behavioural problems	0.0169*	0.00502	0.000243	0.00294
	(0.00915)	(0.00810)	(0.00480)	(0.00452)
Percentage of. students who are low academic achievers	-0.0358***	-0.0100	-0.0164***	-0.0136***
	(0.00828)	(0.00829)	(0.00434)	(0.00411)
Percentage of students with special needs	0.0225**	0.0117	0.0285***	0.0258***
	(0.0102)	(0.00917)	(0.00500)	(0.00434)

	LAC		OECD	
	(1)	(2)	(3)	(4)
VARIABLES	Frequent ICT use	ICT self-efficacy	Frequent ICT use	ICT self-efficacy
Percentage of students from socio-economically disadvantaged homes	0.00457	-0.0176***	0.00391	0.00214
	(0.00609)	(0.00611)	(0.00461)	(0.00405)
Percentage of academically gifted students	0.0112	0.00691	0.0131***	0.000551
	(0.00706)	(0.00684)	(0.00413)	(0.00333)
Percentage of students from socio-economically disadvantaged homes (school level)	-0.00147	0.00434	-0.00902*	0.00398
	(0.00669)	(0.00580)	(0.00546)	(0.00513)
Percentage of. students who are immigrants or with migrant background (school level)	-0.00514	-0.00826	-0.00546	-0.00566
	(0.0113)	(0.0107)	(0.00602)	(0.00512)
Experiences as a teacher (in total)	-0.000749	-0.00187*	0.000386	0.000336
	(0.00105)	(0.00105)	(0.000572)	(0.000523)
Teacher age	0.00303***	0.00118	0.000463	-0.00209***
	(0.000986)	(0.00100)	(0.000569)	(0.000548)
Female	0.0441***	-0.0110	0.0147**	-0.0281***
	(0.0123)	(0.0104)	(0.00628)	(0.00645)
Employment status at this school: permanent employment	0.00674	0.00390	0.0262***	0.0141
	(0.0166)	(0.0144)	(0.00982)	(0.00855)
Privately-managed school	-0.0120	0.0242	0.00579	0.0185*
	(0.0216)	(0.0185)	(0.0111)	(0.0100)
School location: rural	0.0642**	0.0425*	0.00270	0.00158
	(0.0279)	(0.0242)	(0.0152)	(0.0139)
Teacher can determine course content, including national regional curricula	0.00277	-0.0123	-0.0147	0.00159
	(0.0196)	(0.0162)	(0.0103)	(0.00795)
Teacher can choose which learning materials are used	-0.0198	0.00809	0.0169	-2.43e-06
	(0.0182)	(0.0171)	(0.0108)	(0.00865)
Shortage or inadequacy of digital technology hinders instruction quite a bit/a lot	-0.0424*	-0.0546***	-0.0267***	-0.0400***
	(0.0222)	(0.0199)	(0.00930)	(0.00882)
Insufficient Internet access hinders instruction quite a bit/a lot	-0.0222	-0.0122	-0.0174	-0.0380***
	(0.0212)	(0.0179)	(0.0107)	(0.0102)
Team innovativeness index	-0.00191	-0.00271	-0.000777	0.00548***
	(0.00283)	(0.00299)	(0.00171)	(0.00175)
Organizational innovativeness index	0.00522	0.00203	0.00471***	0.00344**
	(0.00372)	(0.00297)	(0.00180)	(0.00170)
Constant	-0.172	-0.337***	-0.0889	-0.400***
	(0.132)	(0.108)	(0.0543)	(0.0519)
Country fixed effects	Yes	Yes	Yes	Yes
Observations	7 421	7 443	55 696	58 327
Number of groups	193	193	398	398

Note: "Frequent ICT use" is a dummy for letting students us ICT for projects or class work frequently or always. "ICT self-efficacy" is a dummy variable equal to one if the teacher reports being able to support student learning quite a bit or a lot through the use of digital technology. Estimations obtained through multilevel mixed-effects linear regressions. Estimations on OECD countries exclude Chile and Mexico. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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Annex Table 4.A.3. Factors related to teachers' frequent use of ICT for students' projects/class work, by country

Dependent variable- dummy for letting students us ICT for projects or class work frequently or always

	(1)	(2)	(3)	(4)	(5)
	Ciudad Autonoma de Buenos Aires (Argentina)	Brazil	Colombia	Chile	Mexico
Positive impact of professional development on teaching practice	0.128**	0.0485	0.0368	0.0402	-0.0281
	(0.0648)	(0.0328)	(0.0390)	(0.0368)	(0.0306)
Job satisfaction index	-0.00743	-0.00654	-0.00218	-0.00162	0.00565
	(0.00926)	(0.00857)	(0.00713)	(0.00809)	(0.00809)
Personal utility value index	-0.00688	-0.00269	-0.00451	0.00474	0.0103*
	(0.00635)	(0.00538)	(0.00406)	(0.00605)	(0.00595)
Social utility value index	-0.0143**	-0.00188	-0.00533	0.00386	-0.0125
	(0.00708)	(0.00671)	(0.0109)	(0.0108)	(0.0101)
Use of ICT for teaching included in initial teacher education or training	0.120***	-0.0107	0.0470	0.0358	0.0297
	(0.0334)	(0.0348)	(0.0319)	(0.0426)	(0.0315)
Felt well/very well prepared for teaching using ICT (after initial teacher education or training)	0.0521	0.160***	0.105***	0.0852**	0.180***
	(0.0368)	(0.0306)	(0.0258)	(0.0372)	(0.0363)
ICT skills for teaching included in professional development	0.100***	0.0550*	0.135***	0.165***	0.0557**
	(0.0290)	(0.0334)	(0.0318)	(0.0286)	(0.0258)
High professional development needs in ICT skills for teaching	-0.0499	0.0301	-0.0420*	-0.0186	-0.0954***
	(0.0414)	(0.0307)	(0.0247)	(0.0419)	(0.0347)
Self-efficacy in classroom management index	-0.00972	-0.0192*	0.00980	-0.0247**	0.00336
	(0.00937)	(0.0100)	(0.0116)	(0.00966)	(0.00799)
Self-efficacy in instruction index	0.0450***	0.0246***	0.0441***	0.0250**	0.0129
	(0.00995)	(0.00864)	(0.00979)	(0.00973)	(0.00857)
Self-efficacy in student engagement index	0.0145	0.0240**	0.00520	0.0143	0.00381
	(0.0111)	(0.00960)	(0.0106)	(0.00928)	(0.00831)
Professional collaboration in lessons among teachers index	-0.0138**	0.0242***	0.0163***	0.0157**	0.0307***
	(0.00695)	(0.00685)	(0.00503)	(0.00779)	(0.00560)
Teacher-student relations index	0.0103	0.00223	0.00772	0.0101	-0.000970
	(0.00773)	(0.00770)	(0.00541)	(0.00771)	(0.00632)
Teachers perceived disciplinary climate index	0.0105	-0.00804	-0.00277	-0.00415	0.00187
	(0.00898)	(0.00823)	(0.00736)	(0.00783)	(0.00746)
Percentage of students with first language different from instruction language	0.00260	-0.00501	0.00735	0.0383*	0.00812
	(0.0164)	(0.0207)	(0.0155)	(0.0207)	(0.0174)
Percentage of students with behavioural problems	-0.00747	0.0520***	-0.0158	0.00703	0.0113
	(0.0234)	(0.0170)	(0.0176)	(0.0229)	(0.0153)
Percentage of students who are low academic achievers	-0.0460**	-0.0164	0.00447	-0.0281	-0.0505***
	(0.0228)	(0.0175)	(0.0159)	(0.0219)	(0.0150)
Percentage of students with special needs	0.0116	0.0378	0.0336*	-0.00331	0.0341*
	(0.0289)	(0.0248)	(0.0192)	(0.0222)	(0.0202)
Percentage of students from socio-economically disadvantaged homes	0.0623***	-0.0153	0.0250*	0.0212	-0.00408
	(0.0203)	(0.0131)	(0.0137)	(0.0151)	(0.0131)
Percentage of academically gifted students	0.0216	0.0301	-0.00863	0.000188	0.00156
	(0.0149)	(0.0203)	(0.0129)	(0.0148)	(0.0134)

	(1)	(2)	(3)	(4)	(5)
	Ciudad Autonoma de Buenos Aires (Argentina)	Brazil	Colombia	Chile	Mexico
Percentage of students from socio-economically disadvantaged homes (school level)	-0.0182	-0.0205	-0.0132	-0.00448	0.00420
	(0.0261)	(0.0164)	(0.0140)	(0.0119)	(0.0154)
Percentage of students who are immigrants or with migrant background (school level)	-5.76e-05	-0.0262	-0.0111	0.0228	0.000170
	(0.0224)	(0.0274)	(0.0261)	(0.0245)	(0.0212)
Experiences as a teacher (in total)	-0.00150	-0.00101	0.000972	-0.000669	-0.000236
	(0.00234)	(0.00232)	(0.00179)	(0.00327)	(0.00164)
Teacher age	0.00272	0.00164	0.000300	0.00497*	0.00393**
	(0.00216)	(0.00217)	(0.00169)	(0.00268)	(0.00156)
Female	-0.00238	0.0658**	0.0257	0.0325	0.0588***
	(0.0319)	(0.0263)	(0.0231)	(0.0308)	(0.0219)
Employment status at this school: permanent employment	0.0747	-0.0203	-0.0387	0.00724	0.0149
	(0.0461)	(0.0426)	(0.0386)	(0.0384)	(0.0272)
Privately-managed school	-0.00622	0.00213	0.00297	-0.00434	0.0361
	(0.0614)	(0.0502)	(0.0456)	(0.0362)	(0.0506)
School location: rural		0.0197	0.0688	0.138***	0.0669
		(0.0651)	(0.0434)	(0.0488)	(0.0458)
Teacher can determine course content, including. national regional curricula	-0.0305	0.00425	0.0154	-0.00942	0.0394
	(0.0511)	(0.0382)	(0.0342)	(0.0366)	(0.0401)
Teacher can choose which learning materials are used	0.0369	-0.0596*	-0.00473	-0.00278	-0.0152
	(0.0524)	(0.0328)	(0.0345)	(0.0389)	(0.0281)
Shortage or inadequacy of digital technology hinders instruction quite a bit/a lot	-0.0805*	-0.0208	0.00872	-0.00173	-0.0497
	(0.0485)	(0.0492)	(0.0309)	(0.0731)	(0.0348)
Insufficient Internet access hinders instruction quite a bit/a lot	0.0455	-0.0777*	-0.0444	-0.0415	0.00598
	(0.0517)	(0.0456)	(0.0343)	(0.0508)	(0.0379)
Team innovativeness index	0.00174	-0.00827	-0.00964*	-0.00816	0.00655
	(0.00783)	(0.00691)	(0.00517)	(0.00665)	(0.00523)
Organisational innovativeness index	0.00288	0.00131	0.00177	0.00923	-0.00500
	(0.00804)	(0.00759)	(0.00586)	(0.00795)	(0.00813)
Constant	-0.191	-0.144	-0.292	-0.338	-0.234
	(0.266)	(0.233)	(0.229)	(0.250)	(0.249)
Observations	1 135	1 456	1 543	971	1 751

Note: The dependent variables is a dummy for letting students us ICT for projects or class work frequently or always Estimations obtained through multilevel mixed-effects linear regressions. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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Annex Table 4.A.4. Factors related to teachers' self-efficacy in supporting student learning through ICT use, by country

Dependent variable: Support student learning through the use of digital technology quite a bit or a lot

	(1) Ciudad Autonoma de Buenos Aires (Argentina)	(2) Brazil	(3) Colombia	(4) Chile	(5) Mexico
Positive impact of professional development on teaching practice	0.0124	-0.00184	0.0548	0.00673	-0.00336
	(0.0622)	(0.0370)	(0.0358)	(0.0290)	(0.0336)
Job satisfaction index	-0.00364	-0.00425	-0.00705	0.00526	-0.00887
	(0.0100)	(0.00669)	(0.00572)	(0.00724)	(0.00920)
Personal utility value index	0.00432	0.00452	0.00931**	0.00548	-0.00405
	(0.00540)	(0.00537)	(0.00376)	(0.00483)	(0.00562)
Social utility value index	-0.00952	-0.0173**	-0.00708	-0.00947	-0.0174*
	(0.00650)	(0.00707)	(0.00896)	(0.00808)	(0.0104)
Use of ICT for teaching included in initial teacher education or training	0.0523	0.00415	0.109***	0.0363	0.0263
	(0.0401)	(0.0298)	(0.0300)	(0.0400)	(0.0288)
Felt well/very well prepared for teaching using ICT (after initial teacher education or training)	0.0817**	0.210***	0.0573**	0.122***	0.226***
	(0.0351)	(0.0288)	(0.0226)	(0.0352)	(0.0312)
ICT skills for teaching included in professional development	0.126***	0.0940***	0.171***	0.111***	0.151***
	(0.0361)	(0.0298)	(0.0260)	(0.0253)	(0.0268)
High professional development needs in ICT skills for teaching	-0.130***	-0.0870***	-0.0775***	-0.0591*	-0.0578*
	(0.0412)	(0.0283)	(0.0216)	(0.0347)	(0.0318)
Self-efficacy in classroom management index	-0.0127	-0.0215**	0.00969	-0.00415	-0.00240
	(0.00977)	(0.00870)	(0.0102)	(0.00851)	(0.00867)
Self-efficacy in instruction index	0.0585***	0.0623***	0.0521***	0.0499***	0.0533***
	(0.00934)	(0.00852)	(0.00961)	(0.00919)	(0.00730)
Self-efficacy in student engagement index	0.0112	0.0180**	0.00208	0.00551	-0.00384
	(0.0106)	(0.00899)	(0.00827)	(0.00954)	(0.00830)
Professional collaboration in lessons among teachers index	0.00504	0.0204***	0.00948**	-0.00481	0.0155***
	(0.00692)	(0.00537)	(0.00454)	(0.00642)	(0.00586)
Teacher-student relations index	0.00817	0.00698	0.0146***	-0.00852	0.0197***
	(0.00679)	(0.00715)	(0.00521)	(0.00625)	(0.00600)
Teachers perceived disciplinary climate index	0.0114	0.00157	-0.00374	0.000741	0.00294
	(0.00840)	(0.00683)	(0.00732)	(0.00606)	(0.00715)
Percentage of students with first language different from instruction language	-0.0226	0.0363**	-0.0215	-0.00347	-0.0137
	(0.0159)	(0.0170)	(0.0149)	(0.0178)	(0.0183)
Percentage of students with behavioural problems	0.00530	-0.00339	-0.00536	0.00672	0.000377
	(0.0199)	(0.0167)	(0.0149)	(0.0166)	(0.0144)
Percentage of students who are low academic achievers	-0.0468**	0.00849	0.00898	-0.00260	-0.0181
	(0.0186)	(0.0143)	(0.0141)	(0.0158)	(0.0161)
Percentage of students with special needs	-0.00155	0.00380	-0.0298**	0.0207	0.0229
	(0.0264)	(0.0196)	(0.0149)	(0.0170)	(0.0220)
Percentage of students from socio-economically disadvantaged homes	0.0470**	-0.0161	-0.0179*	-0.00770	-0.0222*
	(0.0188)	(0.0135)	(0.00975)	(0.0125)	(0.0120)
Percentage of academically gifted students	0.0125	0.0278	-0.00772	0.0142	0.0128
	(0.0158)	(0.0185)	(0.0114)	(0.0127)	(0.0151)

	(1)	(2)	(3)	(4)	(5)
	Ciudad Autonoma de Buenos Aires (Argentina)	Brazil	Colombia	Chile	Mexico
Percentage of students from socio-economically disadvantaged homes (school level)	-0.0362	-0.0119	-0.0228**	0.00752	0.0170
	(0.0296)	(0.0136)	(0.0115)	(0.0100)	(0.0140)
Percentage of students who are immigrants or with migrant background (school level)	-0.00824	-0.0328	-0.0236	-0.0145	0.0228
	(0.0238)	(0.0295)	(0.0210)	(0.0193)	(0.0231)
Experiences as a teacher (in total)	-0.00338	-0.000851	0.000505	-0.00133	-0.00283*
	(0.00258)	(0.00210)	(0.00157)	(0.00265)	(0.00169)
Teacher age	0.00188	-0.00136	-0.00114	0.00216	0.00345**
	(0.00246)	(0.00187)	(0.00166)	(0.00231)	(0.00173)
Female	-0.0765**	0.0344	0.0364*	-0.0130	-0.0341
	(0.0297)	(0.0254)	(0.0213)	(0.0236)	(0.0225)
Employment status at this school: permanent employment	0.112***	-0.0493	-0.0216	-0.00434	0.0505
	(0.0416)	(0.0317)	(0.0310)	(0.0307)	(0.0310)
Privately-managed school	0.0145	0.0911**	-0.0583	-0.0135	0.0927*
	(0.0603)	(0.0396)	(0.0388)	(0.0313)	(0.0484)
School location: rural		0.0219	-0.0142	0.0665*	0.0587
		(0.0481)	(0.0343)	(0.0384)	(0.0523)
Teacher can determine course content, including national regional curricula	0.0154	-0.00475	-0.00218	-0.0476	0.0332
	(0.0373)	(0.0346)	(0.0232)	(0.0304)	(0.0404)
Teacher can choose which learning materials are used	-0.0129	-0.00351	-0.0187	0.0229	-0.0182
	(0.0392)	(0.0331)	(0.0249)	(0.0326)	(0.0285)
Shortage or inadequacy of digital technology hinders instruction quite a bit/a lot	-0.0160	-0.0780**	-0.0212	0.0337	-0.0960***
	(0.0554)	(0.0390)	(0.0326)	(0.0639)	(0.0335)
Insufficient Internet access hinders instruction quite a bit/a lot	-0.0142	0.0761**	-0.0375	-0.0687	-0.0151
	(0.0490)	(0.0365)	(0.0304)	(0.0530)	(0.0339)
Team innovativeness index	0.00763	-0.00248	-0.00907*	0.00664	-0.00704
	(0.00736)	(0.00693)	(0.00478)	(0.00529)	(0.00573)
Organizational innovativeness index	0.00539	0.00464	-0.00165	0.0157**	-0.00367
	(0.00858)	(0.00633)	(0.00511)	(0.00669)	(0.00793)
Constant	-0.434*	-0.288	0.0456	-0.250	-0.372
	(0.259)	(0.194)	(0.234)	(0.234)	(0.238)
Observations	1 139	1 462	1 549	973	1 754

Note: The dependent variable is a dummy variable equal to one if the teacher reports being able to support student learning quite a bit or a lot through the use of digital technology. Estimations obtained through multilevel mixed-effects linear regressions. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on OECD (2018[9]), TALIS 2018 Database, http://www.oecd.org/education/talis/.

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Notes

[1] Results are confirmed also when looking at teachers perceptions on their need for professional development. High levels of need for professional development in ICT skills for teaching are, in fact, associated with a lower likelihood to use ICT frequently and lower self-efficacy in the area.

[2] Teacher collaboration is also often associated with the use of more cognitive activation and active learning strategies, which in turn have been shown to be positively related to student performance (in mathematics) (Le Donné, Fraser and Bousquet, 2016[4]).

[3] A similar share mention the lack of incentives and employer support, in contrast to OECD countries where teachers are most numerous to report conflicts with work schedule as an obstacle to training.

[4] E.g. cyberbullying, excessive use of digital devices, exposure to pornographic content.

5 Adult learning and technology in Latin America

This chapter investigates the new opportunities that digitalisation offers for adult learning, in the shape of open education and massive open online courses (MOOCs). In Latin American countries, patterns of participation in online learning activities tend to reproduce gaps in participation in standard forms of adult learning. Highly skilled, highly educated individuals are more likely to benefit from these new learning opportunities.

Summary of the main insights

Digitalisation transforms workplaces and Latin American countries need to foster high quality, flexible options for learning at all stages of life.

- Latin American countries are lagging behind in terms of exposure to digitalisation, but as technologies progressively permeate every aspect of work and societies, this situation is expected to change rapidly in the future. Latin American individuals and workers will need to be equipped with a well-rounded set of skills to be able to adapt to these changes.
- Skills are crucial to thrive in an increasingly digital and interconnected world, but Latin American countries perform poorly in terms of their populations' skills. Latin American countries display particularly large shares of young people lacking basic skills. In Ecuador and Peru, almost half of young people aged in 16-24 perform poorly in literacy, numeracy and problem solving in technology-rich environments. The same holds for prime-age individuals: more than 60% of them lack basic skills.
- In Latin American countries, participation in formal and non-formal job-related adult learning is not widespread. Around 24% of adults in Latin American countries, who wanted to participate (more) in training, did not do so because training was too expensive. In contrast, this is the case for only 16% of adults in OECD countries. More worryingly, a large share of adults in OECD (50%) and Latin American countries (57%), do not participate and do not want to participate in training.
- New technologies can contribute to finding a solution to these problems by providing new opportunities for developing skills and engaging individuals who may find standard forms of adult training to be of difficult access, ineffective or of insufficient quality.

Open or distance education tends to reproduce inequalities in participation observed also in 'standard' adult learning.

- Latin American countries with available data in the OECD Survey of Adult Skills, a product of the Programme for the International Assessment of Adult Competencies (PIAAC), display, on average, larger levels of participation in open or distance education than the average of OECD countries. Shares of adults engaging in such courses in Latin America range from 8% in Peru to 13% in Chile.
- Many individuals engage in open or distance education for job-related reasons and tend to find it useful. Around 55% of Latin American adults who engage in open or distance education do so in order to perform better at their jobs and to improve their career prospects. Personal interests or desire to enhance one's knowledge or skills in a specific area come second among reasons for participation. This pattern holds in OECD and Latin American countries alike. Individuals who combine work and education are the most numerous to engage in open education.
- In Latin American and OECD countries alike, participation levels in open and distance education increase with the level of skills (whether in literacy or problem solving in technology-rich environments) and with educational attainment. Conversely, workers who lack a contract in their current job are less likely to engage in open or distance education.
- Age plays an important role in explaining participation in open or distance education in Latin America. Around 58% of adults who engage in open and distance education are 20-40 years old in Latin American countries. They represent 52% of participants in OECD countries.

- Patterns of participation in open and distance education tend to reproduce or even amplify patterns of participation in standard forms of adult learning. Engaging low-skilled workers in adult learning remains a challenge that does not seem to improve when looking at the participation in open and distance education.

There is scope to further harness the potential of massive open online courses (MOOCs).

- MOOC enrolments have disproportionately come from very developed countries (scoring very high on the Human Development Index). A large number of Latin American countries, including Brazil, Colombia, Costa Rica, Mexico, score 'high' in the Human Development Index whereas only Argentina and Chile are rated as 'very high'.
- In a similar vein to open education and standard forms of adult training, participation in MOOCs has tended to be higher among the highly skilled, highly educated and among individuals with higher socio-economic status. Latin American countries display a similar pattern of participation in MOOCs. Data from edX MOOC participants in 2012-2013 showed that in Latin America, most MOOC participants were very young (the median age of participants was 26 years old), mostly men (76%), and holding a Bachelor or a Master's degree (more than 60% of participants).

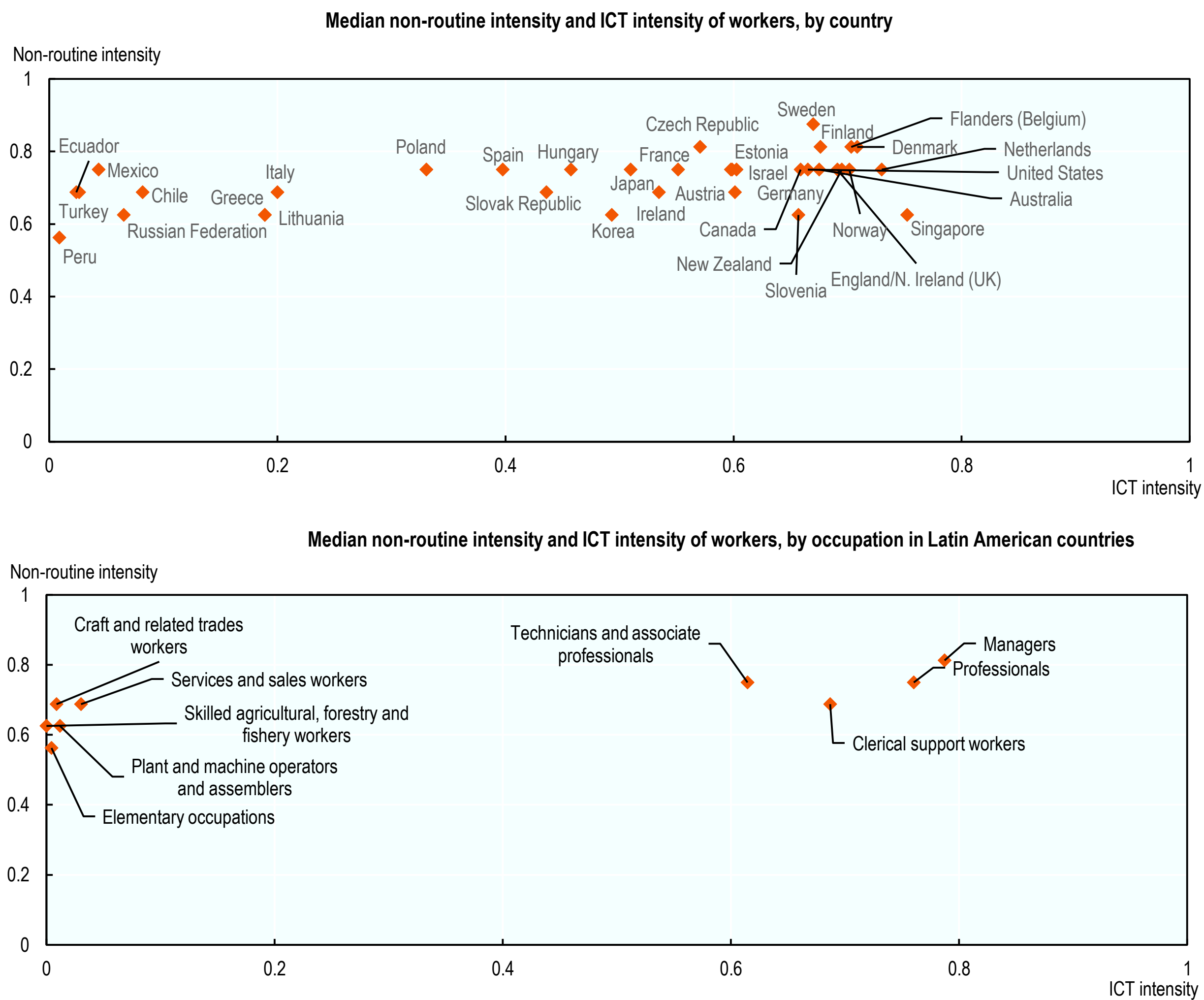
Setting the scene: Adult learning in a digital world of work

Digitalisation reshapes the world of work and societies, raising the need to train and develop skills throughout life. The new technological wave is already transforming occupations. The increasing use of new technologies in workplaces can substitute workers in the performance of routine tasks or complement them in other tasks (Autor, Levy and Murnane, 2003[1]), thereby changing the skills needed on the job. Despite many of the changes being digital in nature, workers will need much more than just digital skills to adapt (OECD, 2019[2]). Acquiring digital skills, in fact, will not be sufficient to shield workers from the radical transformation happening in the labour market and even occupations that are at the frontier of new technologies (e.g. software developers, big data specialists) will require a good level of cognitive skills and socio-emotional skills (OECD, 2019[2]).

Latin American countries are lagging behind in terms of exposure to digitalisation. Among countries with available data in the OECD Survey of Adult Skills (PIAAC), Chile, Ecuador, Mexico and Peru display particularly low levels of adoption of information and communications technology (ICT) at work (Figure 5.1).[1] The informal sector, relatively large in Latin American economies, is likely not to be fully captured by these statistics since the OECD Survey of Adult Skills (PIAAC) does not allow identifying informal workers based on the standard definition of informality. ICT and non-routine intensities for Latin American countries with available data in the OECD Survey of Adult Skills (PIAAC) may therefore be overestimated if informal workers use ICT less intensively at work and have more routine-intensive jobs. As technologies progressively permeate every aspect of work and societies, this situation is expected to change rapidly in the future and workers in the region will certainly need to be equipped with a well-rounded set of skills to be able to adapt to these changes.

Differences in the nature of occupations and their skills proficiency (literacy and computer skills) account for a large share of the observed differences across countries in their overall exposure to digitalisation in the workplace, as measured by the ICT intensity and non-routine intensity indicators (OECD, 2019[2]). In Latin American (Figure 5.1) and OECD countries (OECD, 2019[2]), occupations largely differ in their exposure to digitalisation. High-skilled occupations, such as managers or professionals perform more intensively ICT and non-routine tasks at work. Such occupations are unlikely to experience substantial changes, although advances in machine learning or artificial intelligence may further alter the tasks carried out at work by those workers. In contrast, workers in occupations with low ICT intensity and non-routine intensity, such as elementary occupations or plant and machine operators are likely to see substantially changes in their jobs. Some of their tasks may be automated, whereas the introduction of new technologies in their workplace will require them to increasingly work with ICT.

Figure 5.1. Latin American countries and occupations' exposure to digitalisation



Note: Indicators are based on the OECD Skills Outlook 2019 (OECD, 2019[2]). The top panel plots countries' median non-routine and ICT intensities across all workers, while the bottom panel plots one-digit occupations' median non-routine and ICT intensities across all workers of that group of occupations in all countries. For example, the median non-routine intensity across all workers in Turkey is 0.7, meaning that 50% of all workers in Turkey are in jobs with a non-routine intensity above 0.7 and 50% are in jobs with a non-routine intensity below 0.7. The non-routine intensity of jobs indicator is computed following the methodology proposed by (Marcolin, Miroudot and Squicciarini, 2016[3])and builds on items that capture the extent to which one's job is codifiable and sequentiable. It is close to 0 when the job is routine-intensive and to 1 when the job is not routine-intensive. The ICT intensity of jobs indicator was developed in work by (Grundke et al., 2017[4])and describes tasks associated with ICT use, from reading and writing emails to using word-processing or spreadsheet software, or a programming language. It is close to 0 when the job is not ICT-intensive and to 1 when the job is ICT-intensive. Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey: year of reference 2015. Ecuador, Hungary, Mexico, Peru and the United States: Year of reference 2017. All other countries: year of reference 2012. Data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly.
Source: OECD calculations based on OECD (2017[5]), *Survey of Adults Skills (PIAAC) (2012, 2015, 2017*), (database), http://www.oecd.org/skills/piaac/.

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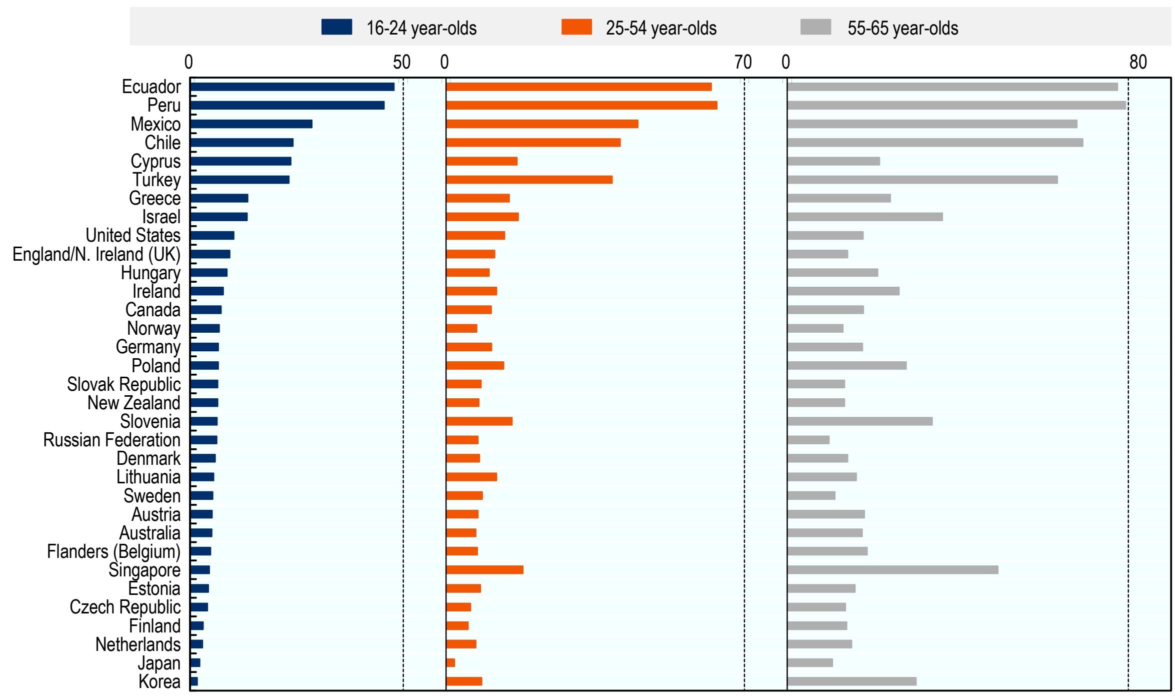
Figure 5.2. Share of individuals lacking basic skills by age groups

Share of youth (16-24), prime age adults (25-54) and older people (55-65) lacking basic skills, by country (%)



Note: Indicator developed based on (OECD, 2019[2]). Individuals lacking basic skills score at most Level 1 (inclusive) in literacy and numeracy and at most Below Level 1 (inclusive) in problem solving (including failing ICT core and having no computer experience). Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey: Year of reference 2015. Ecuador, Hungary, Mexico, Peru and United States: Year of reference 2017. All other countries: Year of reference 2012. Data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly.
Source: OECD calculations based on OECD (2017[5]), *Survey of Adults Skills (PIAAC) (2012, 2015, 2017)*, (database), http://www.oecd.org/skills/piaac/.

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Fostering high quality, flexible options for learning at all stages of life are crucial challenges. In Latin American countries, participation in formal and non-formal job-related adult learning is not widespread (Figure 5.3). The average participation in adult learning across Latin American countries remains below the OECD average (OECD, forthcoming[6]), despite Latin American countries outperforming some OECD countries such as Greece, Italy and Turkey. Indeed, large disparities in participation patterns are present both among OECD countries and Latin American countries.

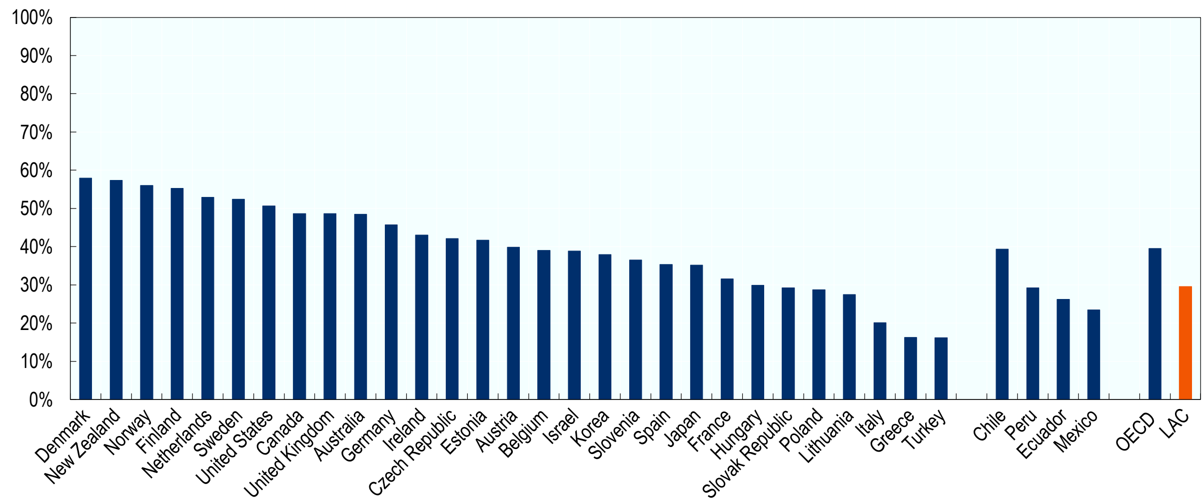
Several reasons can explain the low participation of adults in adult learning activities. One of the main barriers for participation relates to financial costs (Figure 5.4). Around 24% of adults in Latin American countries with available data in the OECD Survey for Adult Skills (PIAAC), who wanted to participate (more) in training, did not do so because training was too expensive. In contrast, this is the case for only 16% of adults in OECD countries. More worryingly, a large share of adults in OECD (50%) and Latin American countries (57%), do not participate and do not want to participate in training (OECD, forthcoming[6]).

As in the case of initial education, new technologies can contribute to find a solution to these problems by providing new opportunities for developing skills and engaging individuals who may find standard forms of adult training to be of difficult access, ineffective or of insufficient quality.

Evidence shows already that workers in more digital-intensive work environments are generally more likely to maintain their skills and they are also more prone to learn by doing, keep their skills up to date and learn from co-workers (OECD, 2019[2]). Beyond the opportunities to learn by doing in a digital workplace, digitalisation also bring many options for developing skills (outside and at work) through the rise of alternative and potentially less expensive and more flexible forms of learning, such as open education and MOOCs.

Figure 5.3. Participation in adult learning

Percentage of adults who participated in formal or non-formal job-related adult learning in the past 12 months



Source: OECD (2019[7]), Dashboard on Priorities for Adult Learning, http://www.oecd.org/employment/skills-and-work/adult-learning/dashboard.htm.

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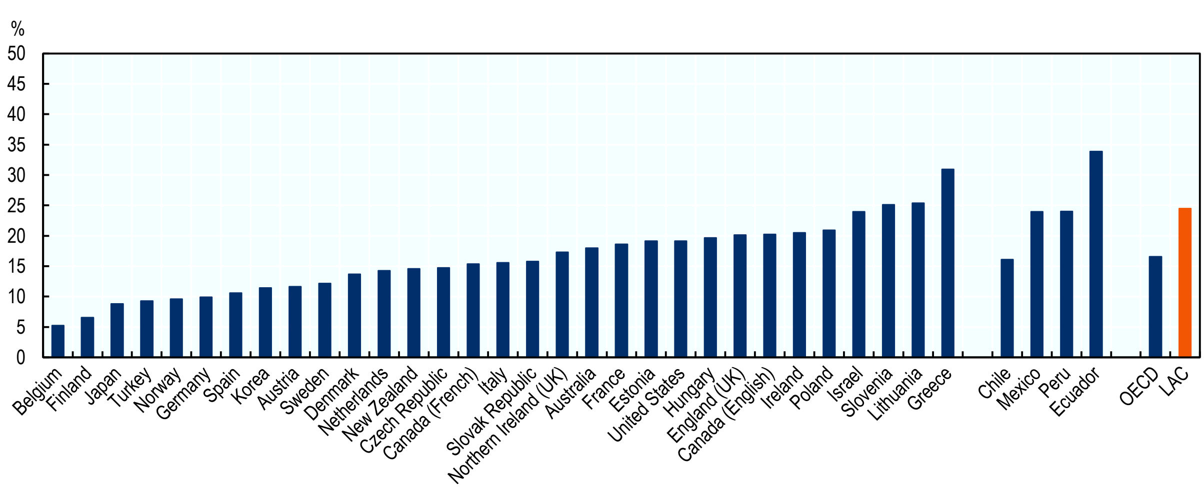
Figure 5.4. Financial barriers to participation in adult training

Share of adults who wanted to participate (more) in training, but did not because too expensive



Source: OECD (forthcoming[6]), *Adult Learning Systems in Latin America and the Role of Employers*.

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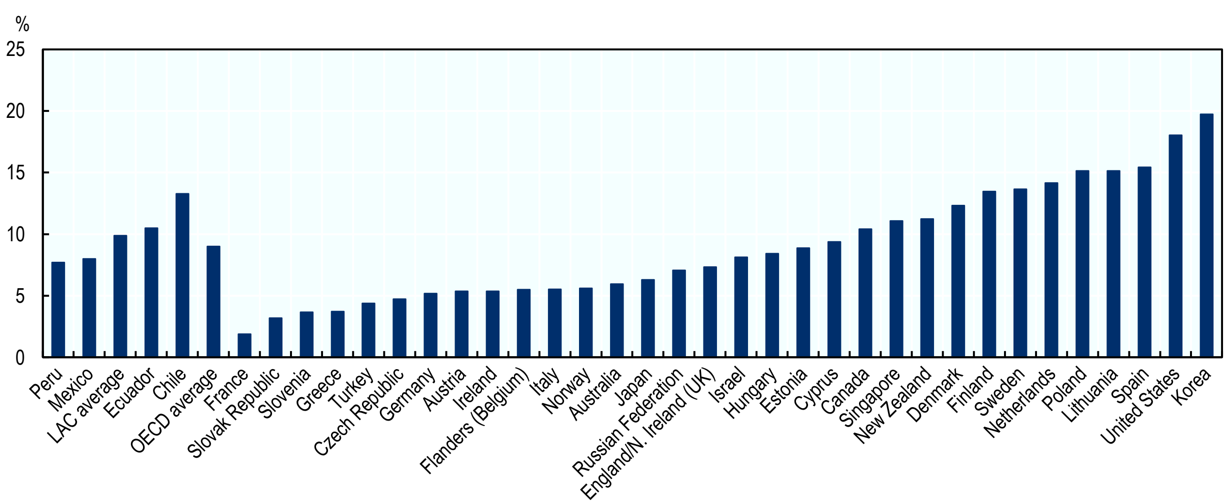
Open education reproduces inequalities in participation in standard adult learning

The OECD Survey of Adult Skills (PIAAC) provides evidence on patterns of participation in open or distance education. These courses do not result in formal qualifications and are “similar to face-to-face courses but take place via postal or correspondence or electronic media, linking together instructors, teachers and tutors or students who are not together in the classroom” (OECD Survey of Adult Skills (PIAAC), n.d.[8]).

Latin American countries with available data in the OECD Survey of Adult Skills (PIAAC) display, on average, larger levels of participation in open or distance education than the average of OECD countries (Figure 5.5). Shares of adults engaging in such courses range from 8% in Peru to 13% in Chile. That being said, OECD countries display considerable variation in participation patterns, from less than 2% of adults in France to almost 20% in Korea.[2]

Figure 5.5. Participation in open education

Percentage of the population having participated in open or distance education in the 12 months before the survey, 16- 65-year-olds



Note: In the PIAAC questionnaire, open or distance education is defined as not leading to formal qualification. It covers courses that are similar to face-to-face courses but take place via postal or correspondence or electronic media, linking together instructors, teachers and tutors or students who are not together in the classroom. Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey: Year of reference 2015. Ecuador, Hungary, Mexico, Peru and the United States: Year of reference 2017. All other countries: Year of reference 2012. Data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly.
Source: OECD calculations based on OECD (2017[5]), *Survey of Adults Skills (PIAAC) (2012, 2015, 2017)*, (database), http://www.oecd.org/skills/piaac/.

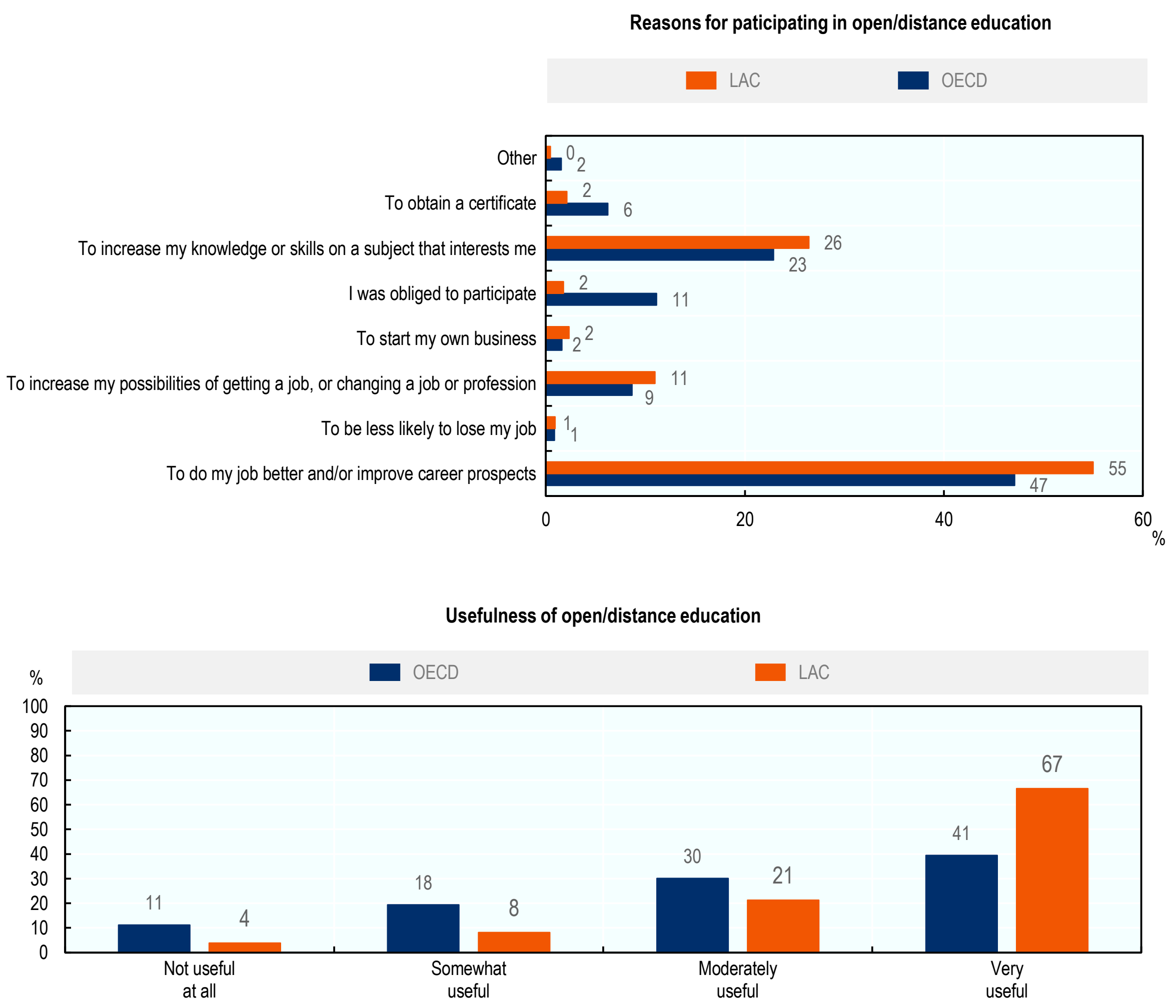
StatLink https://doi.org/10.1787/888934136079

Many individuals engage in open or distance education for job-related reasons and tend to find it useful (Figure 5.6). This pattern holds in OECD and Latin American countries alike. Around 55% of Latin American adults who engage in open or distance education do so in order to perform better at their jobs and to improve their career prospects. Personal interests or desire to enhance one’s knowledge or skills in a specific area come second among reasons for participation.

In fact, those who are closest to the labour market, whether employed or unemployed, tend to use open or distance education the most (Figure 5.7). Latin American countries display a similar pattern to OECD countries, although in Mexico the share of participants in open or distance education who are unemployed is even larger than that of those who participate in education while being employed. Individuals who combine work and education are the most numerous to engage in open education, suggesting that open or distance education paths provide flexible opportunities for students to developing skills and acquiring knowledge while combining work obligations (OECD, 2019[2]).

Figure 5.6. Reasons for and usefulness of participation in open/distance education

Share of individuals who have participated in open/distance education in the 12 months before the survey



Source: OECD calculations based on OECD (2017[5]), *Survey of Adults Skills (PIAAC) (2012, 2015, 2017*), (database), http://www.oecd.org/skills/piaac/.

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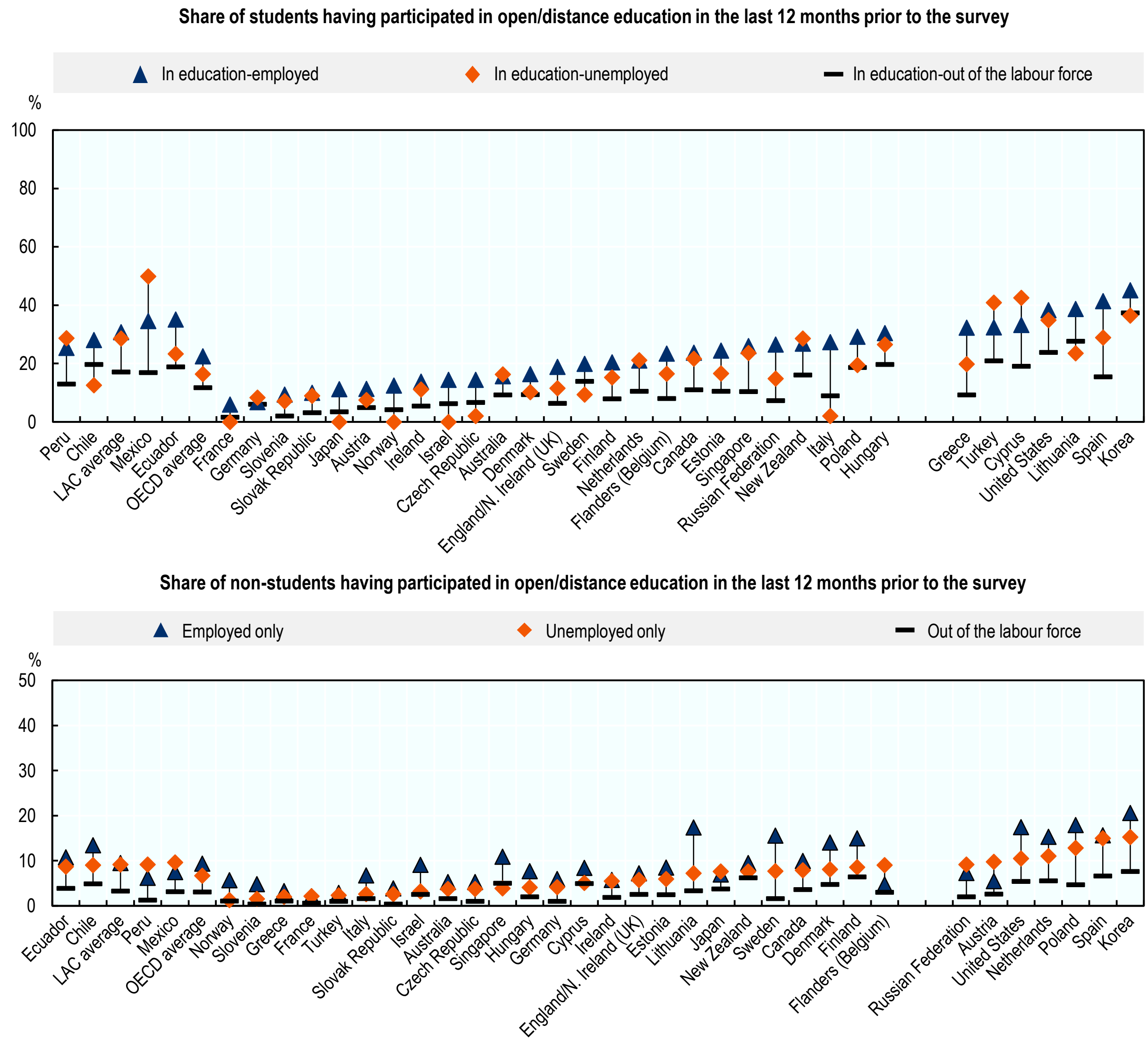
Figure 5.7. Participation in open education by employment and education status



Note: In the PIAAC questionnaire, open or distance education is defined as not leading to formal qualification. It covers courses that are similar to face-to-face courses but take place via postal or correspondence or electronic media, linking together instructors, teachers and tutors or students who are not together in the classroom. The first panel considers the share of individuals who declare not to be in formal education and have participated in open/distance education. The second panel considers the share of individuals who declare to be in formal education and have participated in open/distance education. Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey: Year of reference 2015. Ecuador, Hungary, Mexico, Peru and the United States: Year of reference 2017. All other countries: Year of reference 2012. Data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly.
Source: OECD calculations based on OECD (2017[5]), *Survey of Adults Skills (PIAAC) (2012, 2015, 2017)*, (database), http://www.oecd.org/skills/piaac/.

StatLink https://doi.org/10.1787/888934136117

Participation in standard adult learning and open education is weaker amongst those who are most likely to benefit from training

Older individuals, the low skilled, with lower educational levels are less likely to participate in formal and non-formal job-related training (OECD, 2019[9]). As in most OECD countries, Latin American countries with available data display significant gaps in participation in adult learning by age, education level, wage and employment status. Older workers and less skilled individuals (Figure 5.8) display significantly lower levels of engagement in adult learning, but only a limited gap emerges between unemployed and employed individuals in Latin American countries.

Among the OECD countries with available data for assessing the inclusiveness of job-related adult learning, Chile was one of the poorest performing countries, showing the largest gap in participation between older and prime-age workers as well as between low-skilled and medium/high-skilled workers (OECD, 2019[9]). At the same time, among Latin American countries, Chile displays the best performance in terms of adults' participation in formal or non-formal learning.

In Latin American and OECD countries alike, participation levels in open and distance education increase with the level of skills (whether in literacy or problem solving in technology-rich environments) and with educational attainment. Preliminary evidence from experimental research shows that online degrees can potentially expand the number of individuals accessing education (Box 5.1). Nevertheless, such expansions are likely to benefit those with better skills (digital and non-digital), better access to ICT infrastructure or higher motivation to train. Patterns of participation in open and distance education tend to reproduce and even amplify patterns of participation in standard forms of adult learning. Engaging low-skilled workers in adult learning remains a challenge that does not seem to improve when looking at the participation in open and distance education.

Box 5.1. Georgia Tech's Online Master of Science in Computer Science

Goodman, Melkers and Pallais (2019[10]) bring first evidence related to the effectiveness of online degrees at expanding the number of people enrolling in higher education.

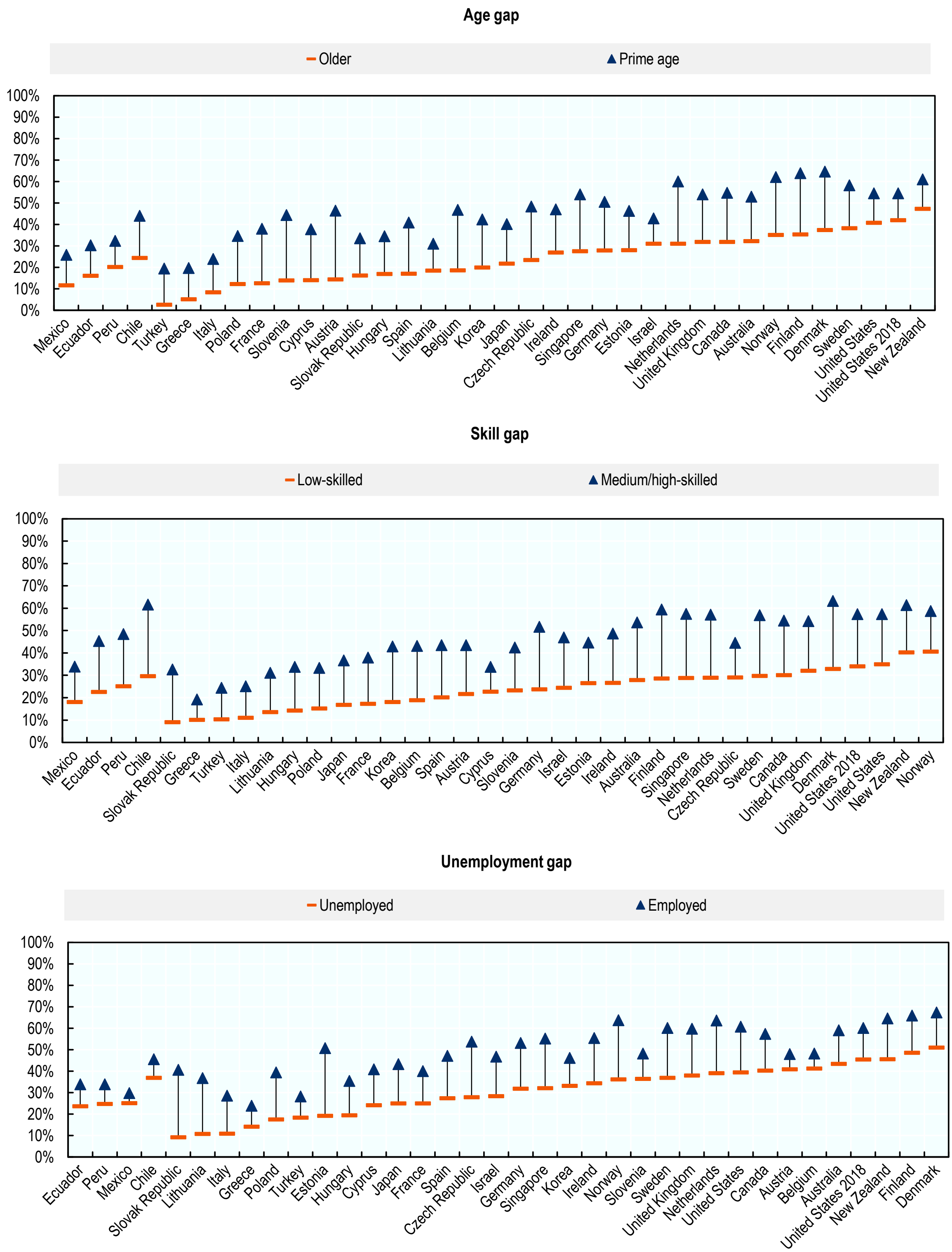
Their evaluation focuses on Georgia Tech's Online Master of Science in Computer Science. Using a regression discontinuity design, they show that access to the online programme increases educational enrolment substantially. The online programme drew primarily mid-career individuals in contrast to younger applicants for the in-person version. The evaluation suggested that the online degree managed to fill a gap in traditional education, by drawing individuals who would not have enrolled otherwise and providing high-quality instruction. Indeed, the degree is provided by a highly regarded institution, online students slightly outperformed in-person ones and the degree had a significantly lower cost than its in-person version.

In 2019, Georgia Tech's Online Master of Science in Computer Science had more than 9 000 students (Class Central, 2019[11]).

Source: Class Central (2019[11]), By The Numbers: MOOCs in 2019 — Class Central, https://www.classcentral.com/report/mooc-stats-2019/; Goodman J., J. Melkers and A. Pallais (2019[10]); "Can online delivery increase access to education?", *Journal of Labor Economics*, http://dx.doi.org/10.1086/698895.

Figure 5.8. Gaps in participation in adult learning

Share of adults who participated in formal or non-formal job-related adult learning in the past 12 months



Source: OECD (2019[7]), Dashboard on Priorities for Adult Learning, http://www.oecd.org/employment/skills-and-work/adult-learning/dashboard.htm.

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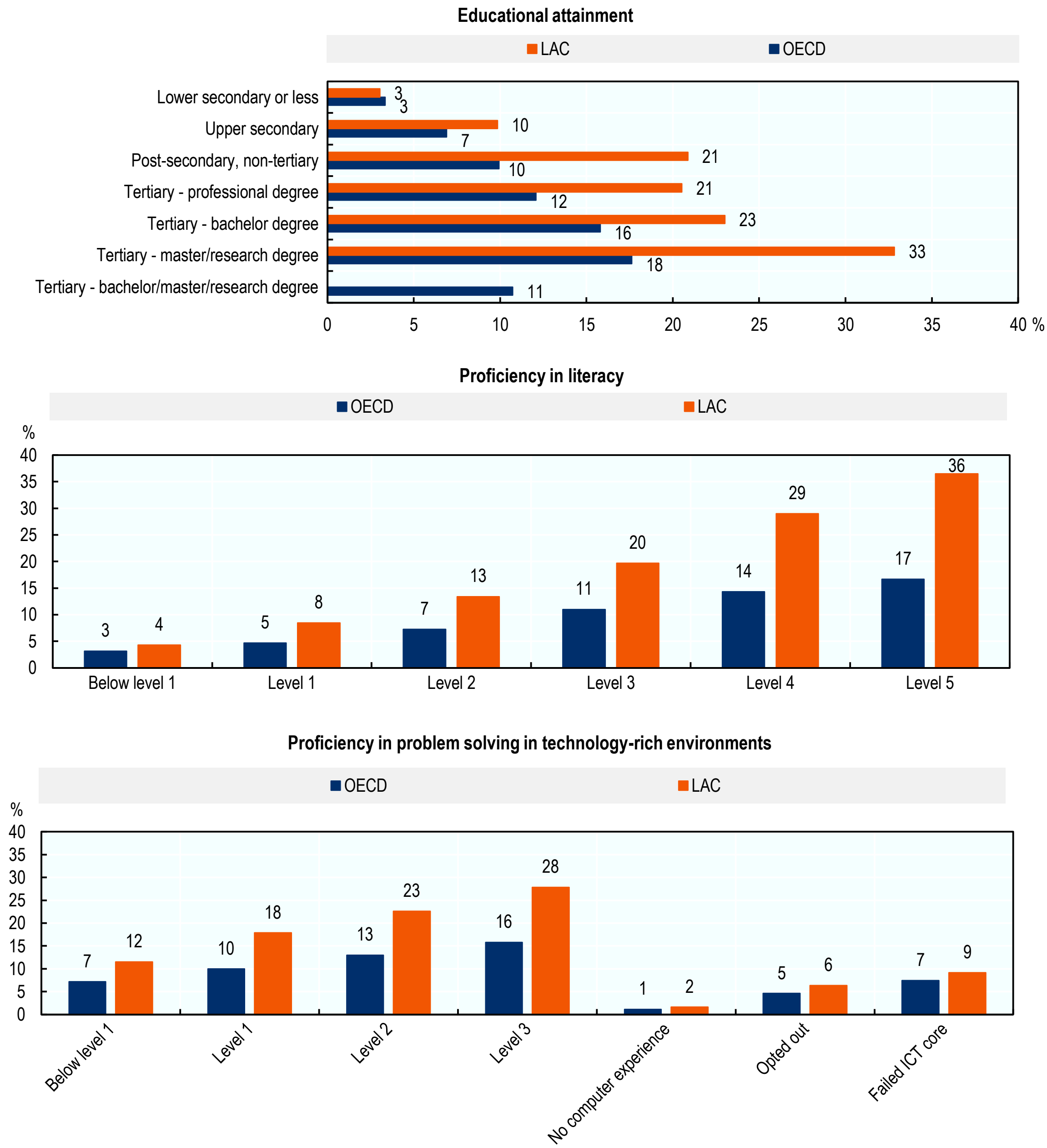
Figure 5.9. Participation in open/distance education by educational attainment and skills proficiency

As a percentage of each category



Note: In the PIAAC questionnaire, open or distance education is defined as not leading to formal qualification. It covers courses that are similar to face-to-face courses but take place via postal or correspondence or electronic media, linking together instructors, teachers and tutors or students who are not together in the classroom.

Source: OECD calculations based on OECD (2017[5]), Survey of Adults Skills (PIAAC) (2012, 2015, 2017), (database), http://www.oecd.org/skills/piaac/.

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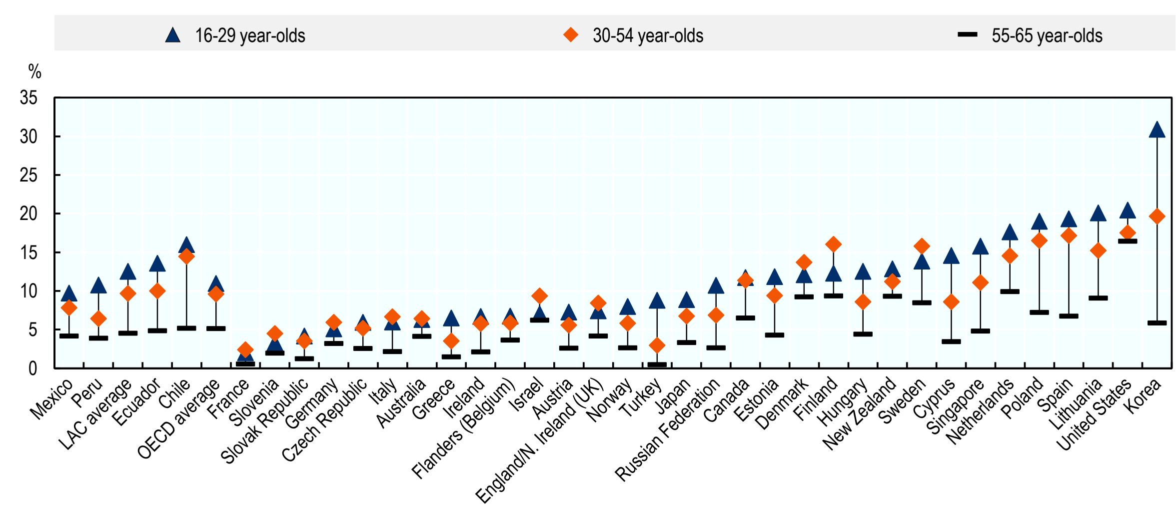
When focusing on Latin America, individuals who are most in need of reskilling or upskilling are yet the least likely to leverage new technologies for learning (Figure 5.9). In addition, open and distance education benefits younger people more (Figure 5.10) and older individuals, less familiar with new technologies, are the least likely to participate in these forms of learning. Evidence shows that around 58% of adults who engage in open and distance education are aged 20-40 years old in Latin American countries. They represent 52% of participants in OECD countries.

Labour market informality is yet another piece of the equation. Informality is widespread in many Latin American countries, representing around half of employment. Informality is higher in rural areas, among women and less-educated workers (ILO, 2018[12]). This situation translates into a “social vulnerability trap” in Latin America. Informal workers usually have a low and unstable income and no access to social protection, and, as such, have limited resources to devote to training. This makes them less productive relative to more educated and skilled peers hindering, in turn, their chances of accessing formal and better quality jobs. Likewise, informal workers have reduced opportunities for learning and training as they are generally less likely to be granted access to formal training programmes and employers in the informal sector are less likely to have any incentives or resources to devote to training (OECD et al., 2019[13]). Evidence from the OECD Survey of Adult Skills (PIAAC) for Latin American countries shows that workers who lack a contract in their current job are less likely to engage in open or distance education (Figure 5.11). In certain cases, for instance in Ecuador and Peru, gaps in participation between workers in the formal and informal labour market exceed 10 percentage points.

Figure 5.10. Participation in open/distance education by age

Percentage of the population having participated in open or distance education in the 12 months prior to the survey, by age group

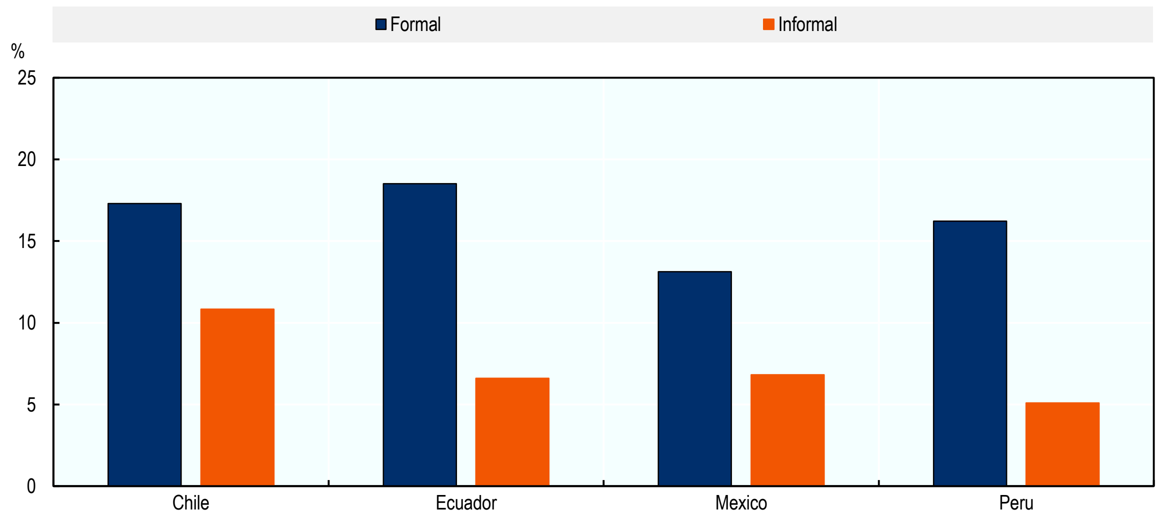


Note: In the PIAAC questionnaire, open or distance education is defined as not leading to formal qualification. It covers courses which are similar to face-to-face courses but take place via postal or correspondence or electronic media, linking together instructors, teachers and tutors or students who are not together in the classroom. Individuals aged 16 to 19 in formal compulsory education were not asked the questions. Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia and Turkey: Year of reference 2015. Ecuador, Hungary, Mexico, Peru and United States: Year of reference 2017. All other countries: Year of reference 2012. Data for Belgium refer only to Flanders and data for the United Kingdom refer to England and Northern Ireland jointly.
Source: OECD calculations based on OECD (2017[5]), *Survey of Adults Skills (PIAAC) (2012, 2015, 2017)*, (database), http://www.oecd.org/skills/piaac/.

StatLink https://doi.org/10.1787/888934136174

Figure 5.11. Participation in open/distance education and informality

Share of individuals who have participated in open/distance education in the 12 months before the survey, by presence of contract in current job



Note: Individuals in informal employment are defined as individuals in employment who have no contract in their current job.
Source: OECD calculations based on OECD (2017[5]), *Survey of Adults Skills (PIAAC) (2012, 2015, 2017)*, (database), http://www.oecd.org/skills/piaac/.

StatLink https://doi.org/10.1787/888934136193

There is scope to further harness the potential of MOOCs in reaching those most in need of training

The rise of MOOCs has broadened the opportunities brought about by open education for developing skills at any time, from any place, with access to training provided by top universities or leading experts in the field. In 2019, there were around 110 million MOOC users worldwide (excluding the People's Republic of China), attending courses from more than 900 universities (Class Central, 2019[11]). The number of degrees offered online through MOOCs rose to 50, although fewer degrees have been launched in 2019 in comparison to 2018 (Class Central, 2019[11]).

MOOCs provide enhanced flexibility for learning, allowing individuals to sign up and follow courses generally for free, although students have usually to pay to obtain a certification. MOOCs are offered in a large number of areas, with business and technology representing more than 40% of courses covered in 2019, followed by social sciences (11%) and science (9.2%) (Class Central, 2019[11]). In addition, evidence form the first years of MOOCs suggests that MOOCs foster multi-disciplinarity as many individuals who enter a MOOC platform for one type of course are likely to continue with courses in different subjects (OECD, 2019[2]; Chuang, 2017[14]).

Box 5.2. Experimental evidence on online learning

Online learning environments

Evidence from the experimental research literature shows that blended learning environments, combining face-to-face and online activities, are more beneficial to student outcomes than courses delivered solely online (Escueta et al., 2017[15]). Focusing on a college course in microeconomics at a large public university in the Northeast of the United States, Alpert, Couch and Harmo (2016[16]) performed a randomised experiment assigning students to three types of instructional formats: classroom instruction, blended instruction and online instruction. Students who followed the blended instruction format performed on a par with those enrolled in classroom instruction, whereas students attending online learning only displayed significantly poorer learning outcomes.

MOOCs

Experimental research on MOOCs has mostly examined ways to enhance participants' efforts and expand access to MOOCs, through behavioural and mind-set interventions (Escueta et al., 2017[15]). Such interventions have focused on "social comparisons" (that make students aware of the performance of other students), commitment devices to reduce procrastination[3] or reducing "social identity" threats[4] more likely to be experienced by students from more disadvantages backgrounds (Abdul Latif Jameel Poverty Action Lab, 2019[17]; Escueta et al., 2017[15]). Although the number of high-quality experimental evaluations related to MOOCs remains limited, most of the behavioural and mind-set interventions have been successful at enhancing persistence and completion rates (Abdul Latif Jameel Poverty Action Lab, 2019[17]).

Among these interventions, Kizilcec et al. (2017[18]) explore the role of "social identity" threat as a driver of the gap in MOOC enrolment and completion rates between more-developed and less-developed countries. Data from an initial survey suggested that individuals from less-developed countries were more fearful about being perceived negatively in MOOCs due to their nationality than those from more advanced economies. In addition, there is also a risk that individuals from less-developed countries perceive themselves as outsiders since many MOOCs are designed in the United States, or if they are aware of education or work-related stereotypes others may hold against them. Kizilcec et al (2017[18]) evaluate therefore the effectiveness of mind-set interventions[5] targeting the "social identity" threat on a sample of participants in a Stanford University and then in a Harvard University MOOC. Individuals from Egypt, India and Pakistan were over-represented among those from less-developed economies in the experiment. The intervention was successful at closing the gap between less- and more-developed economies in terms of MOOC persistence (measured as the number of course materials individuals had engaged with) and completion.

Source: Alpert, W.T., K.A. Couch and O.R. Harmon: (2016[16]), "A randomized assessment of online learning", *American Economic Review*, http://dx.doi.org/10.1257/aer.p20161057; Escueta, M. et al. (2017[15]), "Education technology: An evidence-based review", *NBER Working Paper*, No. 23744, http://www.nber.org/papers/w23744; Abdul Latif Jameel Poverty Action Lab (2019[17]), "Will technology transform education for the better?", *J-PAL Evidence Review*, https://www.povertyactionlab.org/sites/default/files/documents/education-technology-evidence-review.pdf; Kizilcec, R. F. et al. (2017[18]), "Closing global achievement gaps in MOOCs", *Science*, http://dx.doi.org/10.1126/science.aag2063.

Low completion rates have been one of the main challenges associated with the development of MOOCs. Data from the edX platform show that one in two individuals who register for MOOCs do not attend the course. In addition, new enrolments have been on a decline since 2016 and completion rates of those who have registered and viewed the course but did not ask for certification have remained at below 10% throughout the 2013-2018 period (Reich and Ruipérez-Valiente, 2019[19]). Online learning environments have been shown to be less beneficial to learners than blended ones and behavioural and mind-set interventions have sought to enhance MOOC completion rates (Box 5.2). Most experimental evaluations of such interventions have found positive effects (Escueta et al., 2017[15]). At the same time, non-completion is not necessarily a problem in itself if individuals retrieve the information they need and acquire knowledge by following the course even if only partially. The objectives of MOOC participants are likely to be very different, from interest in a specific topic or desire to obtain a recognised certificate for employment opportunities (OECD, 2019[2]), translating into different incentives for completing courses. At the same time, MOOCs have also faced challenges related to the difficulty of recreating aspects of in-person learning experiences that are particularly valuable in the learning process (OECD, 2015[20]). Blended learning environments, which combine in person and online activities, appear to be more beneficial to student outcomes that purely online learning ones (Box 5.2).

When looking at the use of open and distance learning in Latin America, it is worth noting that MOOC enrolments have disproportionately come from countries rated very high on the Human Development Index (HDI)[6] and this pattern has remained relatively stable in the last decade (Reich and Ruipérez-Valiente, 2019[19]). MOOCs have managed to reach individuals from countries outside of the United States. For instance, in 2013, 29% of HarvardX-MITx viewers were from the United States and only around 7% came from Latin American and Caribbean countries (Figure 5.12).

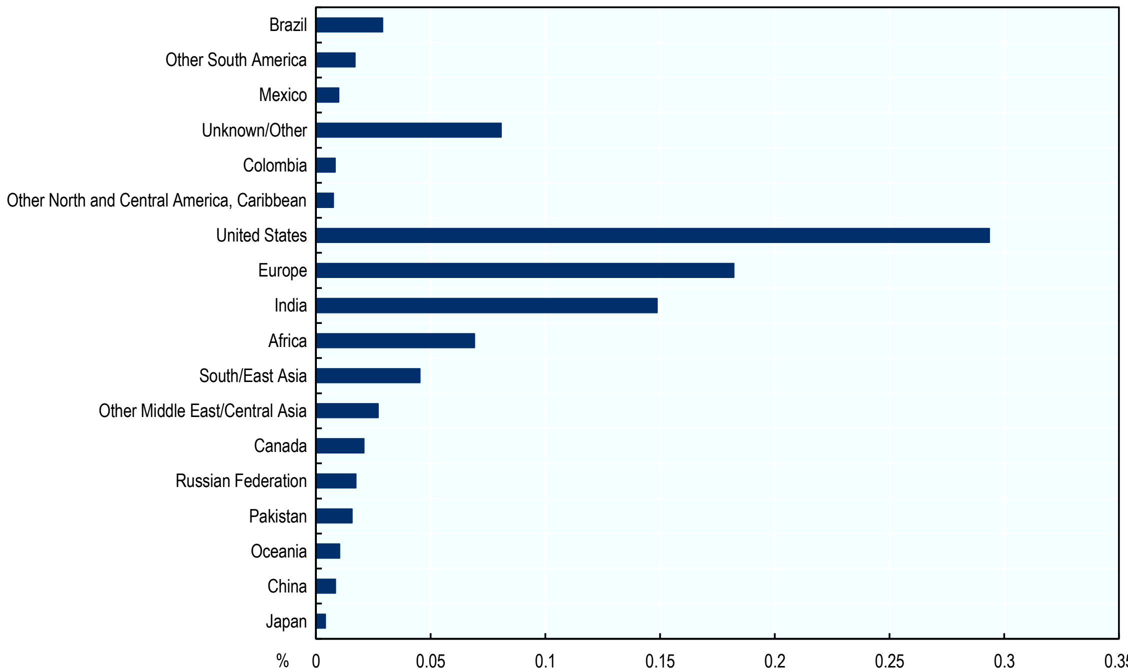
Nevertheless, on average between 2012 and 2018, 60% of MOOC enrolments have been represented by enrolments from countries with very high HDI, followed by an average of 20% of enrolments from countries with high HDI and another 20% from countries with medium HDI (Reich and Ruipérez-Valiente, 2019[19]). A large number of Latin American countries, including Brazil, Colombia, Costa Rica and Mexico, score 'high' in the Human Development Index, whereas only Argentina and Chile are rated as 'very high'. Latin American individuals have engaged in MOOCs but the number of enrolments likely remains below that of most OECD countries. The same patterns hold for MOOC certification rates that have been substantially higher in the most developed economies (Reich and Ruipérez-Valiente, 2019[19]).

In a similar vein to open education and standard forms of adult training, participation in MOOCs has tended to be higher among the highly skilled, highly educated and among individuals with higher socio-economic status. Data from 68 MOOCs ran by Harvard and MIT in 2012-2014 and gathering more than 160 000 participants from the United States showed that most MOOC participants came from more affluent and better-educated neighbourhoods (Hansen and Reich, 2015[21]). Among participants, young individuals from high socio-economic backgrounds were more likely to obtain a certificate. In fact, most MOOC participants are around 30 years old (Music, 2016[22]). A different survey provided evidence that more than 70% of MOOC participants held a Bachelor's degree (Chuang, 2017[14]). As expected, having strong digital skills also enhances MOOC participation, suggesting that skills are an important source of divide in the use of and benefits that can be derived from new digital learning opportunities (Castaño-Muñoz et al., 2017[23]; Castaño Muñoz, Punie and Inamorato dos Santos, 2015[24]).

Latin American countries display a similar pattern of participation in MOOCS. Data from edX MOOC participants in 2012-2013 showed that in Latin America, most MOOC participants were very young (the median age of participants was 26 years old), mostly men (76%), holding a Bachelor or a Master's degree (more than 60% of participants) (Music, 2016[22]). Evidence from the MOOC programme of the Inter-American Development Bank (IDBx) between 2014 and 2017 provided a similar picture of participation skewed towards the younger, more-educated individuals (González et al., 2017[25]). However, subjects covered by IDBx were more specific as they focused on development-related topics and hence, were more likely to attract participation from individuals with higher levels of education (Box 5.3).

Figure 5.12. MITx and HarvardX MOOC viewers in 2013

Share of MOOC viewers, by country/region among all MOOC viewers



Source: Adapted from MITx And HarvardX (2014[26]), "HarvardX-MITx Person-Course Academic Year 2013 De-Identified dataset, version 1.0", http://dx.doi.org/10.7910/dvn/26147.

StatLink https://doi.org/10.1787/888934136212

Box 5.3. Evidence from the IDBx MOOC programme in Latin America

González et al. (2017[25]) provide evidence on MOOCs offered by the Inter-American Development Bank on edX. These MOOCs covered development-related topics (e.g. management for development results, sustainable development of cities, pensions).

As in the case of MOOCs provided by more general MOOC platforms, completion rates for IDBx were low (9% of enrolled individuals). Most MOOC participants came from Colombia, Peru, Mexico and Ecuador. Accounting for the size of the each country's economically active population displayed a different ranking, with Barbados, Costa Rica, Ecuador and Peru being top countries in terms of enrolment.

More than half of MOOC participants were aged between 26 and 39 years old and 70% had at least a Bachelor's degree. Given the type of topics covered by IDBx, most MOOC participants were development practitioners and 33% of them worked in the public sector. A survey ran on a sample of more than 6 000 learners showed that more than 90% of survey respondents considered the MOOC to have had a positive impact on knowledge and skills for their current job.

Source: González, E. et al (2017[25]), *A Glimpse on How MOOCs from IDB are Impacting Learners in Latin America, Proceedings of the International Conference MOOC-MAKER 2017, Antigua Guatemala, Guatemala, 16-17 November 2017*, http://ceur-ws.org/Vol-1993/7.pdf.

The initial promise of MOOCs has revolved around the expansion of access to education and learning for those who would otherwise not engage in higher education or adult training (Reich and Ruipérez-Valiente, 2019[19]) or who could only access education or training of low quality.[7] Nevertheless, the provision of MOOCs has progressively shifted from a model based on free online courses to the delivery of micro-credentials and increasingly, paid fully online degrees (Shah, 2018[27]). This development is likely to benefit even more those who have the resources and the skills to engage in such programmes. There is still scope for MOOCs to reach less-skilled individuals or outsiders of formal education systems who would mostly benefit from additional training opportunities brought by new technologies. Policies that develop individuals' access to high-quality ICT infrastructure and digital competence are first steps in supporting the expansion of access to participants who may lack the resources and computer skills to be able to access MOOCs. Behavioural interventions have been shown to be successful at enhancing MOOC efforts and completion (Box 5.2), thereby increasing the motivation, the chances of success and therefore the attractiveness of MOOCs for those in search of additional training opportunities. In a similar vein, the provision of MOOCs in a larger number of languages allows reaching a larger audience.

The availability of data and information on MOOCs effectiveness and quality would equally support an expansion in participation, for instance, by facilitating the use of MOOCs by companies to train their workers. Evidence on the effect of MOOCs on skills development is still lacking, especially since individuals take MOOCs for different reasons and the exact role MOOCs play relative to other forms of education provision is difficult to establish (Escueta et al., 2017[15]). Survey data tend to show that many employees see MOOCs as a useful tool to develop skills for their current job (Hamori, 2018[28]; Gonzalez Vazquez et al., 2019[29]), but the potential of MOOCs for employee professional development remains to be further exploited (OECD, 2019[2]). A close collaboration between governments, social partners, MOOC platforms and education and training providers is needed in order to better assess the quality of MOOCs and facilitate the recognition and certification of skills acquired through MOOCs (OECD, 2019[2]). Online certificates, badges, portfolios, nanodegrees are only a few examples of the many certification opportunities brought about by new technologies. Making certification easier and more accessible, as well as enhancing support participants receive while they engage in MOOCs can further enhance individual incentives for participating in this type of learning activity. In addition, defining standards and good practices for certification, and integrating acquired certificates in national qualification frameworks can also enhance the recognition and certification of skills acquired though digital learning opportunities (OECD, 2019[2]).

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Notes

[1] Similar results are found for other emerging economies such as Turkey and the Russian Federation.

[2] For Latin American countries, participation in open or distance education is likely to capture also adults' participation in MOOCs. The OECD Survey of Adult Skills (PIAAC) collected data in three rounds, with most OECD countries being surveyed in 2012, while Latin American ones being surveyed in 2015 (Chile) and 2017 (Ecuador, Mexico and Peru). It is likely therefore that data from later rounds of the survey also reflect participation in MOOCs, whereas in 2012, MOOCs were only in their early stages (OECD, 2019[2]).

[3] MOOC followers are more likely to procrastinate since an instructor is not following them. Patterson (2018[30]) examines the effect of commitment devices making students pre-commit to time limits in Internet activities that could be distracting for them. Students who had the commitment device devote 24% more of their time to working on the course in comparison to students in the control group.

[4] Kizilcec et al. (2017[18]) define social threat as the "fear of being seen as less capable because of one's group".

[5] Mind-set interventions are interventions that target "students' attitudes, beliefs, and dispositions as key factors that can support or inhibit student success" (Snipes and Tran, 2017[32]) in order to enhance student outcomes (Escueta et al., 2017[15]).

[6] The Human Development Index is a composite index based on indicators of life expectancy, education and per capita income indicators.

[7] For instance, Colombia has a relatively large number of low-quality private "garage universities" attended mostly by disadvantaged students (OECD, 2019[31]).

OECD Skills Studies

Making the Most of Technology for Learning and Training in Latin America

Digitalisation is transforming the world of work and societies, and creating opportunities to learn and develop skills in new ways, times and places. The adoption and use of digital technologies can help Latin American countries close the skills gap with more advanced economies. *Making the Most of Technology for Learning and Training in Latin America* demonstrates how Latin American countries can realise the potential of new technologies for skills development in schools and all stages of life. It identifies barriers to accessing ICT infrastructure and connectivity limitations in Latin America, and provides recommendations on how they can be overcome to ensure that all students and citizens can benefit from new technologies for learning. The report explores the relationship between technology use in initial education and students' performance in Latin America, and how policies can best support teachers as digital tools enter their classrooms. Digitalisation provides new opportunities for lifelong learning and this report examines the potential of open education and MOOCs in reaching those adults who are most in need of training in Latin American countries.

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