International Summit on the Teaching Profession

Teaching for the Future

GLOBAL ENGAGEMENT, SUSTAINABILITY AND DIGITAL SKILLS

OECD

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OECD
BETTER POLICIES FOR BETTER LIVES

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FOREWORD

In April 2023, the US Department of Education, the Organisation for Economic Co-operation and Development (OECD), and Education International are bringing education ministers, union leaders and other teacher leaders together for the International Summit on the Teaching Profession with the aim to better support the teaching profession in meeting the formidable challenges of 21st century education.

One of the secrets of the success of the International Summit on the Teaching Profession is that it explores difficult and controversial issues on the basis of sound evidence, provided by the OECD as the global leader for internationally comparative data and analysis. This report provides the background for the Summit.

The first session of the Summit examines ways to elevate and enhance the teaching profession. Some countries face dire teacher shortages while in others the teaching profession continues to be an attractive career choice. These differences among countries are not simply explained by teacher salaries or material conditions, thus making this a promising field for peer learning and policy dialogue.

The second session looks at ways to educate global and cultural competence as well as civic engagement. For many countries, this has become a major issue to ensure students are better prepared to succeed in an interconnected world and to counter rising economic, social, political and cultural polarisation.

The third session explores ways to leverage digital technologies to ensure equitable access and enhanced learning. The COVID-19 pandemic fundamentally transformed learning by forcing schools worldwide to find alternatives to face-to-face instruction by engaging with the digital world. The Summit provides an opportunity to explore how countries are progressing towards reconciling the potential opportunities and risks of digital technologies with the social and relational nature of learning.

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The report is based on information and extracts from a number of publications including the OECD's Programme for International Student Assessment (PISA), in particular the PISA assessment of Global Competence, the OECD's Teaching and Learning International Survey (TALIS), OECD's publication World Class, the 28th edition of OECD's Education Policy Perspectives, OECD's report Education in the Digital Age: Healthy and Happy Children, OECD's Review of the Effectiveness of Resource Utilisation in School and the OECD Digital Education Outlook.

The report was edited by Duncan Crawford and designed and laid out by Della Shin with communications support from Rachel Linden and Stephen Flynn.

TABLE OF CONTENTS

FOREWORD 3
ACKNOWLEDGEMENTS 4

CHAPTER 1 INTRODUCTION 7
Future-proofing education 8
Education for a new social contract 12
Digital transformation 12
Reimagining the purposes of education 13
Diversifying landscapes of education and skills 13
References 14

CHAPTER 2 ELEVATING AND ENHANCING THE TEACHING PROFESSION 15
Rising expectations 16
Attracting high-quality teachers 16
Educating high-quality teachers 20
Updating teachers' skills 25
Supporting professional discretion 28
Creating a culture of sharing 28
Owning their profession 29
Cultivating effective system leadership 31
Teacher leadership provides an essential starting point 32
References 34

CHAPTER 3 EDUCATING FOR GLOBAL AND CULTURAL COMPETENCE AND CIVIC ENGAGEMENT 37
What schools can do to support learning about global issues 40
Securing equitable opportunities for students to develop global skills 42
Promoting an inclusive learning environment 46
Supporting teachers 48
The parent factor 49
Communities can also play an important role 50
The role of multilingual skills 53
References 54

CHAPTER 4 **LEVERAGING THE POTENTIAL OF DIGITAL TECHNOLOGIES IN EDUCATION** 55

The promise of digital technologies ... 56
Raising effectiveness ... 58
Improving equity ... 61
Leveraging efficiency ... 64
Smart technologies as socio-technical systems ... 65
Algorithm accuracy ... 67
Designing for use ... 68
Smart technology and data governance: transparency, fairness and ethics ... 70
Encouraging innovation inside and outside of school ... 72
References ... 74

FIGURES

Figure 1.1 Time spent on the Internet ... 9
Figure 1.2 Task-oriented navigation activities ... 10

Figure 2.1 In some countries, most teachers feel their work is not valued by society ... 18
Figure 2.2 Teachers are neither more nor less skilled than the average college graduate ... 19
Figure 2.3 Student performance is related to, but not dependent on, teachers' skills ... 20
Figure 2.4 Teachers' sense of preparedness for different elements of teaching (ISCED 2), 2018 ... 21
Figure 2.5 Informal exchange is more common among teachers than deep professional collaboration ... 27
Figure 2.6 Feeling effective as a teacher is linked to collaborating with colleagues ... 27

Figure 3.1 Countries' and economies' relative performance in global competence ... 39
Figure 3.2 Multicultural learning at school ... 41
Figure 3.3 Differences in relative performance in global competence, by gender ... 42
Figure 3.4 Students' awareness of global issues ... 44
Figure 3.5 Students' cognitive adaptability ... 45
Figure 3.6 Principals' views on teachers' multicultural beliefs ... 46
Figure 3.7 Students' perception of discrimination at school ... 47
Figure 3.8 Perception of discrimination at school and students' respect for people from other cultures ... 48
Figure 3.9 Teachers' need for professional development in teaching culturally diverse students ... 49
Figure 3.10 Students who reported having contact with people from other countries at school ... 51
Figure 3.11 Contact with people from other countries, and attitudes towards global issues ... 52
Figure 3.12 Students who learn multiple foreign languages at school ... 54

Figure 4.1 Students who use computers at school the most score the lowest in reading digital and printed text ... 57
Figure 4.2 Digitalisation at the Luwan No 1 Central Primary School in Shanghai ... 60
Figure 4.3 The "digital classroom" system at Tongji University's first demonstration high school ... 60
Figure 4.4 Access to a computer linked to the Internet at home for doing schoolwork, by school's socio-economic status ... 62
Figure 4.5 Relationship between access to digital resources at home and emergent aspects of reading ... 63

BOXES

Box 2.1 HertsCam Network supporting non-positional teacher leadership internationally ... 32
Box 3.1 Colombia – Peace and global citizenship education – Policy leaders and scholars ... 40
Box 4.1 Integrating AI and learning analytics in school: examples from China ... 59
Box 4.2 Personalisation in maths homework can help reduce the achievement gap: a US study ... 64

01
INTRODUCTION

This chapter discusses the future of learning, challenges to policy makers and the need to radically reimagine how education systems function in the decades to come.

FUTURE-PROOFING EDUCATION

Unless you have been living under a rock or shut yourself off from all communication with the outside world, you will have probably heard of the film *Don't Look Up*. Equally acclaimed and panned by audiences and critics, the movie tells the story of two scientists, played by Leonardo DiCaprio and Jennifer Lawrence, who discover a super-sized comet is on a collision course with Earth and the difficulties they face in convincing politicians and the media of the threat.

The satire is a vivid critique of governments' inadequate response to climate change and there are real world lessons for us all. Rising temperatures, digital technologies and globalisation have disruptive implications for economies and societies, and those implications are not predetermined. It is the nature of our collective responses to these disruptions that determines their outcomes – the continuous interplay between the technological frontier and the cultural, social, institutional and economic agents that we mobilise in response. Predicting the future is always uncertain, but the better we become at imagining and anticipating multiple versions of the future, the better we can prepare for what eventually comes to pass.

The OECD has long advocated future-thinking in policy making to prepare for shocks and surprises – be it climate change, digitalisation or pandemics. This is important because the future will almost always surprise us. For a start, intangibles are the driver of today's economy, and since intangibles are all about knowledge and skills, it makes education central. An example of their power is the growth of tech companies compared to the declining revenue of the traditional companies that dominated the Fortune 500 decades ago. The great thing is that unlike tangible assets, knowledge can be used repeatedly and in multiple places at the same time, and that explains the rapid growth companies focused on intangibles. In education, we should ask ourselves what knowledge and skills are needed for participating in an increasingly intangible economy in which the kinds of things that are easy to teach and test have also become easy to digitise and automate. What knowledge, skills, attitudes and values do we need for generating new ideas and products? Or for organising and governing new ways of working and producing? And what is the role of new technologies in facilitating learning?

Over time, we have also seen a shift in the way we use our time towards leisure and family, data for most countries show that we work less, even if it sometimes doesn't quite look so. Can education help individuals, young and old, to develop the knowledge and skills needed to engage meaningfully across all aspects of life?

The digital world is revolutionising the way people work. While in the past our location and physical bodies anchored our identity and relationships, we can now create virtual profiles to suit any purpose and share these with anyone, anywhere. Social media and interest-based platforms have expanded exponentially, giving people tools with which to grow their networks and find support, express themselves, experiment with desired identities, and selectively self-present. However, these opportunities also raise questions about safety, transparency and the boundaries between exploration and manipulation. Teachers must learn to better leverage these new opportunities, while also helping individuals learn to ethically and responsibly participate in evolving digital environments.

Knowledge also means power. Whereas only an elite few produced traditional encyclopedias or the mass media of the 20th century, today's social media and Internet sites like Wikipedia are fed by the masses. For example, the number of wiki pages grew from about 10 000 to over 250 million in just 20 years. This barrage of information has created new challenges. Students were already spending more than 35 hours per week online on average across OECD countries, according to 2018 PISA data (Figure 1.1). However, very few countries are doing enough to ensure students are prepared for the digital world. PISA data shows that Korea, Singapore and parts of China are the only jurisdictions where more than

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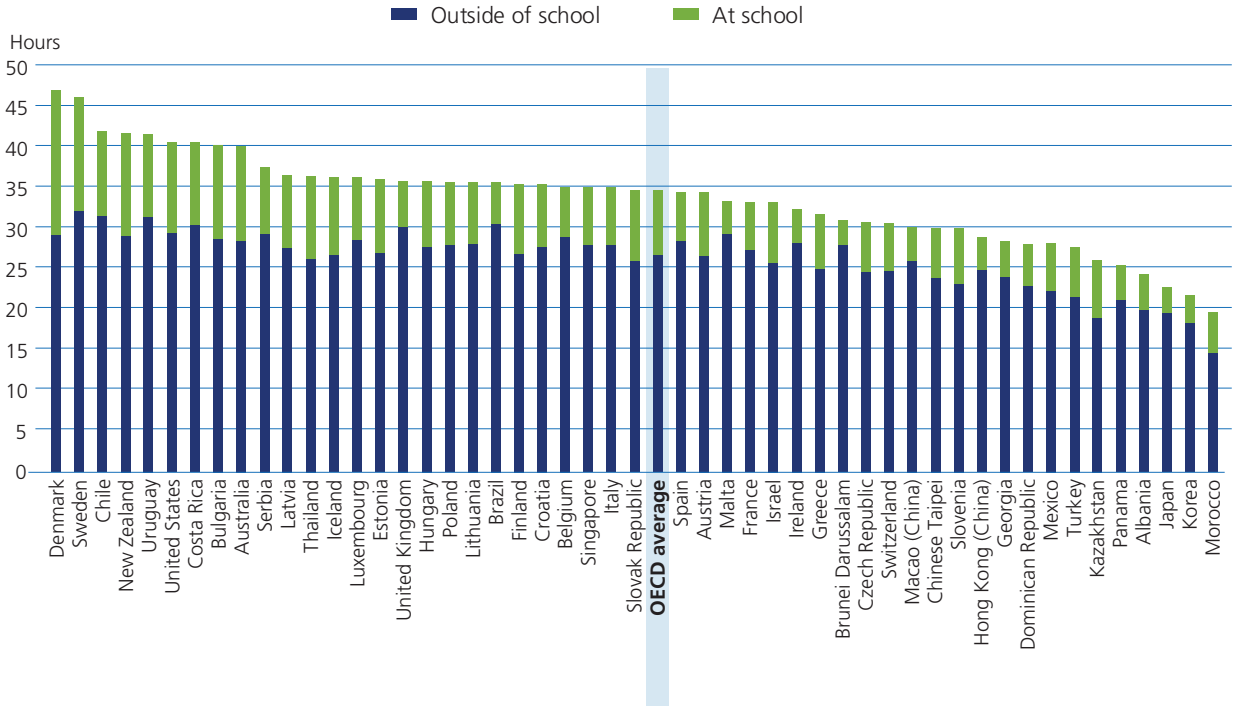
half of 15-year-olds are able to perform tasks such as identifying fake news or reconciling different sources of information (Figure 1.2). In most countries with comparable data, the majority of students have limited digital navigation skills. Many do not even have the basics. So how can we better support all individuals to access and use knowledge effectively? What types of education are needed to enable students, teachers and education leaders to do that effectively? And what (digital) skills and attitudes are needed to effectively evaluate the quality and trustworthiness of information? How can we support teachers to validate the knowledge they use in their practice? Our social circles also influence our access to knowledge. Should educational institutions work more actively to strengthen (digital) social ties? If so, how?

One thing is clear: in this age of digital transformation and artificial intelligence, we need to think harder about what makes us human and how we complement, not substitute, new technologies being developed.

The conventional approach in education is often to break problems down into manageable bits and pieces and then to train students how to solve these different areas. But modern societies create value by integrating different fields of knowledge, making connections between ideas that previously seemed unrelated, building bridges between varied ways of thinking and different cultures, and then connecting the dots to create innovative new approaches.

Figure 1.1 **Time spent on the Internet**

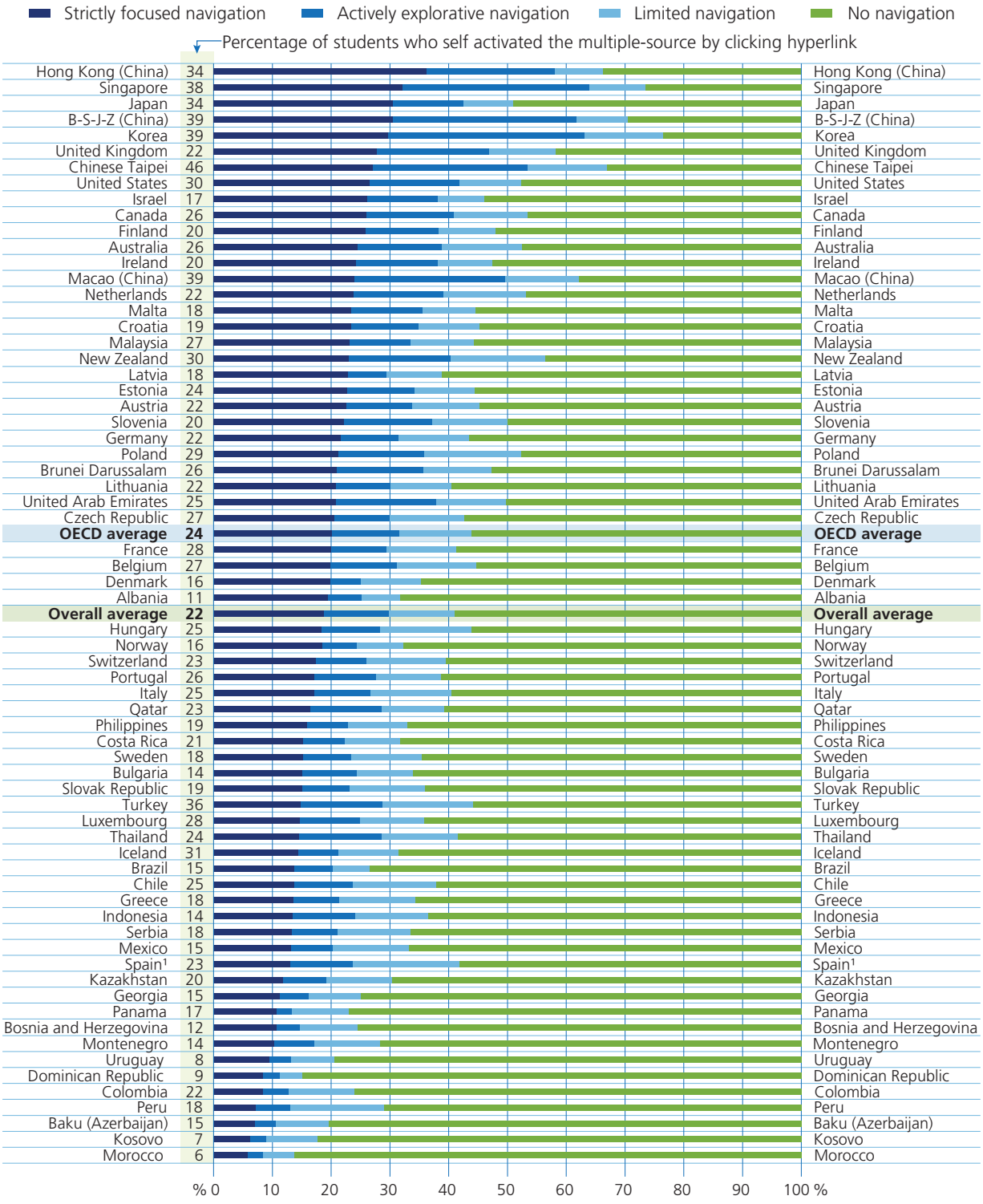
Number of hours per week spent using the Internet



Countries and economies are ranked in descending order of the total number of hours per week spent using the Internet.

Source: (OECD, 2018[1]), PISA 2018 Database, Tables B.1.1 and B.1.2.

Figure 1.2 Task-oriented navigation activities



Notes: This Figure shows the average rank of students in the international comparison of students taking the same test unit of Rapa Nui.

1. In 2018, some regions in Spain conducted their high-stakes exams for tenth-grade students earlier in the year than in the past, which resulted in the testing period for these exams coinciding with the end of the PISA testing window. Because of this overlap, a number of students were negatively disposed towards the PISA test and did not try their best to demonstrate their proficiency. Although the data of only a minority of students show clear signs of lack of engagement (see PISA 2018 Results Volume I, Annex A9), the comparability of PISA 2018 data for Spain with those from earlier PISA assessments cannot be fully ensured.

Countries and economies are ranked in descending order of the percentage of students in strictly focused navigation group.

Source: (OECD, 2018[1]), PISA 2018 Database, Table B.3.9.

In the past, the use of technology in schools was frequently limited to supporting and conserving existing practices. In contrast, students have often been early adopters of technology, outpacing their learning environments. Schools need to catch up. They need to use technologies to liberate learning from past conventions and connect learners in new and powerful ways, with sources of knowledge, and with innovative applications.

For too long, schools have been divided in a multitude of ways. Teachers and content divided by subjects, students separated according to expectations of their future career prospects; the rest of the world separate from daily school life with little engagement with families and a reluctance to partner with other schools. There needs to be a paradigm shift with the future focused on integration, where school culture concentrates on the inter-relation of subjects and the integration of students.

In today's schools, students typically learn individually and at the end of the school year we certify their individual achievements. But the more interdependent the world becomes, the more we need great collaborators and orchestrators. Schools need to help students learn to be autonomous in their thinking and develop an identity that is aware of the pluralism of modern living. At work, at home, and in the community, people will need a broad understanding of how others live, in different cultures and traditions, and how others think, whether as scientists or as artists. The foundations for this don't all come naturally. We are all born with "bonding social capital", a sense of belonging to our family or other people with shared experiences, common purposes or pursuits. But it requires deliberate and continuous effort to create the kind of "bridging social capital" through which we can share experiences, ideas and innovation with others, and increase our radius of trust to others.

Data also highlights that meeting the global goal of net zero emissions by 2050 will require bold action. For example, in the field of energy, as demand for renewables has risen and related technology has improved, the cost of renewables has fallen. However, we continue to burn fossil fuels like coal, oil and natural gas at an unsustainable rate and the world's carbon footprint keeps growing.

More must be done to fight against climate change and education has a pivotal role to play. Education is key to providing all citizens with an understanding of the science behind the climate crisis, as well as its socio-demographic, political and ethical implications. Vocational education and training (VET) can equip young and adult learners with the skills needed for greener jobs. Moreover, education can make a fundamental contribution by offering learners the space to take direct action in their communities while fostering pro-environmental attitudes and behaviours.

Education and training systems must support people to continuously learn, unlearn and relearn as we transit towards "greener" economies and societies. In parallel, research systems must engage in the kind of long-term, risk-taking research that is needed to find innovate solutions to the current unsustainable global growth model, while also ensuring shared prosperity for all.

Furthermore, as large employers and consumers, education systems must "green up" their infrastructure and operations, enhancing their environmental performance while preparing for challenges such as the increased likelihood and severity of events like floods and droughts. These are not issues from a distant future; they are happening now.

Whether you're a fan or not, *Don't Look Up* raises an important message and reminds us that in our global and interconnected world, incremental threats like climate change as well as abrupt systemic disruptions like COVID-19 will continue to challenge our ways of living, working and learning. Most importantly, the film shows that those with vested interests can mislead the public, and that we must not wilfully look away from tackling complex issues.

EDUCATION FOR A NEW SOCIAL CONTRACT

For those with the right knowledge and skills, digitalisation and globalisation have been liberating and exciting. New jobs, new markets and more life choices are just some of the opportunities. But for those insufficiently prepared for this new world, that can mean vulnerable and insecure work with few prospects. Economies are shifting towards becoming regional hubs of production, linked together by global chains of information and goods, but concentrated where comparative advantage can be built and renewed. This makes the distribution of knowledge and wealth crucial, which is intimately tied to equity in the distribution of education opportunities.

Education is widely recognised as having unique potential to reduce inequality and build strong foundations for inclusive and democratic societies. However, in several OECD countries, upward social mobility has become more difficult to achieve. In fact, the fear of downward social mobility is becoming more common in the middle classes. And large parts of the population seem to have lost faith in the "social contract" of the 20th-century welfare state of which public education is a key component. In this context, trust in school systems falters. That can potentially mean young people from vulnerable backgrounds no longer invest their time and energy in schooling. Beyond education, people who have lost trust in the "social contract" are at risk of becoming disillusioned with the "system", embracing populism and turning away from democracy.

Education is still the main institutional framework that keeps societies together. By instilling a common canon of knowledge, shared behaviours and collective social values, education develops shared identities and a sense of belonging that facilitates citizens' active engagement in democratic processes. Education's role in safeguarding democracy, however, goes much further. Literature has identified several dimensions of civic engagement that education can foster. For example, by providing knowledge about political processes and other forms of civic engagement, promoting trust in society, and encouraging tolerance towards different cultures and viewpoints (OECD, 2022[2]).

It should also be acknowledged that while education has unique potential to reduce inequality, it can also amplify inequality when educational opportunities are not fairly distributed within societies. Evidence shows that education contributes to the transmission of advantages and privileges from one generation to the other. This is to be kept in mind when personalised learning rises in importance because it disrupts the "one-size-fits-all" approach of schooling that was dominant until now. Another dimension contributing to the status quo of inequities that needs re-assessing is school selection driven by the residential area or social background of families.

DIGITAL TRANSFORMATION

To keep pace and anticipate the impact of technological change requires vision, boldness and courage from leaders and policy makers, as well as capacity on the ground. AI, cloud computing, big data, the Internet of Things, virtual reality, and other forms of digitalisation are fundamentally reshaping the world. The future looks increasing digital with enhanced connectivity, disruptive digital business models, mostly automated physical production, increasingly virtual work, and digitised global trade. All this will transform businesses and markets, the nature of work and the demand for skills, as well as the ways in which people participate in physical or virtual communities and engage in personal relationships. Digitalisation affects security and privacy as well as health and well-being, particularly among children.

This transformation has led to an abundance of information that is easy to spread instantaneously and globally, and has upended traditional sources of news. In particular, the spread of mis- and disinformation poses a fundamental threat to the fact-based exchange of information that underpins democracy.

This development further highlights the need to equip people with media and digital literacy skills, and advance critical thinking skills and ethical judgment, to navigate and understand the world around them. This is a priority for OECD.

Increased use of digital tools in education is one of the legacies of COVID-19 school closures. However, much more can be done. Digital technologies can create new learning opportunities for those who struggle to enrol in formal education. These include older people, youth who are not in employment, education, or training (NEETs), and people with special needs. Technology can also enable educators and learners to access knowledge in multiple formats, and in ways that bridge time and space and often at a lower cost.

One distinguishing feature of digital technologies is that besides serving individual learners and educators, they can build an ecosystem of learning predicated on collaboration. Technology can build communities of learners that make education more collaborative, thereby enhancing goal orientation, motivation, persistence, and the development of effective learning strategies. Similarly, technology can build communities in which educators share and enrich educational resources and practices, and collaborate on professional growth and the institutionalisation of professional practice. It can also help system leaders and governments develop and share best practice around curriculum design, policy, and pedagogy. It can also bring education providers and employers closer together, which is particularly important for vocational education and training.

REIMAGINING THE PURPOSES OF EDUCATION

Digitalisation will open hitherto unknown possibilities. Digital technologies do not merely impact our jobs, communities and lives but can also reproduce human capabilities. Smart machines and bio- and neurotech can empower people with enhanced cognitive and sensory capabilities. This raises questions about whether biological and computer engineering will render some forms of human activity redundant and decouple intelligence from consciousness. Digital technologies invite people to think of the ways to best integrate and collaborate with them and reinforce the most "human" parts. This has profound consequences for the purpose of education.

Knowledge about education is turning into the most valuable resource for education itself. Indeed, the growth in science and research is also enhancing the transformative capacity of education systems. New knowledge about education is created at a very rapid pace, renewing the knowledge base on which education thrives. A new "science of learning" is growing, composed of building blocks from cognitive psychology, neuroscience, brain research and social psychology. This offers major opportunities for education systems to re-think their purpose, design, and delivery.

DIVERSIFYING LANDSCAPES OF EDUCATION AND SKILLS

Learning as a fundamental human activity is not bound by space and time. Institutionalised settings remain important in providing spaces and opportunities for learning, but the value proposition of traditional educational institutions is under increasing scrutiny and there are questions as to whether they deliver education that is aligned with real world needs. As the demand for lifelong learning opportunities continues to rise, technology will make it easier to access learning remotely as well as enable learning outside of formal education systems.

At the same time, there is an increasing recognition of diverse actors in society offering learning opportunities. Families and personal social relations – which are themselves under constant transformation – constitute important learning settings which schools must take into account. Social institutions such

as health and welfare systems, politics, religion, traditional and social media, and many other aspects of modern society, will play an ever more important role in socialising people and providing spaces for learning. Employers play a crucial role in lifelong learning by providing continuous professional training and informal learning in the workplace, as well as engaging in social dialogue about the purpose, relevance, and substance of education. Moreover, employer engagement is at the heart of effective career guidance for young people, amplifying labour market signalling and enabling progression towards attractive employment.

The blurring of the clear line between acquiring knowledge and skills (in educational institutions) and applying them (in society and workplaces) is an opportunity to make learning more relevant, authentic, and engaging. Developments like ChatGPT also remind us that the capacity of students to ask good questions is at least as important as learning answers For formal education in educational institutions, such as schools and universities, increased collaboration with other actors in society offers an important avenue for re-inventing themselves, which has potential for significant benefits to learners.

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02

ELEVATING AND ENHANCING THE TEACHING PROFESSION

This chapter examines ways of attracting and supporting the development of high-quality teachers and teaching practices. It draws on results from the OECD Programme for International Student Assessment (PISA), the OECD Teaching and Learning International Survey (TALIS), OECD's publication World Class, the 28th edition of OECD's Education Policy Perspectives, OECD's report Education in the Digital Age: Healthy and Happy Children, and OECD's Review of the Effectiveness of Resource Utilisation in School.

RISING EXPECTATIONS

Among the countries represented in the International Summit of the Teaching Profession (ISTP), Germany pays the highest salaries for experienced teachers, and yet the country faces major teacher shortages (OECD, 2022[1]). In Finland, salaries are below the OECD average and yet, applicants are queuing to become teachers. While, obviously, teachers need to earn a decent salary, there is no systematic cross-country relationship between salary levels and the attractiveness of the teaching profession, suggesting the need to look beyond material conditions when it comes to elevating and enhancing the teaching profession.

This has become an urgent matter as the demands on teachers rises exponentially. We expect teachers to have a deep and broad understanding of what they teach, whom they teach and how students learn, because what teachers know and care about makes such a difference to student learning. We expect them to be great instructors, coaches, mentors and designers of effective and innovative learning environments, as well as technology experts and data scientists. In vocational education and training, we also expect teachers to be experts in their field with up to date and hands-on industry skills and knowledge. We expect teachers to be passionate, compassionate and thoughtful; to make learning central and encourage students' engagement and responsibility; to respond effectively to students of different needs, backgrounds and languages, and to promote tolerance and social cohesion; to provide continual assessments of students and feedback; and to ensure that students feel valued and included in collaborative learning environments. And we expect teachers to collaborate and work in teams - and with other schools and parents - to set common goals, and plan and monitor the attainment of those goals. That is a lot of expectations. No wonder many teachers might feel daunted by the tasks before them.

Not least, students are unlikely to become lifelong learners if they do not see their teachers as active lifelong learners, willing to extend their horizon and question the established wisdom of their times.

Teachers of today's "connected" learners must also meet the challenges that have arisen from digitisation, from information overload to plagiarism, from protecting children from online risks, such as fraud, violations of privacy or online bullying, to setting an adequate and appropriate media diet for their students. They are expected to help educate children to become critical consumers of Internet services and electronic media, to make informed choices and avoid harmful behaviours.

There are other aspects to teaching that make the job particularly challenging. Teachers need to be experts at multitasking as they respond to many different learner needs at the same time. They do their job in a classroom dynamic that is always unpredictable and that leaves teachers little time to think before reacting. How a teacher acts, even with just a single student, can be witnessed by all classmates and that can frame the way a teacher is perceived from that day forward.

But there is more. Most successful people had at least one teacher who made a real difference in their life – because the teacher acted as a role model, or took a genuine interest in the student's welfare and future, or provided emotional support when the student needed it. These aspects of teaching are difficult to compare and quantify, but designing a work organisation and support culture that nurtures these qualities will go a long way towards ensuring that every student succeeds.

ATTRACTING HIGH-QUALITY TEACHERS

Autonomous, self-directed, technology-supported learning will become more prevalent in the future. Nevertheless, learning is a social experience that happens through interactions. Therefore, education systems need to better recognise, enable, and articulate the roles and functions of educators, whether they are teachers, trainers, coaches or other professionals in workplaces, or tutors and peers.

In formal education teachers are professionals who design and engineer learning environments and learning processes, and support learning through a variety of professional interventions. They need deep knowledge and understanding of the content that they teach and how learning happens. But they also face increasing demands to use and interpret ever more sources of data and keep ahead of the curve on rapidly developing teaching and facilitation tools and techniques as well as supporting learners in their well-being. Developing teaching as a profession is an important public policy objective. This includes recruiting and retaining effective teachers; providing them with initial education and continuing professional development; offering induction and mentoring when entering the profession; establishing attractive career structures with appropriate financial compensation; regulating working conditions; and safeguarding the attractiveness and reputation of, and the social trust in, the teaching profession.

The quality of an education system can never exceed the quality of its teachers. So attracting, developing and retaining the best teachers is a key challenge education systems face. To meet that challenge, governments can look to corporations to see how they build their teams. They know that they have to pay attention to how the pool from which they recruit and select their staff is established; the kind of initial education their recruits get before they present themselves for employment; how to mentor new recruits and induct them into their service; what kind of continuing education their employees get; how their compensation is structured; how they reward their best performers and how they improve the performance of those who are struggling; and how they provide opportunities for the best performers to acquire more status and responsibility.

When any industry or organisation recruits professionals, they will do whatever is possible to create a pool of potential employees that comes from the highest-performing segment of the population. Most firms and industries rely heavily on the exam system, schools and universities to sort the calibre of candidates. That is why top Japanese ministries often recruit from Tokyo University, while major Wall Street law firms mainly offer roles to graduates from Harvard, Yale and Stanford. They target these institutions because they believe they are good at recognising the most talented young people, not because of any specific knowledge or skills their graduates can offer. However, no industry can afford to source all of its professionals from the highest-performing segment of graduates, which is why they also structure their operations so the best of the best get key positions and others, who might not be quite as good, are placed in supporting roles.

So what shapes the pool from which industry selects its professionals? Generally it is a combination of the social status associated with the job, the contributions a candidate feels he or she can make while in the job, and the extent to which the work is financially and intellectually rewarding.

The status of the teaching profession in a country has a profound impact on who aspires to enter the profession. Teaching is a highly selective occupation in Finland, with highly skilled, well-educated teachers spread throughout the country. Few occupations in the country have a higher reputation. In the traditionally Confucian cultures, teachers have long had higher social status than most of their counterparts in the West. In some East Asian countries, teachers' pay is fixed by law to make sure that teachers are among the highest paid of all civil servants.

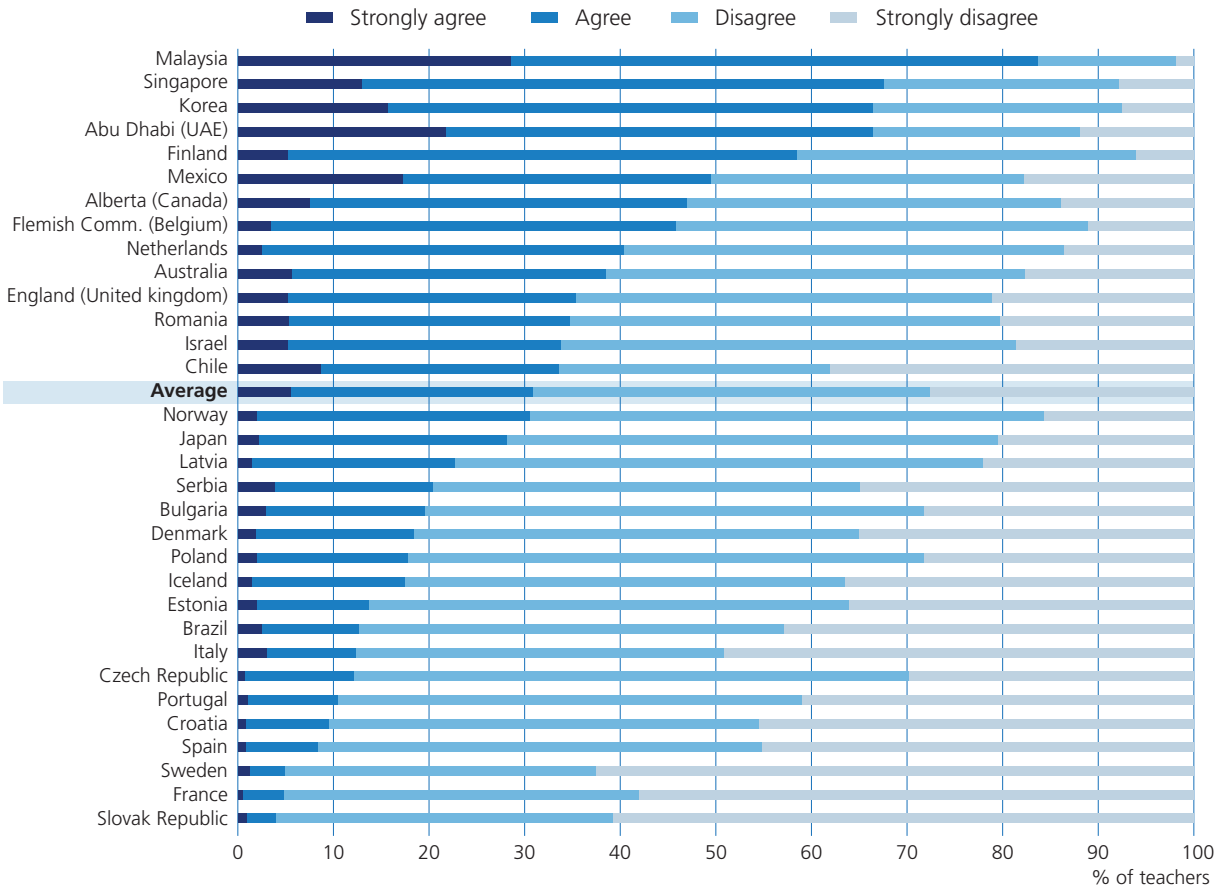
Singapore is notable for its sophisticated approach to improving the quality of the pool from which it selects candidates for teacher education. The government carefully selects its teacher candidates and offers them a monthly stipend, during initial teacher education, that is competitive with the monthly salary for fresh graduates in other fields. In exchange, these teachers-in-training must commit to teaching for at least three years. Singapore also keeps a close watch on starting salaries and adjusts the salaries for new teachers. In effect, the country wants its most qualified candidates to regard teaching as just as

financially attractive as other professions. PISA data show that schools in Singapore have comparatively limited leeway in making hiring decisions. But the principal of the school will join recruitment panels and weigh in on those decisions, well aware that wrong hiring decisions can result in decades of poor teaching. So it's not all just about your school, but about the success of the system.

While it is possible to make teaching more financially attractive, it tends to be much harder to make teaching more intellectually attractive. But it is the latter that is key to attracting highly talented individuals into the profession, particularly as many people who go into teaching do so to make a difference to society. It is hard because it depends on how the work of teachers is organised, the opportunities teachers have for professional growth, and how their work is regarded in the profession and by society at large (Figure 2.1).

Figure 2.1 **In some countries, most teachers feel their work is not valued by society**

Percentage of lower secondary teachers who "agree" or "strongly agree" with the following statement: I think that the teaching profession is valued in society

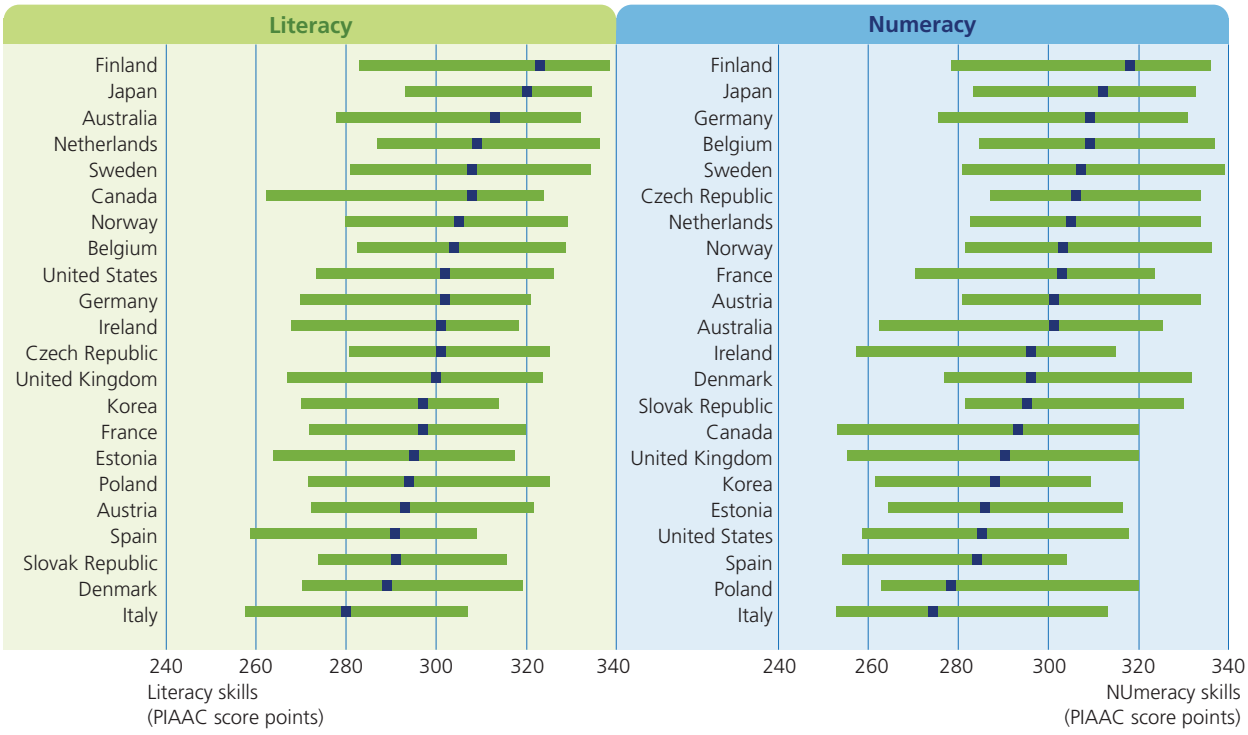


Countries are ranked in descending order, based on the percentage of teachers who «strongly agree» or «agree» that they think that the teaching profession is valued in society.

Source: (OECD, 2014[29]), TALIS 2013 Database, Tables 7.2 and 7.2. http://dx.doi.org/10.1787/888933042219

All this being said, the OECD Survey of Adult Skills shows that there is no country where teachers are drawn from the top third of the highest-achieving college graduates, at least when it comes to skills like literacy and numeracy that can be directly measured and compared (Figure 2.2). In fact, teachers tend to come out remarkably similarly to the average employee with a college or university degree. Interestingly, some of the countries where the skills of teachers do not compare favourably either internationally or with regard to the average college graduate (Poland is one such country) have seen the most rapid progress. That shows how recruiting top-performing graduates is only one component of improving education; the investments countries make in teachers' continued professional development are at least as important. Still, student learning outcomes are related to teachers' skills (Figure 2.3).

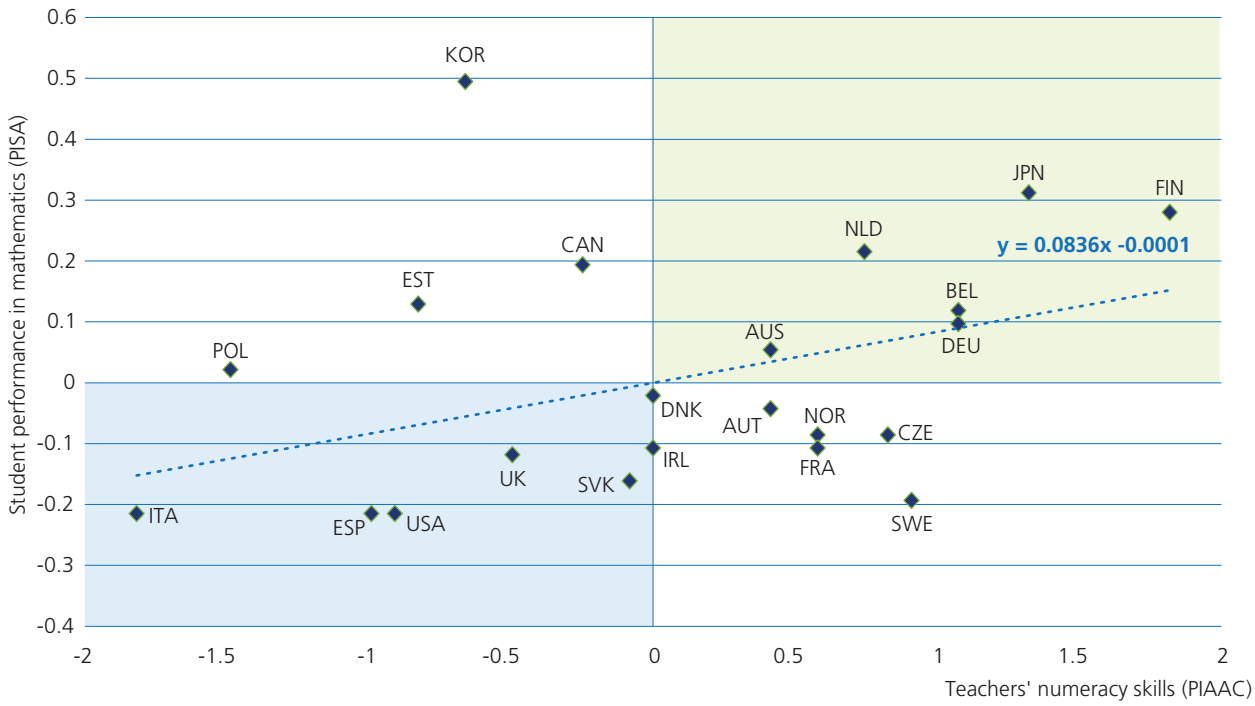
Figure 2.2 **Teachers are neither more nor less skilled than the average college graduate**



Note: The dark segment indicates median cognitive skills of teachers in a country. The horizontal bars show the interval of cognitive skill levels of all college graduates (including teachers) between the 25th and 75th percentile. Countries are ranked by the median teacher skills in numeracy and literacy, respectively.

Source: Adapted from Hanushek, Piopiunik and Wiederhold (2014[3]), *The Value of Smarter Teachers: International Evidence on Teacher Cognitive Skills and Student Performance.*

Figure 2.3 **Student performance is related to, but not dependent on, teachers' skills**



Source: Adapted from Hanushek, Piopiunik and Wiederhold (2014[3]), *The Value of Smarter Teachers: International Evidence on Teacher Cognitive Skills and Student Performance.*

EDUCATING HIGH-QUALITY TEACHERS

What makes an effective teacher? Education researchers Thomas L. Good and Alyson Lavigne summarise some of telling characteristics (Good and Lavigne, 2017[4]): these teachers believe their students are capable of learning and they themselves are capable of teaching; they spend the bulk of their classroom time on instruction; they organise their classrooms and maximise student learning time; they use rapid curriculum pacing based on taking small steps; they use active teaching methods; and they teach students until the students achieve mastery.

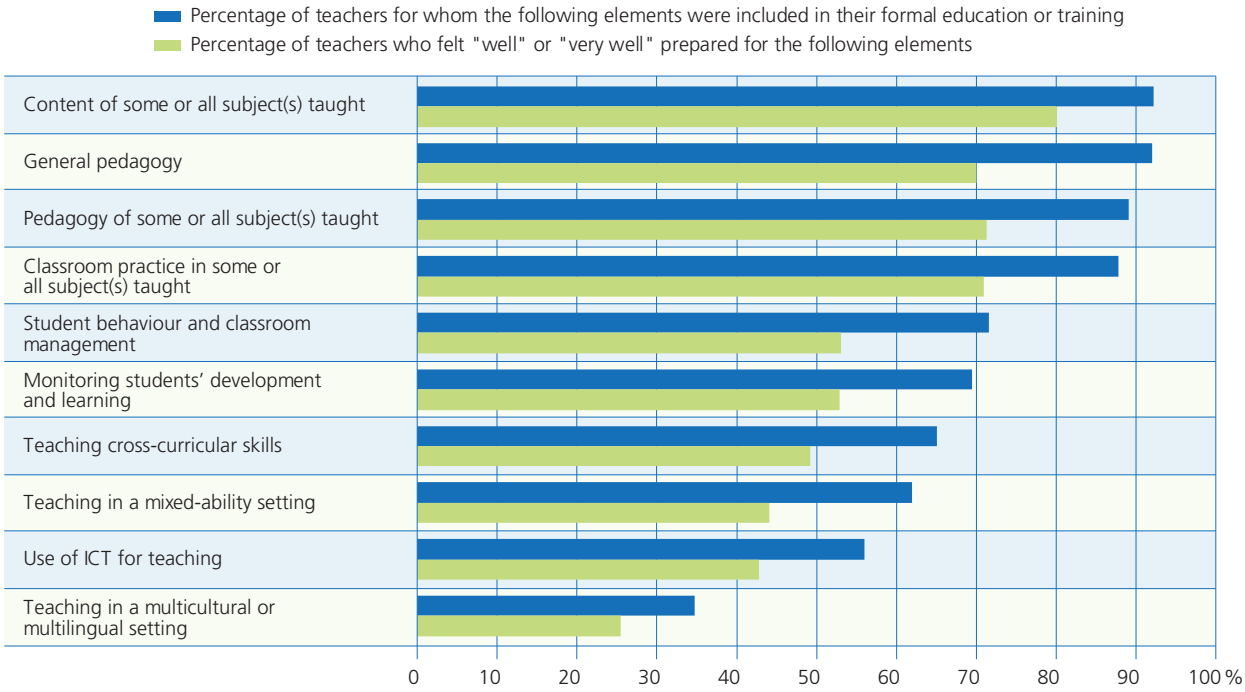
All of this requires high-quality preparation. The quality of initial teacher education therefore matters. In the 2018 TALIS survey, a large majority of lower secondary teachers report having received preparation in content, pedagogy and classroom practice for some or all of the subjects they teach.

Yet, at least one in two teachers in Austria, the Czech Republic, France, Iceland, Italy, Spain and Japan reports feeling underprepared for classroom practice, subject pedagogy or both (Figure 2.4) (OECD, 2021[5]). Teachers frequently struggle to engage students, to manage misbehaviour (Emmer and Stough, 2001[6]) and to transform complex subject-matter knowledge into pedagogical content knowledge (Hill, Rowan and Ball, 2005[7]); (O'Neill and Stephenson, 2012[8]); (Feuer, 2013[9]). This raises concerns about the relevance and effectiveness of initial teacher preparation and the efficient use of resources. Ensuring that teachers feel prepared for the classroom raises the likelihood of them staying in the profession (Ingersoll, 2014[10]), thus preserving systemic investments in the next generation of teachers, and reducing recruitment costs and potential detrimental effects on schools associated with turnover. A particular

challenge for VET teachers is that they need to be equipped with solid pedagogical skills and knowledge as well as industry skills and knowledge – and countries often struggle to find a good balance without making the requirements too demanding or inflexible. (OECD, 2022[11]).

Figure 2.4 **Teachers' sense of preparedness for different elements of teaching (ISCED 2), 2018**

Percentage of teachers who felt "not at all" or "somewhat prepared" for the following elements



Countries and economies are ranked in ascending order of teachers' sense of preparedness in pedagogy.

Source: (OECD, 2019[12]), *TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners,* Table I.4.20, https://doi.org/10.1787/1d0bc92a-en.

Although the evidence on key ingredients of effective teacher education remains limited, there is widespread agreement that effective initial teacher-education programmes must provide student teachers with opportunities to practice their skills in the classroom (OECD, 2019[13]); (Grossman, Hammerness and McDonald, 2009[14]). This successful integration of theoretical and practical components is a central challenge in initial teacher education, but many high-performing education systems have moved their initial teacher-education programmes towards a model based less on preparing academics and more on preparing professionals in classroom settings. This involves getting teachers into schools earlier, spending more time there, and receiving more and better support in the process. These programmes put more emphasis on helping teachers develop skills in diagnosing struggling students early and accurately, and adapting instruction correspondingly. They want prospective teachers to be confident in drawing from a wide repertoire of innovative pedagogies that are experiential, participatory, image-rich and enquiry-based. For vocational education and training, opportunities for practicing skills should involve both practicing teaching skills in a school-setting and developing industry skills in workplaces.

Still, the design of teacher training programmes and the amount and intensity of their practical components varies widely across education systems and different programmes (OECD, 2019[15]). Research indicates that to be most effective, practical experience should take place in schools with a strong culture of professional learning and a sheltered environment for prospective teachers to practice and develop their teaching skills with guidance and supervision (OECD, 2019[15]); (Ronfeldt and Reininger, 2012[16]).

Education authorities can play a role in identifying and supporting schools to provide a suitable learning environment for student teachers and set quality requirements (e.g. concerning the qualifications, experience or evaluation results of teacher mentors). They can also support the quality of initial teacher-education programmes by promoting the collaboration between institutions that prepare teachers for different levels of education so teachers can benefit from their respective strengths in theory or practice. In addition, teacher residency models, in which student teachers spend the majority of their time in school, are a promising way to integrate traditional university-based preparation with on-the-job learning, fostering an exchange between research-based approaches and the professional understanding of experienced teachers.

Several OECD countries and systems participating in OECD's School Resources Review have reformed their initial teacher-education programmes with these objectives in mind (OECD, 2019[15]):

- Since 2015/16, Austria has promoted the collaboration between two types of teacher-education institutions: University colleges of teacher education (Pädagogische Hochschulen, PHs), which train teachers for provincial schools and have closer ties to schools and practice, and universities, which train teachers for federal schools and have particular strengths in theory and research. This aims to ensure teachers can benefit from the best of both approaches.
- Portugal has developed a system to ensure the quality of teachers supervising teacher candidates during their initial teacher-education programmes. The participating teachers are required to have at least five years of experience and to be selected by a higher education institution. It is the institution's responsibility to screen for the quality of supervising teachers and to provide them with training in mentorship.
- In Uruguay, education authorities play an active role in identifying and supporting schools that provide a suitable learning environment for student teachers in primary education. Schools that are designated as practice schools (escuelas de práctica) by the central education authority serve as a practicum site for teacher candidates. Teacher mentors in these schools receive dedicated training for their role and additional compensation in the form of a salary allowance.
- In the United States, a few dozen teacher residency programmes have been set up since the early 2000s to integrate aspects of traditional and alternative teacher preparation pathways, modelled on the medical residency system. Residency programmes typically select teacher candidates to work alongside a mentor for a full year before becoming a teacher of record. Residents also complete coursework leading to both state certification and a master's degree from a partner university. In exchange for tuition remittance and a residency-year stipend, they commit to teaching in the district for a specified period, generally three to five years and often in hard-to-staff schools (OECD, 2019[15]). Most evaluation studies show improved retention outcomes for teachers entering the profession through these residencies, with potential but not definitive learning gains for students of teachers prepared through a residency (Papay et al., 2012[17]); (Guha, 2016[18]).

Beyond an effective integration of theoretical learning and school-based practice, there are other important elements of effective initial teacher training. One concerns the selectivity of teacher-education

programmes. There is an analogy from nature: frogs release a very large number of eggs in the hope that some of their tadpoles will survive and ultimately metamorphose into the next generation of frogs; ducks lay a few eggs, protect and warm them until they hatch, then defend their ducklings with their life. In a way, these different philosophies of reproduction are mirrored in the approaches towards teacher education in different countries. In some countries, teacher education is open to everyone, but it often becomes an option of last resort, and one with a high dropout rate. In other countries, teacher education is highly selective. In these countries, resources are focused on helping those who are admitted become successful teachers.

Many high-performing education systems have moved from using numerous specialised, low-status colleges of teacher education, with relatively low entrance standards, towards using a relatively smaller number of university-based teacher-education colleges with relatively high entrance standards and higher university status. By raising the bar to enter the teaching profession, these countries discourage young people with poor qualifications from becoming teachers. They understand that capable young people, who could go into other high-status occupations, are not likely to enter a profession that society perceives as easy to get into.

Finland has made teacher education one of the most prestigious academic programmes. There are typically more than 10 applicants for every place in Finnish primary school teacher education each year; those who aren't selected can still become attorneys or doctors. Applicants are assessed on the basis of their high school record and their score on the matriculation exam or university entrance exam. If they make it beyond the screening of their academic credentials, the selection process becomes even more rigorous. The candidates are observed in teaching-like activity and interviewed. Only those with a clear aptitude for teaching, in addition to strong academic performance, are admitted.

A combination of raising the bar for entry and granting teachers greater autonomy and control over their classrooms and working conditions has helped lift the status of the profession. Teaching remains one of the most desirable careers among young Finns. Finnish teachers have earned the trust of parents and the wider society, not least by showing that they can help virtually all students become successful learners.

In some countries the initial preparation of teachers includes instruction in research skills. Teachers are expected to use those skills as lifelong learners to question the established wisdom of their times and contribute to improved professional practice. Research is an integral part of what it means to be a professional teacher. In Finland every teacher finishes his or her initial education with a research master's-degree thesis. Because Finland is at the frontier of curriculum design to support creativity and innovation, teachers' work has many of the attractions of the professions that involve research, development and design.

Finally, the COVID-19 pandemic reminds us that teacher training can be easily disrupted and needs to evolve. First, social distancing rules due to the health crisis affected initial teacher-education institutions by forcing them, in many cases, to develop online and hybrid course formats to ensure student teachers could continue to learn. Second, the mass closures of schools disrupted teaching practica. This created an obligation and opportunity to develop alternatives and complements to in-school experiences for teachers. Third, the remote and hybrid teaching contexts during school closures and re-opening phases have put pedagogy for virtual teaching more firmly on the map.

Some of the approaches developed in this period have brought innovations to the delivery of programmes that – if sustained and further improved – may well contribute to their longer-term improvement and continued relevance. The use of virtual learning environments in initial teacher education is not a new phenomenon. Research, however, has so far primarily focused on technology use, rather than its impact

on practice. For example, the use of virtual learning in primary and secondary education has been growing in the United States, yet the number of initial teacher-education programmes integrating online pedagogy in their curriculum component is still small. The lockdowns and mass school closures made digital technologies not just a supplement to the conventional practice of teaching and learning but also a critical medium to ensure the continuity of education systems.

The smart integration of digital technologies in the delivery of initial teacher-education programmes is likely to help prospective teachers in developing general information and communication technology (ICT) skills as part of their initial education. ICT skills and digital literacy help teachers connect with other colleagues while easing geographical and time constraints, for example due to the possibility of asynchronous interaction and saving commuting time (Silva, Usart and Lázaro-Cantabrana, 2019[19]). Familiarity with using digital technology can increase teachers' access to new teaching strategies and pedagogical resources online. Therefore, integrating the use of ICT and digital technologies as part of pedagogical experience in initial teacher education may further strengthen the resilience of prospective teachers. This is because teachers prepared with digital technologies are more likely to take initiative in searching for new tools and networks when adapting to fast-changing needs in today's classroom.

Going forwards, it is important to learn which specific aspects of digital technologies can make classroom teaching more effective. This requires the thorough review and examination of curricula. Equipping teacher candidates with new pedagogies and skills to develop virtual teaching models also requires significant financial and time investments. This could add more requirements to an already packed initial teacher-education curriculum. It is thus critical to assess and explore the respective roles of initial teacher education, induction and continuing professional learning systems. Since technology is fast-changing, initial teacher education mostly needs to prepare teachers to become continuous learners in this area.

The COVID-19 pandemic also impacted on the practice-based experiences of student teachers. Many policy interventions have focused on making initial teacher education more practice-based, so that teacher candidates have opportunities to prepare for the practical challenges of classroom teaching. Attention to practice and field experiences has been a key priority to make initial teacher education more effective, to bridge the divide between theory and practice, as well as to support teacher candidates to develop their personal competences and tacit knowledge about teaching. However, the pandemic disrupted not only the conventional activities in initial teacher education but especially its practice-based programme components.

Initial teacher-education programmes across OECD countries took different approaches to adapt their practice-based components to the context of mass school closures. In Portugal and Chile, for example, when the government suspended schools and universities in March 2020, all education activities, including initial teacher education, moved online. Some initial teacher-education institutions also moved the practicum online, but how these online practica were implemented varied across different settings (Assunção Flores and Gago, 2020[20]); (Sepulveda-Escobar and Morrison, 2020[21]). In Turkey, the Turkish Higher Education Council issued a decision to allow initial teacher-education institutes to experiment with different approaches to organising their teaching practicum during school closures. Bahçeşehir University and Marmara University collaborated to launch an "e-practicum" where student teachers practiced their teaching in a virtual classroom made up of 25 other prospective teachers (Ersin, 2020[22]). In Japan, the Ministry of Education took a different approach. Instead of moving the practicum online, initial teacher-education institutions received an exceptional permission to replace up to one third of required hours of teaching practicum by coursework. The variations in how different systems and initial teacher-education institutions adapted their practice-based components reflect different priorities assigned to the types and amount of experiences deemed critical in initial teacher-education.

The sudden interruption of traditional teaching practica could thus be an opportunity to critically review what types of experiences matter the most to ensure effectiveness in this area. The increased use of digital and mobile technologies could further advance the use of remote support for prospective teachers during their practice experiences. Learning Management Systems (LMS) and video-archives are some of the existing approaches that use digital technologies to support the sharing and exchange of educational experiences to enhance prospective teachers' experience in their teaching practicum (Rideout, 2008[23]); (Prilop, Weber and Kleinknecht, 2020[24]). An increased use of interactive technologies in both schools and initial teacher-education institutions could open the possibility to have real-time and remote engagement with prospective teachers undergoing the practicum in a classroom, as well as providing support remotely for novice teachers in their induction phase. While both application of and research on remote supervision and assessment of teaching practice are limited, some systems, such as the United Kingdom, have experimented with it (Chilton and McCracken, 2017[25]). Remote interactions between student teachers and their supervisors in schools and initial teacher-education institutions hold the potential to enhance guidance, collaboration and reflective practice, which can help overcome the divide between theory and practice in initial teacher-education.

Finally, one of the biggest challenges for the future is to become better at recognising teachers for what they know and can do, rather than how they became a teacher. In some countries, alternative in-routes to teaching have become popular, in others they remain rare. Critics of alternative pathways into teaching maintain that there is just no alternative to the traditional route of undergraduate studies, teacher education and then a career in the classroom, and there is some truth to that. But those critics may underestimate the potential for creativity in the field of education that this combination of talent, passion and experience represents.

The fact that programmes such as global network Teach for All are now so attractive that they can recruit the most promising candidates, even where the general status of the teaching profession is in decline, speaks for itself. These organisations combine intensive initial teacher education and a support system in which teachers work together to create good practice. They also offer smart pathways for teachers to grow in their careers, whether as teachers, or leaders at the school or system level, or even in other areas, such as policy making and social enterprise.

UPDATING TEACHERS' SKILLS

How do good teachers become excellent teachers in a way that is consistent and can be repeated across schools? If we want schools to support more powerful learning for students we need to think harder about how to offer more powerful upskilling and reskilling learning opportunities for teachers.

Teacher development tends to focus on initial teacher education: the knowledge and skills that teachers acquire before starting work as a teacher. Similarly, most of the resources for teachers' development tend to be allocated to pre-service education. But given the rapid changes in education and the long careers of many teachers, teachers' development must be viewed in terms of lifelong learning, with initial teacher education the foundation for ongoing learning, not the summit of professional development. Think about the challenges teachers faced during the pandemic or as a result of technological innovations. No initial teacher-education programme could have predicted these challenges decades ago when today's teachers were educated. In vocational education and training, teachers also need to stay abreast of changes in industry.

Ontario's former premier, Dalton McGuinty, explained at an OECD meeting how he decided not to wait for a new generation of teachers and instead invested in existing schools and teachers, enlisting their commitment to reform and supporting their improvement. This involved extensive capacity-building

in schools, and quarterly meetings between system leaders and teachers' unions, superintendents' organisations, and school leaders' associations to discuss how the reform strategies were developing.

Other countries have also made significant investments in teacher professional development. Teachers in Singapore are entitled to 100 hours of professional development per year to stay up-to-date in their field and to improve their practice. Teacher networks and professional learning communities encourage peer-to-peer learning. The Academy of Singapore Teachers has been in operation since September 2010 to further encourage teachers to continuously share best practices.

So what can be done? Do you follow the example of the United States and some parts of Europe where teacher education is shaped by myriad decisions made by local authorities who have little information how their choices affect the overall national quality of the teaching profession? Singapore has been experimenting with very different approaches. On top of school teaching-practice attachments of between 10 to 22 weeks, its National Institute for Education uses digital technology to bring classrooms into pre-service education, with real-time access to a selection of the country's classrooms. The Institute also carries out an impressive range of classroom-based research to help teachers personalise learning experiences, deal with increasing diversity in their classrooms and differences in learning styles, and keep up with innovations in curricula, pedagogy and digital resources.

As noted before, effective professional development needs to be continuous and include education, practice and feedback, and provide adequate time for follow-up. Successful programmes involve teachers in learning activities that are similar to those they will use with their students.

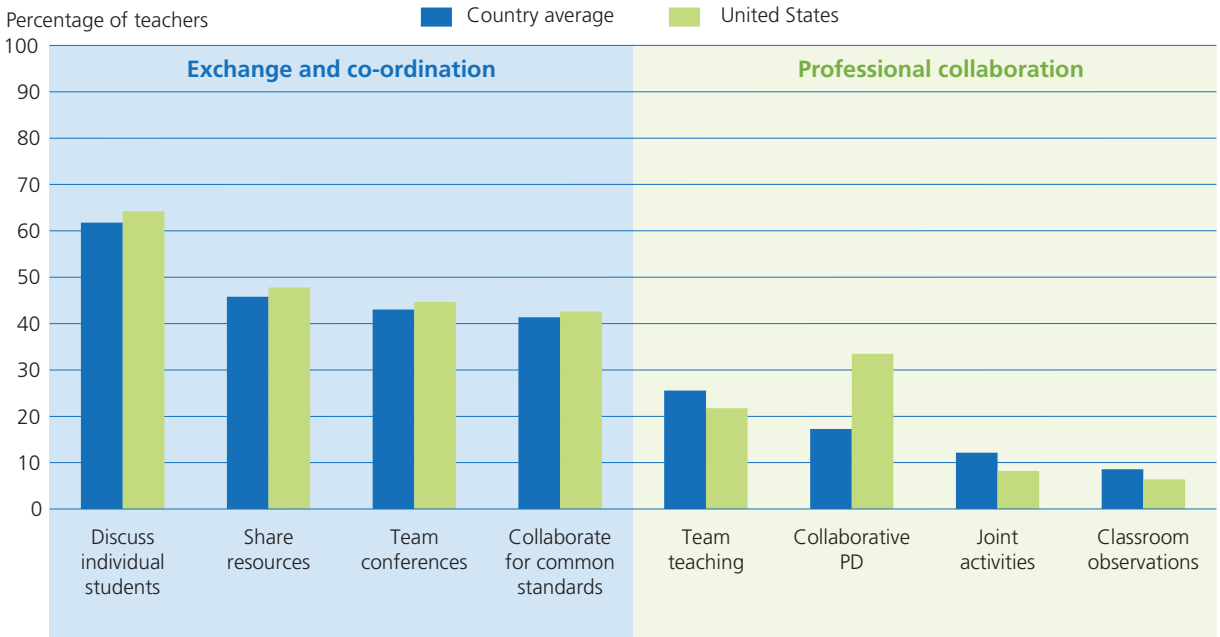
But the key is often not just a large amount of class-taking by serving teachers; it is the underlying career structures and how they inter-relate with the time teachers work together in a form of social organisation that both requires and provides new knowledge and skills that make the difference. Successful programmes encourage the development of teachers' learning communities through which teachers can share their expertise and experiences. There is growing interest in ways to build cumulative knowledge across the profession, for example by strengthening connections between research and practice, and encouraging schools to develop as learning organisations.

David Hung, at Singapore's National Institute for Education, found changing teachers' belief to be the most important point of leverage for change in education (Hung, 2006[26]). He describes the challenge as a shift in instruction from knowledge transmission to knowledge co-creation, from receiving abstractions in textbooks to learning by experimenting, from summative evaluation to formative monitoring. This often requires transforming a fear of failure to a willingness to try. Teachers with a very high or very low sense of self-efficacy may be less likely to use the new skills they have learned, while those with moderate confidence in their own ability might be the most likely to do so. Self-efficacy, in turn, is related to the ways in which work is organised: the more teachers observe other classrooms, engage in collaborative professional development, and teach jointly, the more they perceive themselves as being effective teachers (Figure 2.4).

And yet, surprisingly little is known about the ways in which teachers continue to learn throughout their careers. When first results from TALIS came out in 2009 (OECD, 2009[27]), they showed how teachers reported far less participation in the kinds of professional development activities that are usually considered to be the most effective. The subsequent TALIS surveys in 2013 (OECD, 2014[28]) and 2018 also showed that, across countries, teachers frequently co-ordinate and engage in informal exchanges, while the kinds of professional development activities that are most closely related to teachers' efficacy, such as classroom observations and lesson study, or team teaching, still occurs much more rarely (Figures 2.5 and Figure 2.6).

Figure 2.5 **Informal exchange is more common among teachers than deep professional collaboration**

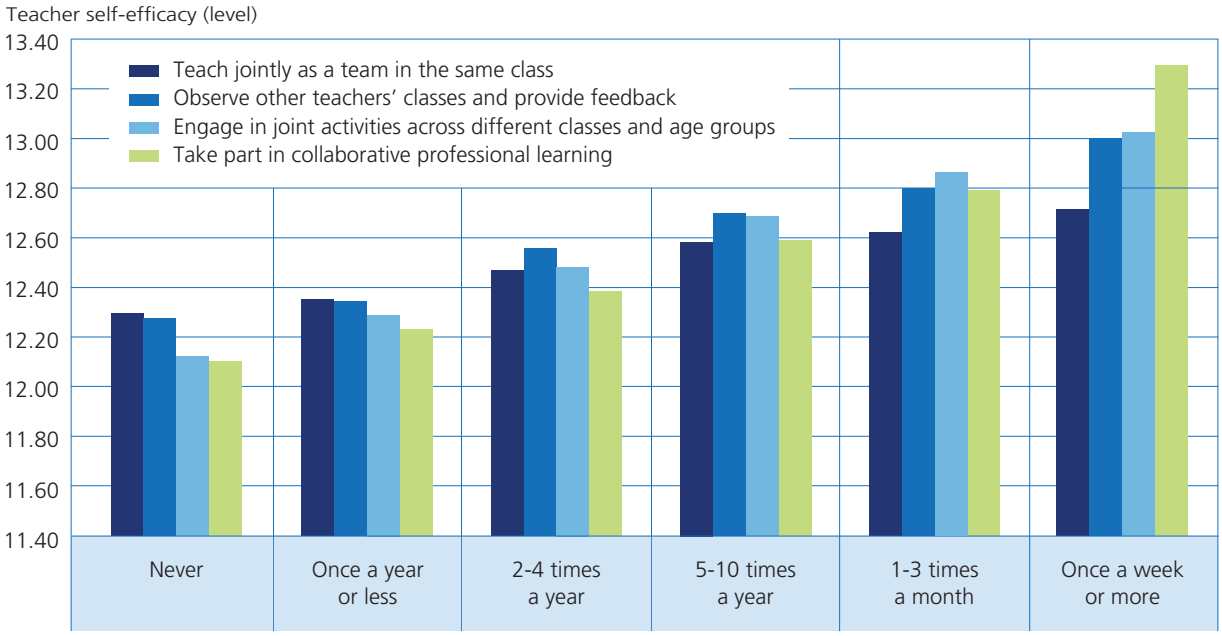
Percentage of lower secondary teachers who reported doing the following activities at least once per month



Source: (OECD, 2014[28]), TALIS 2013 Database, Table 6.15, https://www.oecd.org/education/talis/talis-2013-data.htm (accessed on 20 March 2023).

Figure 2.6 **Feeling effective as a teacher is linked to collaborating with colleagues**

Country average



Note: Teacher self-efficacybyintensityoftypeofteacherpr ofessional collaboration. The more frequently teachers engage in the different types of collaboration, the greater their self-perceived effectiveness.

Source: (OECD, 2014[29]), TALIS 2013 Database, Table 7.10. https://www.oecd.org/education/talis/talis-2013-data.htm, (Accessed on 20 March 2023).

SUPPORTING PROFESSIONAL DISCRETION

One of the key domains of knowledge work is professional discretion, which involves giving knowledge workers the autonomy to make workplace decisions based on their own expertise and experience. Professional discretion also implies freedom of knowledge workers to collaborate with colleagues to share and develop knowledge. Yet this key component of professions is not always present in teaching (Guerriero, 2017[30]).

In TALIS 2018, 78% percent of teachers across 48 countries and systems reported that they participated in school-level decision making. However, while they were fairly likely to collaborate with colleagues on a surface level by discussing specific students (61% of teachers across OECD systems report this, on average) or exchanging teaching materials with colleagues (47%), they were far less likely to engage in deeper forms of collaboration. Only 9% of teachers reported providing observation-based feedback to colleagues and only 21% engaged in collaborative professional learning at least once a month (OECD, 2020[31]). Both of these more in-depth collaboration activities would have been rendered all but impossible during COVID-19-related school closures in 2020.

The content of a teacher's initial education is also important in terms how prepared they feel for teaching and how effective they are as teachers. Research into initial teacher education indicates student achievement is higher when initial teacher training includes a combination of subject-matter content, pedagogy and teaching practice (Guerriero, 2017[30]); (Clotfelter, Ladd and Vigdor, 2007[32]).

Across OECD countries, around 9 out of 10 teachers reported that their initial or current training included content from some or all of the subjects they taught. General teaching practices and practical in-classroom training experience under supervision was also reportedly taught to 9 out of 10 teachers in initial teacher education (OECD, 2019[12]).

While these overall averages seem encouraging, TALIS data also explores other elements of teachers' initial training that are relevant to their work in modern classrooms. Across OECD countries, only 54% of teachers reported that using information and communication technology (ICT) in teaching was covered in their initial teacher education, and only 43% of teachers reported that they felt well or very well prepared for teaching with ICT when they finished their formal training.

CREATING A CULTURE OF SHARING

Big data could support the redesign of education in the same way it has fuelled change in other sectors. Imagine the power of an education system that could share all of its collective expertise and experience through new digital spaces.

But throwing education data into the public space does not, in itself, change how students learn, teachers teach and schools operate. That is the discouraging lesson from many administrative accountability systems. People may have data but that doesn't necessarily lead to changes in education practice.

Turning digital exhaust into digital fuel, and using data as a catalyst to change education practice requires getting out of the "read-only" mode of education systems, in which information is presented as if inscribed in stone. This is about combining transparency with collaboration. Too often, educational institutions are run by experts sitting somewhere in a distant administration who determine the content, rules and regulations affecting hundreds of thousands of students and teachers. Few can figure out how those decisions are made.

If we could make the data on which those decisions are based available to all, and enable teachers at the frontline to experiment and become creators, then we could use big data to help cultivate big trust.

Consider the power of "collaborative consumption", where online markets are created in which people share their cars, and even their apartments, with total strangers. Collaborative consumption has made people micro-entrepreneurs – and the driving force behind it is trust between strangers. In the business world, trustworthy strangers are connected in all sorts of marketplaces. The reason this works is because behind these systems are powerful reputational metrics that help people know their counterparts and build trust. When we want to buy something from a stranger, we can see how other customers have rated the seller, and at the end of the purchase we can rate the seller ourselves. Similarly, the seller can rate us as trustworthy buyers.

It is worth considering the use of technology in Shanghai, the top-ranked education system in PISA 2012. Teachers there are judicious and selective in using technology in their classrooms, but they embrace technology when it comes to enhancing and sharing professional practice. A part of this is using a sophisticated digital platform to share lesson plans. That, in itself, is not unusual; what is different is that the platform is combined with reputational metrics. The more other teachers download, or critique or improve lessons, the greater the reputation of the teacher who had shared them. At the end of the school year, the principal would not just ask how well the teacher had taught his or her students, but what contribution he or she had made to improve the teaching profession and the wider education system.

Shanghai's approach to curated crowdsourcing of education practice is not just a good example of how to identify and share best practice among teachers, it is also much more powerful than performance-related pay as a means to encourage professional growth and development. It might even be fairer, too, since the assessments are based on the views of the entire profession rather than just on the views of a single superior who may be years removed from actual practice.

In this way, Shanghai created a giant open-source community of teachers and unlocked teachers' creativity simply by tapping into the desire of people to contribute, collaborate and be recognised for their efforts. This is how technology can extend the reach of great teaching by recognising that value is often not created vertically, through command and control, but increasingly horizontally, by whom we connect and work with.

When parents are surveyed about the quality of their children's schooling, many rate the school system as poor, but the quality of their children's school as good, irrespective of schooling outcomes. We trust our children's schools because we know them, just as we trust the teachers in these schools because we know them. We have less trust in strangers. But the digital age allows us to create more enriching and valuable social capital. Reputational metrics, such as those used in Shanghai, give strangers faces and identities, and because so many are engaged, we learn whom we can trust.

Obviously, once again, the devil can be in the detail. Successful collaboration depends deeply on relationships, and this may not automatically translate into having the right number of online badges or stars certifying someone is a good collaborator. There is also the risk that digital sharing platforms may become commercialised, limiting the free sharing of experience.

OWNING THEIR PROFESSION

But the heart of great teaching is not technology, it is ownership. Successful education systems in the 21st century will do whatever it takes to develop ownership of professional practice by the teaching profession. Some say we cannot give teachers and education leaders greater autonomy because they lack the capacity and expertise to deliver on it. There may be some truth in that. But simply perpetuating a prescriptive model of teaching will not produce creative teachers: those trained only to reheat pre-cooked hamburgers are unlikely to become master chefs.

By contrast, when teachers feel a sense of ownership over their classrooms, when students feel a sense of ownership over their learning, that is when productive teaching takes place. So the answer is to strengthen trust, transparency, professional autonomy and the collaborative culture of the profession all at the same time.

When teachers assume ownership, it is difficult to ask more of them than they ask of themselves. At the ISTP in 2011, the Netherlands reported the development of teacher-led professional standards. Initially, there were concerns in government this could result in a set of professional standards based on the lowest common denominator. However, the opposite happened. Then-State Secretary for the Ministry of Education, Culture and Science, Sander Dekker, explained to delegates at the ISTP that no government in the Netherlands would have ever been able to impose such demanding standards for the profession as the profession itself had developed. The same holds in other professions: think of barriers to entry in the medical profession or in law. Sometimes professionalism and professional pride seem far better regulators than governments.

Several lessons can be drawn from that experience. First, involving teachers in the development of professional standards is a way to build professional knowledge. Indeed, for teaching standards to be relevant and owned by the profession, it is essential that teachers play a lead role in designing them. Similarly, it is essential that teachers participate in designing methods for teacher appraisal if the appraisal system is to be effective (OECD, 2013[33]). Inviting teachers to participate is a way of recognising their professionalism, the importance of their skills and experience, and the extent of their responsibilities. Teachers will also be more open to being appraised if they are consulted in the process. Thus, designers of appraisal systems need to work with teachers' professional organisations and outstanding teachers from across the system. In the end, teachers, like other professionals, have a genuine interest in safeguarding the standards and reputation of their profession.

Most importantly, teachers must assume ownership of the profession because of the pace of change in 21st-century school systems. Even the most urgent efforts to translate a government-established curriculum into classroom practice typically drag out over a decade. This is because it takes so much time to communicate the goals and methods through the different layers of the system, and to build changes into teacher-education programmes. This slow implementation process leads to a widening gap between what students need to learn, which is changing rapidly, and what and how teachers teach.

The only way to shorten that timeframe is to professionalise teaching, ensuring that teachers have a deep understanding not only of the curriculum as a product, but of the process of designing a curriculum and the pedagogies that will best communicate the ideas behind the curriculum.

Schools face a tough challenge in responding to what will be valuable for young people in the future. Subject-matter content will become less the core, and more the context, of good teaching. Many of today's curricula are designed to equip learners for a static world that no longer exists. Those types of curricula could be delivered with an industrial approach in hierarchical bureaucracies; they do not require teachers to have advanced professional insights into instructional design. But that is no longer good enough. Curricula now need to account for fast-moving flows of knowledge creation.

Paradoxically, the highly standardised industrial work organisation of teaching has often left teachers alone in the classroom. Zero percent school autonomy has meant 100 percent teacher isolation behind closed classroom doors.

As the prescriptive approach weakens, the position of the classroom practitioners needs strengthening. While governments can establish directions and curriculum goals, the teaching profession needs to

take charge of the instructional system, and governments need to find ways to enable and support professionalism. However, increased professional autonomy also implies challenging idiosyncratic practice. It means moving away from every teacher having his or her own approach towards the common use of practices agreed by the profession as effective, making teaching not just an art but also a science.

We should not take freedom as an argument to be idiosyncratic. If a pilot announced to passengers that they were taught to land against the wind but, this time, they want to land with the wind, those onboard would start to feel rather anxious. Of course, it is not easy for school leaders to balance opposing and sometimes challenging opinions on the one hand, while promoting their autonomy and ownership over the profession on the other. Because so many areas of teaching do not yet have clear standards of practice, teachers may infer that there should be complete autonomy in all areas, even in those where the evidence base is well established. So when there is no common agreement on professional practice, teachers may feel disempowered if leaders steer them towards selected evidence.

Finding out which pedagogical approaches work best in which contexts takes time, investment in research, and collaboration so that good ideas spread and are scaled into the profession. This will require a major shift from an industrial work organisation to a truly professional work organisation for teachers and school leaders, in which professional norms of control replace bureaucratic and administrative forms of control. In turn, more professional discretion accorded to teachers will allow them greater latitude in developing student creativity and critical thinking skills that are central to success in the 21st century, and that are much harder to develop in highly prescriptive learning environments. Supporting such a shift is what we should expect from 21st-century education policy.

CULTIVATING EFFECTIVE SYSTEM LEADERSHIP

To paraphrase former US president Calvin Coolidge, changing education bureaucracies can be like moving a graveyard: you never know how many friends the dead have until you try to move them. The bottom line is that school systems are rather conservative social systems. Everyone supports education reform – until it affects their own children. Parents may measure the education of their children against their own education experiences. Teachers may teach how they were taught, rather than how they were taught to teach. But the real obstacle to education reform is often conservative leaders who exploit populism to preserve the status quo; leaders who stick to today's curriculum rather than adapt pedagogical practice to a changing world, because it is so much easier to stay within everybody's comfort zone; leaders who invest in popular solutions, like smaller classes, rather than take the time to convince parents and teachers of the benefits of spending money more effectively, including through investing in greater teacher professionalism.

Effective leadership is central to virtually every aspect of education, particularly when there is little coherence and capacity. While there are many amazing teachers, schools and education programmes in different countries, it takes effective leadership to build a great education system. Educational initiatives and programmes rarely scale; it is usually culture that scales, and culture is the hallmark of effective leadership. Culture is about system learning, system-wide innovation, and purposeful collaboration that can lead to large-scale and ongoing improvement. If you want to effect real and lasting change, do not ask yourself how many teachers support your ideas, ask yourself how many teachers are capable of engaging in effective co-operation.

TEACHER LEADERSHIP PROVIDES AN ESSENTIAL STARTING POINT

Equally important is effective system leadership. The education crisis, reflected in flat education outcomes despite rising investment, is partly a leadership crisis. Finding adequate and forward-looking responses to inter-related changes in technology, globalisation and the environment is ultimately a question of leadership. Effective leadership is vital to creating an environment where institutions, educators, researchers and other innovators can work together as professionals. These kinds of leaders should help people recognise what needs to change, mobilise support and share leadership responsibilities throughout the system.

Box 2.1 HertsCam Network supporting non-positional teacher leadership internationally

The HertsCam Network is an independent teacher-led, not-for-profit organisation which began as a partnership in the 1990s between the University of Cambridge Faculty of Education and local education authorities. Its programmes are being led by teachers and its governance is in the form of a Board of Trustees who are mostly school principals. HertsCam became known for programmes that empowered and enabled teachers as agents of change.

A number of assumptions underpin the work. One is that teacher-led change is fundamental to sustainable improvements in practice. This is seen as valuable to school principals who are interested in school improvement and building collaborative professional cultures in their schools. Key aspects of the methodology include enabling experienced teachers to become facilitators who support groups of colleagues in their own schools over the course of an academic year. They use a set of tools in workshop settings to enable teachers to engage in reflection and discussion through which each individual can design and lead a development project. The focus of each project is determined by the individual teacher after reflection on their professional values and concerns. It might be, for example, 'Developing strategies to raise students' aspirations through dance training' or 'Developing oracy as a tool for learning' or 'Developing strategies to improve the resilience of disadvantaged students'. Membership of the group serves as a source of mutual critical friendship. Certification is based on evidence of participation in the programme and the leadership of development projects collected in a portfolio. Participants are invited to share narrative accounts of their projects in a series of networking scenarios. Many of these are published in a variety of ways.

Teachers report that this form of support not only enables them to improve professional practice in their own classrooms and in that of colleagues, but it also improves their morale and levels of self-efficacy. It therefore contributes significantly to staff recruitment and retention.

Source: (HertsCam Network, n.d.[34]), https://www.hertscam.org.uk (Accessed 22 March 2023).

Leaders who want to make forward-looking changes need to build a shared understanding and collective ownership, make and support the case for change, and remain credible without being populist. They need to focus resources, build capacity, change work organisations, and create the right policy climate with accountability measures designed to encourage innovation and development, rather than compliance. And they need to go against the dynamics of turf and hierarchical bureaucracies that still dominate educational institutions.

System leaders need to tackle institutional structures that too often are built around the interests and habits of educators and administrators rather than learners. Most of our school systems are designed to sort and weed out people, not to open opportunities and address the diverse needs of learners. That might have been an efficient and effective approach for the industrial age, when education was about finding and training a small minority of leaders, and equipping everyone else with just basic knowledge and skills. But in a modern society, where we need to capitalise on everyone's talents and ensure equitable access to learning, such an approach is a barrier to success. Incentives and support are needed so that schools can meet the needs of all pupils, rather than gain an advantage by shifting difficult learners elsewhere.

For schools to be entrepreneurial and able to adapt, system leaders need to be able to mobilise the human, social and financial resources needed for innovation. They need to build strong linkages across sectors and countries, and establish partnerships with government leaders, social entrepreneurs, business executives, researchers and civil society.

It will be important for education policy to get beyond the unproductive wrangling between forces pushing for greater decentralisation and those aiming for greater centralisation of the school system. That debate detracts from the real question of what aspects of education are best managed at what level of the education system, and the overriding principle of subsidiarity, where every layer of the school system should continuously ask itself how it can best support learners and teachers at the frontline.

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03

EDUCATING FOR GLOBAL AND CULTURAL COMPETENCE AND CIVIC ENGAGEMENT

This chapter looks at how to support the teaching of global competencies in schools, and ways of promoting equitable and inclusive learning environments. It draws on results from the PISA assessment of Global Competence.

Globalisation and digitalisation have connected people, cities, countries and continents in ways that vastly increase our individual and collective potential. But the same forces have also made the world more volatile, complex, uncertain and ambiguous. The world has seen a growing disconnect between the infinite growth imperative and the finite resources of our planet; between the financial economy and the real economy; between the wealthy and the poor; between the concept of our gross domestic product and the well-being of people; between what is technologically possible and the social needs of people; and between governance and the perceived voicelessness of people.

No one should hold education responsible for all of this. But neither should one underestimate the role of knowledge, skills, attitudes and values in social, economic and cultural development.

The Sustainable Development Goals, set by the global community for 2030, describe a course of action to end poverty, protect the planet and ensure prosperity for all. These goals are a shared vision for humanity that provide the missing piece to the globalisation puzzle. However, the extent to which these goals will be realised will depend in no small part on what happens in classrooms. Education will be key to reconciling the needs and interests of individuals, communities and nations within an equitable framework based on open borders and a sustainable future, and it will be key to ensuring that the underlying principles of Sustainable Development Goals become a real social contract with citizens.

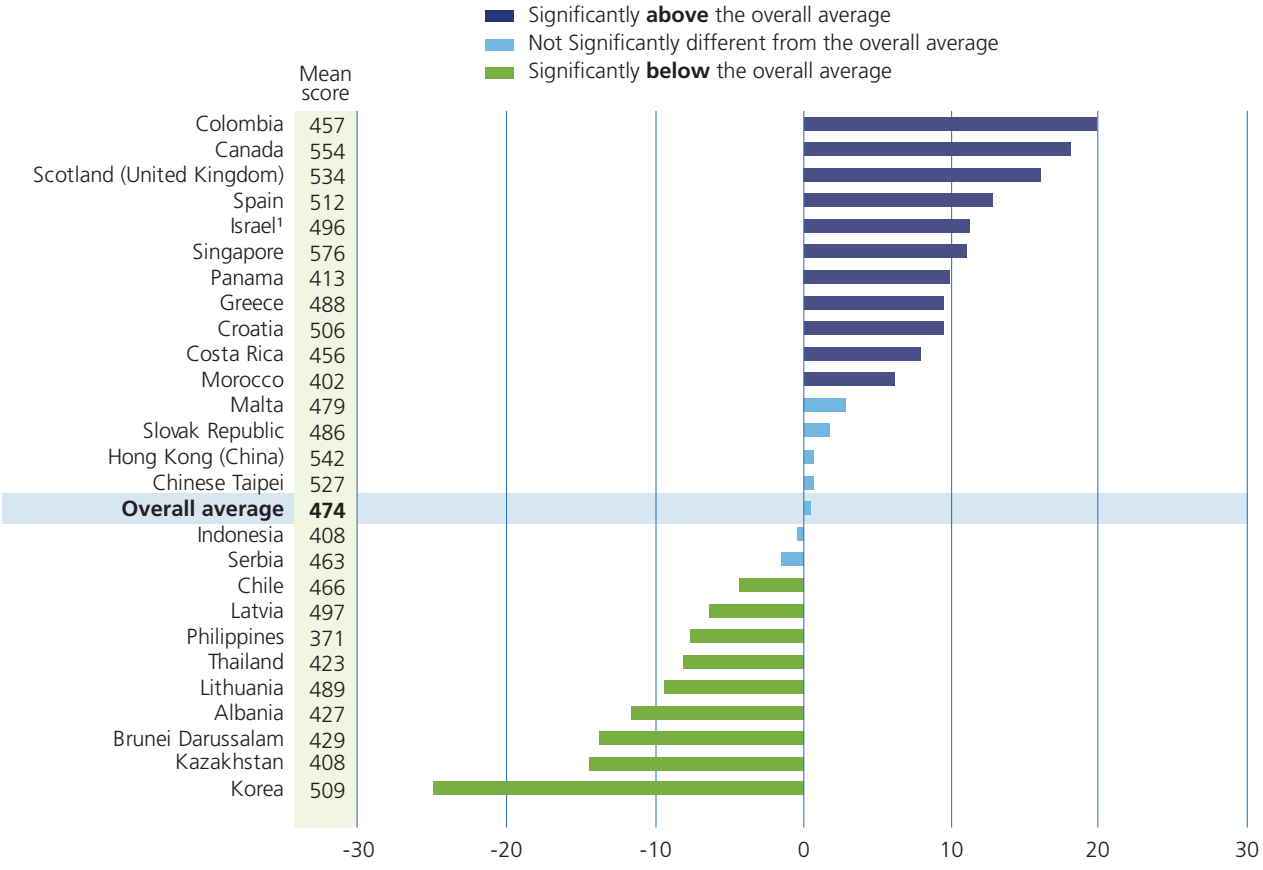
Schools need to help students learn to be autonomous in their thinking and develop an identity that is aware of the pluralism of modern living. At work, at home and in the community, people will need a broad comprehension of how others live, in different cultures and traditions, and how others think, whether as scientists or as artists.

These considerations have led PISA to include 'global competence' in its tri-annual assessments. To do well on this assessment, students need to demonstrate that they can combine knowledge about the world with critical reasoning. PISA 2018 also examined to what extent students understand and appreciate the perspectives and world views of others. It also surveyed students on their disposition to adapt their behaviour and communication to interact with individuals from different traditions and cultures.

It is perhaps no surprise that countries that do well on PISA's assessment of reading literacy, i.e. where students are good at accessing, managing, reflecting on and evaluating information, also tend to do well on the cognitive test that was part of PISA's assessment of global competence. For example, high-performers Singapore and Canada also came top in the assessment of global competence. What is more interesting is that PISA high flyer Canada performs even better on global competence than predicted (Figure 3.1). Equally interesting, Colombia's students often struggle with PISA reading, math and science tasks but do far better on global competence than predicted by their skills. This country once torn by civil war made significant efforts to strengthen civic skills and social cohesion over the last decade, and that seems mirrored in the learning outcomes at school (see Box 3.1). To a somewhat lesser extent, students in Scotland, Spain, Israel, Singapore, Panama, Greece, Croatia, Costa Rica and Morocco do better in global competence than predicted. In turn, students in Korea do less well in global competence than what their performance in reading, math and science predicts.

Figure 3.1 **Countries' and economies' relative performance in global competence**

Score-point difference between actual and expected performance in global competence



1. The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details.

Countries and economies are ranked in descending order of the relative performance in global competence.

Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.6.1. https://doi.org/10.1787/888934170355.

But the most interesting finding from the PISA assessment of global competence is that many school activities - such as the organisation of learning, contact with people from other cultures, and learning other languages - are positively associated with global competence. This shows that education can make a difference and provides a motivation for including this topic in the agenda of the ISTP.

Box 3.1 Colombia – Peace and global citizenship education – Policy leaders and scholars

For over a decade Colombia has engaged in a process of democratisation and peace-building geared to overcoming the armed conflict that afflicted its society in the past. Multiple educational policies sought to support these efforts, preparing young people to participate in the construction of more peaceful local and regional societies. Examples include the National Ministry of Education's efforts such as the National Human Right education plan of 2003; basic standards of citizenship competencies in 2004; the 2013 Law for Living together in schools; and the 2015 peace education initiative, "Cátedra de Paz". among others.

For instance, Colombia's Basic Standards of Citizen Competencies establishes the minimum learning goals that all students in the country should achieve at the end of each education cycle:

> *"As the group of school grades progresses and considering the development of boys and girls, it is expected that they will expand their scope of action. The youngest learn the citizenship skills necessary to function constructively in their close environment (family, classroom). Subsequently, civic competencies grow in complexity and the scope of action widens. Thus, then, it is expected that by the end of the 11th grade, young people will have developed the necessary citizenship skills to, for example, participate constructively in initiatives in favour of non-violence, in political decision making, and make use of the mechanisms of democratic institutions to protect and promote human rights at the local, national and global levels."* (MEN (Ministra de Educación Nacional, Colombia), 2006, pp. 154-155[2])

Colombia sheds light on key opportunities embodied in global competence/citizenship education at scale, including societies fractured by multiple forms of violence.

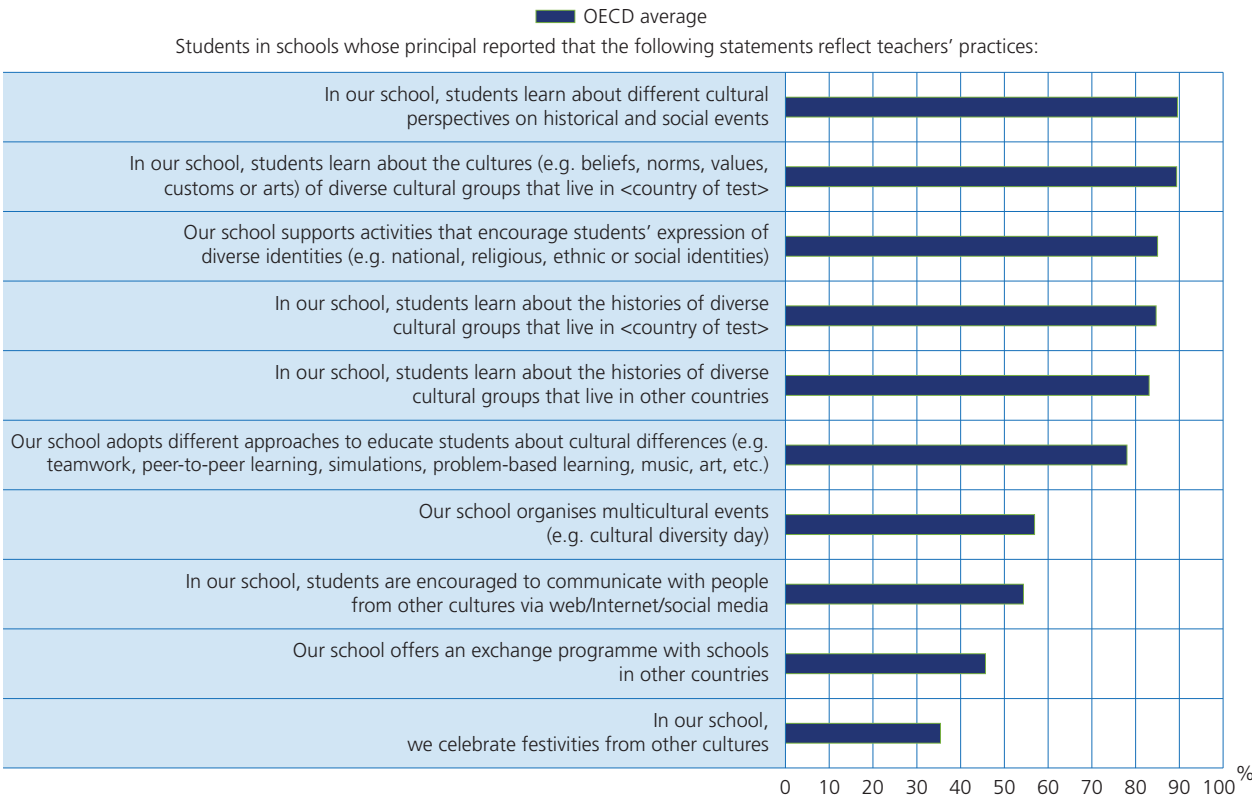
Source: Adapted from Big picture thinking: How to educate the whole person for an interconnected world, Principles and practices, Boix Mansilla and Schleicher (2022[3]) https://issuu.com/oecd.publishing/docs/big-picture-thinking-educating-global-competence (accessed on 21 March 2023).

WHAT SCHOOLS CAN DO TO SUPPORT LEARNING ABOUT GLOBAL ISSUES

According to school principals in PISA, the most common learning activities to support global competence at school were lessons on beliefs, norms, values, customs and arts of diverse cultural groups, as well as learning about different cultural perspectives on historical and social events (Figure 3.2). Less common were celebrations of festivities of other cultures and student exchanges with schools from other countries.

In many countries, the number of such learning activities is positively associated with students' attitudes and dispositions In effect, students engaged in a larger number of learning activities around global competence tended to report more positive attitudes and dispositions to other people and cultures than students engaged in fewer activities.

Figure 3.2 Multicultural learning at school



Note: Items are ranked in descending order of the proportion of students in schools whose principal reported that the statements reflect teachers' practices in their school.

Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.7.12.

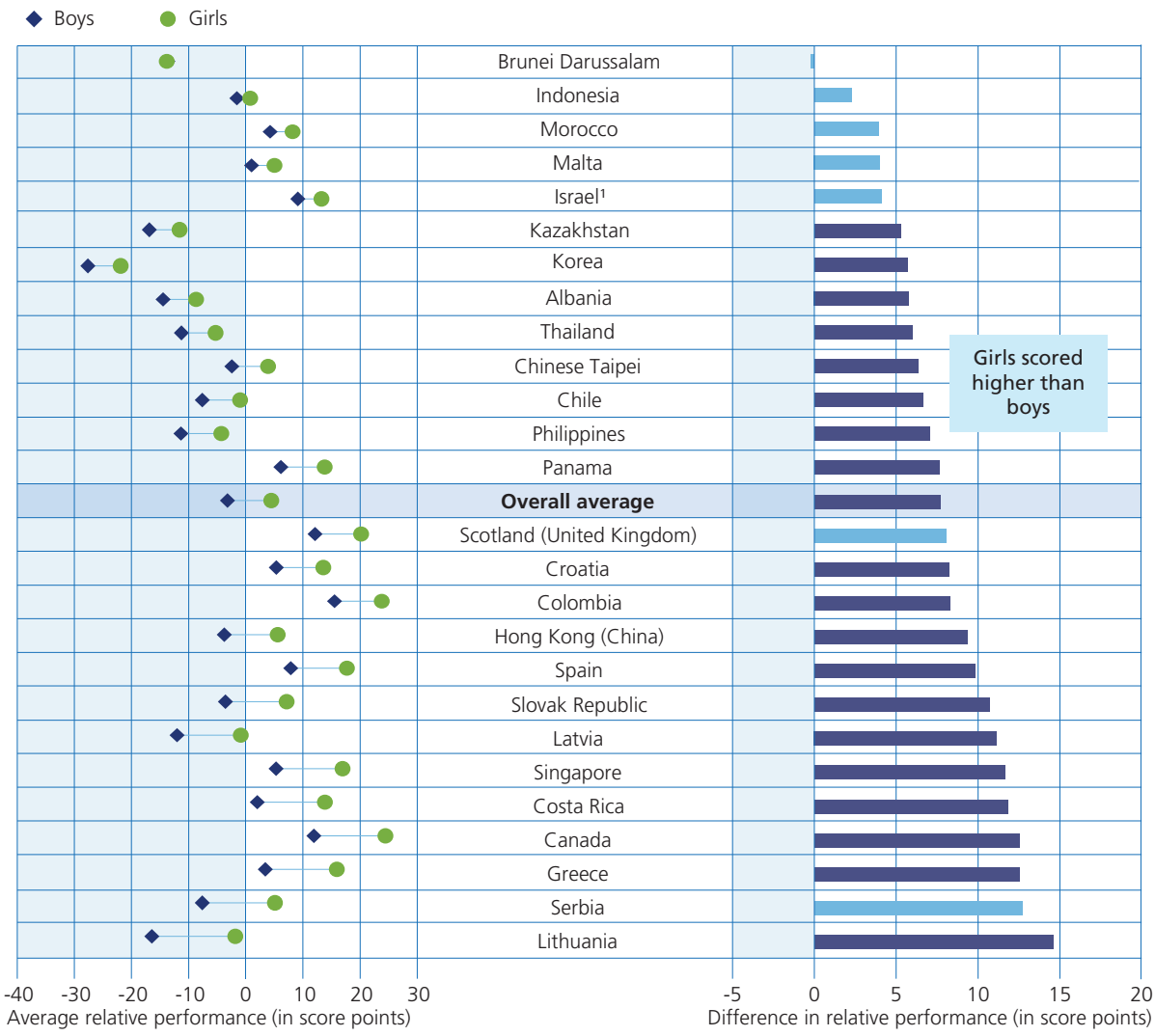
The findings also show large differences in the extent to which global issues (public health, climate change, poverty, migration and conflicts) and intercultural understanding (communication with people from different cultures, openness to intercultural experiences and respect for cultural diversity) are covered in the curriculum. Countries where such issues are commonly part of the curriculum, according to school principals, include Korea, Latvia, Lithuania and Poland. Countries where such topics are rarely covered include Baku (Azerbaijan), Bulgaria, Israel, Italy, Kazakhstan and Moldova.

PISA also showed that the coverage of global issues in the curriculum was positively associated with related student dispositions. The strongest associations were between coverage of climate change and global warming in the curriculum and students' awareness of these issues. Also associated were the coverage of causes of poverty in the curriculum and awareness of migration and movement of people; as well as the coverage of hunger and malnutrition in the curriculum and awareness of this topic. However, there was substantial cross-country variation in the relationship between exposure to global and intercultural learning at school and students' attitudes and dispositions, which suggests that the quality of curriculum implementation could be a major factor.

SECURING EQUITABLE OPPORTUNITIES FOR STUDENTS TO DEVELOP GLOBAL SKILLS

The PISA results show important inequalities in access to opportunities to learn global competence. In most countries, girls tended to outperform boys on the Global Competence assessment (Figure 3.3).

Figure 3.3 **Differences in relative performance in global competence, by gender**



Notes: Statistically significant values are shown in darker tones in the Figure on the right.

Countries and economies are ranked in descending order of the score-point difference in global competence performance between girls and boys.

1. The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details.

Source: (OECD, 2018[1]) OECD, PISA 2018 Database, Table VI.B1.6.4. https://doi.org/10.1787/888934170659.

On average across OECD countries, boys were more likely to report participating in activities in which they are expected to express and discuss their views, while girls were more likely to report participating in activities related to intercultural understanding and communication. For instance, boys were more likely to learn about the interconnectedness of countries' economies, look for news on the Internet or watch the news together during class. They were also more likely to be invited by their teachers to give their personal opinion about international news, to participate in classroom discussions about world events and to analyse global issues together with their classmates. In contrast, girls were more likely to report that they learn how to solve conflicts with their peers in the classroom, learn about different cultures and learn how people from different cultures can have different perspectives on some issues. These gender differences could reflect personal interests and self-efficacy. However, they could also reflect how girls and boys are socialised at home and at school.

The results from PISA also show that advantaged students have access to more opportunities to learn global and intercultural skills than disadvantaged students. The social gap was largest in Australia, Canada, Hong Kong (China), Korea, Macao (China), New Zealand, Scotland (United Kingdom) and Chinese Taipei. But the data show an interesting pattern: Disadvantaged students are less exposed to global and intercultural learning activities and report less positive attitudes than their advantaged peers. But students attending disadvantaged schools are more likely to be exposed to those learning opportunities. What this means is that the lack of access to learning opportunities does not result from lack of opportunities in disadvantaged schools, but rather from within-school mechanisms that result in lower engagement among disadvantaged students. Thus, when school curricula, educational practices and materials are developed, educators need to keep in mind that not all students are predisposed for global and intercultural learning. Those who come from disadvantaged backgrounds may be facing particular challenges and may require content or teaching approaches be better adapted to their needs.

When it comes to learning outcomes and student attitudes the findings show clear socio-economic gaps in favour of advantaged students. Furthermore, in most countries, girls were found to have higher awareness of global issues, greater ability to understand different perspectives, greater interest in learning about other cultures, greater respect for people from other cultures, more positive attitudes towards immigrants, greater awareness of intercultural communication, and greater agency regarding global issues (Figure 3.4 and Figure 3.5). On the other hand, in a majority of countries, boys were more likely to show higher cognitive adaptability than girls.

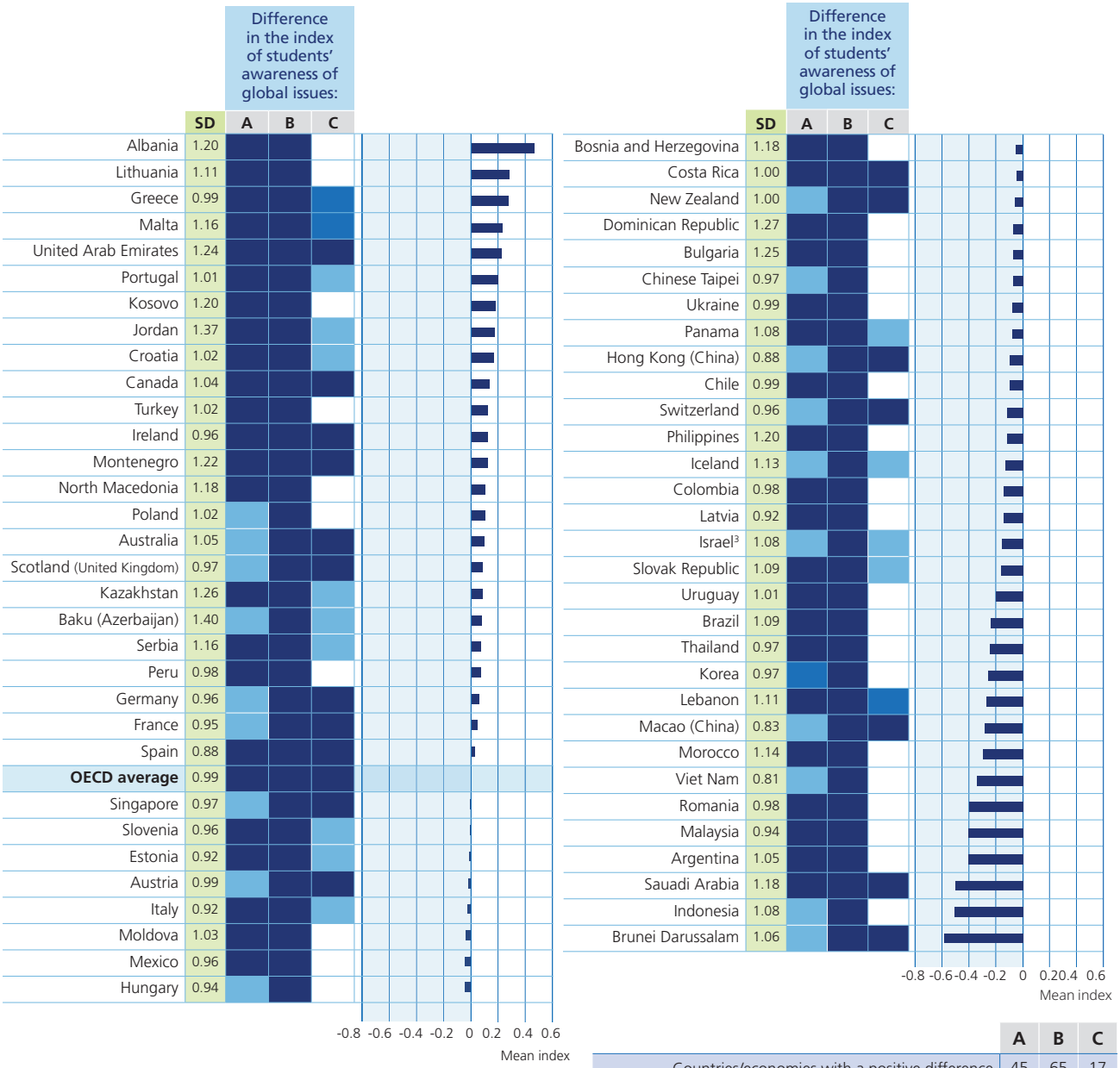
It is noteworthy that in countries with larger immigrant populations (measured here by more than 5% of students with an immigrant background) the gap in learning outcomes between immigrant and native-born students tended to be less pronounced. In some countries, immigrant students reported higher awareness of global issues than their native-born peers, greater self-efficacy regarding global issues, greater ability to understand different perspectives, higher interest in learning about other cultures, greater respect for people from other cultures, higher cognitive adaptability and more positive attitudes towards immigrants. In some countries, having more than 10% immigrant students in school was also associated with more positive attitudes towards immigrants. It seems that more multicultural classrooms could create a culturally rich environment that helps both immigrant and native-born students learn about one another. But this finding holds mainly in long-standing immigrant destinations, suggesting that the positive association may be conditional on successful integration policies.

Figure 3.4 Students' awareness of global issues

Average, dispersion and variation, by students' socio-demographic profile

Positive difference | Negative difference | Difference is not significant | Missing values

A Girls – boys | **B** Top - Bottom quarter of ESCS | **C** Immigrant - non-immigrant students[1,2]



	A	B	C
Countries/economies with a positive difference	45	65	17
Countries/economies with no difference	19	0	16
Countries/economies with a negative difference	1	0	1

1. After accounting for students' and schools' socio-economic profile. The socio-economic profile is measured by the PISA index of economic, social and cultural status (ESCS).

2. Differences between immigrant and non-immigrant students are only presented for countries and economies where more than 5% of students have an immigrant background. The values for countries/economies with smaller proportions of immigrant students are reported as missing.

3. The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details. https://www.oecd.org/pisa/data/pisa2018technicalreport/, (accessed on 20 March 2023).

Countries and economies are ranked in descending order of the index.

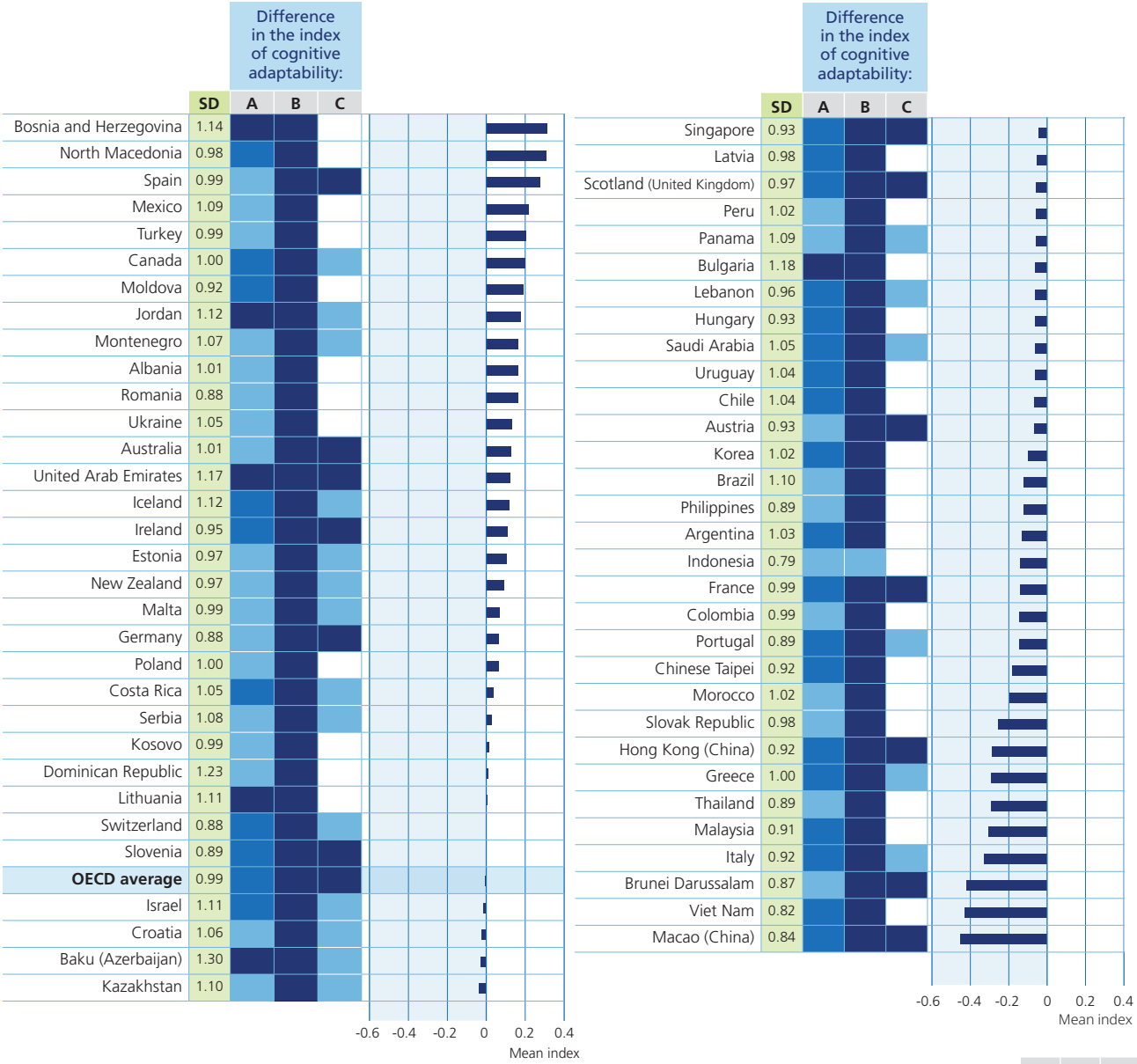
Source: (OECD, 2018[1]) OECD, PISA 2018 Database, Tables VI.B1.2.1 and VI.B1.2.3.

Figure 3.5 Students' cognitive adaptability

Average, dispersion and variations, by students' socio-demographic profile

Positive difference | Negative difference | Difference is not significant | Missing values

A Girls – boys | **B** Top - Bottom quarter of ESCS | **C** Immigrant - non-immigrant students[1,2]



	A	B	C
Countries/economies with a positive difference	6	64	13
Countries/economies with no difference	31	1	21
Countries/economies with a negative difference	28	0	0

1. After accounting for students' and schools' socio-economic profile. The socio-economic profile is measured by the PISA index of economic, social and cultural status (ESCS).

2. Differences between immigrant and non-immigrant students are only presented for countries and economies where more than 5% of students have an immigrant background. The values for countries/economies with smaller proportions of immigrant students are reported as missing.

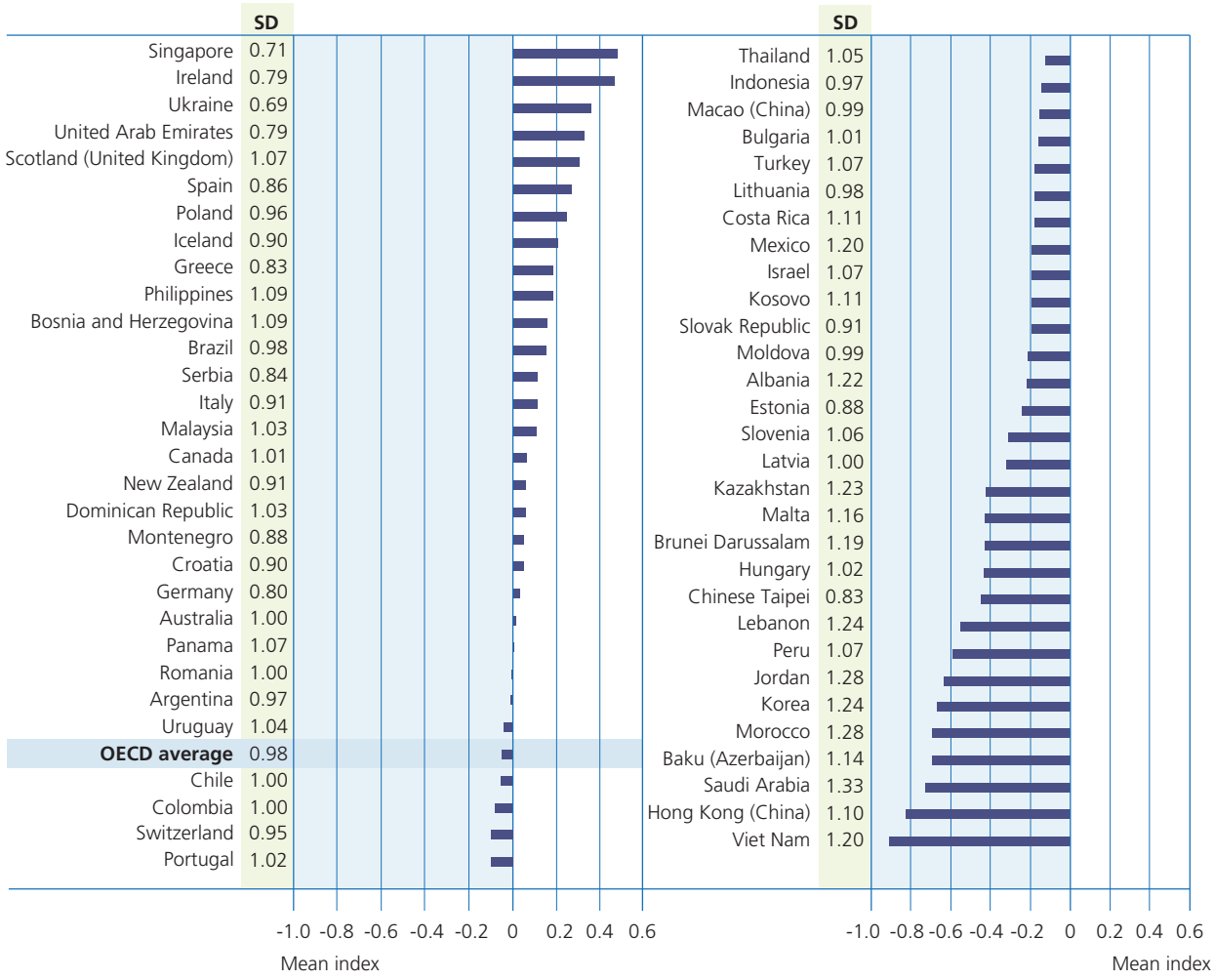
Countries and economies are ranked in descending order of the index of students' cognitive adaptability.

Source: (OECD, 2018[1])OECD, PISA 2018 Database, Table VI.B1.3.7 and Table VI.B1.3.8.

PROMOTING AN INCLUSIVE LEARNING ENVIRONMENT

A very high proportion of students in PISA (more than 90%) attended schools where principals reported positive multicultural beliefs among their teachers on all four statements included in the questionnaire (Figure 3.6). Those questions focused on teachers' attitudes towards people from other cultural groups. The PISA measure of discrimination at school could be seen as both individual and institutional, as discrimination can be the act of one teacher or a reflection of a more institutional problem.

Figure 3.6 **Principals' views on teachers' multicultural beliefs**
Based on principals' reports



Notes: The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details.

Countries and economies are ranked in descending order of principals' views on teachers' multicultural beliefs.

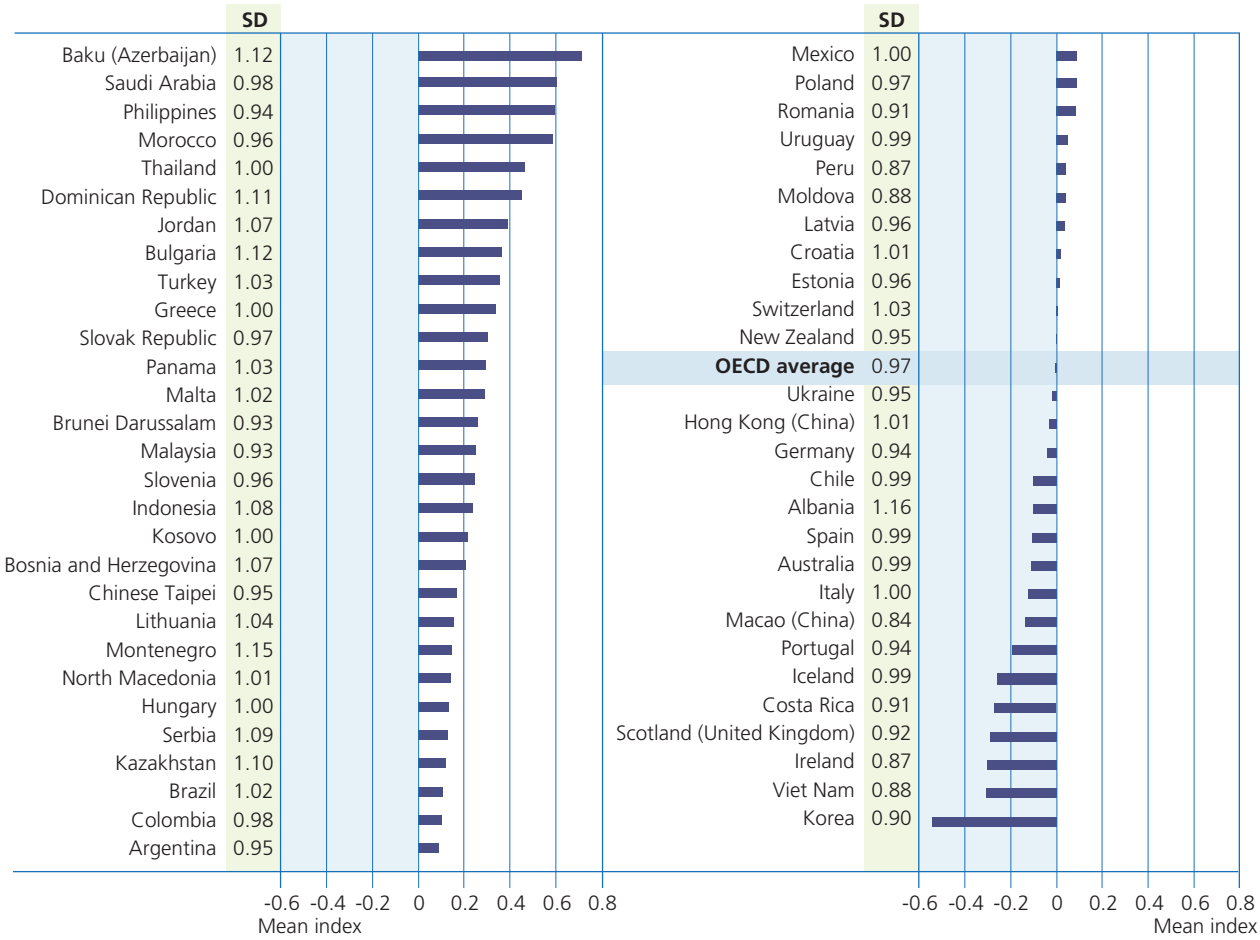
Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.8.11.https://doi.org/10.1787/888934171020,

However, these positive views of principals were not always mirrored in students' perception of discrimination by teachers in their schools (Figure 3.7), and those perceptions seem closely related to students attitudes. The PISA results show consistent negative associations between students' perceptions of discrimination in their school and students' respect for people from other cultures, attitudes towards

immigrants and awareness of intercultural communication. Interestingly, students' perceptions of discrimination at school were less strongly correlated with the knowledge aspects of students' dispositions (i.e. awareness of and self-efficacy regarding global issues) and more with intercultural attitudes towards people from other backgrounds. So students who perceived discrimination by their teachers towards particular groups, such as immigrants and people from other cultural backgrounds, exhibited similar negative attitudes (Figure 3.8).

This highlights the role of teachers and school principals and perhaps the broader school climate in countering or perpetuating discrimination by acting as role models. Students are likely to emulate the behaviour of their teachers. If discrimination becomes an institutional problem, then students may develop discriminatory attitudes towards those who are different from them. By contrast, when teachers do not exhibit discriminatory attitudes and set clear rules about intercultural relations, then students may become aware of what constitutes discriminatory behaviour. Teacher support could also act as a protective factor for students who are at risk of being victims of discrimination.

Figure 3.7 **Students' perception of discrimination at school**
Based on students' reports



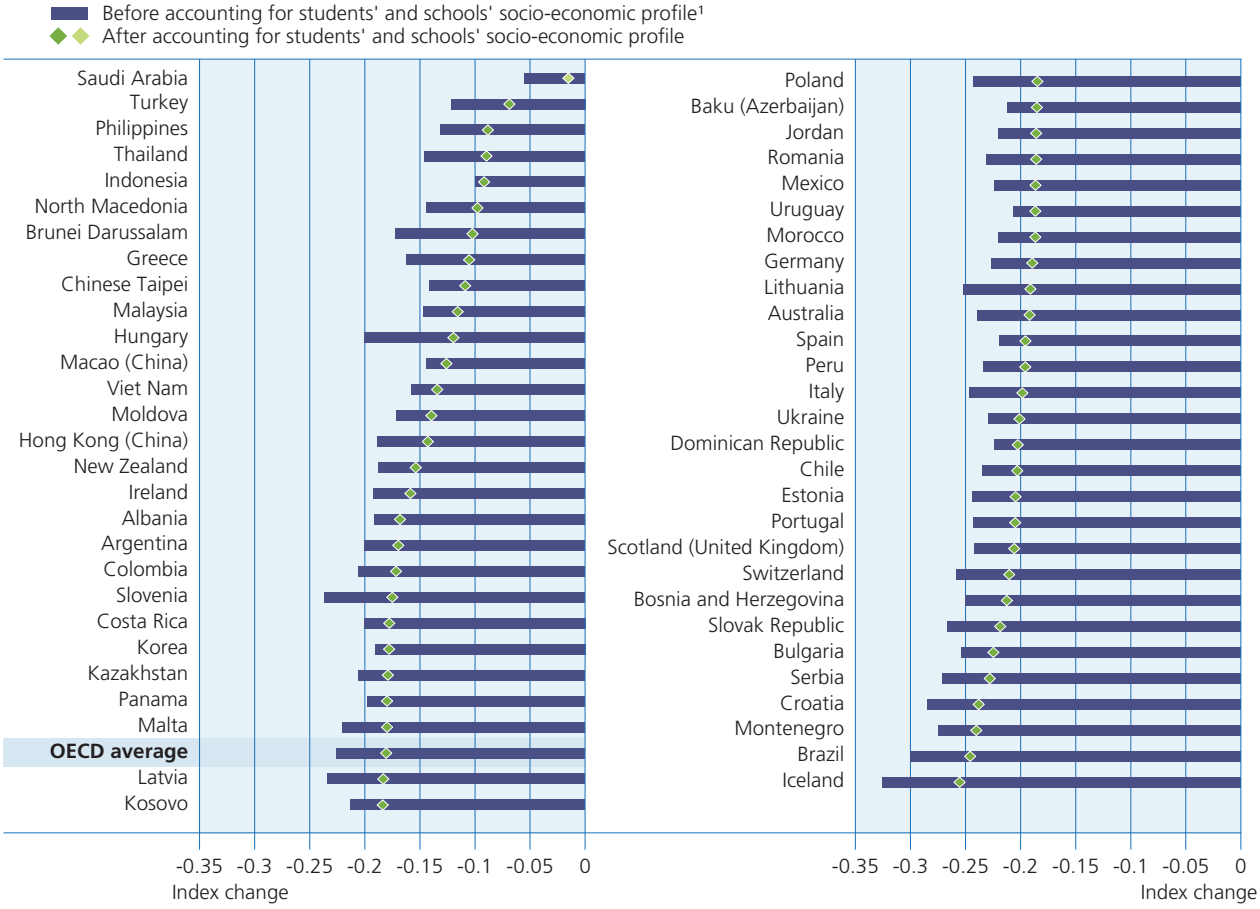
Notes: The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details.

Countries and economies are ranked in descending order of principals' views on teachers' multicultural beliefs.

Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.8.13, https://doi.org/10.1787/888934171039

Figure 3.8 **Perception of discrimination at school and students' respect for people from other cultures**

Change in the index of students' respect for people from other cultures associated with a one-unit increase in the index of discriminatory school climate



Notes: Statistically significant values are shown in darker tones.

The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details.

1. The socio-economic profile is measured by the PISA index of economic, social and cultural status (ESCS).

Countries and economies are ranked in descending order of the strength of the association, after accounting for gender, immigrant background, and students' and schools' socio-economic profile.

Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.8.14, https://doi.org/10.1787/888934171058.

SUPPORTING TEACHERS

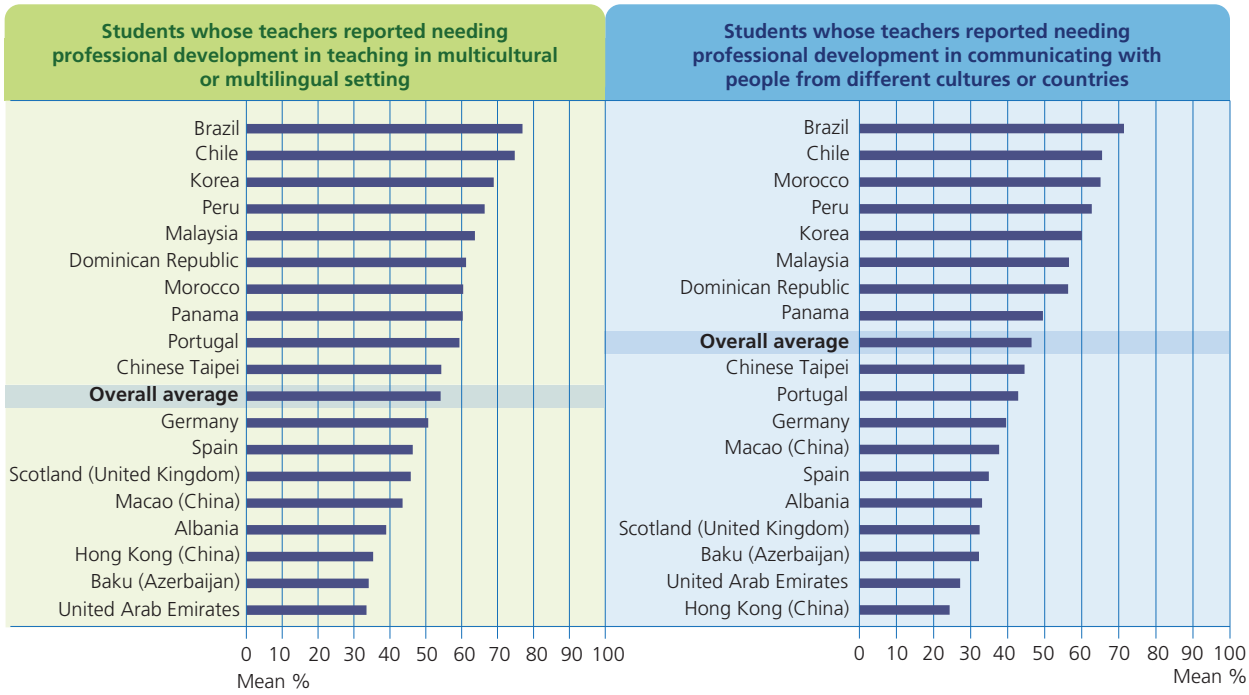
Teachers play an important role in promoting and integrating intercultural understanding in their classrooms. In general, most teachers reported that they are confident in their ability to teach in multicultural settings. In fact, more than 80% of students attended a school whose teachers reported a high degree of self-efficacy, as measured by five statements: "I can cope with the challenges of a multicultural classroom"; "I can adapt my teaching to the cultural diversity of students"; "I can take care that students with and without migrant backgrounds work together"; "I can raise awareness for cultural differences amongst the students"; and "I can contribute to reducing ethnic stereotypes between the students".

At the same time, teachers reported a high need for training in certain areas, such as teaching in multicultural and multilingual settings, teaching intercultural communication, teaching second languages

and teaching about equity and diversity (Figure 3.9). Indeed, the data show highly uneven teacher participation in relevant professional development activities. Across the 18 countries with comparable data, the most common activity was training for teaching about equity and diversity (about 45% of students attended schools where teachers have taken this training activity). By contrast, fewer teachers received professional development on teaching in multicultural or multilingual settings, second-language teaching, or teaching intercultural communication skills, and even fewer participated in such training activities in the previous 12 months. Moreover, few teachers reported that they received training on conflict resolution, on the role of education in confronting discrimination and on culturally-responsive teaching approaches.

Figure 3.9 **Teachers' need for professional development in teaching culturally diverse students**

Based on teachers' reports



Countries and economies are listed in descending order of the percentage of students whose teachers reported needing professional development in these areas.

Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.7.15, https://doi.org/10.1787/888934170811.

THE PARENT FACTOR

Fourteen countries also asked parents questions that mirrored those in the student questionnaire when administering PISA 2018. One set of questions focused on awareness of global issues, another on interest in learning about other cultures and a third on parents' attitudes towards immigrants. The findings show that the parents of students in Croatia, Germany, Ireland and Italy were more aware of global issues than the parents of students in Brazil, Chile, Hong Kong (China), Korea, Macao (China), Mexico and Panama.

Importantly, students' awareness of global issues was positively associated with parental awareness of global issues across all participating countries, even after accounting for students' and schools' socio-economic profile.

As for interest in learning about other cultures, parents in Croatia, the Dominican Republic and Germany reported the greatest interest, while parents in Hong Kong (China), Italy and Macao (China) reported the least interest. In all countries except Panama, students' interest in learning about other cultures was positively associated with their parents' interest in doing so. Furthermore, a positive association was found between parents' attitudes towards immigrants and those of their children across all 14 countries that collected data from the parents' questionnaire.

These results highlight the importance of parenting and the home environment in promoting global and intercultural interests, awareness and skills. Parents and teachers can play important and complementary roles in developing a positive intercultural and global outlook among adolescents. Parents can transmit knowledge about global issues and also act as role models in defining their children's behaviour. Parents who show interest in other people's culture, tolerance towards those who are different from them and awareness of global issues that affect us all are likely to raise children who share those attitudes. This, in turn, can help schools cultivate a climate that embraces those positive attitudes.

COMMUNITIES CAN ALSO PLAY AN IMPORTANT ROLE

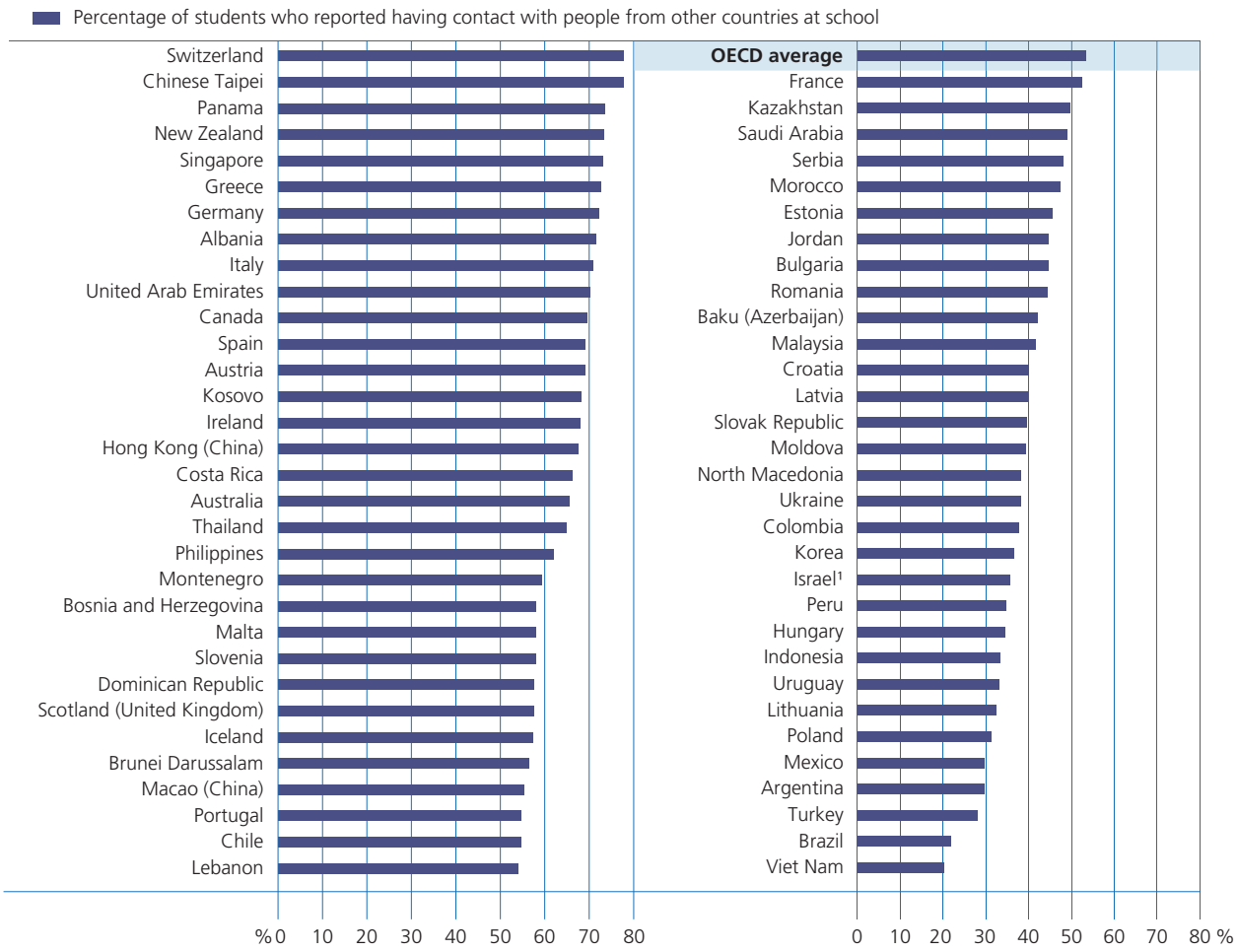
Contact with people from different cultures has the potential to stir curiosity, open minds and create understanding. Students in PISA 2018 were asked whether they have contact with people from other countries in different settings: at school, in their family, in their neighbourhood and in their circle of friends.

On average across OECD countries, 53% of students reported having contact with people from other countries in their school, 54% in their family, 38% in their neighbourhood and 63% in their circle of friends. However, there were substantial variations in those proportions between countries. The proportion of students who reported having contact with people from other countries at school ranged from 70% to 78% in Albania, Germany, Greece, Italy, New Zealand, Panama, Singapore, Switzerland, Chinese Taipei and the United Arab Emirates, but just from 20% to 30% in Argentina, Brazil, Mexico, Turkey and Viet Nam (Figure 3.10). Those results were mirrored by findings for other settings where contact with people from other countries takes place, such as the family, the neighbourhood and the circle of friends.

In general, having contact with people from other countries at school (and in the family, neighbourhood and circle of friends) is positively, weakly to moderately, associated with students' intercultural skills, their attitudes towards living with others and their self-efficacy (Figure 3.11). The most notable associations were found between having contact with people from other countries at school and students' self-efficacy regarding global issues, cognitive adaptability, interest in learning about other cultures, respect for people from other cultures, ability to understand different perspectives and understanding of intercultural communication.

The positive associations may suggest that contact between people of different origins and cultures could foster understanding and mitigate prejudice. In multicultural societies, contact arises naturally at school and beyond. However, in less diverse countries or in education systems that are highly stratified, educators may have to make special efforts to ensure that their students benefit from cultural exposure. For example, through student-exchange or study-abroad programmes that offer an immersive experience of another culture. While these programmes tend to be expensive, in the digital age educators can also use online platforms to organise collaborative activities based on the shared interests of their students. Engagement with local communities, such as visiting a community centre, a place of worship or a local market, is another method of introducing students to the diverse cultures existing within reach of their school.

Figure 3.10 Students who reported having contact with people from other countries at school



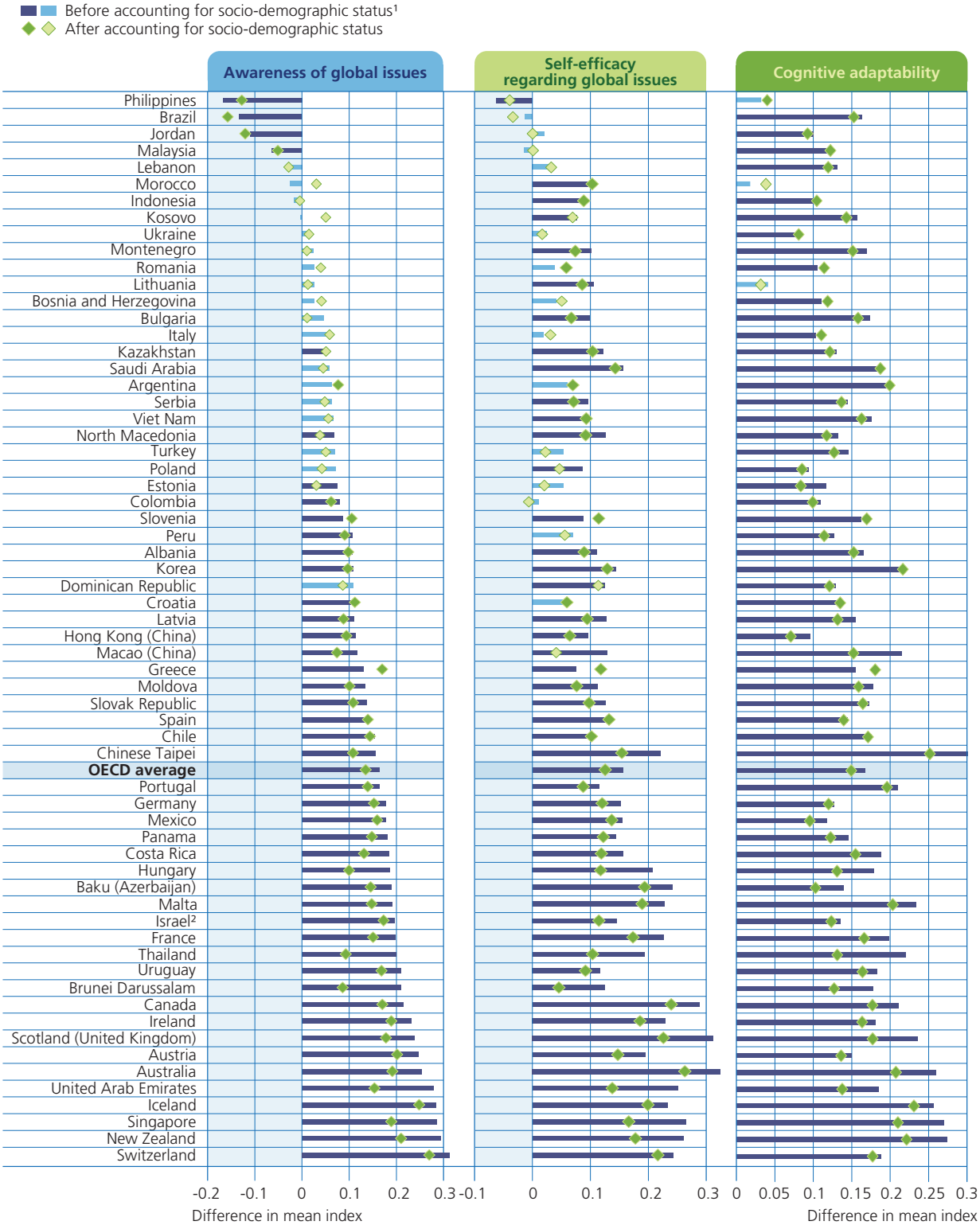
1. The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details.

Countries and economies are ranked in descending order of the percentage of students who reported having contact with people from other countries at school.

Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.4.5,. https://doi.org/10.1787/888934169899.

Figure 3.11 **Contact with people from other countries, and attitudes towards global issues**

Differences in indices between students who reported that they have contact with people from other countries and those who reported that they do not have such contact



Notes: Statistically significant values are shown in a darker tone.

1. Socio-demographic status includes gender, immigrant status and student's and school's index of economic, social and cultural status (ESCS).

2. The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report (OECD, 2018[4]) for details.

Countries and economies are ranked in ascending order of the difference in the index of awareness of global issues.

Source: (OECD, 2018[1])OECD, PISA 2018 Database, Table VI.B1.4.8. https://doi.org/10.1787/888934169918.

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THE ROLE OF MULTILINGUAL SKILLS

Speaking multiple languages is a valuable skill that improves employability and fosters a range of abilities that extend beyond the realm of language proficiency. It has the potential to promote social cohesion and intercultural dialogue by opening the door to a range of content, including literature, music, theatre and cinema, but also to different ways of thinking and different cultures. By doing so, multilingualism brings down barriers and gives young people direct access to content that would otherwise be inaccessible.

The associations between speaking two or more languages and students' attitudes were positive in almost all countries. This may reflect that language learning contributes to improving attitudes, but also that students who have positive global and intercultural attitudes tend to engage in learning multiple languages. Speaking two or more languages was positively associated with awareness of global issues, self-efficacy regarding global issues, cognitive adaptability, interest in learning about other cultures, respect for people from other cultures, positive attitudes towards immigrants, awareness of intercultural communication and the ability to understand the perspectives of others.

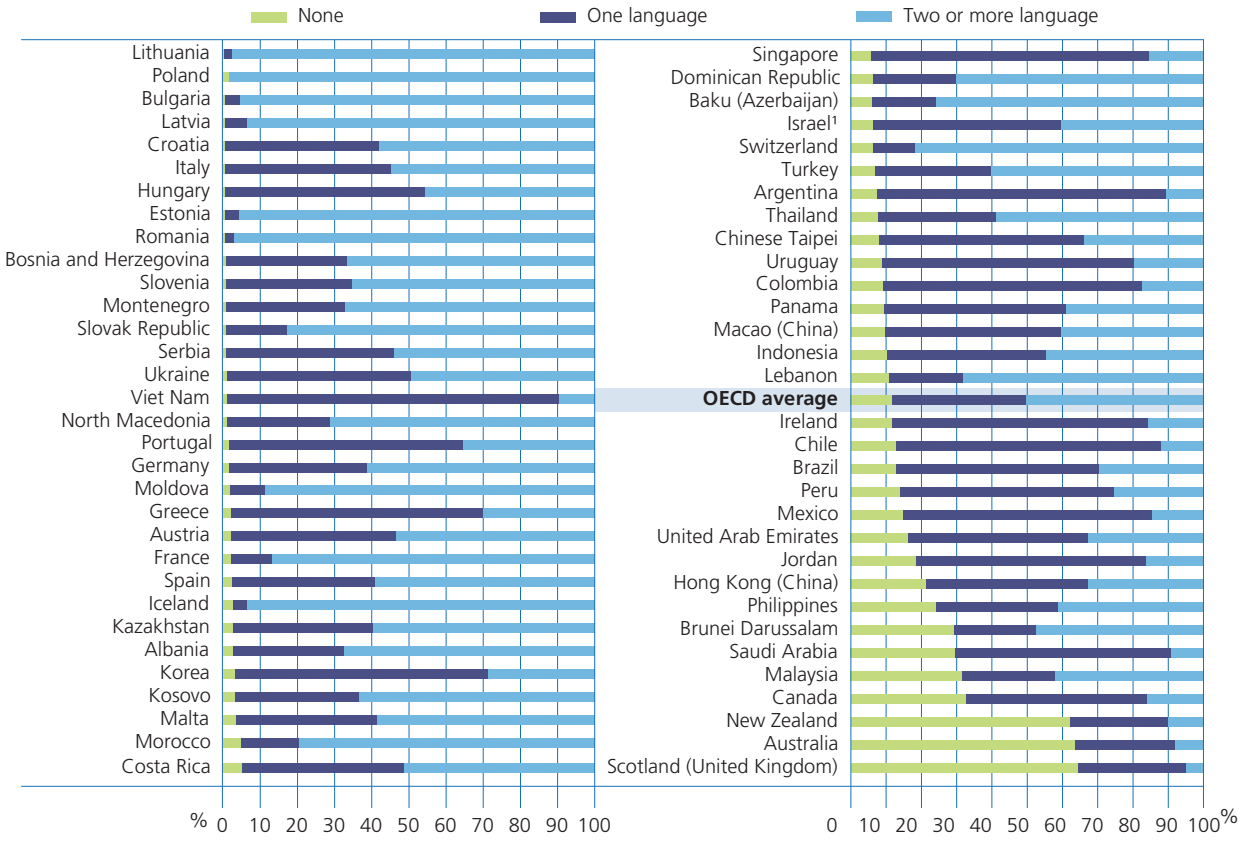
On average across OECD countries, 50% of students reported that they learn two or more languages at school, 38% reported that they learn one foreign language and only 12% reported that they do not learn any foreign language at school. The largest proportion of students (more than 20%) who reported that they do not learn any foreign language at school were observed in Australia, Brunei Darussalam, Malaysia, New Zealand, the Philippines, Saudi Arabia and Scotland (United Kingdom). By contrast, in 42 countries, more than 90% of students reported that they learn at least one foreign language at school (Figure 3.12).

In our times, global connectedness is no longer just an issue for those who travel to faraway places, but it has arrived at everyone's doorsteps. At work, at home and in the community, people need to engage with different ways of thinking and different ways of working, and they need to understand different cultures. The foundations for this don't all come naturally but need to be built. We are all born with what political scientist Robert Putnam calls "bonding social capital" – a sense of belonging to our family or other people with shared experiences, cultural norms, common purposes or pursuits. But it requires deliberate and continuous efforts to create the kind of "bridging social capital" through which we can share experiences, ideas and innovation, and build a shared understanding among groups with diverse experiences and interests, thus increasing our radius of trust to strangers and institutions.

The findings from PISA highlight that public policy can make a real difference: The schools and education systems that are most successful in fostering global knowledge, skills and attitudes among their students are those that offer a curriculum that values openness to the world, provide a positive and inclusive learning environment, offer opportunities to relate to people from other cultures and have teachers who are prepared for teaching global competence.

Getting this right is important. The global competence of our youths today may shape our future as profoundly as their reading, maths and science skills. Not least, societies that value bridging social capital and pluralism will be able to draw on the best talent from anywhere, build on multiple perspectives, and be best positioned to nurture creativity and innovation.

Figure 3.12 **Students who learn multiple foreign languages at school**



1. The global competence sample from Israel does not include students in ultra-Orthodox schools and, thus, is not nationally representative. See PISA 2018 Technical Report, (OECD, 2018[4]) for details.

Countries and economies are ranked in ascending order of the percentage of students who do not learn a foreign language at school.

Source: (OECD, 2018[1]), PISA 2018 Database, Table VI.B1.4.11. https://doi.org/10.1787/888934169994.

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OECD (2018), *PISA 2018 Database*, https://www.oecd.org/pisa/data/2018database/. [1]

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04

LEVERAGING THE POTENTIAL OF DIGITAL TECHNOLOGIES IN EDUCATION

This chapter analyses the potential benefits and risks of digital technologies in education, including the potential contribution to improving standards and equity in classrooms. It is based on Chapter 1 of the OECD Digital Education Outlook as well as the OECD publication World Class.

THE PROMISE OF DIGITAL TECHNOLOGIES

While people have different views on the role of digital technology in classrooms, we cannot ignore the fundamental impact of digital transformation in the world outside of schools. Everywhere, digital technologies are offering firms new business models and opportunities to enter markets and transform their production processes. They can make us live longer and healthier, help us delegate boring or dangerous tasks, and allow us to travel into virtual worlds. People who cannot navigate through the digital landscape can no longer participate fully in our social, economic and cultural life.

Technology, therefore, has a crucial role to play. It can provide teachers with learning environments that support 21st-century methods of teaching and, most importantly, help give students the vital skills they need to succeed in modern society.

Arguments that digital technologies will make teachers redundant are far-fetched. The heart of teaching has always been social and relational. It seems to be one of the most enduring social activities. The value of teaching as a key differentiator is only bound to rise as digitalisation drives forward the unbundling of educational content, accreditation and teaching that makes up traditional schooling. In the digital age, anything that we call our proprietary knowledge and educational content today can become a commodity available to everyone tomorrow. Accreditation still gives educational institutions enormous power, but the future is likely to change that. What will micro-credentialing do to accreditation when employers can directly validate specific knowledge and skills? What will be the impact of employers' ability to see beyond degrees listed on CVs to instead focus on the knowledge and skills of candidates? In the end, the quality of teaching seems the most valuable asset of modern educational institutions.

Still, as in many other professions, digital technologies are likely to assume many of the tasks now carried out by teachers. Even if teaching will never be digitised or outsourced to other places, routine administrative and instructional tasks that take valuable time away from teaching are already being handed over to technology.

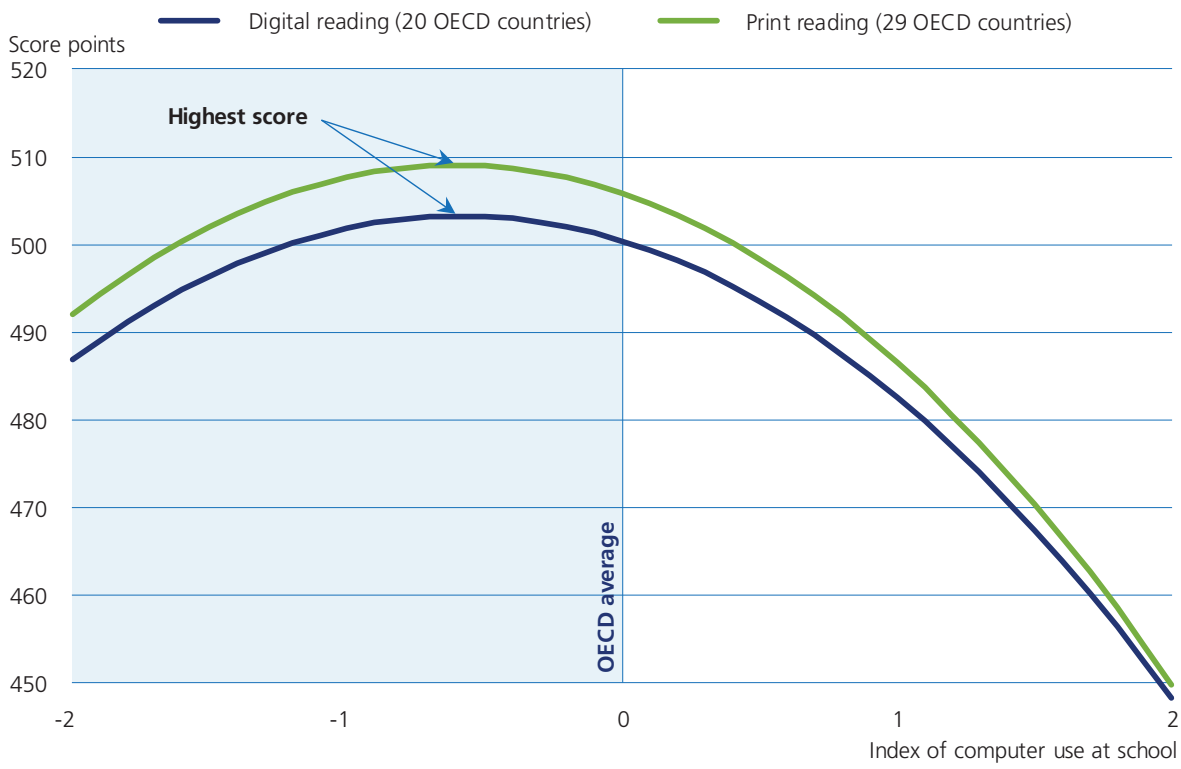
Digital technology now allows us to find entirely new responses to what people learn, how people learn, where people learn and when they learn, and to enrich and extend the reach of excellent teachers and teaching. We can embrace technology in ways that elevate the role of teachers from imparting received knowledge towards working as co-creators of knowledge, as coaches, as mentors and as evaluators. Already today, intelligent digital learning systems cannot just teach us science, but they can simultaneously observe how we study, how we learn science, the kind of tasks and thinking that interest us, and the kind of problems that we find boring or difficult. These systems can then adapt learning to suit our personal learning style with far greater granularity and precision than any traditional classroom setting possibly can. Similarly, virtual laboratories give us the opportunity to design, conduct and learn from experiments, rather than just learning about them.

Technology can enable teachers and students to access specialised materials well beyond textbooks, in multiple formats and in ways that can bridge time and space. Technology can support new ways of teaching that focus on learners as active participants. There are good examples of technology enhancing experiential learning by supporting project- and enquiry-based teaching methods, facilitating hands-on activities and co-operative learning, and delivering formative real-time assessments. There are also interesting examples of technology supporting learning with interactive, non-linear courseware based on state-of-the-art instructional design, sophisticated software for experimentation and simulation, social media and educational games. These are precisely the learning tools that are needed to develop 21st-century knowledge and skills. Not least, one teacher can now educate and inspire millions of learners and communicate their ideas to the whole world.

Perhaps the most distinguishing feature of technology is that it not only serves individual learners and educators, but it can build an ecosystem around learning that is predicated on collaboration. Technology can build communities of learners that make learning more social and more fun, recognising that collaborative learning enhances goal orientation, motivation, persistence and the development of effective learning strategies. Similarly, technology can build communities of teachers and allow them to share and enrich teaching resources and practices, as well as collaborate on professional growth and the institutionalisation of professional practice. It can help system leaders and governments develop and share best practice around curriculum design, policy and pedagogy. Imagine a giant crowdsourcing platform where teachers, education researchers and policy experts collaborate to curate the most relevant content and pedagogical practice to achieve education goals, and where students anywhere in the world have access to the best and most innovative education experiences.

However, the reality in classrooms around the world looks still quite different from these promises. Even where digital technologies are extensively used, their impact on student performance seems mixed, at best. PISA 2018 measured students' digital literacy, and the frequency and intensity with which students use computers at school. Students who use computers moderately at school tend to have somewhat better learning outcomes than students who use computers rarely. But students who use computers very frequently at school do a lot worse in most learning outcomes, even after accounting for social background and student demographics (Figure 4.1). These findings hold for both skills in digital literacy and in mathematics and science. The mere use of technology will not make a positive difference to student learning. The good use of technology is key.

Figure 4.1 **Students who use computers at school the most score the lowest in reading digital and printed text**



Note: OECD average relationship, after accounting for the socio-economic status of students and schools. The lines represent the predicted values of the respective outcome variable, at varying levels of the index of computer use at school.

Source: (OECD, 2012[1]) PISA 2012 Database, Table X.2.
https://www.oecd.org/pisa/data/pisa2012database-downloadabledata.htm (accessed 20 March 2023).

This chapter provides an overview how smart technologies can improve education systems and education delivery, together with some policy pointers on how teachers and schools can leverage these opportunities. The chapter builds on the 2021 OECD Digital Education Outlook.

RAISING EFFECTIVENESS

Attending school or university does not always translate into as much academic learning as one would hope for. Results from PISA have shown that attending school can lead to very different levels of learning outcomes across countries. One of the key promises of smart technologies is to enhance the effectiveness of teaching and learning for better student learning.

In the classroom, applications that directly support student learning show early promise. Personalised learning can provide all students with the appropriate curriculum or task to match their learning needs, and scaffold them within a task, based on a diagnosis of their knowledge and knowledge gaps. This is not only done at the academic level, focusing on the "what", but increasingly considers how students learn and factors such as self-regulation, motivation or effort (Molenaar, 2021[2]). Engagement is key for learning, and solutions to keep students engaged within digital or physical learning environments are being developed to identify their affective states during learning and nudge them towards re-engagement when they seem to disengage (D'Mello, 2021[3]). Social robots perform similar tasks in different ways: they can use adaptive learning to tutor students with natural language, but they can also teach, or motivate them to learn by playing the role of a peer student. They support teachers by enabling the implementation of different types of teaching and learning strategies (Belpaeme and Tanaka, 2021[4]). Finally, smart technologies give students with impairments and special needs access to curriculum materials and allow those students to participate in learning activities to an extent that was not possible before, here again increasing the effectiveness of education (Good, 2021[5]).

Those solutions can be used and remain helpful outside of the classroom too, either for homework, as automated private tutoring or practice solutions, and for lifelong learning. In fact, the largest market for educational technology companies is the consumer market targeting students and parents directly, either for recreational learning activities or for tutoring or test preparation.

A second promise of learning effectiveness comes from classroom analytics that support teachers in providing more effective teaching. This is still work in progress, but many applications already show how a variety of solutions could support teachers in better using their time in class. For example, by suggesting when it is a good time to shift to the next teaching or learning activity, who requires their attention the most, and how they can engage the whole class in collaborative learning activities. While classroom orchestration solutions can help teachers in real time, they also provide feedback on their own practice. For example, how much they talk, to whom, or how they divide their time between different types of activities (Dillenbourg, 2021[6]). Both real-time and post-hoc feedback are akin to personal professional learning opportunities for the teacher in question. This has the significant advantage of being about the specific teacher who was (digitally) observed, rather than about theoretical or general teaching practice. In that sense, smart technology has real potential to improve the teaching practice of all individual teachers, and subsequently the learning outcomes of their students.

At the organisational and system levels, smart technologies also hold promise in making education more effective. Smart technologies can be integrated in most dimensions of school activities, providing administrators, teachers and learners with feedback to manage school resources as well as improve the effectiveness of teaching and learning (Box 4.1). The rise of a new generation of assessments powered by AI also opens new avenues for recognising and evaluating competences that were hard to assess through

paper-and-pencil tests. This could accompany most education systems in their shift towards emphasising skills (in addition to the traditional emphasis on knowledge). Game-based assessments and simulations allow assessments to be designed to be more realistic but also to assess skills such as complex problem solving, creativity or collaboration in new ways (Buckley et al., 2021[7]).

Box 4.1 Integrating AI and learning analytics in school: examples from China

Increasingly, school buildings will be equipped with sensors, cameras, and computers to fulfil certain administrative as well as teaching and learning functions. Some schools are already experimenting and developing innovative ways to integrate smart technologies in their operations. Here are a few examples from Shanghai (China).

The Luwan No 1 Central Primary School (Huangpu District, Shanghai) is a public school integrating AI in its school resource management as well as its teaching and learning – a digital model that may then be extended to other schools. The management of the campus, and the teaching and learning all rely on smart technologies. Using IoT sensing technology, the "digital campus" consists of collecting and analysing campus data to automatically control and manage environmental factors such as security, lighting, water quality and air quality, but also to collect campus activity data; for example, people density in corridors etc. Combined with wearable devices, the school also collects physiological data such as students' body temperature and heart rate as well as academic data and learning process data in order to support teachers and learners. The "digital students" application analyses student data to create a detailed, holistic portrait of students. The collection of data increases the understanding of students' learning status and growth, and provides teachers with data to tailor their teaching to their needs. The data cover discipline, academic level, physical and mental health, aesthetic taste and social practice. Socio-emotional aspects such as learning engagement and affective states are measured by voice and face-recognition technology. Finally, a "digital teaching" system «provides teachers with support on five aspects of teaching: lesson preparation, classroom orchestration, homework, tutoring and evaluation – with functionalities such as "classroom orchestration", "intelligent assessment" and "intelligent homework review". The intelligent tutoring system supports students directly in accessing resources, tools, pathways and personalised guidance. As of June 2021, this model has been studied and adopted by more than 250 schools in Shanghai, Qinghai, Shaanxi, Guizhou, etc.

The demonstration high school affiliated to Tongji University (China) is also implementing a new "digital classroom" system in English, geography and biology. Students' learning data collected in the system is the basis for teaching and further learning. Before the lessons, teachers use digital interactive "practice" tools to assess students' learning; they also conduct short and concise in-class tests from time to time to obtain real-time student learning data. This allows them to change their teaching strategies during class, and to develop individualised after-class strategies. Based on this information, teachers will set online assignments, which are automatically marked by the system and provide the basis to the generation of personalised "knowledge analysis" reports (Figure 4.3). Based on these individual cards, the system proposes micro-tutoring video resources and exercises to meet individual learning needs, and teachers receive guidance to propose targeted after-class assignments and counselling and to customise their teaching to students' needs. The system also allows for collaborative learning with students and teachers being able to see and comment on students' work.

Figure 4.2 Digitalisation at the Luwan No 1 Central Primary School in Shanghai

Note: The left panel shows a screenshot of the campus management system. The right panel shows a student using the classroom handwriting board collecting data about this progress.

Source: Courtesy of the municipal government of Shanghai.

Figure 4.3 The "digital classroom" system at Tongji University's first demonstration high school

Note: The left picture shows the visualisation of a student's acquired knowledge in a chemistry curricula unit. The right picture shows how the system can be used for co-operative learning, with both students and teacher being able to view and assess how all students responded to a given assignment.

Source: Courtesy of the municipal government of Shanghai.

Other demonstration schools focusing on digital technology explore other possible aspects of technology.

- Shanghai Xuhui Middle School has a traditional emphasis on science education and 22 engineering science and innovation labs (18 kinds). After developing 5G in the school campus, it developed a "holographic" science education model based on mixed reality in order to make difficult knowledge more directly understandable and intuitive, and to enhance students' attention and enthusiasm for the subjects. As of June 2021, two lessons ("Exploring the Mysteries of the Solar System" and "Understanding the Bones of the Human Body") were developed and delivered with real-time interaction with Yuanyang No. 1 Middle School (Honghe Prefecture, Yunnan Province).

- The Shanghai Industrial Technology School provides its students with advanced mixed reality and simulation technology to learn manufacturing. Simulation-based training projects are carried out in a 3D virtual environment, containing a series of workstations such as graphic drawing, workpiece handling and work units such as loading and unloading of computer numerical controlled (CNC) machine tools.

Source: (OECD, 2021[8]), OECD Digital Education Outlook 2021, Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots, Box 4.1 https://doi.org/10.1787/589b283f-en.

Finally, the emergence of longitudinal education data systems that follow students through the course of their studies also allows for more effective policy and organisational interventions and a better design of educational offerings. For example, in the United States, the analysis of community college graduation rates, the success of their student placement strategies in "remedial courses" and students' study patterns as part-time or full-time enrolment led to revisiting what the educational experience of community college students actually is and "redesigning" community colleges (Bailey, 2015[9]). As in other sectors (OECD, 2019[10]), the use of data supports policy design and interventions.

IMPROVING EQUITY

Technology can both moderate and amplify inequalities in education. On the one hand, smart technologies can help reduce inequity both by increasing access to learning opportunities for all and improving learning effectiveness for those who need it the most. On the other hand, without the widespread and equitable availability of smart technologies, inequity can rise. They may also leave achievement gaps unchanged or even widened, depending on their differential impact on different learners.

To begin with the difficulties: There are at least two reasons why technology may have a negative effect on equity. The first and most obvious reason lies in the difference in access to devices and connectivity by students from different groups, notably students from lower socio-economic backgrounds (Figure 4.4). These students may not have the devices, the connectivity or the resources that allow accessing and using smart technologies either at the school they attend or at home. Secondly, if technology (e.g. personalised learning) works the same for everyone, those who start with stronger prior knowledge can maintain their advantage or even make faster progress than those with less prior knowledge (Figure 4.5). In spite of supporting students with less prior knowledge, it is thus possible that technology could give greater support to more advanced students. This would widen rather than reduce the achievement gap.

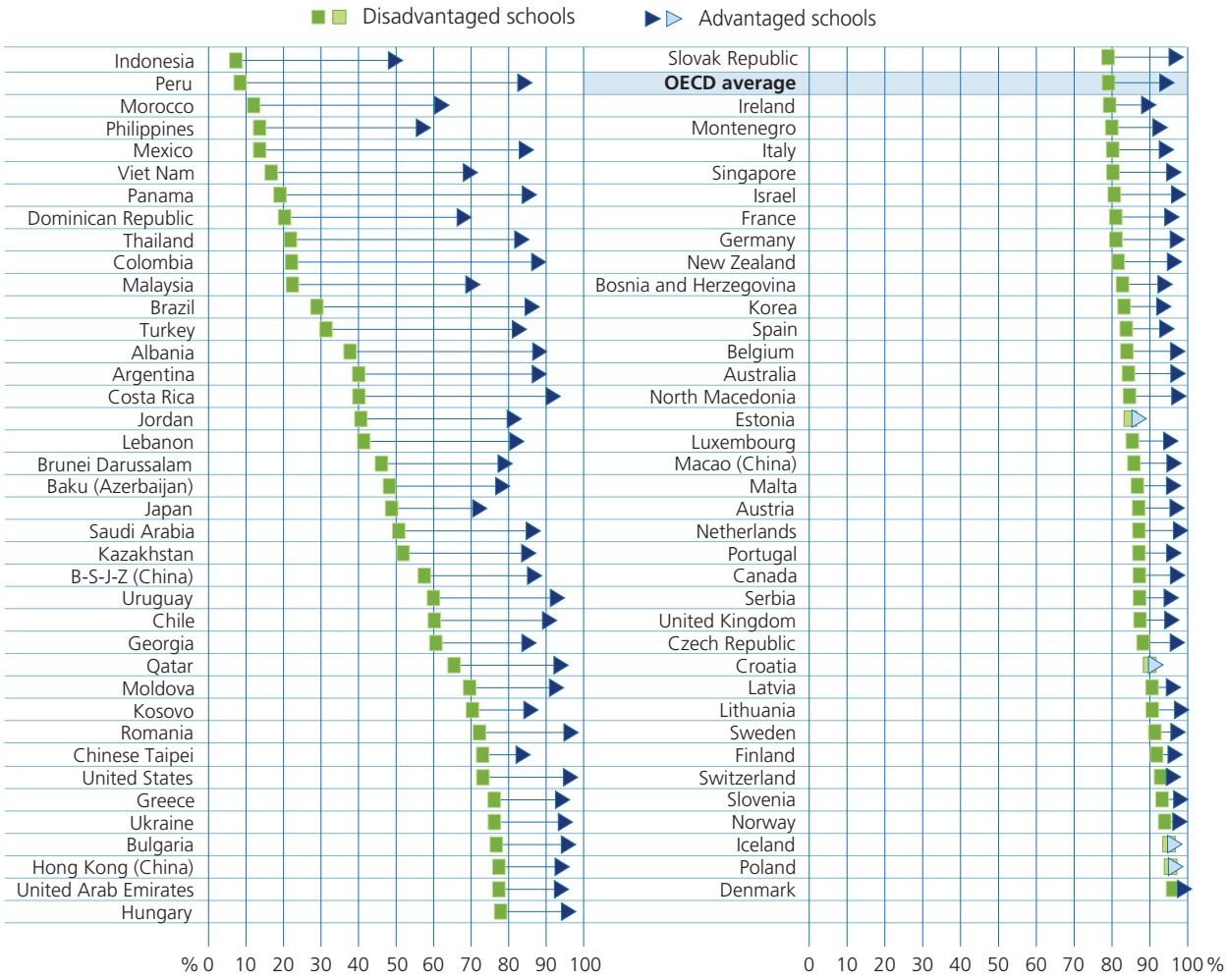
But there are many reasons to believe that smart technologies can advance the equity agenda.

First, learning technology can expand access to learning opportunities. Educational platforms offering open educational resources or massive open online course (MOOC) platforms are good examples. They allow learners to access learning materials with a quality that may be superior to what they can access locally. While many studies have shown that increased access has not decreased inequity at scale – due to low take-up and the fact that most users are already well educated - a recent systematic review of their effect on equity provides a more optimistic perspective, notably for non-English MOOCs or open educational resources (Lambert, 2020[11]).

Just as importantly, smart technologies can reduce inequity by facilitating the inclusion of students with special needs and by adapting learning to different learning styles. Technology has, for example, made it much easier to support the diagnosis of learning difficulties such as dysgraphia, and remedial digital responses have also been developed. A variety of smart technologies applied to learning solutions also make it easier for blind or visually impaired students, as well as deaf or hard-of-hearing students, to access learning materials and easily perform the educational tasks required from other students. Artificial intelligence enabling speech to text (and vice versa) or automatic subtitles are the most obvious examples. Learning technologies also tackle more difficult issues and support the socio-emotional (and thus the subsequent academic) learning of autistic children. They increasingly propose ways to help children with attention deficit hyperactivity disorder (ADHD) to self-regulate and better benefit from their schooling.

Figure 4.4 **Access to a computer linked to the Internet at home for doing schoolwork, by school's socio-economic status**

Percentage of students in advantaged and disadvantaged schools[1]



Notes: Statistically significant values are shown in a darker tone.

1. A socio-economically disadvantaged (advantaged) school is a school whose socio-economic profile (i.e. the average socio-economic status of the students in the school) is in the bottom (top) quarter of the PISA index of economic, social and cultural status amongst all schools in the relevant country/economy.

Countries and economies are ranked in ascending order of the percentage of students who reported having access to the Internet and a computer that can be used for schoolwork at home, in disadvantaged schools.

Source: (OECD, 2018[12]) PISA 2018 Database, Table B.2.5. https://doi.org/10.1787/888934239401.

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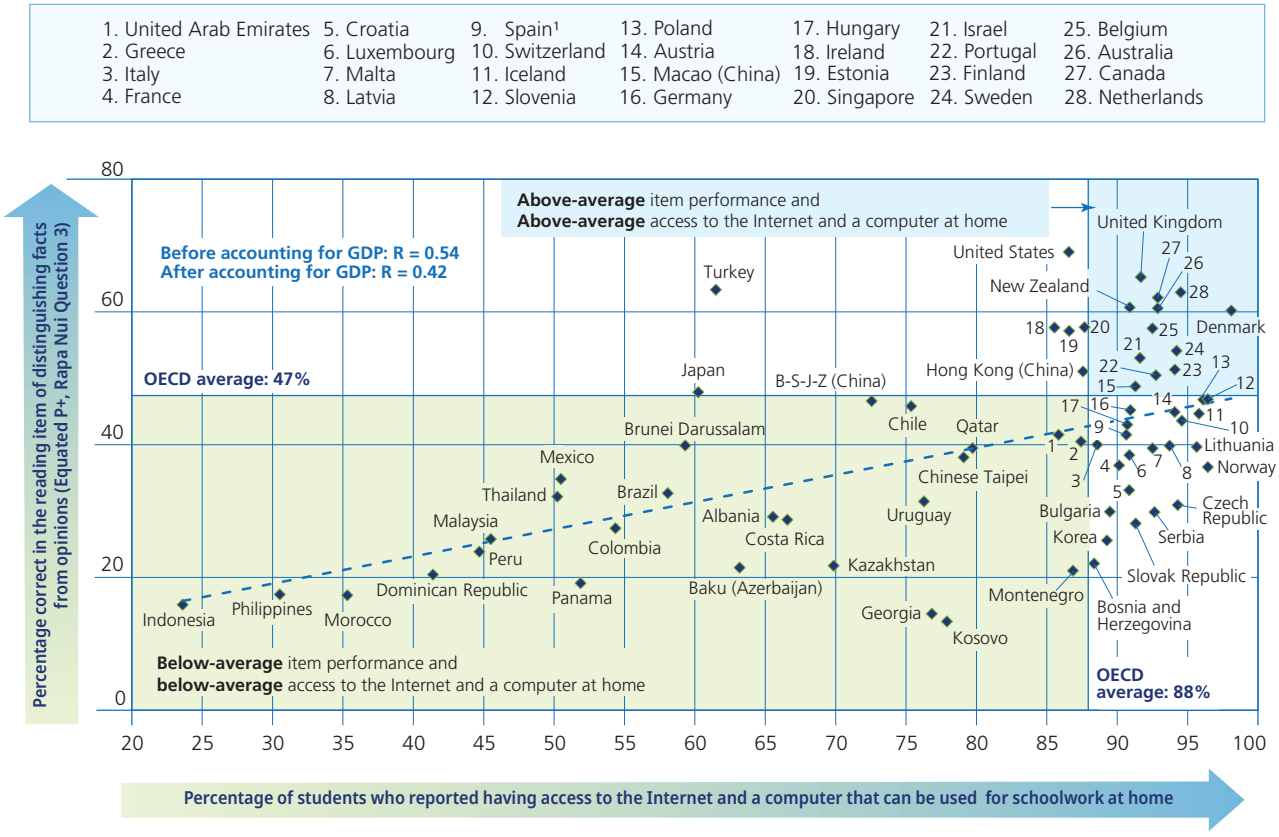
Figure 4.5 **Relationship between access to digital resources at home and emergent aspects of reading**



1. For the comparability of Spain's data see Readers' Guide of PISA 2018 Results (Volume I): What Students Know and Can Do, Annex A9.
Source: (OECD, 2018[12]),PISA 2018 Database, Tables B.2.4 and B.2.8. https://doi.org/10.1787/888934239420.

One caveat here is that inclusion is not just about the individual "fitting in" but also for society to be more inclusive and open to differences (Good, 2021[5]). Technology encourages that by enabling students with special needs to study in a traditional (and inclusive) learning environment, which also changes peoples' view on disability and special needs.

Second, solutions such as early warning systems can help reduce inequity by helping students at risk of dropping out from high school (or university) to graduate – students who drop out typically come from disadvantaged and minority backgrounds. Early warning systems also allow designing appropriate interventions by identifying the factors or indicators most likely to predict dropout (Bowers, 2021[13]). Some use of learning analytics within institutions, for example, to monitor student engagement or redesign study programmes, could also have the same effects (Ifenthaler, 2021[14]).

Third, the use of learning analytics as exemplified by personalisation at the individual level, be it using intelligent tutoring systems or learning analytics to keep students engaged in learning, all hold promise in reducing inequity, notably by supporting students with less prior knowledge to learn at the right

pace Box 4.2. provides an example of an online solution that reduced the learning gap between the strongest and weakest students in mathematics at the beginning of the intervention. There is, however, little evidence that adaptive learning generally reduces achievement gaps between students. Classroom analytics can also give feedback to teachers on how they could improve their teaching; specifically how and when to pay more attention to different group of students in their class, based on their academic level, gender, ethnicity, etc. Adaptive learning technology can help students practice and make progress at home, outside of the classroom, supported by intelligent tutoring systems. This may be particularly important for students coming from households where parents can support their students less effectively with their school work, be it directly or indirectly.

Box 4.2 Personalisation in maths homework can help reduce the achievement gap: a US study

Few studies show that adaptive technology (or personalised learning) reduces the achievement gap between students with more and less prior academic knowledge. And yet, in order for intelligent tutoring systems to reduce achievement gaps, this would indeed be the objective. Evaluated through a randomised control trial, an intervention in the state of Maine (United States) showed that this may become the case (Murphy et al., 2020[15]). Teachers in the intervention were asked to use ASSISTments software to provide students with mathematics homework. The system provides feedback to students as they solve mathematics homework problems and automatically prepares reports for teachers about student performance on daily assignments. Teachers received training and coaching on formative assessment. The study found that students in the schools that were assigned to ASSISTments learned more compared to their peers in the control schools, with large effect sizes, and that the impact was greater for students with lower prior mathematics achievement. The evaluation confirms initial results by (Roschelle et al., 2016[48]) which found both evidence of strong maths learning outcomes when using the platform and also a reduction of the achievement gap.

Source: (OECD, 2021[8]) OECD Digital Education Outlook 2021, Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots, https://doi.org/10.1787/589b283f-en.

LEVERAGING EFFICIENCY

In most sectors other than education, smart technologies are used as a tool to enhance the cost-efficiency of operations, notably by automating tasks and processes, making services faster and often cheaper (OECD, 2019[10]). While education might be behind most other sectors in this respect, digitalisation is also making many educational processes more efficient as interactions between stakeholders and educational institutions become increasingly automated. As noted above, also in teaching and learning, some degree

of automation is gaining ground. To what extent will digitalisation allow for enhanced cost-efficiency and productivity in education?

Any discussion of cost-efficiency should keep in mind that technology incurs investment and maintenance costs, which have to be compared with the costs of current arrangements. Digital technology has not always delivered on its cost-efficiency promises in the past because one has sometimes forgotten that, beyond the initial investment, it needs to be continuously upgraded, maintained, etc.

Nevertheless, as in other sectors, there are good reasons to believe that smart technologies could increase cost-efficiency in education.

One example lies in the application (and admission) process to educational institutions. These are increasingly undertaken through digital platforms, especially in higher education, where a "matching" (or selection) process is often necessary. In cases of open admission institutions, where no selection is required, implementing seamless automated processes is even easier. The implementation of the National Education Information System (NEIS) in Korea, an e-government system allowing, inter alia, for the digital transfer of students' academic records from one school to the other (as well as from school to university) was estimated to save USD 237 million a year in 2010 (KERIS, 2010[17]).

A second area where digitalisation can lead to cost-efficiency is the provision of verifiable degrees and other credentials on blockchain. The development of an infrastructure for digital credentials and the adoption of open standards will gradually lead to a different way of certifying and holding degrees, with individuals being able to manage their qualifications themselves. This is one of the strongest and most immediate arguments of cost-efficiency.

A third area where cost-efficiency is advancing is the collection of system-level statistical information. While statistical information often relied on the establishment of statistical panels (of representative samples of individuals or institutions) and often involved multiple handlings of the same data, the use of administrative data combined with the interoperability of diverse systems has made it much easier to get statistical information from operational services in almost real time (González-Sancho, 2016[18]).

A cost-benefit analysis comparing the benefits of smart technology, including non-financial ones mentioned above, to the benefits of existing solutions, will determine how cost-efficient it is for a given service or educational goal.

SMART TECHNOLOGIES AS SOCIO-TECHNICAL SYSTEMS

The emergence of smart education technologies or solutions powered by artificial intelligence, learning analytics, algorithms and other technologies presents many opportunities. At the same time, they raise important policy questions. How can governments best harness the benefits of technology in education while limiting its possible risks? This involves a good understanding of the opportunities and risks, both from a technical and political dimension. Equally important is social acceptance for those technologies.

Most smart education technologies currently available do not aim to replace teachers or human beings. They were developed with the current education model in mind and are designed as hybrid human-AI systems that require teacher-student interactions and human oversight of the machine at different points. Molenaar (2021[2]) offers a model to better understand the continuum between fully automated and teacher-only education. Most advanced personalisation solutions require teacher intervention or to alert teachers when they should intervene. For example, because students are struggling or need to move to another step of the learning process. Most solutions to support classroom orchestration are also hybrid solutions that merely scaffold teachers in implementing rich learning scenarios for their students.

As Dillenbourg (2021[6]) puts it, "there is a teacher in the loop" and classroom analytics are designed to support teachers in orchestrating the teaching and learning of students, and to provide them with rich learning scenarios – not to replace them.

Contrary to how robots are often presented in other sectors, social robots in education are also not designed to replace teachers, but to support their students for specific learning tasks, in the same spirit as personalisation tools. As of 2021, social robots were mainly effective in accomplishing narrowly defined tasks. They play the role of a teacher assistant, as computers do in their different ways. As for telepresence robots, they enable human teachers to be present from a distance. Good (2021[5]) provides a case showing how smart technologies for students with special needs may create new social relationships between learners and the humans in charge of providing them with appropriate learning tasks – rather than suppress them.

At the system and organisational level, the use of smart technologies follows the same pattern. Early warning systems help predict dropout, but they require a human intervention for "at risk" students not to drop out (Bowers, 2021[13]). Other types of learning analytics used within educational institutions to support decision making also provide information that needs to be acted upon; they do not make final decisions in the place of administrators and teachers (Ifenthaler, 2021[14]).

This is not to say that smart technologies never make decisions or are not designed for full automation. Personalisation systems, classroom analytics, and early warning systems all make some decisions to enact their next step or recommend one to human beings. But they typically only provide input to decisions. Game-based standardised assessments do more than provide a suggestion: they automatically score the test-takers and assess their skills – as is already the case with traditional computer-based standardised assessments. Blockchain technology does not make decisions, it just records trustfully what a variety of (usually) human actors have done, building on different social processes: accrediting institutions, awarding a qualification or credential, storing the credential on some blockchain, sharing the credential with other parties, verifying the authenticity of the credential, etc. (Smolenski, 2021[19]). But both cases also highlight the relevance of thinking of smart technologies as socio-technical systems, that is, systems in which social and technical features interact and are shaped together.

One of the challenges of game-based standardised assessments will be to create social acceptance, if not full trust, as was the case for traditional standardised assessments. Buckley et al. (2021[7]) note that building valid, reliable, and fair game-based assessments is considerably more complex and challenging than designing traditional standardised tests. While it solves a problem with a clear level of efficacy, one challenge to the widespread use of blockchain for credentialing also relates to social change and legal adaptations: social processes to certify credentials already exist and not everyone may be willing to change those social habits – or cope with the uncertainties attached to any new solution.

There are different ways to acknowledge the fact that most smart technologies are hybrid AI-human systems or that, more generally speaking, smart technologies are better designed and understood as socio-technical systems. One is to clearly communicate that while technology could play a bigger role in the future, it currently needs to be supplemented and controlled by human actions in most cases. The ways to recognise those current realities comprises two elements:

- Involving teachers, students and other end users as co-designers in the research and development process can help ensure the usefulness and use of smart digital solutions. It also helps the people involved to understand and shape the social context in which smart education technologies would best be used (the classroom, home, etc.). This should be an aim even when it is challenging to involve end users, for example, students with special needs.

- Public-private partnerships between government, technology researchers within universities and companies, and the education technology industry should be a key characteristic of most research and development projects in this area. This research should go beyond the functionality of technology to analyse how it is used in context and focus on the social and legal adjustments that would be required for their widespread adoption.

ALGORITHM ACCURACY

Smart technologies have made, and are making, very rapid progress. OECD's Digital Education Outlook illustrates their potential benefits in a wide range of educational areas both in terms of teaching, learning and administrative efficacy. Smart technologies often outperform traditional data analysis and technology thanks to more powerful algorithms. Game-based assessments allow skills to be assessed that are difficult to assess through traditional computer-based or paper-and-pencil tests. Personalisation adapts to learner characteristics in ways that pre-existing personalisation methods could not permit – and they possibly do it as well as human teachers. The new algorithms in early warning systems outperform traditional regressions in terms of predictive power and bring visibility to dropout patterns that were not traditionally acknowledged by human administrators or teachers.

Nevertheless, many of the smart technologies presented are not yet mature. In the areas of student engagement, (D'Mello, 2021[3]) points to new approaches that are developed to better measure students' engagement in learning using facial image analysis and other ways, but also notes the inaccuracy of many of the measures used in the field of learning engagement. In the area of classroom analytics, some solutions manage to identify whether learners are working individually or in groups with a very high level of accuracy (90%) but identifying the type of teaching and learning activity remains more challenging (67% of accuracy). These examples are encouraging, as accuracy levels can be very high, but show that this is not guaranteed for any AI-powered education application.

One policy challenge is to ensure that technology solutions perform their tasks with accuracy – or to get a clear sense of that level of accuracy. Despite the rapid advancement of smart technologies, computers and smart education technologies remain imperfect – though not necessarily more imperfect than humans. Some of those imperfections will probably be solved quickly while it may take much longer for others. But it is possible that for some tasks, smart technologies will never be perfectly accurate and remain confounded by false positives, etc. However, the real question is how they compare to humans. After all, humans perform tasks with levels of imperfection too, as the problems that they are addressing are usually complex. Whether full accuracy should be the expected standard is an open question. Probably this should depend on the social stakes related to the task. In many cases, an "accurate enough" diagnosis or decision should be sufficient.

Given that smart technologies are not fully mature and have some intrinsic limitations, it is important for users and governments to recognise those limits without preventing those technologies from improving through increased use. Some possible policy pointers to mitigate the limits of smart technologies while embracing their potential include:

- While smart education technologies can be useful before they are fully accurate (or even without being fully accurate), they should demonstrate a certain level of accuracy in their predictions and diagnoses when they support decision making. Education technology companies could be asked to demonstrate the level of accuracy or effectiveness of their technology solutions with different accuracy requirements depending on the stakes of the supported decision). Those accuracy requirements should ideally be compared with the current performance of human teachers and administrators.

- Until accuracy levels improve, smart education technologies should only inform human decision making and reflection rather than make fully automated decisions or support a decision process that will rarely deviate from their recommendations, especially for high-stakes solutions. Those technology requirements should have a risk-mitigation rather than no-risk policy, acknowledging that smart technologies can be beneficial even when they are not fully accurate. This may imply keeping humans in control in the final stages when social stakes are high.

DESIGNING FOR USE

Education technology solutions are sometimes designed and proposed because they are possible, rather than because they are useful and provide clear benefits to end users in education. Most education technology products are mere educational derivatives of solutions designed for other sectors. Even when technology applications are useful and beneficial, some teachers, learners and users may have no interest in using them. Instances of lack of use and lack of usefulness of education technology have given rise to several critiques of education technology (Cuban, 1986[20]); (Reich, 2020[21]) even though the increased use of technology in classroom instruction represents one of the biggest changes in classrooms of the 2010s (Vincent-Lancrin et al., 2019[22]).

One reason for this lack of use lies in the design of smart technology solutions or in an insufficient understanding of how teachers can use them in their professional practice in ways that support rather than distract them. For example, classroom analytics are useful when they make visible to teachers what is either invisible or not easy to see (either in real time or after class) and when they provide information that they can act upon and interpret (Dillenbourg, 2021[6]).

One aspect of smart technologies that makes them more or less useful relates to how they display final information to end users. The interface between technology and humans is essential. For example, research shows that different types of dashboards can be more or less effective to support teachers and learners, or more appropriate in certain contexts than others (Molenaar, 2021[30]); (Dillenbourg, 2021[34]). Dashboards typically display the final output of the analytics: they can take different forms (e.g. centralised, distributed, ambient) and use different display devices. While the mere appearance of physical social robots does not seem to matter much, social robots work better than virtual agents as users may relate to them in different ways than with a virtual image or a computer (Belpaeme and Tanaka, 2021[32]). The effectiveness of some solutions such as the ECHOES learning environment, which scaffolds autistic children's exploration and learning of social communication skills, partly lies in a setting that fosters communication between the autistic child and the adult monitoring the software and learning environment. This important dimension was actually discovered as the tool was tested and improved rather than as a preconceived use case, showcasing the importance in designing and adapting technology solutions with end users (Good, 2021[5]).

In some cases though, the usefulness of education technology may go beyond offering a technical solution to a specific problem. This is why usefulness and algorithmic accuracy are not always related: a solution with an algorithm accurately performing its task may not always be useful, while algorithms imperfectly performing their task may be useful in certain circumstances. Changing the stakeholders' mindset or catalysing some broader change within an institution or an education system may be its usefulness. Generally speaking, innovation is a driver of professional learning and change (Avvisati, 2013[23]); (Vincent-Lancrin, 2016[24]); (Vincent-Lancrin et al., 2019[25]). Smart technologies play the same role.

Ifenthaler (2021[14]) shows that many universities and institutions introduce learning analytics at the institution-wide level in order to change their organisational culture or processes, and perhaps sometimes

to foster new collaborations and ways of working between different stakeholders within the institution. Providing a solution to a specific problem or automating their processes may only be a secondary objective. Regardless of their effectiveness in reducing student dropout, one of the benefits that early warning systems (and the related research) has already delivered lies in a better and broader understanding of the circumstances leading students to drop out.

Bowers (2021[26]) shows that the traditional conception of students at risk of dropping out (as students with low and declining grades who do not like school) corresponds to only 38% of actual dropouts in the United States. As a result, traditional interventions miss out on the majority of students who actually drop out. Beyond providing real-time information, several of the functionalities of classroom analytics provide feedback to teachers on what happened in their class. This can help trigger professional reflection and learning, hopefully followed by behavioural change and improved teaching proficiency (Dillenbourg, 2021[6]).

If cheaper alternatives are available, in budget, time, cognitive load (or whatever relevant metric), new smart technology solutions may remain unattractive compared to existing human or older technology solutions. This is understandable when learning analytics predict, diagnose or act with little accuracy, but this can also be true for digital solutions with fully accurate or effective algorithms. Many of the digital tools that support teachers and administrators help them to solve very specific problems and sometimes the existing solutions may outperform the new ones. For example, at the system level, game-based assessments and simulations are likely to supplement rather than replace traditional standardised assessments based on batteries of questions: they are much more expensive to design, have less generalisability, and are only better suited to assess complex competences that are more difficult (or impossible) to assess through cheaper traditional alternatives (Buckley et al., 2021[7]). Smolenski (2021[19]) shows that blockchain has the potential to make the credentialing process more cost-efficient and simple for individuals. Blockchain technology can be superior to other technologies in enabling the detection of fraud, for example, but is not necessarily the sole solution to many situations.

One last important point on usefulness relates to the affordability of smart technologies for public establishments and individuals. In the context of education systems, digital technology has to be affordable or it will be out of reach for many. As noted by Good (2021[5]) in the case of students with special needs, smart technologies should be designed to run on low-cost and widely available platforms or devices. This is not always the case but remains one of the conditions to ensuring their benefits are widely accessible. Smolenski (2021[19]) also highlights the importance of open standards in the case of blockchain, partly as a way to make long term costs lower and ensure the solution is more sustainable for the end users (both institutions and individuals). This is true with many other technologies: open standards allow for greater interoperability, more sustainability over time, more competition among vendors, and often lower user costs. Technology solutions that run on widely available platforms are also more affordable and useable than specialised devices.

Several key messages emerge in terms of enhancing the usefulness and usage of smart technologies in education:

- Cost-benefit analysis should typically guide the design and adoption of smart digital solutions for different types of problems, acknowledging that benefits and costs are not just pecuniary.
- While the benefits of any solution may go beyond immediate student academic learning gains, and the costs, beyond merely financial ones, both the expected costs and benefits of smart technologies should be clearly identified and estimated either through research evidence when available and possible or a good theory of action (or theory of change).

- The display (or communication) of information provided by learning analytics and other technology matters in making smart technologies useful to students, teachers and decision makers. More broadly speaking, the design of the interface between human and smart education is often a key aspect of the useability and impact of digital solutions on learning or other targeted goals.
- Smart technology solutions should aim to be low cost and run on widely available platforms/devices to be as affordable as possible, possibly using open standards (and interoperability standards). Governments can support the development of those standards, preferably at the international level. Attention to affordability is essential to making smart technologies accessible to all so as not to reinforce the digital divide. Ensuring smart technology solutions can benefit all learners or institutions is key to equity and inclusiveness.

SMART TECHNOLOGY AND DATA GOVERNANCE: TRANSPARENCY, FAIRNESS AND ETHICS

One key element of any socio-technical system is the broader social context in which the system operates, including its values and principles. Because they rely on large amounts of education data, including sometimes personal data (such as biological markers, face recognition or expression, etc., or require a permanent monitoring and tracking of learners, classrooms or institutions) common concerns about the development and use of smart technologies relate to data protection and privacy, but also to ethical and political concerns. Could - or should - education establishments and systems become a new version of "Big Brother" for the sake of improved learning outcomes? Can governments and other parties be trusted to use this information for the sake of educational improvement – and to enforce robust data protection regimes? What could be the adverse consequences of this use, if not done properly, either in the present or in the future? Could data-rich education technologies, for example, perpetuate and reinforce biases and inequity? These are all tricky questions that do not necessarily have simple answers. Ultimately, embracing smart technologies implies some trust in how they are used, credible safeguards, and some level of understanding and acceptance of their processes and outputs.

Most OECD countries have strong data protection regulation. This is to ensure that personal education data cannot be shared with (or used by) third parties beyond the educational processes for which they are collected unless certain privacy conditions are met. This is the case in the Europe Union with the General Data Protection Regulation (GDPR) and in the United States with the Family Educational Rights and Privacy Act (FERPA), which have both influenced many other data protection laws across countries. Much of the data concerns administrative micro-data (González-Sancho, 2016[18]). The data protection regime usually extends to vendors providing technology solutions to schools and education administrations. It is noteworthy that the enforcement and implementation of data protection regulations can vary from one country to the other (or even within a country). Given these arguably strong safeguards, the fact that privacy and data protection issues remain central in public discussions may point to a lack of trust in how the data are used (or could be used) within the education system and beyond.

Data protection is just one aspect of data governance though. One important question relates to the relationship between governments, the data subjects (who are often the users of, sometimes mandatory, education services), and the private sector that usually develops smart education technologies. This relates to questions of data ownership and of competition policy in the digital world: how should administrative and other education data be shared across education technology companies and public researchers to allow for progress and competition in the smart education technologies sector? How can the interests of learners and other individuals be best preserved in this context? Solutions proposed for sectors outside of the education world could probably be adapted to suit educational needs (OECD, 2019[27]); (OECD, 2019[28]).

Ethical discussions should normally concern what is not regulated within a country and thus aspects for which individuals and authorities have more freedom of action. This is how we interpret the question of "ethics" in educational AI.

The regulation of algorithms is usually not as strong as regulation for data protection. A major concern about algorithms is that they could be biased and have an undesirable social impact for some population groups (based on gender, ethnicity, socio-economic status, etc.) – but also that they could be flawed or just reinforce past human biases rather than reflect current societal values. A usual requirement is to ensure they are transparent and open, and that their "decisions" can be explained and challenged when automated. In the case of the EU General Data Protection Regulation, the regulatory language about algorithms is ambiguous (articles 13-15, 22, and recital 73) and lawyers are still debating what those articles imply in terms of "right of explanation" (transparency) and of the possibility to opt out of or challenge "automated decisions" for citizens. In the European Union, only the French and Hungarian laws have an explicit law about the "right of explanation" (with French law requiring both ex-ante and ex-post explanation in an intelligible way, and Hungarian law, some level of explanation) (Malgieri, 2019[29]). In the United States, there is no regulation about algorithms and their requirements as part of FERPA (or other regulation). Most OECD countries do not have clear regulatory requirements about them as of 2023.

Because algorithms based on machine learning are trained with historical data, many observers are concerned they will reproduce past biased (human) practices, as has apparently been the case in some countries in domains other than education (finance, justice, etc.) (O'Neil, 2016[30]). Several guidelines have been developed to avoid these pitfalls, which can happen at different steps of the process: measurement (data collection or labelling), model learning (when machine learning is involved), and action (when the algorithms detect, diagnose and act, for example). Different possible measures of fairness are also possible, which makes the issue even more complex (Kizilcec, 2020[31]); (Baker and Hawn, 2021[32]). Ifenthaler (2021[14]) mentions several check lists of good practice and ethics for learning analytics. Bowers (2021[13]) points to the "open algorithm" movement in the area of early warning systems and notably to two overlapping sets of criteria to ensure transparency, verification and replicability of algorithms: the AAAA (accurate, accessible, actionable and accountable) and FAIR (findable, accessible, interoperable and reproducible) principles. Molenaar (2021[2]) also points to the importance of transparency to govern learning analytics and algorithms. As was shown in 2019 with some difficulties around exams and grade assignment for university admission in England, when it comes to high-stakes automated decisions, transparency is also about initiating an early dialogue about the criteria, expected social outcomes, relevance and acceptability of smart algorithms with diverse stakeholders from experts through to final users and other social bodies. In some cases, the algorithms can be human-coded rather than involve AI techniques.

Ethical concerns should include a verification and discussion of the effects of smart technologies on different groups and ensure they are aligned with countries' social and political principles. As few people are, in practice, able to verify the effects and impacts of algorithms, some independent groups of stakeholders may be responsible for or even assigned this task. While anyone should be allowed to do it in the frame of an open algorithm culture (at least when algorithms lead to a decision or a quasi-decision), education researchers, non- governmental organisations, but also, possibly, independent governmental agencies, could play an enhanced role in this area.

In the case of the most advanced applications of learning analytics based on a continuous monitoring of individuals (e.g. engagement, self-regulation, classroom orchestration, game-based assessments), another question is whether stakeholders feel comfortable with some aspects of the applications even

if they are legal. While the tracking and data collection necessary to power learning analytics focusing on student engagement, self-regulation or classroom orchestration have to comply with domestic data protection regulations (and algorithm regulation, if any), the question is how to make them compatible with the political values of the country where they are implemented. This may require some imagination in terms of data protection arrangements (such as deleting immediately the data once processed). As in the exam case mentioned above, this also requires a social negotiation with all stakeholders, including transparency about data collection and how they are used. This is not just a matter of regulation or even perceived ethics. Even within the same country, what is acceptable to some communities may not be elsewhere, depending on how smart technologies are introduced.

ENCOURAGING INNOVATION INSIDE AND OUTSIDE OF SCHOOL

When other sectors see flat-lining productivity they look to innovation. In education, systematic investment in innovation is still rare. Public health-research research budgets in OECD countries are 17 times larger than education-research budgets. That says a lot about the role that we expect knowledge to play in advancing practice. Beyond the volume of innovation, its relevance and quality are also important, alongside how fast the idea progresses to having a positive impact.

Innovative change can be more difficult in hierarchical structures that are geared towards rewarding compliance with rules and regulations. One policy approach to foster innovation in education has been to increase autonomy, diversity and competition among educational institutions. But evidence of the benefits of this approach remains patchy.

Innovation in governance is one challenge, innovation in the instructional system another. There is a long history of introducing new methods in education – whether it was television, video, digital whiteboards or computers – in the hope of radically improving teaching and the effectiveness of schooling, only to find, at best, incremental change achieved at higher cost and complexity.

But the bigger issue is that, even where good education research and knowledge exists, many practitioners just do not believe that the problems they face can be solved by science and research. Too many teachers believe that good teaching is an individual art based on inspiration and talent, and not a set of skills you can acquire during a career. Yet it would be a mistake to blame just teachers for that. This problem often goes back to policy due to a lack of incentives and resources to codify professional knowledge and knowhow. In many countries, the room for non-teaching working time is far too limited for teachers to engage in knowledge creation. Because education has not been able to build a professional body of practice, or even a common scientific language as other professions have, practice is often not articulated, invisible, isolated and difficult to transfer. Investing in better knowledge – and disseminating that knowledge widely – must become a priority; it promises to deliver huge rewards.

It is also important to create a more level playing field for innovation in schools. Governments can help strengthen professional autonomy and a collaborative culture where great ideas are refined and shared. Governments can also help with funding, and can offer incentives that raise the profile of, and demand for, what works. But governments alone can only do so much. Silicon Valley works because governments created the conditions for innovation, not because governments do the innovating. Similarly, governments cannot innovate in the classroom; they can only help by opening systems so that there is an innovation-friendly climate where transformative ideas can bloom. That means encouraging innovation within the system and making it open to creative ideas from outside. More of that needs to be happening.

Policy makers often view education industries as providers of goods and services to schools. They tend to underappreciate that innovation in education is also changing the very environment in which schools

operate. In particular, technology-based innovations open up schools to the outside world, both the digital world and the social environment. They also bring new actors into the system, including education industries with their own ideas, views and dreams about what a brighter future could hold.

It is difficult for education systems to treat industry as a valuable partner. Fears of a perceived "marketisation" of education, or the displacement of teachers by computers, often endanger what could be a fruitful dialogue. At the same time, we should be more demanding of the education industry. Most of our children would not voluntarily play with the kinds of software that companies are still able to sell to schools. Is innovation in the education industry as dynamic as it should or could be? Can we break the cartel of a few large suppliers of educational resources who use an army of salespeople to sell their services to a fragmented market? Can we overcome the slow sales cycles, where buyers have to deal with layers and layers of people all "in charge"?

Is it possible to create a business culture for managing innovation in school systems? At the moment, it is easier for administrators to buy new tools and systems, as well as use existing staff, because this costs them "nothing". The treatment of teacher time as a sunk cost means people see no benefit to saving this time. It is worthwhile to explore how industry can help the education sector close the productivity gap with new tools and new practices, organisations and technology.

Finally, education systems need to better identify key agents of change and champion them; and they need to find more effective ways of scaling and disseminating innovations. That is also about finding better ways to recognise, reward and celebrate success, to do whatever is possible to make it easier for innovators to take risks and encourage the emergence of new ideas. One of the most devastating findings from our first survey of teachers (TALIS) was that three in four teachers in the industrialised world consider their workplace an environment that is essentially hostile to innovation. More recent surveys have shown that situation is changing. However, policymakers need to ensure that the use of technology to enhance teaching and learning is not a missed opportunity. Nothing will change unless we embrace the future and continually strive to improve.

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