Effective Teacher Policies

INSIGHTS FROM PISA

OECD

PISA

Effective Teacher Policies

INSIGHTS FROM PISA

Please cite this publication as:
OECD (2018), *Effective Teacher Policies: Insights from PISA*, PISA, OECD Publishing.
http://dx.doi.org/10.1787/9789264301603-en

ISBN 978-92-64-30159-7 (print)
ISBN 978-92-64-30160-3 (PDF)

Series: PISA
ISSN: 19908539 (print)
ISSN: 19963777 (online)

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Foreword

What wise parents want for their children is what governments should want for all children. Everywhere, children from wealthier families will find open doors to a successful life. But children from poor families often have just one single chance in life, and that is a good school that gives them the opportunity to develop their potential. Those who miss that boat rarely catch up, as subsequent education opportunities in life tend to reinforce early education outcomes. Achieving greater equity in education is not just a social justice imperative, it is also a way to use resources more efficiently, and to increase the supply of knowledge and skills that fuel social and economic development and cohesion.

Most education systems now recognise this challenge. The discourse in education policy has advanced considerably from equality (where the assumption was that all students benefit from the same support), to equity (where all students get the support they need), to justice (where all students succeed because inequities in opportunities have been redressed). And yet, successive PISA assessments have shown that, in most countries, a student's or school's postal code remains one of the best predictors of success in education. So what stands between educational aspirations and reality?

PISA 2015 offers an important innovation by integrating a survey of teachers into the assessment; *Effective Teacher Policies* presents first findings from this survey. To some extent these findings are encouraging: more than half of the 69 countries and economies with comparable data now invest more teachers per student into disadvantaged than privileged schools. At the same time, few countries succeed in attracting the most qualified teachers to the most challenging schools. Quite the opposite, in fact: in most countries, teachers in disadvantaged schools are less-qualified and less-experienced, and principals feel that the lack of qualified teachers is a major barrier to overcome disadvantage and improve learning. This makes a big difference, because while the gap in academic achievement between advantaged and disadvantaged students seems unrelated to differences in class size, inequalities in outcomes are much larger in countries where teachers' qualifications and experience are inequitably distributed.

Intuition might suggest that where the hiring of teachers is centrally managed, teacher allocation would end up being more equitable. But the data suggest otherwise. In those countries where schools have greater autonomy over the hiring of teachers and over establishing their salaries, the quality of teachers seems to be better aligned to meet the needs of students and schools.

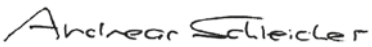
That obviously doesn't mean that increasing school autonomy will improve equity in teacher allocation. But it does suggest that school systems with an enabling and flexible work organisation that places considerable responsibility at the frontline also tend to be good at establishing conditions that better align resources with needs. So it is possible to reconcile aspirations for greater flexibility with the need to ensure quality, equity and coherence in school systems.

The report also shows that high-performing education systems tend to emphasise clinical education as part of initial teacher education; they provide bespoke opportunities for in-service teachers' professional development; and they put teacher-appraisal mechanisms in place that have a strong focus on teachers' continuous improvement. We know those things now because the OECD no longer collects data from students and teachers in isolation, but in a way that allows the two sets of data to be analysed jointly – and, intentionally, not at the level of individual teachers and schools, but in a way that provides education systems with insights into how to ensure that every student benefits from excellent teaching. This marks a major step forward for PISA's aim to help countries design more effective policies.

Of course, that is all easier to say than to do. It will always be difficult for teachers to allocate scarce additional time and resources to the children with the greatest need. People who laud the value of diversity in classrooms are often talking about the classes other people's children attend; it is hard to convince socio-economically advantaged parents whose children go to school with other privileged children that everyone is better off when classes are socially diverse. Policy makers, too, find it challenging to allocate resources where the challenges are greatest and where those resources can have the biggest impact, because poor children usually don't have someone lobbying for them.

But what could be more important than better supporting those teachers and schools working in the most difficult circumstances with holistic approaches in which teachers feel backed in their professional and personal life when they take on additional challenges, and when they know that additional effort will be valued and publicly recognised?

The results from PISA show that this can be done, and in some countries – and in some schools in many countries – even the most disadvantaged children are high performers. It is within our means to deliver a future for millions of learners who currently do not have one.



Andreas Schleicher
Director for Education and Skills

Acknowledgements

This report is the product of a joint effort between the countries participating in PISA and the OECD Secretariat. The report was prepared by Francesco Avvisati; Noémie Le Donné (OECD) drafted Chapter 3 with Francesco Avvisati, and provided input to all remaining chapters; Francesca Borgonovi (OECD) and Seong Won Han (University at Buffalo) drafted Chapter 4 with Francesco Avvisati. Marilyn Achiron edited the report and Guillaume Bousquet provided statistical support. Andreas Schleicher, Yuri Belfali, Pablo Fraser, Miyako Ikeda, David Liebowitz, Adrien Lorenceau, Anna Pons and Karine Tremblay provided valuable feedback at various stages of the report. Rose Bolognini and Rebecca Tessier co-ordinated production and Fung Kwan Tam designed the publication. Administrative support was provided by Juliet Evans, Thomas Marwood, Lesley O'Sullivan and Hanna Varkki. The development of the report was steered by the PISA Governing Board, chaired by Michelle Bruniges (Australia), with Jimin Cho (Korea), Maria Helena Guimarães de Castro (Brazil) and Carmen Tovar Sánchez (Spain) as vice chairs.

Table of Contents

BOX

FIGURES

Executive Summary

Teachers are the most important resource in today's schools. Improving the effectiveness, efficiency and equity of schooling depends, in large measure, on ensuring that competent people want to work as teachers, that their teaching is of high quality and that high-quality teaching benefits all students.

Teacher policies are the regulations and principles that shape the development of teachers and what they do. This report explores three teacher-policy questions: How do the best-performing countries select, develop, evaluate and compensate teachers? How does teacher sorting across schools affect the equity of education systems? And how can countries attract and retain talented men and women to teaching?

WHAT THE DATA TELL US

Using data from the 2015 cycle of the Programme for International Student Assessment (PISA) and other related databases, this report shows that:

- A variety of approaches to selecting and evaluating teachers, and a wide range of career and compensation structures for teachers, can be found across the best-performing countries in PISA. But at least three elements tend to be common to high-performing countries' professional development policies for teachers: a mandatory and extended period of clinical practice as part of pre-service teacher education or of the induction period; the presence of a variety of bespoke opportunities for in-service teachers' professional development, such as workshops organised by the school; and teacher-appraisal mechanisms with a strong focus on teachers' continuous development.
- On average across countries and economies that participated in PISA 2006 and PISA 2015, increases in school responsibility for selecting teachers for hire were associated with improvements in student achievement; reductions in school responsibility were associated with declining student achievement. However, the causal nature of this association cannot be determined.
- In 2015, a majority of countries and economies that participated in PISA compensated disadvantaged schools with smaller classes and/or lower student-teacher ratios. However, in more than a third of countries and economies, teachers in the most disadvantaged schools were less qualified or less experienced than those in the most advantaged schools.

- Gaps in student performance related to socio-economic status were wider in countries where socio-economically disadvantaged schools employed fewer qualified and experienced teachers than advantaged schools.
- Greater school autonomy for managing teachers is associated with more equitable sorting of teachers across schools.
- In 2015, and on average across OECD countries, about 4.2% of 15-year-old students expected to work as teachers – a greater proportion than the current share of teachers in the adult population.
- In 2015, in many countries, students who expected to work as teachers had weaker mathematics and reading skills than students who expected to work in other professions that, like teaching, require at least a university degree. The skills gap between students who expected a career in teaching and students who expected a career as other professionals was often larger in low-performing countries than in top-performing countries. At the same time, the OECD Survey of Adult Skills shows that, in most countries, the literacy and numeracy skills of teachers are on par with those of other college graduates.
- Countries with higher teachers' salaries (relative to GDP) had, on average, larger shares of students who expected to work as teachers. And while in all countries girls were more likely to expect a career in teaching than boys, students' expectations of a teaching career were more gender-balanced in countries with higher teachers' salaries. However, there is no evidence that higher salaries attract high-achieving students into the teaching profession more than low-achieving students.

WHAT THESE RESULTS IMPLY FOR POLICY

The findings show that, contrary to what is often assumed, high-performing systems do not enjoy a natural privilege simply due to a traditional respect for teachers; they have also built a high-quality teaching force as a result of deliberate policy choices, carefully implemented over time. The findings also show that there are multiple models from which other countries can derive inspiration. The fact that high performers are found on three continents and within different traditions of public governance and employment implies that incremental reforms, progressively implemented over time and within the constraints set by larger school policies and social contexts, can go a long way towards improving a system's capacity to select, develop and retain more effective teachers, and ensure that the most talented teachers operate in the most challenging schools and classrooms.

Opponents to school autonomy often voice concerns that greater independence of schools might lead to greater disparities in student performance and, perhaps more worryingly, to an education system that exacerbates existing economic and social inequities. However, the data suggest that this is not the most common result of greater school autonomy. In fact, many countries have been able to combine extensive autonomy of schools with strong incentives to ensure that schools prioritise student learning over other considerations, and with compensatory funding mechanisms to ensure that equity is not jeopardised. If school leaders have some freedom to adapt teachers' responsibilities, working conditions and pay to reflect the difficulty of tasks, they are better able to attract the most talented teachers to the most challenging classrooms.

Still, the report shows that inequities in access to quality teachers and teaching affect both countries with centralised traditions and countries with decentralised traditions of teacher selection and allocation; and that they are strongly related to inequities in learning outcomes between advantaged and disadvantaged students.

These results imply that most countries could do more to oversee how teachers are allocated to schools. This includes not just monitoring the number of teachers, but also keeping a close eye on their qualifications, experience and effectiveness. Any teacher policy that aims to tackle student disadvantage should strive to allocate quality teachers, and not just more teachers, to underserved students.

In addition to limiting the inequitable sorting of teachers across schools, many education systems can also do more to address the needs of all teachers, particularly novice teachers, in disadvantaged schools. Much can be done during initial training and, later, through mentoring and bespoke professional-development opportunities, to equip teachers with the skills needed to work in disadvantaged schools and with an understanding of the social contexts of those schools and their students. Supporting teachers in their most challenging tasks could also help ensure that experienced teachers remain in the profession.

Reader's Guide

Data underlying the figures

The data referred to in this volume are presented in tables available on line. A full list of links to access the tables is included in Annex B.

These symbols are used to denote missing data:

a The category does not apply in the country concerned. Data are therefore missing.

c There are too few observations or no observation to provide reliable estimates (i.e. there are fewer than 30 students or fewer than 5 schools with valid data).

m Data are not available. These data were not submitted by the country or were collected but subsequently removed from the publication for technical reasons.

Country coverage

This publication features data on 72 countries and economies, including all 35 OECD countries (indicated in black font in figures) and 37 partner countries and economies (indicated in blue font in figures).

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Two notes were added to the statistical data related to Cyprus:

Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

B-S-J-G (China) refers to the four PISA-participating China provinces: Beijing, Shanghai, Jiangsu and Guangdong.

...

International averages

The OECD average corresponds to the arithmetic mean of the respective country estimates. It was calculated for most indicators presented in this report. For some indicators, data may not be available for all countries, or specific categories may not apply. Readers should, therefore, keep in mind that the term "OECD average" refers to the OECD countries included in the respective comparisons. In cases where data are not available or do not apply for all sub-categories of a given population or indicator, the "OECD average" may be consistent within each column of a table but not necessarily across all columns of a table.

In analyses involving data from multiple years, the OECD average is reported on consistent sets of OECD countries, and several averages may be reported in the same table. For instance, the "OECD average-35" refers to the average across all 35 OECD countries, and is reported as missing if fewer than 35 OECD countries have comparable data; the "OECD average-33" includes only 33 OECD countries that have non-missing values across all the assessments for which this average itself is non-missing. This restriction allows for valid comparisons of the OECD average over time.

For analyses based on teacher questionnaire data, the average across the 18 countries and economies participating in this optional component of PISA 2015 was computed (Average-18).

Rounding figures

Because of rounding, some figures in tables may not add up exactly to the totals. Totals, differences and averages are always calculated on the basis of exact numbers and are rounded only after calculation.

All standard errors in this publication have been rounded to one or two decimal places. Where the value 0.0 or 0.00 is shown, this does not imply that the standard error is zero, but that it is smaller than 0.05 or 0.005, respectively.

Reporting student data

The report uses "15-year-olds" as shorthand for the PISA target population. PISA covers students who are aged between 15 years 3 months and 16 years 2 months at the time of assessment and who are enrolled in school and have completed at least 6 years of formal schooling, regardless of the type of institution in which they are enrolled, and whether they are in full-time or part-time education, whether they attend academic or vocational programmes, and whether they attend public or private schools or foreign schools within the country.

Focusing on statistically significant differences

This volume discusses only statistically significant differences or changes. These are denoted in darker colours in figures and in bold font in tables. See Annex A for further information.

…

Abbreviations used in this report

ESCS	PISA index of economic, social and cultural status
GDP	Gross domestic product
ICT	Information and Communications Technology
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
PPP	Purchasing power parity
S.D.	Standard deviation
S.E.	Standard error
Score dif.	Score-point difference
% dif.	Percentage-point difference

Further documentation

For further information on the PISA assessment instruments and the methods used in PISA, see the *PISA 2015 Technical Report* (OECD, 2017[1]).

StatLinks

This report uses the OECD StatLinks service. Below each table and chart is a url leading to a corresponding Excel™ workbook containing the underlying data. These urls are stable and will remain unchanged over time. In addition, readers of the e-books will be able to click directly on these links and the workbook will open in a separate window, if their internet browser is open and running.

Reference

OECD (2017), *PISA 2015 Technical Report*, PISA, OECD Publishing, Paris, www.oecd.org/pisa/data/2015-technical-report/. [1]

1

Overview: Teacher Policies Matter

This chapter defines teacher policies and the scope of this report. It then presents the main findings about the variation and effectiveness of teacher policies based on analyses of data from the Programme for International Student Assessment (PISA) and related databases. It concludes by outlining the implications for education policy and practice.

Note regarding B-S-J-G (China)
B-S-J-G (China) refers to the four PISA participating China provinces : Beijing, Shanghai, Jiangsu, Guangdong.

Note regarding CABA (Argentina)
CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.

Note regarding FYROM
FYROM refers to the Former Yugoslav Republic of Macedonia.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The quality of an education system depends on the quality of its teachers; but the quality of teachers cannot exceed the quality of the policies that shape their work environment in school and that guide their selection, recruitment and development.[1]

Analyses in this report use students' performance in assessments of science, reading and mathematics, and students' reports about the school climate, to indicate the capacity of schools and school systems to deliver excellent, equitable and inclusive education. While excellence, equity and inclusion are the effects of many causes, good teacher policies are the foundations on which successful school systems are built. Examples of effective teacher policies can therefore be found by analysing how the most successful schools and systems select, recruit and develop their teachers. The report builds on the analytical framework for teacher policies, developed in the publication, *Teachers Matter* (OECD, 2005[1]), and updated subsequently, and refers to the comparative data and indicators on teacher policies, teacher characteristics, and teacher working conditions produced by three OECD programmes: the Indicators of Education Systems (INES) programme, the Teaching and Learning International Survey (TALIS) and the Programme for International Student Assessment (PISA).[2]

Most of the analyses in this report are correlational in nature, and cannot provide definitive evidence that certain policies or practices have a specific effect, either when implemented in concert or individually. While this limitation is explicitly acknowledged in each chapter, establishing such associations can nevertheless help verify – and dispel – certain myths about teachers and performance in PISA.[3] The association of a particular policy with a specific outcome constitutes one piece of evidence among many (and particularly in conjunction with research evidence from national contexts) to reduce the uncertainty around the merits of this policy. Not all findings in this report suffer equally from this limitation, however. Discussions related to inequalities in teacher resources between schools (see Chapter 3) constitute the most ambitious effort to date to map these disparities by using internationally comparable indicators.

WHAT ARE TEACHER POLICIES?

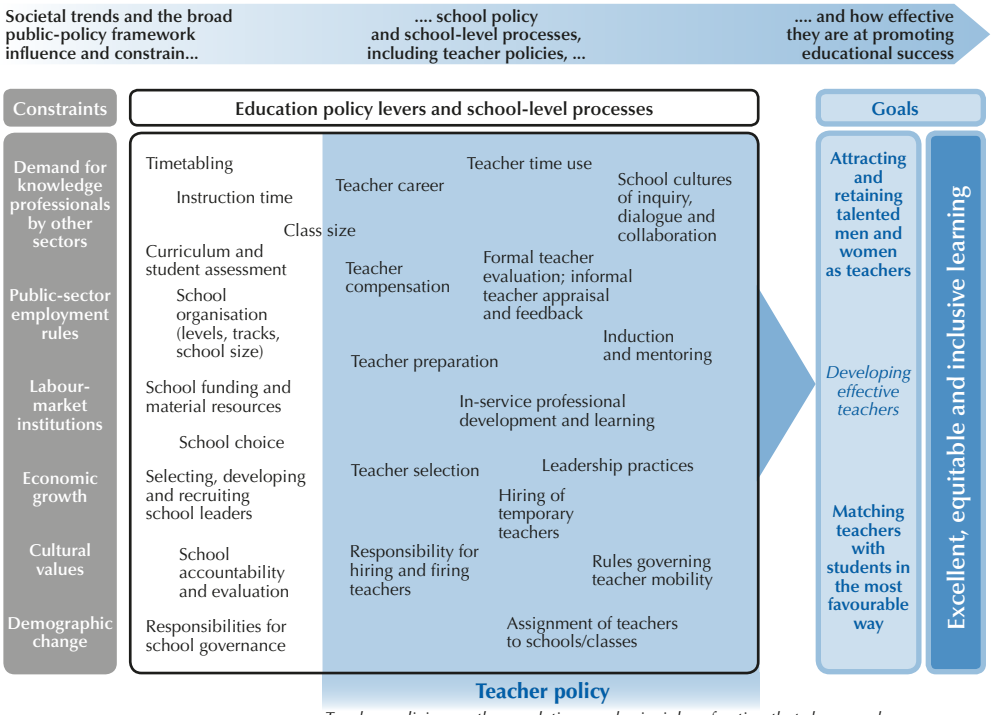
Broadly defined, teacher policies are the regulations and principles of action at the levels of schools and education systems that shape, in a particular time and place, the teaching force and what teachers do. Existing definitions of "teacher policies" comprise several common elements. The *Teachers Matter* report (OECD, 2005[1]), for example, covers policies related to "attracting, recruiting, developing and retaining effective teachers". The same report further classifies these policies into five main clusters: policies related to the preparation and development of teachers (what does it take to become a teacher?); policies related to career structure and incentives (what motivates individuals to work as teachers?); policies that influence the demand for teachers (such as class size, teaching loads, timetabling, etc.); policies that govern and structure the labour market (how are teachers matched to vacancies?); and school processes and practices that influence the work of teachers. These policies are embedded within the larger school policies and societal contexts. Similarly, the term "teacher-related policies" covers the processes of "recruitment, assignment, compensation, evaluation, promotion and retention" of teachers in the review article by Jackson, Rockoff and Staiger (2014[2])

A more recent publication, *Empowered Educators* (Darling-Hammond et al., 2017[3]) emphasises school processes and peer relationships to a larger extent, and identifies the following areas as

having a direct influence on teachers and their work: recruitment (including selection) processes and regulations, teacher preparation, induction and mentoring, professional learning, teacher feedback and appraisal, and career and leadership development. More indirectly, school policies, such as school curricula, assessments and accountability, school-funding strategies, and school organisation and scheduling, also influence and constrain the work of teachers.[4]

Figure 1.1 highlights the main elements of the conceptual framework for this report. This framework views education policy as embedded in a particular society and constrained by the wider institutional and cultural environment of a particular place and time. By setting rules for the school system and guiding the actions of local decision-makers, education policy makers aim to promote excellent, equitable and inclusive learning. Their success in achieving this ultimate goal depends on the policies they choose, and also on how particular policies interact with each other and with the wider environment in which they are applied.

Figure 1.1 ■ **Conceptual framework for analysing teacher policy**



Teacher policies are the regulations and principles of action that shape and constrain who teachers are and what teachers do, through their direct influence on teacher selection, development and allocation.

Notes: The figure presents the main constraints, levers and goals of teacher policy, as defined in this report.
Countries' and schools' success in attaining the goals of teacher policy, and of education policy more generally, is measured through PISA assessments and PISA student, school or teacher questionnaires; the goal of "developing effective teachers" is indicated in italics because no measure of teacher effectiveness is developed in this report.
For further details, please refer to the text.

More specifically, teacher policy is concerned with three intermediate goals: attracting talented men and women to teaching, and retaining them; developing effective teachers; and matching teachers with students in the most favourable way (given the ultimate goal of promoting excellent, equitable and inclusive learning). To study teacher policies means analysing those education policies and school-level practices that most directly relate to these three goals, while acknowledging that these policies and practices are influenced by and interact with a broader set of school policies to produce their results. The regulations and principles of action enumerated in Figure 1.1 constitute, in reality, integrated systems or policy environments, with strong inter-dependencies not only among teacher policies, but also between teacher policy and other areas of school policy, as well as between education policy and the constraints set by the public-policy framework or by societal trends.

This report describes how the rules and actions that govern the aspects highlighted in blue in Figure 1.1, and referred to as "teacher policies", differ across schools and education systems. It then analyses how this variation is related to the capacity of schools and education systems to nurture excellence, equity and inclusiveness, as indicated by student outcomes in PISA, and to two more immediate goals of teacher policy, namely attracting talented men and women to the teaching profession, and matching teachers and students in the most favourable way. The three remaining chapters in this report discuss key goals of teacher policy and of education policy more broadly: nurturing excellent and inclusive learning; ensuring fair and equitable access to education for all; and renewing the teaching profession to ensure its long-term sustainability.

Not all areas that define a system's "teacher policy" and influence the quality of teachers and teaching are covered in the same detail in this report. The attention given to particular aspects often depends on the availability of data in PISA and in other related databases; and inevitably, the emphasis in this report is on those levels of education in which 15-year-olds are enrolled. For a relatively large set of policies, system-level data are available, and can be related to the variation among countries in student outcomes.[5] For a more restricted set of aspects, PISA questionnaires are used to determine their immediate effects on school and teacher characteristics (e.g. the qualification level of teachers, as a measure of initial teacher education). In these cases, and if deemed appropriate, the within-country variation in teacher characteristics and policies, and how it relates to the variation in student composition and student outcomes, is also analysed.

Some areas of teacher policies and of wider education policies with which teacher policies closely interact receive only scant, if any, coverage in this report. The most important omissions are related to rules and principles of action governing teachers' use of time; to the career structure for teaching professionals, which is largely unique to every country and education system; and to school cultures, knowledge flows, and personal relationships that characterise the organisation of schools.[6]

Among teacher policies, school autonomy in hiring, compensating and firing teachers is particularly emphasised in this report. Greater school autonomy increases recruitment and management costs, making it harder to provide consistent service. For this reason, granting schools greater responsibility for hiring teachers could lead to greater disparities in teachers' qualifications and experience among schools (OECD, 2005, p. 12[1]). Managing these risks requires greater care in selecting and training principals and other school leaders, and providing schools in unpopular locations with significantly more resources to remain attractive. More centralised systems, on the other hand,

might find it more difficult to adapt to the diverse and rapidly changing situations in which schools operate. When teacher allocation and promotion is governed by impersonal rules, those rules might result in suboptimal matches between teachers' talents and preferences on the one hand and the needs of schools and students on the other. Many systems combine multiple levels of governance precisely in order to avoid the dangers of both excessive fragmentation and centralisation.

School autonomy in hiring, compensating and firing teachers is often constrained by the broader policy framework and by labour-market institutions, including, for example, unions. In most countries, schooling is principally a public-sector activity. Central or local governments either directly run schools or they provide much of the funding that other organisations use for their schools. As a consequence, in most countries, teachers' employment and the level of responsibility that schools have for hiring and firing teachers is fundamentally shaped by wider public-sector employment policies and practices. Most teachers are either civil servants or are employed under conditions similar to those in the civil service.

There are two basic models of public-sector employment: "career-based" and "position-based" (OECD, 2005[1]; OECD, 2004[4]).

The predominant model for teacher employment in OECD countries is "career-based" public service in which entry is competitive, career development is extensively regulated and lifetime employment is largely guaranteed. Because teachers cannot easily be removed for unsatisfactory performance, the quality of teachers depends mainly on setting high standards for entering teacher-preparation programmes and for the quality of initial preparation, and on the attention given to the quality of teachers' preparation in selection and recruitment processes. This is the prevalent model in France, Italy, Japan and Korea, for example.

By contrast, some countries have "position-based" public service. In these countries, which include Canada, Sweden, Switzerland and the United Kingdom, public servants are required to apply for specific positions by showing that their competencies match specific job requirements. While this can increase recruitment and management costs, and make it harder to provide consistent service, it is often associated with a more flexible labour market for teachers, with multiple points of entry and greater roles for teacher appraisal and in-service training as levers for teacher improvement.

Many countries blend elements of career-based and position-based employment. For example, some countries with career-based public employment have increased the level of school involvement in selecting teachers or in matching teachers to vacancies, or they have introduced performance-management schemes and devolved the responsibility for them to school leaders. More radical reforms of public-sector employment are rare, however, and often encounter significant resistance.

OVERVIEW OF MAIN FINDINGS

Are there qualities unique to teachers in high-performing countries and schools?

Three elements of teachers' professional-development policies are common to high-performing countries:[7] a mandatory and extended period of clinical practice as part of initial teacher education or of the induction period; the presence of a variety of bespoke opportunities for

in-service teachers' professional development, such as workshops organised by the school; and teacher-appraisal mechanisms, either legislated or deeply rooted in school practice, with a strong focus on teachers' continuous improvement. But the shared goal of supporting teachers' professionalism throughout their career translates into many different approaches to selecting and evaluating teachers, and a wide range of career and compensation structures. Both career-based and position-based public employment traditions are found among high-performing systems.

PISA results also show a positive relationship between increases in schools' responsibility for selecting teachers for hire between 2006 and 2015 and contemporaneous improvements in students' performance in science, reading and mathematics. Furthermore, this relationship is stronger across systems in which school-level achievement data are used for accountability practices – e.g. are posted publicly or are tracked over time by an administrative authority. This might suggest that when greater responsibility for teacher selection is devolved to schools, systems are better able to adapt to new circumstances and to growing expectations, and teachers are more committed to students' learning – provided that schools have the right incentives and are held accountable for their outcomes. However, the relationship could also reflect countries' decision to reduce school autonomy if student performance is in decline, or to grant greater autonomy to schools if performance is improving. In other words, the causal direction of this association cannot be determined.

An analysis comparing schools within countries also shows that school performance and student behaviour are positively related to teachers' average years of experience, while teacher turnover rates are negatively related to performance and behaviour, after accounting for differences in students' and teachers' demographic characteristics across schools.

Can teacher sorting compensate for student disadvantage?

Analyses show that a majority of countries and economies that participated in PISA 2015 try to compensate for disadvantage in schools with smaller classes and/or lower student-teacher ratios. However, in more than a third of countries and economies, including many that compensate for disadvantage in schools by allocating more teachers to those schools, teachers in the most disadvantaged schools are less qualified and/or experienced than those in the most advantaged schools (Figure 1.2).

Several countries with career-based teacher employment, including France and Italy, allocate more teachers to disadvantaged schools, but do not provide these schools with the instruments and flexibility required to attract and retain more qualified or experienced teachers in the most challenging classrooms. Sometimes, the very policies that channel more resources to high-need schools might, in fact, deter more-experienced teachers from teaching in these schools. Where centrally set rules for promotion and mobility of teachers privilege teacher preferences and give priority to more senior teachers, and where teachers' pay does not vary greatly across schools or across teachers with similar experience and qualifications, it appears difficult to avoid attracting a high concentration of the most experienced teachers in the most prestigious schools. The Japanese and Korean "career-based" systems appear more successful at compensating schools for student disadvantage, perhaps because they temper seniority-based priority rules with mandatory requirements for teacher mobility and career incentives for teachers who work in high-need schools (Box 1.1).

Figure 1.2 [1/2] ■ How does the quality and quantity of teachers differ between advantaged and disadvantaged schools?

Results based on principals' reports

dd | aa Disadvantaged schools (mean: dd) are **better off** compared to advantaged schools (mean: aa)

dd | aa Disadvantaged schools (mean: dd) are **worse off** compared to advantaged schools (mean: aa)

mm Difference not significant (the overall mean, mm, is reported)

Missing values

	All schools				Public schools and government-dependent private schools			
OECD	Class size (number of students)	Number of students per teacher	Proportion of science teachers with a major in science (%)	Proportion of fully certified teachers (%)	Class size (number of students)	Number of students per teacher	Proportion of science teachers with a major in science (%)	Proportion of fully certified teachers (%)
Australia	25	13 | 12	91 | 96	96	25	13	92	96
Austria	24	10	40 | 84	89	24	10	39 | 87	88
Belgium	17 | 23	7 | 10	48	82 | 95	18 | 23	7 | 11	38 | 57	84
Canada	24 | 28	13 | 15	78	97	24 | 28	13 | 16	77	97
Chile*	34	18	72	25	35	16 | 21	70	23
Czech Republic	21 | 27	13	56 | 71	91 | 96	21 | 27	13	57 | 71	91 | 96
Denmark	22	11 | 13	86		22	11 | 14	85	
Estonia	20 | 30	8 | 12	71	94	19 | 29	8 | 12	70	94
Finland	18 | 20	10	83	93	18 | 20	10	83	93
France	25 | 33	9 | 12	87	19 | 90	25 | 33	9 | 12	87	20 | 92
Germany	22 | 28	14	79	91	22 | 27	14	75 | 90	92
Greece	24	8	44	91	24	7 | 10	42	90
Hungary	26 | 31	6 | 10	75		26 | 32	6 | 9	74	
Iceland	17 | 22	9	20 | 35	82 | 91	17 | 22	9	20 | 36	82 | 92
Ireland	25	12 | 14	93	99	24	12 | 14	92	100
Israel	28 | 33	10	83	79				
Italy	23	8 | 13		83 | 95	23	8 | 13		83 | 97
Japan	33 | 38	9		96	32 | 38	9		96
Korea	29 | 32	13 | 15	90	96	31	13 | 15	92	96
Latvia	17 | 24	7 | 11	79	65	17 | 25	7 | 11	80	66
Luxembourg	21 | 23	9 | 11	63 | 81	64 | 88	20 | 23	9 | 11	63 | 79	64 | 85
Mexico	34 | 40	20	53 | 78	57 | 33	33 | 44	17 | 27	53 | 79	58 | 23
Netherlands	22 | 27	13 | 20	23 | 51	75 | 94	22 | 27	14 | 20	23 | 50	75 | 94
New Zealand	25	14	93	92	26	12 | 15	92	92
Norway	22 | 26	9 | 11	40 | 70	88	22 | 27	9 | 11	42 | 70	88
Poland	22 | 26	8	92	99	22 | 26	8	93	99
Portugal	24 | 27	10 | 12	87	92 | 98	24 | 28	10 | 11	86	96
Slovak Republic	19 | 25	12	62	89 | 96	19 | 25	12	62	89 | 96
Slovenia	25 | 28	9	82 | 88	97	25 | 28	9	82 | 88	97
Spain	27	11 | 15	82	93	27	11 | 15	82	93
Sweden	22 | 25	11	79	89	22 | 25	11	79	89
Switzerland	20	11	46 | 91	86	20	12	46 | 92	87
Turkey	48	14	78	90	48	14	79	92
United Kingdom	24	14	92 | 99	92	23 | 26	13 | 16	92 | 98	96
United States	26	14	96 | 80	92	26	14 | 17	94	94 | 99
*- Massachusetts***					22	11	97	94 | 100
*- North Carolina***					25 | 30	15	97	98

Notes: Differences in class size of less than two students and of student-teacher ratios of less than one student are not reported as significant; differences in proportions of science teachers with a major in science and of fully certified teachers of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

*In Chile the question about the certification of teachers was adapted as "authorised or enabled by the Ministry of Education".

**Massachusetts and North Carolina participated in PISA 2015 with state-level samples representing public schools only.

Countries and economies are ranked by OECD/partner status and in alphabetical order.

Source: OECD PISA 2015 Database, Tables 3.1, 3.2, 3.3, 3.4, 3.11, 3.12, 3.13 and 3.14.

StatLink http://dx.doi.org/10.1787/888933740155

Figure 1.2 [2/2] ■ How does the quality and quantity of teachers differ between advantaged and disadvantaged schools?

Results based on principals' reports

dd | aa Disadvantaged schools (mean: dd) are **better off** compared to advantaged schools (mean: aa)
dd | aa Disadvantaged schools (mean: dd) are **worse off** compared to advantaged schools (mean: aa)
mm Difference not significant (the overall mean, mm, is reported)
Missing values

	All schools				Public schools and government-dependent private schools			
Partners	Class size (number of students)	Number of students per teacher	Proportion of science teachers with a major in science (%)	Proportion of fully certified teachers (%)	Class size (number of students)	Number of students per teacher	Proportion of science teachers with a major in science (%)	Proportion of fully certified teachers (%)
Albania	27	7	72	84	28	8	70	84
Algeria	30	17	36	91	29	17	36	91
Brazil	37	22	21 | 39	87	37	22	29	89
B-S-J-G (China)	46	13	65 | 90	98	47 | 43	12	71 | 98	98
Bulgaria	25	12	94 | 100	97	24 | 27	11 | 14	94 | 100	98
CABA (Argentina)	40	8	18 | 51	89	40	7	32	92
Colombia	30 | 35	24 | 20	80	11	30 | 40	27	84	8
Costa Rica	28	17	93 | 100	90	28	17	97	93
Croatia	24 | 27	10 | 12	89	95	24 | 27	10 | 12	89	95
Dominican Republic	36	19	67		38	19	76	
FYROM	26	12	76 | 84	78	26	12	76 | 83	70 | 75
Georgia	31 | 43	9 | 13	77	18 | 38	31 | 45	9 | 18	76	19 | 44
Hong Kong (China)	31	12 | 14	89	95	31	12 | 14	89	95
Indonesia	27 | 35	12	72 | 88	40 | 82	26 | 33	12	82	41 | 89
Jordan	33	14	82	71	28 | 36	13	84	75
Kosovo	25 | 31	15	100 | 67	73	25 | 32	15	100 | 53	75
Lebanon	27	10	71	69	27	7 | 10	58 | 100	77
Lithuania	20 | 27	8 | 12	93	99	20 | 27	8 | 12	93	99
Macao (China)	35 | 37	13	88 | 94	100	35	14	88 | 98	100
Malta	17 | 22	5 | 9	39 | 79	96 | 83	17 | 22	5 | 8	39 | 93	96 | 70
Moldova	22 | 28	11 | 13	55	67 | 78	22 | 27	11 | 13	54	67 | 79
Montenegro	26 | 30	11 | 9	98	98	26 | 30	11 | 9	98	98
Peru	25 | 28	15	19	92 | 76	24 | 31	13 | 22	19	91
Qatar	34 | 26	12	28 | 35	45 | 60	29 | 32	7 | 9	6 | 27	100 | 72
Romania	23 | 29	14	84	92	23 | 29	15	84	93
Russia	18 | 26	8 | 14	89 | 97	98	18 | 26	8 | 14	89 | 97	98
Singapore	34 | 31	12	91 | 95	91	35	12	92	99 | 91
Chinese Taipei	36 | 39	14 | 18	94	86 | 94	34	14	94	89 | 95
Thailand	33 | 43	18	90	94	33 | 43	16 | 20	91	94
Trinidad and Tobago	25 | 34	10 | 15	80	38 | 64	25 | 35	10 | 14	83 | 78	39 | 63
Tunisia	28	10	79	92	28	10	77	91
United Arab Emirates	33 | 26	15 | 13	90	27 | 18	32	10	97 | 82	50
Uruguay	27	12	6	54 | 63	24 | 30	12	5	56
Viet Nam	41	15	89	86	42	15	89	86
Education systems where disadvantaged schools are better off	38	24	2	4	40	34	3	4
Education systems with no difference	28	41	42	46	29	35	45	48
Education systems where advantaged schools are worse off	3	4	23	16	1	1	20	15

Notes: Differences in class size of less than two students and of student-teacher ratios of less than one student are not reported as significant; differences in proportions of science teachers with a major in science and of fully certified teachers of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

Countries and economies are ranked by OECD/partner status and in alphabetical order.

Source: OECD PISA 2015 Database, Tables 3.1, 3.2, 3.3, 3.4, 3.11, 3.12, 3.13 and 3.14.

StatLink http://dx.doi.org/10.1787/888933740155

Meanwhile, countries with more de-centralised or position-based systems to match teachers to vacancies might also end up with fewer qualified teachers in the most disadvantaged schools (as is observed in Switzerland and the United Kingdom, as well as among public and government-dependent schools in the United States), often with no compensatory improvement in teacher quantity. In Australia, disadvantaged schools even have fewer teachers than the most advantaged schools do, although the latter are often private, independent schools. Overall, however, higher levels of school autonomy for managing teachers are associated with a more equitable sorting of teachers across schools. This implies that many countries are successful at combining the flexibility that comes from greater school autonomy with compensatory funding mechanisms, thereby enabling the most challenging schools to attract the best teachers. Finland, Hong Kong (China) and Ireland (Box 1.2), for example, combine high levels of school responsibility in selecting teachers for hire (and, in the case of Hong Kong [China], in setting their salaries) with compensatory teacher sorting, whereby more, and at least equally qualified teachers, are found in the most disadvantaged schools.

While all countries have disparities in student performance related to socio-economic status, countries in which teachers' qualifications and experience are significantly better in advantaged schools than in disadvantaged schools tend to have larger performance gaps related to students' socio-economic status and therefore less equitable outcomes. In contrast, countries that compensate for disadvantage in schools with smaller classes and student-teacher ratios do not have, on average, narrower performance gaps related to socio-economic status, perhaps because such quantitative compensations do not translate into better quality of teachers and teaching. This suggests that it is not sufficient, and perhaps not necessary, for the most challenging schools to have more teachers, provided these schools are able to attract the most talented and effective teachers.

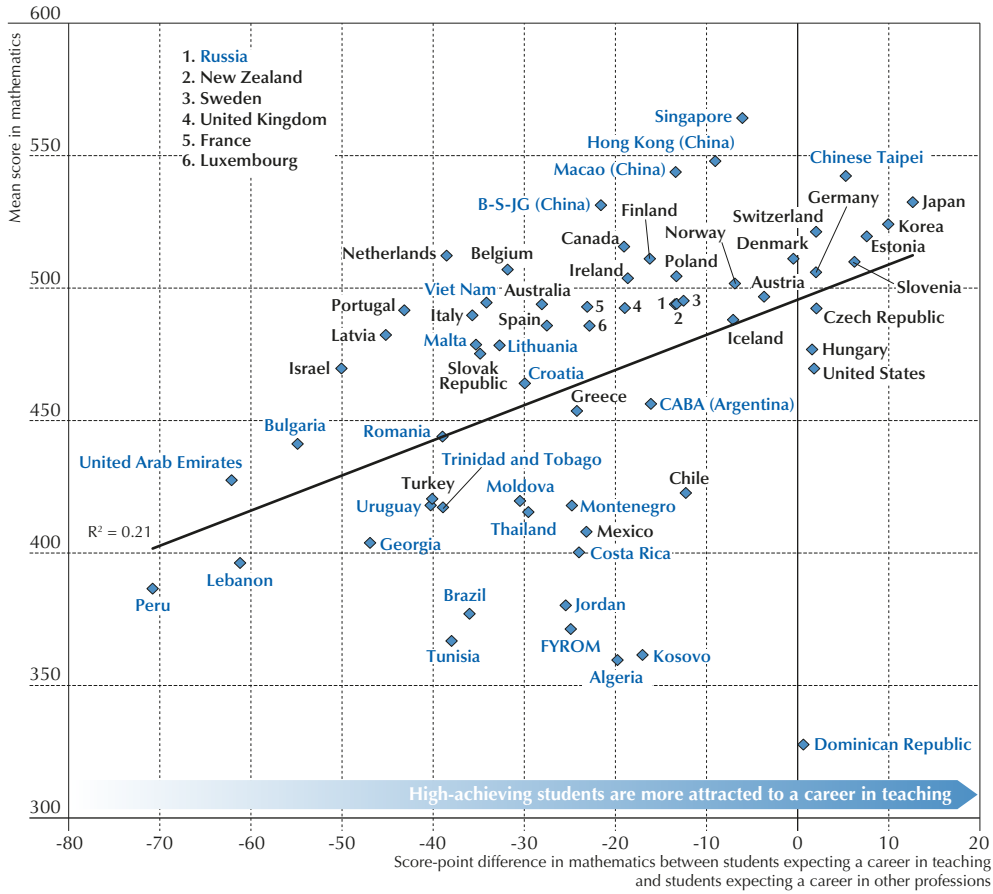
Who wants to have a career in teaching?

Between 2006 and 2015, there has been a marginal decline in 15-year-old students' expectation to pursue a career in teaching. In PISA 2006, about 5% of 15-year-old students expected to be working as teachers when they are 30, while in PISA 2015 about 4.2% of students expected so. Despite this decline, in most countries, the share of 15-year-olds who expect to become teachers remains larger than the share of working-age adults who are teachers today. Considering these responses, concerns about a lack of candidates for a career in teaching are therefore exaggerated (except in a few countries). In fact, the teaching profession enjoys a clear advantage over other occupations that 15-year-olds might not even know exist: all 15-year-olds have had some contact with teachers and have at least an approximate idea of what they do and of their working conditions.

However, the profile of students who see themselves as teachers later on is, in most countries, very much like the stereotypical teacher today. In PISA 2015, boys and immigrant students in particular were less likely than girls and students without an immigrant background to expect to work as teachers, even after accounting for differences in socio-economic status and academic performance. This pattern might reflect the strength of gender stereotypes related to occupations (is this occupation good for someone like me?) and the importance of personal contacts and role models when teenagers are considering their career choices.

Furthermore, while the Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), shows that, in most countries, the literacy and numeracy skills of teachers are on par with those of other college graduates (Hanushek, Piopiunik and Wiederhold, 2014[5]), in many countries, 15-year-old students who in 2015 expected to be working as a teacher when they are 30 had poorer mathematics and reading skills than students who expected to be working in other professions that, like teaching, require at least a university degree. And the skills gap between students who expected a career in teaching and students who expected a career as professionals tended to be larger in low-performing countries than in top-performing countries (Figure 1.3). This echoes long-held concerns about the composition of the teaching workforce: in many countries, fewer high achievers and fewer men choose to become, or to remain, teachers (OECD, 2005[1]).

Figure 1.3 ■ **In which countries are high-achieving students attracted to teaching?**



Source: OECD PISA 2015 Database, Table 4.3; OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.5.3, http://dx.doi.org/10.1787/888933433203.

StatLink http://dx.doi.org/10.1787/888933740174

Surveys of teachers often show that teachers are highly motivated by the intrinsic benefits of teaching: working with children, helping them develop and making a contribution to society. The *Teachers Matter* report, for example, summarises findings from French and Australian surveys, and the opinions of several national experts participating in country reviews, to conclude that extrinsic factors, such as job stability, pay or working hours, are of secondary importance for those who elected a career in teaching and remained in the profession (OECD, 2005, pp. 67-69[1]). While intrinsic factors are no doubt important for current teachers, these studies do not explain why other "potential teachers" elected alternative careers instead of teaching, or quit teaching after a while. In fact, studies that survey a larger pool of graduates about their career choices show that the relative salaries of graduate occupations do play a role in these choices: had teachers' salaries been higher, more "potential teachers" would have seriously considered a career in teaching.

Results of analyses that consider, simultaneously, country-, school-, and student-level factors associated with career expectations indicate that countries with higher teachers' salaries (relative to GDP) tend to have larger shares of students who expect to work as teachers. A weaker positive association is found with the proportion of teachers who reported, in TALIS, that the teaching profession is valued in their society. Furthermore, while in all countries girls were more likely to expect a career in teaching than boys, students' expectations of a teaching career were more gender-balanced in countries with higher teachers' salaries. Boys, in other words, appear more sensitive than girls to differences in teachers' salaries. However, there is no evidence that higher salaries attract high-achieving students into the teaching profession more than low-achieving students.

Another set of analyses considers comparisons over time within countries. These analyses reveal that in countries where teachers' salaries increased more rapidly than per capita GDP between 2005 and 2015, there was often an increase in the percentage of students who reported expecting a career in teaching; while in countries where teachers' salaries did not keep up with overall GDP growth – as in Turkey and Korea – this percentage decreased, on average. However, the relative performance of students who expected to work as teachers declined the most in countries where teachers' salaries increased more rapidly than GDP growth, on average. While this does not necessarily reflect a causal relationship, it suggests, like the previous result, that low-achieving students might be as much, and perhaps more, sensitive to variations in salaries compared to high-achieving students.

Both types of analyses therefore suggest that increases in teachers' salaries can improve the attractiveness of the teaching profession, but might not be enough to attract more high-achieving students to the profession. Extrinsic levers might only indirectly increase selectivity, for example if the increase in the supply of candidates for the teaching profession is met by a stable demand for teachers.

WHAT THESE RESULTS IMPLY FOR POLICY

A high-quality teaching force is the result of deliberate policy choices, carefully implemented over time

Teachers are the most significant resource in today's schools. In every country, teachers' salaries and teacher training represent the greatest share of expenditure in education (OECD, 2017[6]).

The investment in teachers can have significant returns: research increasingly documents how individual teachers, from kindergarten (Araujo et al., 2016[7]) to higher education (Carrell and West, 2010[8]; Braga, Paccagnella and Pellizzari, 2016[9]), make a difference in the learning and life outcomes of otherwise similar students (Rivkin, Hanushek and Kain, 2005[10]; Chetty, Friedman and Rockoff, 2014[11]). This implies that teachers are not interchangeable widgets in an industrial assembly line; individual teachers can change lives – and improve the quality of education that schools provide. Improving the effectiveness, efficiency and equity of schooling depends, in large measure, on ensuring that competent people want to work as teachers, that their teaching is of high quality and that all students have access to high-quality teaching.

It is true that the largest source of variation in student outcomes is attributable to differences in what students bring to school: their prior knowledge and skills, their attitudes, and their family and community background. But such factors are difficult for policy makers to influence, at least in the short term. Among the factors that influence student learning and are potentially open to policy influence, those involving teachers and teaching have the strongest influence. As a recent review of teacher policies in high-performing systems notes, "teaching is where the rubber hits the road […]. Teachers […] and the strategic moves they make […] are the primary mediators of learning" (Darling-Hammond et al., 2017[3]).

Policies that affect teachers and teaching are not only critical for delivering better results and lowering the costs of education. Today, the challenge of improving education is compounded by our rising expectations for what education systems should deliver. In a fast-changing world, we expect students to leave school not only with a (more) solid foundation in the subjects taught in school; we expect them to have the dispositions and skills of lifelong learners, the ability to think critically about complex issues, and the will to constantly adapt and grow as technology advances, and as political and ecological realities change. Delivering on these expectations is only possible if teachers themselves are high-level knowledge workers who constantly advance their own professional knowledge, and expand the repertoire of tools and practices of their profession. Schools and education systems must also have the capacity to adapt to changing conditions and meet new challenges.

The findings in this report show that, contrary to what is often assumed, high-performing systems do not enjoy a natural privilege simply due to a traditional respect for teachers; they have also built a high-quality teaching force as a result of deliberate policy choices, carefully implemented over time. The findings also show that there are multiple models from which other countries can derive inspiration. The fact that high performers are found on three continents and within both career- and position-based systems of public employment implies that incremental reforms, progressively implemented over time and within the constraints set by larger school policies and social contexts, can go a long way towards improving a system's capacity to select, develop and retain more effective teachers and ensure that the most talented teachers operate in the most challenging schools and classrooms.

For example, given the rapid changes in education, the potentially long careers that many teachers have, and the need for updating skills, teachers' professional development must be viewed in terms of lifelong learning, with initial teacher education conceived as providing the

foundation for ongoing learning, rather than producing ready-made professionals. When it comes to selecting and recruiting teachers, countries with position-based public employment traditions might more naturally emphasise aspects that make teachers effective in the classroom and in the diverse (but complementary) roles teachers can play within a team. But several countries with career-based public employment show that the job stability that teachers enjoy under these systems does not necessarily lead to professional stagnation and a lack of collaboration. They often have supplemented rules for teacher selection, mobility and promotion that bear little relation to what makes a teacher effective, with greater responsibility – and accountability – for schools in recruiting, developing and supporting teachers. As a result, schools and systems are better able to adapt. These countries have also ensured that initial teacher education not only provides sound basic training in subject-matter knowledge, pedagogy related to the subject and general pedagogical knowledge, but that it also develops the skills for reflective practice and research on the job.

Teachers must become lifelong learners and inquisitive professionals

All high-performing countries and economies in PISA foresee a mandatory and extended period of (school-based) clinical training as part of pre-service teacher training or of the induction period; guarantee the presence of a variety of bespoke opportunities for in-service teachers' professional development, such as workshops organised by the school; and have teacher-appraisal mechanisms, either legislated or deeply rooted in school practice, with a strong focus on teachers' continuous improvement.

It is clear that greater responsibilities for schools require more skilled leadership teams and stronger support, too. This shows that teacher policy cannot be changed one piece at a time; reform always requires a systemic approach that considers the complementarities among the various areas that shape the work of teachers.

Even when greater responsibilities for selecting and developing teachers are devolved to schools, central and regional authorities play a strong role in ensuring that teacher resources are distributed adequately and equitably among schools.

Opponents to school autonomy often voice concerns that greater independence of schools might lead to greater disparities in student performance and, perhaps more worryingly, to an education system that exacerbates, rather than ameliorates, existing economic and social inequities. However, PISA results suggest that this is not the most common result of greater school autonomy. In fact, many countries have been able to combine extensive autonomy of schools with strong incentives to ensure that schools prioritise student learning over other considerations, such as hiring friends or relatives, and with compensatory funding mechanisms to ensure that equity is not jeopardised. Ireland, for example, shows how school autonomy, in the presence of compensatory funding schemes, can produce equitable access to education opportunities for all (Box 1.2). With strong incentives to operate in the interest of students, and significant degrees of freedom to adapt teachers' working conditions and pay to reflect the difficulty of tasks and additional levels of responsibility, school leaders are probably best placed to attract the most talented teachers to the most challenging classrooms.

The unequal access of disadvantaged students to quality teachers and teaching is a real concern

PISA data show that inequities in access to quality teachers and teaching affect both countries with centralised traditions and countries with decentralised traditions of teacher selection and allocation; and that they are strongly related to inequities in learning outcomes between advantaged and disadvantaged students.

While many countries do compensate schools operating in more challenging environments by allocating additional teachers, few countries are successful at reducing inequities in student performance in this way. This might indicate that, in practice, current efforts are not sufficient to compensate for student disadvantage, or that any positive effects are undermined if policies that allocate more teachers to disadvantaged schools do not also address the issue of teacher quality. Indeed, in many countries, more-qualified and -experienced teachers are less often found in disadvantaged schools; and the more pervasive this situation, the larger the difference in student performance related to socio-economic status in the country.

These results imply that most countries could do more to monitor how teachers are allocated to schools: the number of teachers, but also their qualifications, experience and effectiveness. Any teacher policy that aims to tackle student disadvantage should strive to allocate quality teachers, and not just more teachers, to underserved students.

In response to disparities in teacher quality between advantaged and disadvantaged schools, or between rural and urban schools, countries with decentralised systems of teacher management might need to strengthen the reallocation of school funding and possibly assign the best school leaders to the most challenging schools.

Countries with more centralised systems of teacher selection and recruitment should, in turn, consider increasing the level of school responsibility in these processes. School leaders' capacity to manage human resources cannot be created overnight, however. A gradual approach that initially provides schools with the possibility of creating a limited set of highly attractive project positions for experienced teachers, and of creating stronger and more coherent teams, as has recently been proposed in France (Cour des Comptes, 2017[12]), might be an effective response to this concern.

Targeted financial incentives for teachers – salary increases and other types of financial additional payments – are also often cited as necessary to compensate for unattractive working conditions in particular schools. However, studies that have evaluated such schemes have found positive effects in North Carolina (United States) (Clotfelter et al., 2008[13]) but not in France (Bénabou, Kramarz and Prost, 2009[14]; Prost, 2013[15]). Similar incentives might work differently, depending on the general framework for teacher employment and career progression, and on the size of the incentive.

Alternatively, in response to inequitable teacher sorting, countries with strong centralised traditions of teacher management could consider creating a mobility requirement, such as exists in Japan and Korea, for example (Box 1.1). This requirement should not lead to shorter job assignments, however, as excessive turnover – a problem found more frequently in the most disadvantaged schools – can have adverse effects on teacher collaboration and student performance. Too limited

mobility of teachers between schools, at the same time, can hinder the spread of new ideas and approaches. By introducing a requirement for teacher mobility (e.g. every 5 to 7 years), countries might stimulate continuous professional growth while also ensuring that effective teachers are fairly distributed across schools.

In addition to limiting the inequitable sorting of teachers across schools, many education systems can also do more to address the needs of all teachers, particularly novice teachers, in disadvantaged schools. Much can be done during initial training and, later, through mentoring and bespoke professional development opportunities, to equip teachers with the skills needed to work in disadvantaged schools and with an understanding of the social contexts of those schools and their students. Indirectly, such support can also modify teacher preferences. Teachers typically enjoy helping children develop and making a contribution to society, and have no reason to shy away from the challenges of teaching disadvantaged students. But teachers are also more likely to want to work in disadvantaged schools if they feel they have support from principals, can collaborate with colleagues, and are provided with adequate resources to deal with the problems they face. School leaders who support and empower teachers can not only attract more and better-qualified teachers to work in disadvantaged schools, they also have a positive impact on the school climate more generally. Student behaviour is indeed better in schools whose principals are perceived as transformational leaders.

Overall, this report underlines the benefits of measures to strengthen teacher professionalism and school leadership, and of enhancing information flows throughout the system. These measures can also help countries build self-adjusting systems with feedback at all levels, incentives to react, and tools to strengthen capacities and share expertise among teachers and administrators.

The attractiveness of the teaching profession is related to teachers' salaries; but to promote teaching as a career for top-performing students, job quality matters at least as much as pay

Many countries are trying to attract more people and people from more diverse backgrounds into teaching, not just to avoid shortages of teachers, but also to broaden the range of teachers' backgrounds and experiences, thereby increasing the system's capacity to handle student diversity.

People are attracted to certain professions by some combination of the occupational status, work environment, sense of personal contribution and the financial rewards associated with the given profession. Teacher policy needs to examine these aspects closely. The analyses in this report show that 15-year-old students are already sensitive to financial rewards when considering various occupations. However, the analyses also indicate that the relatively low salaries of teachers, compared with those of other professionals with similar education, are unlikely to be the sole reason it has proven difficult to attract high-achieving students, and students from under-represented backgrounds, to teaching.

School systems often aim to recruit their teachers from the same talent pool from which all of their top professionals are recruited. But people who see themselves as candidates for the professions, and are attracted to the working conditions enjoyed by professionals, might not find what they're looking for in schools that use bureaucratic management to direct teachers' work.

Transforming the work organisation of schools, involving teachers in school decision making, enhancing their leadership responsibilities and promoting teaching as a demanding but fulfilling profession are at least as important as increasing teachers' salaries. Media campaigns to enhance the image of the profession by highlighting its importance for the nation, its sophistication and complexity, and the intellectual excitement it can generate, can also help. Countries that wish to broaden the range of teachers' backgrounds and experiences could concentrate on promoting the benefits of a teaching career to groups who are under-represented in the teaching force, such as men and people from minority backgrounds.

Box 1.1 How Japan and Korea attract excellent teachers to disadvantaged schools

This report shows that socio-economically disadvantaged students in Japan and Korea are at least as likely as advantaged students to be taught by high-quality teachers, as measured by characteristics such as years of experience, being certified for all the subjects taught, and, for science teachers, having a university degree with a major in science.

In Japan, teachers are expected to periodically change schools throughout their career. This is intended to ensure that all schools have access to effective teachers and a balance of experienced and beginning teachers. The allocation of teachers to schools is decided by the local education authority, and the exact rules followed may differ.

In Korea, all teachers are held to high standards, which contributes to the country's high levels of performance and equitable distribution of teachers. Other elements contributing to the high calibre of the teaching force are the highly respected status of teachers, job stability, high pay, and positive working conditions, including high levels of teacher collaboration. A mandatory rotation scheme for teachers in Korea means that teachers are required to move to a different school every five years. Within this scheme, multiple incentives are offered to attract teachers to high-needs schools, including additional salary, smaller classes, less instructional time, additional credit towards future promotion to administrative positions, and the ability to choose the next school where one works. The latter two career incentives are seen as particularly attractive.

Source: OECD, 2005 (p. 159)[1]; OECD, 2012[16]; Kang and Hong, 2008[17].

Box 1.2 Ireland's programme for "Delivering Equality of Opportunity in Schools" (DEIS)

In Ireland, secondary schools with high concentrations of students from disadvantaged backgrounds receive additional financial and other resources to promote good education outcomes. This is the result of a deliberate policy implemented by the Department for Education and Skills.

...

The governance of the school system in Ireland is complex. While the state provides almost all funding for primary and secondary education, most primary schools and a majority of secondary schools are private organisations, with a significant proportion of them managed by church authorities and religious organisations. Some 57% of 15-year-old students participating in PISA, for example, attend private secondary schools (OECD, 2016, Table II.4.6[18]). Private, but publicly funded schools receive direct payments for the salaries of teachers and other staff (e.g. special needs assistants) and grants to cover day-to-day running costs (e.g. heating, cleaning, maintenance). Schools can also undertake fundraising activities; at the secondary level, a small number of schools charge fees, but the majority do not.

Parents have the right to send their children to the school of their choice; when the school has places available, the pupil should be admitted. However, about 20% of schools are oversubscribed, and can apply selection criteria. The Department for Education and Skills regulates school-enrolment policies to ensure a fair and transparent system in all schools, which does not discriminate unfairly against students or parents.

Ireland has a long history of providing assistance to schools serving pupils from disadvantaged backgrounds. Schemes such as the Disadvantaged Areas Scheme (1984), Breaking the Cycle (1996), and Giving Children an Even Break (2001) all provided additional supports to schools to assist them in addressing the problems associated with catering for pupils from disadvantaged backgrounds. Ireland's frame of reference in addressing inequity in education is based on the definition of "educational disadvantage" as contained in the Education Act 1998: "the impediments to education arising from social or economic disadvantage which prevent students from deriving appropriate benefit from education in schools."

Delivering Equality of Opportunity in Schools (DEIS) is the most recent of such programmes, and has the explicit aim of ensuring "that the educational needs of children and young people from disadvantaged communities are prioritised and effectively addressed". The Department of Education and Skills launched DEIS in May 2005. A second DEIS Plan was launched in 2017. The rationale for DEIS is that additional resources are targeted at schools in which disadvantage is most concentrated.

DEIS provides for a standardised system for identifying levels of disadvantage (based on student socio-economic disadvantage) and an integrated School Support Programme. The initial process of identifying schools for participation in DEIS was managed externally by the Educational Research Centre (ERC) on behalf of the Department for Education and Skills. More recently, the Department's statistics section has assumed responsibility for the assessment of schools' level of disadvantage under DEIS.

Under the Schools Support Programme, schools and school clusters or communities are allocated supplementary resources and supports in line with their concentration of disadvantage. About 20% of schools in Ireland are eligible for DEIS support. Schools serving disadvantaged communities are supported with additional per-pupil funding,

...

additional staff, targeted support for school leaders and teachers (e.g. improved access to training, mentoring or coaching schemes), literacy and numeracy support services, and priority access to school meals programmes. They also have access to the School Completion Programme and Home School Community Liaison Services of Tusla, the Child and Family Agency that has a statutory remit in relation to school attendance, participation and retention, and school-community liaison services. Primary schools in areas with the highest concentrations of pupils at risk of educational disadvantage, in particular, receive sufficient staff to reduce class size to below 20 students. Secondary schools in the School Support Programme are provided with greater access to career-guidance professionals and enhanced curricular choices (through staffing and funding support for the Junior Certificate School Programme and the Leaving Certificate Applied Programme).

There is evidence from research undertaken to date that the DEIS programme is having a positive effect on tackling educational disadvantage and reducing gaps in reading and mathematics at the primary level, and in attainment and retention at the post-primary level. However, research also shows that overall performance in DEIS schools continues to remain below the national average.

Source: Department of Education and Skills (2011) "OECD Project Overcoming School Failure: Policies that Work, National Report, Ireland", www.oecd.org/education/innovation-education/49624509.pdf (accessed 12 February 2018); Department of Education and Skills (2017), "DEIS Plan 2017: Delivering Equality of Opportunity in Schools", www.education.ie/en/Publications/Policy-Reports/DEIS-Plan-2017.pdf (accessed 12 February 2018); Department of Education and Skills (n.d.), Department of Education and Skills website, www.education.ie/en (accessed 12 February 2018).

Notes

1. "The quality of teaching is determined not just by the quality of the teachers, but also by the environment in which they work" (OECD, 2005[1]). "The quality of an education system cannot exceed the quality of its teachers, the quality of teaching and teachers cannot exceed the quality of the work organisation in which teachers find themselves, the quality of teacher selection and education, the quality of teacher careers and the quality of teacher evaluation" (Schleicher, 2011[22]). "The quality of an education system cannot exceed the quality of its teachers, and the quality of teachers cannot exceed the quality of the work organisation in schools and the ways in which teachers are supported" (OECD, 2013[23]).

2. The "Indicators of Education Systems" (INES) programme provides data for the indicators produced annually in *Education at a Glance*. The Network for the Collection and Adjudication of System-Level Descriptive Information on Educational Structures, Policies and Practices (NESLI), in particular, develops questionnaires for policy-makers and collects data on system-level indicators in education. While teacher salaries have been a long-standing aspect covered by these questionnaires, recently NESLI has developed thematic questionnaires on teacher evaluation, professional development requirements, career and compensation structures. The "Teaching and Learning International Survey" (TALIS) programme is an international, large-scale survey that focuses on the working conditions of teachers and the learning environment in schools. The "Programme for International Student Assessment" (PISA) programme is a triennial survey that assesses the extent to which 15-year-old students, near the end of their compulsory education, have acquired key knowledge and skills that are essential for full participation in modern societies. As a policy-oriented survey, PISA aims to link student performance data to key factors that shape their learning, in and outside of school, in order to highlight differences in performance and identify the characteristics of students, schools and education systems that perform well. In line with this goal and with the increasing interest in teachers' working conditions and teacher policies, PISA 2015 has extended the scope of the NESLI data collection to cover a larger set of countries, and has introduced a teacher questionnaire among its optional instruments.

3. Examples of such "myths" include the view that in all top-performing countries, teacher-training programmes are highly selective and teachers are paid well, even in comparison with other professionals; or that the most successful countries attract the most talented teachers to the most challenging schools. The remaining chapters will verify, qualify, temper or even dispel these myths, based on the available data.

4. The greater emphasis on school processes in more recent publications about teacher policies, and in particular on less formally regulated aspects such as mentoring, feedback and professional learning supported by peer networks within and across schools, also reflects a paradigm shift in the study and practice of public administration and management. The latter has moved recently from the study of "public administration" as a strong bureaucracy that administers set rules and guidelines, and of "new public management", which emphasises managerial leadership, inputs *and* outputs control (through performance management), and market mechanisms, to viewing (and promoting) a "new public governance" which emphasises how the implementation of policies and the delivery of public services hinges critically on micro-level processes, on social capital (as opposed, or in addition to human capital), and on inter-dependencies between actors at different levels (e.g. Osborne [2006[21]]).

5. In particular, in 2015 and 2016, the OECD extended the indicators developed by the INES programme for the annual *Education at a Glance* publication to partner countries and economies participating in PISA, through a special system-level data collection conducted in collaboration with PISA Governing Board members and National Project Managers. The available information includes indicators on teacher salaries, on teacher preparation, selection, development and career (OECD, 2014[19]) and on teacher-appraisal systems (OECD, 2015[20]). The system-level information used in this report also includes the answers of principals of schools participating in PISA about schools' level of responsibility for selecting teachers and determining their starting salaries and career steps and about teachers' professional development practices, aggregated at the country level. TALIS data based on reports by lower-secondary teachers and principals are used to compare the occupational prestige of the teaching profession, the perception of teacher appraisal and feedback

mechanisms, and the nature of teacher preparation and induction. System-level data have often limitations: For example, the indicator of pay levels used in this report, teachers' statutory salary expressed as a ratio of GDP per capita, is based on statutory rather than actual salaries, does not include other benefits such as vacations and pensions, and the reference point, GDP per capita, does not reflect compensation levels in comparable occupations. But any better indicator would inevitably result in a smaller number of countries being available for the analysis.

6. The reader interested in more comprehensive treatments of teacher policies or interested in particular countries shall complement the analysis in this report with in-depth reports based on systematic reviews, such as *Teachers Matter* (OECD, 2005[1]), *Empowered Educators* (Darling-Hammond et al., 2017[3]), *Education Policy Outlook Country Profiles* (OECD, 2018[24]), a forthcoming report focusing on human resources within the *OECD Review of Policies to Improve the Effectiveness of Resource Use in Schools* (OECD, 2018[25]), and existing and forthcoming reports and thematic analyses based on TALIS data (OECD, 2018[26]).

7. High-performing countries and economies are defined as those that, in PISA 2015, had an above-average share of students performing at the highest levels (Level 5 and above) in science, reading or mathematics – reflecting the ability of these systems to nurture excellence – and, at the same time, a below-average share of students who do not attain the baseline level of proficiency (Level 2) in all three subjects – reflecting the inclusive nature of these systems and their ability to assure minimum standards of learning for all. These criteria led to the selection of 17 countries and economies: Australia, Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]"), Canada, Estonia, Finland, Germany, Hong Kong (China), Japan, Korea, Macao (China), the Netherlands, New Zealand, Norway, Singapore, Slovenia, Switzerland and Chinese Taipei. Two subnational jurisdictions in OECD countries that meet the above-mentioned criteria for high-performing systems, and that contribute to the system-level indicators published in the OECD's annual report, *Education at a Glance*, were also considered: England (United Kingdom) and the Flemish Community of Belgium.

References

Araujo, M. et al. (2016), "Teacher Quality and Learning Outcomes in Kindergarten", *The Quarterly Journal of Economics*, Vol. 131/3, pp. 1415-1453, http://dx.doi.org/10.1093/qje/qjw016. [7]

Bénabou, R., F. Kramarz and **C. Prost** (2009), "The French zones d'éducation prioritaire: Much ado about nothing?", *Economics of Education Review*, Vol. 28, pp. 345-356, http://dx.doi.org/10.1016/j.econedurev.2008.04.005. [14]

Braga, M., M. Paccagnella and **M. Pellizzari** (2016), "The Impact of College Teaching on Students' Academic and Labor Market Outcomes", *Journal of Labor Economics*, Vol. 34/3, pp. 781-822, http://dx.doi.org/10.1086/684952. [9]

Carrell, S. and **J. West** (2010), "Does Professor Quality Matter? Evidence from Random Assignment of Students to Professors", *Journal of Political Economy*, Vol. 118/3, pp. 409-432, http://dx.doi.org/10.1086/653808. [8]

Chetty, R., J. Friedman and **J. Rockoff** (2014), "Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood", *American Economic Review*, Vol. 104/9, pp. 2633-2679, http://dx.doi.org/10.1257/aer.104.9.2633. [11]

Clotfelter, C. et al. (2008), "Would higher salaries keep teachers in high-poverty schools? Evidence from a policy intervention in North Carolina", *Journal of Public Economics*, Vol. 92/5-6, pp. 1352-1370, http://dx.doi.org/10.1016/j.jpubeco.2007.07.003. [13]

Cour des Comptes (2017), *Gérer les enseignants autrement: Une réforme qui reste à faire*, www.ccomptes.fr/fr/documents/39998. [12]

Darling-Hammond, L. et al. (2017), *Empowered Educators: How High-Performing Systems Shape Teaching Quality Around the World*, Jossey-Bass, San Francisco. [3]

Hanushek, E., M. Piopiunik and **S. Wiederhold** (2014), "The Value of Smarter Teachers: International Evidence on Teacher Cognitive Skills and Student Performance", Working Paper No. 20727, National Bureau of Economic Research, Cambridge, MA, http://dx.doi.org/10.3386/w20727. [5]

Jackson, C., J. Rockoff and **D. Staiger** (2014), "Teacher Effects and Teacher-Related Policies", *Annual Review of Economics*, Vol. 6/1, http://dx.doi.org/10.1146/annurev-economics-080213-040845. [2]

Kang, N. and **M. Hong** (2008), "Achieving Excellence in Teacher Workforce and Equity in Learning Opportunities in South Korea", *Educational Researcher*, Vol. 37/4, pp. 200-207, http://dx.doi.org/10.3102/0013189X08319571. [17]

OECD (2004), *Public Sector Modernisation: Modernising Public Employment*, www.oecd.org/site/govgfg/39044838.pdf (accessed on 9 February 2018). [4]

OECD (2005), *Teachers Matter: Attracting, Developing and Retaining Effective Teachers*, OECD Publishing, Paris, http://dx.doi.org/10.1787/19901496. [1]

OECD (2012), *Equity and Quality in Education: Supporting Disadvantaged Students and Schools*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264130852-en. [16]

OECD (2013), *Teachers for the 21st Century: Using Evaluation to Improve Teaching*, International Summit on the Teaching Profession, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264193864-en. [23]

OECD (2014), "Indicator D6 What does it take to become a teacher?", in *Education at a Glance 2014: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2014-34-en. [19]

OECD (2015), "Indicator D7 What Teacher and School Leader Appraisal Systems are in Place?", in *Education at a Glance 2015: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2015-36-en. [20]

OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264267510-en. [18]

OECD (2017), "Indicator B6 On what resources and services is education funding spent?", in *Education at a Glance 2017: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2017-21-en. [6]

OECD (2018), *Education Policy Outlook Country Profiles – OECD*, www.oecd.org/education/profiles.htm (accessed on 23 April 2018). [24]

OECD (2018), *School Resources Review*, www.oecd.org/education/schoolresourcesreview.htm (accessed on 23 April 2018). [25]

OECD (2018), *TALIS - The OECD Teaching and Learning International Survey*, www.oecd.org/talis (accessed on 23 April 2018). [26]

Osborne, S. (2006), "The New Public Governance?", *Public Management Review*, Vol. 8/3, pp. 377-387, http://dx.doi.org/10.1080/14719030600853022. [21]

Prost, C. (2013), "Teacher Mobility: Can Financial Incentives Help Disadvantaged Schools to Retain Their Teachers?", *Annals of Economics and Statistics* 111/112, p. 171, http://dx.doi.org/10.2307/23646330. [15]

Rivkin, S., E. Hanushek and **J. Kain** (2005), "Teachers, Schools, and Academic Achievement", *Econometrica*, Vol. 73/2, pp. 417-458, http://dx.doi.org/10.1111/j.1468-0262.2005.00584.x. [10]

Schleicher, A. (2011), *Building a High-Quality Teaching Profession: Lessons from around the World*, International Summit on the Teaching Profession, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264113046-en. [22]

2

Are there qualities unique to teachers in high-performing countries and schools?

This chapter explores PISA data to establish relationships between the success of education systems and schools in PISA and their teacher policies. The first section focuses on variation across countries, and explores system-level aspects that are common, and in some cases, unique, to high-performing countries and economies. The second section focuses on variations within countries and across time, and explores how changes in student-teacher ratios, class size, teacher compensation, and school autonomy for selecting teachers are related to performance trends across all PISA-participating countries and economies. The last section focuses on variations within countries, and explores how teachers' qualifications and experience, teacher turnover, and support for teachers' professional learning are related to school-level outcomes.

Note regarding B-S-J-G (China)
B-S-J-G (China) refers to the four PISA participating China provinces : Beijing, Shanghai, Jiangsu, Guangdong.

Note regarding CABA (Argentina)
CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.

Note regarding FYROM
FYROM refers to the Former Yugoslav Republic of Macedonia.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

PISA results highlight large differences in students' learning outcomes across countries and schools. By linking those outcomes to data on students' background, to schools' practices, and to education systems' policies, PISA data can help identify the characteristics of schools and education systems that perform well. This chapter helps policy makers and educators learn from policies and practices applied elsewhere, by exploring what teacher-related policies are common and unique to high-performing countries and schools.

Teacher policies are a set of interventions, in a number of areas, that shape the composition of the teaching workforce and the work of teachers. They include recruitment processes, initial teacher preparation and induction policies, career and compensation structures, professional learning opportunities and requirements, and teacher-appraisal policies.

What the data tell us

- There are three elements common to high-performing countries' professional development policies for teachers: a mandatory and extended period of clinical practice as part of pre-service teacher education or of the induction period; the presence of a variety of bespoke opportunities for in-service teachers' professional development, such as workshops organised by the school; and teacher-appraisal mechanisms, either legislated or deeply rooted in school practice, with a strong focus on teachers' continuous improvement.
- On average across countries and economies participating in PISA 2006 and PISA 2015, increases in school responsibility for selecting teachers for hire were associated with improvements in students' performance in science, reading and mathematics; reductions in school responsibility were associated with declining student performance. The causal direction of this association, however, cannot be determined.
- School performance and student behaviour are positively related to teachers' average years of experience, while teacher turnover rates are negatively related to performance and behaviour, after accounting for differences in students' and teachers' demographic characteristics across schools.

Research in international education increasingly points to the role of a strong teaching workforce as a key element of a high-performing system (Darling-Hammond et al., 2017[1]; Jensen et al., 2016[2]; Jensen et al., 2016[3]; Hanushek, Piopiunik and Wiederhold, 2014[4]). Following the publication of the OECD *Teachers Matter* report, a first major study of policies for attracting, developing and retaining effective teachers in schools (OECD, 2005[5]), and at least since the publication of an influential McKinsey Report on education (Barber and Mourshed, 2007[6]), teacher policies have been identified as one key element of high-performers' success in PISA. A decade ago, the authors of that report concluded, based on the analysis of ten top-performing countries, that "three things matter most: 1) getting the right people to become teachers; 2) developing them into effective instructors; 3) ensuring that the system is able to deliver the best possible instruction for every child."

Over the past ten years, the OECD has accumulated a wealth of new data on teacher policies and teachers' working conditions, and on the performance of education systems and schools.

By expanding participation in PISA and comparing performance over time, recent PISA surveys have identified more high-performing and rapidly improving systems. Recent editions of *Education at a Glance* have developed comparative indicators on teachers' careers (OECD, 2014[7]) and teacher-appraisal systems (OECD, 2015[8]).

PISA 2015 expanded the coverage of these indicators to partner countries and economies participating in PISA, through a special system-level data collection conducted in collaboration with PISA Governing Board members and National Project Managers. And PISA 2015 distributed a questionnaire, which was optional for countries, to a sample of teachers in the schools selected for the PISA assessment (see Box 3.1 in Chapter 3). The questionnaire included information about teachers' demographic profile and working conditions, often based on questions first asked as part of the OECD Teaching and Learning International Survey (TALIS) (OECD, 2009[9]; OECD, 2014[10]).

This chapter explores PISA data at the level of education systems and, in the 20 countries and subnational jurisdictions that distributed the teacher questionnaire, at the school level, to establish relationships between the success of education systems and schools in PISA and their teacher policies. The chapter is not a systematic review of teacher policies in high-performing countries, as many aspects of these policies cannot be easily quantified or categorised with the indicators available in the PISA database and related databases. Its goal is not to develop a blueprint for teacher policies, but rather to illustrate the existing evidence and gaps, and thereby contribute to the ongoing debate about effective teacher policies.

The first section focuses on variation across countries, and explores system-level aspects that are common, and in some cases unique, to high-performing countries and economies. In this section, high-performing countries and economies are defined as those that, in PISA 2015, had an above-average share of students performing at the highest levels (Level 5 and above) in science, reading or mathematics – reflecting the ability of these systems to nurture excellence – and, at the same time, a below-average share of students who did not attain the baseline level of proficiency (Level 2) in all three subjects – reflecting the inclusive nature of these systems and their ability to assure minimum standards of learning for all. These criteria led to the selection of 17 countries and economies: Australia, Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]"), Canada, Estonia, Finland, Germany, Hong Kong (China), Japan, Korea, Macao (China), the Netherlands, New Zealand, Norway, Singapore, Slovenia, Switzerland and Chinese Taipei. Two subnational jurisdictions in OECD countries that meet the above-mentioned criteria for high-performing systems, and that contribute to the system-level indicators published in the OECD's annual report, *Education at a Glance*, were also analysed: England (United Kingdom) and the Flemish Community of Belgium.

The second section focuses on variations within countries and across time, and explores how changes in student-teacher ratios, class size, teacher compensation, and school autonomy for selecting teachers are related to performance trends across all PISA-participating countries and economies. While it is conventional wisdom that change in education is slow, data from *Education at a Glance* and from school questionnaires distributed by PISA show that these are areas in which there have been significant changes over the past decade (more specifically, between 2005 or 2006 and 2015). This makes it possible to ask whether these changes have been accompanied by improvements or declines in performance.

The last section focuses on variations within countries, across schools, and explores how teachers' qualifications and experience, teacher turnover, and support for teachers' professional learning are related to performance differences in science, reading and mathematics, and to a positive school climate (as measured through the index of disciplinary climate in science lessons and the incidence of bullying at school). These analyses are restricted to the 20 countries and subnational jurisdictions that distributed the teacher questionnaire.

HOW DO HIGH-PERFORMING COUNTRIES SELECT, DEVELOP AND EVALUATE TEACHERS?

What do high-performing countries have in common? A cursory look at the list of the 19 highest-performing education systems in PISA – as defined above – shows that they span four continents, different levels of economic development, include city-states as well as some of the largest economies in the world, and have widely different histories and social and economic trajectories. Yet several influential studies that have analysed and compared some of the highest-performing countries and economies in PISA have identified common traits in their teacher policies. In addition to the already-cited McKinsey report (Barber and Mourshed, 2007[6]), more recently, a more in-depth review of seven high-performing countries and education systems[1] (Darling-Hammond et al., 2017[1]) concluded that "a key goal in all of the [seven] jurisdictions [is] to develop a strong teaching profession", "a workforce that is highly educated and empowered to make decisions about teaching for the best interests of their students".

It is also intriguing that despite their diversity, these countries and economies not only perform well in PISA; but to a large extent, teachers in these countries and economies reported feeling valued by society at large. Indeed, of the 19 highest-performing countries/economies, 13 participated in the TALIS survey in 2013-14 (for Canada, only the province of Alberta, one of the highest-performing provinces, participated). In Finland, Korea and Singapore, more than 50% of lower secondary teachers agreed, or strongly agreed, with the statement "I think that the teaching profession is valued in society"; and in seven more high-performing participants in TALIS, namely Alberta (Canada), Australia, England (United Kingdom), the Flemish Community of Belgium, New Zealand, the Netherlands, and Shanghai (China), an above-average percentage of teachers agreed with that statement. Two more countries, Japan and Norway, reported levels of agreement close to the international average of 31%. Only one high-performing country in PISA with available data – Estonia – reported low levels of agreement with the statement (14%) (OECD, 2015[11]; OECD, 2014, Table 7.3[10]).

This section takes this conclusion as the starting point to explore the PISA database and the OECD system-level database in search of common traits among a broader set of 19 high-performing countries, economies and subnational regions mentioned in the introduction. While small samples can only support tentative conclusions, this section sets out to identify institutions and practices that support teacher professionalism in high-performing countries; understanding these patterns can help other countries improve their own systems.

The data used in this section mostly come from the annual OECD publication *Education at a Glance*, and have been expanded to include OECD partner economies through a special system-level data collection conducted in 2016 in collaboration with PISA Governing Board members

and National Project Managers. Data refer to lower secondary teachers, even in countries where PISA students are no longer in lower secondary schools. This ensures that data on teacher policies remain comparable across countries, despite varying education structures. Furthermore, in all countries, lower secondary teachers are or have been a strong influence on the development of PISA 15-year-old students' knowledge and skills.

There are several limitations to these data. System-level data are often missing or difficult to access and compile for some countries where responsibility for education policy lies at the subnational level. Important nuances required to interpret these data well are also often missing when the variations in policies across countries must be reduced to a limited number of categories in order to support comparisons. Where possible, and where it was felt to be important, these data are therefore complemented with more qualitative information from in-depth reviews of these countries' policies, and with data from the Teaching and Learning International Survey (TALIS). Finally, the system-level data reflect the recent policy environment (typically, the year 2014 or 2015), and are not necessarily representative of the policies under which a majority of the teachers in 2015 were trained, selected and managed over the course of their career in teaching.

The examination of the data reveals that despite a common goal of supporting teacher professionalism, high-performing countries often use different instruments to select, develop and evaluate teachers. Career and compensation structures also differ widely across this set of countries. In fact, when requirements for entry into the teaching profession, teacher-appraisal mechanisms, and policies regarding professional development, career progression and salaries are compared across the 19 highest-performing countries and economies in PISA, the most common finding is that there are no common traits. The systems that support teachers' professional growth differ among high-performing countries; and the coherence between the different elements within a system – from initial mechanisms for selecting and preparing teachers, through to ongoing structures that provide feedback and support for professional learning and effective teaching – is greater than the coherence across countries in any single element of that continuum. Some high-performing countries, such as Finland, place greater emphasis on recruitment strategies and strong teacher preparation; others, such as Singapore, emphasise formative appraisal and in-service, collaborative professional learning (Darling-Hammond et al., 2017[1]).

Nevertheless, three aspects stand out for being common to all high-performing countries/economies for which relevant information is available.

- First, the presence of a mandatory teaching practicum as part of pre-service education, to ensure that student teachers have some classroom experience before they formally become teachers. Teacher candidates in high-performing countries typically receive extended *clinical training* to help them bridge theory and practice at the beginning of their teaching career; where the practicum included in initial teacher-preparation programmes is short, novice teachers benefit from intensive induction or mentoring programmes to support beginning teachers.
- Second, the presence of a variety of bespoke opportunities for in-service professional development, such as workshops organised by the school. This is perhaps related to the widespread autonomy of schools in selecting teachers for hire; but more than autonomy, it reflects strong capacity at the local level to lead and adapt to changing needs and conditions.

- Finally, the existence (with only one exception: Germany) of teacher-appraisal mechanisms, either legislated or deeply rooted in school practice, with a strong developmental focus. While detailed information is often missing on the specific features of some of these appraisal systems, the available evidence shows that appraisals tend to rely to a large extent on classroom observations and teacher interviews, and to be geared mostly towards teacher improvement; career progression and salary increases are at stake only in a few countries, and are sometimes handled through separate appraisal processes.

How teachers become teachers: Requirements for entry into the teaching profession

Competitive examinations to enter teaching-training programmes or to start teaching can create a more select pool of candidates and even contribute to making teaching a prestigious occupation in some countries. But in contexts where teacher shortages are a problem, such mechanisms may inadvertently discourage potentially suitable candidates from considering a teaching career. And there is hardly any discernible pattern among high-performing countries and economies in PISA in the entry requirements to become teachers – perhaps a reflection of the diversity of local contexts and challenges.

In some high-performing countries and economies, such as Finland, Hong Kong (China), Korea, Macao (China) and Chinese Taipei, candidates must pass a competitive examination to be admitted into pre-service teacher education. In Japan, the competitive examination is held later, as a condition to start teaching; and in Korea and Chinese Taipei, student teachers (who had already passed a competitive examination to enter pre-service teacher education) must pass another competitive examination to start teaching (Figure 2.1).

In other high-performing countries, including Australia, England (United Kingdom), Estonia, Norway, Singapore and Slovenia, there are no competitive examinations to enter teacher-preparation programmes or to start teaching.

The duration of teacher-training programmes, and the level of qualification (bachelor's or master's degree) attained at the end of teacher-training programmes, also vary greatly across the highest-performing countries and economies in PISA. Lower secondary teachers in the Flemish Community of Belgium have the shortest path to teaching, with just three years of teacher preparation, leading to a bachelor's degree.

The most frequent minimum duration of post-secondary studies for teacher-training programmes among high-performing countries and economies, however, is four years. In Australia, England (United Kingdom), Japan, Korea, Macao (China), the Netherlands, Norway and Chinese Taipei, this is the normal duration of initial teacher preparation for lower secondary teachers. In Singapore as well, a bachelor's degree in education is earned in four years, but graduates whose bachelor's degree is not specific to education (as is the case for the majority of new teachers) must participate in a one- or two-year postgraduate teacher-training programme (Diploma in Education). In Estonia, Finland, Slovenia and Switzerland, student teachers must study for five years to earn a master's degree; in Hong Kong (China), the five-year programme leads to a bachelor's degree. Among high-performing countries, the longest path to teaching is in Germany, where teacher preparation for lower secondary teachers typically lasts between six and seven years (and results in a master's degree), including at least one year of practicum (see below).

Figure 2.1 ■ Requirements for entry into the teaching profession

High-performing countries and economies in PISA, lower secondary general programmes, 2013

Yes
At the discretion of institutions
No
a Not applicable
m Missing

	Share of low achievers in all three subjects	Share of top performers in at least one subject (science, reading or mathematics)	Competitive examination required to enter pre-service teacher training	Teaching practicum (pre-service training) is mandatory	Competitive examination required to enter the teaching profession	Duration of teacher-training programme, in years	ISCED 2011 attainment level at the end of teacher training (6: Bachelor's or equivalent; 7: Master's or equivalent)	Credential or license required to start teaching	Credential or license required to become a fully qualified teacher
Australia	11.1	18.4				4	6 or 7		a
B-S-J-G (China)	10.9	27.7	m	m	m	m	m	m	m
Canada	5.9	22.7	m	m	m	m	m	m	m
England (United Kingdom)	9.8	18.1			a	4	7	a	
Estonia	4.7	20.4			a	5	7	a	a
Finland	6.3	21.4			a	5	7	a	a
Flemish Community (Belgium)	10.9	25.2	a		a	3	6	a	a
Germany	9.8	19.2	m		a	6.5	7	a	a
Hong Kong (China)[1]	4.5	29.3				5	6		
Japan	5.6	25.8	a			4	6		a
Korea	7.7	25.6				4	6		a
Macao (China)[2]	3.5	23.9				4	6		
Netherlands	10.9	20.0	a		a	4	6	a	a
New Zealand	10.6	20.5	m		m	m	m	m	m
Norway	8.9	17.6			a	4	6	a	a
Singapore[3]	4.8	39.1			Na	1	6		
Slovenia	8.2	18.1			a	5	7	a	
Switzerland	10.1	22.2	a		a	5	7	a	a
Chinese Taipei	8.3	29.9				4	6		

1. Duration of teacher-training programme refers to the number of years of study for Bachelor of Education (B.Ed.). graduates. However, there are candidates pursuing a one-year, full time postgraduate diploma as their pre-service teacher-training programme.

2. Reference year: 2014/15.

3. The duration of teacher-training programme refers to the Postgraduate Diploma in Education programme, which is the training received by most trainee teachers. This training is required for those whose bachelor's degree is not specific to education. The duration of other full-time initial teacher preparation programmes offered at the National Institute of Education varies according to the programme: Bachelor of Arts/Science (education) – 4 years; Diploma in Education – 1 to 2 years (depending on general or specialisation track); and Postgraduate Diploma in Education (physical education) – 2 years.

Countries and economies are listed in alphabetical order.

Source: OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education,* Tables I.2.9a, I.2.10a, B2.I.45 and B2.I.46, http://dx.doi.org/10.1787/888933433171 and http://dx.doi.org/10.1787/888933433235; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools,* Tables II.6.56 and II.6.57, http://dx.doi.org/10.1787/888933436513; for New Zealand: Education Council (2010), *Approval, review and monitoring processes and requirements for Initial Teacher Education Programmes,* Wellington, Education Council.

StatLink http://dx.doi.org/10.1787/888933740193

Certification requirements can add another layer of selection. While teacher certification, credentials and licenses offer no guarantee of excellence in teaching, they may help ensure that only the most motivated candidates progress in their career. In Australia, there are no competitive examinations to enter teacher training or start teaching, but student teachers must

earn a credential or license in order to start teaching. In most Australian jurisdictions, teachers reach the first level of accreditation upon graduation from an approved initial teacher education programme; but they must renew their registration regularly (typically, every five years), and can advance to full registration after a period of employment as teachers and an appraisal against the Australian Professional Standards for Teachers at "Proficient" level (OECD, 2013, p. 285[11]).

Other high-performing countries, including Singapore, do not restrict or control access to the teaching profession through competitions, licenses or credentials. However, teaching graduates in Singapore must successfully complete a probation period in which their competence for the job is evaluated. Singapore also specifically recruits candidates from the top third of the secondary school graduating class by offering them attractive conditions for study and work, such as a competitive monthly stipend during the training period.

More than competitive examinations, credentials or the duration of teacher-training programmes, a feature of initial teacher preparation that is common to high-performing countries and economies in PISA (except Macao [China]) is a mandatory teaching practicum as part of the pre-service education (information for B-S-J-G [China] and Canada is missing in the *Education at a Glance* database). In contrast, a teaching practicum was not always required as part of pre-service teacher training in Chile, Croatia, the Czech Republic, France, Georgia and the United States (OECD, 2016, Table II.6.56[13]). In Chile, this requirement was introduced only recently by a comprehensive reform of teacher training, teacher careers and teacher working conditions, known as *Política Nacional Docente* (National Teacher Policy), that was passed in 2016 and implemented beginning in 2017 (Ministerio de Educación, 2018[12]).

The duration of the teaching practicum provided as part of initial teacher education for lower secondary teachers is known only for some OECD countries. It ranges from 20 days in Japan and less than two months in Estonia, Korea and Slovenia, to several months in Australia, England (United Kingdom) and Norway, and to one or two full school years in Germany. However, Estonia, Japan and Korea, whose initial practicums are among the shortest, complement their practicums with mandatory induction programmes for novice teachers (OECD, 2014[7]).

Retrospective data based on teachers' reports about their initial education, collected as part of the TALIS survey in 2013-14, show that 90% of lower secondary teachers in Shanghai (China), and more than 70% of lower secondary teachers in England (United Kingdom), Japan, Korea and Singapore had taken part in a formal induction programme in their first regular employment as teachers – compared to an average of 50% across all countries participating in TALIS in 2013-14 (Table 2.16) (OECD, 2015[13]).

All high-performing countries recognise that beginning teachers need intensive support to apply their knowledge to teaching, and to develop professional networks with more experienced mentors. In other words, extended clinical training in the form of a pre-service practicum or a well-mentored induction programme helps teachers in high-performing countries bridge the gap between theory and practice.

The way in which requirements for clinical practice are actually met matter at least as much as their duration for the quality of student-teachers' learning. To help teachers move from theory to practice (and from practice to reflection) at the beginning of their teaching career, it is important

that their classroom practice is enriched with timely and precise feedback, and that the field experience is not disconnected from coursework in teacher education (OECD, 2005[5]). Extended periods of clinical practice, well-supported by mentors and by instructors, during which future teachers gain experience in a broad range of professional tasks, require significant resources. The example set by high-performing systems shows that investing in these resources up front, by attracting, training and supporting good teachers, rather than at the back end, by reducing attrition and firing weak teachers, might have greater payoffs for students (Schleicher, 2011[14]).

School autonomy for selecting teachers

In many school systems in OECD countries and elsewhere, recent decades have seen a general trend towards decentralisation, with responsibilities for budget management, staffing, school buildings, teaching content and processes, and the organisation of learning given to intermediate levels of government and, to a large extent, to schools themselves. Underlying this trend is the idea that education systems need to adapt to rapidly changing conditions, and that local actors are often best placed to identify these changes and the required adjustments.

But this trend also presents challenges in governing education systems: complex, decentralised systems often struggle with lack of leadership capacity at the local level, shared responsibilities across multiple levels, inadequate accountability structures, and the need for mechanisms to align local decisions with more centrally determined strategies (Burns and Köster, 2016[15]). Analyses based on PISA 2012 data, for example, showed that schools with greater autonomy for resource allocation performed worse than otherwise similar schools in their country, on average, except in countries with strong public accountability of schools (those in which all, or almost all schools, posted student achievement data publicly) (OECD, 2013, pp. 52-53[16]).

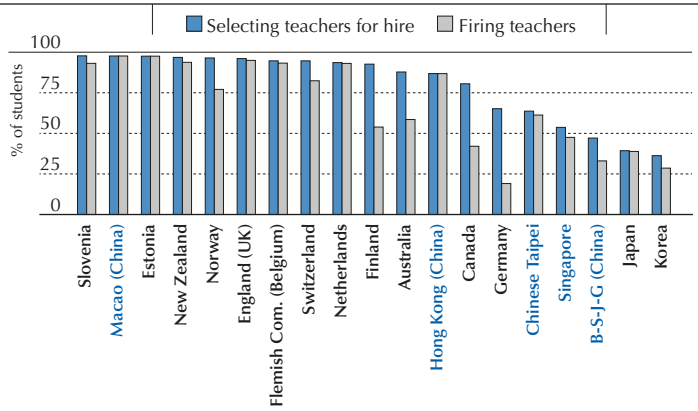
While there are a diversity of governance structures and traditions among high-performing countries, many of those countries outside of East Asia have decentralised systems for selecting or allocating teachers to schools.

In 13 of the 19 highest-performing countries/economies, over 80% of 15-year-old students attended schools whose principal or school governing board has considerable responsibility for selecting teachers for hire (OECD average: 74%), with most of the exceptions to this pattern found among high-performing East Asian systems. In Germany and Chinese Taipei, about two-thirds of the students attended schools with autonomy in selecting teachers for hire; in Singapore, 54% of students, and in B-S-J-G (China), Japan and Korea, less than 50% of students attended such schools (Figure 2.2).[2]

In many countries, school responsibility for firing teachers is less common than school responsibility for selecting teachers for hire. In particular, in Australia, Canada, Finland and Germany, a significantly smaller share of principals reported having a considerable role in decisions about firing teachers than reported having such a role in hiring teachers. Overall, in 9 of the 19 highest-performing countries and economies, over 80% of students attended schools whose principal or school governing board has considerable responsibility for firing teachers; while in 6 other countries, less than 50% of students attended such schools.

Figure 2.2 ■ **School responsibility for selecting teachers**

Percentage of 15-year-old students in schools where the principal or school governing board has considerable responsibility for hiring or firing teachers, based on principals' reports; high-performing countries and economies in PISA



Countries and economies are ranked in descending order of the percentage of students in schools where the principal or the school governing board has considerable responsibility for selecting teachers for hire.

Source: OECD PISA 2015 Database, Table 2.8.

StatLink http://dx.doi.org/10.1787/888933740212

School responsibility for hiring and firing teachers is common in Nordic, Anglo-Saxon, and Eastern European countries, even among lower-performing education systems. These countries are characterised by public sector employment that is "position-based" (OECD, 2005[5]), i.e. where public services tend to focus on selecting the best-suited candidate for each position, whether by external recruitment or internal promotion. In contrast, school autonomy for hiring and firing teachers tends to be less common in France and in South European countries, such as Greece, Italy, Portugal (at least for firing teachers) and Spain, as well as in Latin American countries (with the exception of Chile) and, as already noted, in East Asian systems. These countries are characterised by public sector employment that is "career-based" (OECD, 2005[5]), i.e. where public services tend to recruit based on academic credentials or a civil service entry examination, and once recruited, teachers are allocated to positions according to rules that operate at the system level. In PISA 2015, the percentage of students who attended schools with considerable responsibility for selecting teachers for hire was positively, but only moderately, related to mean performance in science ($r = 0.36$ across all countries; $r = 0.40$ across OECD countries).[3]

Professional development requirements and participation

Like many other professionals, teachers need to stay abreast of what is new in their field and be able to respond to the emerging demands of their job, which is why many countries make professional development mandatory. Among high-performing countries and economies, in Hong Kong (China) and Korea, participation in professional development is compulsory for teachers in order to obtain a promotion or salary increase. It is a requirement for maintaining employment in Australia, England (United Kingdom), Estonia, Finland, Germany, Japan and Slovenia. Such requirements translate into high participation rates in professional development programmes in most of these countries (OECD, 2016, Table II.6.17[13]).

Figure 2.3 ■ **Professional development requirements for teachers**

High-performing countries and economies in PISA, lower secondary general programmes, 2013

Yes
No
a Not applicable
m Missing

	Share of low achievers in all three subjects	Share of top performers in at least one subject (science, reading or mathematics)	Professional development is a compulsory requirement for teachers to maintain employment	Professional development is a compulsory requirement for promotion or salary increase
Australia	11.1	18.4	Yes	No
B-S-J-G (China)	10.9	27.7	m	m
Canada	5.9	22.7	m	m
England (United Kingdom)	9.8	18.1	Yes	No
Estonia	4.7	20.4	Yes	No
Finland	6.3	21.4	Yes	No
Flemish Community (Belgium)	10.9	25.2	No	No
Germany	9.8	19.2	Yes	No
Hong Kong (China)	4.5	29.3	No	Yes
Japan	5.6	25.8	Yes	No
Korea	7.7	25.6	No	Yes
Macao (China)[1]	3.5	23.9	No	No
Netherlands	10.9	20.0	No	No
New Zealand	10.6	20.5	m	m
Norway	8.9	17.6	No	No
Singapore	4.8	39.1	No	No
Slovenia	8.2	18.1	Yes	No
Switzerland	10.1	22.2	m	m
Chinese Taipei	8.3	29.9	No	No

1. Reference year: 2014/15.

Countries and economies are listed in alphabetical order.

Source: OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education,* Tables I.2.9a, I.2.10a, B2.I.45 and B2.I.46, http://dx.doi.org/10.1787/888933433171 and http://dx.doi.org/10.1787/888933433235; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools,* Table II.6.57, http://dx.doi.org/10.1787/888933436513.

StatLink http://dx.doi.org/10.1787/888933740231

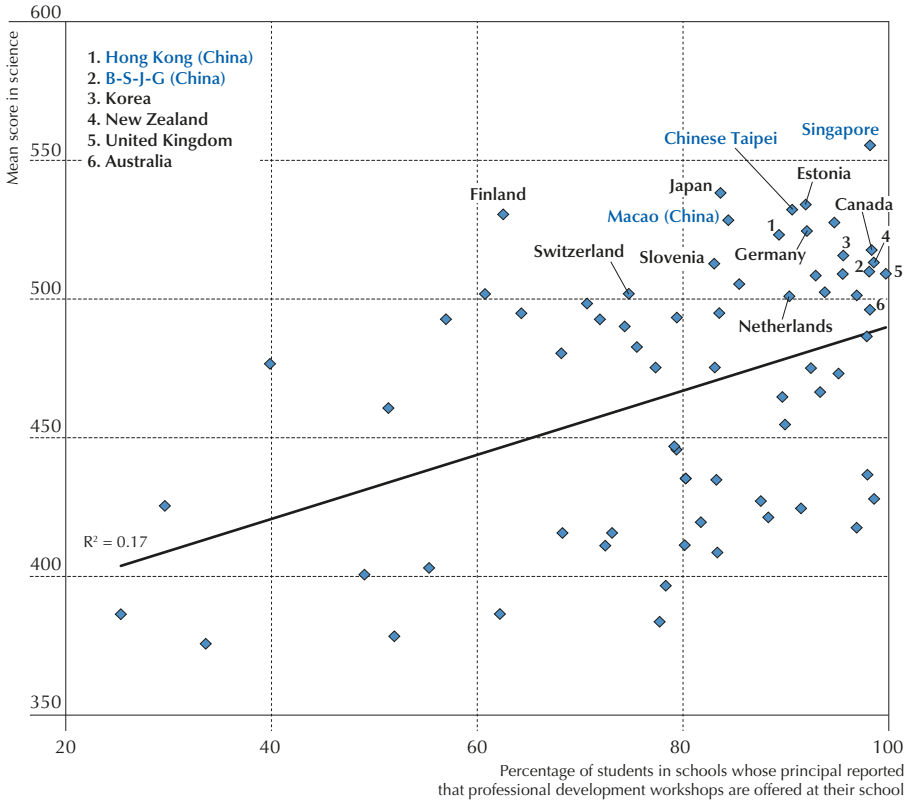
In PISA 2015, principals of schools attended by 15-year-old students were asked what proportion of their teaching staff had participated in professional development activities during the three months prior to the PISA test. Australia, England (United Kingdom) and Singapore were among the countries/economies in which school principals reported that over 80% of teachers had participated in professional development activities, on average (OECD, 2016, Tables II.6.17 and B2.II.42 [13]). Principals in B-S-J-G (China), Canada, Macao (China) and New Zealand reported between 70% and 80% participation, on average, significantly above the OECD average of 51%; in several Canadian provinces, including British Columbia and Alberta, participation rates were above 80%. Among the 19 highest-performing countries and economies in PISA, in the Flemish Community of Belgium, Germany, Japan, Norway and Slovenia principals reported below-average participation in professional development activities.

Participation rates in professional development activities, as reported by principals, were positively related to a country's performance in the PISA 2015 science test (the linear correlation

coefficient is r = 0.40 across all 69 countries/economies with comparable data; r = 0.36 across OECD countries). But the type of professional development activity matters at least as much, if not more, than participation. Performance in science is positively related to the proportion of students in schools that organise in-house professional development activities: inviting specialists to conduct trainings (r = 0.49 across all countries/economies; r = 0.56 across OECD countries), organising workshops that deal with specific issues that the school faces (r = 0.41 across all countries; r = 0.46 across OECD countries) or organising workshops for specific groups of teachers (r = 0.42 across all countries/economies; r = 0.50 across OECD countries).

Figure 2.4 ■ **School-based professional development workshops and science performance**

Based on principals' reports, PISA 2015



Note: Countries/economies named on the chart are the high-performing countries and economies in PISA analysed in this chapter.

Source: OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.2.3, http://dx.doi.org/10.1787/888933433171; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, Tables II.6.20, http://dx.doi.org/10.1787/888933436513.

StatLink http://dx.doi.org/10.1787/888933740250

Indeed, in almost all 19 high-performing systems examined here, at least 80% of PISA-participating students were in schools that organise in-service workshops that deal with specific issues faced by the school (OECD average: 80%) or that organise in-service workshops for specific groups of teachers (OECD average: 69%). These kinds of bespoke in-service workshops were almost universally available in schools attended by 15-year-olds in Australia, B-S-J-G (China), England (United Kingdom), Korea,[4] New Zealand and Singapore; and only slightly less common in the Flemish Community of Belgium, Canada, Estonia, Germany, Hong Kong (China), Japan, Macao (China), the Netherlands, Portugal, Switzerland and Chinese Taipei(where between 70% and 95% of students were in schools that organise such workshops). Such school-based workshops are somewhat less common in Finland, Norway and Slovenia (OECD, 2016, Tables II.6.20 and B2.II.43[13]).

The advantage of school-based workshops, compared to attending a lecture by an external specialist, might come from the peer-learning opportunities they provide, and the fact that feedback and ideas from other experienced teachers in the same school are more directly related to concrete and common challenges in the classroom. The *Teachers Matter* report (OECD, 2005[5]) notes that the most effective forms of professional development focus on clearly articulated priorities, provide ongoing school-based support to classroom teachers, and create opportunities for teachers to observe, experience and try new teaching methods. Effective professional development includes opportunities for teachers to observe, design, perform or expose teaching practices, provides adequate time and follow-up support, and encourages the development of teachers' learning communities (Barrera-Pedemonte, 2016, pp. 19-25[17]).

Desimone (2009[18]) identified five core features of effective professional development activities: they are focused, embedded in collective practice, provide opportunities for active learning, tend to be longer in duration, and are coherent with wider policies and with the knowledge and beliefs of teachers who participate. A recent review of existing research similarly concludes that "activities that are intensive, sustained, collaborative, and focused on materials and problems of practice [have] more impact on teachers' knowledge, classroom practices and student achievement" (Opfer, 2016, p. 7[19]). The same author also analyses TALIS data to show that greater participation in school-embedded professional development is associated with greater reported impact of professional development on teaching knowledge and practice, while participation in professional development activities outside of the school is associated with less reported impact (Opfer, 2016, p. 17[19]).

School workshops and one-to-one coaching or mentoring programmes offer natural settings for productive forms of professional development, although effective professional development might also happen outside of the school or by pooling resources across schools.

Teacher appraisal

Monitoring and appraising teachers is central to the continuous improvement of schooling. Teachers need feedback on their performance to help them identify how to better shape and improve their teaching practice and, with the support of engaged school leadership, develop schools as professional learning communities. Teacher appraisal also provides opportunities to recognise and reward effective teaching. Based on the existing research and in-depth analyses

of numerous teacher-appraisal systems internationally, a recent OECD review concluded that "that there is no single model or global best practice of teacher appraisal"; however, the report provided a number of policy suggestions for improving teacher appraisal, including (OECD, 2013[11]):

- establishing teaching standards to guide teacher appraisal and professional development
- resolving tensions between the developmental and accountability functions of teacher appraisal
- conducting regular developmental appraisals at the school level, based on multiple sources of evidence, including frequent classroom observations conducted by competent evaluators internal to the school
- ensuring that teacher appraisal feeds into professional and school development
- establishing periodic career-progression appraisal involving external evaluators
- preparing teachers for appraisal processes and strengthening the capacity of school leaders for teacher appraisal.

Almost every high-performing country and economy in PISA has a legislated policy of teacher appraisal for lower secondary teachers, as does nearly every lower-performing country and economy. Twelve out of 17 high-performing systems for which data are available for 2015 have a legislated appraisal system for lower secondary teachers. Australia, Canada, England (United Kingdom), the Flemish Community of Belgium, Japan, Korea, Macao (China), the Netherlands, New Zealand, Singapore, Slovenia and Switzerland have national or state laws or regulations in place to regulate one or more types of teacher appraisal.

Countries/economies that have no policy framework about teacher appraisal, such as Estonia, Hong Kong (China), Norway and Chinese Taipei, nevertheless have similar practices that cover a large proportion, if not all, teachers. In Hong Kong (China), for example, the Education Bureau requires all schools to develop their own performance-appraisal system for teachers. In Norway, approaches to teacher appraisal are not regulated nationally, but are typically designed at the local and/or school level, and all teachers are appraised. The only exception among high-performing countries is Germany, which has no legislated teacher appraisal policy (data for B-S-J-G [China] and Finland are missing; teacher-reported information from TALIS can be used to complement system-level data about these two systems) (Figure 2.5).

In Shanghai (China), all lower secondary teachers are in schools that conduct formal appraisals, according to principals' reports; and 98% of lower secondary teachers reported in TALIS that they had received regular formal or informal feedback on their performance and areas for development in their current school. Feedback following classroom observation is particularly widespread (96%) (Table 2.16).

In Finland, in contrast, there is no national policy framework for teacher appraisals; rather, the basis for teacher appraisal is defined in the contract between the local government that employs the teacher and the teachers' trade union. Under these contracts, school principals, who are seen as the pedagogical leaders of the school, typically conduct annual discussions aimed at appraising the teacher's fulfilment of individual objectives set up during the previous year and

determining developmental needs for the following year (OECD, 2013, p. 290[11]). Nevertheless, in 2013, although 74% of Finnish lower secondary teachers were in schools whose principals reported that teachers are formally appraised, as many as 36% of teachers reported that they had not received any formal or informal feedback on their performance and areas for development in their current school – one of the highest percentages among countries participating in TALIS (Table 2.16)

Figure 2.5 ■ **Teacher appraisal**
High-performing countries and economies in PISA, lower secondary general programmes, 2015

Yes
No
a Not applicable
m Missing

	Share of low achievers in all three subjects	Share of top performers in at least one subject (science, reading or mathematics)	Existence of legislated teacher appraisal	Percentage of teachers appraised	Type of appraisal covered by policy framework (if legislated)			Frequency of mandatory, regular appraisals (every ... years)
					Regular appraisal	Appraisal for promotion	Appraisal for reward schemes	
Australia	11.1	18.4		m		m		1
B-S-J-G (China)	10.9	27.7	m	m	m	m	m	m
Canada[1]	5.9	22.7		m	m	m	m	m
England (United Kingdom)[2]	9.8	18.1		90				1
Estonia[3]	4.7	20.4		80	a	a	a	a
Finland	6.3	21.4	m	m	m	m	m	m
Flemish Community (Belgium)	10.9	25.2		m				4
Germany	9.8	19.2		a	a	a	a	a
Hong Kong (China)[4]	4.5	29.3		100	a	a	a	a
Japan	5.6	25.8		m				m
Korea	7.7	25.6		m				1
Macao (China)[2]	3.5	23.9		100				
Netherlands	10.9	20.0		68				3
New Zealand	10.6	20.5		100				1
Norway[3]	8.9	17.6		m	a	a	a	a
Singapore	4.8	39.1		100				0.5
Slovenia	8.2	18.1		100				1
Switzerland	10.1	22.2		m	m	m	m	m
Chinese Taipei[3]	8.3	29.9		a	a	a	a	a

1. Appraisal is legislated in most, but not all, Canadian provinces.
2. Teacher appraisal is legislated in public institutions, and not legislated (but widely practised) in private institutions.
3. Teacher appraisal is not legislated, but similar practices exist.
4. The Education Bureau requires all schools to have a fair and open performance appraisal system for teachers. Schools should develop their own school-based appraisal system in consultation with teachers.

Countries and economies are listed in alphabetical order.

Source: OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Tables I.2.9a, I.2.10a, B2.I.45 and B2.I.46, http://dx.doi.org/10.1787/888933433171 and http://dx.doi.org/10.1787/888933433235; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, Tables II.4.47 and II.4.49, http://dx.doi.org/10.1787/888933436498.

StatLink http://dx.doi.org/10.1787/888933740269

Among the remaining countries with available data, Iceland, Luxembourg and Scotland (United Kingdom) similarly do not have a legislated teacher-appraisal system. Some 43% of lower secondary teachers in Iceland reported (in TALIS) that they had not received any feedback in their current school.

Ten of the 12 high-performing countries and economies with a legislated policy framework for teacher appraisal conduct regular appraisals of teachers. Data for Canada and Switzerland are missing, as different provinces and cantons might have different provisions. Regular appraisals are typically organised at the school level and pursue a mix of purposes, including professional development and establishing teachers' responsibilities and working conditions. The key aspect of such appraisals is that they feed into individual and collective professional development.

Among the remaining participants in PISA with a legislated framework for teacher appraisal, Ireland, Israel, Italy and Spain do not have regulations in place for regular appraisals (OECD, 2016, Table II.4.49[13]). In Spain, only appraisals for teacher registration are covered by the policy framework; each region is responsible for the evaluation and appraisal of its teachers. But TALIS and PISA both indicate that teachers have limited opportunities to receive feedback, based on classroom observation, about their teaching (OECD, 2015[20]). In Italy, only appraisals at the completion of the probationary period are mandated, although a recent reform has established a merit-based component of teachers' salaries that will require the regular appraisal of teacher performance by school-led teacher evaluation committees (OECD, 2017[21]).

The periodicity of regular appraisals can vary widely across countries and economies. In the Flemish Community of Belgium, teachers receive mandatory, periodic appraisals every four years, the longest interval observed across all countries; in the Netherlands, every three years; in Australia, England (United Kingdom), Korea, Macao (China), New Zealand and Slovenia, every year; and in Singapore, twice a year (the frequency of regular appraisals was not reported by B-S-J-G [China], Canada and Japan).

In addition, in five of these countries/economies teachers can receive appraisals as part of reward schemes or when applying for promotion. In Canada, although there is some variation across jurisdictions, there are typically two processes for regular appraisal: teachers' performance is typically appraised every five years (or more frequently if there are concerns about performance), but teachers are also more frequently appraised for their professional development (OECD, 2013[11]).

Where regular teacher appraisals exist, and the information about the aspects appraised and the sources of information used for appraisals is available (eight countries/economies), the policy framework always specifies that the instructional core of teachers' work (planning and preparation, instruction, and the classroom environment) is appraised. This is also the case in all remaining countries that conduct regular appraisals and provided information. In seven countries/economies (all countries with available information except Korea), teachers' participation in professional development activities is also considered (Figure 2.6).

The essence of teaching is displayed in the classroom. This is why appraisals are typically based on classroom observations and on an interview or dialogue between the teacher and evaluators. Seven countries provided this information; only in Korea are interviews not used as an information source. Self-appraisals and teacher portfolios are also frequently used. No high-performing country

conducts teacher tests, and only two – England (United Kingdom) and Singapore – specify that information about student outcomes must be used as one of the sources for the regular assessment of lower secondary teachers. Even if it is not a formal requirement, in all TALIS-participating countries and in all schools whose principals reported that teachers are formally appraised, a large majority of principals reported that the analysis of students' test scores informs teacher appraisal, along with classroom observations and interviews (OECD, 2014, p. 355[10]).

Figure 2.6 ■ **Features of regular teacher appraisals**

High-performing countries and economies in PISA, lower secondary schools, 2015

Yes
No
a Not applicable
m Missing

	Share of low achievers in all three subjects	Share of top performers in at least one subject (science, reading or mathematics)	Aspects appraised		Instruments and information sources used					
			Planning and preparation, instruction, classroom environment	Professional development	Classroom observation	Interview/dialogue between teachers and evaluators	Teacher self-appraisal	Teacher portfolio	Teacher testing	Student outcomes
Australia	11.1	18.4							m	m
B-S-J-G (China)	10.9	27.7	a	a	a	a	a	a	a	a
Canada	5.9	22.7	m	m	m	m	m	m	m	m
England (United Kingdom)	9.8	18.1								
Estonia	4.7	20.4	a	a	a	a	a	a	a	a
Finland	6.3	21.4	m	m	m	m	m	m	m	m
Flemish Community (Belgium)	10.9	25.2			m		m	m	m	m
Germany	9.8	19.2	a	a	a	a	a	a	a	a
Hong Kong (China)	4.5	29.3	a	a	a	a	a	a	a	a
Japan	5.6	25.8	m	m	m	m	m	m	m	m
Korea	7.7	25.6								
Macao (China)	3.5	23.9								
Netherlands	10.9	20.0	m	m	m	m	m	m	m	m
New Zealand	10.6	20.5								
Norway	8.9	17.6	a	a	a	a	a	a	a	a
Singapore	4.8	39.1								
Slovenia	8.2	18.1								
Switzerland	10.1	22.2	m	m	m	m	m	m	m	m
Chinese Taipei	8.3	29.9	a	a	a	a	a	a	a	a

Countries and economies are listed in alphabetical order.

Source: OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Tables I.2.9a, I.2.10a, B2.I.45 and B2.I.46, http://dx.doi.org/10.1787/888933433171 and http://dx.doi.org/10.1787/888933433235; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, Tables II.4.46 and II.4.52, http://dx.doi.org/10.1787/888933436498.

StatLink http://dx.doi.org/10.1787/888933740288

In contrast, teacher tests are the only source of information for regular appraisals in Mexico, and they are also conducted in Chile, Peru and the United Arab Emirates. In Portugal, self-appraisals are the only source of information for regular appraisals. In Brazil and Colombia, classroom observation is also not practiced for regular appraisals, which are informed by student outcomes

in addition to interviews and self-appraisals or portfolios (OECD, 2016, Table II.4.52[13]). This is problematic because teacher appraisals can ensure that individual weaknesses are identified and addressed with suitable professional development activities only if the appraisal includes classroom observations. Teaching is at the core of a teacher's professional responsibilities, and can and should be directly observed (OECD, 2013[11]).

The consequences of teacher appraisals vary more widely, even among high-performing countries and economies with legislated, regular appraisals. Some countries, such as Korea, use separate processes for decisions about career and salaries, and for decisions about teachers' professional development (OECD, 2013, p. 287[11]). But most countries combine accountability and developmental functions in a single process.

In all eight high-performing countries where the information is available, appraisals are used, to some extent, for teachers' professional development. In some cases, such as in Australia, Macao (China), New Zealand and Singapore, the appraisal systematically results in a professional development plan for teachers; in others, such as Korea, a negative rating (underperformance) results in compulsory training. In England (United Kingdom), the Flemish Community of Belgium and Slovenia, the results of teacher appraisal are less formally linked to professional development, but are expected to influence professional development activities (Figure 2.7). Among the remaining countries with regular appraisal systems, in Malta, Qatar, Thailand and Turkey, teachers' professional development is not informed by appraisal results (OECD, 2016, Table II.4.52[13]).

In most cases, teachers' career advancement is at stake in regular appraisals, either because appraisal results – both positive and negative – influence decisions about promotion or the speed at which a teacher progresses through the career structure or salary scale (Australia, Macao [China], Singapore, Slovenia), or because underperformance can result in deferred promotions or career advancement (the Flemish Community of Belgium, Macao [China], New Zealand, Singapore and Slovenia). Results of regular appraisals are not formally linked to career advancement in Japan, nor does Japan conduct special appraisals for promotion. In England (United Kingdom), the results of regular appraisals are also not formally linked to career advancement, but in 2013, 97% of principals in lower secondary schools reported that the results of formal teacher appraisals influence the likelihood of career advancement (Table 2.16).

Teachers' salaries are directly dependent on the results of regular appraisals only in Singapore, where a salary increase is provided, in the form of a pay allowance, for good performance. In Australia, England (United Kingdom), Macao (China), New Zealand and Slovenia, the impact on pay is a reflection of the influence of appraisals on career progressions. In the Flemish Community of Belgium, Japan and Korea, the results of regular teacher appraisals are not used for determining pay levels, although in Korea, there is a separate performance-based incentives system under which teachers are obliged to be appraised annually (OECD, 2013[11]).

Based on in-depth analysis of the existing literature and the review of over 20 teacher-appraisal systems across the world, a recent OECD report highlighted that it is not the existence of formal appraisal requirements, but the design and quality of the processes that matter most if teacher appraisals are to have an impact on teaching and learning outcomes (OECD, 2013[11]).

Figure 2.7 ■ **Use of results from regular teacher appraisals**

High-performing countries and economies in PISA, lower secondary level, 2015

Yes
No
a Not applicable
m Missing

	Share of low achievers in all three subjects	Share of top performers in at least one subject (science, reading or mathematics)	Use of results for professional development			Use of results for career advancement		Use of results for pay levels			
			Appraisal systematically results in a professional development plan	Appraisal is expected to influence professional development activities	Underperformance results in compulsory training	Appraisal results influence decisions about promotion or the speed at which a teacher progresses through the career structure or salary scale	Underperformance results in deferral of promotion or career advancement	Appraisal results affect the base salary	A pay allowance is provided for good performance	Appraisal affects pay levels to the extent that it affects progression through the career structure and/or salary scale	A salary increment is withheld in case of underperformance
Australia	11.1	18.4					m				
B-S-J-G (China)	10.9	27.7	a	a	a	a	a	a	a	a	a
Canada	5.9	22.7	m	m	m	m	m	m	m	m	m
England (United Kingdom)	9.8	18.1									
Estonia	4.7	20.4	a	a	a	a	a	a	a	a	a
Finland	6.3	21.4	m	m	m	m	m	m	m	m	m
Flemish Community (Belgium)	10.9	25.2			m						
Germany	9.8	19.2	a	a	a	a	a	a	a	a	a
Hong Kong (China)	4.5	29.3	a	a	a	a	a	a	a	a	a
Japan	5.6	25.8	m	m	m		m				m
Korea	7.7	25.6									
Macao (China)	3.5	23.9									
Netherlands	10.9	20.0	m	m	m	m	m	m	m	m	m
New Zealand	10.6	20.5									
Norway	8.9	17.6	a	a	a	a	a	a	a	a	a
Singapore	4.8	39.1									
Slovenia	8.2	18.1									
Switzerland	10.1	22.2	m	m	m	m	m	m	m	m	m
Chinese Taipei	8.3	29.9	a	a	a	a	a	a	a	a	a

Countries and economies are listed in alphabetical order.

Source: OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Tables I.2.9a, I.2.10a, B2.I.45 and B2.I.46, http://dx.doi.org/10.1787/888933433171 and http://dx.doi.org/10.1787/888933433235; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, Table II.4.55, http://dx.doi.org/10.1787/888933436498.

StatLink http://dx.doi.org/10.1787/888933740307

Recent literature, based on data from Cincinnati (United States), where teachers are appraised through multiple detailed classroom observations and a review of teachers' work products, has shown that teachers become more effective in promoting student test achievement in post-evaluation years. This suggests that the feedback received during evaluation and the professional development activities undertaken in response help teachers develop new skills or work to improve critical areas (Taylor and Tyler, 2012[22]).

Teachers' salaries and factors that influence teachers' careers and salaries

Higher salaries can help school systems attract more candidates to the teaching profession, and signal that teachers are regarded and treated as professionals. In general, in most high-performing countries and economies for which data are available, teachers earn salaries that are higher than the per capita GDP. The exceptions, among countries with available data, are Macao (China) and Norway, although teachers' salaries in Macao (China) are nevertheless significantly above the OECD average, in real terms (Figure 2.8). But several lower-performing countries also compensate teachers well; and, as seen above, high salaries are not universal among high-performing countries (OECD, 2016, Table II.6.54[13]). It is therefore important to look at other aspects of teacher compensation, including how salary progressions are linked to career structures.

Out of the 19 high-performing countries and economies considered in this section, 11 provided responses on the importance given to various aspects of teaching in determining teachers' career progression and salaries. The relative importance of four factors was investigated: appraisal results (where appraisals are conducted), taking on extra roles and tasks, participation in professional development, and length of service. Results vary greatly across the 11 countries (Figure 2.8).

In Korea, Slovenia and Chinese Taipei, all four factors (three in Chinese Taipei, where there are no teacher appraisals) were rated as equally important for teachers' career progression; but in Korea, length of service has a stronger influence on teachers' salaries than the other factors. In Macao (China) and Singapore, teacher-appraisal results were reported as the major determinant of teachers' career progression and salaries, together with taking on extra roles and tasks (the latter, however, has only a weak influence on salaries in Singapore). In England (United Kingdom) and New Zealand, in contrast, length of service, and taking on extra roles and tasks, were reported as stronger influences on teachers' careers and salaries than teacher-appraisal results, or the participation in professional development which, in England, has no influence at all (Figure 2.8).

In Estonia, taking on extra roles and tasks has the biggest influence on teachers' career progression, while salaries are also influenced to a similar extent by appraisal results (appraisal is conducted by the school management; there is no legislated framework for appraisal). In the Flemish Community of Belgium, length of service has no influence on career progression, but is the only determinant of teachers' salaries. Similarly, in Germany, career progressions are mainly determined by teachers taking on extra roles and tasks, or completing professional development; but salaries depend, to a similar or even larger extent, on length of service (Figure 2.8).

In Australia, length of service has a strong influence on teachers' pay and career progression, while the influence of other factors was not reported (Figure 2.8). But the results of teacher appraisals were reported to influence decisions about promotion and/or progression on the salary scale (Figure 2.7). Similarly, in the Netherlands, the length of service is a strong determinant of teachers' salaries, while the influence of other factors was not reported (Figure 2.8).

Principals' responses to the PISA school questionnaire can also be used to assess the extent to which schools are responsible for determining teachers' salaries, either by establishing starting salaries or by determining the timing or amount of salary increases. In most high-performing countries outside of East Asia, schools have considerable responsibility for selecting teachers for hire; but that does not imply that these teachers are employed and paid directly by schools or that their

employment is not regulated at a more central level. In fact, only in England (United Kingdom), Hong Kong (China), Macao (China) and the Netherlands did more than 50% of students attend schools whose principal or school governing board enjoys considerable responsibility for setting starting salaries for teachers. And only in England (United Kingdom), Estonia, Macao (China) and the Netherlands can a majority of schools (weighted by the student population) determine teachers' salary increases. In the remaining high-performing countries and economies, even where schools are responsible for selecting teachers through hiring and/or firing decisions, teachers' salaries and salary increases are set outside of the school boundaries (Table 2.8).

Figure 2.8 ■ **Factors that influence teachers' salaries and career progression**

High-performing countries and economies in PISA, lower secondary schools, 2015

High
Moderate
Low
No influence at all
a Not applicable
m Missing

	Share of low achievers in all three subjects	Share of top performers in at least one subject (science, reading or mathematics)	Factors that influence teachers' career progression: Teacher appraisal results	Taking on extra roles and tasks	Completion of professional development	Length of service	Factors that influence teachers' salaries: Teacher appraisal results	Taking on extra roles and tasks	Completion of professional development	Length of service	Teachers' salaries after 15 years of experience for teachers with typical training (2014): Teachers' salaries in equivalent USD converted using PPPs (in thousands)	Ratio of salaries to per capita GDP (2014)
Australia	11.1	18.4	m	m	m		m	m	m		57	1.2
B-S-J-G (China)	10.9	27.7	m	m	m	m	m	m	m	m	m	m
Canada	5.9	22.7	m	m	m	m	m	m	m	m	66	1.5
England (United Kingdom)	9.8	18.1									46	m
Estonia	4.7	20.4									m	m
Finland	6.3	21.4	m	m	m	m	m		m		43	1.0
Flemish Com. (Belgium)	10.9	25.2									49	m
Germany	9.8	19.2									69	1.5
Hong Kong (China)	4.5	29.3	m	m	m	m	m	m	m	m	90	1.6
Japan	5.6	25.8	m	m	m	m	m	m	m	m	49	1.4
Korea	7.7	25.6									47	1.4
Macao (China)	3.5	23.9									121	0.9
Netherlands	10.9	20.0	m	m	m	m	m	m	m		66	1.4
New Zealand	10.6	20.5									44	1.2
Norway	8.9	17.6	m	m	m	m	m	m	m	m	44	0.7
Singapore	4.8	39.1									107	1.3
Slovenia	8.2	18.1									38	1.3
Switzerland	10.1	22.2	m	m	m	m	m	m	m	m	m	m
Chinese Taipei	8.3	29.9	a				a				30	1.3

Countries and economies are listed in alphabetical order.

Source: OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Tables I.2.9a, I.2.10a, B2.I.45 and B2.I.46, http://dx.doi.org/10.1787/888933433171 and http://dx.doi.org/10.1787/888933433235; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, Tables II.4.57, II.6.54 and II.6.59, http://dx.doi.org/10.1787/888933436498 and http://dx.doi.org/10.1787/888933436513; OECD (2016), "Indicator D3 How Much are Teachers Paid?", in *Education at a Glance 2016: OECD Indicators*, http://dx.doi.org/10.1787/eag-2016-31-en.

StatLink http://dx.doi.org/10.1787/888933740326

Overall, it appears that teacher compensation levels and the rules governing teachers' careers differ significantly not only across countries in general, but among the more restricted set of high-performing countries and economies as well. A forthcoming thematic report on human resources, part of the OECD School Resources Review project, will analyse best practices governing compensation and benefits.

WHAT SYSTEM-WIDE CHANGES IN TEACHER CHARACTERISTICS AND PRACTICES ARE RELATED TO IMPROVEMENTS IN STUDENT PERFORMANCE AT THE COUNTRY LEVEL?

This section focuses on changes in teacher characteristics and teacher policies within countries, across time. Cross-country associations that are discussed in the first section and are confirmed by within-country patterns of association examined in this second section can be said to be robust. Indeed, these within-country patterns show not only that countries with certain characteristics perform better or worse, on average, but they help ascertain whether performance improved or deteriorated in countries that, through purposeful reforms or other means, changed their teacher policies or characteristics.

The analysis has several limitations. First, data on teacher policies or characteristics that can be compared both across time and across countries are extremely limited: for many of the characteristics noted above, and particularly for the three common traits of high-performing systems cited above – clinical training, bespoke professional development, and formative teacher appraisal – no trend data are available.

Furthermore, although the focus on within-country variations fully accounts for country-level characteristics that remained constant over the period, and which might drive cross-country associations, the causality of the relationships, and which change is the cause and which the effect, might remain unclear. For example, it might be that the perception of deteriorating performance was used to justify reforms in governance, rather than the reforms causing the declines in performance.

Finally, few countries saw significant changes in performance between 2006 and 2015, and the statistical uncertainty around changes in PISA performance can make it more difficult to detect a relationship even where one exists.

Despite these limitations, three conclusions emerge from this analysis:

- System-level changes in the net flow of teachers in and out of the profession, as reflected in student-teacher ratios, in class size, and in hiring flows indicated by the share of teachers under the age of 30, are, in general, unrelated to improvements in PISA performance. However, countries that reduced the incidence of grade repetition tended to limit teacher flows into the profession, perhaps indicating that the reduction in grade repetition rates was motivated at least in part by budget concerns, and that these savings were not totally reinvested in alternative measures to assist low-performing students.
- Changes in teachers' salaries are also unrelated to improvements in performance among countries participating in PISA.

- The only variable that shows some association with system-level improvements or deterioration in performance is the increase in school autonomy for selecting teachers for hire, or for firing teachers. This relationship is stronger across systems in which school-level achievement data are used for accountability practices – e.g. are posted publicly or are tracked over time by an administrative authority.

Most trends in teacher policies and characteristics cover the period between 2006 and 2015 (when based on PISA school-questionnaire data) or between 2005 and 2015 (when based on the annual OECD publication *Education at a Glance*). They are systematically compared to contemporary trends in performance, and sometimes in attainment, between PISA 2006 and PISA 2015. While all three domains in PISA – science, reading and mathematics – can be compared between these dates, the most robust comparison is based on science performance, which was the major domain in both assessments. Associations with science performance trends are therefore highlighted in the text, with the remaining two domains used to verify the robustness of these associations.

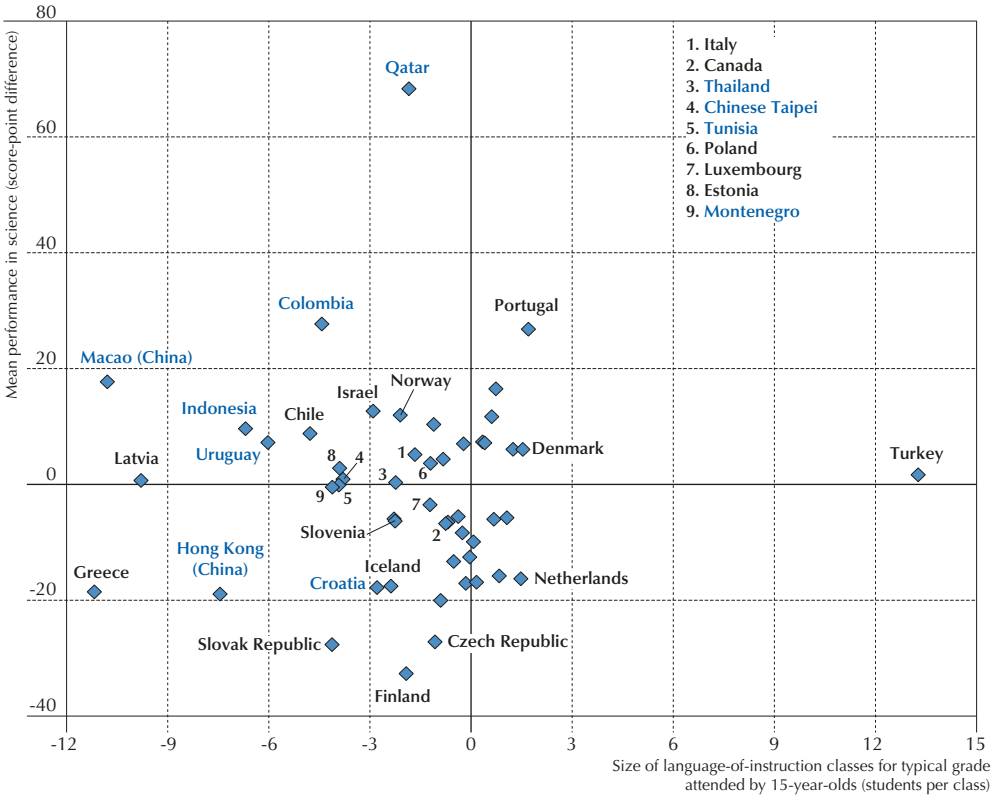
Changes in teacher quantity

Education systems must determine how many teachers are required to offer an adequate education to their students. In order to reduce class size or lighten teachers' teaching load (and increase the amount of time teachers spend preparing lessons or participating in mentoring or professional development activities), for example, the number of teachers per student must increase – or, equivalently, the student-teacher ratio must shrink, unless these changes are compensated for by changes in students' instruction time or in teachers' working time. Student-teacher ratios and, indirectly, class size, also have a considerable impact on the level of expenditure on education.

Smaller classes are often seen as beneficial, because they allow teachers to focus more on the needs of individual students and reduce the amount of class time needed to deal with disruptions. While reducing class size is a costly measure, there is some evidence that smaller classes benefit students in the primary grades in particular (Chetty et al., 2011[23]; Piketty and Valdenaire, 2006[24]; Fredriksson, Öckert and Oosterbeek, 2013[25]), while the evidence is more scant and less certain for lower- and upper-secondary grades (Bouguen, Grenet and Gurgand, 2017[26]; Wößmann and West, 2006[27]).

Class size has been consistently measured in PISA by asking school principals to report the average size of language-of-instruction classes for the typical grade attended by 15-year-old students (also known as the "modal" grade). Across 51 countries/economies with comparable results for 2006 and 2015, changes in average class size were not significantly related to learning trends in science (r = -0.01) or in any PISA domain. The correlation with student-teacher ratios was also low (r = .13), and the positive sign indicates that some of the fastest-improving countries in PISA – such as Portugal and Qatar – had actually reduced, rather than increased, the number of teachers per student (i.e. increased the student-teacher ratio) (Figue 2.9 and Figure 2.10).

Figure 2.9 ■ **Change between 2006 and 2015 in average class size and science performance**



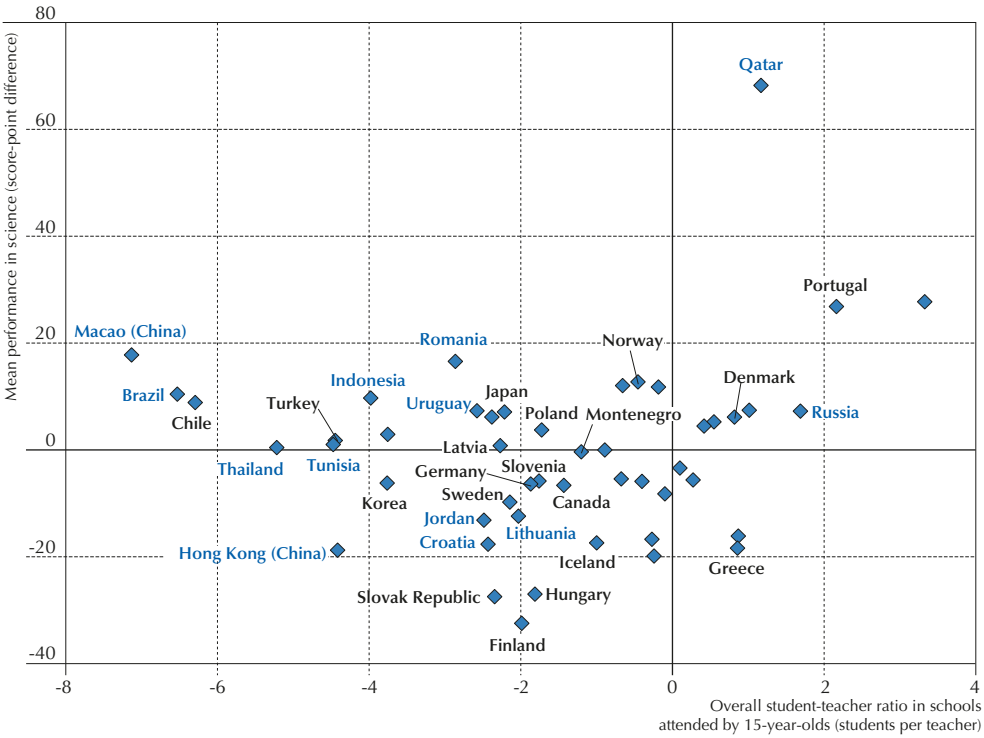
Note: Countries/economies named on the chart show a significant change in average size of language-of-instruction classes between 2006 and 2015. Countries/economies with non-significant changes are Australia, Austria, Belgium, Brazil, Bulgaria, Germany, Hungary, Japan, Jordan, Lithuania, Mexico, New Zealand, Romania, Russia, Spain, Sweden, Switzerland, the United Kingdom and the United States.

Source: OECD PISA 2015 Database, Table 2.7; OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.2.4a, http://dx.doi.org/10.1787/888933433171.

StatLink http://dx.doi.org/10.1787/888933740345

In fact, other data seem to suggest that countries with high rates of grade repetition, and therefore large proportions of students enrolled in lower grades than is typical for their age, such as France and Portugal, were able to reduce the demand for teachers significantly as they reduced the grade-repetition rate. There is indeed a positive correlation between a reduction in the proportion of students whose progress from one grade to the next is delayed and a reduction in the share of teachers under the age of 30 across the 25 OECD countries with available data (r = 0.39). This is apparent in France and Portugal, for example, while the opposite pattern – an increase in the share of students who are held back a grade, and a greater inflow of young teachers – is observed in Chile (Figure 2.11).

Figure 2.10 ■ **Change between 2006 and 2015 in the student-teacher ratio and science performance**



Note: Countries/economies named on the chart show a significant change between 2006 and 2015 in the overall student-teacher ratio in schools attended by 15-year-olds. Countries/economies with non-significant changes are Australia, Belgium, Bulgaria, Colombia, the Czech Republic, Ireland, Israel, Italy, Luxembourg, Mexico, the Netherlands, Spain, Switzerland, Chinese Taipei, the United Kingdom and the United States.

Source: OECD PISA 2015 Database, Table 2.1; OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education,* Table I.2.4a, http://dx.doi.org/10.1787/888933433171.

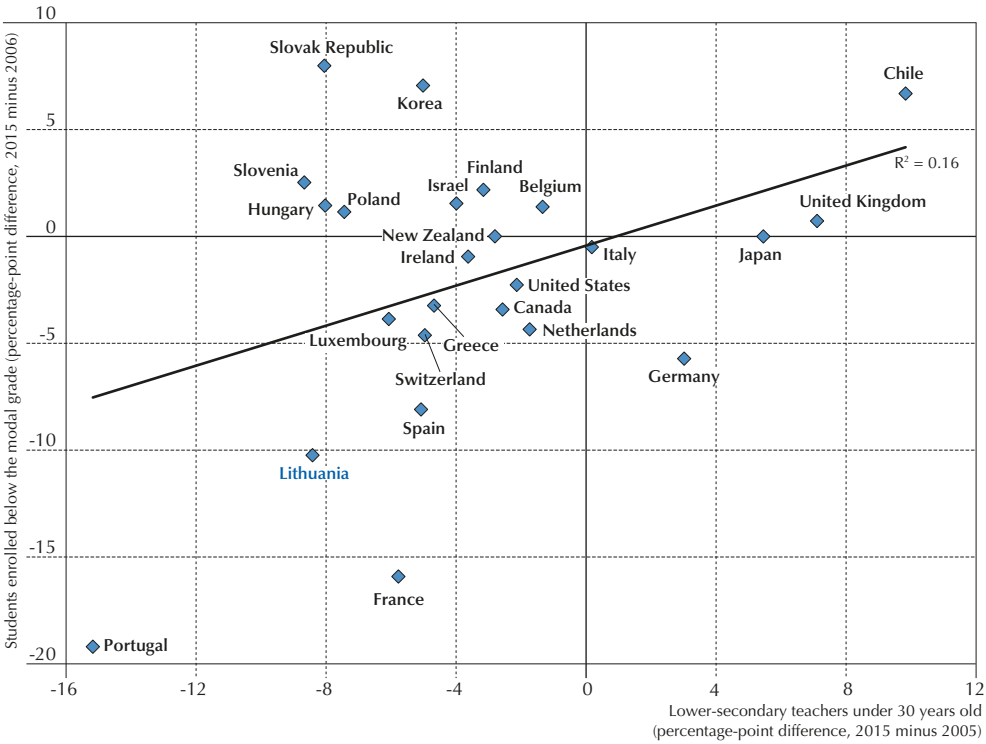
StatLink http://dx.doi.org/10.1787/888933740364

These concurrent trends might indicate that the reduction in grade-repetition rates resulted in lower expenditure on wages for teachers, because the savings accrued when students spend fewer years in primary and lower-secondary school were not entirely reinvested in teacher-led measures to assist low-performing students.

Changes in teacher certification and salaries

There are no valid and reliable indicators for the quality of a country's teacher workforce that can be compared over time and across countries. Even proxies, such as teachers' experience and qualifications, which are included in the OECD education databases, often cannot be compared over time. PISA trends in performance can be compared to simultaneous trends in the share of fully certified teachers and in teachers' statutory salaries, which are sometimes considered to be proxies for teacher quality.

Figure 2.11 ■ **Change between 2005 and 2015 in grade repetition and the inflow of young teachers**



Source: OECD PISA 2015 Database, Table 2.15; OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, Table II.5.5, http://dx.doi.org/10.1787/888933436509.

StatLink http://dx.doi.org/10.1787/888933740383

But the evidence linking higher salaries to greater average quality or effectiveness of teachers is mixed. Reviews of studies based on the variation of salaries within countries tend to find that teachers' salaries are, at best, weakly related to teacher quality (Hanushek and Rivkin, 2006[28]; Hanushek, 2006[29]). However, Dolton and Marcenaro-Gutierrez (2011[30]) find that, over the period 1995-2006, the variation in teachers' salaries across countries and over time is positively related to achievement differences and growth in international assessments of student performance. Salaries might also influence the attractiveness of the teaching profession and thereby the skills profile of future teachers (Leigh, 2012[31]) (also see Chapter 4).

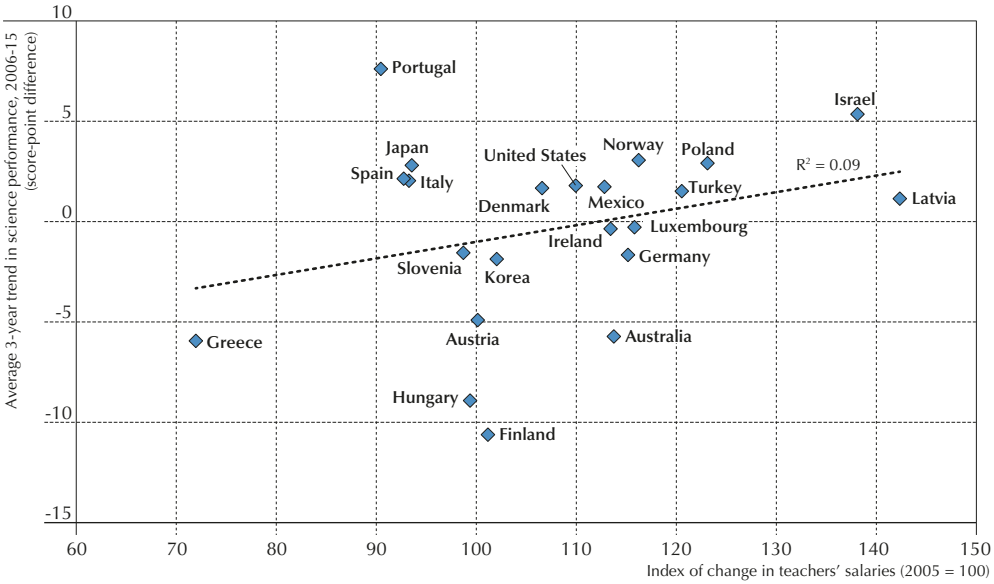
Similarly, while certified teachers can be expected to constitute a more select pool of teachers, evidence from the United States shows that certification can be unrelated to teachers' effectiveness (Kane, Rockoff and Staiger, 2008[32]). Changes in certification rates over time might reflect changes in the standards used for certification, more than changes in the quality of teachers. Therefore, country-level changes in salaries or certification rates might not necessarily reflect changes in the average quality of current teachers.

Changes in teachers' salaries over time might, in fact, be accompanied by improvements or deteriorations in average teacher quality. Some countries might wish to increase teachers' statutory salaries in order to attract better candidates to the teaching profession; but it might take several years before the effects of such a policy are reflected in student outcomes. Other countries might be tempted to raise teachers' salaries in reaction to increased competition from other sectors. That might help retain teachers in the profession, but it cannot fully prevent a reduction in the average quality of the teacher workforce.

Among OECD countries with available data, changes between 2005 and 2015 in teachers' statutory salaries were weakly related to learning trends in science between PISA 2006 and PISA 2015 (r = 0.29). Teachers' salaries increased by 20% or more in Israel, Latvia, Poland and Turkey between 2005 and 2015; only in Israel did science performance improve significantly between 2006 and 2015. Meanwhile, teachers' salaries decreased by more than 20% in Greece – where performance in science also declined – and by about 10% in Portugal – where performance in science improved significantly (Figure 2.12).

Changes in the proportion of fully certified teachers are also unrelated to trends in performance. In two of the fastest-improving countries – Colombia and Qatar – the proportion of fully certified teachers swung in opposite directions, perhaps due to changes in certification requirements.

Figure 2.12 ■ **Trends in teachers' salaries and science performance**



Note: The horizontal axis shows the change between 2005 and 2015 in teachers' statutory salaries after 15 years of experience, in public, general, lower secondary institutions, based on typical qualification levels, converted to constant prices using deflators for private consumption.

Source: OECD PISA 2015 Database, Table 2.14; OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.2.4a, http://dx.doi.org/10.1787/888933433171.

StatLink http://dx.doi.org/10.1787/888933740402

In Colombia, only about 10% of teachers were reported to be fully certified in PISA 2012 and PISA 2015, while more than 80% were so reported in PISA 2006 and PISA 2009; in Qatar, the share increased from 41% in 2006 to 75% in 2015.[5] Most countries saw smaller variations in the proportion of fully certified teachers across the PISA cycles, and these variations are only weakly related to improvements or deterioration in students' PISA performance (Table 2.4).

Changes in school autonomy for hiring and firing teachers

Of the many aspects of teacher policies considered in the first section, the only aspect for which PISA has systematically collected data that can be compared over time is the extent to which schools are responsible for hiring and firing teachers.

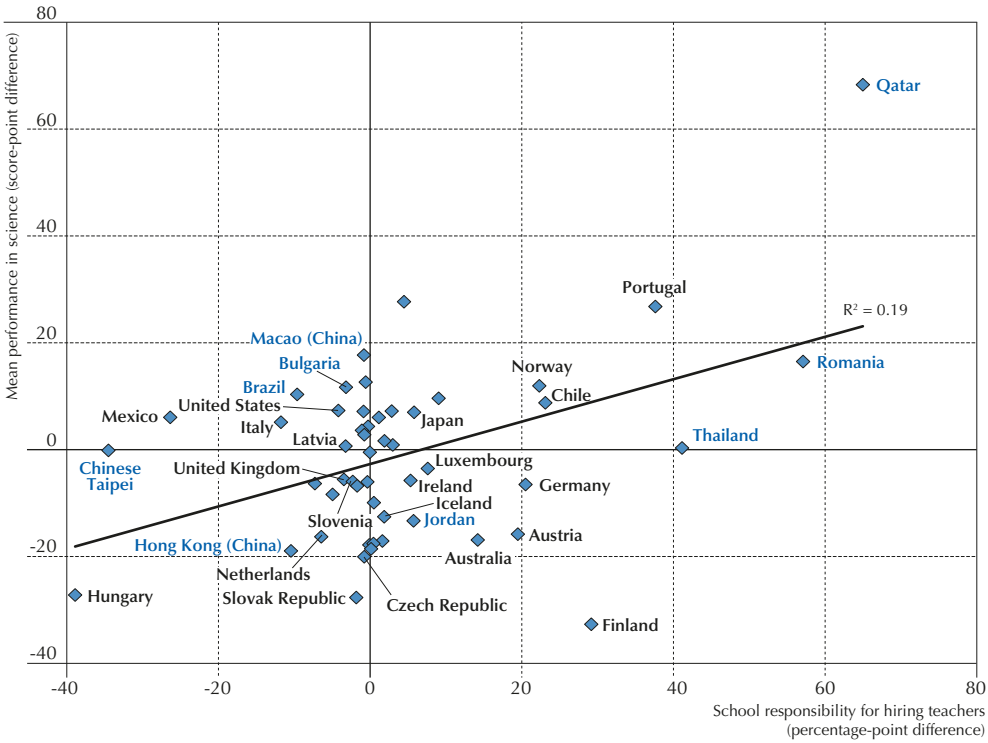
The proportion of students who attend schools whose principal or school governing board has considerable responsibility for selecting teachers for hire increased by more than 40 percentage points between 2006 and 2015 in Qatar, Romania and Thailand, and by between 20 and 40 percentage points in Chile, Finland, Germany, Norway and Portugal. Meanwhile, the proportion of students attending schools that have considerable responsibility for firing teachers, e.g. because they are underperforming or for other reasons, increased by a similar amount (over 50 percentage points) in Qatar and Romania, and increased by between 20 and 30 percentage points in Denmark, Finland and Norway (Table 2.8). Over the same period, Norway, Portugal, Qatar and Romania saw significant improvements in science performance, while results remained stable in Denmark, Germany and Thailand, and mean performance deteriorated in Finland.[6]

In some countries, school autonomy in hiring and firing teachers became less common between 2006 and 2015. In Hungary, where performance declined, and in Chinese Taipei, where performance remained stable, the proportion of students attending schools whose principal reported considerable responsibility for selecting teachers for hire decreased by more than 30 percentage points, as did the proportion of students attending schools with considerable responsibility for firing teachers. Autonomy for hiring teachers also declined in Mexico (-26 percentage points), where science performance remained stable (Table 2.8).

Overall, across all 51 countries/economies with comparable data, improvements in science performance tended to be associated with increases in school autonomy for hiring ($r = 0.44$) and firing ($r = 0.46$) teachers. The relationship remains significant, but weaker ($r = 0.32$), after excluding the two countries with the fastest improvement (Qatar) and decline (Finland) in student performance (How do the best-performing schools support teachers' work?).

In fact, the relationship between changes in school responsibilities for managing teachers and changes in performance appears to be moderated by the extent to which schools, in a particular country, were held accountable for their students' results in 2015. In Finland, Germany, Hungary, Mexico and Chinese Taipei, in 2015 a smaller percentage of 15-year-old students than on average across OECD countries attended schools where achievement data such as graduation rates or a school's average test results are posted publicly or tracked over time by administrative authorities (Table 2.11); and changes in school responsibilities between 2006 and 2015 were not related to changes in performance, on average across these countries. In contrast, in Chile, Denmark, Norway, Portugal, Qatar, Romania and Thailand, such accountability practices were at least as common, in 2015, as on average across OECD countries; and increases in school autonomy between 2006 and 2015 had often been accompanied by improvements in performance.

Figure 2.13 ■ **Change between 2006 and 2015 in school responsibility for hiring teachers and science performance**



Notes: Countries/economies named on the chart show a significant change between 2006 and 2015 in the percentage of 15-year-old students in schools whose principal or school governing board has considerable responsibility for selecting teachers for hire. Countries/economies with non-sigificant changes are Belgium, Colombia, Croatia, Denmark, Estonia, Greece, Israel, Korea, Montenegro, New Zealand, Poland, Russia, Spain, Sweden, Switzerland, Tunisia, Turkey and Uruguay.
The horizontal axis shows the difference, between 2015 and 2006, in the percentage of 15-year-old students in schools whose principal or the school governing board has considerable responsibility for selecting teachers for hire.
Source: OECD PISA 2015 Database, Table 2.8; OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.2.4a, http://dx.doi.org/10.1787/888933433171.
StatLink http://dx.doi.org/10.1787/888933740421

HOW DO THE BEST-PERFORMING SCHOOLS SUPPORT TEACHERS' WORK?

By focusing on system-wide policies and practices, the previous sections have indirectly highlighted the important role that schools play in shaping the composition and work of teachers in high-performing and rapidly improving countries. Most schools in high-performing countries, for example, enrich the professional learning of teachers with bespoke opportunities for professional development, and instructional leaders play an important role in formative teacher-appraisal processes. Furthermore, countries that have devolved greater responsibility to schools to select teachers for hire have seen greater improvements in PISA, on average, than countries that have moved towards more centralised systems.

Successful teacher policies rely on multi-layered governance where there is sufficient capacity at the local level to adapt the delivery of education to rapidly changing and increasingly diverse local contexts, within a strong coherent framework for promoting teacher professionalism (e.g. through more centralised selection and accreditation mechanisms or through school-evaluation processes).

This section looks at what happens at the school level, and, in particular, how differences in teacher characteristics and in the ways in which teachers' work is supported relate to school performance. To do so, the chapter looks beyond the highest-performing countries in PISA to include in the analysis all countries and economies that distributed an optional questionnaire to teachers in PISA-participating schools (see Box 3.1 in Chapter 3).[7] This includes OECD countries Australia, Chile, the Czech Republic, Germany, Italy, Korea, Portugal, Spain and the United States, and partner countries and economies Brazil, B-S-J-G (China), Colombia, the Dominican Republic, Hong Kong (China), Macao (China), Malaysia, Peru, Chinese Taipei and the United Arab Emirates. An international average, based on all countries and economies with available data, excluding Malaysia,[8] is often used as a reference to guide the discussion. Within the United States, the states of Massachusetts and North Carolina also participated in PISA with separate samples (representative of public schools) and distributed the teacher questionnaire. Their estimates are reported, but not included in the international average (which does include the overall estimate for the United States).

In order to explore the factors that are associated with a school's performance and climate, three series of multi-level models of increasing complexity were estimated. The first model is a so-called "empty model", which estimates the share of variation that lies within and between schools for each outcome variable considered. In the two other models, student- and school-level determinants are successively added at the appropriate level of analysis to account for this variation. The second model introduces demographic and socio-economic controls to explore the extent to which differences in student and teacher composition are at the root of between-school differences. The last model introduces three variables that relate to teachers' working conditions within their schools: teachers' turnover rate and the principals' transformational leadership practices (reported by teachers); and the number of different in-house professional development activities organised by the school (reported by the principal). The findings from each model are discussed in the following sections.

Variation in performance and learning climate across schools

Six cycles of PISA data have shown that, in most countries, the variation in the mean performance of schools is at least as large as the variation between the best-performing and the lowest-achieving countries. Every country has some schools that perform significantly better than the average school, and differences in student composition explain only part of this variation. When considering all students who participated in PISA 2015, 22% of the variation in their results lies between countries/economies, but a full 26% of the variation, on average, lies within countries, between schools (OECD, 2016, Figure II.7.1[13]).

When considering only countries/economies that collected data from teachers themselves about who they are and how they are supported in their work at school, about one-third of the variation in performance among students within each country lies between schools, and two-thirds lie

within schools (Table 2.18) – a similar proportion as observed across all PISA-participating countries, on average. The proportion of the overall variation that lies between schools is larger in B-S-J-G (China), the Czech Republic, Germany and Italy – countries where 15-year-old students are sorted into different grades and/or school tracks, depending on their prior performance. The average between-school variation in performance (expressed as a standard deviation) amounts to 50 score points – meaning that, on average, about one out of six schools in every country scores more than 50 points above the mean, and one out of six schools scores more than 50 points below the mean. The between-school standard deviation varies from over 70 score points in B-S-J-G (China) to only about 31 score points in Spain.

The importance of "school effects" – the extent to which schools differ in student outcomes – is also apparent in PISA variables measuring the extent to which the climate at school is conducive to learning. Two indices were chosen to indicate a positive school climate: the index of disciplinary climate in science lessons, and the index of exposure to bullying.

The index of disciplinary climate was constructed from students' reports on how often ("every lesson", "most lessons", "some lessons", "never or hardly ever") the following happened in their science lessons: Students don't listen to what the teacher says; There is noise and disorder; The teacher has to wait a long time for students to quiet down; Students cannot work well; Students don't start working for a long time after the lesson begins.[9] (Higher values of the index correspond to reports of a better classroom climate in science lessons.) In the analysis, the measure of disciplinary climate in science lessons is used as a proxy measure of the typical classroom climate in the school, irrespective of the subject.

Student exposure to bullying is a composite measure of the frequency ("Never or almost never"; "A few times a year"; "A few times a month"; or "Once a week or more") with which students reported that the following things happened to them at school in the 12 months prior to the PISA test: Other students left me out of things on purpose; Other students made fun of me; I was threatened by other students; Other students took away or destroyed things that belonged to me; I got hit or pushed around by other students; Other students spread nasty rumours about me. Higher values on the index correspond to greater exposure to bullying (more varied or more frequent bullying victimisation). Both indices were standardised to have a standard deviation of one across all students, on average.

Both measures showed significant variation not only across students within schools, but also, on average, between schools – meaning that they captured some aspects of the school climate, not just differences in individual students' perception of it. However, perhaps because self-reports are subjective (what is perceived negatively as "noise and disorder" by one student might be perceived positively, as liveliness, by another, for example), the between-school variation was typically a smaller fraction of the overall variation than for more precisely and objectively measured performance.

On average across 18 countries and economies, about one tenth (9%) of the overall variation in students' reports of disciplinary climate in science lessons lies between schools (Table 2.20), as does about 3.4% of the overall variation in reports of exposure to bullying (Table 2.19). This lower percentage might reflect the variety, across schools, of subjective frames of reference

that students adopt when considering a behaviour as threatening or aggressive. It might also reflect the fact that being a victim of bullying is a student-level construct (in schools with a high prevalence of bullying, for example, there might be only a few victims of bullies), while the questions on disciplinary climate explicitly aim to measure the same situation through multiple respondents, even though the particular classes that constitute students' reference point when answering the question might differ across respondents. Interestingly, countries where reports of the classroom climate in science lessons vary the most across schools are not necessarily the same countries where performance varies the most. In Australia and Spain, for example, student performance varied relatively little across schools, reflecting the absence of student sorting by ability prior to the age of 15; but students' reports about the disciplinary climate in class varied as much as on average across countries.

How student and teacher composition relate to school success

A main determinant of a schools' performance in science, and of the average school climate reported by students, is the demographic and socio-economic makeup of the student population. For example, schools with more advantaged students, on average (as indicated by higher average levels of the PISA index of economic, social and cultural status) perform better than schools that have larger concentrations of disadvantage; and within each school, more-advantaged students tend to perform better than their less-advantaged peers.

In most countries, and on average across countries, schools with larger proportions of girls tend to perform better in science even though within schools, girls typically score below boys in science, on average. The share of girls in a school is also a major determinant of the school climate reported by students. Students in schools with larger proportions of girls report a better classroom climate and less exposure to bullying (and girls report a better disciplinary climate, and are less exposed to bullying, compared to boys within the same school) (Tables 2.21, 2.22 and 2.23).

But teacher demographic characteristics are also significantly associated with better performance and school climate, on average across countries that distributed the teacher questionnaire. In particular, two characteristics were added to the model to account for the variation in teacher characteristics across schools: the proportion of fully certified teachers in the school, as reported by school principals, and the average years of experience in the teaching profession, reported by teachers in the same school (Figure 2.14).

In a majority of countries/economies, as well as on average across countries, schools with more experienced teachers tended to have better results in the PISA science test and a better school climate, as reported by students, even after accounting for student demographic characteristics. Average years of experience had a significant, positive association with science performance in the Czech Republic, Italy, the United Arab Emirates and the United States, as well as across countries, on average. The association was not significant in other countries, perhaps because years of experience also reflects cohort effects (reforms in teacher preparation and certification might mean that more recent graduates from teacher training institutions are better prepared than older graduates). Lack of significance might also reflect a small sample size, at the school level, which limits the ability to distinguish weak associations from statistical noise; only moderate and strong associations are detected (Figure 2.14).

Figure 2.14 ■ **How teacher characteristics relate to school performance and climate**

After accounting for student characteristics and for schools' socio-economic profile; results based on multi-level models

Positive relationship
Negative relationship
NS Relationship is not significant
One or more variables are missing; the relationship could not be estimated

	Index of exposure to bullying (based on students' reports)		Index of disciplinary climate in science lessons (based on students' reports)		Student performance in science	
	Share of fully certified teachers	Average years of experience among teachers	Share of fully certified teachers	Average years of experience among teachers	Share of fully certified teachers	Average years of experience among teachers
Average-18	NS				NS	
Australia	NS	NS	NS	NS	NS	NS
Brazil	NS		NS	NS		NS
B-S-J-G (China)	NS	NS		NS		NS
Chile		NS		NS		NS
Colombia	NS	NS	NS	NS		NS
Czech Republic	NS			NS		
Dominican Republic		NS		NS		NS
Germany	NS	NS	NS	NS	NS	NS
Hong Kong (China)	NS					NS
Italy					NS	
Korea	NS	NS	NS		NS	NS
Macao (China)		NS		NS		NS
Peru	NS	NS	NS	NS	NS	NS
Portugal	NS	NS	NS	NS	NS	NS
Spain	NS	NS	NS	NS	NS	NS
Chinese Taipei	NS	NS	NS	NS	NS	NS
United Arab Emirates	NS		NS			
United States	NS	NS	NS		NS	
Massachusetts			NS	NS	NS	NS
North Carolina			NS	NS	NS	NS

Note: Results based on multi-level models, including controls for students' gender, socio-economic status, immigrant background and language spoken at home, as well as for schools' average socio-economic profile and share of female students. Three distinct models were estimated for performance in science, disciplinary climate and bullying. Only countries/economies that distributed the optional teacher questionnaire are included in the analysis. Results for Malaysia are not reported, as the sample may not be representative.

The Average-18 does not include Massachusetts and North Carolina.

Countries and economies are listed in alphabetical order.

Source: OECD PISA 2015 Database, Tables 2.21, 2.22 and 2.23.

StatLink http://dx.doi.org/10.1787/888933740440

The positive association between teaching experience and both performance and school climate suggests that teacher quality and effectiveness is positively related to average teacher experience. There is significant evidence in the research literature to show that average teacher effectiveness tends to increase with years of experience – both because teachers gain valuable skills on the job and through formal professional development opportunities (Wiswall, 2013[33]; Papay and Kraft, 2015[34]; Kraft and Papay, 2014[35]; Jackson, Rockoff and Staiger, 2014[36]). In addition, the least-effective teachers tend to quit teaching more than more-effective teachers do, creating a more select pool of teachers (Hanushek, 2006[29]; Hanushek, Rivkin and Schiman, 2016[37]).

But as with other associations, the relationship established between average years of teaching experience and school results or climate is not necessarily causal. In fact, the association might result from a reverse causality: novice teachers might be disproportionately assigned to underperforming schools initially and, perhaps due to rules that give more experienced teachers a priority to choose where to teach, more experienced teachers might choose or be chosen to work in schools that perform above their expected level because of some other resource that is not fully captured by the demographic and socio-economic controls included in the analysis.

In contrast, the proportion of fully certified teachers is not related to school performance and climate, on average, although the direction and magnitude of the association varies significantly across countries. In three economies – Colombia, Hong Kong (China) and the United Arab Emirates – schools with lower results in science tended to have larger proportions of fully certified teachers, after accounting for differences in student demographics (gender, socio-economic status, immigrant background and language spoken at home). In Colombia and the United Arab Emirates, in fact, only a minority of teachers were "fully certified". In B-S-J-G (China) and the Czech Republic, by contrast, schools with higher scores in science tended to have larger proportions of fully certified teachers – although in B-S-J-G (China) there was limited variation across schools in the share of fully certified teachers, as 98% of all teachers were reported to be fully certified (Figure 2.14 and Table 2.4).

Together, student and teacher demography explained about 66% of the variation in science performance between schools. After accounting for student and teacher demographics, about two-thirds of the schools scored at a level that is within 30 points (above or below) their expected performance (residual between-school standard deviation: 29 score points). Student and teacher demographic characteristics also explained about 25% of the between-school variation in students' reports of disciplinary climate (Tables 2.21 and 2.23).

How teachers' working conditions relate to school success

To understand how the most successful schools support the work of teachers, three variables that relate to important dimensions of their working conditions were added to the analysis: teachers' turnover rate; principals' transformational leadership practices (as reported by teachers); and the number of different in-house professional development activities organised by the school (as reported by the principal).

The teacher turnover rate is measured by the inverse of the average teacher seniority within the school. In schools with relatively stable teaching workforce (number of teachers) and regular flows in and out of the school, the inverse of average seniority (one divided by the average seniority) represents the proportion of teachers who can be expected to leave the school each year, or, equivalently, the proportion of teachers who are joining the school each year. In such a situation, seniority is a good measure of turnover (or the lack of it). In a growing school, however, average seniority tends to be lower than in shrinking schools. The relationship with seniority might therefore be partially confounded by school growth and decline.

School principals' leadership and support is measured through the average index of transformational leadership, a composite measure derived from non-science teachers' agreement ("strongly agree" to "strongly disagree") with the following statements: "The principal tries to

achieve consensus with all staff when defining priorities and goals in school"; "The principal is aware of my needs"; "The principal inspires new ideas for my professional learning"; "The principal treats teaching staff as professionals"; and "The principal ensures our involvement in decision making". Transformational school leaders are able to communicate a mission, encourage development, and build a community with the aim of empowering the teachers to contribute to the school's overall results, thereby indirectly influencing student learning through improvements in staff motivation, commitment and working conditions (Leithwood, Tomlinson and Genge, 1996[38]; Leithwood and Jantzi, 1990[39]; Leithwood, Harris and Hopkins, 2008[40]).

Teachers in the same school had relatively consistent views of the extent to which their principal engages in transformational activities to support their professional growth (Table 2.17). The intra-class correlation is a measure of the extent to which reports varied between schools, rather than only within schools. For this index, the intra-class correlation is about 15% – one of the highest figures for questionnaire-based measures in PISA. It is higher than the intra-class correlation for teachers' reports of job satisfaction, for example, or for students' reports of the disciplinary climate in science lessons.

Finally, teachers' in-house opportunities for professional development are measured by principals' reports about the number of different school-based activities that the school offers: from the more informal ("The teachers in our school co-operate by exchanging ideas or material when teaching specific units or series of lessons") to the more formal ("Our school invites specialists to conduct in-service training for teachers"; "Our school organises in-service workshops which deal with specific issues that our school faces"; "Our school organises in-service workshops for specific groups of teachers [e.g. newly appointed teachers]"). The measure therefore varies between 0 and 4.

Results reveal that, after accounting for teacher and student composition, schools with the best results in science tended to have lower teacher turnover rates (after accounting for differences in teacher experience). This might reflect a negative effect of teacher turnover on teacher effectiveness and student learning; but it might also reflect the greater ability of high-performing schools to retain teachers in their school and in the profession, more generally. The association of teacher turnover with school performance was significant, and negative, in three countries/economies (Australia, Spain and Chinese Taipei), and was positive in one (Brazil) (Figure 2.15).

While teachers' perceptions of the principal as a transformational leader are not related to school performance (though a negative association is observed in Germany), such perceptions are positively related to students' reports about the climate in science lessons, after accounting for differences in student and teacher demographic characteristics. They are also positively related to a lower incidence of bullying in school. The prevalence of bullying was lower in schools where teachers reported that their principals engage in transformational practices (Figure 2.15).

The negative association observed in Germany between transformational leadership and performance might reflect inverse matching, whereby stronger principals are assigned to the schools that struggle the most; or might simply reflect the more urgent need for change and transformation in struggling schools. However, the positive association with the school climate might indicate that principals' leadership can encourage behaviours that are conducive to learning, and indirectly contribute to improve teaching and learning.

School climate has been shown to be associated with valued outcomes of education (Thapa et al., 2013[41]). In particular, the association with disciplinary climate in science lessons was positive and significant in four countries/economies (Brazil, B-S-J-G [China], Italy and the United Arab Emirates) and on average across countries; while the association with the prevalence of bullying is negative and significant in four countries/economies (Australia, Brazil, B-S-J-G [China] and the Dominican Republic), as well as on average across countries (Figure 2.15).

Figure 2.15 ■ **How teachers' working conditions relate to school performance and climate**

After accounting for student and teacher characteristics and for schools' socio-economic profile; results based on multi-level models

Positive relationship
Negative relationship
NS Relationship is not significant
One or more variables are missing; the relationship could not be estimated

	Index of exposure to bullying (based on students' reports)			Index of disciplinary climate in science lessons (based on students' reports)			Student performance in science		
	Index of in-school professional development opportunities	Mean index of principal transformational leadership (teachers' views)	Teacher turnover rate	Index of in-school professional development opportunities	Mean index of principal transformational leadership (teachers' views)	Teacher turnover rate	Index of in-school professional development opportunities	Mean index of principal transformational leadership (teachers' views)	Teacher turnover rate
Average-18	NS		NS	NS		NS	NS	NS	
Australia	NS		NS	NS	NS	NS	NS	NS	
B-S-J-G (China)			NS	NS		NS	NS	NS	NS
Brazil	NS		NS	NS			NS	NS	
Chile	NS	NS	NS	NS	NS	NS	NS	NS	NS
Colombia	NS	NS	NS	NS	NS	NS	NS	NS	NS
Czech Republic	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dominican Republic			NS	NS	NS	NS	NS	NS	NS
Germany	NS	NS		NS	NS	NS	NS		NS
Hong Kong (China)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Italy				NS		NS	NS	NS	NS
Korea	NS	NS	NS		NS	NS	NS	NS	NS
Macao (China)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Peru	NS	NS	NS	NS	NS	NS	NS	NS	NS
Portugal	NS	NS	NS	NS	NS	NS	NS	NS	NS
Spain	NS	NS		NS	NS	NS	NS	NS	
Chinese Taipei	NS	NS	NS	NS	NS	NS	NS	NS	
United Arab Emirates	NS	NS	NS	NS		NS	NS	NS	NS
United States	NS	NS	NS	NS	NS	NS	NS	NS	NS
Massachusetts				NS		NS		NS	NS
North Carolina				NS	NS	NS	NS	NS	NS

Note: Results based on multi-level models, including controls for students' gender, socio-economic status, immigrant background and language spoken at home, as well as for schools' average socio-economic profile, share of female students, average years of experience among teachers and share of fully certified teachers. Three distinct models were estimated for performance in science, disciplinary climate and bullying. Only countries/economies that distributed the optional teacher questionnaire are included in the analysis. Results for Malaysia are not reported, as the sample may not be representative.

The Average-18 does not include Massachusetts and North Carolina.

Countries and economies are listed in alphabetical order.

Source: OECD PISA 2015 Database, Tables 2.25, 2.26 and 2.27.

StatLink http://dx.doi.org/10.1787/888933740459

The index of in-house professional development opportunities was not significantly associated with performance or school climate, on average across countries, after accounting for student and teacher composition and for teacher turnover and principal leadership. There was, nevertheless, a positive and significant association with science performance in public schools in Massachusetts (United States), and with the classroom climate reported by students in Korea – a country in which teacher turnover and principals' transformational leadership were not significantly related to school performance or school climate (Figure 2.15).

Summing up, Figure 2.14 shows that teacher experience is positively related to school performance and student behaviour, while Figure 2.15 shows that teacher turnover is negatively related to performance, after accounting for differences in student and teacher demographic characteristics across schools. Student behaviour, as reflected in the index of disciplinary climate in science lessons and the index of exposure to bullying, is, in turn, more positive in schools whose principal is perceived as a transformational leader who supports and empower teachers.

While the analysis only reveals correlational associations, recent studies, based on rich longitudinal data linking teachers and students over multiple years and grades, suggest that high turnover rates do indeed adversely affect the quality of instruction (Ronfeldt, Loeb and Wyckoff, 2013[42]; Hanushek, Rivkin and Schiman, 2016[37]). Similar, though smaller, effects have been found for within-school churning rates, i.e. the assignment of teachers to a new grade within the same school (Atteberry, Loeb and Wyckoff, 2016[43]). Teacher turnover can harm student learning because schools with high turnover lose institutional memory with departing teachers. Teacher turnover leads to disruption of working norms; and departing teachers are typically more effective than new hires. While, in theory, turnover could also help organisations by infusing new ideas and creating better job matches (e.g. by ensuring that the best teachers are assigned where they can have the greatest impact, and that the worst teachers leave the profession), most studies find that these positive effects are more than offset by the negative effects of teacher turnover on student learning.

A study based on New York City schools, for example, shows that grades with a greater share of teachers new to the school in a particular year saw less growth in achievement; and similarly, within a particular school and grade, the years with more teachers who were new to the school showed less achievement growth (Ronfeldt, Loeb and Wyckoff, 2013[42]). This study further found that all students suffer from high turnover rates, not only those who were assigned to new-to-the-school teachers. This lends support to the view that turnover imposes a cost on the organisation as a whole, and exerts its effect not only through the average quality of teachers.

Another study, based on a large, urban district in Texas (United States), shows that, in general, teachers who quit the school are usually less effective than those who stay; but the resulting need to fill the vacancy leads to the hiring of teachers who are less experienced in the particular grade or in teaching more generally than the departing teachers. As a result, high-turnover schools again show less growth in student achievement (Hanushek, Rivkin and Schiman, 2016[37]).

Notes

1. The seven jurisdictions analysed are: Finland, Singapore, the provinces of New South Wales (Australia) and Victoria (Australia), the states of Alberta (Canada) and Ontario (Canada), and the municipality of Shanghai (China).

2. In several countries where 15-year-olds are found in both lower-secondary and upper-secondary schools, and data on both types of schools are therefore available, principals in upper secondary schools report greater levels of responsibilities for teacher hiring, firing, or compensation than lower-secondary schools (Tables 2.9 and 2.10). Among high-performing countries, this is observed in Germany, Korea, Slovenia, Switzerland and Chinese Taipei.

3. Here, and in the remainder of this chapter, "r" refers to the Pearson correlation coefficient, a measure of the linear association between two variables, which varies between -1 (indicating a perfect inverse relationship between the two variables) and 1 (indicating a perfect linear relationship between two variables). Values close to 0 indicate weak linear relationships.

4. In Korea, only 88% of students were in schools that organise in-service workshops for specific groups of teachers, but 96% of students were in schools that organise workshops that deal with specific issues faced by the school.

5. A change in the translation might explain the strong variation of fully certified teachers across PISA cycles in Colombia. In PISA 2006, the school questionnaire in Colombia asked about "Profesores completamente certificados por una autoridad competente"; in PISA 2012, it asked about "Profesores *normalistas* completamente certificados por una autoridad competente" (emphasis added); in PISA 2015, it asked about "Profesores *totalmente* certificados por *el Ministerio de Educación Nacional*" (emphasis added).

6. Changes in the mean science performance of PISA-participating countries and economies, from 2006 through 2015, can be found in Table 1.2.4a in volume I of *PISA 2015 Results* (OECD, 2016[46]).

7. Two distinct populations of teachers were identified in each school: science and non-science teachers. The sampling rates may differ between the two populations (OECD, 2017[45]). The two populations were given distinct, but partially overlapping questionnaires. Questions on experience and seniority were asked of all teachers; in contrast, questions about the school principal's transformational leadership practices were only asked of non-science teachers. In analyses included in this chapter, teachers' answers are aggregated to the school level through simple, unweighted means.

8. In Malaysia, due to low response rates, the sample of responding schools does not fully cover the target population defined by all schools attended by 15-year-olds enrolled in grade 7 and above in the country. Results for Malaysia must therefore be interpreted with caution (OECD, 2017, p. 271[45]).

9. Full details about the scaling model used for the index of disciplinary climate can be found in the PISA 2015 technical report (OECD, 2017[45]).

References

Atteberry, A., S. Loeb and **J. Wyckoff** (2016), "Teacher Churning: Reassignment Rates and Implications for Student Achievement", *Educational Evaluation and Policy Analysis*, http://dx.doi.org/10.3102/0162373716659929. [43]

Barber, M. and **M. Mourshed** (2007), *How the world's best-performing schools come out on top*, McKinsey&Co, http://mckinseyonsociety.com/how-the-worlds-best-performing-schools-come-out-on-top/ (accessed on 24 November 2017). [6]

Barrera-Pedemonte, F. (2016), "High-Quality Teacher Professional Development and Classroom Teaching Practices: Evidence from Talis 2013", *OECD Education Working Papers*, No. 141, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlpszw26rvd-en. [17]

Bouguen, A., J. Grenet and **M. Gurgand** (2017), "La taille des classes influence-t-elle la reussite scolaire ?", *Les notes de l'IPP*, No. 28, Institut des Politiques Publiques, Paris, www.ipp.eu/wp-content/uploads/2017/09/n28-notesIPP-sept2017.pdf (accessed on 01 December 2017). [26]

Burns, T. and **F. Köster** (2016), "Modern governance challenges in education", in Burns, T. and F. Köster (eds.), *Governing Education in a Complex World*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264255364-3-en. [15]

Chetty, R. et al. (2011), "How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project Star", *The Quarterly Journal of Economics*, Vol. 126/4, pp. 1593-1660, http://dx.doi.org/10.1093/qje/qjr041. [23]

Darling-Hammond, L. et al. (2017), *Empowered Educators: How High-Performing Systems Shape Teaching Quality Around the World*, Jossey-Bass, San Francisco. [1]

Desimone, L. (2009), "Improving Impact Studies of Teachers' Professional Development: Toward Better Conceptualizations and Measures", *Educational Researcher*, Vol. 38/3, pp. 181-199, http://dx.doi.org/10.3102/0013189X08331140. [18]

Dolton, P. and **O. Marcenaro-Gutierrez** (2011), "If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance", *Economic Policy*, Vol. 26/65, pp. 5-55, http://dx.doi.org/10.1111/j.1468-0327.2010.00257.x. [30]

Education Council (2010), *Approval, review and monitoring processes and requirements for Initial Teacher Education Programmes*, https://educationcouncil.org.nz/sites/default/files/Approval%2C%20Review%20and%20Monitoring%20Processes%20guidelines_1.pdf (accessed on 4 April 2017). [47]

Fredriksson, P., B. Öckert and **H. Oosterbeek** (2013), "Long-Term Effects of Class Size *", *The Quarterly Journal of Economics*, Vol. 128/1, pp. 249-285, http://dx.doi.org/10.1093/qje/qjs048. [25]

Hanushek, E. (2006), "School Resources", in Hanushek, E. and F. Welch (eds.), *Handbook of the Economics of Education*, Elsevier, http://dx.doi.org/10.1016/S1574-0692(06)02014-9. [29]

Hanushek, E., M. Piopiunik and **S. Wiederhold** (2014), "The Value of Smarter Teachers: International Evidence on Teacher Cognitive Skills and Student Performance", No. 20727, National Bureau of Economic Research, Cambridge, MA, http://dx.doi.org/10.3386/w20727. [4]

Hanushek, E. and **S. Rivkin** (2006), "Teacher Quality", in Hanushek, E. and F. Welch (eds.), *Handbook of the Economics of Education*, Elsevier, Amsterdam, http://dx.doi.org/10.1016/S1574-0692(06)02018-6. [28]

Hanushek, E., S. Rivkin and **J. Schiman** (2016), "Dynamic effects of teacher turnover on the quality of instruction", *Economics of Education Review*, Vol. 55, pp. 132-148, http://dx.doi.org/10.1016/J.ECONEDUREV.2016.08.004. [37]

Jackson, C., J. Rockoff and **D. Staiger** (2014), "Teacher Effects and Teacher-Related Policies", *Annual Review of Economics*, Vol. 6/1, http://dx.doi.org/10.1146/annurev-economics-080213-040845. [36]

Jensen, B. et al. (2016), *Not So Elementary: Primary School Teacher Quality in High-Performing Systems*, National Center on Education and the Economy, Washington, DC, http://ncee.org/elementary-teachers/. [3]

Jensen, B. et al. (2016), *Beyond PD: Teacher Professional Learning in High-Performing Systems. Teacher Quality Systems in Top Performing Countries*, National Center on Education and the Economy. www.ncee.org/wp-content/uploads/2015/08/BeyondPDWeb.pdf (accessed on 27 February 2018). [2]

Kane, T., J. Rockoff and **D. Staiger** (2008), "What does certification tell us about teacher effectiveness? Evidence from New York City", *Economics of Education Review*, Vol. 27/6, pp. 615-631, http://dx.doi.org/10.1016/J.ECONEDUREV.2007.05.005. [32]

Kraft, M. and **J. Papay** (2014), "Can Professional Environments in Schools Promote Teacher Development? Explaining Heterogeneity in Returns to Teaching Experience", *Educational Evaluation and Policy Analysis*, Vol. 36/4, pp. 476-500, http://dx.doi.org/10.3102/0162373713519496. [35]

Leigh, A. (2012), "Teacher pay and teacher aptitude", *Economics of Education Review*, Vol. 31/3, pp. 41-53, http://dx.doi.org/10.1016/J.ECONEDUREV.2012.02.001. [31]

Leithwood, K., A. Harris and **D. Hopkins** (2008), "Seven strong claims about successful school leadership", *School Leadership & Management*, Vol. 28/1, pp. 27-42, http://dx.doi.org/10.1080/13632430701800060. [40]

Leithwood, K. and **D. Jantzi** (1990), "Transformational Leadership: How Principals Can Help Reform School Cultures", *School Effectiveness and School Improvement*, Vol. 1/4, pp. 249-280, http://dx.doi.org/10.1080/0924345900010402. [39]

Leithwood, K., D. Tomlinson and **M. Genge** (1996), "Transformational School Leadership", in *International Handbook of Educational Leadership and Administration*, Springer Netherlands, Dordrecht, http://dx.doi.org/10.1007/978-94-009-1573-2_23. [38]

Ministerio de Educación (2018), *Política Nacional Docente*, www.politicanacionaldocente.cl/ (accessed on 13 February 2018). [12]

OECD (2005), *Teachers Matter: Attracting, Developing and Retaining Effective Teachers*, OECD Publishing, Paris, http://dx.doi.org/10.1787/19901496. [5]

OECD (2009), *Creating Effective Teaching and Learning Environments: First Results from TALIS*, TALIS, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264068780-en. [9]

OECD (2013), "Teacher appraisal: Enhancing teacher professionalism", in *Synergies for Better Learning: An International Perspective on Evaluation and Assessment*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264190658-9-en. [11]

OECD (2013), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264201156-en. [16]

OECD (2014), *TALIS 2013 Results: An International Perspective on Teaching and Learning*, TALIS, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264196261-en. [10]

OECD (2014), "Indicator D6 What does it take to become a teacher?", in *Education at a Glance 2014: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2014-34-en. [7]

OECD (2015), *TALIS Indicators*, http://stats.oecd.org/Index.aspx?DataSetCode=TALIS_EDUGPS (accessed on 12 December 2017). [13]

OECD (2015), "Spain", in *Education Policy Outlook 2015: Making Reforms Happen*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264225442-31-en. [20]

OECD (2015), "Indicator D7 What Teacher and School Leader Appraisal Systems are in Place?", in *Education at a Glance 2015: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2015-36-en. [8]

OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264267510-en. [44]

OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264266490-en. [46]

OECD (2017), *PISA 2015 Technical Report*, OECD Publishing, www.oecd.org/pisa/data/2015-technical-report/ (accessed on 31 July 2017). [45]

OECD (2017), *Education Policy Outlook Country Profile: Italy*, www.oecd.org/edu/Education-Policy-Outlook-Country-Profile-Italy.pdf (accessed on 12 December 2017). [21]

Opfer, D. (2016), "Conditions and Practices Associated with Teacher Professional Development and Its Impact on Instruction in TALIS 2013", *OECD Education Working Papers*, No. 138, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlss4r0lrg5-en. [19]

Papay, J. and **M. Kraft** (2015), "Productivity returns to experience in the teacher labor market: Methodological challenges and new evidence on long-term career improvement", *Journal of Public Economics*, Vol. 130, pp. 105-119, http://dx.doi.org/10.1016/J.JPUBECO.2015.02.008. [34]

Piketty, T. and **M. Valdenaire** (2006), *L'impact de la taille des classes sur la réussite scolaire dans les écoles, collèges et lycées français*, Ministère de l'Éducation nationale, de l'Enseignement supérieur et de la Recherche - Direction de l'évaluation et de la prospective, http://cache.media.education.gouv.fr/file/48/4/2484.pdf (accessed on 28 November 2017). [24]

Ronfeldt, M., S. Loeb and **J. Wyckoff** (2013), "How Teacher Turnover Harms Student Achievement", *American Educational Research Journal*, Vol. 50/1, http://dx.doi.org/10.3102/0002831212463813. [42]

Schleicher, A. (2011), *Building a High-Quality Teaching Profession: Lessons from around the World*, International Summit on the Teaching Profession, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264113046-en. [14]

Taylor, E. and **J. Tyler** (2012), "The Effect of Evaluation on Teacher Performance", *American Economic Review*, Vol. 102/7, pp. 3628-3651, http://dx.doi.org/10.1257/aer.102.7.3628. [22]

Thapa, A. et al. (2013), "A Review of School Climate Research", *Review of Educational Research*, Vol. 83/3, pp. 357-385, http://dx.doi.org/10.3102/0034654313483907. [41]

Wiswall, M. (2013), "The dynamics of teacher quality", *Journal of Public Economics*, Vol. 100, pp. 61-78, http://dx.doi.org/10.1016/J.JPUBECO.2013.01.006. [33]

Wößmann, L. and **M. West** (2006), "Class-size effects in school systems around the world: Evidence from between-grade variation in TIMSS", *European Economic Review*, Vol. 50/3, pp. 695-736, http://dx.doi.org/10.1016/J.EUROECOREV.2004.11.005. [27]

3

Can teacher sorting compensate for student disadvantage?

This chapter aims to contribute a first-of-its-kind comparative assessment of teacher sorting across schools and its relation to equity in education. It first describes, from an international comparative perspective, how teacher resources, both in quantity and quality, are distributed across more- or less-advantaged schools. It then examines the relationships between indicators of inequity in teacher sorting and inequality in student performance. After identifying the patterns of teacher sorting that are more strongly associated with higher levels of equity, the chapter examines which teacher policies might lead to more equitable education systems.

Note regarding B-S-J-G (China)
B-S-J-G (China) refers to the four PISA participating China provinces : Beijing, Shanghai, Jiangsu, Guangdong.

Note regarding CABA (Argentina)
CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.

Note regarding FYROM
FYROM refers to the Former Yugoslav Republic of Macedonia.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The sorting of students from different socio-economic backgrounds across schools and by study programme, school composition, sector or location has been extensively analysed, including from a comparative perspective (OECD, 2016, pp. 155-181[1]). The relationships between the resulting school segregation or differentiation of the education system on the one hand, and equity in student performance on the other, has also been repeatedly analysed (OECD, 2016, pp. 155-181[1]; Van de Werfhorst and Mijs, 2010[2]). In comparison, little attention has been paid to the way teachers are sorted across schools with different student profiles, and to the influence of this matching of teachers and students on equity in student performance, especially from a cross-country perspective. Such analyses, however, can help identify teacher policies that lead to more equitable education.

What the data tell us

- A majority of countries and economies that participated in PISA 2015 compensate disadvantaged schools with smaller classes and/or lower student-teacher ratios. However, in more than a third of countries and economies, teachers in the most disadvantaged schools are less qualified or experienced than those in the most advantaged schools.
- Cross-country correlations show that gaps in student performance related to socio-economic status are wider when fewer qualified and experienced teachers operate in socio-economically disadvantaged schools, compared to advantaged schools.
- Higher levels of school autonomy for managing teachers tend to produce a more equitable sorting of teachers across schools.

While international studies about teacher sorting are scarce, some researchers have examined how teacher resources are distributed across schools in their country or in some particular regions or districts. Such analyses require national or local datasets containing fine-grained information on both teachers and students in the same schools. There is, for example, an important body of research in the United States, at least since the early 2000s, that has identified the resource gaps that affect the capacity of disadvantaged schools to provide instruction and compensate for student disadvantage (Boyd et al., 2008[3]; Darling-Hammond, 2004[4]; Clotfelter, Ladd and Vigdor, 2005[5]; Murnane and Steele, 2007[6]; Goldhaber, Lavery and Theobald, 2015[7]). Meanwhile, similar evidence is emerging for other countries, such as Chile (Cabezas et al., 2017[8]), England (Allen, Burgess and Mayo, 2017[9]), France (Combe, Tercieux and Terrier, 2016[10]; Cour des comptes, 2017[11]; Prost, 2013[12]), Italy (Abbiati, Argentin and Gerosa, 2017[13]) and Turkey (Özoğlu, 2015[14]).

National or local studies have often shown that, compared to more advantaged schools, disadvantaged schools have teachers who tend to have weaker academic credentials, and are less qualified and certified (Darling-Hammond, 2004[4]; Rivkin, Hanushek and Kain, 2005[15]; Clotfelter, Ladd and Vigdor, 2005[5]; Murnane and Steele, 2007[6]; Donitsa-Schmidt and Zuzovsky, 2016[16]; Goldhaber, Lavery and Theobald, 2015[7]; Prost, 2013[12]). Disadvantaged schools are also found to suffer from higher turnover rates, on average (Allen, Burgess and Mayo, 2017[9]).

In fact, educators and policy makers in many countries seem acutely aware of the inequities in the teacher workforce between more and less advantaged schools. Several countries, including Belgium, Chile, the Czech Republic, France, Greece, the Netherlands, Portugal, and individual states in the United States (Jepsen and Rivkin, 2009[17]; Dieterle, 2015[18]; OECD, 2012[19]; Bénabou, Kramarz and Prost, 2009[20]) are investing more teaching resources in disadvantaged students, schools or areas, in particular through smaller classes and more teaching hours. Several countries, including Australia, England, France, Germany, Sweden and the United States have also introduced policies that award financial bonuses to teachers in high-poverty or remote schools or reduce the weight given to length of service in teachers' voluntary mobility decisions (OECD, 2005, p. 50[21]; Clotfelter et al., 2008[22]; Karsten, 2006[23]). In the United States, federal and local policies (including the "No Child Left Behind" Act of 2001 and the "Every Student Succeeds Act" of 2015) have addressed this issue through financial incentives for more equal allocations of teacher resources within districts, with some success (Knight, 2017[24]; Boyd et al., 2008[3]).

Yet, recent research continues to find differences in teacher resources and quality that are related to student disadvantage (Knight, 2017[24]; Steele et al., 2015[25]). More generally, policy-makers in several countries, including the Flemish Community of Belgium, the Slovak Republic and Uruguay, have expressed concern about the difficulty of retaining high-quality teachers in their most difficult schools, in the context of recent national "School Resources Reviews" (OECD, 2017[26]).

This chapter aims to contribute a first-of-its-kind comparative assessment of teacher sorting across schools and its relation to equity in education. It first describes, from a cross-country perspective, how teacher resources, both in quantity and quality, are distributed across schools with various socio-economic profiles. It then examines the relationships between indicators of inequity in teacher sorting and inequality in student performance as measured by the OECD Programme for International Student Assessment (PISA).[1] After identifying the patterns of teacher sorting that are more strongly associated with higher levels of equity, the chapter concludes by examining which teacher policies, identified through PISA and OECD education data, might lead to more equitable education systems.

No other large-scale international education dataset can better address all three questions at once. The OECD Teaching and Learning International Survey (TALIS) has provided some initial evidence about the distribution of experienced teachers by principals' perceptions of disadvantage (OECD, 2014, pp. 40-43[27]). TALIS has also shown that in many countries, there tends to be less support for teacher professionalism in schools with a high concentration of socio-economically disadvantaged students. Notable exceptions include Alberta (Canada), England (United Kingdom), Finland, Spain and Sweden (OECD, 2016, pp. 91-105 and 183-221[28]). PISA has shown how perceptions of teacher shortages differ across advantaged and disadvantaged schools ((OECD, 2016, p. 203[29]). In both cases, cross-country comparability was limited by the subjective nature of the indicators. However, PISA data allow for the construction of objective indicators of teacher resources and shortages. Some of these indicators (e.g. class size), which are based on principals' reports, can be compared across all schools and education systems, while more fine-grained measures of teachers' qualification and experience can be based on

responses from the teacher questionnaire, an optional component of PISA 2015, distributed in 19 countries and economies only, as well as in Massachusetts and North Carolina public schools (United States), which contributed separate samples (Box 3.1). Above all, the value of PISA lies in the possibility of developing comparative indicators of teacher allocation, across more- or less-advantaged schools, based on both objective and more subjective reports of teacher characteristics. Comparing objective measures and more subjective perceptions of teacher resources within schools will be a main focus of this chapter.

In accordance with existing research (Murnane and Steele, 2007[6]; Goldhaber, Lavery and Theobald, 2015[7]), this chapter mainly compares the teaching resources of schools of varying socio-economic profiles. All schools in each PISA-participating education system are divided into four groups with approximately an equal number of students (quarters), based on the average PISA index of economic, social and cultural status (ESCS) of their 15-year-old students. Schools in the bottom quarter of average ESCS are referred to as "disadvantaged schools"; and schools in the top quarter of average ESCS are referred to as "advantaged schools". In the following sections, a statistically significant difference between advantaged and disadvantaged schools in a given resource parameter is interpreted as an unequal distribution of a given resource; in particular, if a given resource is more present in socio-economically advantaged schools, the observed disparity is considered inequitable.

Several past studies also highlighted teacher resource gaps between schools of varying concentration of students from disadvantaged minorities (e.g. immigrants, ethnic, or cultural groups) or across geographic locations (Clotfelter, Ladd and Vigdor, 2005[5]; Murnane and Steele, 2007[6]; OECD, 2014[27]; Lankford, Loeb and Wyckoff, 2002[30]). Thus, in this chapter, schools' resources are also compared based on two additional school characteristics: a school's academic profile (four quarters) and school location (rural area or village: fewer than 3 000 people; town: 3 000 to 100 000 people; and city: over 100 000 people).

The academic profile of a school is measured by the expected mean school performance, given students' socio-demographic characteristics (ESCS, immigrant background, language spoken at home, gender and age), computed with a regression model. This model ensures that each characteristic is weighted according to its country-specific importance in determining student disadvantage. The differences between schools with different academic profiles are usually similar to the results based on schools with different socio-economic profiles; they are not discussed in this chapter, but are available in online tables (see Annex B).

Inequities in teacher resources between rural and urban schools have been analysed in the United States (Lankford, Loeb and Wyckoff, 2002[30]); urban-rural disparities in educational opportunities are also a frequent concern in low- and middle-income countries (UNESCO, 2015[31]). The main results about the differences between urban and rural schools are highlighted in text boxes throughout the chapter.

Indicators of teaching resources are constructed using principals' responses to the PISA school questionnaire, distributed in all PISA-participating countries and economies, and teachers' responses to the optional teacher questionnaire distributed in 19 countries and economies, as well as in Massachusetts and North Carolina public schools (United States), which contributed separate

samples (Box 3.1). Results discussed in the body of this chapter concern up to 71 countries and subnational jurisdictions[2] (jointly referred to as "education systems") when based on the school questionnaire, and up to 20 countries and subnational jurisdictions[3] when based on the optional teacher questionnaire.

The surveyed teachers received slightly different questionnaires, depending on the main school subject they teach (Box 3.1). Teachers who were listed by school administrators as among teachers of science subjects (e.g. physics, biology, chemistry), either taught separately or within a single "integrated science" course, responded to a questionnaire that included more science-focused questions (as science was the main domain of assessment of PISA 2015). These teachers are referred to as "science teachers" in the following sections. The remaining teachers, who were listed and sampled separately, are referred to as "non-science teachers".

All the analyses presented in this chapter are restricted to principals and teachers working in schools that include the modal ISCED level for 15-year-old students.[4] This ensures that within-country inequalities across schools that participate in PISA, which are the focus of this chapter, are not driven by differences in the way teachers are allocated to schools across education levels. It also ensures that the characteristics of students sampled for PISA, which inform the indicators of school advantage, represent the typical profile of students attending the school. This allows for fairer cross-country comparisons of the way typical teachers of 15-year-olds are sorted across schools.

The findings reported in the chapter cover both public and private schools. However, as teacher sorting is fundamentally shaped by policies determined by national or local authorities (OECD, 2005[21]), analyses are also carried out on the restricted sample of public and government-dependent private schools only and reported in tables available on line (see Annex B). This coverage restriction usually does not change the main conclusions.

Box 3.1 **The PISA 2015 teacher questionnaire and sample**

In 2015, and for the first time, 21 countries and sub-national jurisdictions distributed an optional questionnaire to teachers:

- **OECD countries** (9): Australia, Chile, the Czech Republic, Germany, Italy, Korea, Portugal, Spain and the United States.
- **OECD sub-national jurisdictions** (2): Massachusetts public schools and North Carolina public schools (United States)
- **Partner countries and economies** (10): Brazil, Beijing-Shanghai-Jiangsu-Guangdong (China), Colombia, the Dominican Republic, Hong Kong (China), Macao (China), Malaysia, Peru, Chinese Taipei and the United Arab Emirates.

This questionnaire was intended to provide contextual information about the schools attended by typical 15-year-old students eligible to participate in PISA.

...

The teacher sample in PISA

Teachers were defined as "those whose primary or major activity in school is student instruction, whether it happens in a classroom, in a small group, on a one-to-one basis, or outside regular classrooms". In order to ensure adequate representation of teachers and to guarantee samples that are sufficiently large, the sampled population included teachers who were eligible to teach the modal grade of 15-year-old students – whether they were teaching it currently, had done so before, or will/could do so in the future.

Teachers were listed and randomly sampled within each school as part of two distinct populations: science teachers and teachers who teach other subjects.

In each school, 10 science teachers were randomly sampled if the school had more than 10 science teachers. In smaller schools with fewer than 10 science teachers, all science teachers were selected. Similarly, 15 non-science teachers were randomly sampled if the school had more than 15 science teachers. If not, then all non-science teachers were included in the survey.

There is no teacher-student link in PISA 2015. In other words, the teachers sampled to participate in the survey were all eligible to teach the modal grade of 15-year-old students, as described above, but they were not necessarily teaching the sampled students. In total, the 21 countries and subnational jurisdictions provided data on 33 520 science teachers and 65 555 non-science teachers.

The teacher questionnaire

The teacher questionnaire in PISA 2015 was developed with the objective of collecting detailed information on teacher demographics, instruction, teaching strategies, teacher well-being and school contexts. Such data can be used to analyse differences between countries/economies and to explore how school outcomes are associated with teacher characteristics and practices. Even though some of these dimensions were covered in the school and student questionnaires, surveying teachers directly was thought to be more valid in providing accurate information about them (e.g. teaching strategies). Items in the teacher questionnaire were developed in conjunction with the rest of the PISA instruments and covered similar policy topics.

Two versions of the teacher questionnaire were used for the two teacher populations (i.e. science teachers and teachers who teach other subjects). The questionnaires consisted of a main common core and some population-specific questions. These differences were introduced to gauge particular aspects about science (or non-science) teaching, given that science was the major domain of assessment in PISA 2015. The teacher questionnaire was distributed using a computer-based assessment platform in all 19 countries and economies.

The teacher questionnaire covered the following areas: teacher background, qualifications and professional knowledge (with many questionnaire items taken from the OECD Teaching and Learning International Survey [TALIS]); science teaching practices and the school learning environment; learning time and curriculum; leadership and school management; and school resources.

...

This report uses teachers' responses to questions about their background, qualifications, and professional knowledge, as well as school-level aggregates of teachers' responses to questions about the leadership style of principals and about school resources.

Source: OECD, 2017[32]; Mostafa and Pál, 2018[33].

Results reported in this chapter must be interpreted with some caution. First, the analyses conducted on data from the teacher questionnaire cover only up to 20 countries and subnational jurisdictions (see Box 3.1 and note 3 at the end of this chapter). The small sample should be borne in mind, particularly when interpreting system-level correlations. Second, given in particular the cross-sectional nature of the data, no system-level correlation can be interpreted in a causal manner. Third, comparisons between advantaged and disadvantaged schools are typically drawn at the country level and may therefore fail to reflect differences in teacher-allocation practices and policies across local jurisdictions (e.g. states, regions, districts) or across educational tracks. For example, when the socio-economic conditions differ significantly across districts, it may be possible that country-level analyses conclude to substantial resource gaps between advantaged and disadvantaged schools in a country, even though some districts implement policies aiming at a more equitable allocation of teachers across schools. In this example, resource gaps between disadvantaged and advantaged schools would mainly reflect resource gaps between advantaged and disadvantaged districts and fail to capture the equitable sorting of teachers within districts.

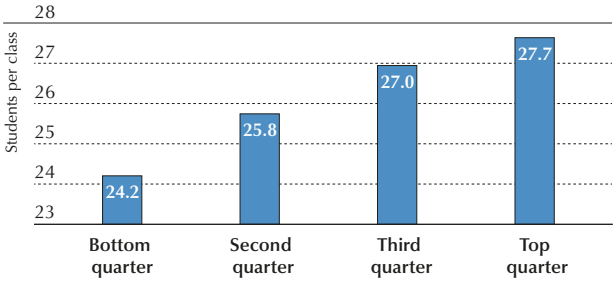
HOW DO SCHOOLS DIFFER WITH RESPECT TO THE QUANTITY OF TEACHER RESOURCES?

Class size and student-teacher ratio

Class size and student-teacher ratios are objective indicators of the quantity of teacher resources allocated to schools. In fact, they are often a policy response to school disadvantage. PISA results indicate that many education systems may be reducing the size of classes, or the student-teacher ratio, in an effort to support socio-economically disadvantaged schools.

PISA asked school principals to report the average size of language-of-instruction[5] classes in the national modal grade for 15-year-old students (Figure 3.1 and Table 3.1). According to principals, on average across OECD countries, there were 24.2 students per class in the schools in the bottom quarter of school socio-economic profile, while there were 27.7 students per class in the schools of the top quarter. This makes for a significant difference of more than three students per class between socio-economically advantaged and disadvantaged schools, confirming that more teacher resources are allocated to disadvantaged schools, on average. Such a positive and significant difference was found in 39 education systems.[6] In Estonia, Georgia, Thailand, and Trinidad and Tobago, the difference in class size between the most-advantaged and the most-disadvantaged schools was about 10 students or more. By contrast, in three countries, socio-economically advantaged schools were found to have significantly smaller classes than disadvantaged schools: in Qatar there were eight more students per class in disadvantaged schools than in advantaged schools; in the United Arab Emirates there were seven more students, and in Singapore there were four more students per class in disadvantaged schools than in advantaged schools (but the difference is almost entirely due to international schools).

Figure 3.1 ■ **Average class size, by quarter of school socio-economic profile**
OECD average



Source: OECD PISA 2015 Database, Table 3.1.
StatLink http://dx.doi.org/10.1787/888933740478

The contrast between the schools in the top quarter of school socio-economic profile and those in the bottom quarter is even sharper when focusing on public and private government-dependent schools only, with a larger difference of 3.8 students per class in favour of disadvantaged schools, on average across OECD countries. Forty out of 70 education systems had smaller classes in disadvantaged schools, after excluding private independent schools. An inverse difference, in favour of advantaged schools, was found only in Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]").

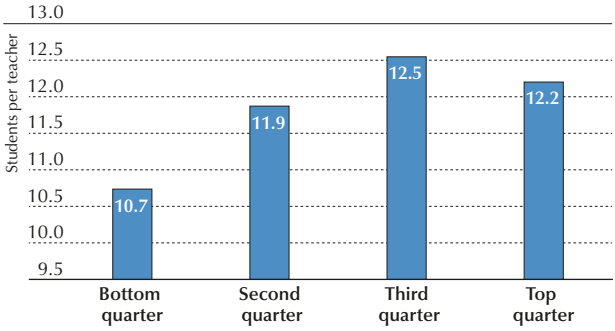
Having smaller classes in disadvantaged schools, therefore, seems to be the result of a deliberate policy of teacher resource allocation in many education systems. This is consistent with national and local studies analysing the implementation of policies aimed at reducing class size in disadvantaged schools. For example, in France, there were three fewer students per class in middle schools located in priority education zones, which are targeted to receive more teaching resources, than in classes in schools in other areas (Caille, Davezies and Garrouste, 2016[34]).

Principals were also asked to report the number of teachers working part time and full time in their schools, and the total number of students, from which a student-teacher ratio, accounting for part-time teaching, was computed (Figure 3.2 and Table 3.3). Unlike the size of language-of-instruction classes, the student-teacher ratio pertains to all school subjects. Class size and the student-teacher ratios are strongly related to each other (OECD, 2016, p. 205[29]), but student-teacher ratios can provide a better proxy of per-pupil expenditure.

As expected, the difference between advantaged and disadvantaged schools in student-teacher ratios was consistent with that in class size. On average across OECD countries, there were 10.7 students per teacher in disadvantaged schools and 12.2 students per teacher in advantaged schools. This results in a significant positive difference of 1.5 students per teacher in favour of disadvantaged schools (and of 2.4 students per teacher when focusing on public and private government-dependent schools only). In Belgium, Estonia, France, Georgia, Hungary, Italy, Latvia, Malta, the Netherlands and the Russian Federation (hereafter "Russia"), the student-teacher ratio in the most disadvantaged schools was more than 30% lower than that in the most

advantaged schools. Four countries and economies showed an inverse pattern, with a lower student-teacher ratio in the most advantaged schools compared with the most disadvantaged schools – most notably Colombia (4.9 fewer students per teacher), the United Arab Emirates (2.7 fewer students) and Australia (1.0 fewer students).[7] In Colombia and Australia, however, the relationship between student-teacher ratios and school disadvantage was hump-shaped: the ratios were lower in the bottom quarter of school socio-economic profile than those in the middle two quarters, but were even lower in the top quarter, possibly because the top quarter includes private, independent schools that cater to the most affluent students. After excluding all private independent schools, both countries no longer showed significant differences in student-teacher ratios between advantaged and disadvantaged schools.

Figure 3.2 ■ **Average student-teacher ratio, by quarter of school socio-economic profile**
OECD average



Source: OECD PISA 2015 Database, Table 3.3.
StatLink http://dx.doi.org/10.1787/888933740497

All in all, there were 19 education systems where disadvantaged schools have more teachers than advantaged schools, as measured by both class size and student-teacher ratios, and another 25 systems where at least one of these measures indicates more teaching resources in disadvantaged schools ( ). The United Arab Emirates was the only country where advantaged schools received more teacher resources, according to both indicators.

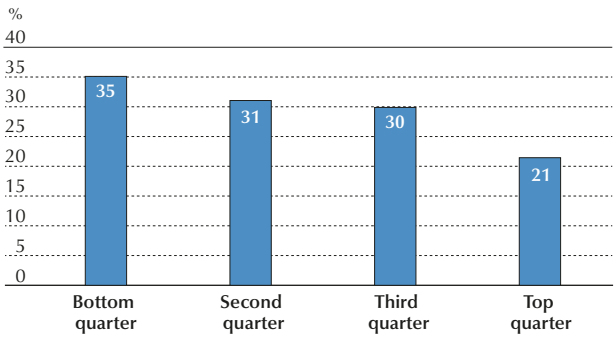
Principals' and teachers' views of teaching staff shortages

Objective measures of the quantity of teacher resources, such as class size and student-teacher ratios, show that education systems have a tendency to allocate a greater quantity of teacher resources to socio-economically disadvantaged schools than to advantaged schools. However, principals and teachers in disadvantaged schools more often report that a lack of teaching staff hinders student learning in their school. Comparing objective and subjective measures of the quantity of teacher resources available within schools gives a clearer picture of the issue of teacher shortages.

The quantity of teacher resources available and its impact on student learning can also be measured by asking school principals and teachers the extent ("not at all", "very little", "to some extent", or "a lot") to which a lack of teaching staff hinders the school's capacity to provide instruction (Figure 3.3 and Table 3.5). On average across OECD countries, 29% of 15-year-old students were enrolled in schools whose principal considers that instruction is hindered by a lack of teaching staff at least to some extent. In the most disadvantaged schools, 35% of students had principals who so reported, compared to only 21% of students in the most advantaged schools, resulting in a significant difference of 14 percentage points at the expense of disadvantaged schools. A significant difference, to the detriment of disadvantaged schools, was also observed in 28 education systems, with the largest differences in Ciudad Autónoma de Buenos Aires (Argentina) (hereafter "CABA [Argentina]"), North Carolina (United States), Spain and Switzerland. Two countries showed a significantly larger share of principals in advantaged schools reporting teacher shortages than principals in disadvantaged schools: the Former Yugoslav Republic of Macedonia (hereafter "FYROM"), where no sampled principals in disadvantaged schools reported that a lack of teaching staff hinders student learning, and Malta, with a small (two percentage-point) difference in favour of disadvantaged schools.

Figure 3.3 ■ **Principals' views on the lack of teaching staff, by quarter of school socio-economic profile**

Percentage of students in schools whose principal reported that the school's capacity to provide instruction is hindered by a lack of teaching staff at least to some extent, OECD average



Source: OECD PISA 2015 Database, Table 3.5.
StatLink http://dx.doi.org/10.1787/888933740516

In countries and economies that participated in the PISA 2015 teacher questionnaire, teachers were also asked about teacher shortages (Tables 3.7 and 3.8). On average across these countries and economies, 31% of science teachers reported that their school's capacity to provide instruction is hindered by a lack of teaching staff.[8] This percentage also varies greatly by school socio-economic profile and by country. Some 37% of science teachers in the most disadvantaged schools and 22% of science teachers in the most advantaged schools reported a lack of teaching staff, resulting in a significant difference of 15 percentage points to the detriment of disadvantaged schools.

Science teachers' views of teacher shortages were significantly more negative in disadvantaged schools in 12 out of the 20 education systems (Australia, Brazil, B-S-J-G [China], Colombia, the Dominican Republic, Germany, Massachusetts [United States], Peru, Spain, Chinese Taipei, the United Arab Emirates and the United States). In most remaining countries and economies, there was no significant difference between advantaged and disadvantaged schools in science teachers' views of teacher shortages; only in Macao (China) was a difference in favour of disadvantaged schools observed. Results based on non-science teachers' reports were consistent with those based on science teachers' reports (Figure 3.4).

Teacher absenteeism can be seen as a temporary form of teacher shortage, and is often perceived as such. PISA asked principals the extent ("not at all", "very little", "to some extent", or "a lot") to which student learning is hindered by teacher absenteeism (Table 3.9). Across OECD countries, 17% of 15-year-old students were enrolled in schools whose principal reported that students' learning is hindered by teacher absenteeism at least to some extent. In the most disadvantaged, schools, 18% of students had principals who so reported, compared to only 13% of students in the most advantaged schools, resulting in a significant difference of more than 5 percentage points, to the detriment of disadvantaged schools. Teacher absenteeism is an issue of particular importance in disadvantaged schools in B-S-J-G (China), Massachusetts (United States), Sweden, the United Arab Emirates and Uruguay, where the difference between disadvantaged and advantaged schools was larger than 20 percentage points. In contrast, in four countries, namely FYROM, Mexico, Qatar and Slovenia, teacher absenteeism seemed to be more of a concern in advantaged schools.

Box 3.2 **Teacher resources in rural and urban schools**

Objective and subjective indicators of teacher resources can also be contrasted across rural and urban schools, in the 63 countries and economies where these school categories are relevant. Rural schools are schools located in rural areas or villages with fewer than 3 000 people, while urban schools are schools located in cities with over 100 000 people.

On average across OECD countries, urban schools had 6 more students per class than rural schools, and a significant and positive difference was observed in 39 of 63 PISA-participating countries and economies. Urban schools also tend to have higher student-teacher ratios (Table 3.1). These differences might result from deliberate policies to allocate more teacher resources to rural than urban schools; but they more likely reflect the population distribution across rural and urban areas and responses to local education demands. When countries choose to maintain schools in sparsely populated areas, they must often reduce class size and the student/teacher ratio below the national average in order to do so.

However, on average across OECD countries, more principals in rural schools (32%) than in urban schools (27%) reported that the school's capacity to provide instruction is hindered by a lack of teaching staff (Table 3.5). Science teachers' views of teaching staff shortages were particularly divergent between rural and urban schools: more science teachers in rural schools than in urban schools – a difference of 23 percentage points between the two groups – reported that their school's capacity to provide instruction is hindered by a lack of teaching staff (Table 3.7).

Figure 3.4 [1/2] ■ Difference between advantaged and disadvantaged schools in the quantity of teacher resources

Disadvantaged schools are **better off** compared to advantaged schools
Disadvantaged schools are **worse off** compared to advantaged schools
Difference not significant
Missing values

	Objective indicators		Subjective indicators			
	Principals' reports		Principals' reports		Science teachers' reports	Non-science teachers' reports
OECD	Class size	Number of students per teacher	Teacher shortages hindering learning	Teacher absenteeism hindering learning	Teacher shortages hindering learning	Teacher shortages hindering learning
Australia						
Austria						
Belgium						
Canada						
Chile						
Czech Republic						
Denmark						
Estonia						
Finland						
France						
Germany						
Greece						
Hungary						
Iceland						
Ireland						
Israel						
Italy						
Japan						
Korea						
Latvia						
Luxembourg						
Mexico						
Netherlands						
New Zealand						
Norway						
Poland						
Portugal						
Slovak Republic						
Slovenia						
Spain						
Sweden						
Switzerland						
Turkey						
United Kingdom						
United States						
*- Massachusetts**						
*- North Carolina**						

* Massachusetts and North Carolina participated in PISA 2015 with state-level samples representing public schools only.

Note: Differences in class size of less than two students and of student-teacher ratios of less than one student are not reported as significant; larger differences are reported as significant based on the estimated standard errors.

Countries and economies are ranked by OECD/partner status and in alphabetical order.

Source: OECD PISA 2015 Database, Tables 3.1, 3.3, 3.5, 3.7, 3.8 and 3.9.

StatLink http://dx.doi.org/10.1787/888933740535

Figure 3.4 [2/2] ■ Difference between advantaged and disadvantaged schools in the quantity of teacher resources

Disadvantaged schools are **better off** compared to advantaged schools
Disadvantaged schools are **worse off** compared to advantaged schools
Difference not significant
Missing values

	Objective indicators		Subjective indicators			
	Principals' reports		Principals' reports		Science teachers' reports	Non-science teachers' reports
Partners	Class size	Number of students per teacher	Teacher shortages hindering learning	Teacher absenteeism hindering learning	Teacher shortages hindering learning	Teacher shortages hindering learning
Albania						
Algeria						
Brazil						
B-S-J-G (China)						
Bulgaria						
CABA (Argentina)						
Colombia						
Costa Rica						
Croatia						
Dominican Republic						
FYROM						
Georgia						
Hong Kong (China)						
Indonesia						
Jordan						
Kosovo						
Lebanon						
Lithuania						
Macao (China)						
Malta						
Moldova						
Montenegro						
Peru						
Qatar						
Romania						
Russia						
Singapore						
Chinese Taipei						
Thailand						
Trinidad and Tobago						
Tunisia						
United Arab Emirates						
Uruguay						
Viet Nam						
Education systems where disadvantaged schools are better off	39	24	2	4	1	1
Education systems with no difference	29	43	41	51	7	5
Education systems where advantaged schools are worse off	3	4	28	16	12	14

Note: Differences in class size of less than two students and of student-teacher ratios of less than one student are not reported as significant; larger differences are reported as significant based on the estimated standard errors.
Countries and economies are ranked by OECD/partner status and in alphabetical order.
Source: OECD PISA 2015 Database, Tables 3.1, 3.3, 3.5, 3.7, 3.8 and 3.9.
StatLink http://dx.doi.org/10.1787/888933740535

Figure 3.4 provides a visual summary of how additional teacher resources are allocated between the most and the least advantaged schools, using a range of indicators. For one country, objective and subjective indicators often provide conflicting information about the equitable distribution of teacher resources. What can be concluded is that, in many education systems, disadvantaged schools tend to have objectively more teacher resources. Yet, even in education systems that channel more resources to disadvantaged schools, principals and teachers in those schools have a tendency to report higher or not significantly different rates of teacher shortages than their counterparts in advantaged schools. Their perceptions of a lack of teaching staff could imply that the additional teaching resources they receive are not sufficient or do not meet the school's particular needs[9] to compensate fully for student disadvantage.

HOW DOES TEACHER QUALITY DIFFER ACROSS SCHOOLS?

Many education systems compensate school socio-economic disadvantage by increasing the quantity of teacher resources. However, studies conducted on national or local data have shown that investing in teacher quantity is often done at the cost of teacher quality. Several states in the United States that have implemented policies to reduce class size show a decline in the quality of teacher recruitment (Jepsen and Rivkin, 2009[17]; Dieterle, 2015[18]). In France, a policy allocating more resources to priority education zones has probably also inadvertently cast these zones in a negative light, to the extent that families that can might choose to avoid these areas, thereby aggravating socio-economic segregation (Davezies and Garrouste, 2014[35]), and prospective teachers might perceive schools in these zones as low-quality work environments (Prost, 2013[12]). The policy also triggered adverse effects on local teacher teams, such as greater uncertainty in teacher assignments to schools (assignments were only completed closer to the start of a new school year), the recruitment of less-experienced teachers, and higher turnover rates (Bénabou, Kramarz and Prost, 2009[36]).

While such national studies reveal possible unintended consequences of teacher-allocation mechanisms that aim to compensate for student disadvantage with more teacher resources, evidence on what these mean for teacher quality is missing for many countries. This section describes, from an international comparative perspective, how teacher quality is distributed across schools with different socio-economic profiles. It relies on both objective and subjective measures of teacher quality through a series of PISA indicators of teacher initial education, qualification, experience and behaviour.

Teacher education and qualification

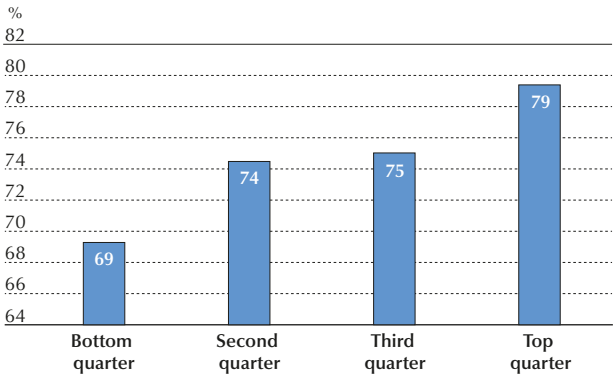
Teachers' pre-service education and training aim to equip teachers with the necessary skills to help students learn. Because the content and the quality of teachers' education can affect student learning (Clotfelter, Ladd and Vigdor, 2007[37]; Clotfelter, Ladd and Vigdor, 2010[38]; Darling-Hammond, 2004[4]; Monk, 1994[39]; Ronfeldt and Reininger, 2012[40]), the distribution of quality teachers across schools can influence equity in student performance.[10] Specifically, some studies have found that students taught by teachers who hold a subject-specific certification do better in that subject (see Akiba, LeTendre and Scribner (2007[41]) for a review).

At the same time, teachers' credentials and certification can influence teachers' employment conditions, such as teachers' salaries, the volume of teaching duties or school assignment. Teachers with more education and/or more specialised training might work in different schools, either because teachers with higher credentials are given more choice in school assignment or because education authorities allocate teachers to different school tracks based on their qualifications.

PISA asked school principals to report the proportion of science teachers with a university degree and a major in science (Figure 3.5 and Table 3.11), and to report the proportions of fully certified teachers and fully certified science teachers in their school (Tables 3.13 and 3.15). On average across OECD countries, 74% of science teachers had a university degree with a major in science, but only 69% of science teachers in disadvantaged schools fit this profile while 79% of science teachers in advantaged schools did. This makes for a significant difference of 10 percentage points between the top and bottom quarters of school socio-economic profile, on average across OECD countries.

Figure 3.5 ■ **Science teachers with a university major in science, by quarter of school socio-economic profile**

OECD average



Source: OECD PISA 2015 Database, Table 3.11.

StatLink http://dx.doi.org/10.1787/888933740554

Similar differences were observed in 23 education systems, with the largest found in Austria (a 44 percentage-point difference) and Switzerland (a 45 percentage-point difference). Both systems are characterised by student tracking at lower secondary level, whereby students of different ability (and often different socio-economic status) follow different curricula. The United States and Kosovo, are two notable exceptions: in these countries, disadvantaged schools employed a larger share of science teachers who majored in science in university; in the United States, however, this no longer holds true when the sample is restricted to public and private, but government-dependent, schools (Table 3.12). Results also show that in the remaining 44 education systems, advantaged and disadvantaged schools employed an equivalent share of science teachers with a university degree and a major in science.[11]

Figure 3.6 [1/2] ■ Difference between advantaged and disadvantaged schools in the qualifications of science teachers

Results based on principals' reports

Disadvantaged schools have more qualified science teachers compared to advantaged schools
Advantaged schools have more qualified science teachers compared to disadvantaged schools
Difference not significant
Missing values

OECD	Proportion of science teachers with a major in science	Proportion of fully certified science teachers
Australia	Advantaged schools	
Austria	Advantaged schools	
Belgium		Advantaged schools
Canada		
Chile*		
Czech Republic	Advantaged schools	Advantaged schools
Denmark		Missing values
Estonia		
Finland		
France		Advantaged schools
Germany		Advantaged schools
Greece		
Hungary		Missing values
Iceland	Advantaged schools	Advantaged schools
Ireland		
Israel		
Italy	Missing values	
Japan	Missing values	
Korea		
Latvia		
Luxembourg	Advantaged schools	Advantaged schools
Mexico	Advantaged schools	Disadvantaged schools
Netherlands	Advantaged schools	
New Zealand		
Norway	Advantaged schools	Missing values
Poland		
Portugal		
Slovak Republic		
Slovenia	Advantaged schools	
Spain		
Sweden		
Switzerland	Advantaged schools	
Turkey		Advantaged schools
United Kingdom	Advantaged schools	
United States	Disadvantaged schools	
*- Massachusetts***		Advantaged schools
*- North Carolina***		

Notes: Differences in proportions of science teachers with a major in science/who are fully certified of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

*In Chile the question about the certification of teachers was adapted as "authorised or enabled by the Ministry of Education".

**Massachusetts and North Carolina participated in PISA 2015 with state-level samples representing public schools only.

Countries and economies are ranked by OECD/partner status and in alphabetical order.

Source: OECD PISA 2015 Database, Tables 3.11 and 3.15.

StatLink http://dx.doi.org/10.1787/888933740573

Figure 3.6 [2/2] ■ Difference between advantaged and disadvantaged schools in the qualifications of science teachers

Results based on principals' reports

Disadvantaged schools have more qualified science teachers compared to advantaged schools
Advantaged schools have more qualified science teachers compared to disadvantaged schools
Difference not significant
Missing values

Partners	Proportion of science teachers with a major in science	Proportion of fully certified science teachers
Albania		
Algeria		
Brazil		
B-S-J-G (China)		
Bulgaria		
CABA (Argentina)		
Colombia		
Costa Rica		
Croatia		
Dominican Republic		
FYROM		
Georgia		
Hong Kong (China)		
Indonesia		
Jordan		
Kosovo		
Lebanon		
Lithuania		
Macao (China)		
Malta		
Moldova		
Montenegro		
Peru		
Qatar		
Romania		
Russia		
Singapore		
Chinese Taipei		
Thailand		
Trinidad and Tobago		
Tunisia		
United Arab Emirates		
Uruguay		
Viet Nam		
Education systems where disadvantaged schools have more qualified science teachers	2	5
Education systems with no difference	44	45
Education systems where advantaged schools have more qualified science teachers	23	17

Notes: Differences in proportions of science teachers with a major in science/who are fully certified of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

Countries and economies are ranked by OECD/partner status and in alphabetical order.

Source: OECD PISA 2015 Database, Tables 3.11 and 3.15.

StatLink http://dx.doi.org/10.1787/888933740573

Similar results were observed when looking at the share of fully certified teachers and fully certified science teachers within schools. The quarter of most socio-economically advantaged schools employed more fully certified science teachers than the bottom quarter (by 6 percentage points), on average across OECD countries. The widest gap was observed in France (68 percentage points), where only 26% of science teachers who teach in schools in the bottom quarter of school socio-economic profile were fully certified, compared to 94% of science teachers in advantaged schools who were. By contrast, FYROM, Kosovo, Mexico, Thailand, and Trinidad and Tobago showed larger proportions of fully certified science teachers in the least-advantaged schools.

Disparities in the shares of teachers with a major in science or who are fully certified might reflect differences in qualification requirements for different education tracks (Abbiati, Argentin and Gerosa, 2017[13]). In France, for example, schools in the bottom quarter of school socio-economic profile are more frequently vocational or technical high schools than those in the top quarter. This could partly explain why the gap between advantaged and disadvantaged schools is so large in France. In Italy, researchers found a systematic pairing of desirable teachers' traits (including marks earned at graduation and field of study) with more advantaged students. The study found that tracking in upper secondary school explains a large part of this pattern, which suggests that tracking could contribute to inequalities in education not only by segregating students, but also through qualitative differences in the teaching staff working in each track (Abbiati, Argentin and Gerosa, 2017, p. 39[13]).

Such differences can also result from market-allocation mechanisms in countries where schools compete with each other to attract the best teachers. Researchers in Chile have analysed why primary school teachers who had better initial training (in terms of accreditation, type and years of study) mostly work in higher-income schools (Cabezas et al., 2017[8]). They found that the type of school in which teachers completed their secondary education is related to the type of school in which they first work, indicating that teachers search for a job through their networks.

Teacher experience

Along with teacher initial training and certification, teachers' work experience helps shape their skills and competencies. Years of experience might be particularly important early in a teacher's career. Some evidence shows that each additional year of experience is related to higher student achievement, especially during a teacher's first five years in the profession (Rockoff, 2004[42]; Rivkin, Hanushek and Kain, 2005[15]; Harris and Sass, 2011[43]). At the same time, teachers' willingness to implement innovative practices or reforms might also decline with a teacher's age and experience (Goodson, Moore and Hargreaves, 2006[44]).

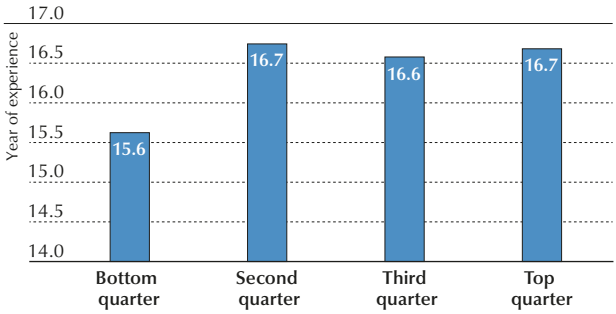
The relationship between teacher experience and student learning has been repeatedly analysed in empirical studies (Hanushek and Rivkin, 2006[45]; Croninger et al., 2007[46]; Leigh, 2010[47]; Jackson, Rockoff and Staiger, 2014[48]). Most studies find that teacher experience and student achievement are positively related (also see Chapter 2, Figure 2.14). Assigning more-experienced teachers to disadvantaged schools could therefore be a way to compensate for student disadvantage.

In the countries and economies that distributed the PISA 2015 teacher questionnaire, teachers were asked to report how many years of teaching experience they have in total (Figure 3.7 and

Figure 3.8, Tables 3.17 and 3.18). On average across 18 education systems,[12] both science and non-science teachers reported having about 16.4 years of teaching experience. However, teachers in schools in the top quarter of school socio-economic profile had about one more year of experience, on average, than teachers in bottom-quarter schools. Advantaged schools in Australia, the Dominican Republic, Italy, Portugal and the United States employed significantly more experienced teachers than disadvantaged schools did, both in science and in subjects other than science. By contrast, in Macao (China) and the United Arab Emirates, science teachers in disadvantaged schools had two more years of experience than science teachers in advantaged schools; and in Hong Kong (China) and the United Arab Emirates, the same was observed among non-science teachers. This indicates that, even though there are education systems where more experienced teachers teach in high-need schools, the opposite pattern is more common.

Figure 3.7 ■ **Average teacher experience, by quarter of school socio-economic profile**

Average across countries and economies that distributed the PISA teacher questionnaire; non-science teachers



Note: The average includes all countries that distributed the PISA teacher questionnaire, except Malaysia.
Source: OECD PISA 2015 Database, Table 3.17.
StatLink http://dx.doi.org/10.1787/888933740592

This tendency might reflect different teacher retention rates across schools or mobility schemes through which teachers with more years of service have priority in choosing their preferred school.

Advantaged schools might provide more satisfactory working conditions for teachers, and are thus able to retain teachers longer. Teachers in these schools might, for example, be more familiar with the typical background and issues that students in these schools face. They might spend more time on instruction and less time on managing students' behavioural problems (and prefer doing so), because they can count on students' families to provide complementary efforts in education and discipline. Teachers in advantaged schools might also benefit from a stronger collaborative culture and instructional leadership in the school, or from the formal or informal feedback they receive about their effectiveness, through student performance and success in life. In some countries, advantaged schools might offer higher wages or better benefits than

disadvantaged schools; but often non-monetary perks, such as better professional equipment, or shorter or more pleasant commutes might justify a preference for working in more advantaged schools. Recent analysis carried out on PISA 2015 data indeed indicate that teachers tend to be more satisfied with their job when they work in socio-economically advantaged schools, even after accounting for school performance (Mostafa and Pál, 2018[33]).

If most teachers share similar preferences for working in more advantaged schools, teacher mobility between schools can complement and reinforce the sorting of teachers by experience. More advantaged schools become associated with higher status, and are more attractive to teachers who would like to move up a ladder of prestige and perhaps enjoy working with colleagues at a similar career stage as their own.

Teacher mobility across schools (rather than out of the profession entirely) might play a significant role in the sorting of experienced teachers in countries where teachers are employed as civil servants and, once recruited, allocated to positions according to rules that operate at the system level rather than at the school level (so-called career-based employment; see OECD [2005[21]]). In such education systems, internal mobility is often voluntary and priority is typically given to more experienced teachers, who have greater choices in where they teach. In Italy, for example, the share of teachers applying for a transfer to another school was found to be negatively related to student achievement in the school teachers currently work (Barbieri, Rossetti and Sestito, 2013[49]). As a result, disadvantaged schools tend to suffer from higher teacher turnover and larger shares of novice teachers, and must often rely on short-term staffing to fill vacancies. Similar findings were reported in Turkey (Özoğlu, 2015[14]). The mandatory mobility schemes found in Japan and Korea (OECD, 2005, p. 159[21]), whereby teachers are assigned to a new school periodically, might uniformly increase turnover rates across all schools, and result in greater balance of experienced and beginning teachers across schools (see Box 1.1 in Chapter 1).

A teacher's length of service within a given school (seniority) might also positively influence her or his teaching. Evidence from the United States shows that teachers new to an assignment, such as teachers new to school, to a subject or to a grade, are not as effective as more senior teachers within a school. Furthermore, disadvantaged students are slightly more likely to be assigned to such teachers (Atteberry, Loeb and Wyckoff, 2016[50]). Turnover, which is inversely related to average teacher seniority within a school, has also proven to be detrimental to student learning and to be more prevalent in disadvantaged schools (Hanushek, Rivkin and Schiman, 2016[51]; Ronfeldt, Loeb and Wyckoff, 2013[52]; Jackson, Rockoff and Staiger, 2014[48]; Boyd et al., 2008[3]).

The negative effects of turnover are observed even though, as seen in the United States, teachers who leave their school are often the least effective teachers, particularly in schools that enrol predominantly low-income students (Hanushek and Rivkin, 2010[53]). Meanwhile, evidence of a positive association between the level of school disadvantage and the teacher-turnover rate is emerging for other countries too, including England (Allen, Burgess and Mayo, 2017[9]) and Italy (Barbieri, Rossetti and Sestito, 2013[49]).

In countries and economies that distributed the teacher questionnaire, PISA asked teachers about the number of years they have worked as teachers in their current schools (Figure 3.8, Tables 3.19 and 3.20). On average across 18 countries and economies, science and non-science teachers reported having slightly more than nine years of teaching experience in their schools.

Yet, in some participating education systems, seniority was unequally distributed across schools, depending on the schools' socio-economic profile. Six countries, namely Australia, the Dominican Republic, Italy, Portugal, Spain and the United States, showed a pattern where either science or non-science teachers in advantaged schools have more seniority than teachers in disadvantaged schools. This pattern was particularly strong in the Dominican Republic, Italy and Spain, where both science and non-science teachers in advantaged schools were more senior than their counterparts in disadvantaged schools. In these countries, socio-economically disadvantaged schools were more subject to teacher turnover and therefore to team instability.

Figure 3.8 ■ **Difference between advantaged and disadvantaged schools in teacher characteristics**

Results based on teachers' reports

Disadvantaged schools have **better resources** compared to advantaged schools
Disadvantaged schools have **worse resources** compared to advantaged schools
Difference not significant

	Science teachers' reports				Non-science teachers' reports			
OECD	Average years of experience as teachers	Average years of seniority in school	Proportion of science teachers who are trained or certified in all subjects they teach	Proportion of science teachers with a fixed-term contract (one school year or less)	Average years of experience as teachers	Average years of seniority in school	Proportion of non-science teachers who are trained or certified in all subjects they teach	Proportion of science teachers with a fixed-term contract (one school year or less)
Australia								
Chile								
Czech Republic								
Germany								
Italy								
Korea								
Portugal								
Spain								
United States								
*- Massachusetts**								
*- North Carolina**								
Partners								
Brazil								
B-S-J-G (China)								
Colombia								
Dominican Republic								
Hong Kong (China)								
Macao (China)								
Peru								
Chinese Taipei								
United Arab Emirates								
Education systems where disadvantaged schools have better resources	2	3	0	1	2	3	0	2
Education systems with no difference	13	13	17	14	13	12	15	11
Education systems where advantaged schools have better resources	5	4	3	5	5	5	5	7

*Massachusetts and North Carolina participated in PISA 2015 with state-level samples representing public schools only.
Countries and economies are ranked by OECD/partner status and in alphabetical order.
Source: OECD PISA 2015 Database, Tables 3.17, 3.18, 3.19, 3.20, 3.21, 3.22, 3.23 and 3.24.
StatLink http://dx.doi.org/10.1787/888933740611

By contrast, in Chile, Hong Kong (China), Macao (China) and the United Arab Emirates, science teachers or non-science teachers in advantaged schools had less average seniority than those in disadvantaged schools, and that difference was significant for both types of teachers in Macao (China) and the United Arab Emirates.

Other indicators derived from the teacher questionnaire also point towards greater difficulties among disadvantaged schools in filling vacancies in their staff. In 7 out of 20 education systems (Australia, Brazil, Chile, Italy, Macao [China], Portugal and Spain), disadvantaged schools had a larger share of non-science teachers who are employed on a fixed-term contract for a period of one school year or less, compared to advantaged schools (Figure 3.8 and Table 3.22); the opposite was observed in B-S-J-G (China) and Colombia. In five countries/economies (Australia, Brazil, the Czech Republic, Germany and Macao [China]), non-science teachers in disadvantaged schools taught subjects that were not included in their teacher education, training or qualification programme more often than non-science teachers in advantaged schools did (Table 3.24); no country showed the opposite pattern.

Principals' and teachers' views of teacher quality

Based on objective measures of teachers' initial education, qualification and work experience, PISA shows that very few countries compensate student disadvantage by allocating their most qualified and experienced teachers to high-needs schools, either through centralised or de-centralised mechanisms. More subjective measures of teacher quality, based on school principals' and teachers' reports, tend to confirm the results derived from the objective indicators reported above.

PISA asked school principals and teachers to report the extent ("not at all", "very little", 'to some extent" or "a lot") to which they believe that learning in their school is hindered by "inadequate or poorly qualified teaching staff". According to both principals' and teachers' views, schools in the bottom quarter of school socio-economic profile suffered more than schools in the top quarter from inadequate or poorly qualified teachers. When focusing on principals' views, the difference between advantaged and disadvantaged schools was significant in 27 out of 71 education systems (Figure 3.9 and Table 3.25). Across OECD countries, there were an additional 10% of students in disadvantaged schools whose school principal reported inadequate or poorly qualified teaching staff, compared to students in advantaged schools. Luxembourg stood out as an exception, with more than twice as many students in advantaged schools (32%) as in disadvantaged schools (14%) whose principals reported inadequate or poorly qualified staff.

Teachers' views were similar to those of principals, according to the responses collected in education systems that distributed the PISA 2015 teacher questionnaire (Figure 3.9, Tables 3.27 and 3.28). On average across 18 countries and economies, non-science teachers in disadvantaged schools were nine percentage points more likely than non-science teachers in advantaged schools to report that learning in the school is hindered by inadequate or poorly qualified teaching staff. A significant difference, to the detriment of disadvantaged schools, was found in 13 out of 20 education systems, while no education system that distributed the teacher questionnaire showed a significant difference in favour of disadvantaged schools. Results based on science teachers' reports were similar.

Figure 3.9 [1/2] ■ Difference between advantaged and disadvantaged schools in the quality of teacher resources

Results based on principals' and teachers' reports

Disadvantaged schools have **better resources** compared to advantaged schools
Disadvantaged schools have **worse resources** compared to advantaged schools
Difference not significant
Missing values

	Objective indicators	Subjective perceptions: Student learning is hindered by…			
	Principals' reports	Principals' reports		Science teachers' reports	Non-science teachers' reports
OECD	Proportion of fully certified teachers	Inadequate or poorly qualified teachers	Teachers not being prepared for classes	Inadequate or poorly qualified teachers	Inadequate or poorly qualified teachers
Australia					
Austria					
Belgium					
Canada					
Chile*					
Czech Republic					
Denmark					
Estonia					
Finland					
France					
Germany					
Greece					
Hungary					
Iceland					
Ireland					
Israel					
Italy					
Japan					
Korea					
Latvia					
Luxembourg					
Mexico					
Netherlands					
New Zealand					
Norway					
Poland					
Portugal					
Slovak Republic					
Slovenia					
Spain					
Sweden					
Switzerland					
Turkey					
United Kingdom					
United States					
*- Massachusetts***					
*- North Carolina***					

Note: Differences in proportions of fully certified teachers of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

*In Chile the question about the certification of teachers was adapted as "authorised or enabled by the Ministry of Education".

**Massachusetts and North Carolina participated in PISA 2015 with state-level samples representing public schools only.

Countries and economies are ranked by OECD/partner status and in alphabetical order.

Source: OECD PISA 2015 Database, Tables 3.13, 3.25, 3.27, 3.28 and 3.29.

StatLink http://dx.doi.org/10.1787/888933740630

Figure 3.9 [2/2] ■ Difference between advantaged and disadvantaged schools in the quality of teacher resources

Results based on principals' and teachers' reports

Disadvantaged schools have **better resources** compared to advantaged schools
Disadvantaged schools have **worse resources** compared to advantaged schools
Difference not significant
Missing values

	Objective indicators	Subjective perceptions: Student learning is hindered by…			
	Principals' reports	Principals' reports		Science teachers' reports	Non-science teachers' reports
Partners	Proportion of fully certified teachers	Inadequate or poorly qualified teachers	Teachers not being prepared for classes	Inadequate or poorly qualified teachers	Inadequate or poorly qualified teachers
Albania					
Algeria					
Brazil					
B-S-J-G (China)					
Bulgaria					
CABA (Argentina)					
Colombia					
Costa Rica					
Croatia					
Dominican Republic					
FYROM					
Georgia					
Hong Kong (China)					
Indonesia					
Jordan					
Kosovo					
Lebanon					
Lithuania					
Macao (China)					
Malta					
Moldova					
Montenegro					
Peru					
Qatar					
Romania					
Russia					
Singapore					
Chinese Taipei					
Thailand					
Trinidad and Tobago					
Tunisia					
United Arab Emirates					
Uruguay					
Viet Nam					
Education systems where disadvantaged schools have better resources	4	2	3	0	0
Education systems with no difference	47	42	50	12	7
Education systems where advantaged schools have better resources	17	27	18	8	13

Note: Differences in proportions of fully certified teachers of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

Countries and economies are ranked by OECD/partner status and in alphabetical order.

Source: OECD PISA 2015 Database, Tables 3.13, 3.25, 3.27, 3.28 and 3.29.

StatLink http://dx.doi.org/10.1787/888933740630

PISA also asked school principals from all participating countries and economies to report the extent ("not at all", "very little", 'to some extent" or "a lot") to which they believe that learning in their school is hindered by teachers not being well-prepared for classes and teachers not meeting individual students' needs.

On average across OECD countries, 12% of students were enrolled in schools whose principals reported that the school's capacity to provide instruction is hindered at least to some extent by teachers not being well-prepared for class (Figure 3.9 and Table 3.29). In the most advantaged schools, 8% of students had principals who so reported, only about half as many (15%) as in the most disadvantaged schools. In 18 of 71 education systems, principals in disadvantaged schools were more likely than their counterparts in advantaged schools to report that teachers are not well-prepared for class. In B-S-J-G (China), the share of students enrolled in schools whose principal reported that teachers are not well-prepared for classes was about 30% in advantaged schools, but about 71% in disadvantaged schools; in the United States, this share was only about 3% in advantaged schools, but almost 30% in disadvantaged schools. In Belgium, Brazil and France, about 10% of students in the most advantaged schools were exposed to underprepared teachers, according to school principals, but the share was about three times larger in the most disadvantaged schools. In contrast, in 50 countries and economies, no significant difference between advantaged and disadvantaged schools was observed.

Figure 3.9 provides a graphic summary of how teachers are allocated between the most- and the least-advantaged schools, using a range of objective and subjective indicators of teacher qualification and preparation. Regardless of the indicator considered, there are few education systems that appear to compensate student disadvantage by allocating better-qualified or more effective teachers to schools serving disadvantaged students. In a substantial number of countries/economies, principals and teachers reported that teachers in the most-advantaged schools are better-qualified or -prepared than their counterparts in the least-advantaged schools.

Box 3.3 **Teacher quality in rural and urban schools**

Objective and subjective indicators of teacher quality can also be compared across rural and urban schools in the 63 countries and economies where these school categories are relevant. Rural schools are schools located in rural areas or villages with fewer than 3 000 people, while urban schools are schools located in cities with over 100 000 people.

On average across OECD countries, there was no significant difference between rural and urban schools in the share of fully certified teachers (Table 3.13). Yet in 13 countries and economies, urban schools employed larger shares of fully certified teachers than rural schools, with the largest differences observed in Indonesia, Kosovo, Turkey and the United Kingdom. The opposite pattern was observed in 9 countries and economies, with the largest differences observed in Mexico and the United Arab Emirates.

But when considering the qualifications of science teachers as opposed to those of all teachers, substantial differences between urban and rural schools emerge. On average across OECD countries, urban schools employed larger shares of fully certified science teachers and science teachers with a major in science (Tables 3.13 and 3.15). This might suggest that

…

rural schools have greater difficulty in attracting the most skilled teachers in certain school subjects, such as science, where the supply of qualified teachers is perhaps more scarce and more sensitive to differences in salaries and working conditions, given the many other careers that science graduates can pursue.

On average across the education systems that distributed the teacher questionnaire, urban schools employed more experienced teachers and suffer less teacher turnover (among non-science teachers) than rural schools (Tables 3.17, 3.18, 3.19 and 3.20). This indicates that, on average, rural schools find it harder to retain teachers, perhaps because of inaccessibility, longer commutes, lack of school resources, or poorer-quality professional equipment. Principals and teachers in rural schools were also more likely to report that a lack of teaching staff or inadequate or poorly qualified teachers hinder the school's capacity to provide instruction (Tables 3.5, 3.7, 3.8, 3.25, 3.27 and 3.28).

TEACHER QUANTITY OR TEACHER QUALITY? HOW EDUCATION SYSTEMS COMPENSATE FOR STUDENT DISADVANTAGE

Countries can compensate for student disadvantage by investing more teacher resources and/or allocating better-qualified teachers to high-need schools. Figures 3.10 and 3.11 show the extent to which education systems make use of each lever, separately and in combination. The figures map an indicator of compensation through teacher quantity – measured by smaller classes and/or lower student-teacher ratios in disadvantaged schools compared to advantaged schools – with an indicator of compensation through teacher quality – measured in Figure 3.10 by a larger proportion of fully certified teachers, and/or a greater proportion of science teachers with a major in science, and in Figure 3.11 by teachers' average years of experience in the profession (available for 20 education systems only).

Nine distinct profiles emerge from these figures by crossing three levels of compensation through quantity, and three levels of compensation through quality of teacher resources. According to the most common profile (the middle right cell), countries allocate more teachers to underserved schools, without significantly or clearly investing in better teacher quality. This profile includes 21 out of 69 education systems in Figure 3.10 (30 out of 70 systems, when considering public and private-government dependent schools only, as in Panel B), and 8 out of 20 education systems in Figure 3.11.

The next most common pattern in Figure 3.10 includes 18 education systems (19 when considering public and private, government-dependent schools only, as in Panel B). The education systems in the bottom right cell provide more teacher resources to high-need schools, but teachers in these schools are less qualified and/or less frequently certified, on average. Countries and economies that fit this profile compensate for school disadvantage through teaching quantity, but do so at the cost of teaching quality. This profile corresponds to several European countries, including Belgium, the Czech Republic, France, Italy and the Netherlands, which have implemented policies channelling more teacher resources to high-need schools and areas; but the side effect is that qualified teachers are deterred from teaching in these schools.

Figure 3.10 [1/2] ■ Teacher quantity and teacher qualifications in disadvantaged schools

Results based on principals' reports

Full compensation for student disadvantage through more ***and*** better qualified/certified teachers

Partial compensation for student disadvantage through more ***or*** better qualified/certified teachers

Incomplete compensation for student disadvantage through more ***but*** less qualified/certified teachers, or through more qualified/certified ***but*** fewer teachers

No compensation for student disadvantage

A All schools

Disadvantaged schools[1] have…	… fewer teachers per student or larger classes than advantaged schools	… a similar[2] student-teacher ratio and class size as advantaged schools	... more teachers per student or smaller classes than advantaged schools
... a greater proportion of fully certified teachers, or of science teachers with a major in science, than advantaged schools	United Arab Emirates	United States	Kosovo, Peru
… a similar[2] proportion of fully certified teachers and of science teachers with a major in science as advantaged schools		Albania, Algeria, Chile*, Colombia, Dominican Republic, Greece, Jordan, Lebanon, Montenegro, New Zealand, Tunisia, Turkey, Viet Nam	Canada, Croatia, Denmark**, Estonia, Finland, Germany, Hong Kong (China), Hungary**, Ireland, Israel, Japan***, Korea, Latvia, Lithuania, Malta, Mexico, Poland, Romania, Spain, Sweden, Thailand
… a smaller proportion of fully certified teachers or of science teachers with a major in science than advantaged schools	Australia, Qatar, Singapore	Austria, Brazil, B-S-J-G (China), Bulgaria, CABA (Argentina), Costa Rica, FYROM, Switzerland, United Kingdom, Uruguay	Belgium, Czech Republic, France, Georgia, Iceland, Indonesia, Italy***, Luxembourg, Macao (China), Moldova, Netherlands, Norway, Portugal, Russia, Slovak Republic, Slovenia, Chinese Taipei, Trinidad and Tobago

1. Advantaged schools are schools in the top quarter of school socio-economic profile; disadvantaged schools are schools in the bottom quarter of school socio-economic profile.

2. Education systems where the two indicators considered show significant differences in opposing directions are also classified in this category.

Notes: All analyses are restricted to schools with the modal ISCED level for 15-year-old students.

Panel B considers only public and private government-dependent schools; the distinction is not available for Israel. Samples for Massachusetts and North Carolina (United States) are restricted to public schools by design.

Differences in class size of less than two students and of student-teacher ratios of less than one student are not reported as significant; differences in proportions of science teachers with a major in science and of fully certified teachers of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

*In Chile the question about the certification of teachers was adapted as "authorised or enabled by the Ministry of Education".

**The proportion of fully certified teachers is not available in Denmark and Hungary.

***The proportion of science teachers with a major in science is not available in Italy and Japan.

Source: OECD PISA 2015 Database, Tables 3.1, 3.2, 3.3, 3.4, 3.11, 3.12, 3.13 and 3.14.

StatLink http://dx.doi.org/10.1787/888933740649

Figure 3.10 [2/2] ■ Teacher quantity and teacher qualifications in disadvantaged schools

Results based on principals' reports

Full compensation for student disadvantage through more ***and*** better qualified/certified teachers

Partial compensation for student disadvantage through more ***or*** better qualified/certified teachers

Incomplete compensation for student disadvantage through more ***but*** less qualified/certified teachers, or through more qualified/certified ***but*** fewer teachers

No compensation for student disadvantage

B **Public and government-dependent private schools only**

Disadvantaged schools[1] have…	… fewer teachers per student or larger classes than advantaged schools	… a similar[2] student-teacher ratio and class size as advantaged schools	... more teachers per student or smaller classes than advantaged schools
... a greater proportion of fully certified teachers, or of science teachers with a major in science, than advantaged schools		Singapore, United Arab Emirates	Kosovo
… a similar[2] proportion of fully certified teachers and of science teachers with a major in science as advantaged schools		Albania, Algeria, Australia, Brazil, CABA (Argentina), Costa Rica, Dominican Republic, Montenegro, Tunisia, Turkey, Viet Nam	Canada, Chile*, Colombia, Croatia, Denmark**, Estonia, Finland, Greece, Hong Kong (China), Hungary**, Ireland, Japan***, Jordan, Korea, Latvia, Lithuania, Malta, Mexico, New Zealand, Peru, Poland, Portugal, Qatar, Romania, Spain, Sweden, Thailand, Trinidad and Tobago, Uruguay, *North Carolina (United States)*
… a smaller proportion of fully certified teachers or of science teachers with a major in science than advantaged schools	B-S-J-G (China)	Austria, FYROM, Macao (China), Switzerland, Chinese Taipei, *Massachusetts (United States)*	Belgium, Bulgaria, Czech Republic, France, Georgia, Germany, Iceland, Indonesia, Italy***, Lebanon, Luxembourg, Moldova, Netherlands, Norway, Russia, Slovak Republic, Slovenia, United Kingdom, United States

1. Advantaged schools are schools in the top quarter of school socio-economic profile; disadvantaged schools are schools in the bottom quarter of school socio-economic profile.

2. Education systems where the two indicators considered show significant differences in opposing directions are also classified in this category.

Notes: All analyses are restricted to schools with the modal ISCED level for 15-year-old students.

Panel B considers only public and private government-dependent schools; the distinction is not available for Israel. Samples for Massachusetts and North Carolina (United States) are restricted to public schools by design.

Differences in class size of less than two students and of student-teacher ratios of less than one student are not reported as significant; differences in proportions of science teachers with a major in science and of fully certified teachers of less than four percentage points are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

*In Chile the question about the certification of teachers was adapted as "authorised or enabled by the Ministry of Education".

**The proportion of fully certified teachers is not available in Denmark and Hungary.

***The proportion of science teachers with a major in science is not available in Italy and Japan.

Source: OECD PISA 2015 Database, Tables 3.1, 3.2, 3.3, 3.4, 3.11, 3.12, 3.13 and 3.14.

StatLink http://dx.doi.org/10.1787/888933740649

Figure 3.11 ■ Teacher quantity and experience in disadvantaged schools

Results based on principals' and non-science teachers' reports

Full compensation for student disadvantage through more ***and*** more experienced teachers

Partial compensation for student disadvantage through more and equally experienced teachers

Incomplete compensation for student disadvantage through more ***but*** less experienced teachers, or through more experienced ***but*** fewer teachers

No compensation for student disadvantage

Disadvantaged schools[1] have…	… fewer teachers per student or larger classes than advantaged schools	… a similar[2] student-teacher ratio and class size as advantaged schools	... more teachers per student or smaller classes than advantaged schools
… more experienced teachers, on average	United Arab Emirates		Hong Kong (China)
… similarly[2] experienced teachers, on average		Chile, Brazil, B-S-J-G (China), Colombia, *Massachusetts (United States)**	Czech Republic, Germany, Korea, Spain, Macao (China), Peru, Chinese Taipei, *North Carolina (United States)**
… less experienced teachers, on average	Australia	United States, Dominican Republic	Italy

1. Advantaged schools are schools in the top quarter of school socio-economic profile; disadvantaged schools are schools in the bottom quarter of school socio-economic profile.

2. Education systems where the two indicators considered show significant differences in opposing directions are also classified in this category.

Notes: All analyses are restricted to schools with the modal ISCED level for 15-year-old students.

*Samples for Massachusetts and North Carolina (United States) are restricted to public schools.

Differences in class size of less than two students and of student-teacher ratios of less than one student are not reported as significant. Larger differences are reported as significant based on the estimated standard errors.

Source: OECD PISA 2015 Database, Tables 3.1, 3.3 and 3.18.

StatLink http://dx.doi.org/10.1787/888933740668

Another relatively common profile (the bottom middle cell) involves employing less-qualified teachers in disadvantaged schools, with no significant differences in teacher quantity. This profile groups 10 education systems, including Austria, Switzerland and the United Kingdom. When teacher quality is indicated by experience, as in Figure 3.11, the United States also belongs to this group.[13]

The last relatively common profile (the middle cell in Figure 3.10) groups education systems that do not significantly or clearly allocate more or better-qualified teachers to disadvantaged schools. Among OECD countries, and when considering all types of schools, Chile, Greece, New Zealand and Turkey belong to this group; when considering public and private government-dependent schools only, Australia and Turkey belong to this group.

Some rare exceptions stand out from the figures. In Kosovo and Peru, disadvantaged schools employ both more and better-qualified teachers (Figure 3.10); the same is true in Ireland (see Box 1.2 in Chapter 1), although the difference in teachers' qualifications is small, and therefore not considered significant. Hong Kong (China) similarly allocates more, and more-experienced, teachers to the most disadvantaged schools (Figure 3.11). By contrast, in Australia, disadvantaged

schools employ fewer, less-qualified and less-experienced teachers than the most advantaged schools do; although this is mostly driven by private, independent schools, which tend to have more advantaged students. Similarly, in Singapore, disadvantaged schools have larger classes than advantaged schools, but the difference is in large part driven by private independent schools, which are predominantly schools catering to international students. Among public and government-dependent private schools (the large majority of schools in Singapore), there is, in fact, no significant difference in class sizes between disadvantaged and advantaged schools, and disadvantaged schools have a larger proportion of fully certified teachers.

As indicated in the introduction of this chapter, these results need to be interpreted with caution as comparisons between advantaged and disadvantaged schools are drawn at the system level. For example, this may explain why the four Chinese entities as a whole – Beijing-Shanghai-Jiangsu-Guangdong – are not found to compensate for student disadvantage in any dimension, despite the existence of equitable teacher-allocation policies within some provinces (OECD, 2016[54]). The resource gaps observed between advantaged and disadvantaged schools in B-S-J-G may reflect differences between the four entities more than differences between schools within these entities.

HOW IS TEACHER SORTING RELATED TO SOCIO-ECONOMIC INEQUALITY IN STUDENT PERFORMANCE?

The relationships between socio-economic inequality in student performance and stratification of the education systems into grade levels, study programmes or school types have been repeatedly analysed (OECD, 2016, pp. 201-240[29]; Van de Werfhorst and Mijs, 2010[2]). Much less attention has been given to the relationship between teacher sorting across schools and socio-economic inequality in student performance. PISA offers a unique opportunity to compare this relationship across countries. Data from PISA can also be used to identify the teacher characteristics that are equally found in advantaged and disadvantaged schools in countries with more equitable education systems.

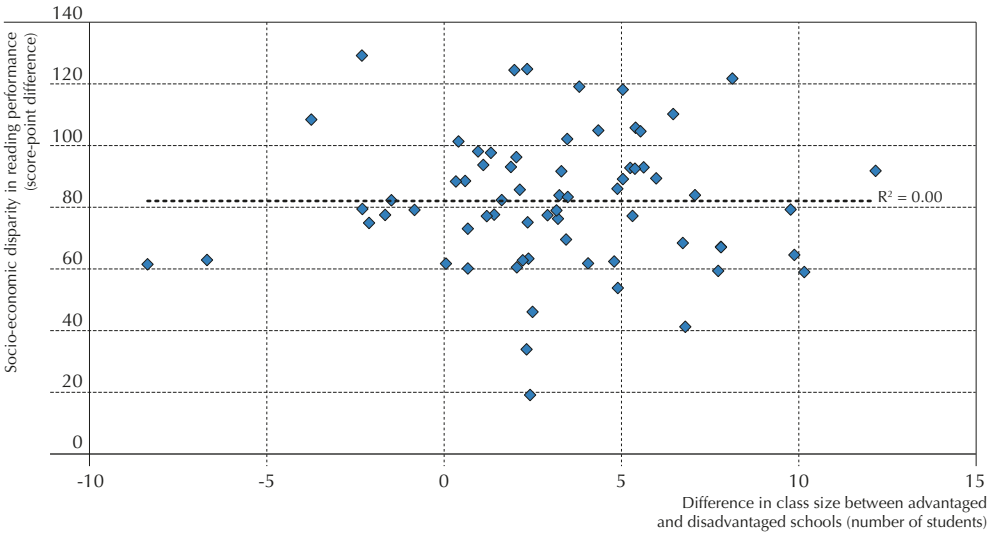
This section correlates the difference between advantaged and disadvantaged schools in the characteristics of their teacher workforce with the average performance gap between advantaged and disadvantaged students,[14] a system-level indicator of socio-economic inequality. In the following sections, teacher-sorting indicators that refer to all teachers, or to non-science teachers in particular, are related to the performance gap in reading; while teacher-sorting indicators that refer to science teachers only are related to the performance gap in science.

Teacher shortage and equity in student performance

The previous sections highlighted a tendency to compensate for student disadvantage by allocating more teachers to high-need schools, through smaller classes or lower student-teacher ratios. However, no system-level association is observed between such compensation policies and equity in student performance. For example, the linear correlation coefficient – a measure of the strength and direction of the association between two variables – is close to 0 ($r = 0.00$) between differences in class size and performance gaps in reading.[15] This means that, in countries that compensate for student disadvantage by reducing class size, there are not, on average, smaller or larger gaps in performance, compared to countries where class size is not related to students' socio-economic status, or where classes are larger in disadvantaged schools than in advantaged schools (Figure 3.12).

Figure 3.12 ■ **Relationship between socio-economic differences in reading performance and in class size**

Difference in reading performance between students in the top quarter and students in the bottom quarter of socio-economic status and average difference between advantaged and disadvantaged schools in the size of language-of-instruction classes



Note: The dotted line indicates a non-significant relationship. Each diamond represents a country/economy.
Source: OECD PISA 2015 Database, Table 3.1; *OECD (2016), PISA 2015 Results (Volume I): Excellence and Equity in Education,* Table I.6.3b, http://dx.doi.org/10.1787/888933433214.
StatLink http://dx.doi.org/10.1787/888933740687

This does not imply that compensation through allocating additional teaching resources cannot reduce inequalities in student performance related to socio-economic status; but it might indicate that, in practice, current efforts are not sufficient to compensate for student disadvantage, or that any positive effects are undermined if such policies also result in differences between advantaged and disadvantaged schools in the average quality of teachers. Indeed, recent reviews of the impact of class size on achievement show positive effects of smaller classes in several countries (France, Israel, Norway, Sweden and the United States), particularly in primary grades, and after controlling for all confounding factors (Bouguen, Grenet and Gurgand, 2017[55]). However, Figure 3.10 shows that several countries that compensate disadvantaged schools with smaller classes or lower student-teacher ratios end up, as an unintended consequence, having less-qualified teachers in the most disadvantaged schools. The combined effect may then explain why policies that focus on the quantity of teachers alone, without considering the quality of teachers, are ineffective in closing performance gaps between advantaged and disadvantaged students.

Results based on teachers' perceptions of teacher shortage in the 18 countries and economies that distributed the PISA 2015 teacher questionnaire provide a complementary perspective on the issue. Wider performance gaps in reading were observed in countries where teachers in disadvantaged schools reported, to a greater extent than teachers in advantaged schools, that the school's capacity

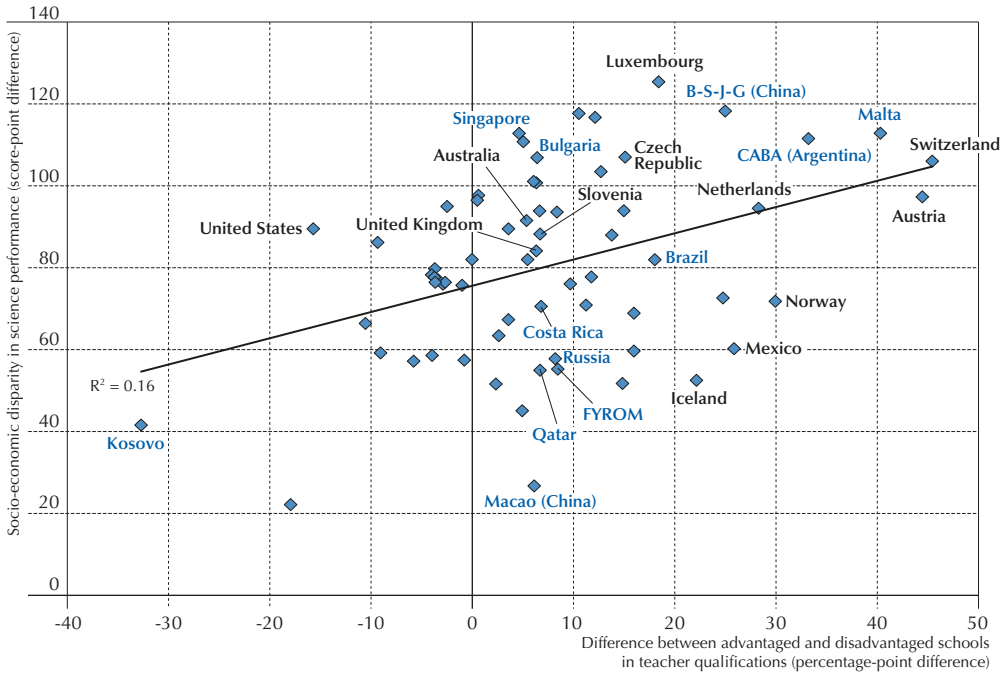
to provide instruction is hindered by a lack of teaching staff (r=0.42 based on science teachers' reports, r=-0.39 for non-science teachers' reports).[16] This moderate association might reveal that, despite objective indications of additional resources, teachers consider that much more would be needed to compensate for students' difficulties in disadvantaged schools.

Teacher sorting and equity in student performance

Teachers in advantaged and in disadvantaged schools often differ in their qualifications, experience and behaviour, with the most-qualified and -experienced teachers often found in more advantaged schools. This section examines whether teacher sorting based on teacher-quality indicators is related to equity in performance.

Figure 3.13 ■ **Relationship between socio-economic differences in science performance and in teacher qualifications**

Difference in science performance between students in the top quarter and students in the bottom quarter of socio-economic status and average difference between advantaged and disadvantaged schools in the proportion of science teachers with a major in science



Note: Countries named on the chart show a significant difference between advantaged and disadvantaged schools in the proportion of science teachers with a major in science. Countries/economies where the difference is not significant are Albania, Algeria, Belgium, Canada, Chile, Colombia, Denmark, the Dominican Republic, Estonia, Finland, France,Georgia, Germany, Greece, Hong Kong (China), Hungary, Indonesia, Ireland, Israel, Jordan, Korea, Latvia, Lebanon, Lithuania, Moldova, Montenegro, New Zealand, Peru, Poland, Portugal, Romania, the Slovak Republic, Spain, Sweden, Chinese Taipei, Thailand, Trinidad and Tobago, Tunisia, Turkey, the United Arab Emirates, Uruguay and Viet Nam.

Source: OECD PISA 2015 Database, Table 3.11; *OECD (2016), PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.6.3a, http://dx.doi.org/10.1787/888933433214.

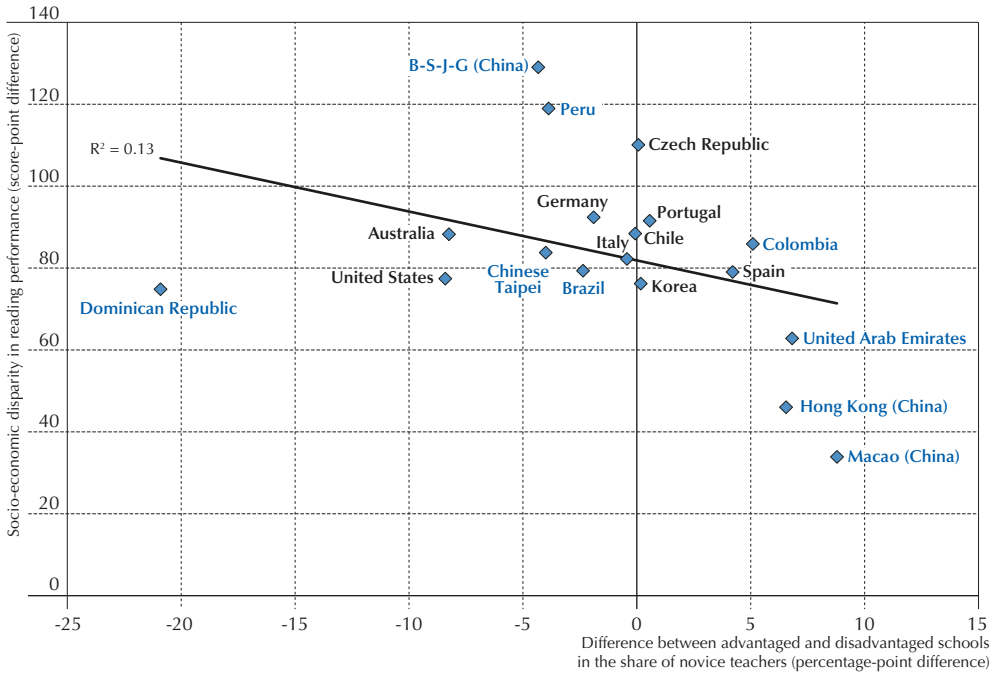
StatLink http://dx.doi.org/10.1787/888933740706

Results show that differences in teachers' initial education and certification are related to socio-economic gaps in performance. On average across all PISA-participating countries and economies, the wider the gap between socio-economically advantaged schools and disadvantaged schools in their science teachers' qualifications (as measured by having a university degree with a major in science), the wider also the difference in science performance between students in the top and bottom quarters of socio-economic status (r = 0.40) (Figure 3.13).[17]

In 18 countries/economies that distributed the optional teacher questionnaire, the degree of sorting of teachers according to their professional experience was also associated with equity in student performance. PISA data show that the wider the difference between advantaged and disadvantaged schools in teachers' experience, the larger the difference in reading performance between students in the top and the bottom quarters of socio-economic status (r = 0.26, based on non-science teachers' reports). In particular, the more unbalanced the distribution of novice teachers (teachers with five years of experience or less), the more unequal the performance of students of varying socio-economic status (r = -0.37) (Figure 3.14).[18]

Figure 3.14 ■ **Relationship between socio-economic differences in reading performance and in the share of novice teachers**

Difference in reading performance between students in the top quarter and students in the bottom quarter of socio-economic status and average difference between advantaged and disadvantaged schools in the proportion of novice non-science teachers



Source: OECD PISA 2015 Database, Table 3.40; OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.6.3b, http://dx.doi.org/10.1787/888933433214.

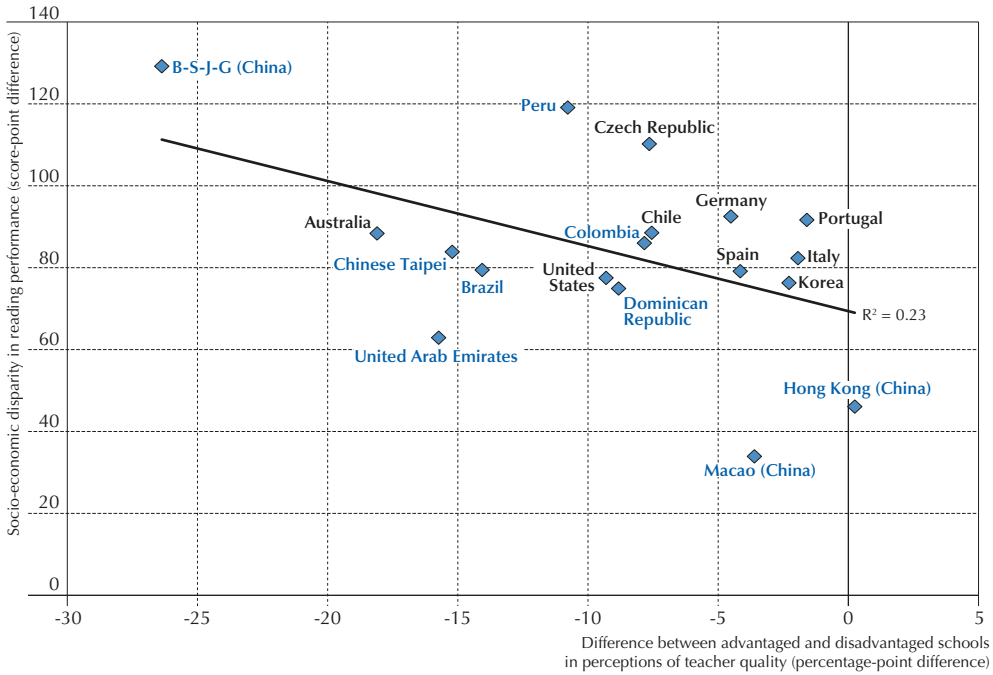
StatLink http://dx.doi.org/10.1787/888933740725

Past research indicates that more-experienced teachers are more effective, and that differences in teacher effectiveness might be particularly marked in the first years after entering the teacher profession, because the least-effective teachers tend to quit the profession more than more-effective teachers do. That not only creates a more select pool of teachers (Hanushek, 2006[56]; Hanushek, Rivkin and Schiman, 2016[51]), teachers also gain valuable skills on the job and through formal professional-development opportunities (Wiswall, 2013[57]; Papay and Kraft, 2015[58]; Kraft and Papay, 2014[59]; Harris and Sass, 2011[43]).

Countries also tend to have wider gaps in reading performance related to socio-economic status if teachers in disadvantaged schools are more likely than teachers in advantaged schools to report that inadequate or poorly qualified teachers limit the quality of instruction in their school (r=-0.48) (Fiure 3.15).[19]

Figure 3.15 ■ **Relationship between socio-economic differences in reading performance and in perceptions of teacher quality**

Difference in reading performance between students in the top quarter and students in the bottom quarter of socio-economic status and average difference between advantaged and disadvantaged schools in the proportion of non-science teachers who reported that their school's capacity to provide instruction is hindered by inadequate or poorly qualified teaching staff at least to some extent



Source: OECD PISA 2015 Database, Table 3.28; OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Table I.6.3b, http://dx.doi.org/10.1787/888933433214.

StatLink http://dx.doi.org/10.1787/888933740744

Thus, on average across PISA-participating education systems, both objective and subjective indicators of teacher quality showed that an unequal distribution of quality teachers across schools might be associated with differences in performance related to students' socio-economic status. In many countries, more-qualified and -experienced teachers were less often found in disadvantaged schools; and the more pervasive this situation, the larger the difference in student performance related to socio-economic status in the country. This suggests that any teacher policy that aims to tackle student disadvantage should strive to allocate quality teachers, and not just more teachers, to underserved students.

HOW CAN TEACHER POLICIES PROMOTE GREATER EQUITY IN EDUCATION?

The last section of this chapter concludes by highlighting teacher policies, identified through PISA and OECD education data, that might lead to more equitable education systems. Teacher policies that are associated with a more equitable sorting of teachers across schools are examined first; then, the section concludes by examining how teachers working in high-need schools can be supported, when the sorting of teachers cannot be altered.

Teacher policies and teacher sorting

More often than not, countries struggle to attract and retain qualified and experienced teachers in high-need schools.

Several education systems have introduced financial incentives to compensate teachers for working in challenging circumstances. However, there is little evidence about the effect of such measures on teacher allocation, and results are mixed. Researchers in the United States found that wage bonuses can reduce turnover rates in disadvantaged schools. Clotfelter et al. (2008[22]) evaluated the effect of an experiment carried out in North Carolina in the early 2000s. Certified mathematics, science and special education teachers were awarded an annual bonus if they worked in public secondary schools with high poverty rates or low academic performance. They estimated that this bonus pay led to a reduction in mean turnover rates, particularly due to greater retention of experienced teachers.

Hanushek, Rivkin and Schiman (2016) also concluded that teacher evaluation and compensation systems that link pay increases to student performance might be successful in retaining, supporting and attracting more effective teachers, especially in disadvantaged schools. In the early 2000s, teachers in France received bonuses and additional career incentives for teaching in "priority education zones". But these incentives attracted mostly inexperienced teachers, and had no effect on turnover rates (Bénabou, Kramarz and Prost, 2009[20]; Prost, 2013[12]). Such contrasting results might indicate that financial incentives work differently in "career-based" systems of teacher employment, where teachers are tenured civil servants and incentives might be perceived as temporary, compared to more decentralised "position-based" systems, where teachers are often employed by the schools themselves and pay increases are perceived as permanent (OECD, 2005[21]).

In fact, PISA data tend to show that greater school autonomy for managing teachers tends to produce more equitable sorting of teachers across schools. For example, the higher the percentage of students in schools whose principals reported considerable responsibility for determining teachers' salary increases, the narrower the difference in experience between teachers in

advantaged schools and those in disadvantaged schools (r=–0.52). Similarly, in countries with greater school autonomy in determining teachers' salary increases, teachers in advantaged schools had perceptions similar to those of teachers in disadvantaged schools about the extent to which teacher shortages affect instruction in their schools (r=0.61). Correlations were similar for other aspects of teacher management, such as selecting teachers for hire, firing teachers, or establishing teachers' starting salaries, showing that more decentralised human-resource management might produce more equitable allocations of teachers across schools (Figure 3.16).

One reason why this may be the case is that schools with greater autonomy in selecting teachers and determining their salaries might have more tools to attract, and especially to retain, effective teachers, through financial incentives (career prospects, salary increases, or tailored compensation for challenging working conditions), but also by offering coaching and mentoring support to help teachers succeed. These findings are consistent with research that shows a stronger, positive effect of school competition on teacher quality in disadvantaged schools (Hanushek and Rivkin, 2003[60]). Autonomy appears to be particularly beneficial in systems with high levels of public accountability for schools (OECD, 2013, pp. 52-53[61]).

In addition to financial incentives, and particularly in countries with more centralised teacher allocation and compensation mechanisms, offering formal training and mentoring, or more informal support, might help disadvantaged schools attract and develop talented teachers. The last section describes whether teachers working in these schools actually receive more support.

Providing support to teachers working in disadvantaged schools

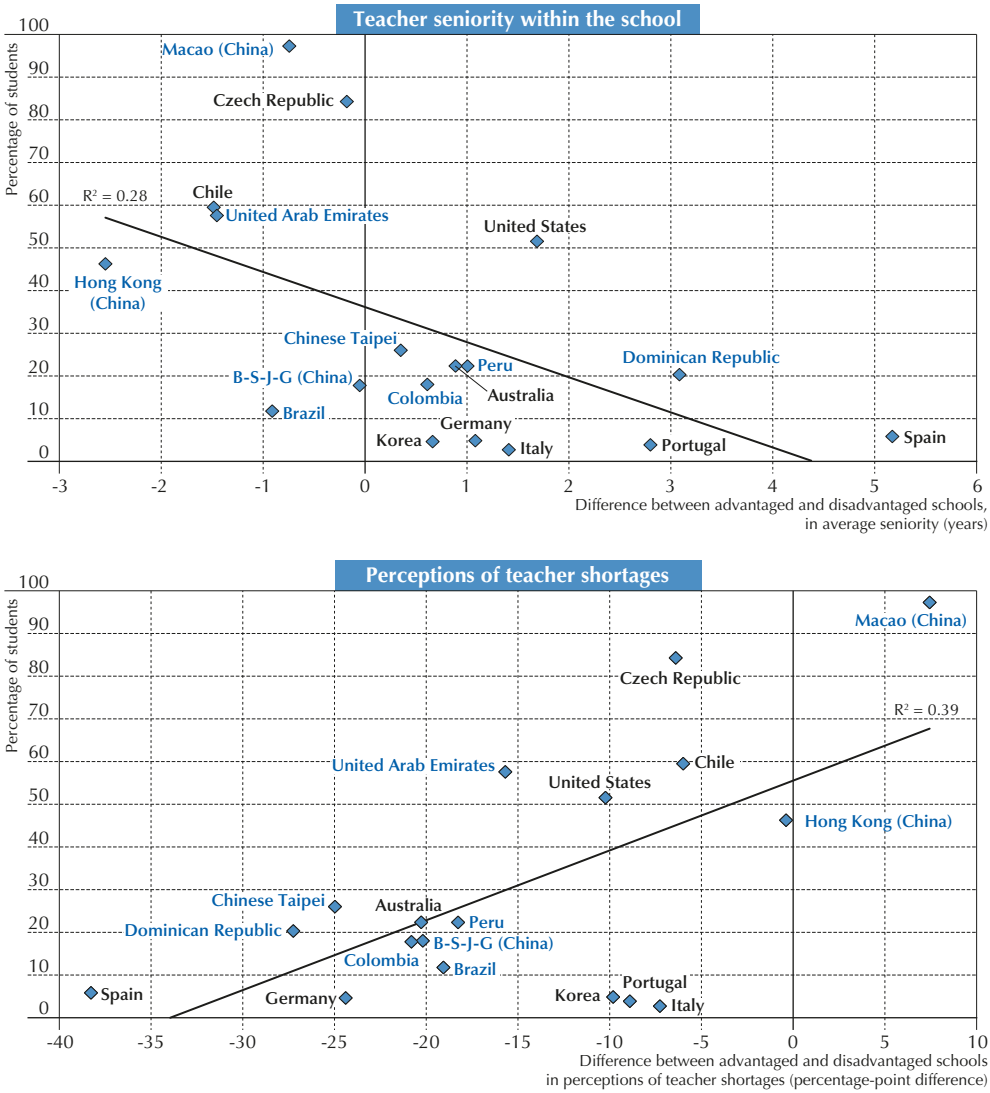
Previous results have shown that teachers working in disadvantaged schools tend to be less prepared and experienced. This section examines whether teachers in disadvantaged schools receive additional support to compensate for their relative lack of qualifications. Teacher support can take the form of participation in a professional-development programme, in a network of teachers formed specifically for the professional development of teachers, in a formal mentoring or peer-observation scheme at the school level, or of informal dialogue with colleagues on how to improve their teaching. Teacher support can also be an aspect of school leadership, as part of transformational practices.

PISA measures teachers' participation in professional-development programmes through principals' reports, whereas the remaining training and support activities are only measured through teachers' responses to the (optional) teacher questionnaire.

On average across OECD countries, principals reported that 51% of teachers had attended a programme of professional development during the three months prior to the survey, and this share was not significantly different whether focusing on teachers in advantaged or disadvantaged schools (OECD, 2016, p. 200 and Table II.6.18[29]). However, in six countries and economies – France, FYROM, Germany, Macao (China), Montenegro and Switzerland – more teachers in the most disadvantaged quarter of schools had participated in professional-development activities than had teachers in the most advantaged quarter of schools. The opposite – where significantly more teachers in advantaged schools than in disadvantaged schools had participated in professional-development activities – was found in 11 countries and economies, namely Algeria, Georgia, Iceland, Kosovo, Luxembourg, Malta, Mexico, Slovenia, Spain, Trinidad and Tobago, and Turkey.

Figure 3.16 ■ **School responsibility for determining teachers' salaries and teacher sorting**

How the differences between advantaged and disadvantaged schools in non-science-teachers' average years of seniority within the school and in the proportion of non-science teachers who reported that the school's capacity to provide instruction is hindered by a lack of teaching staff at least to some extent relate to the percentage of students in schools whose principal or the school governing board has considerable responsibility for determining teachers' salary increases



Source: OECD PISA 2015 Database, Tables 2.8, 3.8 and 3.20.

StatLink http://dx.doi.org/10.1787/888933740763

PISA also asked teachers whether, over the previous three months, they had participated in certain types of professional-development activities. On average across 18 countries and economies, 57% of non-science teachers reported that they had participated in a network of teachers formed specifically for the professional development of teachers, 62% in a formal mentoring or peer-observation scheme at the school level, and 95% had engaged in informal dialogue with colleagues on how to improve their teaching (Tables 3.31, 3.33 and 3.35).

However none of these activities – networking, mentoring, peer observation or coaching – was more frequently offered in high-needs schools, on average across countries, and in most countries.[20] In fact, mentoring, coaching and peer observation were more frequently offered in more-advantaged schools in Chile and Colombia (for non-science teachers), and in Spain (for both science and non-science teachers). The opposite pattern was observed only in the Dominican Republic, Macao (China) and the United Arab Emirates, and in Hong Kong (China) for science teachers only. Countries in which teachers in advantaged schools had participated more in mentoring, coaching or peer-observation activities than had teachers in disadvantaged schools tended to have greater differences in student performance related to socio-economic status (r = 0.45 for reading gaps).

Principals can play an important role in supporting teacher effectiveness. There has been little quantitative research conducted on the distribution of quality principals across schools with different socio-economic profiles (Urick and Bowers, 2014[62]). Yet, effective leadership can serve multiple goals of schools and particularly struggling schools, such as improving student achievement or retaining teachers.

To measure principals' quality, PISA 2015 asked non-science teachers the extent to which they agree with the five following statements regarding their school principal: the principal tries to achieve consensus with all staff when defining priorities and goals in school; the principal is aware of the teachers' needs; the principal inspires new ideas for [their] professional learning; the principal treats teaching staff as professionals; and the principal ensures the teachers' involvement in decision making. The index of transformational leadership combines these five items to measure the extent to which teachers view their principal as a transformational leader. Higher values on this index indicate stronger transformational leadership. To examine how principals are sorted across schools, mean values of the index for schools in the bottom and the top quarters of socio-economic status can be compared (Table 3.37).

In most education systems that distributed the teacher questionnaire, there was no significant difference between advantaged and disadvantaged schools in the level of transformational leadership of their principals, according to teachers. However, in 3 out of 20 education systems – Colombia, Macao (China) and Peru – teachers in advantaged schools expressed a higher opinion of their school leader than did teachers in disadvantaged schools. By contrast, in Spain and the United Arab Emirates, teachers in disadvantaged schools expressed a better opinion of their school leaders than did teachers in advantaged schools.

Notes

1. While inequality refers simply to the observed variation in a particular characteristic, equity is a normative concept, informed by an idea of social justice. In this chapter, inequity refers to a situation in which the unequal access to educational resources across groups of students (defined by their family background or demographic characteristics) reinforces their initial advantage or disadvantage.

2. Population coverage is too small to ensure comparability of results for Argentina, Kazakhstan and Malaysia. Their results are reported in tables available on line (see Annex B) but not discussed in the body of the chapter. In contrast, results for public schools in Massachusetts and North Carolina (United States), which constitute separate samples from the national sample for the United States, are discussed throughout the chapter and reported in all tables. However, these two samples do not contribute to the international averages.

3. The PISA technical standards were met in all countries and subnational entities that distributed the PISA 2015 teacher questionnaire, except Malaysia. In this country, the weighted response rate among the initially sampled schools (51%) fell well short of the standard PISA response rate of 85%. Therefore, the results might not be comparable to those of other countries. Malaysia was excluded from the country averages and country-level correlations, which were computed using data from the remaining 20 countries and subnational jurisdictions that distributed the optional teacher questionnaire.

4. The "modal ISCED level" is defined here as a level attended by at least one-third of the PISA sample. In Albania, Argentina, B-S-J-G (China), Colombia, Costa Rica, the Czech Republic, Indonesia, Kazakhstan, Luxembourg, Macao (China), Mexico, Portugal, the Slovak Republic, Chinese Taipei, Trinidad and Tobago, Tunisia and Uruguay, both lower secondary (ISCED level 2) and upper secondary (ISCED level 3) schools meet this definition. In all other countries, analyses are restricted to either lower secondary or upper secondary schools.

5. Language of instruction refers to the language in which students from the school took the PISA test.

6. Throughout the text and figures, differences in class size of fewer than two students are not reported as significant; larger differences are reported as significant based on the estimated standard errors.

7. Throughout the text and figures, differences in student-teacher ratios of fewer than one student per teacher are not reported as significant; larger differences are reported as significant based on the estimated standard errors.

8. In order to compute averages and shares based on teacher responses, teacher weights were generated so that the sum of teacher weights within each school is equal to the sum of student weights within the same school. All science teachers within a school have the same weight, as do all non-science teachers within a school. Data for science and non-science teachers are analysed separately, as these define two distinct and non-overlapping populations for sampling.

9. These perceptions can reflect a lack of certain types of teachers only, such as the lack of teachers of a particular subject.

10. Overall, the research literature, based mostly on data from the United States, has found mixed results about the effects of teacher observable characteristics – such as their tertiary degree, their certification status or their experience – on student achievement. Most studies report positive effects of experience, although these are sometimes described as "weak" or as limited to the first few years. Many studies further find positive effects of teacher certifications or licenses on student achievement growth (Clotfelter, Ladd and Vigdor, 2007[37]; Goldhaber and Brewer, 2000[66]; Clotfelter, Ladd and Vigdor, 2010[38]), with some studies, however, reporting only small effects (Kane, Rockoff and Staiger, 2008[67]). Teachers' tertiary qualifications, such as holding a college major in education or a master's degree, are, in contrast, often found to be unrelated to students' performance in school (Buddin and Zamarro, 2009[68]; Chingos and Peterson, 2011[69]).

11. Throughout the text and figures, differences in the proportion of fully certified teachers, of fully certified science teachers, and of science teachers with a major in science of less than four percentage points are not reported as significant; larger differences are reported as significant based on the estimated standard errors.

12. Results for two sub-national jurisdictions in the United States – Massachusetts (public schools) and North Carolina (public schools) – are not included in the international average reported in this chapter.

13. The classification of the United States education system as a whole varies significantly depending on whether private independent schools, which tend to be among the most advantaged schools, are included in the analyses.

14. Advantaged students are students in the top national quarter of the index of economic, social and cultural status (ESCS); disadvantaged students are students in the bottom national quarter of this index.

15. "r" refers to the Pearson correlation coefficient, a measure of the linear association between two variables, which varies between -1 (indicating a perfect inverse relationship between the two variables) and 1 (indicating a perfect linear relationship between two variables). Values close to 0 indicate weak linear relationships. There is also no correlation (r = 0.03) between mean scores in reading and disparities in class size between advantaged and disadvantaged schools.

16. The correlation between the difference in teachers' perceptions of teacher shortage between advantaged and disadvantaged schools and mean performance in reading is also positive: countries where teachers in disadvantaged schools perceive that a lack of teaching staff hinders instruction more than in advantaged schools tend to perform worse (r = 0.53 for science teachers' perceptions; r = 0.34 for non-science teachers' perceptions).

17. The correlation between mean scores in science and disparities in science teachers' qualifications between advantaged and disadvantaged schools is weak (r = 0.21).

18. Countries/economies in which novice teachers are more frequently found in advantaged schools than in disadvantaged schools also tend to have higher mean performance in reading (r = 0.43).

19. The correlation between the difference in teachers' perceptions of teacher shortage between advantaged and disadvantaged schools and mean performance in reading is weak (r = 0.25).

20. These results are consistent with findings from 38 countries and economies that participated in TALIS 2013: no significant difference was found between schools with low concentrations of disadvantaged students and those with high concentrations of disadvantaged students in teachers' participation in network activities (OECD, 2016, p. 97[28]).

References

Abbiati, G., G. Argentin and **T. Gerosa** (2017), "Different Teachers for Different Students? Evidence on Teacher-Student Matching and its Consequences in the Italian Case", pp. 12-58, http://dx.doi.org/10.1429/86375. [13]

Akiba, M., G. LeTendre and **J. Scribner** (2007), "Teacher Quality, Opportunity Gap, and National Achievement in 46 Countries", *Educational Researcher*, Vol. 36/7, pp. 369-387, http://dx.doi.org/10.3102/0013189X07308739. [41]

Allen, R., S. Burgess and **J. Mayo** (2017), "The teacher labour market, teacher turnover and disadvantaged schools: new evidence for England", *Education Economics*, Vol. 26/1, pp. 4-23, http://dx.doi.org/10.1080/09645292.2017.1366425. [9]

Atteberry, A., S. Loeb and **J. Wyckoff** (2016), "Teacher Churning: Reassignment Rates and Implications for Student Achievement", *Educational Evaluation and Policy Analysis*, http://dx.doi.org/10.3102/0162373716659929. [50]

Barbieri, G., C. Rossetti and **P. Sestito** (2013), "Teacher mobility and student learning", *INVALSI Working Papers*, No. 18, INVALSI, www.aiel.it/Old/bacheca/LUISS/papers/rossetti.pdf (accessed on 11 December 2017). [49]

Bénabou, R., F. Kramarz and **C. Prost** (2009), "The French zones d'éducation prioritaire: Much ado about nothing?", *Economics of Education Review*, Vol. 28/3, pp. 345-356, http://dx.doi.org/10.1016/J.ECONEDUREV.2008.04.005. [20]

Bouguen, A., J. Grenet and **M. Gurgand** (2017), "La taille des classes influence-t-elle la reussite scolaire ?", *Les notes de l'IPP*, No. 28, Institut des Politiques Publiques, Paris, www.ipp.eu/wp-content/uploads/2017/09/n28-notesIPP-sept2017.pdf (accessed on 01 December 2017). [55]

Boyd, D. et al. (2008), "The narrowing gap in New York City teacher qualifications and its implications for student achievement in high-poverty schools", *Journal of Policy Analysis and Management*, Vol. 27/4, pp. 793-818, http://dx.doi.org/10.1002/pam.20377. [3]

Buddin, R. and **G. Zamarro** (2009), "Teacher qualifications and student achievement in urban elementary schools", *Journal of Urban Economics*, Vol. 66/2, pp. 103-115, http://dx.doi.org/10.1016/J.JUE.2009.05.001. [65]

Cabezas, V. et al. (2017), "First job and the unequal distribution of primary school teachers: Evidence for the case of Chile", *Teaching and Teacher Education*, Vol. 64, pp. 66-78, http://dx.doi.org/10.1016/J.TATE.2017.01.017. [8]

Caille, J., L. Davezies and **M. Garrouste** (2016), "Les résultats scolaires des collégiens bénéficient-ils des réseaux ambition réussite ?", *Revue économique*, Vol. 67/3, p. 639, http://dx.doi.org/10.3917/reco.673.0639. [34]

Chingos, M. and **P. Peterson** (2011), "It's easier to pick a good teacher than to train one: Familiar and new results on the correlates of teacher effectiveness", *Economics of Education Review*, Vol. 30/3, pp. 449-465, http://dx.doi.org/10.1016/J.ECONEDUREV.2010.12.010. [66]

Clotfelter, C., H. Ladd and **J. Vigdor** (2005), "Who teaches whom? Race and the distribution of novice teachers", *Economics of Education Review*, Vol. 24/4, pp. 377-392, http://dx.doi.org/10.1016/J.ECONEDUREV.2004.06.008. [5]

Clotfelter, C., H. Ladd and **J. Vigdor** (2007), "Teacher credentials and student achievement: Longitudinal analysis with student fixed effects", *Economics of Education Review*, Vol. 26/6, pp. 673-682, http://dx.doi.org/10.1016/J.ECONEDUREV.2007.10.002. [37]

Clotfelter, C. et al. (2008), "Would higher salaries keep teachers in high-poverty schools? Evidence from a policy intervention in North Carolina", *Journal of Public Economics*, Vol. 92/5-6, pp. 1352-1370, http://dx.doi.org/10.1016/J.JPUBECO.2007.07.003. [22]

Clotfelter, C., H. Ladd and **J. Vigdor** (2010), "Teacher Credentials and Student Achievement in High School", *Journal of Human Resources*, Vol. 45/3, pp. 655-681, http://dx.doi.org/10.3368/jhr.45.3.655. [38]

Combe, J., O. Tercieux and **C. Terrier** (2016), "Améliorer la mobilité des enseignants: Un nouvel algorithme ne pénalisant pas les académies les moins attractives", *Éducation et formations* 92, http://cache.media.education.gouv.fr/file/revue_92/08/0/depp-2016-EF-92-Ameliorer-mobilite-enseignants-un-nouvel-algorithme-ne-penalisant-pas-academies-moins-attractives_686080.pdf (accessed on 07 December 2017), pp. 57-75. [10]

Cour des comptes (2017), "Gérer les enseignants autrement - Rapport public thématique", www.ccomptes.fr/sites/default/files/2017-10/20171004-rapport-gerer-enseignants-autrement.pdf (accessed on 07 December 2017). [11]

Croninger, R. et al. (2007), "Teacher qualifications and early learning: Effects of certification, degree, and experience on first-grade student achievement", *Economics of Education Review*, Vol. 26/3, pp. 312-324, http://dx.doi.org/10.1016/j.econedurev.2005.05.008. [46]

Darling-Hammond, L. (2004), "Inequality and the Right to Learn: Access to Qualified Teachers in California's Public Schools", *Teachers College Record*, Vol. 106/10, http://internationalteachercert.wiki.educ.msu.edu/file/view/Darling-Hammond+%282004%29.pdf (accessed on 07 December 2017), pp. 1936-1966. [4]

Davezies, L. and **M. Garrouste** (2014), "More harm than good? Sorting effects in a compensatory education program", *CREST Working Papers*, No. 2014-42, CREST, Paris, http://manongarrouste.fr/sites/default/files/Davezies_Garrouste.pdf (accessed on 11 December 2017). [35]

Dieterle, S. (2015), "Class-size reduction policies and the quality of entering teachers", *Labour Economics*, Vol. 36, pp. 35-47, http://dx.doi.org/10.1016/J.LABECO.2015.07.005. [18]

Donitsa-Schmidt, S. and **R. Zuzovsky** (2016), "Quantitative and qualitative teacher shortage and the turnover phenomenon", *International Journal of Educational Research*, Vol. 77, pp. 83-91, http://dx.doi.org/10.1016/J.IJER.2016.03.005. [16]

Goldhaber, D. and **D. Brewer** (2000), "Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement", *Educational Evaluation and Policy Analysis*, Vol. 22/2, pp. 129-145, http://dx.doi.org/10.3102/01623737022002129. [63]

Goldhaber, D., L. Lavery and **R. Theobald** (2015), "Uneven Playing Field? Assessing the Teacher Quality Gap Between Advantaged and Disadvantaged Students", *Educational Researcher*, Vol. 44/5, pp. 293-307, http://dx.doi.org/10.3102/0013189X15592622. [7]

Goodson, I., S. Moore and **A. Hargreaves** (2006), "Teacher Nostalgia and the Sustainability of Reform: The Generation and Degeneration of Teachers' Missions, Memory, and Meaning", *Educational Administration Quarterly*, Vol. 42/1, pp. 42-61, http://dx.doi.org/10.1177/0013161X05278180. [44]

Hanushek, E. and **S. Rivkin** (2003), "Does Public School Competition Affect Teacher Quality? 1 Does Public School Competition Affect Teacher Quality?", in Hoxby, C. (ed.), *The Economics of School Choice*, University of Chicago Press, Chicago, www.nber.org/chapters/c10084 (accessed on 11 December 2017). [60]

Hanushek, E. (2006), "School Resources", in Hanushek, E. and F. Welch (eds.), *Handbook of the Economics of Education*, Elsevier, http://dx.doi.org/10.1016/S1574-0692(06)02014-9. [56]

Hanushek, E. and **F. Welch** (eds.) (2006), *Teacher Quality*, Elsevier, http://dx.doi.org/10.1016/S1574-0692(06)02018-6. [45]

Hanushek, E. and **S. Rivkin** (2010), *Constrained Job Matching: Does Teacher Job Search Harm Disadvantaged Urban Schools?*, Working Paper No. 15616, National Bureau of Economic Research, Cambridge, MA, http://dx. doi.org/10.3386/w15816. [53]

Hanushek, E., S. Rivkin and **J. Schiman** (2016), "Dynamic effects of teacher turnover on the quality of instruction", *Economics of Education Review*, Vol. 55, pp. 132-148, http://dx.doi.org/10.1016/J.ECONEDUREV.2016.08.004. [51]

Harris, D. and **T. Sass** (2011), "Teacher training, teacher quality and student achievement", *Journal of Public Economics*, Vol. 95/7-8, pp. 798-812, http://dx.doi.org/10.1016/J.JPUBECO.2010.11.009. [43]

Jackson, C., J. Rockoff and **D. Staiger** (2014), "Teacher Effects and Teacher-Related Policies", *Annual Review of Economics*, Vol. 6/1, pp. 801-825, http://dx.doi.org/10.1146/annurev-economics- 080213-040845. [48]

Jepsen, C. and **S. Rivkin** (2009), "Class Size Reduction and Student Achievement", *Journal of Human Resources*, Vol. 44/1, pp. 223-250, http://dx.doi.org/10.3368/jhr.44.1.223. [17]

Kane, T., J. Rockoff and **D. Staiger** (2008), "What does certification tell us about teacher effectiveness? Evidence from New York City", *Economics of Education Review*, Vol. 27/6, pp. 615-631, http://dx.doi.org/10.1016/J.ECONEDUREV.2007.05.005. [64]

Karsten, S. (2006), *Policies for Disadvantaged Children under Scrutiny: The Dutch Policy Compared with Policies in France, England, Flanders and the USA*, Taylor & Francis, Ltd., http://dx.doi.org/10.2307/29727780. [23]

Knight, D.S. (2017), "Are school districts allocating resources equitably? The every student succeeds act, teacher experience gaps, and equitable resource allocation", *Educational Policy,* Advance online publication, http://dx.doi.org/10.1177/0895904817719523. [24]

Kraft, M. and **J. Papay** (2014), "Can Professional Environments in Schools Promote Teacher Development? Explaining Heterogeneity in Returns to Teaching Experience", *Educational Evaluation and Policy Analysis*, Vol. 36/4, pp. 476-500, http://dx.doi.org/10.3102/0162373713519496. [59]

Lankford, H., S. Loeb and **J. Wyckoff** (2002), "Teacher Sorting and the Plight of Urban Schools: A Descriptive Analysis", *Educational Evaluation and Policy Analysis*, Vol. 24/1, pp. 37-62, http://dx.doi.org/10.3102/01623737024001037. [30]

Leigh, A. (2010), "Estimating teacher effectiveness from two-year changes in students' test scores", *Economics of Education Review*, Vol. 29/3, pp. 480-488, http://dx.doi.org/10.1016/J.ECONEDUREV.2009.10.010. [47]

Monk, D. (1994), "Subject area preparation of secondary mathematics and science teachers and student achievement", *Economics of Education Review*, Vol. 13/2, pp. 125-145, http://dx.doi.org/10.1016/0272-7757(94)90003-5. [39]

Mostafa, T. and J. Pál (2018), "Science teachers' satisfaction: Evidence from the PISA 2015 teacher survey", *OECD Education Working Papers*, No. 168, OECD Publishing, Paris, http://dx.doi.org/10.1787/1ecdb4e3-en. [33]

Murnane, R. and **J. Steele** (2007), "What is the problem? The challenge of providing effective teachers for all children.", *The Future of children*, Vol. 17/1, www.ncbi.nlm.nih.gov/pubmed/17407921 (accessed on 07 December 2017), pp. 15-43. [6]

OECD (2005), *Teachers Matter: Attracting, Developing and Retaining Effective Teachers*, OECD Publishing, Paris, http://dx.doi.org/10.1787/19901496. [21]

OECD (2012), *Equity and Quality in Education: Supporting Disadvantaged Students and Schools*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264130852-en. [19]

OECD (2013), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264201156-en. [61]

OECD (2014), *TALIS 2013 Results: An International Perspective on Teaching and Learning*, TALIS, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264196261-en. [27]

OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264266490-en. [1]

OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264267510-en. [29]

OECD (2016), *Education in China: A Snapshot*, www.oecd.org/china/Education-in-China-a-snapshot.pdf (accessed on 12 January 2018). [54]

OECD (2016), *Supporting Teacher Professionalism: Insights from TALIS 2013*, TALIS, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264248601-en. [28]

OECD (2017), *The Funding of School Education*, OECD Publishing, http://dx.doi.org/10.1787/9789264276147-en. [26]

OECD (2017), *PISA 2015 Technical Report*, OECD Publishing, www.oecd.org/pisa/data/2015-technical-report/ (accessed on 31 July 2017). [32]

Özoğlu, M. (2015), "Mobility-Related Teacher Turnover and the Unequal Distribution of Experienced Teachers in Turkey", *Educational Sciences: Theory & Practice*, Vol. 15/4, http://dx.doi.org/10.12738/estp.2015.4.2619. [14]

Papay, J. and **M. Kraft** (2015), "Productivity returns to experience in the teacher labor market: Methodological challenges and new evidence on long-term career improvement", *Journal of Public Economics*, Vol. 130, pp. 105-119, http://dx.doi.org/10.1016/J.JPUBECO.2015.02.008. [58]

Prost, C. (2013), "Teacher Mobility: Can Financial Incentives Help Disadvantaged Schools to Retain Their Teachers?", *Annals of Economics and Statistics,* No. 111/112, pp. 171-191, http://dx.doi.org/10.2307/23646330. [12]

Rivkin, S., E. Hanushek and **J. Kain** (2005), "Teachers, Schools, and Academic Achievement", *Econometrica*, Vol. 73/2, pp. 417-458, http://dx.doi.org/10.1111/j.1468-0262.2005.00584.x. [15]

Rockoff, J. (2004), "The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data", *American Economic Review*, Vol. 94/2, pp. 247-252, http://dx.doi.org/10.1257/0002828041302244. [42]

Ronfeldt, M. and **M. Reininger** (2012), "More or better student teaching?", *Teaching and Teacher Education*, Vol. 28/8, pp. 1091-1106, http://dx.doi.org/10.1016/J.TATE.2012.06.003. [40]

Ronfeldt, M., S. Loeb and **J. Wyckoff** (2013), "How Teacher Turnover Harms Student Achievement", *American Educational Research Journal*, Vol. 50/1, http://dx.doi.org/10.3102/0002831212463813. [52]

Steele, J. et al. (2015), "The distribution and mobility of effective teachers: Evidence from a large, urban school district", *Economics of Education Review*, Vol. 48, http://dx.doi.org/10.1016/j.econedurev.2015.05.009. [25]

UNESCO (2015), *Education for All 2000-2015: Achievements and Challenges*, UNESCO Publishing, http://unesdoc.unesco.org/images/0023/002322/232205e.pdf (accessed on 20 December 2017). [31]

Urick, A. and **A. Bowers** (2014), "What Are the Different Types of Principals Across the United States? A Latent Class Analysis of Principal Perception of Leadership", *Educational Administration Quarterly*, Vol. 50/1, pp. 96-134, http://dx.doi.org/10.1177/0013161X13489019. [62]

Van de Werfhorst, H. and **J. Mijs** (2010), "Achievement Inequality and the Institutional Structure of Educational Systems: A Comparative Perspective", *Annu. Rev. Sociol*, Vol. 36, pp. 407-28, http://dx.doi.org/10.1146/annurev.soc.012809.102538. [2]

Wiswall, M. (2013), "The dynamics of teacher quality", *Journal of Public Economics*, Vol. 100, pp. 61-78, http://dx.doi.org/10.1016/J.JPUBECO.2013.01.006. [57]

4

Who aspires to a career in teaching?

This chapter examines the characteristics of 15-year-old students who expect to work as teachers, and how these changed between 2006 and 2015. It also explores how the number and type of students who aspire to a career in teaching relates to teachers' salaries, the social status of the teaching profession in the country, and teachers' working conditions.

Note regarding B-S-J-G (China)
B-S-J-G (China) refers to the four PISA participating China provinces : Beijing, Shanghai, Jiangsu, Guangdong.

Note regarding CABA (Argentina)
CABA (Argentina) refers to the Ciudad Autónoma de Buenos Aires, Argentina.

Note regarding FYROM
FYROM refers to the Former Yugoslav Republic of Macedonia.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

A growing awareness that the quality of schooling critically depends on teachers' skills has led to mounting concerns among policy makers about the difficulty of attracting high-achieving and motivated candidates into the teaching profession (Bruns and Luque, 2015[1]). Across PISA-participating countries, many school principals reported that a shortage of high-quality teachers hinders their schools' ability to provide quality instruction, especially in the subjects of mathematics and science (OECD, 2013, pp. 100-101[2]; OECD, 2016, pp. 202-203[3]). In Europe and the United States, such concerns are often compounded by worries that the gender, cultural and language background of the teaching workforce does not reflect that of students they will teach (Dilworth and Coleman, 2014[4]; Donlevy, Meierkord and Rajania, 2016[5]).

What the data tell us

- On average across OECD countries, in PISA 2006, about 5.5% of 15-year-old students expected to work as teachers when they are 30, while in PISA 2015 about 4.2% of students expected to work as teachers.
- In PISA 2015, the typical profile of students who expected to work as teachers later on varied across countries; but in many countries, students who expected to work as teachers had poorer mathematics and reading skills than students who expected to work in other professions that, like teaching, require at least a university degree.
- In PISA 2015, boys and immigrant students were less likely than girls and students without an immigrant background to expect to work as teachers.
- In most countries, the typical profile of students who expected to work as teachers did not change between 2006 and 2015.

In many countries student diversity is on the rise, due to international migration or the expansion of secondary education; but male teachers, or teachers with a migrant or minority background, remain rare (OECD, 2005, p. 59[6]; Donlevy, Meierkord and Rajania, 2016[5]). Yet there is evidence that when teachers have similar experiences as their students, they are better able to understand their students' needs and approach them in ways that best promote their learning (Dee, 2004[7]; Egalite and Kisida, 2018[8]; Egalite, Kisida and Winters, 2015[9]).

A more diverse teaching workforce could be beneficial for all students, not just boys and minority students. A teaching force that reflects the composition of the student body – ethnic, religious and cultural minorities, and students with an immigrant background – provides all students with potential role models who have positive connotations (i.e. teachers) and come from diverse backgrounds. Such exposure to different backgrounds can help children learn to approach social diversity positively (Binder et al., 2009[10]; Mercer and Mercer, 1986[11]). Similarly, a teaching workforce that includes a larger number of men, particularly in early education and in subjects such as the arts and the humanities, can prevent boys and girls from forming strong views on the feminine or masculine nature of particular jobs (such as the caring professions) or subjects (Cheryan et al., 2011[12]; Moss-Racusin and Johnson, 2016[13]).

While several large-scale international studies allow researchers and policy makers to examine the evolution of student background characteristics over time, comparable data on the diversity of the teaching workforce is limited, particularly with respect to immigrant background and socio-economic status. To provide more insights into what motivates a diverse and skilled pool of candidates to enter the teaching profession, this chapter uses data from PISA 2006 and 2015, and analyses cross-country differences and trends over time in the characteristics of 15-year-old students who expect to work as teachers when they are 30 years old. This chapter also identifies factors that are associated with countries' ability to attract individuals with high skills and with an unconventional background (i.e. men and children of non-native parents) to the teaching profession.

Students' career expectations illustrate the extent to which teenage students, and particularly those with high academic potential, consider a career in teaching. Factors that shape early career aspirations greatly determine the overall pool of prospective candidates to enter the "teaching pipeline", even though alternative pathways that enable adults to enter the profession at any point in their lives can mitigate the influence of these factors.

The aim of this chapter is to identify differences between countries in the extent to which 15-year-old students, high-achieving students and students with unconventional backgrounds expect to work as teachers. The chapter also attempts to explain these differences between countries by relating them to the working conditions, social status and monetary compensation enjoyed by teachers in different countries.

The chapter is structured as follows: a first section on teacher shortages in PISA-participating countries introduces the analysis and provides important context for the study of 15-year-olds' expectations of a career in teaching. Attracting high-achieving students to the teaching profession might be particularly important in countries that suffer from shortages of teachers, or where perceptions of teacher shortages are worsening over time.

Then, descriptive statistics based on data from PISA 2015 are reported. Descriptive analyses illustrate, for each country, the percentage of students who expect to work as teachers and differences in the background characteristics between students who expect to work as teachers and those who do not. In order to draw the profile of students who expect to work as teachers in each country, the chapter examines differences in students' expectations of a teaching career by gender, immigrant background, parents' highest educational attainment, and students' performance in reading and mathematics.

The chapter then examines whether between-country differences in teachers' salaries and the social status of the teaching profession explain between-country differences in students' expectations of a career in teaching;[1] and whether changes in teachers' salaries and working conditions over time are related to changes, between 2006 and 2015, in the number and type of students who aspire to a career in teaching.[2]

Most analyses in this chapter rely on a single question included in the PISA 2006 and 2015 surveys that asked 15-year-old students: "What kind of job do you expect to have when you are about 30 years old?" Student responses to this open-ended question were coded and classified using the four-digit classification numbers of the International Standard Classification

of Occupations (ISCO). Analyses reported in this chapter refer to students who indicated that they expect to work as teachers in general, or specifically as primary, secondary or special education teachers. Students who reported that they expect to work as college, university, higher education or pre-primary teachers, or as pre-primary or primary associate teachers are excluded.

When comparing students' career expectations across countries and time using PISA data, it is important to bear in mind a number of limitations. First, the question on career expectations has more missing values than other questions in PISA. Second, the predictive value of students' reports on their future career can differ across countries, because of differences in the degree to which students are required to make choices at an early age to enter specific careers, and the existence of flexible pathways in the education system and labour market. Finally, the PISA target population covers 15-year-olds enrolled in lower secondary or upper secondary school, but enrolment rates of 15-year-olds differ across countries and over time. This variation could partly contribute to the differences in students' career expectations reported when they are 15 years old. These limitations are discussed in greater detail in Boxes 4.1 and 4.2.

Box 4.1 **How reliable are PISA data on students' career expectations?**

Answering open-ended questions, such as "*What kind of job do you expect to have when you are about 30 years old?*", requires more effort from students than answering other questions in the background questionnaire. As a result, the PISA career-expectations question has response rates that, in some countries, are considerably lower than the typical PISA question. The high share of missing responses contributes to uncertainty in cross-country comparisons.

On average across OECD countries, about 11% of students in 2015 (14% of students in 2006) had missing responses on the career-expectations question (Table 4.6). By contrast, only about 2% of students in 2015 had missing responses on the number of televisions at home ("How many of these are there at your home? Televisions"), and 10% of students had missing responses on attendance at a science club ("How often do you do these things? Attend a science club"). These two questions were chosen for comparison because they appeared in both the PISA 2015 and 2006 student questionnaires, were easy for students to answer because of the closed format, and they appeared before (televisions) and after (attend a science club) the question about career expectations.

The percentage of students with missing responses on the career-expectations question varies widely across countries (Table 4.6). The highest missing-response rate on career expectations in 2015 was observed in Germany, where about 26% of students had missing or invalid responses, followed by Austria (23%), Iceland (22%), Canada (21%) and Chinese Taipei (21%). In Mexico, Peru and Viet Nam, only around 3% of students had missing or invalid responses to the career-expectations question; in Korea, around 4% of students had missing or invalid responses.

...

This variation across countries might also reflect genuine uncertainty, or indecision, about one's future, rather than just a lack of engagement with the more demanding response format. An indirect indicator of indecision and a lack of clear career plans is students' willingness to report on their parents' occupation (which is also open-ended and therefore demanding) but not on their expectations for their own future occupation. Table 4.7 reports, for each country with available data, the percentage of students who had valid responses for their father's and mother's occupation but invalid responses for their own future occupation.

On average across OECD countries, about 8% of students in 2015 reported their parents' occupation but not their own career expectations (Table 4.7). The largest percentages of students who reported their parents' occupations but not their own expected occupations were observed in Austria (20%), Iceland (18%), Chinese Taipei (17%), Canada and Georgia (16%).

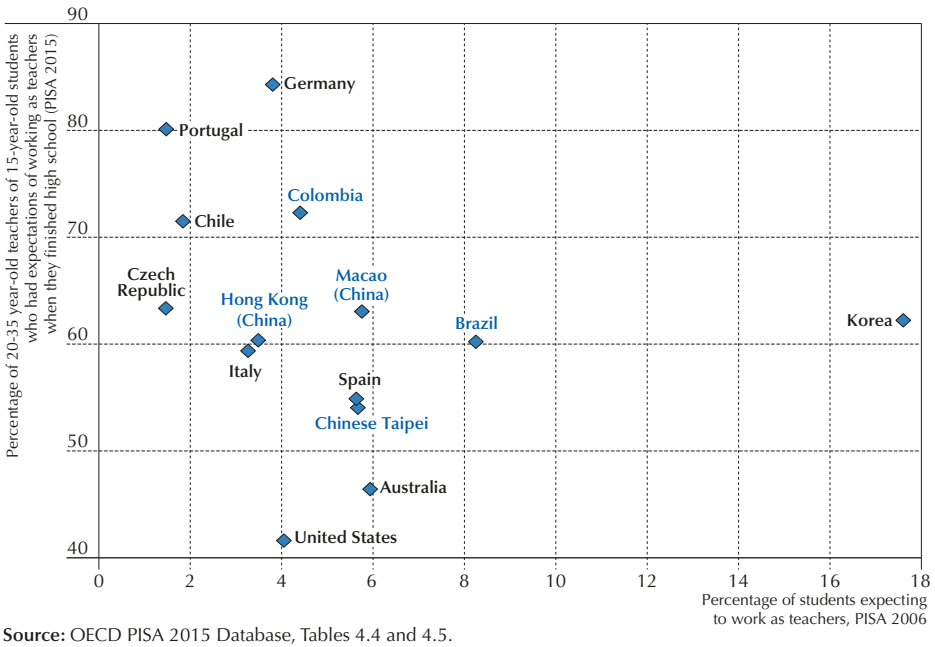
Box 4.2 **How predictive of the future are teenagers' career expectations?**

Prior research based on the recollections of student teachers, or of in-service teachers, suggests that early expectations of a teaching career play an important role in decisions to enter teacher training and the teaching profession (Aksu et al., 2010[14]; Richardson and Watt, 2005[15]), and that individuals typically decide to become teachers during the secondary school years (Lee, Clery and Presley, 2001[16]; Page and Page, 1984[17]) before graduating from high school (Brookhart and Freeman, 1992[18]). Prospective studies, which compare early career aspirations with actual careers observed during follow-up surveys for the same individuals, confirm the importance of adolescent career aspirations for career choices more generally (Ashby and Schoon, 2010[19]; Schoon and Parsons, 2002[20]).[3]

Data from the teacher questionnaire, an optional component of PISA 2015, provide (for 18 countries/economies) retrospective evidence on the importance of early career aspirations for the decision to become a teacher. In PISA 2015, teachers reported whether pursuing a career in the teaching profession was their goal after completing upper secondary school. On average across 14 countries that distributed the teacher questionnaire in 2015 and that have available data in both PISA 2015 and 2006, about 62% of 20-35 year-old teachers who teach 15-year-old students had chosen to become teachers by the end of secondary school (Figure 4.1).[4] The data also highlight substantial variations across countries. In Germany, about 84% of young teachers had chosen their career by the end of secondary school, while in the United States, only about 42% of these teachers of 15-year-old students had chosen to become teachers by the end of secondary school. The remaining countries fall between these two extremes.

...

Figure 4.1 ■ **When did today's teachers decide to work as teachers?**



Source: OECD PISA 2015 Database, Tables 4.4 and 4.5.
StatLink http://dx.doi.org/10.1787/888933740782

Figure 4.1 shows that in many countries – including Colombia, Germany and Portugal – where relatively few students reported, in PISA 2006, that they expect to work as teachers, the critical education and career choices that lead to a teaching career typically start before the end of high school, as indicated by the high share of current teachers who reported that working in the teaching profession was already their goal when they finished high school. By contrast, in Australia, Chinese Taipei and the United States, around half of today's young teachers had decided to work as teachers only after they had left high school, possibly because tertiary studies and education systems offer multiple, and relatively flexible, pathways into the teaching profession. In these countries, 15-year-olds' expectations of a career in teaching should be viewed as a significant indication of the attractiveness of the profession; but policies targeted at older adults can redress imbalances and shortages of qualified teachers.

TRENDS IN THE PERCEPTION OF TEACHER SHORTAGES

School principals' reports show that shortages of qualified mathematics and science teachers are persistent and affect a large proportion of students in several countries. In 2003 and 2012, principals of schools sampled for PISA were asked whether their school's capacity to provide instruction was hindered by a lack of qualified science or mathematics teachers.[5]

Figure 4.2 ■ **Trends between 2003 and 2012 in principals' reports of teacher shortages**

Percentage of students whose principal reported that the school's capacity to provide instruction is hindered a lot by a lack of qualified mathematics or science teachers

1. The change between 2003 and 2012 in the percentage of students whose principal reported that the school's capacity to provide instruction is hindered a lot by a lack of qualified teachers in mathematics is statistically significant.

2. The change between 2003 and 2012 in the percentage of students whose principal reported that the school's capacity to provide instruction is hindered a lot by a lack of qualified teachers in science is statistically significant.

Note: The OECD average in this figure includes only OECD countries with comparable data in 2012 and 2003.

Countries are ranked in descending order of the percentage of students whose principal reported, in 2012, that the school's capacity to provide instruction is hindered a lot by a lack of qualified mathematics teachers.

Source: OECD (2013), *PISA 2012 Results: What Makes Schools Successful? Resources, Policies and Practices (Volume IV)*, Table IV.3.37, http://dx.doi.org/10.1787/888932957479.

StatLink http://dx.doi.org/10.1787/888933740801

On average across OECD countries, about 17% of students in 2012 were in schools whose principals reported that the school's capacity to provide instruction is hindered by a lack of qualified mathematics and science teachers. According to school principals, teacher shortages that hinder instruction affected the largest proportion of students in Luxembourg (69% in mathematics and 71% in science), Jordan (46% in mathematics and 50% in science), Thailand (45% in mathematics and 47% in science), Chile (43% in mathematics and 42% in science) and the Netherlands (43% in mathematics and 32% in science) (OECD, 2013, Figure IV.3.5[2]).

These percentages are high but, in many countries, they mark an improvement over the even larger proportions observed in 2003. Students in 2012 were less likely than students in 2003 to attend schools whose principal reported that a lack of qualified teachers hinders learning. On average across OECD countries in 2003, about 21% of students who participated in PISA attended schools whose principal reported that a lack of qualified mathematics and science teachers hinders student learning "to some extent" or "a lot" (Figure 4.2). Decreases in the number of principals who reported shortages of qualified mathematics teachers were observed in 20 out the 35 countries and economies with comparable data between 2003 and 2012 (Figure 4.2).

The largest improvement was observed in Turkey (a 42 percentage-point decrease in the share of 15-year-old students whose principals reported that a lack of qualified teachers hinders instruction in mathematics, and a 46 percentage-point decrease concerning science instruction). Large improvements were also observed in Greece and Indonesia (Figure 4.2).

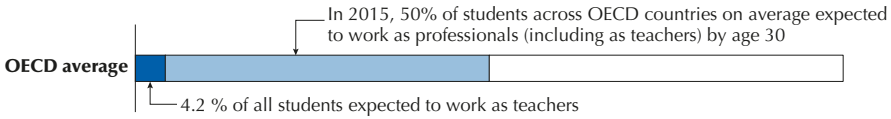
A deteriorating trend was observed in six countries concerning mathematics teachers (Austria, Germany, Korea, Luxembourg, the Netherlands and Switzerland), and in four countries concerning science teachers (Korea, Luxembourg, the Netherlands and Thailand). In these countries, more students in 2012 than in 2003 attended schools whose principals reported that a lack of qualified science/mathematics teachers hinders instruction in science/mathematics.

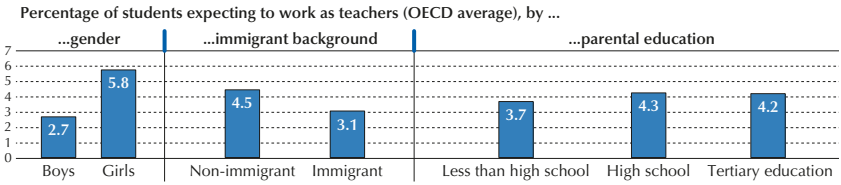
BACKGROUND CHARACTERISTICS OF STUDENTS WHO EXPECT TO WORK AS TEACHERS: EVIDENCE FROM PISA 2015

On average in 2015, about 50% of students in OECD countries reported that they expect to work as professionals, which comprise high status occupations that typically require a university degree. Among these, about 4.2% of all students expected to work as teachers (Figure 4.3). By comparison, the number of teachers in primary, lower secondary and upper secondary education represented about 2.4% of the labour force across OECD countries in 2013.[6] This means that, in general, the share of students expecting a teaching career is larger than the share of working-age people who are teaching today. At least at this early stage of career orientation, concerns about the lack of candidates for a career in teaching are therefore exaggerated. In fact, teaching enjoys a clear advantage over other occupations that 15-year-olds may not even know exist: all 15-year-old students have had some contact with teachers and have at least an approximate idea of what they do and of their working conditions.

However, the percentage of students who expected, in 2015, to have a career as teacher varied widely across countries. The teaching profession appeared to be a particularly sought-after profession in Algeria, Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]") Ireland, Korea, Kosovo, Luxembourg, Thailand, Tunisia and Viet Nam.

Figure 4.3 [1/2] ■ Students who expect to work as teachers





OECD	Percentage of students expecting a career in teaching	Percentage of students expecting a career as professionals	Percentage of students expecting a career in teaching, by gender		Percentage of students expecting a career in teaching, by immigrant background		Percentage of students expecting a career in teaching, by parental education		
			Boys	Girls	Non-immigrant	Immigrant	Less than high school	High school	Tertiary education
Australia	5.7	57.4	**2.9**	**8.6**	**6.3**	**4.3**	5.6	6.2	5.6
Austria	5.2	49.1	**2.3**	**8.2**	**5.6**	**3.7**	5.5	5.6	5.1
Belgium*	4.5	51.2	4.0	4.9	4.6	4.1	4.1	4.2	4.6
Canada	1.1	69.3	**0.4**	**1.7**	1.2	0.9	0.5	1.3	1.0
Chile	2.7	61.9	**1.7**	**3.8**	2.7	1.9	2.8	3.0	2.6
Czech Republic	3.3	35.6	**1.5**	**5.2**	3.4	2.6	**0.6**	3.6	**3.3**
Denmark	1.2	33.1	**0.7**	**1.6**	1.1	1.5	1.2	1.3	1.1
Estonia	1.4	55.3	**0.7**	**2.1**	1.4	1.3	0.0	1.6	1.4
Finland	4.6	37.1	**2.8**	**6.5**	**4.8**	**0.4**	0.0	3.6	4.9
France	3.8	44.3	**2.1**	**5.4**	**4.0**	**2.5**	4.0	3.9	3.8
Germany	3.6	37.2	**1.9**	**5.2**	3.6	3.6	**2.6**	3.9	**4.2**
Greece	5.9	59.4	**3.9**	**8.0**	5.9	6.5	5.4	5.8	6.0
Hungary	2.1	37.2	**1.2**	**3.1**	2.0	5.7	**0.0**	1.8	**2.6**
Iceland	2.1	60.3	1.8	2.4	2.1	2.1	2.6	2.3	2.0
Ireland	11.8	61.4	**6.7**	**16.9**	**12.9**	**4.3**	11.6	13.4	11.1
Israel	4.9	54.0	**3.0**	**6.7**	**5.4**	**2.7**	**14.3**	6.5	**3.7**
Italy	3.2	48.7	**1.1**	**5.2**	3.2	3.5	3.3	3.1	3.3
Japan	6.7	41.4	7.4	6.1	6.7	2.9	**3.8**	4.5	**8.1**
Korea	10.7	52.5	**9.2**	**12.3**	10.7	c	**4.7**	9.5	**11.7**
Latvia	0.8	43.4	**0.2**	**1.4**	0.8	0.8	**0.0**	1.3	**0.5**
Luxembourg	9.9	49.4	**6.9**	**12.6**	**12.5**	**7.8**	9.5	9.5	10.3
Mexico	4.1	73.1	**2.4**	**5.9**	4.1	6.7	**5.6**	3.3	**2.5**
Netherlands	4.9	36.3	**3.5**	**6.3**	5.1	3.4	3.9	5.5	4.8
New Zealand	3.0	51.4	**1.2**	**4.8**	**3.4**	**1.8**	4.0	3.8	2.7
Norway	3.2	46.7	**1.8**	**4.7**	**3.4**	**1.9**	1.8	3.2	3.4
Poland	2.4	39.7	**1.2**	**3.7**	2.4	c	1.5	2.4	2.9
Portugal	1.3	55.4	1.3	1.3	**1.4**	**0.1**	1.4	1.3	1.3
Slovak Republic	2.9	34.5	**0.9**	**5.1**	**2.9**	**0.0**	1.8	3.0	2.9
Slovenia	4.4	45.7	**2.2**	**6.8**	4.6	2.8	3.0	4.1	4.8
Spain	5.6	60.7	**4.1**	**7.1**	5.8	4.8	5.4	5.7	5.7
Sweden	1.5	42.2	**1.1**	**2.0**	1.5	1.5	1.3	0.9	1.7
Switzerland	6.0	38.4	**3.1**	**9.1**	**7.1**	**3.9**	**3.5**	5.9	**6.5**
Turkey	5.6	64.5	**3.9**	**7.4**	5.5	6.2	**6.4**	6.3	**3.9**
United Kingdom	5.0	61.4	**3.7**	**6.3**	**5.5**	**2.8**	5.2	6.0	4.7
United States	2.8	61.2	**1.4**	**4.2**	3.1	2.2	2.3	2.4	3.2

* French and German-speaking Communities.

Notes: Values that are statistically significant (difference boys–girls, or immigrant – non-immigrant or tertiary – less than high school) are indicated in bold (see Annex A).

Professionals include scientists, engineers, medical professionals, teachers, and business, legal, social science and related professionals.

Countries are ranked in descending order of the percentage of 15-year-old students who expect to be working in the teaching profession when they are 30 years old.

Source: OECD PISA 2015 Database, Tables 4.1 and 4.2.

StatLink http://dx.doi.org/10.1787/888933740820

Figure 4.3 [2/2] ■ Students who expect to work as teachers

Partners	Percentage of students expecting a career in teaching	Percentage of students expecting a career as professionals	Percentage of students expecting a career in teaching, by gender		Percentage of students expecting a career in teaching, by immigrant background		Percentage of students expecting a career in teaching, by parental education		
			Boys	Girls	Non-immigrant	Immigrant	Less than high school	High school	Tertiary education
Algeria	23.0	62.4	**15.3**	**31.4**	23.1	20.5	**27.8**	22.0	**18.5**
Brazil	2.4	68.5	**1.7**	**3.0**	2.4	4.1	**3.4**	1.9	**1.8**
B-S-J-G (China)	9.6	39.4	**4.8**	**15.0**	**9.7**	**0.0**	9.6	9.8	9.3
Bulgaria	1.6	50.0	**0.7**	**2.6**	**1.6**	**0.0**	1.8	1.9	1.4
CABA (Argentina)	2.2	72.3	1.5	2.7	2.1	2.5	2.2	3.6	1.8
Colombia	0.0	61.9	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Costa Rica	3.3	64.4	3.0	3.5	3.3	2.5	**4.7**	3.1	**2.6**
Croatia	6.6	41.9	**2.7**	**10.3**	6.9	5.0	4.7	8.1	5.6
Dominican Republic	1.2	70.6	0.8	1.6	**1.2**	**0.0**	**1.8**	1.5	**0.8**
FYROM	7.8	54.3	**5.9**	**9.9**	7.8	5.2	**11.8**	8.1	**6.8**
Georgia	2.2	55.5	**1.0**	**3.5**	**2.2**	**0.0**	4.9	2.8	1.7
Hong Kong (China)	6.6	56.6	6.1	7.0	**5.7**	**8.2**	6.9	6.4	6.8
Indonesia	0.3	35.7	**0.1**	**0.4**	0.3	c	0.3	0.2	0.3
Jordan	1.0	66.1	**0.1**	**1.7**	0.9	0.9	1.3	1.6	0.6
Kosovo	17.3	66.0	**9.2**	**25.3**	17.4	13.3	**23.2**	20.3	**14.5**
Lebanon	8.4	70.1	**4.1**	**12.0**	8.0	11.5	**11.7**	9.3	**5.7**
Lithuania	1.8	45.9	**0.9**	**2.7**	**1.8**	**0.3**	2.9	2.2	1.6
Macao (China)	8.2	50.8	**6.6**	**9.8**	7.9	8.5	8.8	7.9	7.8
Malta	8.4	57.3	**5.4**	**11.4**	**8.8**	**3.7**	8.5	8.6	8.1
Moldova	2.7	48.0	**0.9**	**4.6**	2.6	1.5	2.3	3.4	2.2
Montenegro	6.9	46.7	**3.3**	**10.5**	**7.1**	**3.3**	9.9	8.2	6.2
Peru	1.4	68.0	**0.8**	**1.9**	**1.3**	**0.0**	**2.7**	1.1	**1.1**
Qatar	0.0	59.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Romania	4.0	51.3	**2.5**	**5.4**	4.0	c	3.4	4.4	3.7
Russia	2.6	50.9	**0.6**	**4.5**	2.6	3.3	2.0	4.8	2.6
Singapore	4.4	60.1	**3.5**	**5.3**	4.5	4.1	5.6	4.2	4.4
Chinese Taipei	4.1	46.2	4.3	3.9	4.2	c	3.8	3.5	4.5
Thailand	10.2	40.5	**5.2**	**14.0**	10.2	12.2	**13.1**	9.0	**6.6**
Trinidad and Tobago	3.7	55.9	**1.3**	**5.9**	3.9	2.2	4.2	3.9	3.5
Tunisia	11.8	66.3	**9.7**	**13.5**	11.5	19.6	**14.6**	12.7	**9.3**
United Arab Emirates	1.5	58.5	**0.4**	**2.5**	**2.3**	**0.9**	**2.7**	2.7	**1.1**
Uruguay	4.9	57.5	**1.9**	**7.6**	**5.1**	**0.0**	**6.3**	4.8	**3.5**
Viet Nam	12.4	43.8	**5.9**	**18.6**	12.3	c	**14.3**	9.2	**7.3**

Notes: Values that are statistically significant (difference boys–girls, or immigrant – non-immigrant or tertiary – less than high school) are indicated in bold (see Annex A).

Professionals include scientists, engineers, medical professionals, teachers, and business, legal, social science and related professionals.

Countries are ranked in descending order of the percentage of 15-year-old students who expect to be working in the teaching profession when they are 30 years old.

Source: OECD PISA 2015 Database, Tables 4.1 and 4.2.

StatLink http://dx.doi.org/10.1787/888933740839

By contrast, the teaching profession attracted less than 1.5% of 15-year-olds in Albania, Canada, Colombia, Denmark, the Dominican Republic, Estonia, Indonesia, Jordan, Latvia, Peru, Portugal, Qatar and the United Arab Emirates.

The typical student expecting a career in teaching is, in most countries, a girl with no immigrant background (Table 4.1). She tends to be academically weaker than other students who expect, just like her, a professional career requiring university-level education (Table 4.3).

Several top-performing countries, such as Finland, Korea and Singapore, build high-quality education workforces by recruiting the best high school graduates into teacher-education institutions and then channelling them into the teaching profession (Kang and Hong, 2008[21];

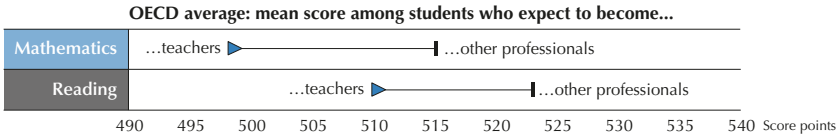
Sahlberg, 2010[22]; Barber and Mourshed, 2007[23])[7]. Teachers' verbal and mathematical skills, acquired in school, are indeed strongly related to student outcomes (Darling-Hammond and Youngs, 2002[24]; Wayne and Youngs, 2003[25]) and have been found to predict cross-country differences in the reading and mathematics skills of students, even after accounting for the average skills in the adult population (Hanushek, Piopiunik and Wiederhold, 2014[26]; Meroni, Vera-Toscano and Costa, 2015[27]). By examining the reading and mathematics scores of students who expect to work as teachers, this chapter can indicate how successful countries are at attracting high-achieving students into teaching careers.

While the Survey of Adult Skills (PIAAC) shows that, in most countries, the literacy and numeracy skills of teachers are on par with those of other college graduates (Hanushek, Piopiunik and Wiederhold, 2014[26]), PISA 2015 reveals marked differences across countries in the skills profile of students who expected to work as teachers. On average across OECD countries, and in a majority of countries/economies, students who aspired to be teachers had significantly lower reading and mathematics scores than students who expected to pursue professional occupations other than teaching (Figure 4.4). Furthermore, the skills gap between students who expected a career in teaching (would-be teachers) and students who expected a career as professionals (would-be professionals) tended to be larger in low-performing countries than in top-performing countries. The linear correlation coefficient (hereafter indicated by the letter "r") between average mathematics performance, on the one hand, and the difference in performance between would-be teachers and would-be professionals, more generally, is 0.45 (see Figure 1.3 in Chapter 1). This suggests that teaching is not an attractive career for high-achieving students in a majority of countries, particularly in countries that perform below the OECD average in PISA.

The largest differences in mathematics skills between would-be teachers and would-be professionals were observed in Bulgaria, Georgia, Israel, Latvia, Lebanon, Peru, Portugal, Turkey, the United Arab Emirates and Uruguay. In these countries, would-be teachers scored at least 40 points below would-be professionals. By contrast, in Japan and Korea, students who expected to work as teachers scored higher in mathematics than students who aspired to be professionals, but not teachers, and there was no difference between the two groups of students in average reading scores. In Austria and Slovenia, students who expected to work as teachers scored higher in reading than students who aspired to be professionals, but not teachers, and there was no difference between the two groups in average mathematics scores. In Chile, Ciudad Autónoma de Buenos Aires (Argentina) (hereafter "CABA [Argentina]"), the Czech Republic, Denmark, the Dominican Republic, Estonia, Germany, Hong Kong (China), Hungary, Iceland, Jordan, Norway, New Zealand, Poland, Russia, Singapore, Sweden, Switzerland, Chinese Taipei and the United States, there was no difference in average reading and mathematics scores between students who expected to work as teachers and those who expected to work as other professionals (Figure 4.4).

Women represent more than two in three teachers and academic staff at all levels of education (i.e. from pre-primary through tertiary education) (OECD, 2016[28]). This pattern has become a source of concern in some countries. The proportion of female teachers has been rising since the early 1990s, and that over-representation of women in the teaching force – what some have termed the "feminisation" of teaching (Kelleher et al., 2011[29]) – might even increase in the coming years, as male teachers, who tend to be older, begin to retire (OECD, 2005[6]; UNESCO, 2012[30]).

Figure 4.4 [1/2] ■ Mathematics and reading performance among students who expect to work as teachers



	Mean score in mathematics among students who expect to become...		Mean score in reading among students who expect to become...	
OECD	Teachers	Other professionals	Teachers	Other professionals
Australia	**493**	**521**	**512**	**535**
Austria	520	523	**534**	**516**
Belgium*	**496**	**528**	**492**	**527**
Canada	**515**	**534**	538	547
Chile	426	438	473	478
Czech Republic	537	534	539	539
Denmark	528	529	526	525
Estonia	546	539	553	543
Finland	**529**	**545**	**555**	**567**
France	**510**	**533**	**529**	**547**
Germany	547	545	568	556
Greece	**451**	**475**	**475**	**496**
Hungary	527	526	526	520
Iceland	498	505	497	504
Ireland	**503**	**522**	**527**	**544**
Israel	**430**	**480**	**439**	**493**
Italy	**479**	**514**	**495**	**515**
Japan	**565**	**552**	545	537
Korea	**554**	**544**	546	541
Latvia	**458**	**503**	**469**	**515**
Luxembourg	**505**	**528**	**512**	**530**
Mexico	**392**	**415**	**407**	**431**
Netherlands	**511**	**549**	**508**	**544**
New Zealand	502	515	535	538
Norway	518	525	543	545
Poland	521	534	534	544
Portugal	**471**	**514**	**476**	**522**
Slovak Republic	**482**	**517**	**480**	**506**
Slovenia	545	538	**553**	**541**
Spain	**476**	**504**	**494**	**517**
Sweden	503	516	519	533
Switzerland	558	555	539	532
Turkey	397	437	**415**	**446**
United Kingdom	**491**	**510**	**506**	**518**
United States	487	485	527	517

* French and German-speaking Communities.

Notes: Values that are statistically significant (difference between students expecting to become teachers and students expecting to become professionals) are indicated in bold (see Annex A).

Professionals include scientists, engineers, medical professionals, teachers, and business, legal, social science and related professionals.

Countries are ranked in descending order of the percentage of 15-year-old students who expect to be working in the teaching profession when they are 30 years old.

Source: OECD PISA 2015 Database, Tables 4.1 and 4.2.

StatLink http://dx.doi.org/10.1787/888933740839

Figure 4.4 [2/2] ■ Mathematics and reading performance among students who expect to work as teachers

	Mean score in mathematics among students who expect to become...		Mean score in reading among students who expect to become...	
Partners	Teachers	Other professionals	Teachers	Other professionals
Algeria	**352**	**372**	**347**	**365**
Brazil	**354**	**390**	**382**	**427**
B-S-J-G (China)	**543**	**565**	**508**	**531**
Bulgaria	421	476	**424**	**482**
CABA (Argentina)	443	459	461	483
Colombia	c	395	c	434
Costa Rica	**383**	**407**	**402**	**435**
Croatia	**475**	**505**	**515**	**534**
Dominican Republic	**333**	**333**	375	366
FYROM	**367**	**392**	**349**	**378**
Georgia	375	422	**372**	**427**
Hong Kong (China)	558	567	538	546
Indonesia	c	394	c	409
Jordan	**375**	**401**	416	435
Kosovo	**360**	**377**	**357**	**368**
Lebanon	**360**	**421**	**311**	**377**
Lithuania	**475**	**508**	**479**	**509**
Macao (China)	**549**	**562**	**514**	**527**
Malta	**490**	**525**	**469**	**496**
Moldova	**422**	**452**	**433**	**457**
Montenegro	**419**	**444**	**437**	**463**
Peru	327	398	**328**	**412**
Qatar	c	427	c	434
Romania	438	477	**430**	**472**
Russia	494	508	507	515
Singapore	572	578	545	550
Chinese Taipei	**582**	**577**	526	530
Thailand	**415**	**444**	**413**	**446**
Trinidad and Tobago	**407**	**446**	**430**	**460**
Tunisia	**350**	**388**	**347**	**387**
United Arab Emirates	**385**	**447**	**411**	**458**
Uruguay	**400**	**441**	**434**	**468**
Viet Nam	478	512	**476**	**503**

Notes: Values that are statistically significant (difference between students expecting to become teachers and students expecting to become professionals) are indicated in bold (see Annex A).

Professionals include scientists, engineers, medical professionals, teachers, and business, legal, social science and related professionals.

Countries are ranked in descending order of the percentage of 15-year-old students who expect to be working in the teaching profession when they are 30 years old.

Source: OECD PISA 2015 Database, Tables 4.1 and 4.2.

StatLink http://dx.doi.org/10.1787/888933740839

PISA 2015 reveals that just as occupations are segregated along gender lines, so are students' career expectations. The share of girls who expected to work in computing and engineering was far smaller than the share of boys who expected to work in those fields (OECD, 2016, p. 117[31]), but girls outnumbered boys among those who expected to work as teachers. In almost every OECD country, more girls than boys expected to work as teachers. Less than 3% of boys, on average across OECD countries, expected a career in the teaching profession, while almost 6% of girls expected to work as teachers. However, in Belgium (French and German-speaking Communities), CABA (Argentina), Costa Rica, the Dominican Republic, Hong Kong (China), Iceland, Japan, Portugal and Chinese Taipei, there were no gender differences in the proportion of students who expected to work as teachers.

In many countries, recent international migration flows have led to large increases in the number of foreign-born students and of children of foreign-born parents (Donlevy, Meierkord and Rajania, 2016[5]; OECD, 2010[32]). However, the teaching workforce has remained relatively homogeneous in most countries. For example, across OECD countries, teachers tend to be from a middle-class background and from the majority population (OECD, 2010[33]). PISA reveals that this pattern is likely to continue in the future. On average across OECD countries, immigrant students were less likely than non-immigrant students to expect to work as teachers.

The social background of would-be teachers is more varied across countries. On average across OECD countries, about 4% of students expected to work as a teacher, regardless of their parents' level of education (3.7% of students whose parents did not complete high school, 4.3% of students whose parents graduated from high school, and 4.2% of students whose parents completed tertiary education so reported). In 16 countries and economies, however, students whose parents did not complete high school were more likely to expect to work as a teacher than students whose parents completed tertiary education. Large differences in favour of students with low-educated parents are found in Algeria, Israel, Kosovo, Lebanon, Thailand and Viet Nam, in particular. In these countries, a career in teaching might be perceived as a pathway to social mobility; however, this pattern might also reveal a lack of selectivity in teacher education programmes.

Bruns and Luque (2015[1]) report how, in a number of Latin American countries, several teacher-education institutions are of low quality: there is virtually no winnowing of teacher candidates at the point of entry into teacher education, teacher education is often subsidised, and academic standards are lower than in other professions. While these features might make teacher-education programmes popular among students whose parents are unfamiliar with tertiary education, many graduates of these programmes do not find jobs as classroom teachers. By contrast, in nine OECD countries – the Czech Republic, Estonia, Finland, Germany, Hungary, Japan, Korea, Latvia and Switzerland – students whose parents completed tertiary education were more likely to expect to work as a teacher than students whose parents had not completed high school.

To investigate which individual background characteristics are most strongly associated with the likelihood that students will expect to work as teachers, logistic regression models that jointly account for multiple background characteristics influencing students' career expectations were estimated for each country. While descriptive statistics illustrate the raw differences in the characteristics of students who expect to work as teachers, logistic regressions estimate the influence of a specific factor, net of other characteristics that are correlated with this factor.

Results confirm that, in a majority of countries, girls were more likely than boys to expect to work as teachers, even after accounting for family background and performance (Table 4.9). Belgium (French and German-speaking Communities), Colombia, Costa Rica, the Dominican Republic, Hong Kong (China), Iceland, Japan, Portugal, Qatar and Chinese Taipei are notable exceptions, since in these countries and economies, boys and girls were equally likely (or unlikely) to expect to work as teachers. Immigrant students were less likely to expect to work as teachers, on average across OECD countries (Table 4.9).

In as many as 20 countries and economies, as well as on average across OECD countries, students from socio-economically disadvantaged families were more likely than students from advantaged families to expect to work as teachers, after accounting for other student characteristics and for performance. In all but one of the remaining countries and economies considered, the family's socio-economic status was not associated with students' expectations of pursuing a teaching career.

Analyses restricted to the subsample of students who expected to work as professionals (Table 4.9) confirm that among these students, and after accounting for their gender and family background, high-achieving students were less likely to expect a teaching career, on average across OECD countries.

TEACHERS' SALARIES, SOCIAL STATUS OF THE TEACHING PROFESSION AND EXPECTATIONS OF A TEACHING CAREER: EVIDENCE FROM PISA 2015

Faced with the difficulty of attracting high-achieving students to teacher-education programmes and concerned by a possible fall in the social standing of the teaching profession over the years, policy makers need to know how to attract more, and more-qualified candidates in particular, to the teaching profession. Self-report surveys often show that current teachers are highly motivated by the intrinsic benefits of teaching – working with children, helping them develop and making a contribution to society. The *Teachers Matter* report, for example, summarises findings from French and Australian surveys, and the opinions of several national experts participating in country reviews, to conclude that extrinsic factors (such as job stability, pay or working hours) are of secondary importance for those who chose a career in teaching and remained in the career (OECD, 2005, pp. 67-69[6]).

While intrinsic factors are no doubt important for current teachers, these studies do not explain why other "potential teachers" chose to pursue other careers instead of teaching, or quit teaching after a while. In fact, studies that survey a larger pool of graduates about their career choices show that the relative salaries of graduate occupations do play a role in these choices: had teachers' salaries been higher, more "potential teachers" would have seriously considered a career in teaching (Dolton, 2014[34]; Dolton, 2006[35]). Several recent studies suggest that teachers' low salaries and low social status might deter academically talented students, students from minority backgrounds, and men from pursuing a career in teaching, as more lucrative and prestigious options are available (Cunningham and Hargreaves, 2007[36]; Donlevy, Meierkord and Rajania, 2016[5]; Park and Byun, 2015[37]).

On average across OECD countries, primary school teachers earn 81% of what a tertiary-educated, 25-64 year-old, full-time, full-year worker earns; lower secondary teachers are paid 85% of that benchmark salary; and upper secondary teachers are paid 89% of that benchmark salary (OECD, 2016[28]). Moreover, data from the second cycle of the Teacher and Learning International Survey (TALIS) show that the social status of the teaching profession varies across countries. In 2013-14, TALIS asked teachers to report whether they agreed with the statement "I think that the teaching profession is valued in society". In Malaysia, about 84% of lower secondary teachers reported that the teaching profession is valued in society, whereas only 4% of lower secondary teachers in the Slovak Republic so reported (see Table 2.16).

To examine the association between students' expectations of a teaching career, teachers' salaries and the social status of the teaching profession, an analysis that relates the likelihood of students expecting a career in teaching to student and school characteristics and to country-level differences in teachers' pay and social status was conducted.[8] Thirty-two countries that participated in both the second cycle of TALIS and in PISA 2015, and for which data on teachers' salaries are available, were included in the analysis.[9]

Two country-level variables in this model are of particular interest: teachers' salaries and the social status of the teaching profession. Teachers' salaries are measured as the ratio of annual statutory salaries in lower secondary public institutions after 15 years of experience to per capita GDP (OECD, 2016, Table II.6.54[3]). The social status of the teaching profession is derived from the percentage of teachers in a country who agreed or strongly agreed with the statement that the teaching profession is valued in society (see Table 2.16). Both teachers' salaries and the social status of teaching profession were standardised across countries.

In addition, the analysis also accounts for differences in per capita GDP and in how representative the PISA sample is of all 15-year-olds in the country, and for school- and student-level differences, such as gender, socio-economic status, performance and urban/rural location, which are known to influence students' career choices. The associations between the likelihood of expecting a career in teaching, and these school- and student-level factors, are in line with the average results from country-specific analyses reported in Table 4.9.

At the country level, results indicate that both teachers' salaries and the social status of the teaching profession are positively associated with students' expectations to work as teachers (Table 4.10). In countries where teachers' salaries are higher, 15-year-old students were more likely to expect to work as teachers (Model 1). Likewise, in countries where more teachers think that the teaching profession is valued in their society, 15-year-old students were more likely to expect to work as teachers (Model 2). When teachers' salaries and the social status of the teaching profession are jointly introduced in the model, the latter association is positive but no longer statistically significant at the 5% level, indicating that the association with teachers' salaries is stronger (Model 3). These results suggest that more candidates can be attracted to teaching if teachers are better paid.

Next, analyses were developed to examine what kinds of candidates, in particular, are sensitive to differences in social status and in salaries. These analyses investigate whether teachers' salaries and the social status of the teaching profession are related in different ways to students' expectations of a teaching career, depending on the students' academic proficiency and certain characteristics, namely gender, socio-economic status, immigrant background and mathematics performance. Results indicate that boys were more sensitive to salary differences, but that there is no evidence that higher salaries would attract high-achieving students into the teaching profession to a greater extent than low-achieving students.

In countries where teachers' salaries are higher, both boys and girls were more likely to expect to work as teachers. However, girls appeared to be less sensitive to teachers' salaries than boys, and students' expectations of a teaching career were more gender-balanced in countries with higher teachers' salaries (Table 4.10, Models 1a and 3a). Teachers' salaries are positively associated

with students' expectations to work as teachers across all levels of student performance, with no significant variation between high and low performers (Table 4.10, Models 1d and 3d). Similarly, cross-country differences in teachers' salaries are not related to within-country gaps in students' expectations of a teaching career between socio-economically advantaged students and disadvantaged students, and between immigrant students and non-immigrant students; nor can the social status of the teaching profession account for such gaps (Table 4.10, Models 1-3b and 1-3c).

WHO EXPECTS TO BECOME A TEACHER? TRENDS BETWEEN 2006 AND 2015

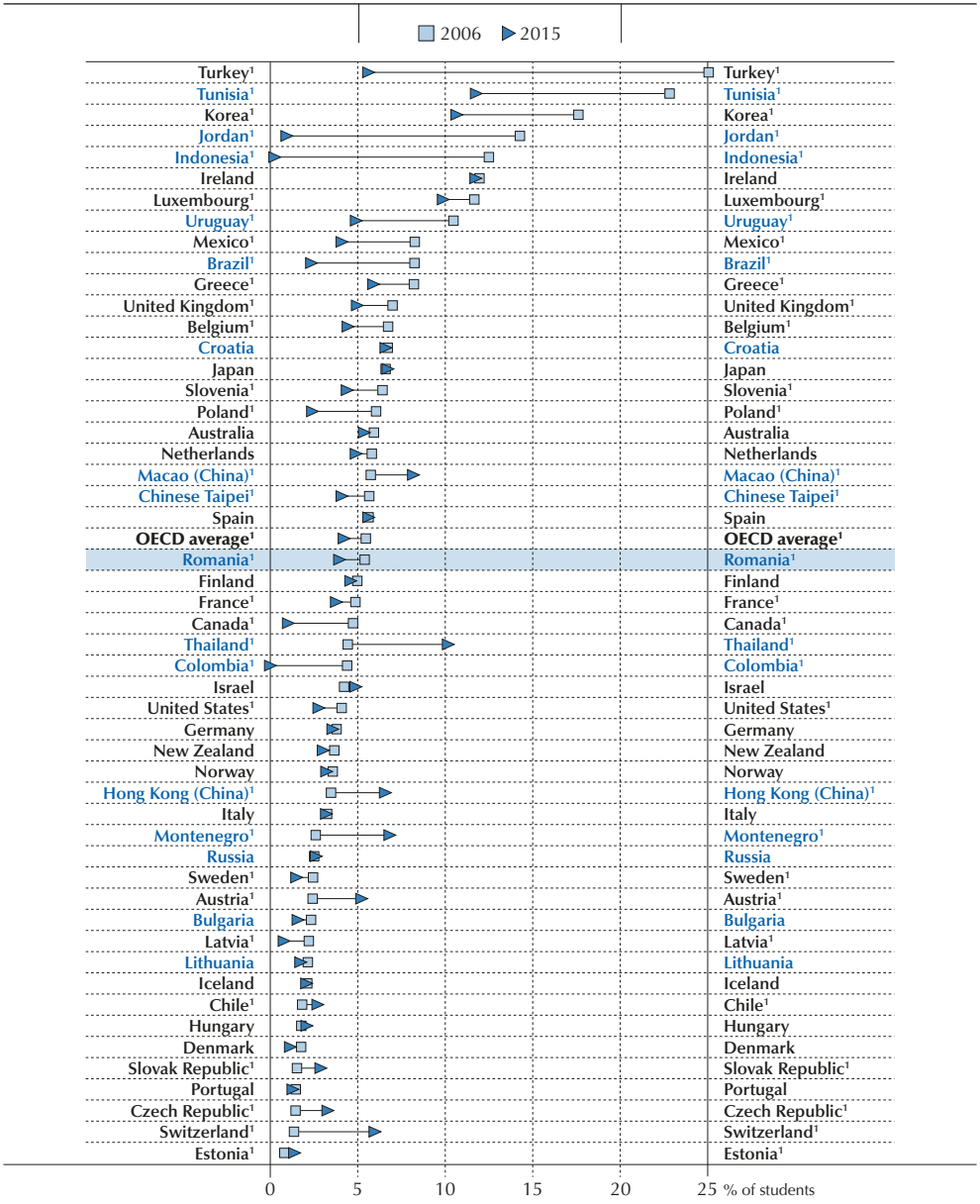
On average, about 5.5% of students in PISA 2006 expected to work as teachers, whereas about 4.2% of students in PISA 2015 held similar expectations (Figure 4.5). However, there are substantial between-country differences in the way the percentage of students expecting to become teachers has changed over time. In 10 countries and economies, significant increases in the percentage of students who expected to work as teachers were observed between 2006 and 2015. Thailand shows the largest increase in this share of students (an increase of about six percentage points during the period), followed by Switzerland, Montenegro, Hong Kong (China), Austria and Macao (China), all with increases of between two and four percentage points. The share of students who expected to pursue a career in teaching also increased in Chile, the Czech Republic, Estonia and the Slovak Republic, but by less than two percentage points.

By contrast, in 22 countries/economies, there was downward trend in the share of students who expected a teaching career. Turkey shows the largest drop – by 19 percentage points – followed by Jordan, Indonesia and Tunisia (with decreases of between 10 and 14 percentage points). The declines in Turkey, Jordan and Indonesia might be related to the large increases in secondary enrolment rates, and in the share of 15-year-olds represented in the PISA population (OECD, 2016, Table I.6.1[31]). On the one hand, the high demand for teachers that this implied might have contributed to the large shares of students who expected a career as teachers in the past. On the other hand, the increase in the overall number of 15-year-old students means that the number of students who expected a career in teaching declined less sharply than the share of students who expected so.

Trend comparisons indicate that, in the majority of countries, changes in the academic performance of students who reported that they expect to work as teachers were similar to those of students who expected to pursue a career other than teaching. However, in seven countries, as well as on average across OECD countries, the reading and mathematics scores of students who reported that they expect to work as teachers improved less – or declined faster – than those of students with different career expectations, resulting in a less academically select pool of teacher candidates: Croatia, Finland, Germany, Ireland, the Netherlands, Spain and the United Kingdom (the same negative trend was observed in Luxembourg and Montenegro for mathematics scores only, and in France and Latvia for reading scores only [Table 4.4]).

On average across countries, reductions in the share of students who expected to work as teachers coincided with improvements in the relative performance of the students who held such expectations. There is a negative correlation between changes in the share of students with expectations of a career in teaching and changes in the performance premium in mathematics between these students and students with other career expectations ($r = -0.23$ across 50 countries and economies with valid data; $r = -0.30$ after excluding Turkey, an outlier).

Figure 4.5 ■ **Change between 2006 and 2015 in the percentage of students who expect to work as teachers**



1. Countries/economies in which the change between 2006 and 2015 is statistically significant.

Countries and economies are ranked in descending order of the percentage of 15-year-old students, in 2006, who expect to be working as teachers when they are 30 years old.

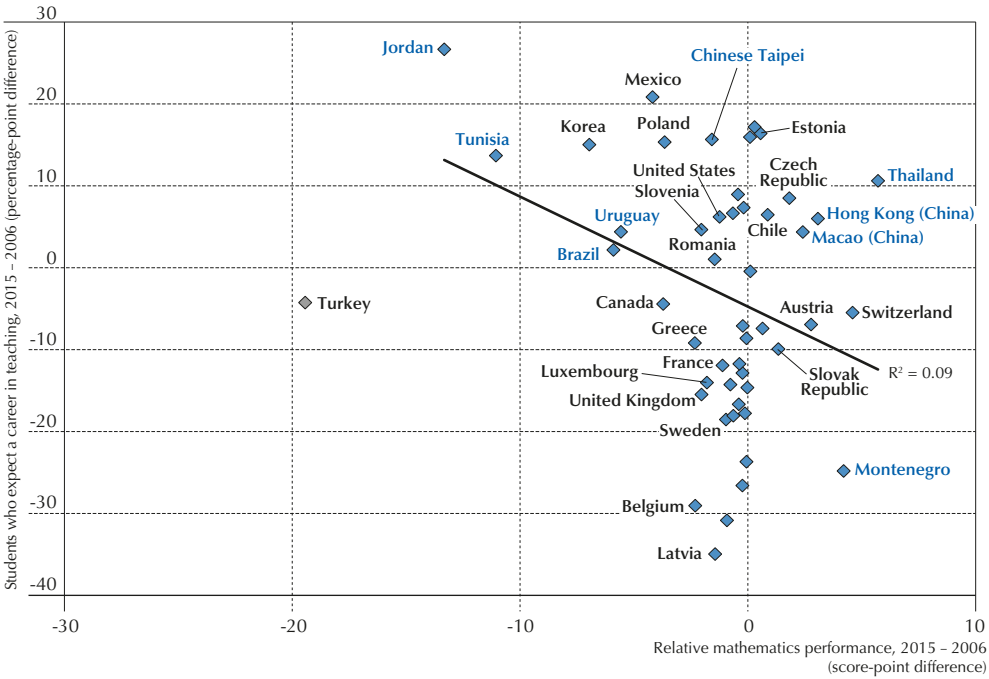
Source: OECD PISA 2015 Database, Table 4.4.

StatLink http://dx.doi.org/10.1787/888933740858

This could mean that expectations of a career in teaching among academically weaker students are more volatile, and perhaps more sensitive to changes in teachers' compensation and working conditions, than those of academically stronger students (Figure 4.6).

Figure 4.6 ■ **Change between 2006 and 2015 in expectations of a teaching career and students' relative performance in mathematics**

How changes in the score-point difference between students who expect a teaching career and students with other career expectations relate to changes in the percentage of students who expect a teaching career (PISA 2015 – PISA 2006)



Notes: Countries/economies named on the chart show a significant change in the percentage of students who expect a career as teachers between 2006 and 2015. Countries/economies where the increase or decrease is not significant are Australia, Bulgaria, Croatia, Denmark, Finland, Germany, Hungary, Iceland, Ireland, Israel, Italy, Japan, Lithuania, the Netherlands, New Zealand, Norway, Portugal, the Russian Federation and Spain.

The line indicates the linear relationship observed between the relative mathematics performance of students who expected a teaching career and the share of such students in each country/economy. The data for Turkey are not used to estimate this relationship.

Source: OECD PISA 2015 Database, Table 4.4.

StatLink http://dx.doi.org/10.1787/888933740877

In Bulgaria, Canada, Indonesia, Montenegro, Switzerland and Uruguay, the proportion of girls among students who expected a career in teaching increased significantly between 2006 and 2015. In contrast, in Hong Kong (China), the Netherlands, Portugal, Spain, Chinese Taipei and the United Kingdom, the group of students who expected a career in teaching became more

masculine over the period (Table 4.4). No correlation is observed between the overall change in the share of students who expected a career in teaching and the change in the share of girls among this group of students. This means that, in general, the expectations of boys and girls evolved in similar directions, and with similar intensity, over the period.

WHAT FACTORS EXPLAIN TRENDS BETWEEN 2006 AND 2015?

Were there country-specific changes in teachers' working conditions that could explain trends in students' expectations to become teachers? In order to examine this, country-level changes in students' expectations to pursue a teaching career were related to changes in the ratio of students to teaching staff and in teachers' salaries. Salary changes were measured both in real and in relative terms, i.e. adjusted for inflation (in real terms) and compared to the average income growth across the economy, as measured by per capita GDP levels (in relative terms).[10]

Results reveal that changes in teachers' relative salaries are positively associated with changes in students' expectations of a teaching career overall. In other words, in countries where teachers' salaries increased more rapidly than per capita GDP between 2005 and 2015, there was often an increase in the percentage of students who expected to work as teachers; in countries where teachers' salaries did not keep up with overall GDP growth – as was the case in Korea and Turkey – this percentage decreased, on average ($r = 0.43$, across 24 OECD countries). However, the relative performance of students who expected to work as teachers decreased, on average, in countries where teachers' salaries increased more rapidly than GDP growth ($r = -0.50$ for mathematics) (Figure 4.7).

Both PISA 2015 analyses (Table 4.10) and trends analyses (Figure 4.7) therefore suggest that increases in teachers' salaries might not be enough to attract more high-achieving students to the teaching profession.

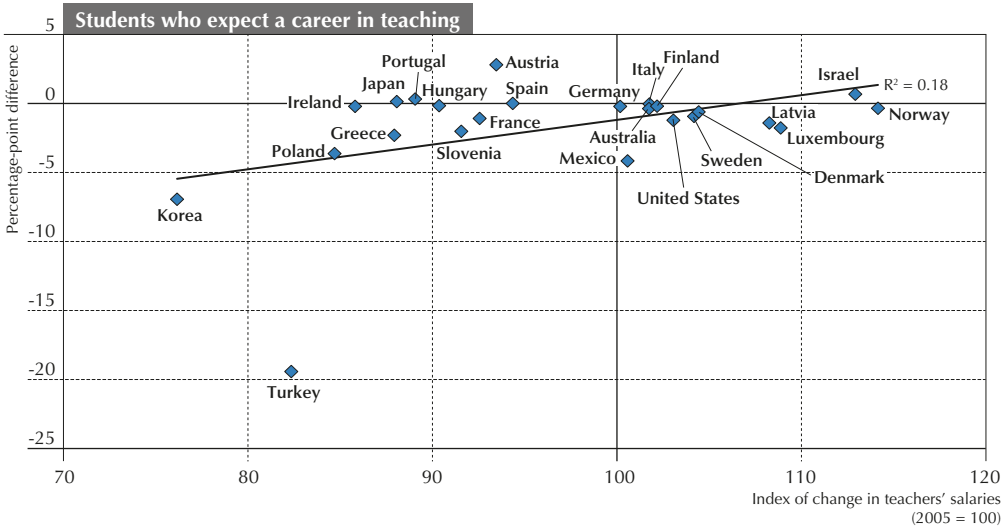
In contrast, reductions in the number of students per teacher, in schools attended by 15-year-olds, are unrelated to the overall share of students who expected a career in teaching, but are associated with better relative mathematics performance among students who expected a career in teaching, even though the association is weak ($r = -.31$ across 47 countries/economies) (Figure 4.8). To the extent that lower student-teacher ratios signal better working conditions – e.g. less instruction time and smaller classes – this might suggest that high-performing students are more sensitive to their teachers' working conditions, when deciding whether to pursue a career in teaching, than to monetary compensation.

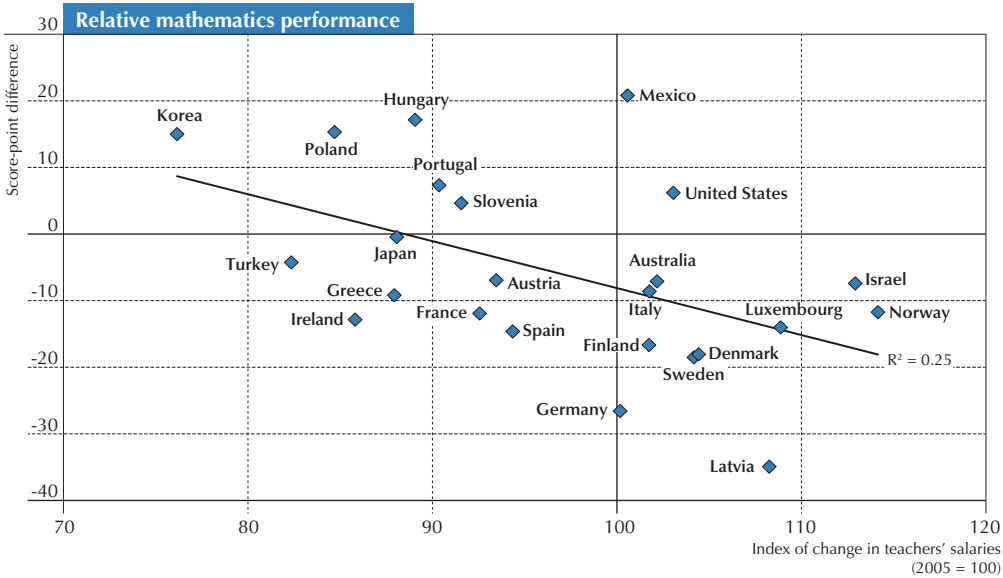
CONCLUSION

Attracting high-achieving and highly motivated candidates to the teaching profession is a top priority in many countries. The quality of the teaching force has been shown to be more important than any other aspect of schooling in predicting students' academic outcomes (Nye, Konstantopoulos and Hedges, 2004[38]; Rivkin, Hanushek and Kain, 2005[39]). But the analysis in this chapter shows that only a few – and mostly high-performing – countries are able to attract top-of-the class students into teaching.

Figure 4.7 ■ **Change between 2006 and 2015 in teachers' relative salaries and students' expectations of a teaching career**

How changes in teachers' salaries after 15 years of experience relative to GDP (2005 to 2015) relate to changes in the percentage of students who expect a teaching career and to changes in the score-point difference between students who expect a teaching career and students with other career expectations (PISA 2015 – PISA 2006)



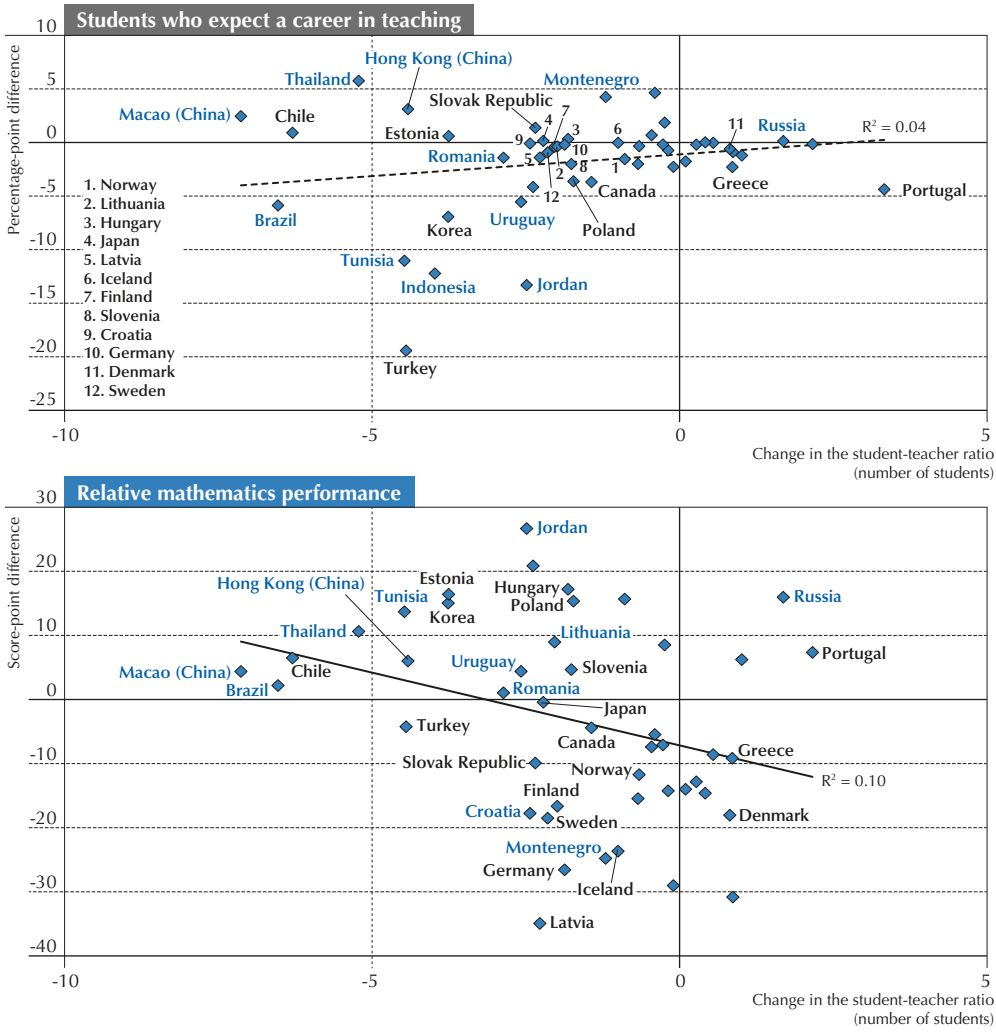


Source: OECD PISA 2015 Database, Tables 2.14 and 4.4.

StatLink http://dx.doi.org/10.1787/888933740896

Figure 4.8 ■ **Change between 2006 and 2015 in student-teacher ratios and students' expectations of a teaching career**

How changes in the average student-teacher ratio in schools attended by 15-year-olds relate to changes in the percentage of students who expect a career in teaching and to changes in the score-point difference between students who expect a career in teaching and students with other career expectations (PISA 2015 – PISA 2006)



Notes: Countries/economies named on the charts show significant changes in the average student-teacher ratio in schools attended by 15-year-olds between 2006 and 2015. Countries and economies included in this chart with non-significant changes in the student-teacher ratio are: Australia, Belgium, Bulgaria, Colombia, the Czech Republic, Ireland, Israel, Italy, Luxembourg, Mexico, the Netherlands, Spain, Switzerland, Chinese Taipei, the United Kingdom and the United States.

The dotted line indicates a non-significant relationship.

Source: OECD PISA 2015 Database, Tables 2.1 and 4.4.

StatLink http://dx.doi.org/10.1787/888933740915

Recently, concerns about the demographic composition of the teaching profession have also emerged. Male teachers, and teachers with a migrant background, are generally under-represented compared to the actual diversity of students (OECD, 2005, p. 59[6]; Donlevy, Meierkord and Rajania, 2016[5]). This is a critical issue because teachers from minority backgrounds can serve as role models for students from the same, or other, minority backgrounds (Zirkel, 2002[40]), as well as for all students (King, 1993[41]). These teachers can also apply their understanding of minority students' cultural backgrounds and experiences to their work (Warikoo, 2004[42]). The literature also indicates that assignment to a same-gender teacher can significantly improve achievement, and influences teachers' perceptions of their students' performance and students' engagement with their teacher's subject (Lim and Meer, 2017[43]; Dee, 2005[44]; Dee, 2007[45]).

Despite the suggested benefits of diversity in the teaching workforce, analyses reported in this chapter suggest that the teaching force in elementary and secondary schools is likely to remain homogeneous in the future.

Several studies suggest that salary increases and better working conditions would attract more high-skilled teacher candidates and candidates from diverse backgrounds (Guarino, Santibañez and Daley, 2006[46]; Leigh, 2012[47]). However, results presented in this chapter suggest that extrinsic economic incentives alone are not sufficient, and might even prove more attractive to low-achieving students (whose career decisions appears more sensitive to salary levels) than to high-achieving students.

These results are in line with evidence emerging from previous analyses based on PISA 2006. Han, Borgonovi and Guerriero (2017[48]) found that in countries with higher teachers' salaries, students are more likely to expect to work as teachers; but the positive association between teachers' salaries and students' expectations of a teaching career differs depending on students' performance in mathematics. They found that teachers' salaries were not associated with high-achieving students' expectations to pursue a teaching career, whereas higher teachers' salaries were associated with middle- and low-achieving students' expectations to become a teacher.

In contrast, this chapter suggests that high-performing students are at least as sensitive as low-achieving students to other characteristics of teaching – such as student-teacher ratios and whether teachers reported that the teaching profession is valued in society. Thus, policy makers should consider a wide range of qualitative improvements to teachers' working conditions to make teaching careers more attractive to high-achieving students. At the same time, they could perhaps increase the level of professional autonomy and responsibility, the opportunities for personal and intellectual growth, and the possibilities of career progression that teachers enjoy – and make students more aware of these aspects of the "job description", in order to help make teaching a more attractive option for high-achieving students in particular. Sahlberg (2010[22]) suggests that one of the main reasons why teaching attracts high-performing students in Finland is the (accurate) perception of the profession as providing high levels of autonomy and intellectual challenge. Policy makers might also consider more direct ways of attracting the most talented students into teaching, e.g. with merit-based scholarships or targeted subsidies, as exist in Shanghai (Darling-Hammond et al., 2017[49]) and as have been introduced, since 2010, in Chile (Bruns and Luque, 2015, pp. 26-27[1]; Ministerio de Educación, 2018[50]).

Results suggest that higher teachers' salaries might reduce gender imbalances in the teaching profession, but only marginally. Targeted policies, such as communications and media campaigns, outreach efforts, and flexible pathways to enter the teaching profession for individuals with unconventional backgrounds, such as those offered through the "Teach for All" network,[11] are likely to be more cost-effective.

Notes

1. Data from the Teaching and Learning International Survey (TALIS) 2013 are used for this analysis, together with data on teachers' salaries from the OECD *Education at a Glance* database, which was extended, for partner countries and economies, through a special system-level data collection conducted in collaboration with PISA Governing Board members and National Project Managers (OECD, 2016, Table II.6.54[3]).

2. Both PISA 2006 and 2015 questionnaires included a single open-ended question about students' career expectations. The PISA 2006 dataset used the ISCO-88 classification, while the PISA 2015 used the ISCO-08 classification. Although the ISCO-88 and ISCO-08 classifications differ, the International Labour Organization (ILO) has developed conversion matrices that make it possible to align the ISCO-88 occupational categories with the more recent ISCO-08 categories. Data on changes in teachers' salaries (adjusted for inflation) are available for 24 OECD countries only, and are based on the *Education at a Glance* database (see Table 2.14). Data on class size and the ratio of students to teaching staff are based on principals' reports to the PISA school questionnaire, and refer to language-of-instruction classes for the modal grade attended by 15-year-olds, and to student-teacher ratios in schools attended by 15-year-olds, respectively (see Tables 2.1 and 2.7).

3. The British Cohort Study of 1970, an ongoing study that follows individuals born in 1970, asked participants at age 16 – i.e. in 1986 – about their occupational interests and aspirations. These can be compared to their actual careers as observed in later follow-up surveys.

4. In order to compute shares of teachers for this analysis, teacher weights were generated so that the sum of teacher weights within each school is equal to the sum of student weights within the same school. All science teachers within a school have the same weight, as do all non-science teachers within a school. Data for science and non-science teachers are analysed separately, as these define two distinct and non-overlapping populations for sampling. The text reports the average percentage of teachers – both science and non-science teachers – who had chosen to pursue a teaching career by the end of secondary school.

5. Information on teacher shortages in mathematics and science was not collected in PISA 2015.

6. Source: http://databank.worldbank.org/data/reports.aspx?source=Education-Statistics-~-All-Indicators#, accessed 15 December 2017.

7. Also see Chapter 2.

8. Three-level models, with students (level 1) nested within schools (level 2) and within countries (level 3), were estimated. Because the dependent variable is binary, this chapter uses hierarchical generalised linear models (HGLMs) in which the level 1 sampling model is a Bernoulli distribution (Raudenbush and Bryk, 2002[52]). The country weight factor for normalised weights (multilevel analysis), CNTFAC, was used to ensure that each country contributes equally to the analysis (OECD, 2009[51]).

9. Thirty-six countries/economies participated in both surveys; however, data on statutory teachers' salaries are not available for England (United Kingdom) the Russian Federation and Shanghai (China), which were therefore not included in the analysis. Belgium is also not included, as only the Flemish Community participated in TALIS, but only the French and German-speaking communities collected data on students' career expectations. TALIS data for Canada and the United Arab Emirates refer to the province of Alberta and the Emirate of Abu Dhabi only.

10. Data on changes in teachers' salaries between 2005 and 2015 are available in Table 2.14 for 24 OECD countries. Data on per capita GDP growth between 2005 and 2015 (adjusted for inflation) were downloaded from the OECD Annual National Accounts database (http://stats.oecd.org, accessed 18 December 2017).

11. https://teachforall.org/; accessed 15 February 2018.

References

Aksu, M. et al. (2010), "Who are the future teachers in Turkey? Characteristics of entering student teachers", *International Journal of Educational Development*, Vol. 30/1, pp. 91-101, http://dx.doi.org/10.1016/J.IJEDUDEV.2009.06.005. [14]

Ashby, J. and **I. Schoon** (2010), "Career success: The role of teenage career aspirations, ambition value and gender in predicting adult social status and earnings", *Journal of Vocational Behavior*, Vol. 77/3, pp. 350-360, http://dx.doi.org/10.1016/J.JVB.2010.06.006. [19]

Barber, M. and **M. Mourshed** (2007), *How the world's best-performing schools come out on top*, McKinsey&Co, http://mckinseyonsociety.com/how-the-worlds-best-performing-schools-come-out-on-top/ (accessed on 24 November 2017). [23]

Binder, J. et al. (2009), "Does contact reduce prejudice or does prejudice reduce contact? A longitudinal test of the contact hypothesis among majority and minority groups in three european countries", *Journal of Personality and Social Psychology*, Vol. 96/4, pp. 843-856, http://dx.doi.org/10.1037/a0013470. [10]

Brookhart, S. and **D. Freeman** (1992), "Characteristics of Entering Teacher Candidates", *Review of Educational Research*, Vol. 62/1, p. 37, http://dx.doi.org/10.2307/1170715. [18]

Bruns, B. and **J. Luque** (2015), *Great Teachers: How to Raise Student Learning in Latin America and the Caribbean*, The World Bank Group, Washington DC, http://dx.doi.org/doi:10.1596/978-1-4648-0151-8. [1]

Cheryan, S. et al. (2011), "Do Female and Male Role Models Who Embody STEM Stereotypes Hinder Women's Anticipated Success in STEM?", *Social Psychological and Personality Science*, Vol. 2/6, pp. 656-664, http://dx.doi.org/10.1177/1948550611405218. [12]

Cunningham, M. and **L. Hargreaves** (2007), *Minority ethnic teachers' professional experiences: Evidence from the Teacher Status Project*, DfES Research Report RR853. [36]

Darling-Hammond, L. and **P. Youngs** (2002), "Defining 'Highly Qualified Teachers': What Does 'Scientifically-Based Research' Actually Tell Us?", *Educational Researcher,* Vol. 31/9, pp. 13-25, http://dx.doi.org/10.3102/0013189X031009013. [24]

Darling-Hammond, L. et al. (2017), *Empowered Educators: How High-Performing Systems Shape Teaching Quality Around the World*, Jossey-Bass, San Francisco. [49]

Dee, T. (2004), "Teachers, Race, and Student Achievement in a Randomized Experiment", *Review of Economics and Statistics*, Vol. 86/1, pp. 195-210, http://dx.doi.org/10.1162/003465304323023750. [7]

Dee, T. (2005), "A teacher like me: Does race, ethnicity, or gender matter?", *American Economic Review,* Vol. 95/2, pp. 158-165, http://dx.doi.org/10.1257/000282805774670446. [44]

Dee, T. (2007), "Teachers and the Gender Gaps in Student Achievement", Journal of Human Resources, Vol. XLII, pp. 528-554, http://dx.doi.org/10.3368/jhr.XLII.3.528. [45]

Dilworth, M. and **J. Coleman** (2014), *Time for a Change Diversity in Teaching Revisited*, National Education Association, Washington DC, www.nea.org/assets/docs/Time_for_a_Change_Diversity_in_Teaching_Revisited_(web).pdf (accessed on 6 March 2018). [4]

Dolton, P. (2006), "Teacher Supply", in Hanushek, E., S. Machin and L. Woessmann (eds.), *Handbook of the economics of education*, North-Holland, http://dx.doi.org/10.1016/S1574-0692(06)02019-8. [35]

Dolton, P. (2014), "The Economics of UK Teacher Supply: The Graduate's Decision", *The Economic Journal*, Vol. 100/400, www.jstor.org/stable/pdf/2234187.pdf (accessed on 6 March 2018). [34]

Donlevy, V., A. Meierkord and **A. Rajania** (2016), *Study on the diversity within the teaching profession with particular focus on migrant and/or minority background*, European Commission, Brussels, http://dx.doi.org/10.2766/17921. [5]

Egalite, A., B. Kisida and **M. Winters** (2015), "Representation in the classroom: The effect of own-race teachers on student achievement", *Economics of Education Review*, Vol. 45, pp. 44-52, http://dx.doi.org/10.1016/J.ECONEDUREV.2015.01.007. [9]

Egalite, A. and **B. Kisida** (2018), "The Effects of Teacher Match on Students' Academic Perceptions and Attitudes", *Educational Evaluation and Policy Analysis*, Vol. 40/1, pp. 59-81, http://dx.doi.org/10.3102/0162373717714056. [8]

Guarino, C., L. Santibañez and **G. Daley** (2006), "Teacher Recruitment and Retention: A Review of the Recent Empirical Literature", *Review of Educational Research*, Vol. 76/2, pp. 173-208, http://dx.doi.org/10.3102/00346543076002173. [46]

Han, S., F. Borgonovi and **S. Guerriero** (2017), "What Motivates High School Students to Want to Be Teachers? The Role of Salary, Working Conditions, and Societal Evaluations About Occupations in a Comparative Perspective", *American Educational Research Journal*, Vol. 55/1, pp. 3-39, http://dx.doi.org/10.3102/0002831217729875. [48]

Hanushek, E., M. Piopiunik and **S. Wiederhold** (2014), "The Value of Smarter Teachers: International Evidence on Teacher Cognitive Skills and Student Performance", Working Paper, No. 20727, National Bureau of Economic Research, Cambridge, MA, http://dx.doi.org/10.3386/w20727. [26]

Kang, N. and **M. Hong** (2008), "Achieving Excellence in Teacher Workforce and Equity in Learning Opportunities in South Korea", *Educational Researcher*, Vol. 37/4, pp. 200-207, http://dx.doi.org/10.3102/0013189X08319571. [21]

Kelleher, F. et al. (2011), *Women and the Teaching Profession Exploring the Feminisation Debate*, Commonwealth Secretariat and UNESCO, London, http://unesdoc.unesco.org/images/0021/002122/212200e.pdf (accessed on 6 March 2018). [29]

King, S. (1993), "The Limited Presence of African-American Teachers", *Review of Educational Research*, Vol. 63/2, pp. 115-149, http://dx.doi.org/10.3102/00346543063002115. [41]

Lee, J., S. Clery and **J. Presley** (2001), *Path to teaching*, Illinois Education Research Council, Southern Illinois University. [16]

Leigh, A. (2012), "Teacher pay and teacher aptitude", *Economics of Education Review*, Vol. 31/3, pp. 41-53, http://dx.doi.org/10.1016/J.ECONEDUREV.2012.02.001. [47]

Lim, J. and **J. Meer** (2017), "Persistent Effects of Teacher-Student Gender Matches", Working Paper, No. 24128, National Bureau of Economic Research, Cambridge, MA, http://dx.doi.org/10.3386/w24128. [43]

Mercer, W. and **M. Mercer** (1986), "Standardized Testing: Its Impact on Blacks in Florida's Education System", *Urban Educator*, Vol. 8/1, pp. 105-113. [11]

Meroni, E., E. Vera-Toscano and P. Costa (2015), "Can low skill teachers make good students? Empirical evidence from PIAAC and PISA", *Journal of Policy Modeling*, Vol. 37/2, pp. 308-323, http://dx.doi.org/10.1016/J.JPOLMOD.2015.02.006. [27]

Ministerio de Educación, C. (2018), *Política Nacional Docente*, www.politicanacionaldocente.cl/ (accessed on 6 March 2018). [50]

Moss-Racusin, C. and **E. Johnson** (2016), "Backlash against male elementary educators", *Journal of Applied Social Psychology*, Vol. 46/7, pp. 379-393, http://dx.doi.org/10.1111/jasp.12366. [13]

Nye, B., S. Konstantopoulos and **L. Hedges** (2004), "How Large Are Teacher Effects?", *Educational Evaluation and Policy Analysis*, Vol. 26/3, pp. 237-257, http://dx.doi.org/10.3102/01623737026003237. [38]

OECD (2005), *Teachers Matter: Attracting, Developing and Retaining Effective Teachers*, OECD Publishing, Paris, http://dx.doi.org/10.1787/19901496. [6]

OECD (2009), *PISA Data Analysis Manual: SPSS, Second Edition*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264056275-en. [51]

OECD (2010), *Closing the Gap for Immigrant Students: Policies, Practice and Performance*, OECD Reviews of Migrant Education, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264075788-en. [32]

OECD (2010), *Educating Teachers for Diversity: Meeting the Challenge*, Educational Research and Innovation, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264079731-en. [33]

OECD (2013), *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264201156-en. [2]

OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264267510-en. [3]

OECD (2016), *Education at a Glance 2016: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2016-en. [28]

OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264266490-en. [31]

Page, J. and **F. Page** (1984), *High School Senior Perceptions of Teaching as a Career Opportunity.*, Paper presented at the Annual Meeting of the Association of Teacher Educators, New Orleans LA, https://eric.ed.gov/?id=ED241534 (accessed on 6 March 2018). [17]

Park, H. and **S. Byun** (2015), "Why Some Countries Attract More High-Ability Young Students to Teaching: Cross-National Comparisons of Students' Expectation of Becoming a Teacher", *Comparative Education Review*, Vol. 59/3, pp. 523-549, http://dx.doi.org/10.1086/681930. [37]

Raudenbush, S. and **A. Bryk** (2002), *Hierarchical Linear Models: Applications and Data Analysis Methods*, Sage Publications, Thousand Oaks. [52]

Richardson, P. and **H. Watt** (2005), "'I've decided to become a teacher': Influences on career change", *Teaching and Teacher Education*, Vol. 21/5, pp. 475-489, http://dx.doi.org/10.1016/J.TATE.2005.03.007. [15]

Rivkin, S., E. Hanushek and **J. Kain** (2005), "Teachers, Schools, and Academic Achievement", *Econometrica*, Vol. 73/2, pp. 417-458, http://dx.doi.org/10.1111/j.1468-0262.2005.00584.x. [39]

Sahlberg, P. (2010), *The Secret to Finland's Success: Educating Teachers*, Stanford Center for Opportunity Policy in Education Research Brief, https://edpolicy.stanford.edu/library/publications/290 (accessed on 6 March 2018). [22]

Schoon, I. and **S. Parsons** (2002), "Teenage Aspirations for Future Careers and Occupational Outcomes", *Journal of Vocational Behavior*, Vol. 60/2, pp. 262-288, http://dx.doi.org/10.1006/JVBE.2001.1867. [20]

UNESCO (2012), *World Atlas of Gender Equality in Education*, UNESCO, Paris. [30]

Warikoo, N. (2004), "Race and the teacher–student relationship: Interpersonal connections between West Indian students and their teachers in a New York City high school", *Race Ethnicity and Education*, Vol. 7/2, pp. 135-147, http://dx.doi.org/10.1080/1361332042000234268. [42]

Wayne, A. and P. Youngs (2003), "Teacher Characteristics and Student Achievement Gains: A Review", *Review of Educational Research,* Vol 73/1, pp. 89-122, http://dx.doi.org/10.3102/00346543073001089. [25]

Zirkel, S. (2002), "Is There A Place for Me? Role Models and Academic Identity among White Students and Students of Color", *Teachers College Record*, Vol. 104/2, pp. 357-376, http://dx.doi.org/10.1111/1467-9620.00166. [40]

Annex A

TECHNICAL NOTES ON ANALYSES IN THIS REPORT

Standard errors and significance tests

The statistics in this report (e.g. means and patterns of association between variables) represent estimates that are based on samples, rather than values that could be calculated if every student, teacher and principal in every country had answered every question. Consequently, it is important to measure the degree of uncertainty of the estimates when inferences are made about countries' populations of students, teachers and schools. In PISA, each estimate has an associated degree of uncertainty, which is expressed through a standard error.

In many cases, readers are primarily interested in whether a given value in a particular country is different from a second value in the same or another country, e.g. whether the average class size in the modal grade for 15-year-olds increased between 2006 and 2015 or whether it is larger in the most advantaged schools than in the most disadvantaged schools. In the tables and charts used in this report, differences are labelled as statistically significant when a difference of that magnitude or larger would be observed less than 5% of the time, if there were actually no difference in corresponding population values. Similarly, the risk of reporting a correlation as significant if there is, in fact, no correlation between two measures, is contained at 5%. Throughout the report, significance tests were undertaken to assess the statistical significance of the comparisons made.

With the exception of statistics based on multilevel models (see below), the reported standard errors are computed with a balanced repeated replication (BRR) methodology. In some cases – e.g. where a proportion is estimated to be equal to 0% or 100%, or where the entire population of schools with a particular characteristic was included (census), rather than a sample, this method results in an estimated sampling uncertainty of 0. The corresponding estimate is replaced by a "c" in the tables, to indicate that there are too few observations to provide reliable estimates of the statistical uncertainty. Indeed, the lack of variation within the sample does not constitute definite evidence that there is no variation in the population at large; and even if there is no sampling uncertainty when a census is conducted, there may be other sources of uncertainty – such as misreporting, item non-response, etc. – that are not quantified in standard errors.

Overall ratios and average ratios

When comparing the student-teacher ratio or the proportion of fully certified teachers across countries or across types of schools, the quantity of interest is, in this report, the overall ratio that can be obtained by dividing the total number of students (or of fully certified teachers) in the target population by the total number of teachers in the target population. In most cases (i.e. unless all schools are exactly of the same size) this overall ratio differs from the average of school-level ratios.

This report estimates the overall student-teacher ratio, proportion of fully certified teachers, and proportion of teachers with a major in science from school samples, by first computing the numerator and denominator as the (weighted) sum of school-level totals, then dividing the numerator by the denominator.

Definition of advantaged and disadvantaged schools

Chapter 3 defines advantaged and disadvantaged schools in terms of the socio-economic profile and of the academic profile of schools. For both definitions, all schools in each PISA-participating education system are ranked by a composite score and then divided into four groups with approximately an equal number of students (quarters).

The socio-economic profile of a school is measured by the average PISA index of economic, social and cultural status (ESCS) of its 15-year-old students. Schools in the bottom quarter of average ESCS are referred to as "socio-economically disadvantaged schools"; and schools in the top quarter of average ESCS are referred to as "socio-economically advantaged schools".

The academic profile of a school is measured by the expected mean performance, given its students' socio-demographic characteristics (ESCS, immigrant background, language spoken at home, gender and age), computed with a regression model. This model ensures that each characteristic is weighted according to its country-specific importance in determining student disadvantage.

Pearson and Spearman correlation coefficients

Correlation coefficients measure the strength and direction of the statistical association between two variables. Correlation coefficients vary between -1 and 1; values around 0 indicate a weak association, while the extreme values indicate the strongest possible negative or positive association.

The Pearson correlation coefficient (indicated by the letter r) measures the strength and direction of the linear relationship between two variables. In this report, Pearson correlation coefficients are used to quantify relationships between country-level statistics. With only two variables (*x* and *y*), the r-square measure (indicated by R^2) of the linear regression of *y* on *x* (or, equivalently, of *x* on *y*) is the square of the Pearson correlation coefficient between the two variables.

The Spearman correlation is a measure of how well the relationship between two variables can be described by a monotonic (but not necessarily linear) function. Spearman correlation coefficients are computed in Chapter 3 at the school level. Because the Spearman correlation coefficient is based on the rank of each school within the sample rather than on its value, it is not affected by weights. Standard errors based on BRR weights could therefore not be computed.

Use of student, school and teacher weights

The target population in PISA is 15-year-old students, but a two-stage sampling procedure is used in PISA. After the population is defined, school samples are selected with a probability proportional to the expected number of eligible students in each school. Only in a second sampling stage are students drawn from among the eligible students in each selected school.

Although the student samples were drawn from within a sample of schools, the school sample was designed to optimise the resulting sample of students, rather than to give an optimal sample of schools. It is therefore preferable to analyse the school-level variables as attributes of students (e.g. in terms of the share of 15-year-old students affected), rather than as elements in their own right.

Most analyses of student and school characteristics are therefore weighted by student final weights (or their sum, in the case of school characteristics), and use student replicate weights for estimating standard errors.

As an exception, estimates of "overall ratios" in which the denominator corresponds to the population of teachers (student-teacher ratios; proportions of fully certified teachers and proportion of science teachers with a university degree and a major in science) use school weights, which correspond to the inverse of the prior probability of selection for each selected school. Replicate school weights were generated for these analyses in analogy with the student replicate weights in the database, by applying the replicate factors observed for student weights within the school (one value among 0.2929, 0.5, 0.6464,1, 1.3536, 1.5 or 1.7071) to the base school weights (OECD, 2017, pp. 123-124[1])

Analyses based on teacher responses to the teacher questionnaires are weighted by student weights. In particular, in order to compute averages and shares based on teacher responses, final teacher weights were generated so that the sum of teacher weights within each school is equal to the sum of student weights within the same school. The same procedure was used to generate replicate teacher weights in analogy with the student replicate weights in the database. All science teachers within a school have the same weight, as do all non-science teachers within a school. Data for science and non-science teachers are analysed separately, as these define two distinct and non-overlapping populations for sampling.

For the computation of means, this is equivalent to aggregating teacher responses to the school level through simple, unweighted means, and then applying student weights to these school-level aggregates.

Statistics based on multilevel models

Statistics based on multilevel models include variance components (between- and within-school variance), the index of intra-class correlation derived from these components, and regression coefficients where this has been indicated.

Two-level models in Chapter 2

Multilevel models in Chapter 2 are specified as two-level regression models (the student and school levels, or the teacher and school levels), with normally distributed residuals, and estimated with maximum likelihood estimation. Where the dependent variable is science, reading, or mathematics performance, the estimation uses ten plausible values for each student's performance on the performance scale. Models were estimated using the Stata ® (version 15.1) "mixed" module.

In two-level models, weights are used at both the student/teacher and school levels. The purpose of these weights is to account for differences in the probabilities of students being selected in the sample.

For multilevel models where the dependent variable is at the student level, final student weights (W_FSTUWT) were used. Students' within-school weights correspond to student final weights, rescaled to amount to the sample size within each school. School weights correspond to the sum of final student weights within each school. This definition of school weights is the same used in the PISA 2015 and PISA 2012 Initial Reports.

For multilevel models where the dependent variable is at the teacher level, all teachers included in the model were assigned a weight equal to 1; school weights correspond to the sum of final student weights within each school.

The index of intra-class correlation is defined and estimated as:

$$100* \frac{\sigma_w^2}{\sigma_w^2 + \sigma_b^2}$$

where σ_w^2 and σ_b^2, respectively, represent the within- and between-variance estimates.

Estimates based on multilevel models, and the between-school variance estimate in particular, depend on how schools are defined and organised within countries and by the units that were chosen for sampling purposes. For example, in some countries, some of the schools in the PISA sample were defined as administrative units (even if they spanned several geographically separate institutions, as in Italy); in others they were defined as those parts of larger educational institutions that serve 15-year-olds; in still others they were defined as physical school buildings; and in others they were defined from a management perspective (e.g. entities having a principal). The *PISA 2015 Technical Report* (OECD, 2017, pp. 86-88[1]) provides an overview of how schools are defined.

Because of the manner in which students and teachers were sampled, the within-school variation includes variation between classes as well as between students.

Three-level models in Chapter 4

Chapter 4 estimates a three-level regression model where the dependent variable is binary (expecting a career as a teacher). In this model, students (level 1) are nested within schools (level 2) and within countries (level 3). Because the dependent variable is binary, the regression model is specified as a

hierarchical generalised linear model (HGLM) with level 1 residuals following a Bernoulli distribution (Raudenbush and Bryk, 2002[2]). Normalised student weights were used in the estimation: these normalised weights ensure that each country contributes equally to the analysis (OECD, 2009, p. 219[3]). Models were estimated using HLM 7.

Standard errors in statistics estimated from multilevel models

For statistics based on multilevel models (such as the estimates of variance components and regression coefficients from multilevel regression models) the standard errors are not estimated with the usual replication method, which accounts for stratification and sampling rates from finite populations. Instead, standard errors are "model-based": their computation assumes that schools, and students within schools, are sampled at random (with sampling probabilities reflected in school and student weights) from a theoretical, infinite population of schools and students which complies with the model's parametric assumptions.

The standard error for the estimated index of intra-class correlation is calculated by deriving an approximate distribution for it from the (model-based) standard errors for the variance components, using the delta-method.

References

OECD (2009), *PISA Data Analysis Manual: SPSS, Second Edition*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264056275-en. [3]

OECD (2017), *PISA 2015 Technical Report*, PISA, OECD Publishing, Paris, www.oecd.org/pisa/data/2015-technical-report/ (accessed on 31 July 2017). [1]

Raudenbush, S. and **A. Bryk** (2002), *Hierarchical Linear Models: Applications and Data Analysis Methods*, Sage Publications, Thousand Oaks. [2]

Annex B

LIST OF TABLES AVAILABLE ON LINE

The following tables are available in electronic form only.

Chapter 2 Are there qualities unique to teachers in high-performing countries and schools?

http://dx.doi.org/10.1787/888933740934

WEB	Table 2.1	Student-teacher ratio in schools attended by 15-year-olds, 2006 through 2015
WEB	Table 2.2	Student-teacher ratio in lower secondary schools
WEB	Table 2.3	Student-teacher ratio in upper secondary schools
WEB	Table 2.4	Fully certified teachers in schools attended by 15-year-olds
WEB	Table 2.5	Fully certified teachers in lower secondary schools
WEB	Table 2.6	Fully certified teachers in upper secondary schools
WEB	Table 2.7	Class size in the modal grade for 15-year-olds, 2006 through 2015
WEB	Table 2.8	School responsibility for selecting and compensating teachers, 2006 through 2015
WEB	Table 2.9	School responsibility for selecting and compensating teachers, 2006 through 2015 (lower secondary schools)
WEB	Table 2.10	School responsibility for selecting and compensating teachers, 2006 through 2015 (upper secondary schools)
WEB	Table 2.11	Use of achievement data for school accountability, 2006 through 2015
WEB	Table 2.12	Use of achievement data for school accountability, 2006 through 2015 (lower secondary schools)
WEB	Table 2.13	Use of achievement data for school accountability, 2006 through 2015 (upper secondary schools)
WEB	Table 2.14	Change in teachers' salaries (2005-15)
WEB	Table 2.15	Age distribution of teachers (2005 and 2015)
WEB	Table 2.16	Social status of the teaching profession, teacher initial education, appraisal and feedback
WEB	Table 2.17	Teachers' views on school leadership
WEB	Table 2.18	Variation in science performance between and within schools
WEB	Table 2.19	Variation in student exposure to bullying between and within schools
WEB	Table 2.20	Variation in the disciplinary climate in science classes between and within schools
WEB	Table 2.21	Student and teacher characteristics associated with science performance
WEB	Table 2.22	Student and teacher characteristics associated with student exposure to bullying
WEB	Table 2.23	Student and teacher characteristics associated with the disciplinary climate in science classes
WEB	Table 2.24	Student and teacher characteristics associated with students' satisfaction with life
WEB	Table 2.25	Teacher working conditions associated with science performance
WEB	Table 2.26	Teacher working conditions associated with student exposure to bullying
WEB	Table 2.27	Teacher working conditions associated with the disciplinary climate in science classes
WEB	Table 2.28	Teacher working conditions associated with students' satisfaction with life

Chapter 3 Can teacher sorting compensate for student disadvantage?

http://dx.doi.org/10.1787/888933740953

WEB	Table 3.1	Variation in class size, by school characteristics
WEB	Table 3.2	Variation in class size, by school characteristics and type
WEB	Table 3.3	Students-teacher ratio, by school characteristics
WEB	Table 3.4	Students teacher ratio, by school characteristics and type
WEB	Table 3.5	Principals' views on the lack of teaching staff, by school characteristics
WEB	Table 3.6	Principals' views on the lack of teaching staff, by school characteristics and type
WEB	Tablle 3.7	Science teachers' views on the lack of teaching staff, by school characteristics
WEB	Table 3.8	Non-science teachers' views on the lack of teaching staff, by school characteristics
WEB	Table 3.9	Teacher absenteeism, by school characteristics
WEB	Table 3.10	Teacher absenteeism, by school characteristics and type
WEB	Table 3.11	Science teachers with a university degree and a major in science, by school characteristics
WEB	Table 3.12	Science teachers with a university degree and a major in science, by school characteristics and type
WEB	Table 3.13	Fully certified teachers, by school characteristics
WEB	Table 3.14	Fully certified teachers, by school characteristics and type
WEB	Table 3.15	Fully certified science teachers, by school characteristics
WEB	Table 3.16	Fully certified science teachers, by school characteristics and type
WEB	Table 3.17	Variation in science teachers' teaching experience, by school characteristics
WEB	Table 3.18	Variation in non-science teachers' teaching experience, by school characteristics

...

WEB Table 3.19 Variation in science teachers' seniority in the school, by school characteristics
WEB Table 3.20 Variation in non-science teachers' seniority in the school, by school characteristics
WEB Table 3.21 Science teachers with a short-term contract, by school characteristics
WEB Table 3.22 Non-science teachers with a short-term contract, by school characteristics
WEB Table 3.23 Trained science teachers, by school characteristics
WEB Table 3.24 Trained non-science teachers, by school characteristics
WEB Table 3.25 Principals' negative views on the teaching staff, by school characteristics
WEB Table 3.26 Principals' negative views on the teaching staff, by school characteristics and type
WEB Table 3.27 Science teachers' negative views on the teaching staff, by school characteristics
WEB Table 3.28 Non-cience teachers' negative views on the teaching staff, by school characteristics
WEB Table 3.29 Teachers not being well prepared for classes, by school characteristics
WEB Table 3.30 Teachers not being well prepared for classes, by school characteristics and type
WEB Table 3.31 Science teachers who participate in a network of teachers, by school characteristics
WEB Table 3.32 Non-science teachers who participate in a network of teachers, by school characteristics
WEB Table 3.33 Science teachers who mentor or coach other teachers, by school characteristics
WEB Table 3.34 Non-science teachers who mentor or coach other teachers, by school characteristics
WEB Table 3.35 Science teachers who talk informally with colleagues, by school characteristics
WEB Table 3.36 Non-science teachers who talk informally with colleagues, by school characteristics
WEB Table 3.37 Variation in non-science teachers' perceptions of the school leader as a transformational leader, by school characteristics
WEB Table 3.38 Variation in non-science teachers' perceptions of the school leader as a transformational leader, by school characteristics and type
WEB Table 3.39 Novice science teachers, by school characteristics
WEB Table 3.40 Novice non-science teachers, by school characteristics

Chapter 4 Who aspires to a career in teaching?

http://dx.doi.org/10.1787/888933740972

WEB Table 4.1 Students who expect a teaching career, by student background
WEB Table 4.2 Expectations of a teaching career among students who expect to work as professionals, by student background
WEB Table 4.3 Performance in science, reading and mathematics, by career expectation
WEB Table 4.4 Students who expect a career in teaching, 2006 and 2015
WEB Table 4.5 Current teachers' early career plans
WEB Table 4.6 Students with missing information on three questions in PISA 2006 and PISA 2015
WEB Table 4.7 Students' indecision about their future career in PISA 2006 and PISA 2015
WEB Table 4.8 Factors related to students' expectations of a teaching career
WEB Table 4.9 Factors related to students' expectations of a career in teaching rather than another profession
WEB Table 4.10 Relationship among teachers' salaries, status of teaching profession, and students' expectations of a teaching career

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where governments work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Union takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

OECD PUBLISHING, 2, rue André-Pascal, 75775 PARIS CEDEX 16
(98 2017 06 1P) ISBN 978-92-64-30159-7 – 2018

Effective Teacher Policies

INSIGHTS FROM PISA

Teachers are the most important resource in today's schools. In every country, teachers' salaries and training represent the greatest share of expenditure in education. And this investment in teachers can have significant returns: research shows that being taught by the best teachers can make a real difference in the learning and life outcomes of otherwise similar students. Teachers, in other words, are not interchangeable workers in some sort of industrial assembly line; individual teachers can change lives – and better teachers are crucial to improving the education that schools provide. Improving the effectiveness, efficiency and equity of schooling depends, in large measure, on ensuring that competent people want to work as teachers, that their teaching is of high quality and that high-quality teaching is provided to all students.

This report, building on data from the Indicators of Education Systems (INES) programme, the Teaching and Learning International Survey (TALIS) and the Programme for International Student Assessment (PISA), explores three teacher-policy questions: How do the best-performing countries select, develop, evaluate and compensate teachers? How does teacher sorting across schools affect the equity of education systems? And how can countries attract and retain talented men and women to teaching?

Consult this publication on line at: ***http://dx.doi.org/10.1787/9789264301603-en***

This work is published on the *OECD iLibrary,* which gathers all OECD books, periodicals and statistical databases.
Visit ***www.oecd-ilibrary.org*** for more information.

OECD*publishing*
www.oecd.org/publishing

ISBN 978-92-64-30159-7
98 2017 06 1P

9 789264 301597