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.

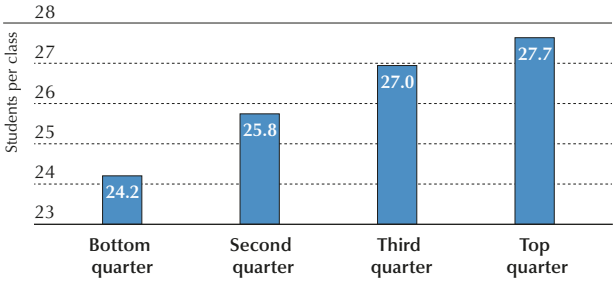
HOW DO SCHOOLS DIFFER WITH RESPECT TO THE QUANTITY OF TEACHER RESOURCES?

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]").

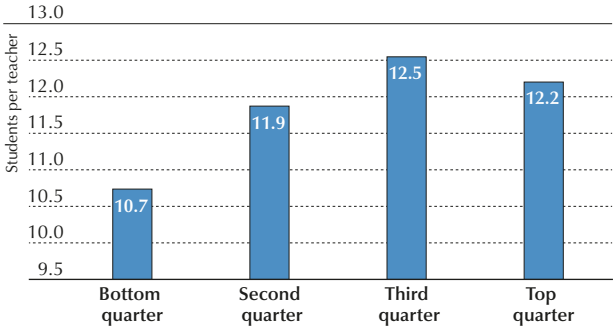
Having smaller classes in disadvantaged schools, therefore, seems to be the result of a deliberate policy of teacher resource allocation in many education systems. This is consistent with national and local studies analysing the implementation of policies aimed at reducing class size in disadvantaged 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.

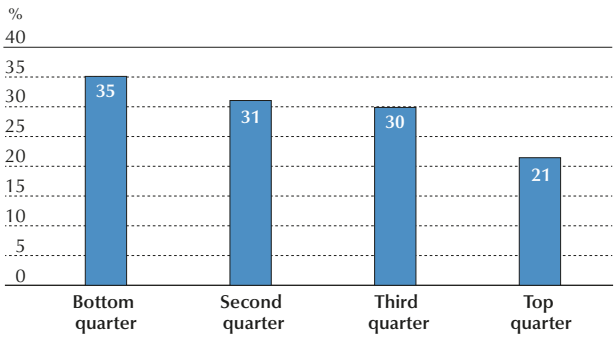
Principals' and teachers' views of teaching staff shortages

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

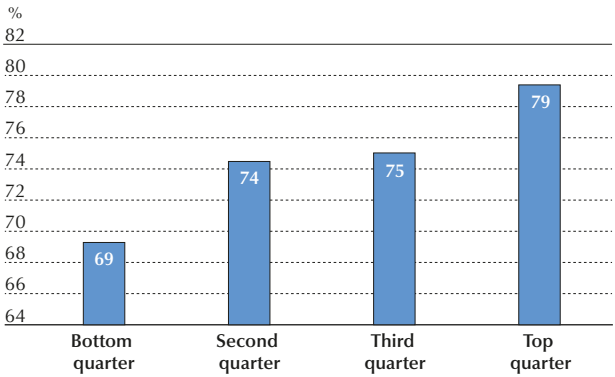
Teachers' pre-service education and training aim to equip teachers with the necessary skills to help students learn. Because the content and the quality of teachers' education can affect student learning (Clotfelter, Ladd and Vigdor, 2007[37]; Clotfelter, Ladd and Vigdor, 2010[38]; Darling-Hammond, 2004[4]; 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]).

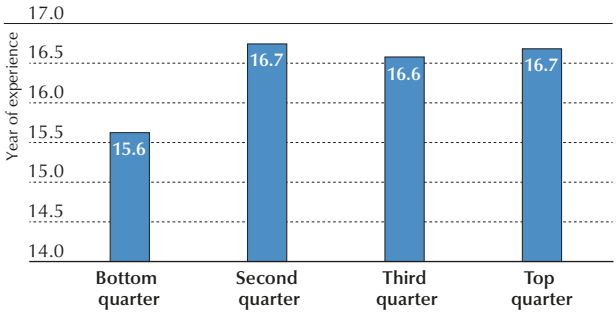
The relationship between teacher experience and student learning has been repeatedly analysed in empirical studies (Hanushek and Rivkin, 2006[45]; Croninger et al., 2007[46]; Leigh, 2010[47]; Jackson, Rockoff and Staiger, 2014[48]). Most studies find that teacher experience and student achievement are 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.

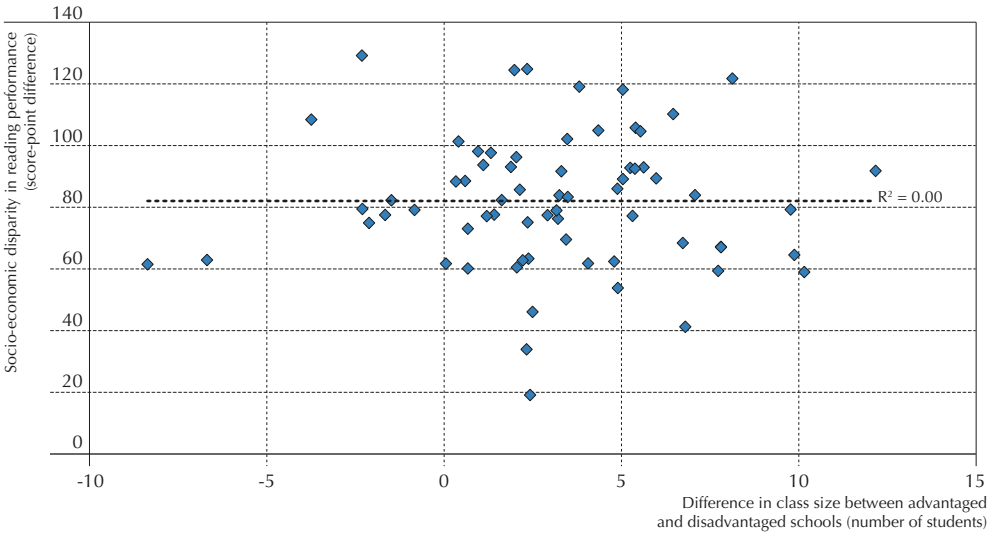
This section correlates the difference between advantaged and disadvantaged schools in the characteristics of their teacher workforce with the average performance gap between advantaged and disadvantaged students,[14] a system-level indicator of socio-economic inequality. In the following sections, teacher-sorting 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

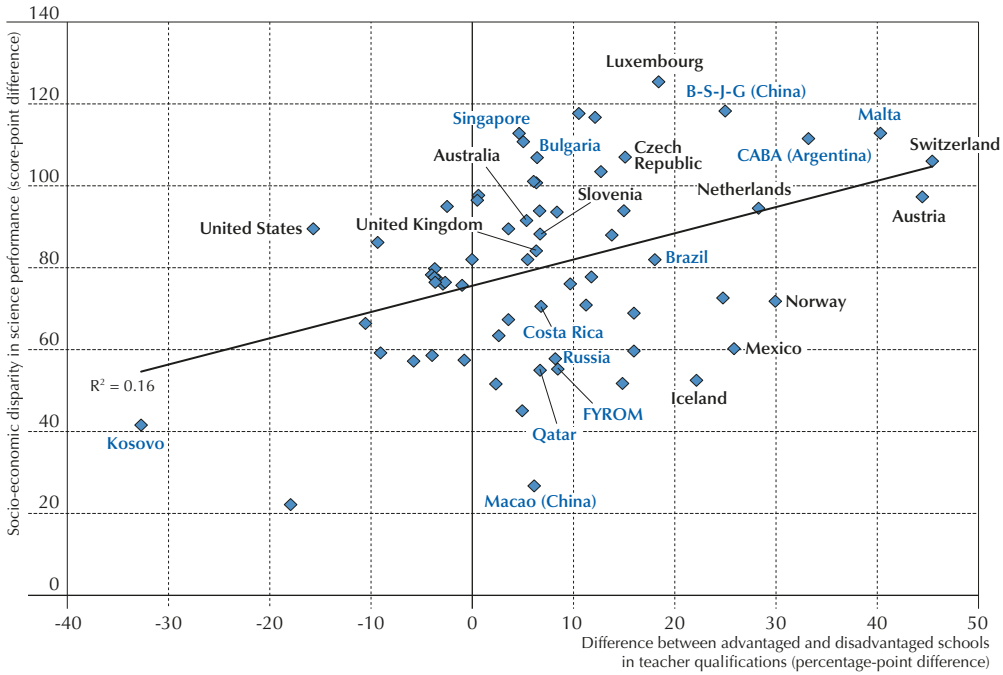
to provide instruction is hindered by a lack of teaching staff (r=0.42 based on science teachers' reports, r=-0.39 for non-science teachers' reports).[16] This moderate association might reveal that, despite objective indications of additional resources, teachers consider that much more would be needed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

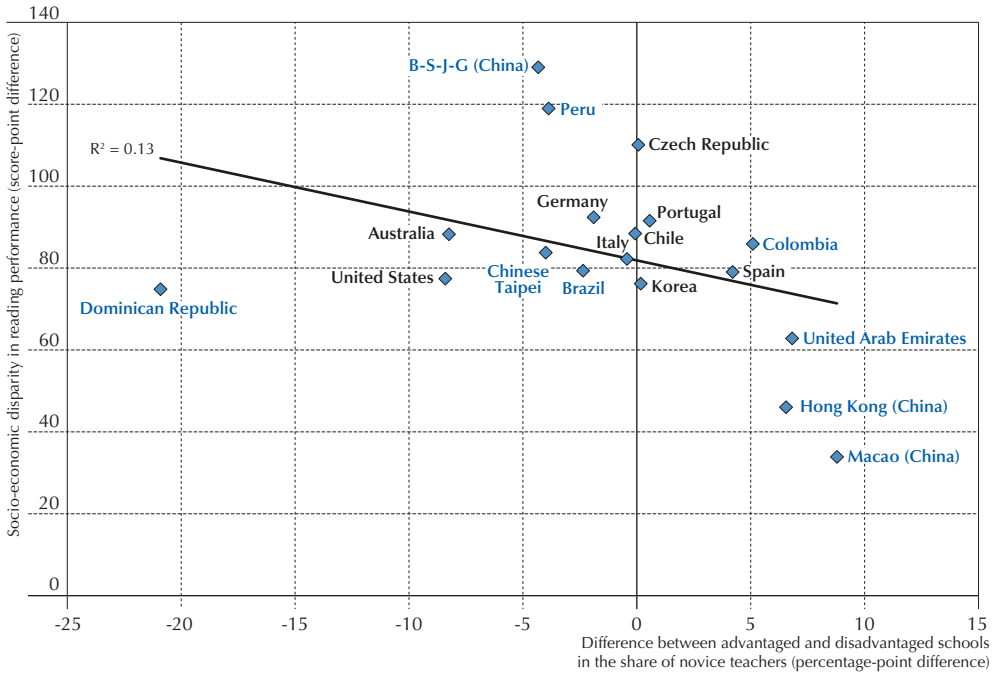
StatLink http://dx.doi.org/10.1787/888933740706

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.

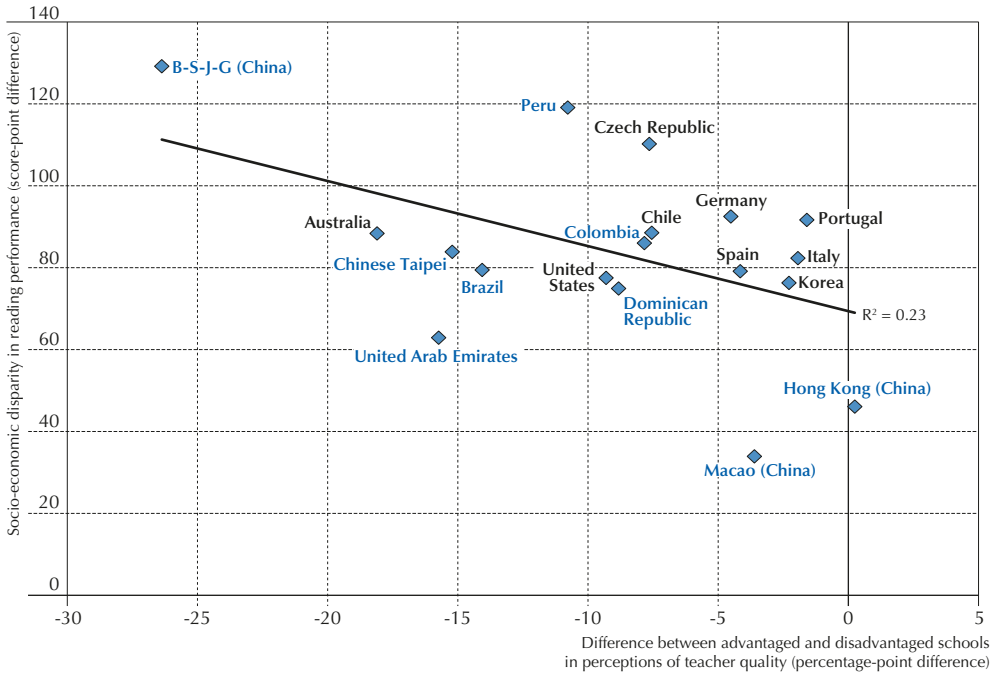
StatLink http://dx.doi.org/10.1787/888933740725

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

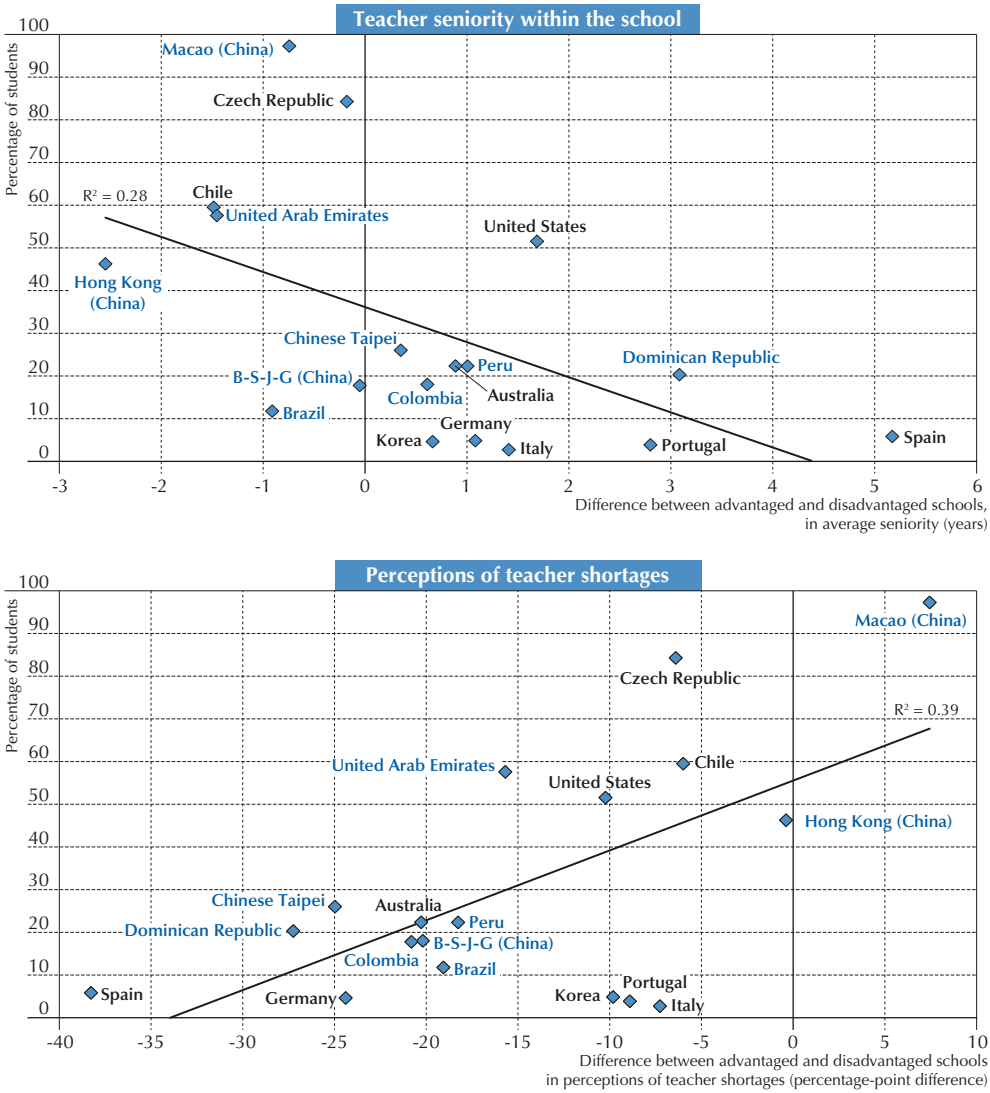
Previous results have shown that teachers working in disadvantaged schools tend to be less prepared and experienced. This section examines whether teachers in disadvantaged schools receive additional support to compensate for their relative lack of qualifications. Teacher support can take the form of 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]).

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