3

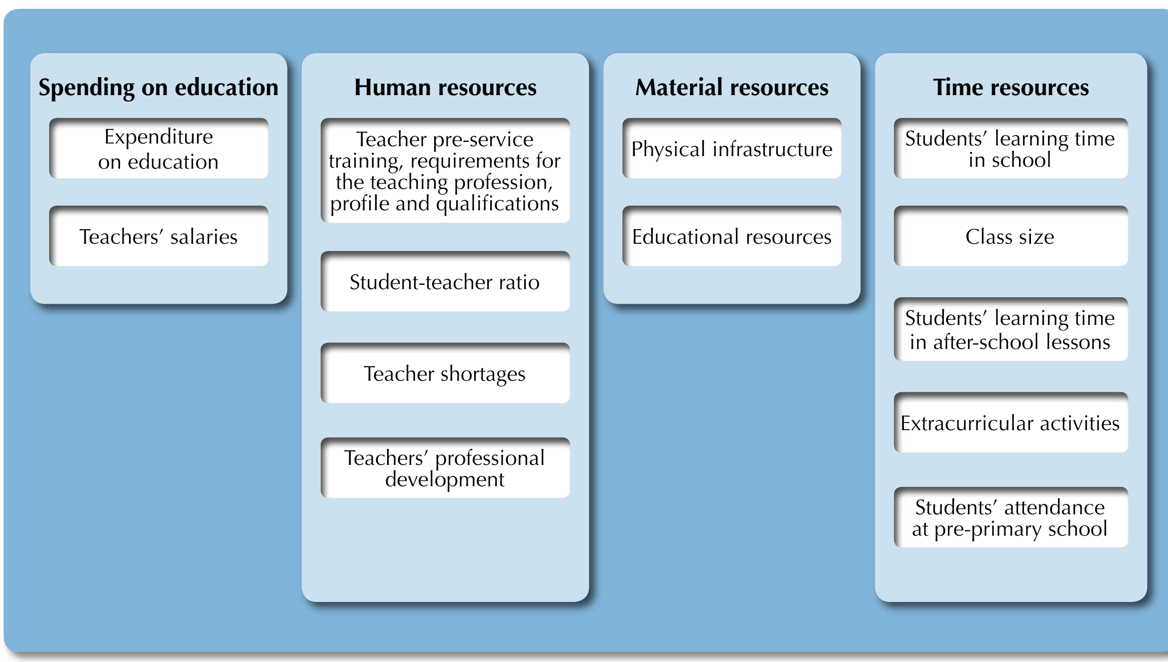
Resources Invested in Education

This chapter examines the allocation of human, material and financial resources throughout school systems and the amount of time dedicated to instruction and learning. Resource allocation is also discussed as it relates to school location, the socio-economic profile of schools, programme orientation, education level, and whether a school is public or private. The chapter also analyses changes since 2003 in the level of resources devoted to education and how those resources are allocated.

This chapter examines the allocation of resources to school systems. Human, material and financial resources are examined in this chapter as well as the amount of time dedicated to instruction and learning as shown in Figure IV.3.1.

Although research on school effects has generally shown a modest relationship between educational resources and student learning (Fuller, 1987; Greenwald, Hedges and Laine, 1996; Buchmann and Hannum, 2001; Rivkin, Hanushek and Kain, 2005; Murillo and Román, 2011; Hægeland, Raaum and Salvanes, 2012; Nicoletti and Rabe, 2012), a basic set of resources is crucial for providing students with the opportunity to learn. This chapter focuses not only on the average level of resources available in each school system, but also on how school resources are allocated across schools within systems. Given that some research shows that allocating additional financial resources to disadvantaged schools reduces the achievement gap between disadvantaged and other schools (Lamb, Teese and Helme, 2005; Henry, Fortner and Thompson, 2010), resource allocation has implications for equity in a school system and, as such, is an important consideration for policy makers.

■ Figure IV.3.1 ■
Resources invested in education as covered in PISA 2012



What the data tell us

- In Luxembourg, Jordan, Thailand, Turkey and Shanghai-China, more than three in ten students are in schools whose principals reported that a lack of qualified mathematics teachers hinders to some extent or a lot the schools' capacity to provide instruction (the OECD average is fewer than two in ten students attend such schools).
- On average across OECD countries, students who are in socio-economically disadvantaged schools tend to be in classes with four students fewer than students in advantaged schools; but disadvantaged schools tend to be more likely to suffer from teacher shortages, and shortages or inadequacy of educational materials and physical infrastructures than advantaged schools.
- Trends between 2003 and 2012 reveal a reduction in the student-teacher ratio, an increase in classroom instruction time dedicated to mathematics, and a reduction in the time students spend doing mathematics homework. These changes are seen across different types of schools and among both advantaged and disadvantaged students.
- Fifteen-year-old students in 2012 were more likely than 15-year-olds in 2003 to have attended at least one year of pre-primary education, but many of the students who did not attend were disadvantaged – the students who could benefit from pre-primary education the most.

In this chapter, resource allocation across schools is examined by comparing human, material and time resources allocated to schools according to various school features, such as school location, the socio-economic profile of schools, programme orientation, education level, and school type (see also Box IV.3.1). The chapter also analyses how the overall resource level and resource allocation across schools have changed since PISA 2003.

Chapter 1 shows that most of the relationship between school resources and performance is also related to schools' socio-economic intake. In other words, the quality and quantity of school resources can play an important role in mediating the impact of students' socio-economic status on performance.

FINANCIAL RESOURCES

Expenditure on education

Chapter 1 shows that improvements in performance require policies and practices that address more than spending on education, particularly among high-income countries and economies. High-performing systems tend to prioritise higher salaries for teachers.

Policy makers must constantly balance expenditure on education with expenditure for many other public services. Yet despite the competing demands for resources, expenditure on education has increased over the past few years. Between 2001 and 2010, expenditure per primary, secondary and post-secondary non-tertiary student[1] has increased 40%, on average across OECD countries with data available for both 2001 and 2010 (Table IV.3.1).

Financial resources can be allocated to salaries paid to teachers, administrators and support staff; maintenance or construction costs of buildings and infrastructure; and operational costs, such as transportation and meals for students.

Total expenditure by educational institutions per student from the age of 6 to 15[2] exceeds USD 100 000 (PPP-corrected dollars) in Luxembourg, Switzerland, Norway, Austria, the Unites States and Denmark. In Luxembourg, cumulative expenditure per students exceeds USD 190 000. In contrast, in Turkey, Mexico and the partner countries Viet Nam, Jordan, Peru, Thailand, Malaysia, Uruguay, Colombia, Tunisia and Montenegro, cumulative expenditure per student over this age period is less than USD 25 000 (Table IV.3.1). As expected, spending on education and per capita GDP are highly correlated (r=0.95 across OECD countries and r=0.94 across all participating countries and economies in PISA 2012). School systems with greater total expenditure on education tend to be those with higher levels of per capita GDP (Tables IV.3.1 and IV.3.2).

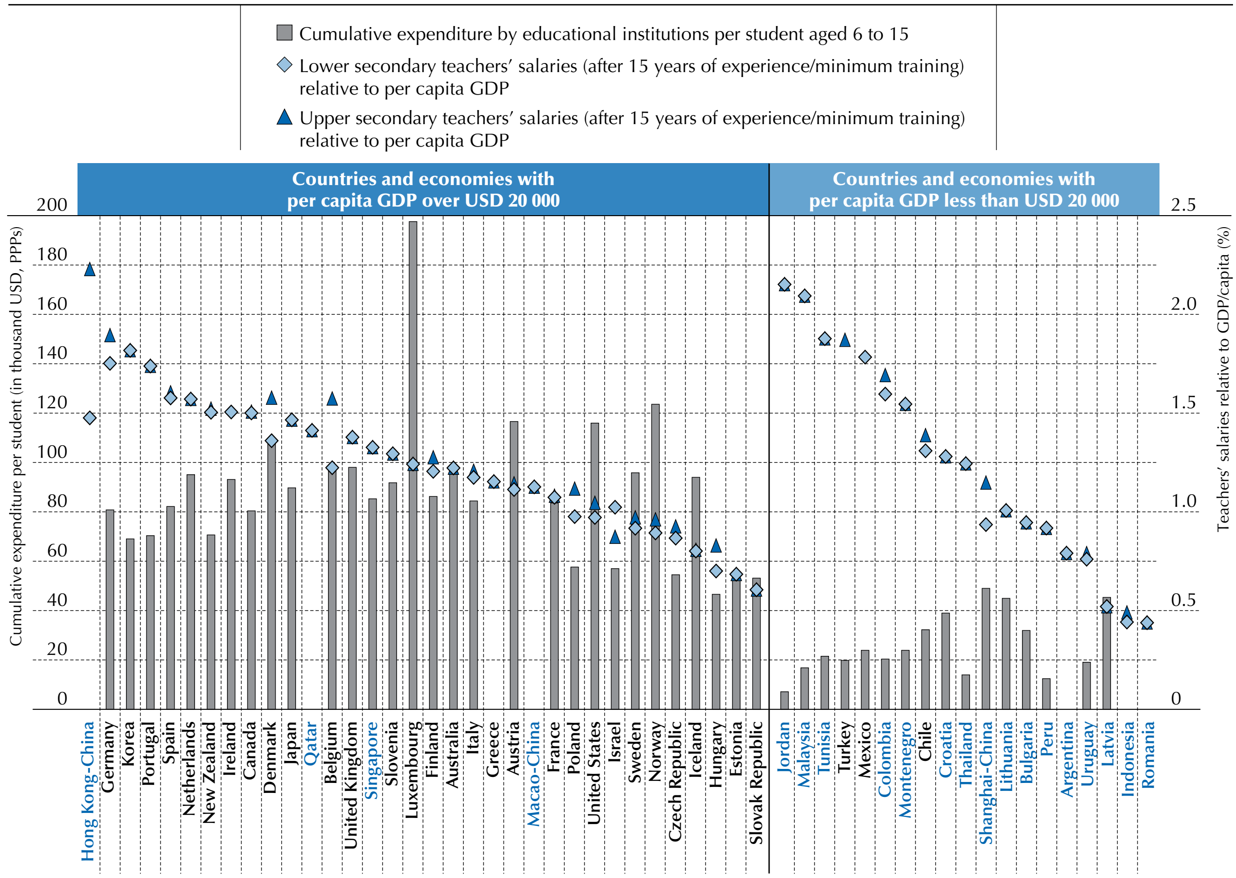
Teachers' salaries

Teachers' salaries represent the largest single cost in expenditure on education (OECD, 2013). School systems differ not only in how much they pay teachers but in the structure of their pay scales. Lower secondary teachers' salaries[3] in OECD countries are 124% of per capita GDP, corrected for differences in purchasing power parities. Relative to their country's national income, lower secondary teachers in Korea, Mexico, Germany, Portugal, Spain, the Netherlands, Ireland, New Zealand, Canada and the partner countries Jordan, Malaysia, Tunisia, Colombia and Montenegro earn the most. In these countries, annual earnings for lower secondary teachers are between 150% and 215% of per capita GDP. By contrast, annual earnings for lower secondary teachers are 70% or less of per capita GDP in the Slovak Republic, Estonia, Hungary and the partner countries Romania, Indonesia and Latvia. Upper secondary teachers' salaries in OECD countries are 129% of per capita GDP. In Germany, Turkey, Korea, Portugal, Spain and the partner countries and economies Hong Kong-China, Jordan, Malaysia, Tunisia and Colombia, upper secondary teachers' salaries are between 160% and 223% of per capita GDP. By contrast, in the Slovak Republic, Estonia and the partner countries Romania, Indonesia and Latvia, they are between 44% and 68% of per capita GDP (Table IV.3.3).

In all school systems, teachers' salaries rise during the course of a career, although the rate of change differs greatly. In Korea and the partner countries and economies Shanghai-China, Malaysia, Jordan, Singapore and Romania, salaries at the top of the scale are 2.5 times higher than starting salaries[4] and it takes between 20 and 40 years to reach the top salary. In Shanghai-China, this ratio is particularly high: the salary at the top of the scale is 4.5 times greater than the starting salary for lower secondary teachers, and it is 5.6 times greater for upper secondary teachers. By contrast, in Denmark, Iceland, Norway, Slovenia, Sweden, Finland, Germany, the Slovak Republic, the Czech Republic, Spain and the partner countries Peru, Montenegro and Croatia, teachers' salaries at the top of the scale is at most 1.4 times higher than starting salaries (Table IV.3.3).

■ Figure IV.3.2 ■

Expenditure on education and teachers' salaries



Notes: Teachers' salaries in Belgium are the average teachers' salaries of the French and Flemish communities of Belgium. Teachers' salaries in the United Kingdom are the average teachers' salaries in England and Scotland.
Countries and economies are ranked in descending order of teachers' salaries (average of lower and upper secondary teachers' salaries).
Source: OECD, PISA 2012 Database, Tables IV.3.1, IV.3.2 and IV.3.3.
StatLink http://dx.doi.org/10.1787/888932957327

Higher salaries can help school systems to attract the best candidates to the teaching profession, and they signal that teachers are regarded and treated as professionals. But paying teachers well is only part of the equation: school systems must also nurture and retain the best of their teachers. The next section examines these aspects more in detail.

HUMAN RESOURCES

According to results described in Chapter 1, schools that suffer from greater levels of teacher shortage tend to have lower scores in PISA.

Teachers are an essential resource for learning: the quality of a school system cannot exceed the quality of its teachers. Teachers interact with students daily and help students acquire the knowledge that they are expected to have by the time they leave school. Thus, attracting, developing and retaining effective teachers is a priority for public policy, although the policies related to teachers differ widely across countries (OECD, 2005). The type and quality of the training they receive, as well as the requirements to enter and progress through the teaching profession, have significant consequences on the quality of the teaching force.

Pre-service teacher training

Competitive examinations are required to enter pre-service teacher training (for public primary and secondary education) in Australia, Finland, Germany, Greece, Hungary, Ireland, Israel, Korea, Mexico and Turkey and the partner countries and economies Bulgaria, Colombia, Croatia, Indonesia, Lithuania, Macao-China, Romania, Shanghai-China, Chinese Taipei, the United Arab Emirates and Viet Nam (Table IV.3.4). In Austria, competitive examinations are required only

for teacher training in primary education. Pre-service teacher training is longest in Germany, where teacher pre-service training for primary teachers lasts 5.5 years, between 5.5 and 6.5 years for lower secondary teachers, and 6.5 years for upper secondary teachers. For teaching at primary levels, pre-service training is the shortest (three years) in Austria, Belgium, Spain and Switzerland; for teaching at lower secondary levels it is the shortest (three years) in Belgium; and for teaching at the upper secondary level, pre-service training is the shortest in England (UK) and Israel (3.5 years). A teaching practicum is required as part of pre-service training for primary teachers in all OECD countries except Chile and England (UK), and in all partner countries and economies except Brazil, Jordan and Tunisia. Teaching practicums are also required for lower secondary education in all OECD and partner countries and economies, except Brazil, Chile, England (UK), Jordan, Macao-China and Romania. Teaching practicums are also required for upper secondary education in all OECD and partner countries and economies except Austria, Chile, Denmark, England (UK) and Mexico among OECD countries, and partner countries and economies Brazil, Jordan, Macao-China and Romania.

Countries and economies can be categorised into four groups according to whether their public-school teacher pre-service training system requires a competitive examination and by the average duration of the training programme as shown in Figure IV.3.3.[5] Two groups require no entrance examination. One of these groups has a comparatively short pre-service training programme, and the other group has a comparatively long programme. The two additional groups require a competitive entrance examination, one with a short pre-service training programme and another with a comparatively long programme.

■ Figure IV.3.3 ■

Profiles of teacher pre-service training across countries and economies

	No examination to enter pre-service training	Competitive examination to enter pre-service training
Relatively short duration of pre-service training programme (less than 4.3 years)	Belgium (Fl.) Belgium (Fr.) England (UK) Hong Kong-China Iceland Japan Latvia Liechtenstein Montenegro New Zealand Poland Qatar Singapore Sweden United States Uruguay	Australia Bulgaria Croatia Greece Israel Lithuania Macao-China Romania Shanghai-China Chinese Taipei Viet Nam
Relatively long duration of pre-service training programme (more than 4.3 years)	Canada Czech Republic Denmark Estonia France Italy Luxembourg Malaysia Netherlands Norway Peru Portugal Scotland (UK) Slovak Republic Spain Switzerland	Austria Colombia Finland Germany Hungary Indonesia Ireland Korea Mexico Turkey
Countries and economies with no information on duration and/or examination	Albania Argentina Brazil Chile Costa Rica Jordan Kazakhstan	Russian Federation Serbia Slovenia Thailand Tunisia United Arab Emirates

Source: OECD, PISA 2012 Database, Table IV.3.4.

Requirements to enter the teaching profession

A competitive examination is required to enter the teaching profession for primary and secondary school in France, Germany, Greece, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Spain, Turkey, the United States and the partner countries and economies Brazil, Colombia, Macao-China, Peru, Qatar, Romania, Shanghai-China, Chinese Taipei, Thailand, the United Arab Emirates and Viet Nam.

A credential or license, in addition to the education diploma, is required to start teaching or to become a fully qualified lower or upper secondary teacher in Australia, Canada, Denmark, England (UK), Germany, Iceland, Ireland, Israel, Italy, Japan, Korea, Mexico, New Zealand, Scotland (UK), Switzerland, the United States and the partner countries and economies Bulgaria, Croatia, Hong Kong-China, Indonesia, Malaysia, Montenegro, Shanghai-China, Chinese-Taipei, Thailand, the United Arab Emirates and Viet Nam.

A teaching practicum is required for lower or upper secondary teachers to obtain a credential/licence or is required after being recruited, during an induction/probation period, in Austria, Canada, Denmark, England (UK), Germany, Greece, Hungary, Ireland, Israel, Japan, Korea, Luxembourg, New Zealand, Scotland (UK), Spain, Turkey, the United States and the partner countries and economies Colombia, Croatia, Malaysia, Montenegro, Qatar, Romania, Shanghai-China, Chinese Taipei, the United Arab Emirates and Viet Nam.

Just over half of the participating countries and economies (18 OECD and 11 partner countries and economies) have a register for lower or upper secondary teachers. A register for teachers is an administrative record that contains a detailed profile of teachers, including such information as their qualifications, experience and career path. Continuing education is compulsory for remaining employed in the teaching profession at the lower and upper secondary levels in Belgium (French community), England (UK), Estonia, Finland, Hungary, Iceland, Israel, Japan, Luxembourg, the Netherlands, Scotland (UK), the United States and the partner countries and economies Croatia, Liechtenstein, Montenegro, Romania, Shanghai-China, Thailand, the United Arab Emirates and Viet Nam (Table IV.3.5).

Teacher profile and qualifications

How are these policies and requirements exercised at school? PISA 2012 asked school principals to report the composition and qualifications of teachers in their schools. Across OECD countries, the average 15-year-old student is in a school whose principal reported that 87% of teachers are fully certified. In 47 participating countries and economies, school principals reported that 80% of teachers or more are fully certified, while in Colombia and Chile, principals reported that fewer than 20% of teachers are fully certified. In addition, the average 15-year-old student in OECD countries attends a school whose principal reported that 85% of teachers have a university-level qualification (i.e. university or similar qualification). In 48 participating countries and economies, principals reported that more than 80% of teachers have such a qualification, while in Serbia, Uruguay and Argentina, principals reported that fewer than 20% of teachers have attained that qualification (Figure IV.3.4 and Table IV.3.6).

Box IV.3.1. **Socio-economically disadvantaged and advantaged schools**

Socio-economically disadvantaged and advantaged schools are identified within individual school systems by comparing the average socio-economic status of the students in the system and the average socio-economic status of the students in each school (Monseur and Crahay, 2008). Student socio-economic status is measured by the *PISA index of economic, social and cultural status* (ESCS).

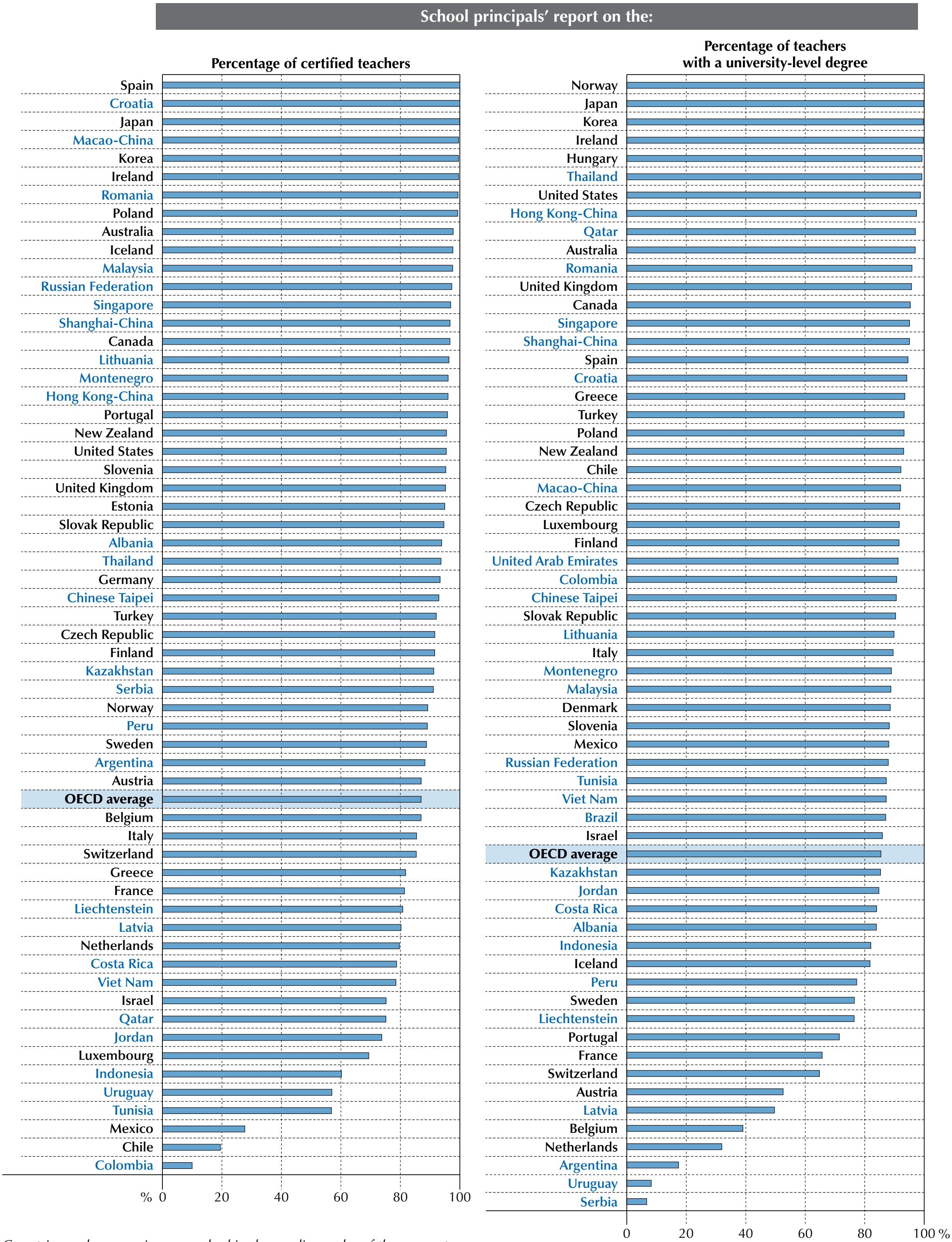
Within each school system, schools are categorised into three groups:

- socio-economically advantaged schools: schools where the average socio-economic status of 15-year-old students is more advantaged than the average socio-economic status of students in the system as a whole;
- socio-economically average schools: schools where the average socio-economic status of 15-year-old students is not statistically different from the average socio-economic status of students in the system as a whole; or
- socio-economically disadvantaged schools: schools where the average socio-economic status of 15-year-old students is more disadvantaged than the average socio-economic status of students in the system as a whole.

The difference between a school average and the system average is statistically tested considering the confidence interval for school and system averages. Table IV.3.7 presents the percentage of students allocated to the three groups in PISA 2012. Table II.4.2 in Volume II presents average socio-economic, demographic and academic characteristics of schools in these three groups.

■ Figure IV.3.4 ■

Teachers' profiles and qualifications



Countries and economies are ranked in descending order of the percentages.
Source: OECD, PISA 2012 Database, Table IV.3.6.
StatLink http://dx.doi.org/10.1787/888932957327

Student-teacher ratio

PISA 2012 asked school principals to report the total number of teachers and students in their schools.[6] The student-teacher ratio is not equivalent to class size. For example, schools with large special education programmes tend to have many teachers, but the size of regular classes is not reduced by the school's high teacher-student ratio. Also, the amount of preparation time per day allotted to teachers may vary across schools and across school systems. More teachers are needed where more preparation time is given and class size remains constant.

Across OECD countries, the average student attends a school where the student-teacher ratio is 13 students to one teacher. Student-teacher ratios range from over 25 students per teacher in Mexico, Brazil and Colombia, to fewer than 10 students per teacher in Liechtenstein, Portugal, Luxembourg, Greece, Belgium, Poland, Latvia and Kazakhstan (Table IV.3.8).

Student-teacher ratios do not vary much within countries and economies, but in some countries there is a difference of around three or more students per teacher between socio-economically advantaged and disadvantaged schools. In Brazil, Turkey, Shanghai-China, Romania, Uruguay and Macao-China, disadvantaged schools tend to have more students per teacher than advantaged schools, while in Belgium, the Netherlands, Italy, Qatar, Estonia, the Russian Federation, Mexico, Peru and Japan advantaged schools have at least three more students per teacher than disadvantaged schools (Table IV.3.9).

Teacher shortages

In order to assess how school principals perceive the adequacy of the supply of teachers in their schools, they are asked to report on the extent to which they think instruction in their school is hindered by a lack of qualified teachers and staff in key areas. This information was combined to create a composite *index of teacher shortage*, such that the index has an average of 0 and a standard deviation of 1 for OECD countries. Higher values on the index indicate principals' perception that there are more problems with instruction because of teacher shortages. Caution is required in interpreting these results: school principals across countries and economies, and even within countries and economies, may have different expectations and benchmarks to determine whether there is a lack of qualified teachers. Nonetheless, these reports provide valuable information that can be used to assess whether schools or school systems are providing their students with adequate human resources.

According to school principals, teacher shortages hindered instruction the most in Luxembourg, Jordan, Thailand, Turkey and Shanghai-China. In these countries and economies, between 31% and 69% of students are in schools whose principals reported that a lack of qualified mathematics teachers hindered to some extent or a lot the schools' capacity to provide instruction (the OECD average is 17%). By contrast, in Poland, Bulgaria, Portugal, Serbia and Spain relatively few principals reported that teacher shortages hindered instruction. In these countries, only around 1% to 4% of students are in schools whose principals reported that a lack of qualified mathematics teachers hindered instruction to some extent or a lot (Figure IV.3.5 and Table IV.3.10).

Teacher shortages vary within countries, as measured by the standard deviation of the *index of teacher shortage*. Variation is comparatively large in Jordan, the United Arab Emirates, Colombia, Kazakhstan, Macao-China and Shanghai-China, while it is comparatively small in Poland, Bulgaria, Lithuania, Slovenia and Serbia (Figure IV.3.5 and Table IV.3.10). In 30 countries and economies, principals in socio-economically disadvantaged schools reported more teacher shortage than those in advantaged schools. Particularly wide gaps between advantaged and disadvantaged schools in teacher shortage are observed in Chinese Taipei, Australia, New Zealand, Brazil, Sweden, the Slovak Republic, Shanghai-China, Uruguay, Indonesia, Mexico, Turkey, Serbia, the Czech Republic, Chile, the United States, Ireland, Viet Nam and Peru, where the difference is greater than 0.5 index points (i.e. a half of the standard deviation of this index). In 14 countries and economies, principals of public schools tended to report more teacher shortage than those of private schools. In all of these countries and economies except the United Arab Emirates and Italy, principals of disadvantaged schools reported more teacher shortage than those of advantaged schools (Table IV.3.11).

On average across OECD countries, principals of schools located in rural areas reported more teacher shortage than principals of schools in towns, and they, in turn, reported more teacher shortage than principals of schools in cities. This is observed in Iceland, Mexico and Qatar. However, in the Slovak Republic, the Czech Republic, Hungary, Chile and Romania, principals of schools located in towns and cities reported similar levels of teacher shortage, while principals of schools located in rural areas reported more teacher shortage than principals of schools in towns.

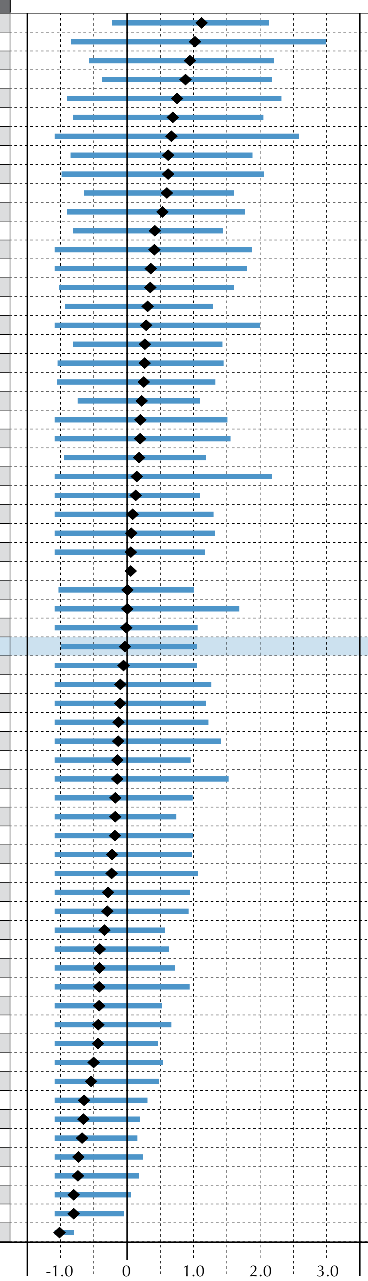
■ Figure IV.3.5 ■

Impact of teacher shortage on instruction, school principals' views

A Lack of qualified mathematics teachers
B Lack of qualified science teachers
C Lack of qualified language-of-instruction teachers
D Lack of qualified teachers of other subjects

Percentage of students in schools whose principals reported that the following phenomena hindered student learning "to some extent" or "a lot"

Index of teacher shortage
- Range between top and bottom quarters
- ◆ Average index



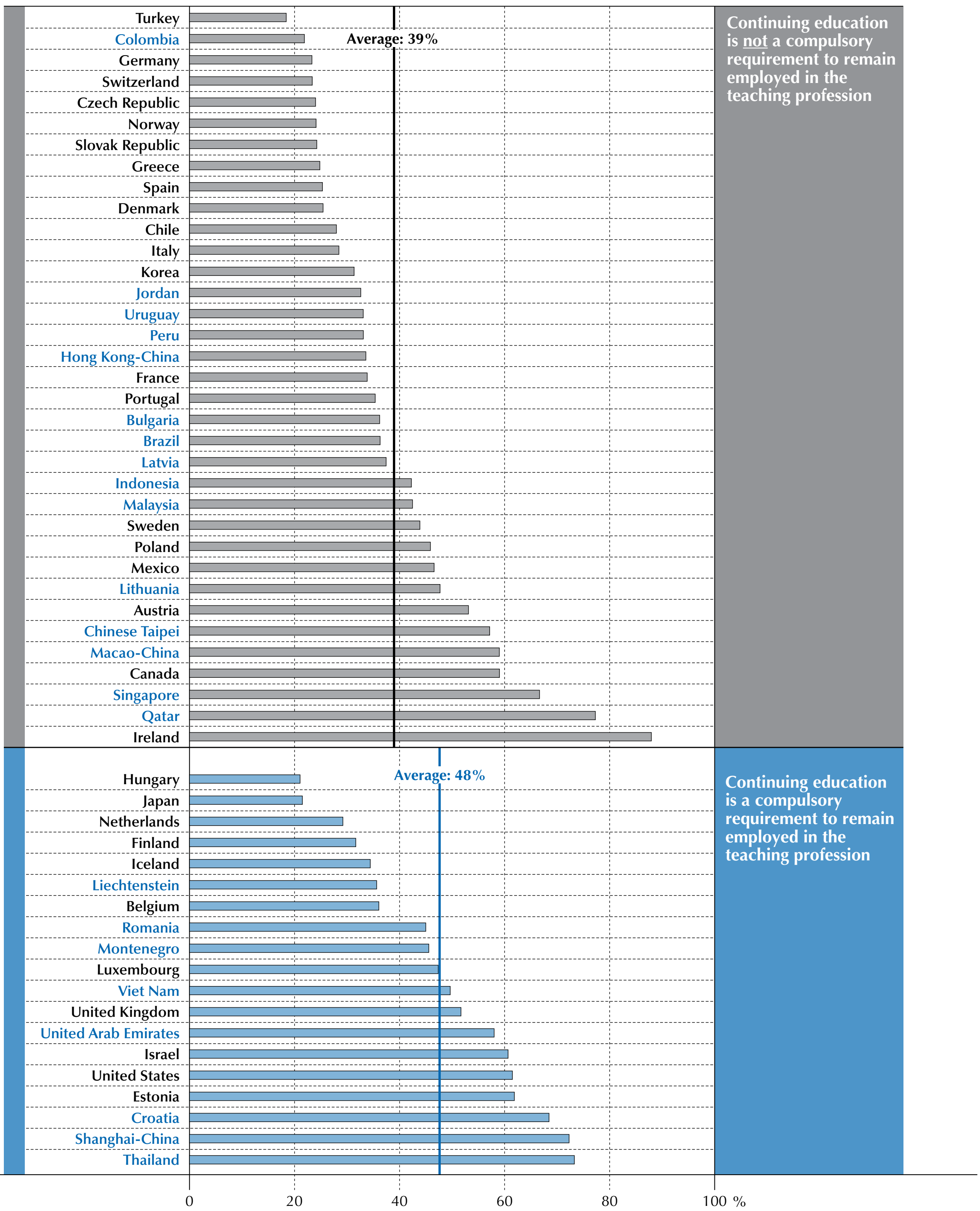
	A	B	C	D	Variability in the index (S.D.)	Difference between private and public schools (priv.-pub.) Index difference	Difference between advantaged and disadvantaged schools (adv.-disadv.) Index difference
Luxembourg	69	71	18	40	0.92	1.41*	-0.44*
Jordan	46	50	44	46	1.48	0.57	-0.49
Thailand	45	47	44	57	1.10	0.29	-0.15
Turkey	31	42	28	36	1.03	c	-0.65*
Shanghai-China	36	37	32	41	1.24	-0.12	-0.70*
Israel	36	39	34	39	1.11	c	0.14
Colombia	32	34	30	48	1.40	0.38	-0.05
Peru	29	31	26	44	1.06	0.99*	-0.51*
Chile	43	42	27	33	1.19	0.48*	-0.59*
Netherlands	45	32	23	37	0.88	0.00	-0.05
Mexico	28	23	25	33	1.03	0.70*	-0.65*
Germany	18	38	7	39	0.87	0.41	-0.33
Viet Nam	30	33	31	31	1.18	1.12*	-0.53*
Russian Federation	27	24	22	39	1.13	c	-0.25
Uruguay	34	26	13	37	1.02	0.82*	-0.70*
Norway	19	13	20	26	0.87	c	-0.25
Kazakhstan	32	31	20	35	1.29	-0.27	0.11
Indonesia	13	16	13	23	0.93	-0.25	-0.68*
Belgium	25	21	9	42	0.96	0.08	-0.48*
Italy	16	14	15	25	0.92	0.55*	0.06
Malaysia	7	8	26	34	0.76	-0.64	0.08
Australia	32	25	12	23	1.04	0.50*	-0.80*
Brazil	18	22	13	38	1.04	0.76*	-0.79*
Iceland	23	28	9	19	0.83	c	-0.49*
United Arab Emirates	21	23	23	25	1.40	0.80*	-0.30
Singapore	6	6	24	25	0.84	c	-0.04
New Zealand	22	15	7	24	0.93	0.52	-0.80*
Korea	12	14	13	17	1.03	-0.07	0.24
Switzerland	14	23	4	26	0.89	0.20	-0.20
Liechtenstein	0	0	7	33	0.73	c	c
Estonia	17	18	6	16	0.78	0.37	0.19
Macao-China	28	24	15	27	1.25	c	-0.13*
Costa Rica	7	13	8	25	0.84	0.29	-0.05
OECD average	17	17	9	21	0.85	0.25*	-0.32*
Sweden	14	20	4	22	0.85	0.01	-0.76*
Argentina	10	14	12	24	1.01	0.22	-0.04
Tunisia	10	12	9	28	0.93	c	-0.12
Austria	14	16	14	21	0.99	0.26	-0.27
Qatar	17	21	10	14	1.10	0.85*	-0.12*
Ireland	14	6	5	30	0.84	-0.05	-0.54*
Chinese Taipei	12	16	11	22	1.17	-0.19	-1.16*
France	8	5	7	21	0.85	-0.27	-0.10
Denmark	3	7	2	15	0.71	0.28*	-0.39*
United Kingdom	16	14	8	11	0.88	0.23	-0.43*
Hong Kong-China	11	4	6	14	0.89	-0.14	-0.47*
Albania	8	13	5	18	0.94	0.21	m
Japan	8	9	3	12	0.89	0.07	-0.26
Canada	13	7	4	16	0.85	0.07	-0.29*
Slovak Republic	5	5	2	25	0.71	0.06	-0.70*
Latvia	3	6	5	4	0.76	c	0.09
Greece	5	9	7	9	0.94	c	-0.20
United States	9	9	2	11	0.91	-0.18	-0.58*
Czech Republic	5	4	1	10	0.70	0.41*	-0.60*
Croatia	12	10	1	9	0.77	c	-0.29
Finland	4	4	1	12	0.67	-0.10	-0.11
Montenegro	14	9	0	2	0.72	c	-0.28*
Romania	1	8	4	5	0.72	c	-0.21
Hungary	3	7	1	5	0.66	-0.21	-0.40*
Lithuania	1	3	1	2	0.59	c	-0.12
Slovenia	1	0	0	2	0.59	-0.30*	0.07*
Spain	2	2	1	7	0.64	0.09	-0.17*
Serbia	4	4	1	3	0.60	c	-0.62*
Portugal	1	1	1	2	0.65	0.12	-0.05
Bulgaria	1	1	0	8	0.48	c	-0.07
Poland	0	1	0	0	0.25	0.04	-0.02

Notes: Higher values on the *index of teacher shortage* indicate greater incidence of teacher shortage. Differences that are significant at the 5% level ($p < 0.05$) are marked with *.
Countries and economies are ranked in descending order of the average index.
Source: OECD, PISA 2012 Database, Tables IV.3.10 and IV.3.11.
StatLink http://dx.doi.org/10.1787/888932957327

■ Figure IV.3.6 ■

Continuing education necessary to remain employed as a teacher

Mean percentage of mathematics teachers who have attended a programme of professional development with a focus on mathematics during the previous three months



Notes: In Iceland, the majority of 15-year-olds are at the lower secondary level, therefore the information at the lower secondary in Table IV.3.5 is used.
Belgium is grouped as "continuing education is compulsory requirement" even though it is not a compulsory requirement in the Flemish Community of Belgium.
Countries and economies are ranked in ascending order of the percentages.
Source: OECD, PISA 2012 Database, Tables IV.3.5 and IV.3.12.
StatLink http://dx.doi.org/10.1787/888932957327

In contrast, in Colombia, Australia, Indonesia, Uruguay, Viet Nam, New Zealand, Montenegro, Chinese Taipei, the United Arab Emirates, Peru, Brazil, Norway, Ireland, Finland and Canada, principals of schools located in rural areas and in towns reported similar levels of teacher shortage, while principals of schools located in cities reported less teacher shortage than principals of schools in towns. In 34 countries and economies, the level of teacher shortage reported by principals does not vary by where school is located (Table IV.3.11).

Teachers' professional development

How is the requirement that teachers pursue continuing education implemented? Across OECD countries, the average 15-year-old student attends a school whose principal reported that 39% of those who teach mathematics in his or her school have attended a programme of professional development, with a focus on mathematics, during the previous three months. This proportion varies greatly across countries: in Ireland, Qatar, Thailand, Shanghai-China, Croatia, Singapore, Estonia, the United States, New Zealand and Israel, at least 60% of teachers attended such a programme, while in Turkey, Hungary, Japan, Colombia, Germany, Switzerland, the Czech Republic, Norway, the Slovak Republic and Greece, 25% of teachers or fewer did so (Figure IV.3.6 and Table IV.3.12). As expected, in those countries where it is compulsory for teachers to participate in continuing education, teachers are more likely to have attended professional development programmes (48% on average) than teachers in those countries/economies where it is not compulsory (39% on average) (as shown in Figure IV.3.6). The timing of the PISA data collection largely affects principals' responses on this proportion since they were asked to report teachers' attendance in professional development programmes during the three months prior to the assessment. For example, if most teachers in a country or economy participate in professional development programmes during summer holidays and the PISA data collection was conducted before the summer break in this country, the reported proportion would be underestimated.

In 18 countries and economies, more mathematics teachers in socio-economically advantaged schools than in disadvantaged schools attended a programme of professional development. The gap is especially wide in Luxembourg, Austria, Turkey, Serbia, Chinese Taipei and Shanghai-China, where the difference between advantaged and disadvantaged schools in the percentage of teachers who attended such a programme during the previous three months is 25 percentage points or more (Table IV.3.13).

On average across OECD countries, mathematics teachers in public schools are more likely (40%) than those in private schools (37%) to attend a programme of professional development. This is the case in Qatar, the United Arab Emirates, Canada, Thailand, France, Switzerland, Germany and Finland, where the difference ranges from 8 to 40 percentage points. In contrast, in Shanghai-China and Luxembourg, mathematics teachers in private schools are more likely than those in public schools to attend such a programme (Table IV.3.13).

Across OECD countries, there is no difference between schools located in towns and those located in cities, on average, in the likelihood of mathematics teachers attending a programme of professional development. But mathematics teachers in schools in rural areas are less likely to attend such a programme than those in schools located in towns. This is observed in Slovenia, Iceland, Denmark, Hungary, the Slovak Republic, Norway and Mexico. However, in 45 countries and economies, there is no difference among schools located in rural areas, towns and cities in the likelihood of mathematics teachers attending a professional development programme (Table IV.3.13).

MATERIAL RESOURCES

The educational resources available in a school tend to be related to the system's overall performance as well as schools' average level of performance, according to the results examined in Chapter 1. Furthermore, it is shown that high performing systems tend to allocate resource more equitably between socio-economically advantaged and disadvantaged schools.

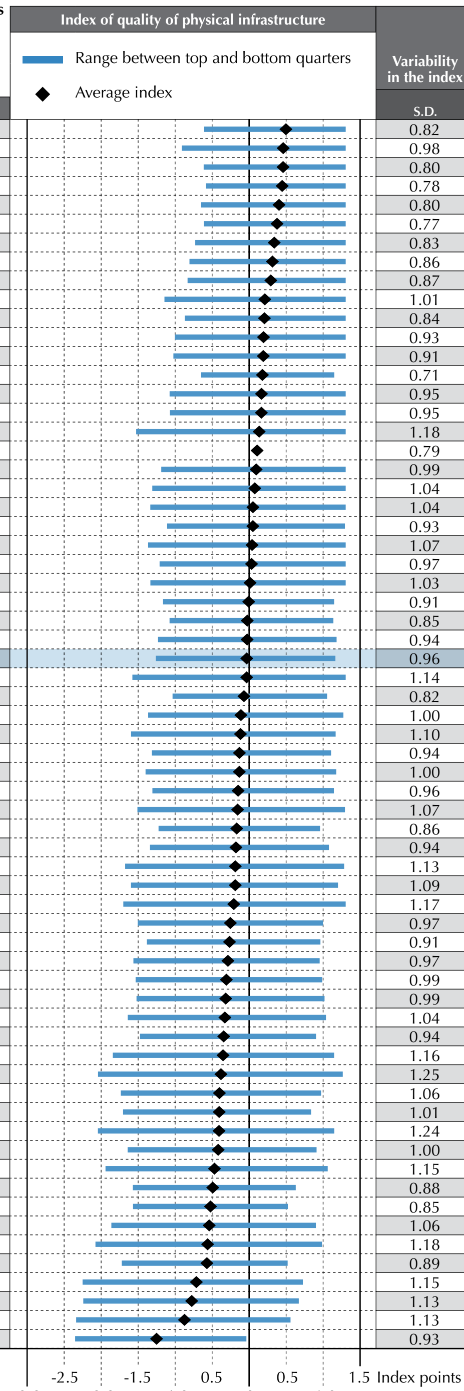
While an adequate physical infrastructure and supply of educational resources does not guarantee good learning outcomes, the absence of such resources could negatively affect learning. What matters for student achievement and other education outcomes is not necessarily the availability of resources, but the quality of those resources and how effectively they are used (Gamoran, Secada and Marrett, 2000).

The PISA 2012 School Questionnaire asked school principals to report on not only the availability of school resources, on how the availability or non-availability of certain school resources affect teaching and learning in their schools.

■ Figure IV.3.7 ■

School principals' views on adequacy of physical infrastructure

A Shortage or inadequacy of school buildings and grounds
B Shortage or inadequacy of heating/cooling and lighting systems
C Shortage or inadequacy of instructional space (e.g. classrooms)



	Percentage of students in schools whose principals reported that the following phenomena hindered student learning "not at all" or "very little"			Variability in the index	Difference between private and public schools (priv.-pub.)	Difference between advantaged and disadvantaged schools (adv.-disadv.)
	A	B	C	S.D.	Index difference	Index difference
Poland	79	89	91	0.82	0.06	-0.25
Qatar	66	93	74	0.98	0.36*	0.23*
United States	83	94	79	0.80	-0.09	0.47*
Czech Republic	86	88	87	0.78	0.04	-0.12
Singapore	78	92	84	0.80	c	0.25*
Latvia	87	84	91	0.77	c	-0.40*
Iceland	72	94	81	0.83	c	0.18*
Canada	75	87	79	0.86	-0.14	0.05
Switzerland	77	88	75	0.87	-0.28	0.03
Sweden	73	77	79	1.01	-0.36	0.60*
Hungary	74	89	79	0.84	-0.04	-0.10
France	68	82	73	0.93	0.04	-0.18
Bulgaria	68	81	80	0.91	c	-0.39*
Romania	78	84	83	0.71	c	0.18
Australia	70	79	73	0.95	-0.61*	0.51*
Russian Federation	62	75	80	0.95	c	-0.16
United Arab Emirates	67	76	71	1.18	-0.77*	0.69*
Liechtenstein	48	93	48	0.79	c	c
Estonia	70	83	67	0.99	-1.04*	-0.30
Malaysia	66	87	68	1.04	-0.26	-0.16
Chinese Taipei	65	83	65	1.04	-0.27	0.34
Slovenia	70	78	77	0.93	-0.42*	-0.20*
United Kingdom	60	80	70	1.07	-0.17	-0.45*
New Zealand	65	87	66	0.97	-1.12*	-0.23
Spain	68	74	70	1.03	-0.79*	0.57*
Lithuania	64	72	79	0.91	c	-0.50*
Hong Kong-China	53	95	65	0.85	0.36	0.29
Germany	69	83	60	0.94	-0.33	-0.14
OECD average	65	77	67	0.96	-0.37*	0.13*
Ireland	58	86	61	1.14	0.01	-0.11
Montenegro	56	78	73	0.82	c	0.25*
Macao-China	48	85	67	1.00	c	0.65*
Chile	74	60	76	1.10	-0.93*	0.92*
Japan	66	67	66	0.94	-0.56*	0.39*
Slovak Republic	56	73	68	1.00	0.29	-0.12
Belgium	57	76	59	0.96	0.12	0.13
Austria	61	74	52	1.07	-0.03	-0.07
Denmark	63	76	69	0.86	-0.27	-0.04
Korea	64	83	53	0.94	-0.08	-0.18
Shanghai-China	45	82	58	1.13	0.11	0.29
Greece	53	79	65	1.09	c	0.53*
Kazakhstan	53	67	52	1.17	-0.79	0.07
Turkey	53	84	61	0.97	c	0.78*
Portugal	58	49	68	0.91	-0.83*	0.73*
Netherlands	65	56	56	0.97	0.18	0.11
Norway	59	58	57	0.99	c	0.05
Finland	59	61	58	0.99	-0.66*	-0.38
Italy	58	61	60	1.04	-0.90*	0.04
Serbia	41	79	52	0.94	c	0.10
Brazil	54	49	67	1.16	-1.36*	1.30*
Argentina	56	50	59	1.25	-1.04*	1.25*
Mexico	61	54	60	1.06	-1.13*	0.82*
Viet Nam	50	46	69	1.01	-0.63	0.47*
Uruguay	52	52	57	1.24	-1.17*	1.32*
Albania	46	46	67	1.00	-1.59*	m
Peru	44	57	58	1.15	-1.01*	0.94*
Luxembourg	35	86	43	0.88	-0.25*	0.20*
Indonesia	68	32	71	0.85	-0.32*	0.66*
Israel	40	68	44	1.06	c	0.06
Jordan	48	43	60	1.18	-0.77*	0.54
Croatia	34	72	49	0.89	c	-0.24
Costa Rica	52	47	47	1.15	-1.54*	1.12*
Colombia	37	52	49	1.13	-1.16*	0.58*
Thailand	36	45	41	1.13	-0.93*	0.42*
Tunisia	30	12	33	0.93	c	0.18

Notes: Higher values on the *index of quality of physical infrastructure* indicate better physical infrastructure. Differences that are significant at the 5% level ($p < 0.05$) are marked with *.
Countries and economies are ranked in descending order of the average index.
Source: OECD, PISA 2012 Database, Tables IV.3.14 and IV.3.15.
StatLink http://dx.doi.org/10.1787/888932957327

Physical infrastructure and educational resources

School principals were asked to report on whether their schools' capacity to provide instruction was hindered ("not at all", "very little", "to some extent", or "a lot") by a shortage or inadequacy of physical infrastructure, such as school buildings and grounds; heating/cooling and lighting systems; and instructional space, such as classrooms. The responses were combined to create an *index of quality of physical infrastructure* that has a mean of zero and a standard deviation of one in OECD countries. Positive values reflect principals' perceptions that the shortage of physical infrastructure hinders learning to a lesser extent than the OECD average, and negative values indicate that school principals believe the shortage hinders learning to a greater extent.

On average across OECD countries, 65% to 77% of students are in schools whose principals reported that shortages or inadequacy of school buildings and grounds, heating/cooling and lighting systems, or instructional spaces do not hinder at all or hinder very little their school's capacity to provide instruction. In Latvia, the Czech Republic, the United States, Poland, Romania, Singapore, Switzerland and Canada, 75% or more of students are in schools whose principals reported that shortages or inadequacy of school buildings and grounds do not hinder learning at all or hinder learning very little, while in Tunisia, Croatia, Luxembourg, Thailand and Colombia, fewer than 40% of students are in such school. The variation, between schools, in the quality of physical infrastructure and its effect on instruction reported by principals is notable in Argentina, Uruguay, Jordan, the United Arab Emirates, Kazakhstan and Brazil, while it is small in Romania, Latvia, the Czech Republic and Liechtenstein (Figure IV.3.7 and Table IV.3.14).

In 27 countries and economies, principals of disadvantaged schools tended to report more shortages or inadequacy of physical infrastructure than did principals of advantaged schools. This difference is of one index point or more on the *index of quality of physical infrastructure* (i.e. over one standard deviation of the index) in Uruguay, Brazil, Argentina and Costa Rica. In contrast, in Lithuania, the United Kingdom, Latvia, Bulgaria and Slovenia, principals of advantaged schools tended to report more shortages or inadequacy of physical infrastructure than did principals of disadvantaged schools. In 24 countries and economies, principals of public schools tended to report more shortages or inadequacy of physical infrastructure than did principals of private schools. The difference in reporting is over one index point (i.e. over one standard deviation of the index) in Albania, Costa Rica, Brazil, Uruguay, Colombia, Mexico, New Zealand, Argentina, Estonia and Peru. On average across OECD countries, principals in schools located in rural areas tended to report more shortages or inadequacy of physical infrastructure than principals of schools located in towns. However, in 33 countries and economies, the level of shortages or inadequacy of physical infrastructure reported by principals does not vary by where school is located (Figure IV.3.7 and Table IV.3.15).

School principals also reported their perceptions about educational resources in their school. They were asked to report whether their school's capacity to provide instruction was hindered by a shortage or inadequacy of: science laboratory equipment, instructional materials (e.g. textbooks), computers for instruction, Internet connectivity, computer software for instruction, and library materials. The responses were combined to create *an index of quality of schools' educational resources* that has a mean of zero and a standard deviation of one in OECD countries. Positive values reflect principals' perceptions that a shortage of educational resources hinders learning to a lesser extent than the OECD average, and negative values indicate that school principals believe the shortage hinders learning to a greater extent.

An average of around 80% of students across OECD countries attends schools whose principals reported that the school's capacity to provide instruction was not hindered at all or hindered very little by a shortage or inadequacy of instructional materials or a lack or inadequacy of Internet connectivity. Some 74% of students are in schools whose principals reported that instruction was not hindered at all or hindered very little by a shortage or inadequacy of library materials. Between 66% and 69% of students are in schools whose principals reported that instruction was not hindered at all or was hindered very little by shortages or inadequacy of science laboratory equipment, computer software for instruction or computers for instruction. Principals in Singapore, Qatar and Liechtenstein reported that instruction is not hindered by a shortage of educational resources, while in Colombia, Tunisia, Peru and Costa Rica, principals reported that instruction is hindered to some extent by a shortage of educational resources (Figure IV.3.8 and Table IV.3.16).

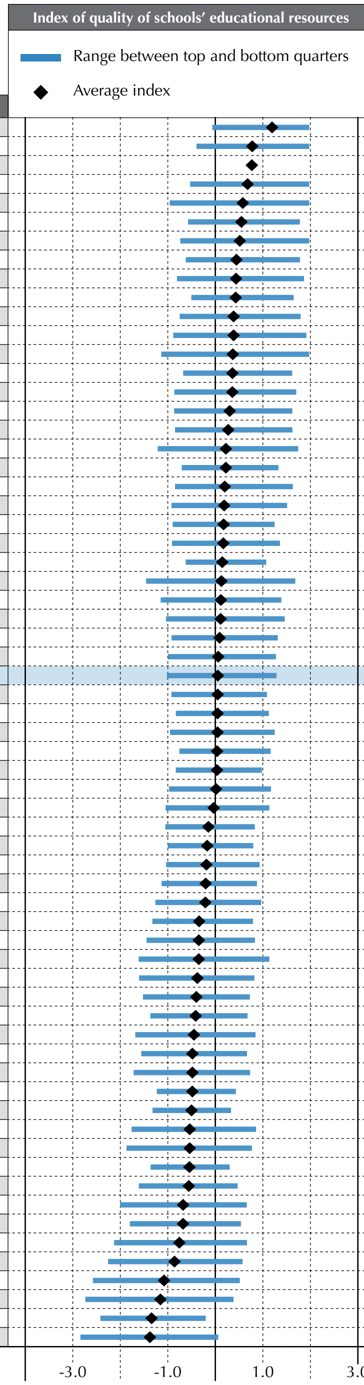
In 35 countries and economies, principals of disadvantaged schools reported more shortage or inadequacy of educational resources than did principals of advantaged schools. This difference amounts to more than one index point (i.e. more than one standard deviation) in Peru, Costa Rica, Mexico, Brazil and Indonesia. In contrast, in Finland, principals of disadvantaged schools reported less shortage or inadequacy of educational resources than did those of advantaged schools.

■ Figure IV.3.8 ■

School principals' views on adequacy of educational resources

- A: Shortage or inadequacy of science laboratory equipment
- B: Shortage or inadequacy of instructional materials (e.g. textbooks)
- C: Shortage or inadequacy of computers for instruction
- D: Lack or inadequacy of Internet connectivity
- E: Shortage or inadequacy of computer software for instruction
- F: Shortage or inadequacy of library materials

Percentage of students in schools whose principals reported that the following phenomena hindered student learning "not at all" or "very little"



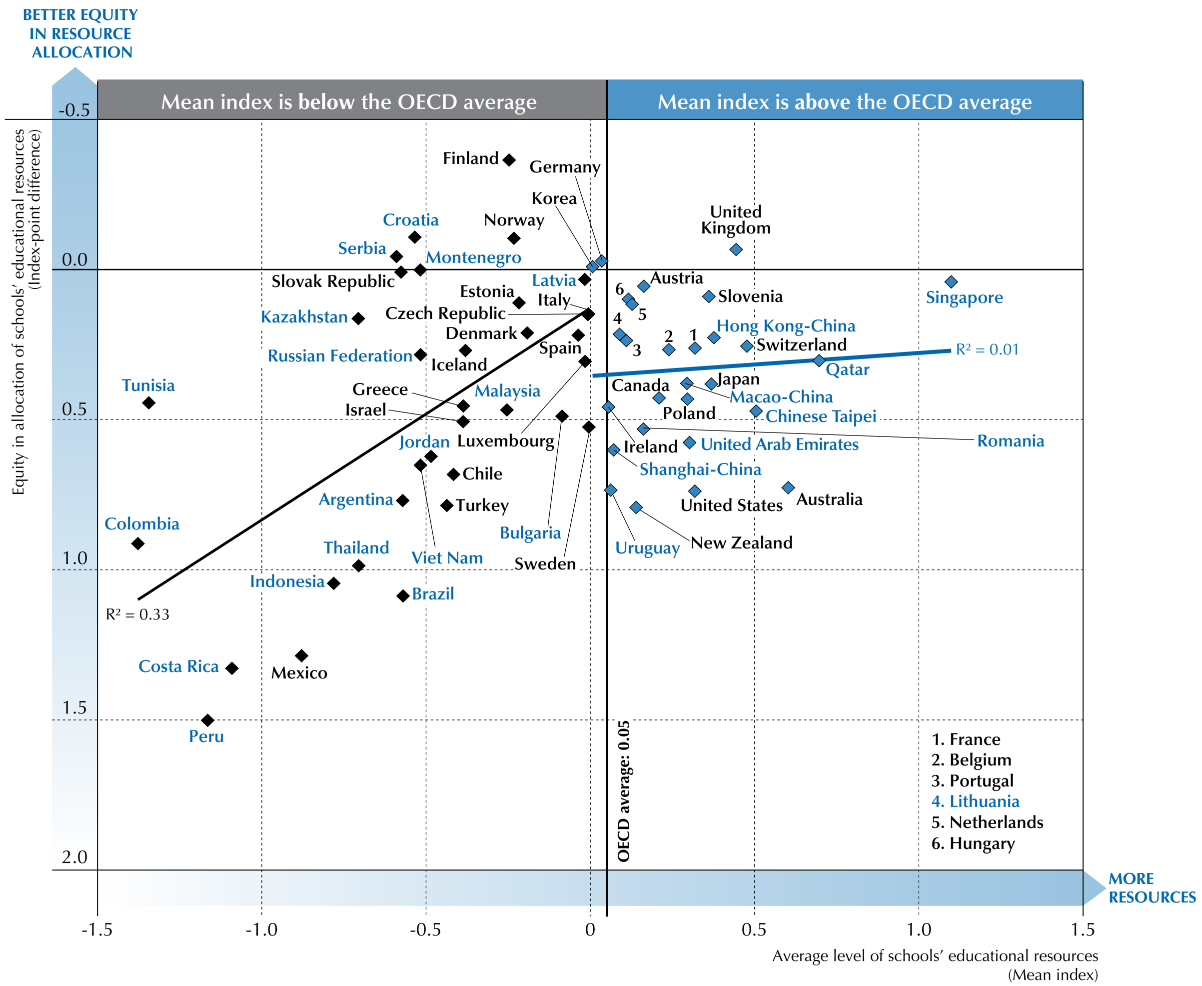
	A	B	C	D	E	F	Variability in the index: S.D.	Difference between private and public schools (priv.-pub.): Index difference	Difference between advantaged and disadvantaged schools (adv.-disadv.): Index difference
Singapore	97	98	93	95	94	97	0.87	c	0.04*
Qatar	79	96	83	89	81	84	0.98	0.46*	0.30*
Liechtenstein	99	99	100	100	100	62	0.51	c	c
Australia	86	91	89	82	86	89	0.97	-0.59*	0.73*
Chinese Taipei	72	88	88	86	82	80	1.20	-0.12	0.47
Switzerland	81	89	76	81	85	89	0.93	0.25	0.26
United Kingdom	82	89	76	81	83	84	1.06	-0.39*	-0.07
Hong Kong-China	96	87	79	92	77	83	0.93	0.06	0.23
Japan	79	96	79	79	75	79	1.02	-0.42*	0.38
Slovenia	87	78	89	96	82	88	0.84	-0.76*	0.09*
France	88	87	69	77	79	89	0.98	0.17	0.26
United States	79	85	67	85	77	82	1.07	-0.59	0.74*
United Arab Emirates	75	83	72	71	71	73	1.21	-0.73*	0.58*
Poland	71	88	74	93	73	87	0.90	0.00	0.43*
Macao-China	78	82	87	75	79	79	1.02	c	0.38*
Belgium	83	90	71	78	80	79	0.98	-0.18	0.27
Canada	83	84	64	77	73	86	0.97	-0.38*	0.43*
Austria	62	85	73	82	72	88	1.16	0.16	0.06
Romania	74	71	74	94	82	83	0.82	c	0.53*
New Zealand	89	92	56	62	69	91	0.98	-1.33*	0.79*
Netherlands	82	91	54	71	67	84	0.95	0.06	0.12
Hungary	59	88	82	80	76	83	0.84	-0.21	0.10
Portugal	72	91	76	81	65	84	0.91	-0.70*	0.24
Lithuania	69	88	81	94	68	84	0.69	c	0.22
Shanghai-China	61	78	72	71	62	72	1.24	0.12	0.60*
Uruguay	82	76	71	71	57	72	1.03	-0.82*	0.73*
Ireland	75	87	70	77	61	55	0.97	0.23	0.46
Germany	71	89	68	70	69	82	0.89	0.04	-0.03
Korea	68	84	82	93	75	67	0.92	0.00	-0.01
OECD average	69	80	66	79	68	74	0.92	-0.39*	0.31*
Sweden	81	84	50	76	74	80	0.83	-0.27	0.52*
Czech Republic	66	72	81	93	72	68	0.80	0.02	0.15
Italy	63	88	75	83	66	73	0.89	-0.27	0.15
Luxembourg	76	77	59	93	92	70	0.78	-0.64*	0.31*
Latvia	74	78	70	91	77	77	0.73	c	0.03
Spain	69	91	61	70	58	73	0.86	-0.22*	0.22*
Bulgaria	53	75	63	90	67	69	0.88	c	0.49*
Denmark	80	77	58	66	64	81	0.78	-0.56*	0.21
Estonia	53	60	63	96	68	64	0.74	-0.19	0.11
Norway	64	81	63	68	58	62	0.82	c	-0.10
Finland	74	81	57	76	51	66	0.82	-0.35*	-0.36*
Malaysia	82	93	42	49	54	73	0.90	-0.92	0.47*
Iceland	44	75	42	85	59	67	0.85	c	0.27*
Greece	71	70	45	79	53	46	0.96	c	0.45*
Israel	53	70	51	65	57	63	1.10	c	0.51*
Chile	47	72	72	72	43	68	1.00	-0.67*	0.68*
Turkey	43	72	59	77	60	64	0.92	c	0.79*
Albania	32	82	47	59	52	55	0.83	-0.97*	m
Jordan	60	74	42	43	52	75	1.02	-0.92*	0.62*
Russian Federation	37	70	44	60	46	60	0.91	c	0.28
Viet Nam	32	73	54	64	52	55	0.99	-0.74*	0.65*
Montenegro	38	60	55	74	35	69	0.65	c	0.00
Croatia	43	65	50	74	36	59	0.66	c	-0.11
Brazil	36	86	47	52	40	58	1.05	-1.38*	1.09*
Argentina	45	62	49	46	49	69	1.07	-0.26	0.77*
Slovak Republic	43	20	64	79	50	46	0.69	-0.44*	0.01
Serbia	37	51	54	68	56	55	0.86	c	-0.04
Thailand	32	63	47	53	45	40	1.07	-0.71*	0.99*
Kazakhstan	32	53	40	45	38	52	0.96	-1.05*	0.16
Indonesia	40	62	42	52	46	53	1.12	-0.14	1.05*
Mexico	39	60	39	46	43	45	1.14	-1.30*	1.29*
Costa Rica	22	43	43	51	41	36	1.24	-1.76*	1.33*
Peru	28	42	40	43	33	29	1.24	-1.30*	1.50*
Tunisia	21	41	17	22	35	16	0.93	c	0.44*
Colombia	26	33	31	30	25	30	1.17	-1.63*	0.91*

Notes: Higher values on the *index of quality of schools' educational resources* indicate better quality of schools' educational resources. Differences that are significant at the 5% level ($p < 0.05$) are marked with *.
Countries and economies are ranked in descending order of the average index.
Source: OECD, PISA 2012 Database, Tables IV.3.16 and IV.3.17.
StatLink http://dx.doi.org/10.1787/888932957327

In 26 countries and economies, principals of public schools reported more shortage or inadequacy of educational resources than did principals of private schools. In 36 countries and economies, the level of shortage or inadequacy of educational resources reported by school principals did not vary according to where the schools are located. On average across OECD countries, principals of schools located in cities reported less shortage or inadequacy of educational resources than did principals of schools located in towns; this is observed in 14 countries and economies. In contrast, in Austria, Belgium, Germany, Iceland and Qatar, principals of schools located in cities reported more shortages or in adequacy of educational resources did those of schools located in towns. In Argentina, Mexico, Chile, Thailand, Peru, Albania, Malaysia and Qatar, principals of schools located in rural areas reported more shortages or inadequacy than did principals of schools in towns (Figure IV.3.8 and Table IV.3.17).

■ Figure IV.3.9 ■

Equity in allocation of educational resources



Notes: The vertical axis refers to the difference in the *index of quality of schools' educational resources* between socio-economically advantaged and disadvantaged schools (adv. - disadv.).
The horizontal axis refers to the mean *index of quality of schools' educational resources*.
Source: OECD, PISA 2012 Database, Tables IV.3.16 and IV.3.17.
StatLink http://dx.doi.org/10.1787/888932957327

As shown in Figure IV.3.9, among the countries and economies where the average educational resource is below the OECD average, the overall level of educational resources is related to the level of equity in resource allocation between socio-economically advantaged and disadvantaged schools. The lower the overall level of schools' educational resources, the greater the gap in educational resources between advantaged and disadvantaged schools. Scarce resources tend to be more concentrated in advantaged schools, and disadvantaged schools tend to suffer from inadequacy

or shortage of resources; and the overall level of schools' educational resources is also related to systems' average performance (correlation coefficient is 0.70). By contrast, among countries and economies where the overall level of educational resources is above the OECD average, equity in resource allocation is not necessary linked to the overall level of resources; and the overall level of educational resources is not related to systems' average performance, either (correlation coefficient is 0.12).

School principals were asked to report in detail the number of computers available to students, at school, for educational purposes, and the number of these computers that are connected to the Internet. In Australia, Austria, New Zealand, Macao-China and the United Kingdom, at least one computer per student is available while in Turkey, Indonesia, Montenegro, Malaysia and Brazil five or more students share one computer. In a majority of countries and economies, over 95% of these computers are connected to the Internet; but in Indonesia, Kazakhstan, Tunisia and Peru, more than one in three of these computers are not connected to the Internet (Table IV.3.18).

Across OECD countries, about one in three students attends a school whose principal reported that less than 10% of work in class requires Internet access; more than one in two students are in schools where between 10% and 50% of work in class requires Internet access; and the remaining students (10%) attend schools where more than 50% of work in class requires Internet access (Table IV.3.19).

Box IV.3.2. **Improving in PISA: Tunisia**

Tunisia's performance in all three PISA subjects has improved over the past decade: in mathematics, by 3 score points per year; in reading, by 3.8 score points per year; and in science, by 2.2 score points per year. In 2003, the country's mean score in mathematics was 359 points; in 2012, it had improved to 388 points. This improvement reflects a considerable reduction in the proportion of students who scored below Level 2 in mathematics. In 2003, almost four out of five students (78%) failed to attain this baseline level of proficiency in mathematics; by 2012, this share had shrunk to around two out of three students (68%). Improvements in mathematics and reading scores are observed among both low- and high-achieving students, while improvements in science scores are seen only among low-achieving students.

Despite these improvements in the learning environment, 15-year-old students in 2012 had more negative dispositions towards school and mathematics than their counterparts in 2003 did; and the share of students who reported that they arrived late for school in the two weeks prior to the PISA test grew from 38% in 2003 to 52% in 2012.

Improvements in performance coincided with improvements in some aspect of the learning environment in Tunisia's schools. Students and principals reported fewer student- and teacher-related factors that hinder learning in 2012 than they did in 2003. In addition, the student-teacher ratio decreased from 19.4 in 2003 to 12.1 in 2012, and students attend schools whose principal is less likely to report that a shortage of teachers, educational material or physical infrastructure hinders student learning. Students are also more exposed to mathematics in school, as the average student in 2012 now spends 26 more minutes per week in mathematics lessons than the average student in 2003 did. Students in 2003 reported spending almost five hours per week on mathematics homework, while students in 2012 reported spending around three-and-a-half hours per week. In 2003, 62% of students reported that they had repeated a grade; by 2012, 38% of students so reported; as a result, 15-year old-students at the time of the PISA test in 2012 were more likely to be in upper secondary education than 15-year-olds in PISA 2003. Students in 2012 were also less likely than their counterparts in 2003 to be in schools that group students by ability.

In the 2000s, several policies were adopted with the aim of promoting student learning. The "School of Tomorrow" (*École de demain*) established the framework for these policies with planned implementation between 2002 and 2007. While the changes received wide support from teachers and parents, they have yet to be fully adopted because of the political uncertainty in Tunisia. Those policies that have been implemented focus on changing the curriculum and changing the way teachers teach. They also foster a culture of evaluation of schools and the school system, one of the reasons why Tunisia began participating in PISA in 2003 and continued to do so in every subsequent assessment.

...

In line with the PISA results outlined above, mandated teaching time for mathematics at the primary and top-level lower secondary schools was increased from four to five hours per week. The curriculum was further modified to introduce the teaching of physics and information technologies. Teachers were encouraged to modify their teaching methods to emphasise learning through student-directed problem solving and to make better use of information and communication technologies (ICT) in the teaching of Arabic, French, mathematics and sciences. To help teachers adopt of these new methods, national teaching manuals were revised and now include CDs with the relevant software for ICT-supported teaching.

In addition, Tunisia increased its budget for education, spending three times more per student at the secondary level and more than double at the primary level in 2011 than it did in 2001. These additional financial resources are devoted to providing information and communication technologies to schools, reducing class size, raising teachers' salaries, and improving the physical working conditions for teachers.

Sources :

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TIME RESOURCES

According to the results discussed in Chapter 1, at the school level, there is some relationship between the time students spend learning in and after school and their performance, but no clear pattern of this relationship is observed across countries and economies. Across all countries and economies that participated in PISA 2012, high-performing systems offer more creative extracurricular activities, and more students attend pre-primary education, and for a longer period of time, in these systems.

Ever since the seminal study by John B. Carroll (1963) on the extent of learning as a function of the instructional time a student receives relative to the time the student needs, educators and policy makers have attempted to understand how students' hours in school should be organised to maximise learning (Bloom, 1968). The literature suggests that optimising academic learning time is one of the key factors in improving academic achievement (Carroll, 1989; Hawley and Rosenholtz, 1984; Sheerens and Bosker, 1997; Marzano, 2003). The extent of students' exposure to content is the core of the concept of "opportunity to learn" (Schmidt and Maier, 2009), which is discussed in detail in Volume I.

While learning takes place in a variety of formal and informal settings, research indicates that structured lesson time at school is an important pre-requisite for students to develop the competencies that are assessed in the PISA 2012 framework (Scheerens and Bosker, 1997; Seidel and Shavelson, 2007; OECD, 2013a). Determining how learning time is associated with performance is difficult, given that many factors can influence the productivity of learning time. Yet research finds that the more time students spend learning, on average, the higher their grades (Fisher et al., 1980; Clark and Linn, 2003; Smith, 2002; Lavy, 2010).

What is less straightforward is how after-school lessons and individual study can promote academic achievement or be better organised to develop students' skills. While schools are structured learning environments with less variability than after-school programmes (Entwisle, Alexander and Olson 1997), both the quantity and quality of learning opportunities in informal settings are likely to vary more. Indirect evidence of this comes from studies examining the possible causes of the differences related to socio-economic status in the cognitive skills of young children entering school (Hart and Risley, 1995; Natriello, McDill and Pallas, 1990; Huttenlocher et al., 1991; Jencks and Phillips, 1998; Levin and Belfield, 2002). In these studies, differences in informal learning opportunities can be attributed to: more restricted vocabulary used by adults in the social networks of children coming from disadvantaged backgrounds; lower participation rates in pre-school education among children from disadvantaged backgrounds; the lack of educational resources available to parents with little education; and the fact that the achievement gap between social groups tends to grow during school breaks, reflecting differences in what children are exposed to while they are outside of school and formal learning environments.

Intended learning time in school

School systems make decisions about the overall amount of time devoted to instruction and what material students should be taught and at what age. Total intended instruction time is an estimate of the number of hours during which students are taught both compulsory and non-compulsory parts of the curriculum, as per public regulations. On average across OECD countries, students are expected to receive an average of around 7 700 hours of school (primary and secondary) by the time they are 14. Most of this instruction time is compulsory (OECD, 2013b). This total intended instruction time for students up to 14 years old ranges from over 9 400 hours in Australia, Greece and Chile and the partner country Colombia, to less than 6 000 hours in Estonia, Finland, Poland and Sweden and the partner countries and economies Argentina, Lithuania, Latvia, Croatia, the Russian Federation, Hong Kong-China, Bulgaria, Montenegro, Tunisia and Albania (Table IV.3.20).

Some systems allocate more learning time for older students than younger students, while other systems do the opposite. In the Czech Republic, Mexico, Hungary, Korea and the partner countries and economies the Russian Federation, Indonesia, Bulgaria, Chinese Taipei, Lithuania, Croatia, Macao-China and Latvia, the average number of hours per year of total intended instruction time for students between 12 and 14 years is more than that for students up to 9 years old (between 1.4 and 1.9 times more). By contrast, in Greece, Luxembourg, Turkey and the partner country Uruguay, the average number of hours per year of total intended instruction time for students aged between 12 and 14 is less than that for students up to 9 years old (between 0.67 and 0.98 times less) (Table IV.3.20).

Students' learning time in regular school lessons

PISA 2012 asked students to report the average number of minutes per class period and the number of class periods per week for mathematics, language of instruction and science.[7] Across OECD countries, students reported spending 3 hours and 38 minutes per week in mathematics lessons, 3 hours and 35 minutes per week in language-of-instruction classes, and 3 hours and 20 minutes per week in science lessons (Figure IV.3.10 and Table IV.3.21).

Student learning time in regular lessons varies greatly across school systems. Students in Chile spend around 6 hours and 40 minutes and students in Canada and the United Arab Emirates spend around 5 hours and 15 minutes in regular mathematics lessons per week. By contrast, students in Bulgaria, Montenegro, Croatia and Hungary spend less than 2 hours and 30 minutes in regular mathematics lessons per week. Meanwhile, students in Chile spend 6 hours and 14 minutes per week and students in Canada, Denmark and Tunisia spend between 5 hours and 6 minutes and 5 hours and 16 minutes per week in language-of-instruction classes. By contrast, students in Kazakhstan spend 1 hour and 49 minutes per week and students in the Russian Federation, Uruguay, Thailand, Bulgaria, Austria and Serbia spend between 2 hours and 15 minutes and 2 hours 25 minutes per week in language-of-instruction classes. Students in the United Arab Emirates and Canada spend 5 hours and 6 minutes; students in Lithuania spend 5 hours and 21 minutes per week in science lessons. By contrast, students in Montenegro spend 1 hour and 45 minutes, students in Italy spend 2 hours and 16 minutes, and students in Iceland spend 2 hours and 21 minutes per week in science lessons (Figure IV.3.10 and Table IV.3.21).

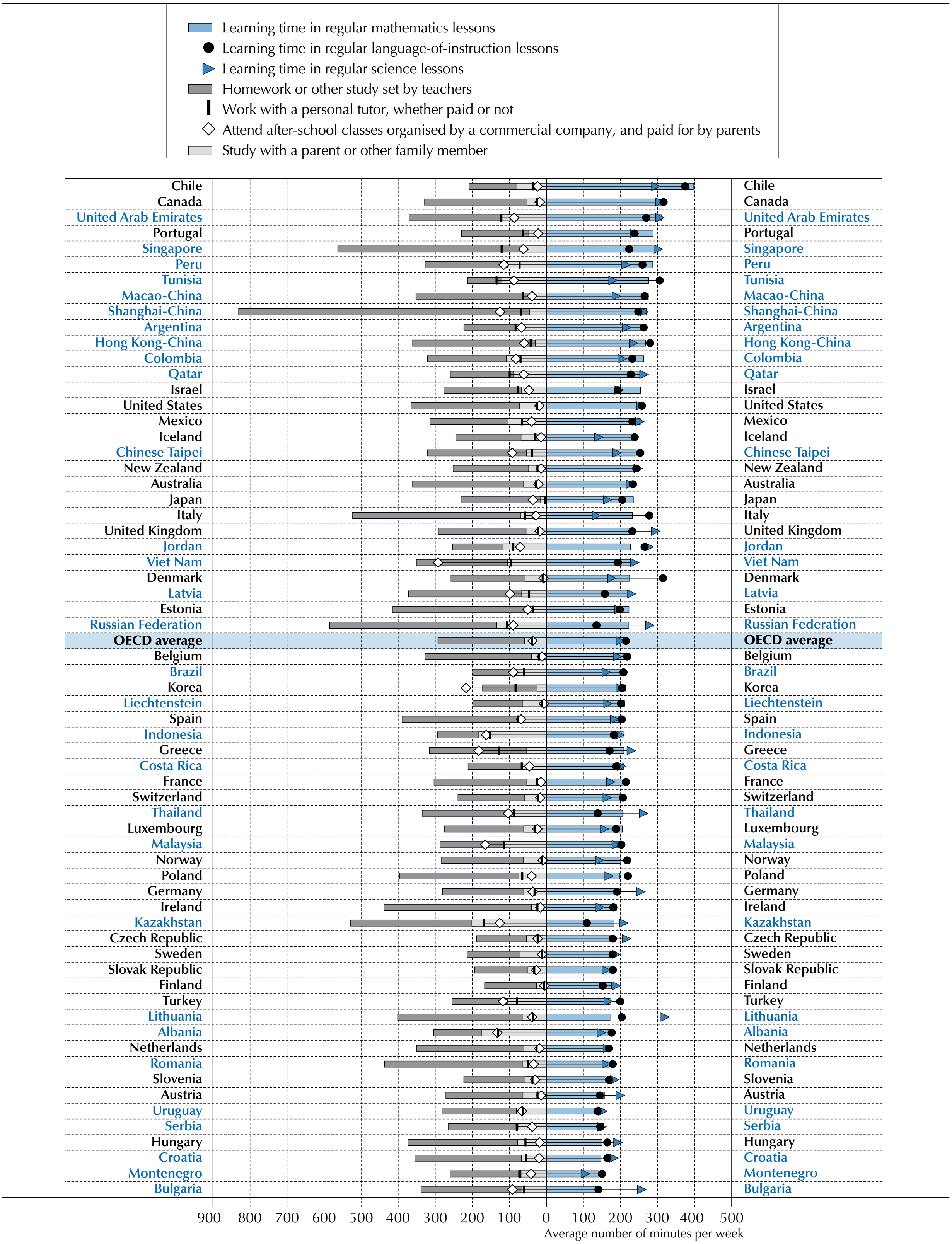
Students in school systems that provide an above-average amount of learning time in mathematics classes also tend to spend an above-average learning time in language of instruction lessons ($r = 0.85$ across OECD countries and $r = 0.82$ across all participating countries and economies). Students in systems that provide above-average learning time in regular mathematics lessons tend to spend more time in regular science lessons ($r = 0.59$ across OECD countries and $r = 0.51$ across all participating countries and economies). However, in some systems, such as those in Bulgaria and Lithuania, students spend less-than-average time in regular mathematics lessons, while they spend more-than-average time in regular science lessons.

Even within individual school systems, the amount of learning time in regular lessons, as reported by 15-year-old students, can vary. In most school systems, there is greater variation in learning time in regular science lessons than in regular mathematics or reading lessons. In Greece, Slovenia, Poland, Estonia, Ireland, Lithuania, Hungary, Finland and Serbia, the amount of learning time that students spend in regular mathematics lessons does not vary much, while in Chile, Peru, the United Arab Emirates, Argentina, Tunisia, Indonesia, Colombia and the United States, there are notable differences (Table IV.3.21).

On average across OECD countries, students who are in socio-economically disadvantaged schools tend to spend fewer minutes in regular mathematics lessons than students in advantaged schools. This is true in many countries and economies, especially in Japan, Chinese Taipei and Argentina, where students in advantaged schools spend an average of over 76 minutes more per week in regular mathematics lessons than students in disadvantaged schools. However, the opposite is observed in the United Arab Emirates, Germany, Switzerland, Austria, the United Kingdom and Qatar, where students in disadvantaged schools spend an average of between 5 to 35 minutes more per week in regular mathematics lessons than students in advantaged schools (Table IV.3.22).

■ Figure IV.3.10 ■

Student learning time in school and after school



Countries and economies are ranked in descending order of average time spent per week in regular mathematics lessons.
Source: OECD, PISA 2012 Database, Tables IV.3.21 and IV.3.27.
StatLink http://dx.doi.org/10.1787/888932957327

These differences in learning time between disadvantaged and advantaged schools are also related to other school features, such as differences in learning time between lower or upper secondary levels, public or private schools, or academic or vocational schools, depending on the structure of individual school systems. As shown in Chapter 2, socio-economically disadvantaged students are, in general, more likely to repeat a grade, so they have a greater chance of being enrolled at the lower secondary level in some systems. Whether students in lower secondary school spend more time learning mathematics than those at the upper secondary level depends on the education system. For example, in Argentina students at the upper secondary level spend 40 minutes more per week in regular mathematics class than students in lower secondary school, while in Switzerland students at the lower secondary level spend 59 minutes more per week in regular mathematics class than students in upper secondary school (Table IV.3.22)

Because the PISA sample is age-based, students are drawn from various grade levels and from both lower and upper secondary levels. It is important to keep this in mind when comparing the amount of time students invest in reading, mathematics and science lessons, because these lessons may be compulsory at one level (and hence in one school system, depending on the education level 15-year-old students attend) and not in the other (see also Box IV.1.1).

Class size

Class size can affect learning in various ways. Large classes may limit the time and attention teachers can devote to individual students, rather than to the whole class; and they may also be more prone to disturbances from noisy and disruptive students. As a result, teachers may have to adopt different pedagogical styles to compensate, which may, in turn, affect learning. While some research shows that smaller classes can improve non-cognitive skills (Dee and West, 2011), research on class size has generally found a weak relationship between small classes and better performance (Ehrenberg et al., 2001; Piketty and Valdenaire, 2006). Class size seems to be more important in the earlier years of schooling than it is for 15-year-olds (Finn, 1998; Chetty et al., 2011; Dynarski, Hyman and Schanzenbach, 2011). Moreover, the effects of class size on student performance seem to be culture-specific: comparatively large classes are found in many Asian countries where average student performance is high.

Students were asked to report the average number of students who attend their language-of-instruction class. On average across OECD countries, there are 24 students in a language-of-instruction class. In Viet Nam, Chinese Taipei, Japan, Thailand, Shanghai-China and Macao-China, there are 35 or more students per class, while in Liechtenstein, Finland, Latvia, Belgium, Switzerland, Iceland, Kazakhstan and Denmark there are fewer than 20 students. Class size varies greatly in Mexico, Jordan and Thailand, while in Greece, Finland, Denmark, Romania, Poland, Luxembourg, Italy, Croatia and Portugal language-of-instruction classes for 15-year-olds are roughly the same size (Table IV.3.23).

Classes in advantaged schools tend to be larger than those in disadvantaged schools by four students, on average across OECD countries. This is true in 51 countries and economies, while in Singapore, Qatar and the United Arab Emirates, classes in advantaged schools tend to be smaller than those in disadvantaged schools. There is no difference in class size between public and private schools, on average across OECD countries; and upper secondary students tend to be in larger classes than lower secondary students, on average across OECD countries. This is true in 29 countries and economies, while the opposite is observed in Germany, Turkey, Singapore, Australia, Kazakhstan, Israel, the Russian Federation, Qatar and Ireland. On average across OECD countries, the size of classes in schools located in rural areas tend to be smaller than those in schools located in towns or cities, and there is no difference in class size between classes in schools located in towns and those in schools located in cities (Table IV.3.24).

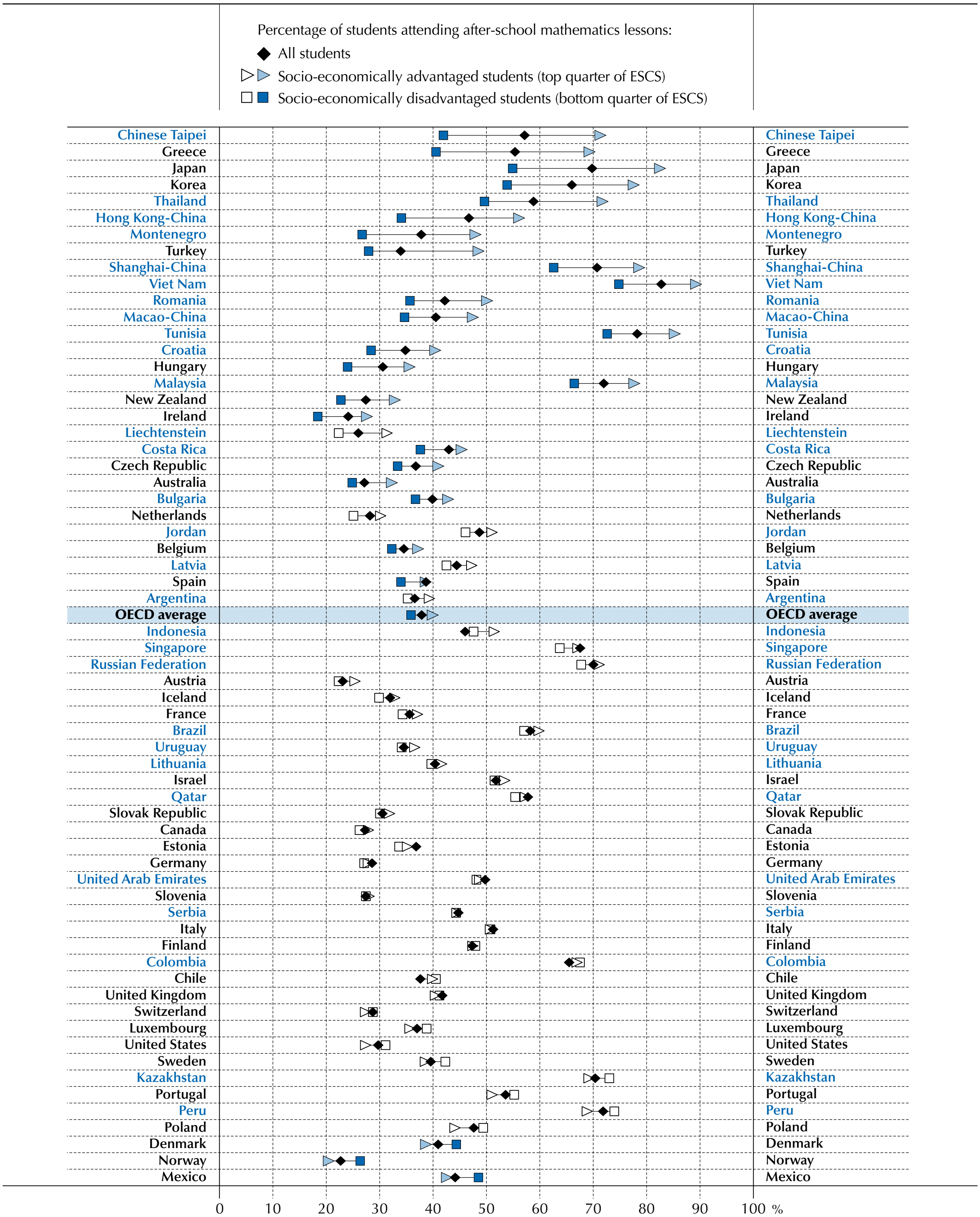
Students' learning time in after-school lessons

Students were asked to report the number of hours they typically spend per week attending after-school lessons in mathematics, language of instruction and science. These are lessons that may be given at their school, at their home or somewhere else. Across OECD countries, students are more likely to attend after-school lessons in mathematics than in language of instruction or science. Around 73% of students reported that they do not attend after-school lessons in the language of instruction or science; more students attend after-school mathematics lessons, while 62% of students reported that they did not attend such lessons, another 30% of students reported that they attend after-school mathematics lessons, but for less than four hours per week, and 8% of students attend such lessons for four or more hours per week (Table IV.3.25).

Students' attendance in after-school lessons varies greatly across countries. In Viet Nam, Tunisia, Malaysia, Peru, Shanghai-China, Kazakhstan, the Russian Federation and Japan, around 70% or more of students attend after-school lessons in mathematics. In Viet Nam, Tunisia and Peru, between 28% and 36% of students attend these lessons for four hours or more per week.

■ Figure IV.3.11 ■

Attendance in after-school lessons



Notes: White symbols represent differences that are not statistically significant.
ESCS refers to the *PISA index of economic, social and cultural status.*
Countries and economies are ranked in descending order of the difference in the percentages between students who are in the bottom quarter of ESCS and those who are in the top quarter (top - bottom).
Source: OECD, PISA 2012 Database, Tables IV.3.25 and IV.3.26.
StatLink http://dx.doi.org/10.1787/888932957327

By contrast, in Norway, Austria, Ireland, Liechtenstein, Australia, Canada, New Zealand, Slovenia, the Netherlands, Germany, Switzerland and the United States, 70% or more of students do not attend after-school lessons in mathematics. In these countries, between 2% and 7% of students attend these lessons for four hours or more per week (Figure IV.3.11 and Table IV.3.25). The nature and purpose of after-school lessons vary. In some schools and school systems, after-school lessons are provided mainly to support struggling students, while in others they are mainly for enrichment.

On average across OECD countries, socio-economically advantaged students are more likely to attend after-school lessons in mathematics (40%) than disadvantaged students (36%). This is true in 25 countries and economies; in Chinese Taipei, Greece and Japan, the difference is between 27 and 30 percentage points. By contrast, in Mexico, Norway and Denmark, the opposite is observed: the proportion of disadvantaged students who attend after-school lessons in mathematics is larger than that of advantaged students by 5 percentage points or more. Across OECD countries, lower secondary students are more likely to attend after-school lessons in mathematics than upper secondary students, on average; and students who attend schools in a city are more likely to attend these lessons than students in schools located in other areas (Figure IV.3.11 and Table IV.3.26).

Students were also asked to report the average time they spend each week on various types of after-school study activities, all school subjects combined. Across OECD countries, students reported that they spend 4.9 hours per week on homework or other study set by their teacher. Of this time, 1.3 hours are spent with another person overseeing the study and providing help if necessary, either at school or elsewhere. Students also reported that they spend 39 minutes per week working with a personal tutor, and 37 minutes per week attending after-school classes organised by a commercial company and paid for by their parents (Figure IV.3.10 and Table IV.3.27).

Students in Shanghai-China, the Russian Federation, Singapore, Kazakhstan, Italy, Ireland and Romania reported that they spend at least seven hours per week on homework or other study set by their teachers. In Shanghai-China, students spend almost 14 hours per week. By contrast, in Finland, Korea, the Czech Republic, the Slovak Republic, Liechtenstein, Brazil, Chile, Costa Rica, Tunisia, Sweden, Argentina, Slovenia, Portugal and Japan, students spend less than four hours per week on this. Students in Kazakhstan, Indonesia, Tunisia, Albania, Greece, the United Arab Emirates and Singapore reported that they spend two hours per week or more working with a personal tutor. Students in Viet Nam, Korea, Greece, Malaysia, Indonesia, Albania, Kazakhstan and Shanghai-China reported that they spend more than two hours per week attending after-school classes organised by a commercial company and paid for by their parents.

Hours that students spend doing homework or other study set by teachers vary between schools. On average across OECD countries, students who attend socio-economically advantaged schools tend to spend two hours per week longer on this than students who attend disadvantaged schools. This is true in 59 countries and economies. Across OECD countries, students in private schools spend more time doing homework or other study set by teachers than students in public schools, on average; upper secondary students spend more time on this than lower secondary students; students in schools located in cities spend more time than students in schools located in towns; and students in schools in cities or towns spend more time on this than students in schools located in rural areas (Table IV.3.28).

Some schools organise extra mathematics lessons at school. School principals reported on whether their school offers mathematics lessons in addition to the mathematics lessons offered during the usual school hours. Across OECD countries, two out of three students attend schools whose principals reported that such additional mathematics lessons are offered. In the Russian Federation, Hong Kong-China, Luxembourg, Viet Nam, Serbia, Macao-China, the United Kingdom, Kazakhstan, Korea, Malaysia, Singapore and Thailand, over 90% of students are in schools that offer these kinds of additional mathematics lessons, while fewer than half of students in Greece, Norway, Colombia, Denmark, Spain, Peru, Turkey, Costa Rica, Austria and Shanghai-China attend such schools (Table IV.3.29).

The additional mathematics lessons that are offered in some schools are usually for both enrichment and remedial purposes. Across OECD countries, 54% of students are in schools whose principals reported that the school offers enrichment and remedial mathematics lessons. Another 32% of students are in schools that offer remedial mathematics lessons only. Some 6% of students are in schools that offer enrichment mathematics lessons only. The remaining 7% of students are in schools that offer additional mathematics lessons based on the prior achievement level of the students. In most participating countries and economies, offering both enrichment and remedial mathematics lessons appears to be most common. However, in Luxembourg, Austria, the Netherlands, Spain, Chile, Belgium and Denmark, offering remedial mathematics lessons only is more common than offering both remedial and enrichment lessons. In these countries, there is at least an 18 percentage-point difference in the proportion of students in schools that offer remedial lessons only and those in schools that offer both remedial and enrichment lessons (Table IV.3.29).

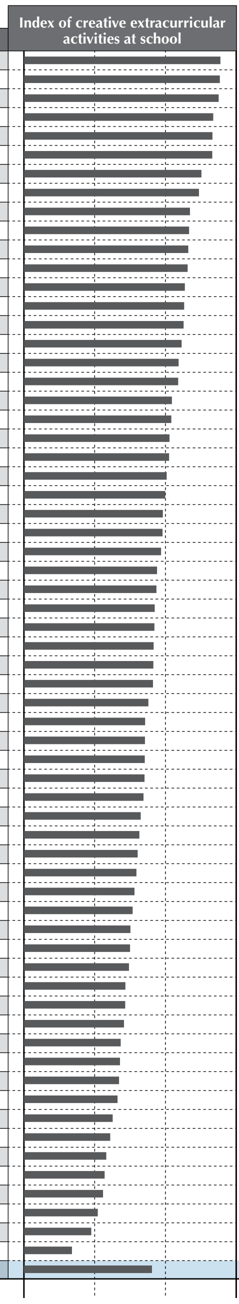
Figure IV.3.12
Extracurricular activities

Creative extracurricular activities at school

Percentage of students in schools whose principals reported that the following activities are offered at school

- A Band, orchestra or choir
- B School play or school musical
- C Art club or art activities

	A	B	C
Macao-China	87	96	94
Hong Kong-China	93	86	98
United Kingdom	96	90	92
Canada	88	91	89
United States	92	86	88
New Zealand	99	84	85
Poland	81	88	87
Singapore	98	70	86
Lithuania	92	59	88
Latvia	76	67	91
Luxembourg	74	79	79
Costa Rica	83	76	76
Shanghai-China	74	67	87
Thailand	68	72	87
Germany	83	64	79
Japan	85	42	95
Slovenia	74	75	74
Australia	91	68	64
Estonia	83	58	75
Chinese Taipei	74	50	89
Korea	73	43	93
Liechtenstein	79	60	72
Kazakhstan	63	51	89
Serbia	70	81	51
France	42	72	83
Switzerland	71	60	68
Chile	69	48	80
Montenegro	38	87	63
Iceland	54	74	68
Netherlands	58	63	65
Hungary	69	51	65
Qatar	28	78	80
Albania	45	62	79
Mexico	56	56	72
Malaysia	42	42	94
Peru	55	59	61
Russian Federation	66	40	65
Turkey	52	67	51
Romania	51	56	63
Colombia	52	54	68
Indonesia	51	54	61
Israel	60	52	56
Bulgaria	49	52	62
Finland	80	43	37
Ireland	67	39	57
Croatia	45	62	48
United Arab Emirates	21	64	68
Viet Nam	18	85	47
Uruguay	70	52	27
Sweden	68	46	30
Tunisia	33	55	62
Greece	57	45	43
Italy	30	72	37
Portugal	30	54	52
Slovak Republic	31	48	57
Jordan	25	54	55
Brazil	23	58	46
Belgium	31	52	40
Czech Republic	41	24	52
Denmark	46	39	30
Austria	52	35	28
Argentina	27	33	46
Spain	29	45	22
Norway	29	32	8
OECD average	63	59	62

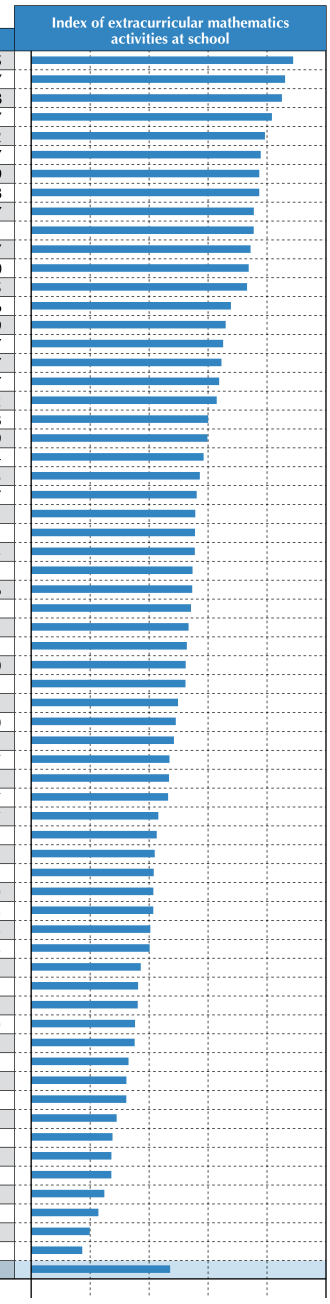


Extracurricular mathematics activities at school

Percentage of students in schools whose principals reported that the following activities are offered at school

- D Mathematics club
- E Mathematics competitions
- F Club with a focus on computers/information and communication technology
- G Either enrichment or remedial mathematics after-school lessons
- H Both enrichment and remedial mathematics after-school lessons

	D	E	F	G	H
Hong Kong-China	90	91	97	18	75
Poland	94	100	78	8	77
Malaysia	97	80	86	11	78
Korea	76	76	85	19	77
United Kingdom	73	94	77	21	62
Thailand	80	53	91	13	77
Macao-China	62	88	76	24	69
Russian Federation	66	97	51	18	78
Slovenia	64	99	59	37	57
Kazakhstan	64	98	64	36	61
Qatar	72	91	72	23	57
Slovak Republic	85	91	93	22	40
Singapore	21	87	95	12	75
Hungary	51	79	57	18	66
Albania	67	91	48	30	59
Portugal	45	98	12	12	77
New Zealand	25	97	53	19	57
Chinese Taipei	42	59	68	21	67
United Arab Emirates	58	86	65	24	42
Montenegro	40	55	69	43	48
Viet Nam	26	82	17	16	79
Romania	44	68	49	63	34
Lithuania	20	93	34	11	65
Shanghai-China	68	67	70	22	27
Latvia	35	92	29	16	52
Croatia	20	71	40	22	63
Serbia	18	75	46	40	45
Estonia	30	92	42	30	42
Tunisia	52	56	59	39	36
United States	56	68	55	27	31
Canada	42	77	54	34	31
Australia	27	95	30	22	45
Indonesia	37	68	46	33	40
Bulgaria	36	80	58	25	32
Luxembourg	20	79	34	72	23
Italy	6	67	21	24	60
Mexico	34	82	31	31	32
Israel	10	48	47	36	47
Czech Republic	33	85	38	21	22
Germany	21	58	60	29	27
Finland	8	88	12	33	37
Argentina	41	42	51	32	23
Brazil	8	92	17	12	41
France	11	73	24	24	35
Peru	30	81	31	28	19
Jordan	33	38	44	36	28
Japan	7	12	56	20	54
Chile	13	42	49	51	24
Costa Rica	32	61	22	25	23
Iceland	7	67	23	23	31
Ireland	19	61	26	26	22
Turkey	19	23	57	18	30
Uruguay	6	26	24	44	38
Colombia	29	61	24	13	21
Sweden	10	58	3	39	26
Belgium	1	70	9	37	21
Greece	9	75	17	15	15
Switzerland	5	28	18	38	23
Spain	8	66	13	27	11
Liechtenstein	3	34	29	32	20
Netherlands	3	47	5	34	14
Austria	2	33	20	37	12
Norway	6	32	19	26	8
Denmark	7	11	9	27	13
OECD average	27	67	38	28	37



Countries and economies are ranked in descending order of the average index.
Source: OECD, PISA 2012 Database, Tables IV.3.31 and IV.3.32.
StatLink http://dx.doi.org/10.1787/888932957327

Extracurricular activities

Instruction doesn't just occur inside classroom walls; extracurricular activities, such as sports activities and teams, debate clubs, academic clubs, bands, orchestras or choirs, can improve students' cognitive and non-cognitive skills. Skills such as persistence, independence, following instructions, working well within groups, dealing with authority figures, and fitting in with peers are needed for students to succeed in school – and beyond (Farkas, 2003; Carneiro and Heckman, 2005; Covay and Carbonaro, 2009, Howie et al., 2010).

School principals were asked to report whether their school offers various extracurricular activities to students in the modal grade for 15-year-olds. Across OECD countries, 90% of students are in schools that support a sports team or sporting activities; 73% are in schools that offer volunteering or service activities; 67% are in schools that offer mathematics competitions; 63% are in schools that support a band, orchestra or choir; 62% are in schools that offer an art club or art activities; 59% are in schools that produce a school play or musical; 56% are in schools that support a school yearbook, newspaper or magazine; 38% are in schools that support a club with a focus on computers and information and communications technologies (ICT); 30% are in schools that support a chess club; and 27% are in schools that support a mathematics club (Table IV.3.30).

Some of the principals' responses to these questions were combined to create two indices. One is an *index of creative extracurricular activities at school*, which is the sum of principals' responses on whether schools offer: band, orchestra or choir; school play or school musical; and art club or art activities. The other index is an *index of extracurricular mathematics activities at school*, which is the sum of principals' responses on whether schools offer: mathematics club; mathematics competitions; club with a focus on computers and ICT; and one more separate question regarding the availability of additional mathematics lessons (for remedial only, for enhancement only, or for both remedial and enhancement), which was described in the previous section. The *index of creative extracurricular activities at school* ranges from 0 to 3, as this is the sum of availability of three activities, and the *index of extracurricular mathematics activities at school* ranges from 0 to 5, as this is the sum of five activities (see Annex A1).

As shown in Figure IV.3.12, in Macao-China, Hong Kong-China and the United Kingdom, schools tend to offer more creative extracurricular activities (in these countries and economies, the index score ranges from 2.75 to 2.78), while schools in Norway, Spain, Argentina, Austria, Denmark and the Czech Republic do not offer many creative extracurricular activities (in these countries and economies, the index score ranges from 0.68 to 1.16). In 20 countries and economies, schools offer three or more out of five extracurricular mathematics activities, on average, while schools in Hong Kong-China, Poland, Malaysia and Korea offer four or more of these activities, on average. By contrast, schools in Denmark, Norway, Austria, the Netherlands, Liechtenstein, Spain, Switzerland and Greece offer fewer than one-and-a-half of these activities. School systems in which schools offer more creative extracurricular activities also tend to offer more extracurricular mathematics activities ($r = 0.58$ across OECD countries and $r = 0.52$ across all participating countries and economies).

Students' attendance at pre-primary school

Whether and for how long students are enrolled in pre-primary education is another important aspect of time resources invested in education. Many of the inequalities that exist within school systems are already present when students first enter formal schooling and persist as students progress through schooling (Entwisle, Alexander and Olson 1997; Downey, Von Hippel and Broh 2004; Mistry et al., 2010). Because research shows that inequalities tend to grow when students are not attending school such as during long school breaks (Entwisle, Alexander and Olson, 1997; Alexander, Entwisle and Olson, 2001; Downey, Von Hippel and Broh, 2004), earlier entry into the school system may reduce inequalities in education – as long as participation in pre-primary schooling is universal and the learning opportunities across pre-primary schools are of high quality and relatively homogeneous. Earlier entry into pre-primary school prepares students better for entry into – and success in – formal schooling (Hart and Risley, 1995; Heckman, 2000; Chetty et al., 2011).

Across OECD countries, 93% of students reported that they had attended pre-primary education. In 52 participating countries and economies, over 80% of students reported that they had attended pre-primary education. However, in Indonesia, Tunisia and Montenegro, between 32% and 46% of students reported that they had not attended pre-primary education, as did 70% of students in Turkey and 65% of students in Kazakhstan. In general, most students had attended pre-primary education for more than one year: across OECD countries, 74% of students reported that they had attended pre-primary education for more than one year. In 24 participating countries and economies, over 80% of students reported that they had attended pre-primary education for more than one year (Table IV.3.33).

An average of 67% of students in socio-economically disadvantaged schools had attended pre-primary education for more than one year, while 81% of students in advantaged schools had done so. This is true in almost all participating countries and economies. The difference is around 44 percentage points in Poland and Lithuania and between 39 and 30 percentage points in Croatia, Kazakhstan, Argentina, Finland and Malaysia. On average across OECD countries, students in private schools (79%) are more likely than students in public schools (73%) to have attended pre-primary education for more than one year; 15-year-old upper secondary students (73%) are more likely than lower secondary students (68%) to have attended pre-primary school; and students in schools located in towns or cities are more likely to attend pre-primary school than students in schools located in rural areas (Table IV.3.34).

Box IV.3.3 describes how indices like the *index of quality of schools' educational resources* are compared across PISA assessments.

Box IV.3.3. Comparing PISA scale indices between 2003 and 2012

PISA scale indices, like the *PISA index of economic, social and cultural status*, the *index of teacher shortage*, the *index of quality of physical infrastructure*, the *index of quality of educational resources,* the *index of disciplinary climate,* the *index of teacher-student relations,* the *index of teacher morale,* the *index of student-related factors affecting school climate* and the *index of teacher-related factors affecting school climate*, are based on information gathered from the student questionnaire. In PISA 2012, each index is scaled so that a value of 0 indicates the OECD average and a value of 1 indicates the average standard deviation across OECD countries (see Annex A1 for details on how each index is constructed). Similarly, in PISA 2003, each index was scaled so that a value of 0 indicated the OECD average and a value of 1 indicated the average standard deviation across OECD countries. To compare the evolution of these indices over time, the PISA 2012 scale was used and all index values for PISA 2003 were rescaled accordingly. As a result, the values of the indices for 2003 presented in this report differ from those produced in *Learning for Tomorrow's World: First Results from PISA 2003* (OECD, 2004a).

TRENDS IN RESOURCES INVESTED IN EDUCATION SINCE PISA 2003

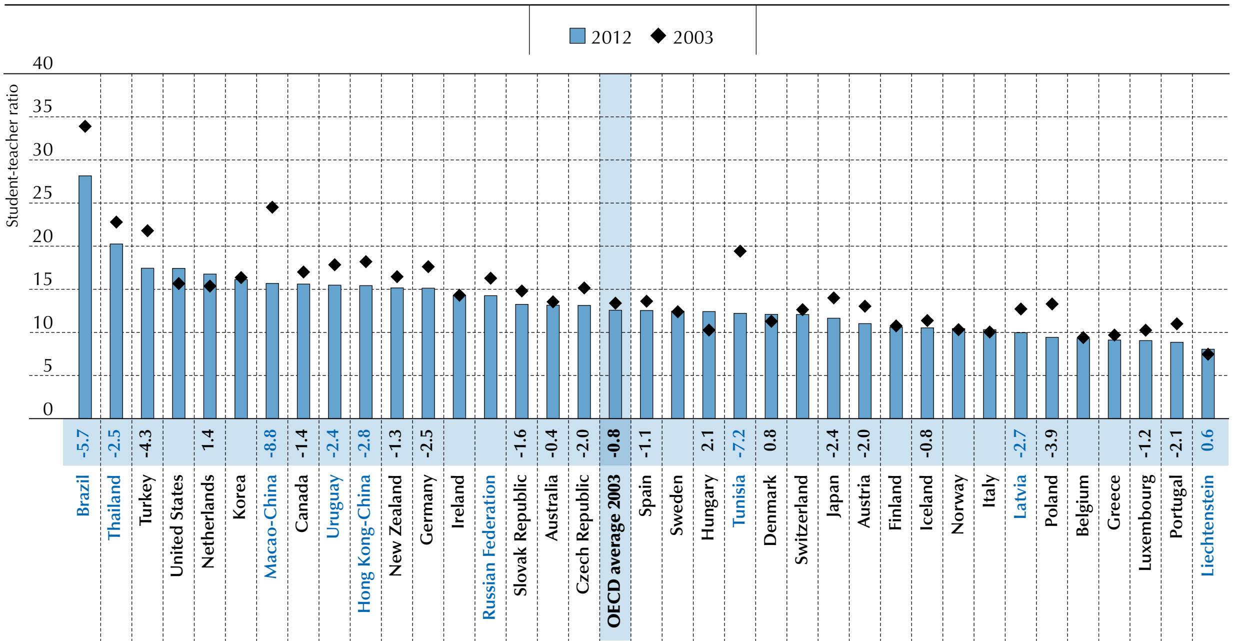
Overall, most countries and economies with comparable data between 2003 and 2012 have moved towards better-staffed and better-equipped schools. Trends between 2003 and 2012 also reveal an increase in classroom instruction time dedicated to mathematics and a reduction in the time students spend doing mathematics homework. Fifteen-year-old students in 2012 were also more likely than 15-year-olds in 2003 to have attended at least one year of pre-primary education.[8]

Between 2001 and 2010, financial investment in education increased significantly. On average across OECD countries with comparable data from PISA 2003 and PISA 2012,[9] national cumulative expenditure per student from the age of 6 to the age of 15 increased by 40% in real terms. Increases in cumulative expenditure per student are notable in the Slovak Republic, where investments nearly tripled during the period, and in Ireland and Poland, where they doubled. Moreover, in most countries and economies, growth in investment in education for students up to the age of 15 outpaced GDP growth, signalling that countries have privileged spending on education. Only in Iceland, Mexico and Italy did real cumulative expenditure decrease during the period (Tables IV.3.1 and IV.3.2).

On average across OECD countries with comparable data from PISA 2003 and PISA 2012, there has been a reduction in student-teacher ratios. In 2003, the average 15-year-old student attended a school with student-teacher ratio of 13.4 students per teacher; by 2012 this ratio had dropped to 12.6 students per teacher. Of the 36 countries and economies with comparable data for this period, 21 saw a reduction in student-teacher ratios, particularly Macao-China, Tunisia and Brazil, where the average student in 2012 attended a school where there were at least five fewer students per teacher than there were in 2003 (Tunisia's improvement in PISA and recent education policies and programmes is outlined in Box IV.3.2). By contrast, Hungary, the Netherlands, Denmark and Liechtenstein are the only countries with comparable data that saw an increase in student-teacher ratios during this period (Figure IV.3.13 and Table IV.3.35). The overall reduction in student-teacher ratios observed across OECD countries with comparable data applies to advantaged and disadvantaged students, advantaged and disadvantaged schools, private and public schools, lower and upper secondary students, and schools located in rural, town or urban areas (Table IV.3.36).

■ Figure IV.3.13 ■

Change between 2003 and 2012 in average student-teacher ratios



Notes: Only countries and economies with comparable data from PISA 2003 and PISA 2012 are shown.
The change in student-teacher ratios (2012 - 2003) is shown above the country/economy name. Only statistically significant differences are shown.
OECD average 2003 compares only OECD countries with comparable results in 2012 and 2003.
Countries and economies are ranked in descending order of the student-teacher ratio in PISA 2012.
Source: OECD, PISA 2012 Database, Table IV.3.35.
StatLink http://dx.doi.org/10.1787/888932957327

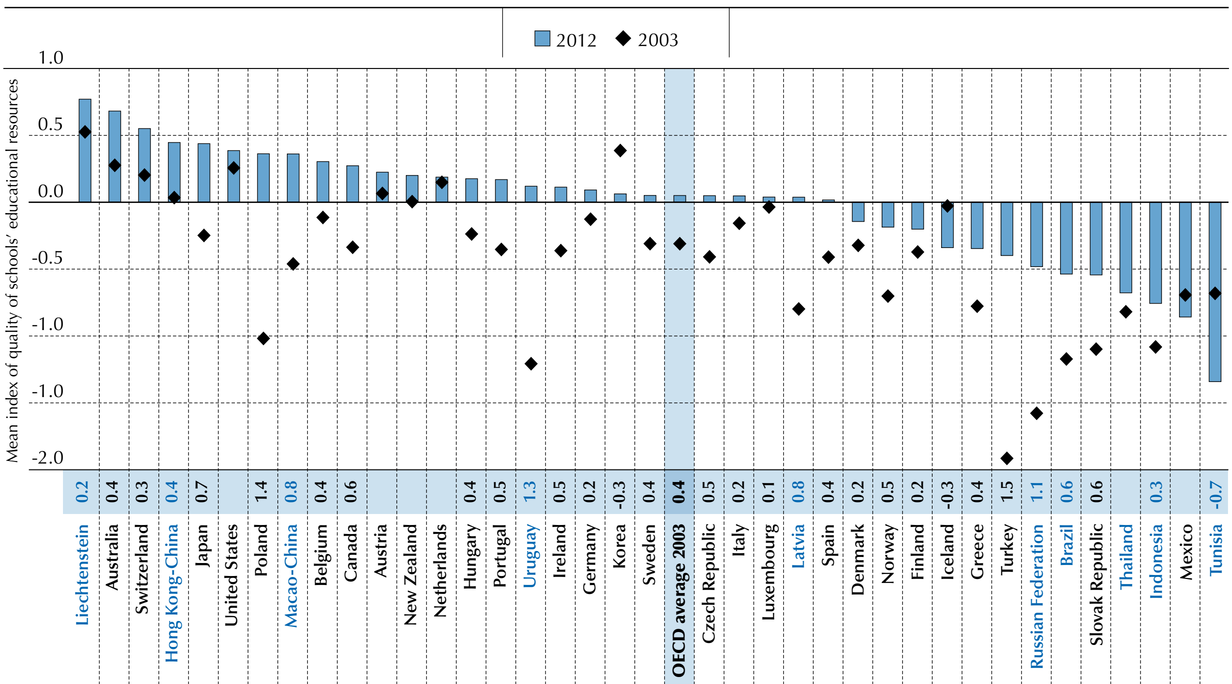
School principals' reports also signal trends towards better-staffed schools. Students in 2012 were less likely than students in 2003 to attend schools whose principal reported that a lack of qualified teachers hinders learning. On average across OECD countries, students in 2012 were around five percentage points less likely than students in 2003 to attend schools whose principal reported that a lack of qualified mathematics teachers hinders instruction. In 2003, more than one in two students in Turkey, Luxembourg, Uruguay and Indonesia, attended schools whose principal signalled that a lack of qualified mathematics teachers hindered learning; in 2012 this was the case only for students in Luxembourg, among all countries and economies with comparable data from PISA 2003 and PISA 2012. Reductions in teacher shortages were observed in 20 of the 38 countries and economies with comparable data for the period. The largest reductions in teacher shortages were observed in Turkey and Indonesia, where students in 2012 were at least 35 percentage points less likely than students in 2003 to attend schools whose principals reported that a lack of qualified mathematics, science or language-of-assessment teachers hindered instruction to some extent or a lot. However, increases in teacher shortages are observed in eight countries and economies (Table IV.3.37). In Korea, for example, students in 2012 were ten percentage points more likely than students in 2003 to attend schools whose principal reported that a lack of qualified mathematics teachers hindered instruction to some extent or a lot. The fact that instruction was less hindered by a lack of qualified teachers in 2012 than in 2003, on average among OECD countries, was also observed across advantaged and disadvantaged schools, public and private schools, lower and upper secondary school programmes, and in schools located in rural, town or urban areas, on average (Table IV.3.39).

More school principals in 2012 than in 2003 reported that schools are in good physical condition. On average across the OECD countries with comparable data from PISA 2003 and PISA 2012, students are significantly less likely to attend schools whose principal reported that the inadequacy or shortage of school buildings, heating or cooling systems or instructional space hindered the capacity to provide instruction by six, four and five percentage points, respectively. Deterioration in the quality of overall material conditions, as measured by the *index of quality of physical infrastructure* were observed in 22 of the 38 countries with comparable data, particularly in Turkey. In Tunisia, Thailand and Korea more school principals in 2012 than in 2003 reported that the quality of the physical infrastructure – particularly a lack of sufficient instructional space – hindered learning (Table IV.3.40). The average positive trend among OECD countries with comparable data, that instruction is less hindered by a lack of adequate physical infrastructure, is observed in both advantaged and disadvantaged schools, public and private schools, lower and upper secondary school programmes, and schools located in rural, town or urban areas, on average (Table IV.3.42).

Students in 2012 are also less likely than their counterparts were in 2003 to attend schools whose principal reported that the school's capacity to provide instruction is hindered by a lack of instructional materials. In 29 of the 38 countries and economies with comparable data, there is an increase in the *index of quality of schools' educational resources*, with the largest improvements observed in Turkey, Poland, Uruguay and the Russian Federation. In Turkey, for example, students are more than 40 percentage points less likely to attend schools whose principal reported that a lack of instructional materials (e.g. textbooks) or computer software for instruction hinders the school's capacity to provide instruction. By contrast, the *index of quality of schools' educational resources* fell – signalling a greater likelihood that students attend schools where a lack of material resources hinders the school's capacity to provide instruction – in Tunisia, Korea and Iceland (Figure IV.3.14 and Table IV.3.43). The overall trend among OECD countries, that a lack of educational resources hinders the school's capacity to provide instruction to a lower extent in 2012 than in 2003, was observed across all school types (advantaged and disadvantaged students, advantaged and disadvantaged schools, private and public schools, lower and upper secondary programmes, and urban and rural schools) (Table IV.3.45).

■ Figure IV.3.14 ■

Change between 2003 and 2012 in the index of quality of schools' educational resources (e.g. textbooks)

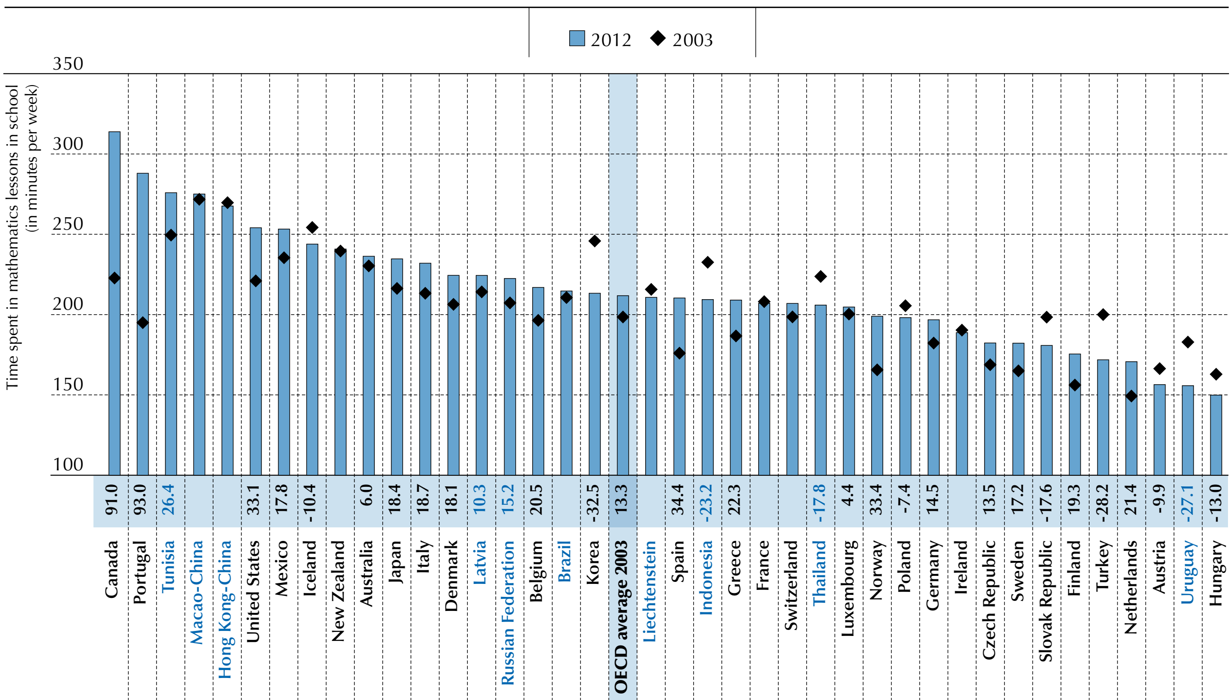


Notes: Only countries and economies with comparable data from PISA 2003 and PISA 2012 are shown.
The change in the *index of quality of schools' educational resources* (2012 - 2003) is shown above the country/economy name. Only statistically significant differences are shown.
For comparability over time, PISA 2003 values on the *index of quality of schools' educational resources* have been rescaled to the PISA 2012 scale of the index. PISA 2003 results reported in this figure may thus differ from those presented in *Learning for Tomorrow's World: First Results from PISA 2003* (OECD, 2004a) (see Annex A5 for more details).
OECD average 2003 compares only OECD countries with comparable results in 2012 and 2003.
Countries and economies are ranked in descending order of the mean index of quality of schools' educational resources *in PISA 2012.*
Source: OECD, PISA 2012 Database, Table IV.3.43.
StatLink http://dx.doi.org/10.1787/888932957327

Across OECD countries, students spent an average of 13 minutes per week more in mathematics classes in 2012 than they did in 2003. Average time spent in regular school lessons in mathematics per week increased by more than an hour-and-a-half in Portugal and Canada, and by more than 30 minutes in Spain, Norway and the United States. As a result of these changes, mathematics instruction for 15-year-olds in Portugal increased from an average of 3 hours and 15 minutes per week to 4 hours and 48 minutes per week. In Canada, average mathematic instruction time increased from 3 hours and 43 minutes to around 5 hours and 14 minutes. Increases in exposure to mathematics between 2003 and 2012 by more than 15 minutes per week when comparing are observed in an additional 14 countries and economies. In contrast, average learning time in mathematics shrank in ten countries and economies. Only in Korea – which had the fifth longest amount of learning time in 2003 – did the total learning time in mathematics fall by more than 30 minutes. Average weekly instruction time in mathematics also decreased in Turkey, Uruguay, Indonesia, Thailand and the Slovak Republic by at least 15 minutes per week. Countries and economies that saw an increase in weekly mathematics instruction time are not necessarily those that had shorter instruction time in 2003 (the correlation between instruction time in 2003 and change in instruction time between 2003 and 2012 is weak at -0.14) (Figure IV.3.15 and Table IV.3.46). The overall trend among OECD countries, that students spend more time in mathematics classes, is observed across all school types (advantaged and disadvantaged, private and public, lower and upper secondary programmes, and urban and rural schools) (Tables IV.3.47[1] and IV.3.47[2]).

■ Figure IV.3.15 ■

Change between 2003 and 2012 in the average time spent in mathematics lessons in school

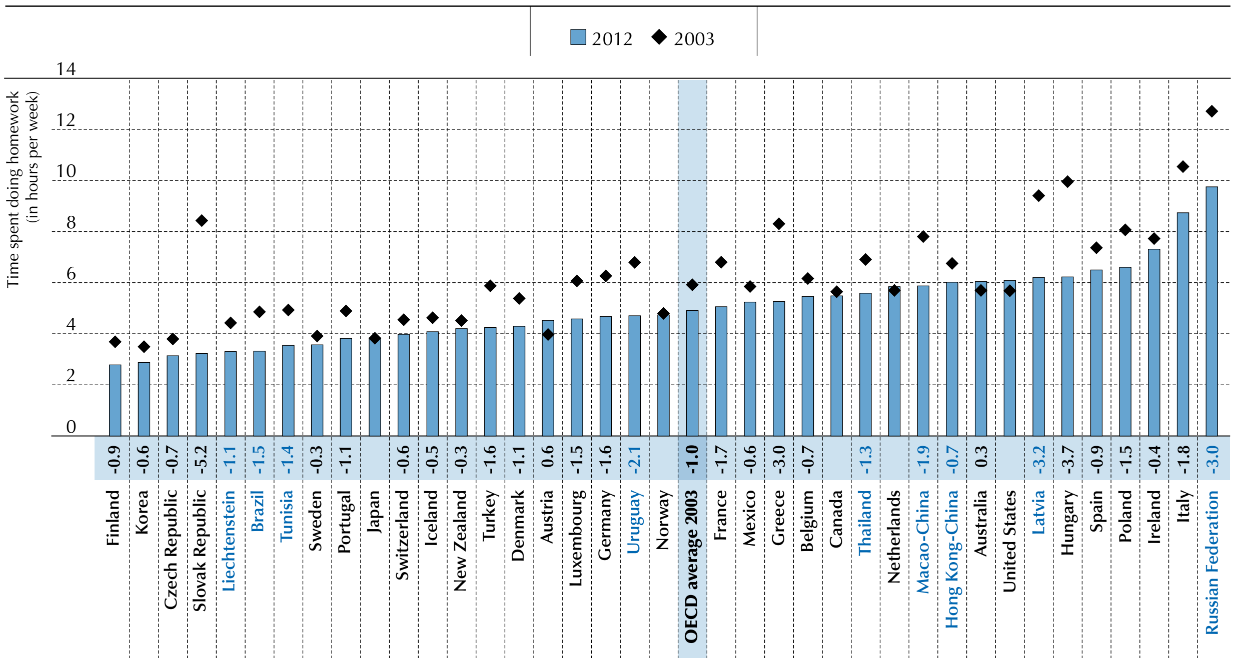


Notes: Only countries and economies with comparable data from PISA 2003 and PISA 2012 are shown.
The change in learning time (2012 - 2003) is shown above the country/economy name. Only statistically significant differences are shown.
OECD average 2003 compares only OECD countries with comparable results in 2012 and 2003.
Countries and economies are ranked in descending order of the average minutes students spent in mathematics lessons in school per week in PISA 2012.
Source: OECD, PISA 2012 Database, Table IV.3.46.
StatLink http://dx.doi.org/10.1787/888932957327

Trends also show that students spend less time on homework in 2012 that their counterparts in 2003 did. In 2003 and across OECD countries that had comparable data from 2003 and 2012, 15-year-old students reported spending 5.9 hours per week on homework or other study set by teachers. By 2012, this time had shrunk by one hour a week, to 4.9 hours. Average time spent on homework decreased in 31 of the 38 countries and economies with comparable data. It shrank by more than five hours per week in the Slovak Republic and by more than three hours per week in Hungary, Latvia and Greece. These reductions tend to be greatest among those countries and economies that recorded the most number of hours spent on homework in 2003 (correlation between average time spent in homework in 2003 and change to 2012 of -0.68). In 2003 in the Russian Federation, Italy and Hungary, the average student reported spending more than ten hours per week on homework; by 2012, the number of hours spent doing homework dropped by around two hours per week in Italy and by around three hours per week in the Russian Federation and Hungary. An exception to this trend is Finland, where the average student in 2003 spent a relatively short time doing homework (3.7 hours per week) and in 2012, the average student spent almost one hour less on homework. As a result of these changes, the difference in time spent on homework between those countries where students do more homework and those where students do less has narrowed over time (Figure IV.3.16 and Table IV.3.48). The general trend among OECD countries, that students spend less time doing homework in 2012 than they did in 2003, was observed among both advantaged and disadvantaged students and across all school types (advantaged and disadvantaged, private and public, lower and upper secondary programmes, and urban and rural schools) (Table IV.3.49).

■ Figure IV.3.16 ■

Change between 2003 and 2012 in the average time spent doing homework



Notes: Only countries and economies with comparable data from PISA 2003 and PISA 2012 are shown.
The change in time spent doing homework (2012 - 2003) is shown above the country/economy name. Only statistically significant differences are shown.
OECD average 2003 compares only OECD countries with comparable results in 2012 and 2003.
Countries and economies are ranked in ascending order of the average time students spent doing homework in PISA 2012.
Source: OECD, PISA 2012 Database, Table IV.3.48.
StatLink http://dx.doi.org/10.1787/888932957327

Fifteen-year-old students' mathematics (and reading) achievement is related to their school readiness when they entered primary school (Duncan et al., 2008). Depending on the quality of the programme, pre-primary school can promote school readiness, particularly if these programmes last more than one year. In PISA 2003, and on average across the OECD countries that have comparable data between PISA 2003 and PISA 2012, 69% of 15-year-olds reported that they had attended a pre-primary school for more than one year; in 2012, 75% of students reported so. The United States saw an increase of more than 60 percentage points in the share of students who had attended pre-primary school for more than one year: while the great majority of 15-year-old students in 2003 had attended pre-primary school for one year or less, around three out of four 15-year-old students in 2012 had done so for more than one year. Increases in the share of students who had attended pre-primary school for more than one year are notable in Latvia, where the share of students who had attended pre-primary school for more than one year increased by almost 20 percentage points, with a similar reduction in the share of students who had not attended pre-primary school (Table IV.3.50).

Similarly, in 2012, 15-year-old students in Thailand, Denmark, Sweden and Ireland were at least ten percentage points more likely than their counterparts in 2003 to have attended pre-primary school for at least a year. By contrast, attendance in pre-primary school for more than one year declined significantly in the Russian Federation, Finland, Tunisia, Korea and France during the period. In the Russian Federation, attendance in pre-primary school for any period of time dropped by more than five percentage points, while in Tunisia, the four percentage-point drop is offset by a nine percentage-point reduction in the share of 15-year-olds who had not attended pre-primary education (Table IV.3.50).

The general trend observed among OECD countries, that a larger proportion of 15-year-old students had spent at least a year in pre-primary school, was observed among both advantaged and disadvantaged students, as well as in disadvantaged and advantaged schools, public and private schools, lower and upper secondary programmes, and urban and rural schools. The growth in this enrolment is significantly stronger among advantaged students than disadvantaged students, and among students attending advantaged schools than those attending disadvantaged schools. This signals that those students who could benefit the most from attending pre-primary education (i.e. those from disadvantaged backgrounds) are those who have benefited the least from the greater enrolment in pre-primary education (Table IV.3.51).

Notes

1. This only covers expenditure on educational institutions.

2. These resources are allocated throughout a student's educational career, and countries spend different amounts per student. Caution is required in interpreting this indicator, as school systems are organised in many different ways across countries. For example, some school systems include special education in school budgets while others don't. Some school systems sponsor extensive recreational, athletic, and extra-curricular activities that are not related to the kind of academic instruction. In addition, some countries require schools to pay the pensions and health insurance of school staff, while others include these costs in the national budget for all citizens.

3. This refers to the scheduled annual salary of a full-time classroom teacher with the minimum training necessary to be fully qualified, plus 15 years of experience.

4. Starting salaries refer to the average scheduled gross salary per year for a full-time teacher with the minimum training necessary to be fully qualified at the beginning of the teaching career. Maximum salaries refer to the maximum annual salary (top of the salary scale) for a full-time classroom teacher with the maximum qualifications recognised for compensation.

5. These groups are created using a cluster analysis with the Ward method (which groups countries and economies to minimise the variance within each cluster) using data available in Table IV.3.4. Variables that entered the analyses are: whether competitive examinations are required to enter pre-service teacher training (coded as 1 for "Yes" and 0 for "No" and taken as the average of the requirement in the primary, lower secondary and upper secondary levels); the duration of teacher-training programmes in years (as an average of the duration of training leading to teaching in the primary, lower secondary and upper secondary levels; when more than one duration is available for a particular level, the average is also taken); and the requirement of a practicum as part of pre-service training (coded as 1 for "Yes" and 0 for "No" and taken as the average of the requirement in the primary, lower secondary and upper secondary levels). Information for the duration of teacher-training programmes is unavailable for Brazil, Chile and the United Arab Emirates, so these countries are excluded from the cluster analysis.

6. Annex A1 provides detailed information on how student-teacher ratio is computed.

7. Based on these two sets of questions, the minutes per week that students spend learning mathematics, language of instruction and science in regular lessons are computed.

8. Although questions included in the PISA 2003 questionnaires allow for trend comparisons in resources invested in education, not all questions are common to both questionnaires. In particular, there were no comparable questions on teachers' continuing education programmes, teacher qualifications, class size, extracurricular activities or after-school learning.

9. Data for PISA 2003 come from *Education at a Glance 2004: OECD Indicators* (OECD, 2004b) and refer to the year 2001. Data for PISA 2012 come from *Education at a Glance 2012: OECD Indicators* (OECD, 2012) and refer to the year 2010. Results for the year 2001 have been adjusted by inflation to ensure comparability with 2010.

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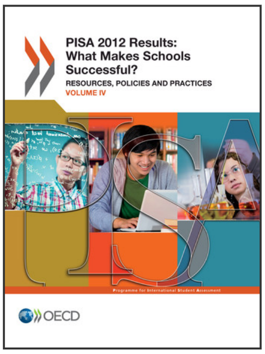

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