5

School and system characteristics and student performance in science

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INTRODUCTION

Chapter 4 showed the considerable impact that socio-economic background can have on student performance and, by implication, on the distribution of educational opportunities. At the same time, many factors of socio-economic disadvantage are not directly amenable to education policy, at least not in the short term. For example, the educational attainment of parents can only gradually improve and average family wealth depends on the long-term economic and social development of a country. The importance of socio-economic disadvantage, and the realisation that aspects of such disadvantage only change over extended periods of time, give rise to vital questions for policy makers: what can schools and school policies do to raise overall student performance? And similarly, what can they do to moderate the impact that socio-economic background has on student performance, thus promoting a more equitable distribution of learning opportunities?

Studies such as PISA can address these questions only up to a point. This is both because many important contextual factors cannot be captured by international comparative surveys of this kind and because such surveys do not examine processes over time and thus do not allow cause and effect to be firmly established (Box 5.1). However, it is possible to describe both the learning environment of schools and education systems and the results achieved, using multilevel analysis.[1]

PISA 2000, PISA 2003 and PISA 2006 examined school factors selected on the basis of three strands of research:

- Studies on effective teaching and instruction, which tend to focus on classroom management and teaching strategies, such as students' opportunity to learn, time on task, monitoring performance at classroom levels, approaches to teaching, and differentiation practices.
- Studies on school effectiveness, which focus on organisational and managerial characteristics of schools, such as school and classroom climate, performance orientation, school autonomy and educational leadership, evaluation strategies and practices, parental involvement and staff development.
- Studies on resource inputs, which focus, for example, on school size, student/teaching staff ratios, the quality of schools' physical infrastructures and of their educational resources, teacher experience, training and compensation, and how these translate into educational outcomes.

The questions that the various PISA surveys asked students, school principals and parents were drawn up from these three areas, concentrating on those aspects that had received support in earlier empirical research. No data were collected from teachers, mainly because teaching is a cumulative process and because in most countries 15-year-old students are taught by multiple teachers. It has not yet been possible to establish a methodology to link students and teachers in surveys like PISA in ways such that meaningful inferences can be made as to the influence of teacher characteristics and behaviour on learning outcomes. Therefore, inferences on teaching and learning are only made indirectly from the perspective of students and school principals.

This chapter focuses on the following six groups of school and system-level factors:

- Admitting, grouping and selecting
- School management and funding
- Parental pressure and choice
- Accountability policies
- School autonomy
- School resources (human, material and educational)

Box 5.1 **Interpreting the data from schools and their relationship to student performance**

The PISA 2006 indices are based on students' and school principals' reports of the learning environment and organisation of schools and of the social and economic contexts in which learning takes place. Several of the PISA 2006 indices summarise the responses of students or school principals to a series of related questions. The questions were selected from larger constructs on the basis of theoretical considerations and previous research. Structural equation modelling was used to confirm the theoretically expected dimensions of the indices and to validate their comparability across countries. For this purpose, a model was estimated separately for each country, as well as collectively for all OECD countries. For detailed information on the construction of the PISA 2006 indices and the models, see Annexes A1 and A8.

Several limitations of the information collected from principals should be taken into account in the interpretation of the data:

- On average, only 300 principals were surveyed in each OECD country and in seven countries fewer than 170 principals were surveyed.
- Although principals are able to provide information about their schools, generalising from a single source of information for each school (and then matching that information with students' reports) is not straightforward. Most importantly, students' performance usually relates to the work of many teachers in various subject areas.
- The learning environment in which 15-year-olds find themselves and which PISA examines may only be partially indicative of the learning environment that shaped their educational experiences earlier in their schooling career, particularly in education systems where students progress through different types of educational institutions at the lower secondary and upper secondary levels. To the extent that the current learning environment of 15-year-olds differs from that of their earlier school years, the contextual data collected by PISA is an imperfect proxy for the cumulative learning environments of students, and their effect on learning outcomes is therefore likely to be underestimated.
- The definition of the school in which students are taught is not straightforward in some countries, because 15-year-olds may be in different school types that vary in the level of education provided or the programme destination.[2] Because of the manner in which students were sampled, the within-school variation includes variation between classes as well as variation between students.
- The study of school resources requires precision that might not be easily captured in surveys, especially surveys with time restrictions that affect what can be requested of respondents. For example, a principal may not have accurate data on such matters as class sizes in specific subjects, nor the time or resources to gather such data. Moreover, it is important to associate specific resources with specific students rather than school averages to ascertain how a change in one type of resource might impact student performance. The combination of these restrictions limits the ability of PISA to provide direct statistical estimates of the effects of school resources on educational outcomes. Caution is therefore required in interpreting the school resource indicators bearing in mind that there are potential measurement problems and omitted variables. However, despite these caveats, the information from the school questionnaire can be instructive as it provides important insights into the ways in which national and sub-national authorities implement their educational objectives.

...

In using results from non-experimental data on school performance such as the PISA database, it is also important to bear in mind the distinction between school effects and the effects of schooling, particularly when interpreting the modest association between factors such as school resources, policies, and institutional characteristics and student performance. The effect of schooling is the influence on performance of not being schooled versus being schooled, which, as a set of well-controlled studies has shown, can have significant impact not only on knowledge but also on fundamental cognitive skills (*e.g.* Blair *et al.,* 2005; Ceci, 1991; Downing and Martinez, 2002). School effects are education researchers' shorthand way of referring to the effect on academic performance of attending one school or another, usually schools that differ in resources or policies or institutional characteristics. Where schools and school systems do not vary in fundamental ways, the school effect can be modest. Nevertheless, modest school effects should not be confused with a lack of an effect by schooling.

Where data based on reports from school principals or parents are presented in this report, it has been weighted so that it reflects the number of 15-year-olds enrolled in each school.

Under each of these headings, the chapter examines the relevant features of school policies, practices and institutional characteristics, as well as their relationship with student performance before and after accounting for demographic and socio-economic background factors. The chapter also examines the relationship between the factors and the impact which socio-economic background has on student performance in order to gauge how these factors contribute to equity in the distribution of educational opportunities.

The analyses in this chapter were undertaken separately with science, reading and mathematics as learning outcomes. Since the results did not vary in fundamental ways across the different subject areas, the results are discussed only for science performance.

ADMITTANCE, SELECTION AND GROUPING POLICIES

As noted in Chapter 4, catering to an increasingly diverse student body such that all students benefit from effective instruction represents formidable challenges for education systems. The approaches that countries have taken to address this challenge vary: some have non-selective school systems that seek to provide all students with similar opportunities for learning by requiring that each school caters to the full range of student performance. Other countries respond to diversity explicitly by forming groups of students through selection either between schools or between classes within schools, with the aim of serving students according to their academic potential and/or interests in specific programmes. PISA 2006 collected information on school admittance policies, the degree of institutional stratification in education systems and the approaches to within-school differentiation that schools pursue.

School admittance policies

Admission and placement policies establish frameworks for the selection of students for academic programmes and for streaming students according to career goals and educational needs. In countries with large performance differences between programmes and schools or where socio-economic segregation is firmly entrenched through residential segregation, admission and grouping policies have high stakes for parents and students. Effective schools may be more successful in attracting motivated students and in retaining good teachers; conversely, a "brain drain" of students and staff risks causing the deterioration of other schools. Moreover, once admitted to school, students become members of a community of peers and adults and, as shown in Chapter 4, the socio-economic context of the school in which students are

enrolled tends to be much more strongly related to student learning outcomes than students' individual socio-economic background.

To assess the academic selectivity of education systems, school principals were asked to what extent they considered the following when admitting students to their schools: students' residence; students' academic records (including placement tests); recommendations from feeder schools; parents' endorsement of the instructional or religious philosophy of the school; students' needs or desires for a specific programme; and the past or present attendance of other family members at the school.

Among these criteria, students' residence in a particular area tended to be the most frequently reported one. On average, across OECD countries, 47% of 15-year-old students are enrolled in schools whose school principals reported that students' residence was a prerequisite or a high priority for school admittance. However, this ranges from less than 10% in Belgium, Hungary and Mexico, and the partner countries/economies Croatia, Macao-China, Hong Kong-China, Slovenia, Chile, Serbia and Argentina, to over 80% in Iceland, Poland, the United States and Switzerland, and the partner country Tunisia (Figure 5.1).

Students' academic records followed as the next most frequently reported criterion, at 27% on average across OECD countries. These records may involve a formal test, an informal assessment of attainment or a formal qualification. Such academic selection can have positive features. It may help both stronger and weaker performers by adapting learning environments to the needs of each group, permitting each group to learn at its own pace, providing a reward in the form of entrance to a desired institution or a track that encourages attainment. On the other hand, it could also be argued that academic selection hinders the learning of those who are not selected because: high quality and high status programmes and institutions are naturally in high demand and when academic selection is used to choose entrants, those with initially weaker attainment can end up with lower quality education; weaker performers are not able to benefit from the expectations and aspirations of stronger performers and thus improve their own performance; sorting based on attainment can stigmatise those who do not meet the attainment standard, labelling them as poor performers and reducing their prospects in future education or in the labour market; and prior attainment levels, particularly at young ages, are a weak guide to future potential (Brunello *et al.,* 2006). Since many initial differences in performance are attributable to socio-economic background, the differential impact of socio-economic background on life chances could also be increased. In Japan, the Netherlands, Austria, Hungary, Korea and Switzerland, and in the partner countries/economies Serbia, Croatia, Bulgaria, Hong Kong-China, Montenegro, Macao-China, Indonesia, Romania, Qatar and Chinese Taipei, more than one-half of 15-year-olds are enrolled in schools whose principals reported that consideration of students' academic records was a prerequisite or at least of high priority when deciding on school admittance. In contrast, in Iceland, Sweden, Ireland, Spain, Denmark, Finland, Greece, Portugal, Italy, the United States, Australia, New Zealand and the United Kingdom, and the partner countries Argentina, Brazil and Uruguay, this is the case for less than 10% of students (Figure 5.1).

Students' need or desire for a specific programme follows next, with an OECD average of 19%, and attendance of other family members at the school (past or present) follows with an OECD average of 17%. Recommendations from feeder schools are at an OECD average of 13%, but there is considerable variation in this criterion across schools. Less than 1% of 15-year-olds students in Sweden and Norway are enrolled in schools in which recommendations from feeder schools are a prerequisite or of high priority for admittance and in 34 countries this is less than 10%, while it is 90% in the Netherlands and 40% in Switzerland, as well as 59% in the partner economy Macao-China. The parents' endorsement of the instructional or religious philosophy of the school is a prerequisite or high priority in the admission of 12% of students on average, across OECD countries (Figure 5.1).

Figure 5.1 [Part 1/2]
School admittance policies

Percentage of students in schools where the principal reported the following as a "prerequisite" or a "high priority" for admittance at their school

Residence in a particular area	% of students	Students' academic records	% of students	Recommendations of feeder schools	% of students
Iceland	94	Serbia	91	Netherlands	90
Tunisia	83	Croatia	91	Macao-China	59
Poland	82	Japan	86	Switzerland	40
United States	81	Bulgaria	84	Germany	38
Switzerland	80	Hong Kong-China	83	Thailand	33
Norway	79	Montenegro	67	Japan	26
Canada	78	Macao-China	66	Canada	22
Finland	75	Netherlands	65	Qatar	22
Qatar	74	Austria	65	Hong Kong-China	20
Greece	71	Hungary	64	Israel	19
Thailand	71	Indonesia	63	Indonesia	18
Spain	68	Romania	62	Australia	18
Germany	65	Korea	59	New Zealand	16
Jordan	65	Qatar	53	Chinese Taipei	16
United Kingdom	61	Chinese Taipei	53	Tunisia	14
Sweden	57	Switzerland	51	Jordan	14
Portugal	57	Slovak Republic	46	Kyrgyzstan	13
Denmark	55	Estonia	44	Ireland	12
Lithuania	53	Thailand	44	Korea	11
Kyrgyzstan	50	Czech Republic	42	Colombia	11
New Zealand	49	Luxembourg	42	Argentina	10
Azerbaijan	47	Germany	39	Bulgaria	9
Luxembourg	42	Slovenia	38	Estonia	9
Ireland	42	Mexico	38	Romania	9
Estonia	42	Israel	36	United States	9
Australia	42	Chile	33	Mexico	9
Russian Federation	41	Turkey	29	Denmark	9
Israel	39	Jordan	27	Russian Federation	8
Turkey	35	Belgium	26	Luxembourg	8
Chinese Taipei	33	Tunisia	24	Chile	7
Bulgaria	29	Kyrgyzstan	23	Belgium	7
Austria	25	Colombia	20	United Kingdom	7
Korea	23	Latvia	18	Serbia	7
Uruguay	22	Azerbaijan	17	Azerbaijan	7
Czech Republic	21	Poland	13	Italy	7
Latvia	20	Lithuania	11	Iceland	7
Indonesia	20	Russian Federation	11	Poland	6
Brazil	20	Canada	10	Austria	5
Japan	20	United Kingdom	10	Brazil	5
Slovak Republic	19	New Zealand	9	Slovak Republic	3
Colombia	15	Australia	9	Czech Republic	3
Romania	12	Uruguay	9	Croatia	3
Italy	11	Brazil	8	Spain	2
Netherlands	10	United States	8	Finland	2
Montenegro	10	Italy	7	Latvia	2
Argentina	10	Argentina	7	Lithuania	2
Mexico	10	Portugal	7	Turkey	1
Serbia	9	Greece	4	Slovenia	1
Chile	7	Finland	4	Greece	1
Slovenia	6	Denmark	4	Portugal	1
Hong Kong-China	5	Spain	3	Uruguay	1
Hungary	4	Ireland	2	Hungary	1
Belgium	2	Sweden	2	Norway	1
Macao-China	2	Iceland	1	Sweden	0
Croatia	2	Norway	a	Montenegro	a
OECD average	**47**	**OECD average**	**27**	**OECD average**	**13**

Source: OECD PISA 2006 database, Table 5.1.
StatLink http://dx.doi.org/10.1787/141887160188

Figure 5.1 [Part 2/2]
School admittance policies

Percentage of students in schools where the principal reported the following as a "prerequisite" or a "high priority" for admittance at their school

Parents' endorsement of the instructional or religious philosophy of the school

Country	% of students
Bulgaria	48
Thailand	48
Belgium	40
Qatar	35
Indonesia	35
Israel	33
Australia	27
Ireland	27
Hungary	23
Denmark	20
Netherlands	19
New Zealand	19
Colombia	19
Azerbaijan	17
Russian Federation	17
Argentina	16
Chinese Taipei	16
Canada	15
Spain	14
Hong Kong-China	13
Chile	12
United Kingdom	12
Jordan	12
Romania	12
Macao-China	12
Czech Republic	11
Brazil	11
Germany	11
Austria	10
Italy	10
Portugal	10
Latvia	10
Finland	10
Iceland	10
Estonia	9
Japan	9
Serbia	8
Kyrgyzstan	7
Slovak Republic	7
Luxembourg	7
Uruguay	6
Mexico	6
Poland	6
United States	5
Slovenia	5
Lithuania	4
Greece	4
Montenegro	4
Korea	4
Tunisia	3
Sweden	3
Norway	2
Switzerland	2
Turkey	1
Croatia	1
OECD average	**12**

Students' needs or desires for a special programme

Country	% of students
Bulgaria	75
Serbia	71
Slovenia	64
Romania	48
Latvia	46
Thailand	44
Austria	44
Portugal	41
Canada	37
Italy	33
Hungary	30
Japan	29
Tunisia	27
Israel	26
Australia	25
Indonesia	25
Chinese Taipei	22
United States	22
Germany	22
Switzerland	21
Argentina	20
Colombia	20
Netherlands	20
New Zealand	19
Russian Federation	19
Iceland	19
Slovak Republic	18
Qatar	17
Finland	17
Denmark	17
Jordan	16
Kyrgyzstan	15
Korea	15
Ireland	14
Greece	14
Belgium	13
Spain	13
Chile	12
Mexico	12
Luxembourg	11
Macao-China	11
Uruguay	11
Czech Republic	10
Sweden	10
United Kingdom	10
Estonia	9
Montenegro	9
Croatia	8
Lithuania	8
Hong Kong-China	7
Brazil	6
Turkey	5
Azerbaijan	5
Poland	5
Norway	3
OECD average	**19**

Attendance of other family members at the school

Country	% of students
Bulgaria	51
Spain	48
Australia	42
Luxembourg	41
Ireland	37
Qatar	34
United Kingdom	33
Portugal	31
New Zealand	31
Argentina	27
Canada	26
Macao-China	25
Greece	24
Denmark	24
Thailand	19
Germany	17
Hong Kong-China	17
Chile	16
Lithuania	15
Jordan	13
Russian Federation	13
Finland	13
Austria	13
Tunisia	12
Israel	12
Sweden	12
Italy	11
Latvia	11
Kyrgyzstan	11
Mexico	11
Serbia	10
Belgium	10
Iceland	10
Estonia	10
United States	10
Chinese Taipei	9
Indonesia	8
Romania	7
Uruguay	7
Azerbaijan	6
Brazil	6
Slovenia	6
Japan	6
Colombia	5
Poland	5
Norway	5
Netherlands	4
Czech Republic	4
Hungary	4
Turkey	3
Slovak Republic	3
Montenegro	2
Switzerland	2
Croatia	1
Korea	1
OECD average	**17**

Source: OECD PISA 2006 database, Table 5.1.
StatLink http://dx.doi.org/10.1787/141887160188

Institutional differentiation and grade repetition

Many education systems contain mechanisms for dividing students into separate types of education, with different curricula, different qualifications at the end of the programme and different expectations for the transition to further education or work, representing different tracks. Commonly, more academic tracks offer readier access to university-level education, and vocational tracks provide training for particular jobs or trades in the labour market (although these may also provide options for continued education).

One device to differentiate among students is the use of different institutions or programmes that seek to separate students, in accordance with their performance or other characteristics. Where students are stratified based on their performance, this is often done on the assumption that their talents will develop best in a learning environment in which they can stimulate each other equally well, and that an intellectually homogeneous student body will be conducive to the efficiency of teaching.

The measures shown in Table 5.2 range from essentially undivided secondary education until the age of 15 years to systems with four or more school types or distinct educational programmes (the Czech Republic, the Slovak Republic, Austria, Belgium, Germany, Ireland, Luxembourg, the Netherlands, and Switzerland, and the partner countries Montenegro and Qatar).

Figure 5.2

Interrelationships between institutional factors

Measured by the cross-country correlation of the relevant variables

OECD countries
All participating countries

1 Number of school types or distinct educational programmes available to 15-year-olds
2 Proportion of 15-year-olds enrolled in programmes that give access to vocational studies at the next programme level or direct access to the labour market
3 First age of selection in the education system
4 Proportion of repeaters in participating schools (lower secondary education)
5 Proportion of repeaters in participating schools (upper secondary education)
6 Mean performance on the science scale
7 Variance of student performance on the science scale
8 Total variance expressed as a percentage of the average variance in student performance across OECD countries
9 Variance between schools expressed as a percentage of the average variance in student performance across OECD countries
10 Strength of the relationship between student performance and the PISA index of economic, social and cultural status
11 Existence of standards-based external examinations

	1		2		3		4		5		6		7		8		9		10		11	
	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]	Correlation coef.[1]	P-value[1]
1			**0.56**	**(0.00)**	**-0.86**	**(0.00)**	0.05	(0.81)	0.24	(0.21)	-0.15	(0.45)	-0.05	(0.81)	-0.07	(0.70)	**0.72**	**(0.00)**	**0.52**	**(0.00)**	0.10	(0.62)
2	**0.31**	**(0.02)**			**-0.50**	**(0.01)**	-0.05	(0.80)	0.12	(0.56)	0.17	(0.40)	0.03	(0.89)	0.01	(0.97)	**0.59**	**(0.00)**	0.17	(0.39)	0.15	(0.45)
3	**-0.66**	**(0.00)**	-0.24	(0.08)			0.01	(0.97)	-0.14	(0.47)	0.23	(0.23)	0.12	(0.52)	0.14	(0.45)	**-0.75**	**(0.00)**	**-0.53**	**(0.00)**	-0.03	(0.86)
4	-0.12	(0.40)	-0.15	(0.29)	-0.05	(0.73)			**0.93**	**(0.00)**	-0.20	(0.28)	-0.14	(0.47)	-0.14	(0.45)	-0.03	(0.86)	0.29	(0.12)	**-0.41**	**(0.03)**
5	0.04	(0.76)	-0.05	(0.73)	-0.13	(0.33)	**0.91**	**(0.00)**			-0.22	(0.24)	-0.15	(0.42)	-0.17	(0.38)	0.13	(0.51)	0.33	(0.08)	-0.31	(0.10)
6	0.12	(0.37)	0.05	(0.73)	-0.06	(0.68)	**-0.30**	**(0.03)**	-0.22	(0.10)			**0.47**	**(0.01)**	**0.46**	**(0.01)**	-0.03	(0.88)	-0.30	(0.10)	0.29	(0.12)
7	0.08	(0.55)	-0.04	(0.79)	-0.14	(0.30)	-0.09	(0.52)	0.00	(0.99)	**0.48**	**(0.00)**			**1.00**	**(0.00)**	0.24	(0.20)	0.11	(0.55)	-0.03	(0.88)
8	0.06	(0.67)	-0.04	(0.77)	-0.13	(0.35)	-0.10	(0.48)	-0.02	(0.91)	**0.46**	**(0.00)**	**0.99**	**(0.00)**			0.21	(0.27)	0.11	(0.56)	-0.03	(0.89)
9	**0.54**	**(0.00)**	**0.29**	**(0.04)**	**-0.65**	**(0.00)**	0.02	(0.88)	0.18	(0.17)	-0.02	(0.91)	**0.39**	**(0.00)**	**0.39**	**(0.00)**			**0.50**	**(0.00)**	-0.01	(0.96)
10	0.24	(0.08)	0.05	(0.71)	**-0.48**	**(0.00)**	0.10	(0.44)	0.22	(0.10)	0.07	(0.61)	**0.43**	**(0.00)**	**0.42**	**(0.00)**	**0.51**	**(0.00)**			-0.09	(0.64)
11	0.14	(0.31)	-0.07	(0.62)	0.08	(0.54)	**-0.48**	**(0.00)**	**-0.42**	**(0.00)**	0.26	(0.05)	0.06	(0.63)	0.07	(0.61)	-0.04	(0.78)	-0.16	(0.25)		

Note: The proportion of explained variance is obtained by squaring the correlations shown in this figure.
1. Values that are statistically significant at the 5% level ($p<0.05$) are indicated in bold.
Source: OECD PISA 2006 database, Table 5.2.
StatLink http://dx.doi.org/10.1787/141887160188

Simple cross-country comparisons across OECD countries show that, while the number of school types or distinct educational programmes available to 15-year-olds is not related to average country performance in science (see column 6 and row 1 in Figure 5.2), it accounts for 52% of the share of the OECD average variation that lies between schools (see column 9 and row 1 in Figure 5.2).[3] The picture is similar when the partner countries and economies are included, although the relationship is slightly weaker then (29% see column 1 and row 9 in Figure 5.2).

Even more important, the number of school types or distinct educational programmes accounts for 27% of the cross-country variation among OECD countries in the strength of the relationship between socio-economic background and student performance (see column 10 and row 1 in Figure 5.2). In other words, in countries with a larger number of distinct programme types, socio-economic background tends to have a significantly larger impact on student performance, suggesting that stratification tends to be associated with socio-economic segregation. One aspect of such differentiation is the separate provision of academic and vocational programmes. Vocational programmes differ from academic ones not only with regard to their subject-matter content, but also in that they generally prepare students for specific types of occupations and, in some cases, for direct entry into the labour market. The proportion of students enrolled in vocational educational programmes varies from 1% or less in one-third of the OECD countries and one-half of the partner countires/economies to over one-half of students in the Netherlands (55%), and in the partner countries Serbia (76%), Montenegro (68%) and Slovenia (52%) (Table 5.2).

An important dimension of tracking and streaming is the age at which decisions between different school types are generally made and therefore at which students and their parents are faced with choices. Such decisions occur very early in Austria and Germany, at the age of 10 years. By contrast, in countries such as New Zealand, Spain and the United States no formal differentiation takes place between schools until the completion of secondary education (Table 5.2). While there is no relationship between the age of selection and country mean performance, the share of the variation in student performance that lies between schools tends to be much higher in countries with early selection policies. In fact, the age of selection accounts for more than half of the between-school differences across OECD countries (see column 9 and row 3 in Figure 5.2) and it accounts for 42% of the between-school differences across all participating countries (see column 3 and row 9 in Figure 5.2). While this in itself is not surprising because variation in school performance could be considered an intended outcome of educational tracking, the findings also show that education systems with lower ages of selection tend to show much larger socio-economic disparities, with the age of selection explaining 28% of the country average of the strength of the relationship between the PISA index of economic, social and cultural status and student performance in OECD countries (see column 10 and row 3 in Figure 5.2). The reason why the age at which differentiation begins is closely associated with socio-economic selectivity may be explained by the fact that students are more dependent upon their parents and their parental resources when they are younger. In systems with a high degree of institutional differentiation, parents from higher socio-economic backgrounds are in a better position to promote their children's chances than in a system in which such decisions are taken at a later age, and students themselves play a bigger role.

Grade repetition can also be considered as a form of differentiation in that it seeks to adapt curriculum content to student performance. In most countries, the requirement to repeat a year typically follows a formal or informal assessment of the student by the teachers towards the end of the school year, which suggests that the student has not adequately understood the material taught or reached the expected level of competence although sometimes repetition reflects failure in only some subjects. School principals were asked what percentage of students in their school repeated a grade at the levels of lower and upper secondary education

(ISCED 2 and 3, respectively), in the previous year of schooling. Across OECD countries, principals reported an average retention rate of 3 and 4% respectively. However, the proportions vary widely across countries: both in lower and upper secondary education, retention rates of 10% or more were reported in Portugal and Spain, as well as in the partner countries Tunisia, Uruguay, Argentina and Brazil. In the partner economy Macao-China, this was reported for lower secondary education, and in Luxembourg, for upper secondary education (Table 5.2). The results from PISA 2003 (*www.pisa.oecd.org*) show that, across countries, the performance of students who have repeated a school year remains lower than the national average. A number of other studies have also compared outcomes for those students who repeated years with others who were promoted despite poor results and found that grade repetition had little benefit and often led to the stigmatisation of the students concerned. It should be noted that the full economic costs of grade repetition, including the additional year of tuition plus the opportunity costs of one year of a student's time, which will mainly affect the student in the form of lower life-time earnings, typically after a delay, tend on average to be in the order of USD 20 000 per student per year repeated (OECD, 2005d).

An explanation for these results is not straightforward. There is no intrinsic reason why institutional differentiation should necessarily lead to the greater variation in student performance, or the greater socio-economic selectivity that the data show. If teaching homogeneous groups of students is more efficient than teaching heterogeneous groups, this should increase the overall level of student performance rather than the dispersion of scores. However, in homogeneous environments, while high-performing students may profit from the wider opportunities to learn from one another, and stimulate each other's performance, low performers may not be able to access effective models and support.

It may also be that in institutionally differentiated systems it is easier to move students not meeting certain performance standards to other schools, tracks or streams with lower performance expectations, rather than investing the effort to raise their performance. Finally, it could be that a learning environment that has a greater variety of student abilities and backgrounds may stimulate teachers to use approaches that involve a higher degree of individual attention for students.

The question, of course, remains whether institutional differentiation might still contribute to raising overall performance levels. This question cannot be answered conclusively with a cross-sectional survey such as PISA. The five OECD countries that show both above-average science performance and below-average impact of socio-economic background on student performance – namely Australia, Canada, Finland, Japan and Korea – do not track students early. The OECD countries with more stratified education systems tend to perform less well, but this tendency is small and not statistically significant.

While educational structures are deeply embedded in the historical and cultural context of countries, they are not static. Indeed, across OECD countries there has been a significant trend from highly stratified towards more integrated educational structures since the 1960s (Field *et al.,* 2007). The Nordic countries were among the first to make the change more than a generation ago, while Spain introduced such a reform as recently as the early 1990s by adding two more years of comprehensive schooling. The most recent example is Poland, which delayed the separation of students into different institutional tracks by one year, and since the reform of the schooling structure in Poland[4] was implemented between the PISA 2000 and PISA 2003 assessments, it warrants further discussion in this context. As shown in Chapter 4, for Poland there was a large decrease in the between-school variance between PISA 2000 and PISA 2003 for science, from 50.7% of the OECD average variation in student performance, of which the largest proportion was accounted for by the different school tracks, to 14.9%. Poland is now among the countries with the lowest between-school variance (12.2% in PISA 2006; see Tables 4.1a, 4.1b and 4.1c) – a result that researchers have associated with the fact that the 15-year-old students assessed by PISA were no longer separated into different school tracks.

An important question remains, of course, as to whether the more integrated structure of the education system in Poland merely led to a redistribution of the performance variance among schools or whether it induced genuine improvement in learning outcomes. A more detailed analysis of changes in the performance on the PISA measures in Poland sheds light on this. First of all, as described in Chapter 6, Poland showed the second largest increase in average reading performance among OECD countries, an increase of 17 score points between PISA 2000 and PISA 2003 and a further increase of 11 score points between PISA 2003 and PISA 2006. In the initial period, most of that increase occurred at the lower end of the performance distribution: in the PISA 2000 assessment, 23.3% of the students had scored at Level 1 or below. In the vocationally oriented track (comprising 23% of the student population) this proportion amounted to almost three quarters. It appears that students in this track benefited most from the more integrated school system, as the proportion of poor performers in the student population, those who scored at Level 1 or below, dropped from 23.3% to 16.8% in PISA 2003 and to 16.1% in PISA 2006. The question arises, of course, as to whether the more integrated school system was disadvantageous for the better performers. The results from PISA lend no support to this hypothesis, however. On the contrary, the proportion of students at the highest two performance levels increased from 25% in PISA 2000 to 29% in PISA 2003 and to 35% in PISA 2006. The results were very similar for mathematics.

Ability grouping within schools

Apart from institutional differentiation, students can be also grouped within the schools they attend. The rationale behind this practice is much the same as for institutional differentiation, namely to be able to meet the students' needs better by creating a more homogeneous learning environment.

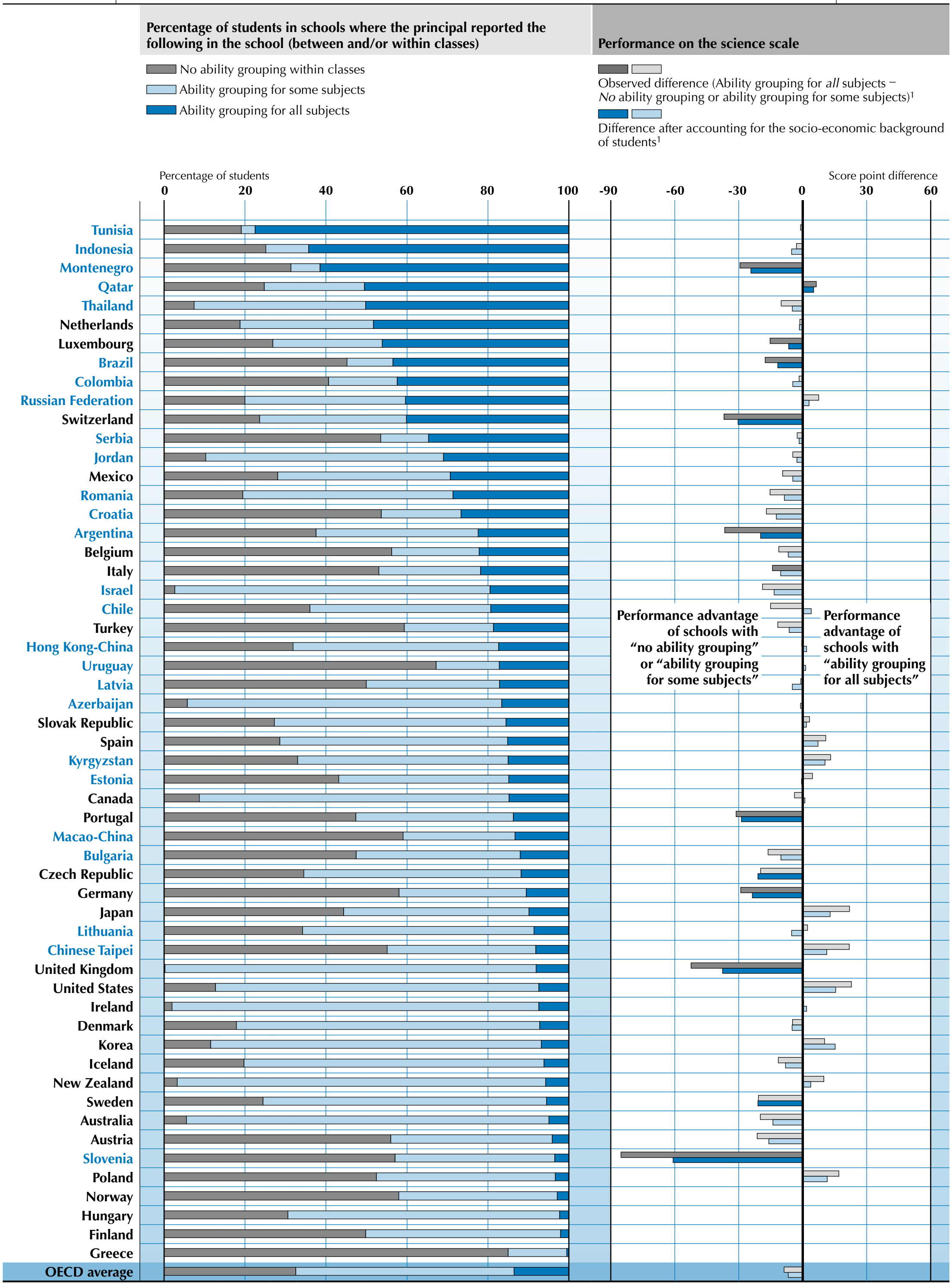
PISA asked school principals to report whether students were grouped by ability into different classes or within their class, and were asked whether these groupings were carried through for all subjects, for some subjects (without specifying which), or not at all.[5] From these questions, three different forms of ability grouping within schools can be identified. On average across OECD countries, 14% of 15-year-olds are in schools reporting there is ability grouping for all subjects within schools (between and/or within classes); 54% are in schools reporting there is ability grouping for some subjects but not for all subjects within schools; and 33% are in schools reporting there is no ability grouping takes place (Figure 5.3 and Table 5.3).

Across countries, the proportions of 15-year-olds in these three forms of ability grouping within schools vary considerably. Over 85% of 15-year-olds were in schools where school principals did not report any form of ability grouping in Greece, and between 52% and 67% in Poland, Italy, Austria, Belgium, Norway, Germany and Turkey, and in the partner countries/economies Serbia, Croatia, Chinese Taipei, Slovenia, Macao-China and Uruguay.

However, in the United Kingdom, Ireland, New Zealand, Australia and Canada, as well as in the partner countries Israel, Azerbaijan and Thailand, over 90% of 15-year-olds are in schools where school principals reported ability grouping for all or some subjects, and in all of these countries, the age of first selection in the education system is 15 or above (Tables 5.2 and 5.3).

In the Netherlands, Luxembourg, and Switzerland and the partner countries Tunisia, Indonesia, Montenegro, Qatar, Thailand, Brazil, Colombia and the Russian Federation over 40% of 15-year-olds are in schools where school principals reported the grouping of students within schools based on their ability for all subjects. On the other hand, this is 5% or below in Greece, Finland, Hungary, Norway, Poland, Austria and Australia, and the partner country Slovenia (Figure 5.3).

Figure 5.3
Ability grouping within schools and student performance in science



1. Statistically significant differences are marked in a darker tone.
Source: OECD PISA 2006 database, Table 5.3.
StatLink http://dx.doi.org/10.1787/141887160188

How does ability grouping within schools for all subjects, compared to no ability grouping or ability grouping only for some subjects, relate to student performance? In six OECD countries and four partner countries the science performance in schools that reported ability grouping for all subjects is lower; only in the partner country Qatar is it slightly higher than in schools without ability grouping or ability grouping only for some subjects (Figure 5.3).[6]

After accounting for the students' home backgrounds, students in schools that practise no ability grouping or ability grouping only for some subjects outperform those with ability grouping for all subjects in the United Kingdom, Switzerland, Portugal, Germany, the Czech Republic, Sweden and Luxembourg, as well as in the partner countries Slovenia, Montenegro, Argentina and Brazil, with the differences ranging between 7 and 61 score points.

The relationship between school admittance, selection and ability grouping and student performance in science

When assessing the extent to which the above factors relate to student and school performance, the individual effects of the factors on learning outcomes cannot simply be added, since they are interrelated. In the following, the effect of each factor is considered in turn, but in a model that takes the other factors into account. This section also shows the effect of these factors in Australia, Canada, Finland, Japan and Korea, the five OECD countries that show both above-average performance in science and a below-average impact of socio-economic background on performance. At the end of the chapter, a more elaborated version of the model is presented that also incorporates other school and system-level factors.

Across Australia, Canada, Finland, Japan and Korea (see the top-right quadrant in Figure 4.10), on average, 8% of 15-year-olds are enrolled in schools which reported practising ability grouping for all subjects within schools (OECD average 14%). This varies from 2% in Finland to 15% in Canada. In four out of these five countries, the first selection in education systems is at the age of 15 or later (OECD average 13.6). The number of school types or distinct educational programmes available to 15-year-ods is 1.6 on average: ranging from one programme in three countries to two in Japan and three in Korea (OECD average 2.5). On the other hand, considerable variation can be observed with regard to the academic selectivity of school admittance across these five countries. On average across these five countries, 26% of 15-year-olds are in schools with high academic selectivity, defined as schools reporting that academic records or feeder school recommendations were a prerequisite for school admittance (OECD average 19%), while 33% are in schools with low academic selectivity, defined as schools reporting that neither academic records nor feeder school recommendations were considered for school admittance (OECD average 42%). While the figures for high and low academic selectivity are 72% and 1% in Japan, they are 3% and 79% in Finland (Table 5.22).

As shown in Chapter 4, socio-economic factors play a role both at the level of individual students and through the aggregate context they provide for learning in schools. To examine this, the following analysis takes into account both the individual socio-economic background of students, as measured by the PISA index of economic, social and cultural status, and the socio-economic intake of the school, as measured by the school average of the same index. To examine the net relationship between admittance, selection and grouping policies and science performance, adjustments were made for demographic and socio-economic factors.[7] Such an adjustment allows a comparison of schools that are operating in similar socio-economic contexts. The net effects resulting from such an adjustment may, however, provide an incomplete picture of the true effect of admittance, selection and grouping policies because some of the performance differences are jointly attributable to admittance arrangements and socio-economic factors. For example, selection could reinforce socio-economic factors such that students from more

disadvantaged socio-economic backgrounds tend to be redirected to schools with lower performance expectations. Conversely, the interpretation of the school factors without an adjustment for the contextual factors (referred to as gross models in this chapter) ignores differences in the composition of schools and the country context. Gross and net effects are therefore both relevant. Parents and other stakeholders, for example, may be most interested in the overall performance results of schools, including any effects that are conferred by the socio-economic intake of schools, whereas those interested in the quality and effectiveness of schools and education systems may be primarily interested in the net effects.

The factors considered in both the net and gross models are the ones described in the preceding sections: school admittance based on academic record and recommendation of feeder schools, ability-grouping within school for all subjects, the age of first selection, and the number of distinct study programmes offered to 15-year-old students in a country (Box 5.2).[8]

Not surprisingly, schools reporting higher degrees of academic selectivity, where a student's academic record and/or recommendations from feeder schools are a prerequisite for admittance to the school, tend to perform better. Across the participating countries, the advantage amounts to 30.4 score points on the PISA science scale, equivalent to almost a school year; however, this is reduced to 18.1 score points after accounting for demographic and socio-economic factors (see the first table in Box 5.2). While these results suggest that individual schools benefit from more restrictive admission policies, this does not answer the question of how academic selectivity plays out for the education system as a whole. Do education systems in which schools have a higher degree of academic selectivity perform better or worse overall, all other things being equal? A separate model examined whether having a greater proportion of selective schools had an impact on the overall performance of the education system, beyond the individual school effect. The results show that there is no statistically significant compositional effect, that is, while selective schools tend to perform better, school systems with a greater proportion of selective schools do not perform better, other factors being equal.[9]

While an examination of the extent to which school or system-level variables relate to the overall performance of students is important, it is equally important to examine how those factors relate to equity-related issues. PISA assesses equity in the education system by the strength of the relationship between student performance and the socio-economic background of students and schools, measured through the PISA index of economic, social and cultural status (Table 5.20a).[10] The greater the dependence of educational performance on socio-economic factors, the less efficiently the human potential of the students is utilised and the greater the inequalities in educational opportunities. This part of the analysis therefore seeks to assess whether particular school and system-level factors are associated with the impact of socio-economic background on student performance. This is assessed by measuring the increase or decrease in the impact which one unit of the PISA index of economic, social and cultural status has, on average, on student performance in science. The results of this analysis suggest that whether individual students are in academically more selective schools or not does not appear to affect the impact which their socio-economic background has on their performance (see the second table in Box 5.2).

A similar analysis can be undertaken for school practices relating to ability grouping. Students in schools where principals reported that students in their school were grouped by ability for all subjects within the school, tend to perform lower in science, an effect which amounts to 10.2 score points in the gross model and 4.5 points in the net model (see the first table in Box 5.2). At the same time, whether students are in schools that practise or do not practise within-school ability grouping for all subjects appears to have no association with the impact that socio-economic background has on student performance (see the second table in Box 5.2).

Box 5.2 Multilevel models: Admitting, grouping and selecting

Admitting, grouping and selecting and student performance

	Gross		Net	
	Change in score	p-value	Change in score	p-value
School with ability grouping for all subjects within school (1=ability grouping between and/or within classes for all subjects; 0=no ability grouping or ability grouping for some subjects within school)	-10.2	(0.000)	-4.5	(0.002)
School with high academic selectivity of school admittance (1= academic record and/or recommendation of feeders schools are of prerequisite for student admittance; 0=others)	30.4	(0.000)	18.1	(0.000)
School with low academic selectivity of school admittance (1= neither academic record nor recommendation of feeders schools is considered for student admittance; 0=others)	-14.5	(0.000)	-1.6	(0.264)
System with early selection (each additional year between the first age of selection and the age of 15)	-4.2	(0.331)	-0.4	(0.927)
System-level number of school types or distinct educational programmes available to 15-year-olds	6.9	(0.357)	3.3	(0.607)

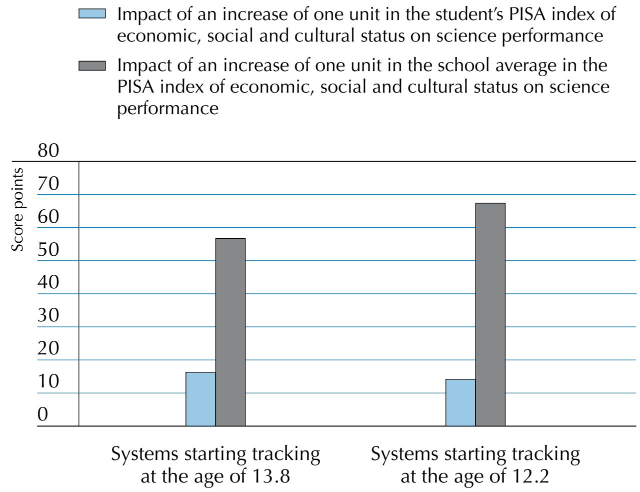
Admitting, grouping and selecting and the impact of socio-economic background

	Increase in score points in science corresponding to one unit increase of the student's PISA index of economic, social and cultural status		Increase in score points in science corresponding to one unit increase of the school average of the PISA index of economic, social and cultural status	
	Change in relationship	p-value	Change in relationship	p-value
School with ability grouping for all subjects within school (1=ability grouping between and/or within classes for all subjects; 0=no ability grouping or ability grouping for some subjects within school)	0.6	(0.311)		
School with high academic selectivity of school admittance (1= academic record and/or recommendation of feeders schools are of prerequisite for student admittance; 0=others)	-1.2	(0.139)		
School with low academic selectivity of school admittance (1= neither academic record nor recommendation of feeders schools is considered for student admittance; 0=others)	1.1	(0.084)		
System with early selection (each additional year between the first age of selection and the age of 15)	-1.3	(0.056)	6.6	(0.009)
System-level number of school types or distinct educational programmes available to 15-year-olds	-1.3	(0.294)	6.2	(0.049)

Notes: The analysis is based on 55 participating countries. The p-value (probability value) is the likelihood that a given multilevel analysis regression coefficient has been obtained by chance alone, and its real value is equal to zero. Thus, the smaller the p-value, the more likely that a given system or school-level variable is related to science performance. Data in shaded cells are statistically significant. Statistical significance was tested at the 0.5% level ($p<0.005$) for the school-level factors and at the 10% level ($p<0.1$) for the system-level factors as there are more than 14 000 cases at the school-level and only 55 cases at the system level in the analysis (in order to balance the Type I and Type II errors). A Type I error means that a conclusion can be drawn from the multilevel analysis results that a given institutional variable is related to science performance, when this is not the case; a Type II error means that a conclusion can be drawn from the multilevel analysis results that a given institutional variable is not related to science performance, when this is the case. In the net model, the following demographic and socio-economic background factors are accounted for: at the student level, the PISA index of economic, social and cultural status of student, gender, students' and parents' country of birth and the language spoken at home; at the school level, the socio-economic intake of the school, the school location and the school size; and at the country level, the national average economic, social and cultural status.

More detailed results for the first table are presented in Table 5.19a and for the second table in Table 5.20a. The model is described in Annex A8.

Figure 5.4
Impact of the socio-economic background of students and schools on student performance in science, by tracking systems



Note: Across the 55 countries, the average years spent between the first age of selection in the education system and the age of 15 is 1.2 and the standard deviation is 1.6. "System starting tracking at the age of 13.8" is a system starting tracking at the average stage (subtracting 1.2 years from the age of 15). "System starting tracking at the age of 12.2" is a system starting tracking at an early stage (one standard deviation earlier than the average therefore subtracting 1.6 years from the age of 13.8).
Source: OECD PISA 2006 database, Table 5.19a.
StatLink http://dx.doi.org/10.1787/141887160188

Whether, and at what age, students are placed in different institutional tracks or not is not related to student performance (see the first table in Box 5.2). However, institutional tracking is closely related to the impact which socio-economic background has on student performance (see the second table in Box 5.2): The earlier students are stratified into separate institutions or programmes, the stronger is the impact which the school's average socio-economic background has on performance. In fact, for each additional year that students are stratified into different institutions before the age of 15 – when they were tested by PISA – the impact which one unit of the school's average PISA index of economic, social and cultural status has on student performance increases by 6.6 score points. Similarly, with each additional educational programme into which 15-year-olds can be tracked, the impact which the school's average socio-economic composition has on student performance increases by 6.2 score points. On the other hand, the results suggest that the socio-economic segregation that is associated with tracking does create a more homogenous environment within schools, which is reflected in a slight decrease of the impact of students' background on performance within schools. However, this decrease is much smaller than the increase associated with the school's socio-economic impact. Thus, on balance, early selection into different institutional tracks appears to reinforce socio-economic inequalities in learning opportunities. This explains why the overall impact of socio-economic background on student performance is so much higher in highly stratified and early selective school systems. Figure 5.4 presents a comparison between education systems starting tracking at the age of 13.8 years (see the bars on the left in Figure 5.4) and education systems starting tracking 1.6 years earlier, which is equivalent to one standard deviation across the 55 countries in the model (see the bars on the right in Figure 5.4). The length of the bars in light grey represents the impact of one unit increase in the PISA index of economic, social and cultural status of students on performance in science and the length of the bars in dark grey represents the impact of one unit increase in the school average of the PISA index of economic, social and cultural status on performance in science.

PUBLIC AND PRIVATE STAKEHOLDERS IN THE MANAGEMENT AND FINANCING OF SCHOOLS

School education is mainly a public enterprise. Nevertheless, with an increasing variety of educational opportunities, programmes and providers, governments are forging new partnerships to mobilise resources for education and to design new policies that allow the different stakeholders to participate more fully and to share costs and benefits more equitably.

On average across OECD countries, 4% of 15-year-olds are enrolled in schools that reported being privately managed and predominantly privately financed (referred to as government-independent private schools) (Figure 5.5). In accordance with OECD standards, these are schools in which principals reported management by non-governmental organisations such as churches, trade unions or business enterprises and/or have governing boards consisting mostly of members not selected by a public agency. At least 50% of their funds come from private sources, such as fees paid by parents, donations, sponsorships or parental fund-raising, and other non-public sources.

There are only a few countries in which such a model of private education is common. Only in Japan, Korea, Mexico and Spain, and in the partner countries/economies Chinese Taipei, Macao-China, Indonesia, Jordan, Uruguay, Colombia and Thailand, is the proportion of students enrolled in independent private schools greater than 10%. By contrast, in more than one-half of the participating countries, independent private schools do not exist or 3% or less of 15-year-olds are enrolled in such schools (Figure 5.5).

Private education is not only a way of mobilising resources from a wider range of funding sources; it is sometimes also regarded as a way of making education more cost-effective. Publicly financed schools are not necessarily also publicly managed. Instead, governments can transfer funds to public and private educational institutions according to various allocation mechanisms (OECD, 2007). By making the funding for educational institutions dependent on parents' choosing to enrol their children, governments sometimes seek to introduce incentives for institutions to organise programmes and teaching in ways that better meet diverse student requirements and interests, thus reducing the costs of failure and mismatches. Direct public funding of institutions based on student enrolments or student credit-hours is one model for this. Giving money to students and their families (through, for example, scholarships or vouchers) to spend in public or private educational institutions of their choice is another method.

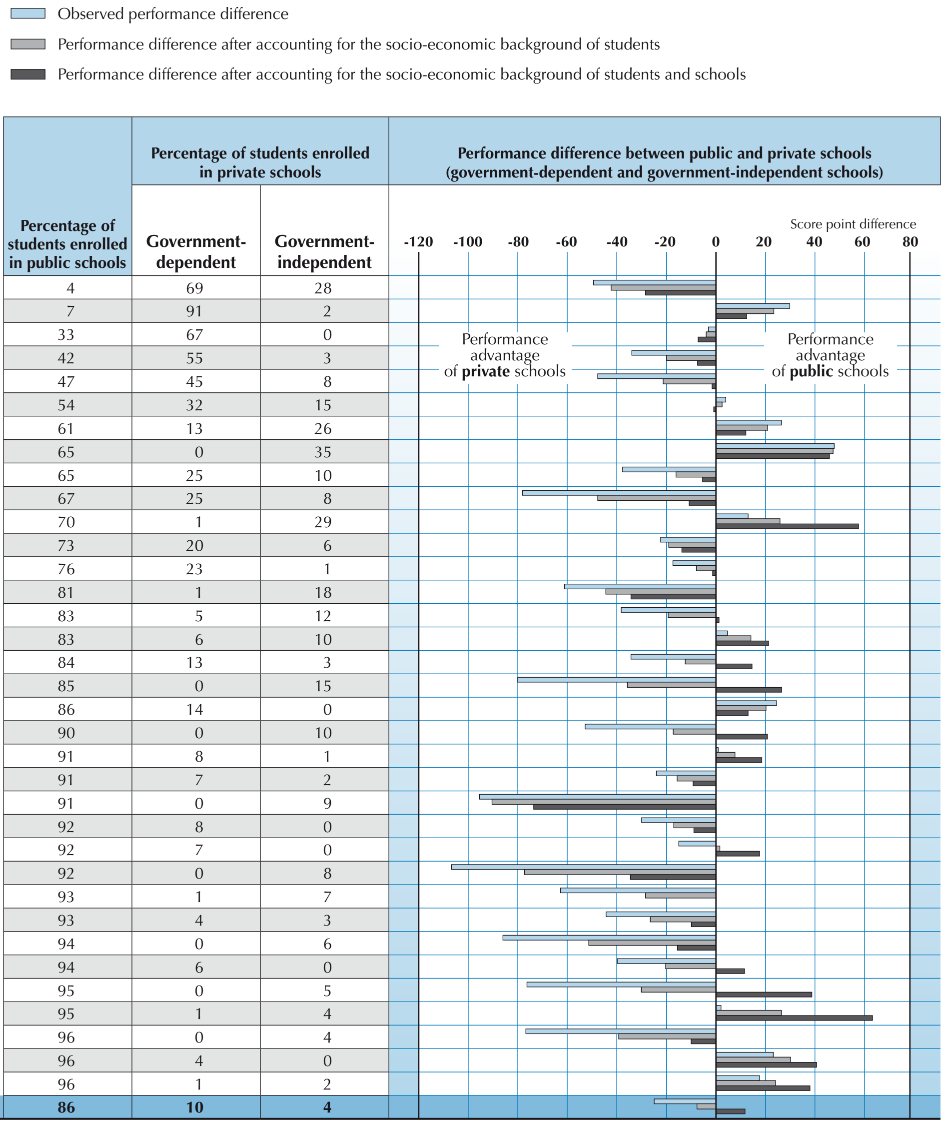
Schools that are privately managed but predominantly financed through the public purse (defined here as government-dependent private schools) are a much more common model of private schooling in OECD countries than are privately financed schools. On average across the OECD countries with comparable data, 11% of 15-year-olds are enrolled in government-dependent private schools. In Ireland and the Netherlands, as well as in the partner economies Macao-China and Hong Kong-China, the range lies between 55 and 91% (Figure 5.5).[11]

The relationship between public and private stakeholders in the management and financing of schools and student performance in science

Across Australia, Canada, Finland, Japan and Korea, the five OECD countries with both above-average performance in science and below-average impact of socio-economic background on performance (see the top-right quadrant in Figure 4.10), on average, 22% of 15-year-olds are in schools that reported being managed privately and 75% of total funding comes from public sources (OECD average 17% and 85 % respectively). However, there is considerable variation in this among these five countries: in Finland, 3% of 15-year-olds are in schools that are managed privately and all of the funding comes from public sources, while in Korea 46% of 15-year-olds are in schools managed privately and only 47% of funding comes from public sources (Table 5.22).

Figure 5.5
Public and private schools

	Percentage of students enrolled in public schools	Percentage of students enrolled in private schools: Government-dependent	Percentage of students enrolled in private schools: Government-independent
Macao-China	4	69	28
Hong Kong-China	7	91	2
Netherlands	33	67	0
Ireland	42	55	3
Chile	47	45	8
Korea	54	32	15
Indonesia	61	13	26
Chinese Taipei	65	0	35
Spain	65	25	10
Argentina	67	25	8
Japan	70	1	29
Israel	73	20	6
Denmark	76	23	1
Jordan	81	1	18
Colombia	83	5	12
Thailand	83	6	10
Hungary	84	13	3
Uruguay	85	0	15
Luxembourg	86	14	0
Mexico	90	0	10
Austria	91	8	1
Portugal	91	7	2
Qatar	91	0	9
Sweden	92	8	0
Slovak Republic	92	7	0
Brazil	92	0	8
United States	93	1	7
Canada	93	4	3
United Kingdom	94	0	6
Germany	94	6	0
Greece	95	0	5
Switzerland	95	1	4
New Zealand	96	0	4
Czech Republic	96	4	0
Italy	96	1	2
OECD average	**86**	**10**	**4**



Source: OECD PISA 2006 database, Table 5.4.
StatLink http://dx.doi.org/10.1787/141887160188

How do these institutional arrangements relate to school performance? This question is difficult to answer, not only because student characteristics sometimes differ between public and private schools, but also because in some countries private schools are unevenly spread across different school types, such as general and vocational programmes, which may, in turn, be related to performance. On average across the countries with a significant share of private enrolment, students in private schools outperform students in public schools in 21 countries, while public schools outperform private ones in four countries.[12] The performance advantage of private schools is 25 score points, on average across OECD countries.

It amounts to between 17 and 63 score points in Denmark, Portugal, Sweden, Ireland, Hungary, Spain, Canada, Mexico, and the United States, and the partner countries/economies Colombia, Chile, Macao-China and Jordan, to between 76 and 96 score points in Greece, New Zealand and the United Kingdom, as well as in the partner countries Argentina, Uruguay and Qatar, and to 107 score points in the partner country Brazil (Figure 5.5).

In the interpretation of these figures, it is important to recognise that there are many factors that affect school choice. Insufficient family wealth can, for example, be an important impediment to students wanting to attend independent private schools with a high level of tuition fees. Even government-dependent private schools that charge no tuition fees can cater for a different clientele or apply more restrictive transfer or selection practices.

One way to examine this is to adjust for differences in the socio-economic background of students and schools. The results for this are also shown in Figure 5.5. If the family background of students is accounted for, an average advantage remains for private schools although it diminishes to 8 score points. The net advantage of private schools is between 16 and 48 score points in Spain, Sweden, Mexico, Ireland, Canada, the United States, Greece and New Zealand, and in the partner countries/economies Colombia, Chile, Uruguay, Macao-China, Jordan and Argentina. It is between 51 and 90 score points in the United Kingdom, as well as in the partner countries Brazil and Qatar.

The picture changes further when in addition to students' family background the socio-economic background of schools' intakes is also taken into account. The impact of this contextual effect, which was discussed in detail in Chapter 4, on school performance is strong and, once it is accounted for, public schools have an advantage of 12 score points over private schools, on average across OECD countries. Once the impact of students' and schools' socio-economic background is accounted for, Canada is the only OECD country where private schools outperform public schools in a way that is statistically significant, although that is more commonly the case in the partner countries/economies Qatar, Brazil, Jordan and Macao-China.[13] Conversely, in Switzerland, Japan, the Czech Republic, Greece, Italy, Mexico and Luxembourg, as well as in the partner countries/economies Chinese Taipei, Uruguay and Thailand, public schools outperform private schools once the socio-economic context of students and schools is accounted for.

That said, while the performance of private schools does not tend to be superior once socio-economic factors have been accounted for, in many countries they may still pose an attractive alternative for parents looking to maximise the benefits for their children, including those benefits that are conferred to students through the socio-economic level of schools' intake.

In addition to the country-specific results shown in Figure 5.5, multilevel models were also employed to estimate the gross and net relationships between public or private school management and school performance (see the first table in Box 5.3). The results suggest that, without adjusting for demographic and socio-economic factors, private management of schools is associated with better performance,[14] as is the share of private investment in school financing. However, neither effect is visible once demographic and socio-economic factors have been accounted for. This suggests that private schools may realise their advantage not only from the socio-economic advantage that students bring with them, but even more so because their combined socio-economic intake allows them to create a learning environment that is more conducive to learning.[15] Analysis was also undertaken to assess whether public or private management and funding affects the relationship between socio-economic background and performance and no impact was found, that is the data do not lend support to the hypothesis that a greater proportion of private schools is associated with larger socio-economic disparities in schooling outcomes (see the second table in Box 5.3).

Box 5.3 **Multilevel models: School management and funding – public or private**

School management and funding and student performance

	Gross		Net	
	Change in score	p-value	Change in score	p-value
School being privately managed (1=private; 0=public)	20.0	(0.002)	-2.6	(0.353)
School with high proportion of school funding from government sources (each additional 10% of funding from government sources)	-3.2	(0.000)	0.3	(0.436)

School management and funding and the impact of socio-economic background

	Increase in score points in science corresponding to one unit increase of the student's PISA index of economic, social and cultural status	
	Change in relationship	p-value
School being privately managed (1=private; 0=public)	-0.7	(0.382)
School with high proportion of school funding from government sources (each additional 10% of funding from government sources)	0.2	(0.174)

Note: See Box 5.2 for general notes.

More detailed results in the first table are presented in Table 5.19b and those in the second table are in Table 5.20b. The model is described in Annex A8.

THE ROLE OF PARENTS: SCHOOL CHOICE AND PARENTAL INFLUENCE ON SCHOOLS

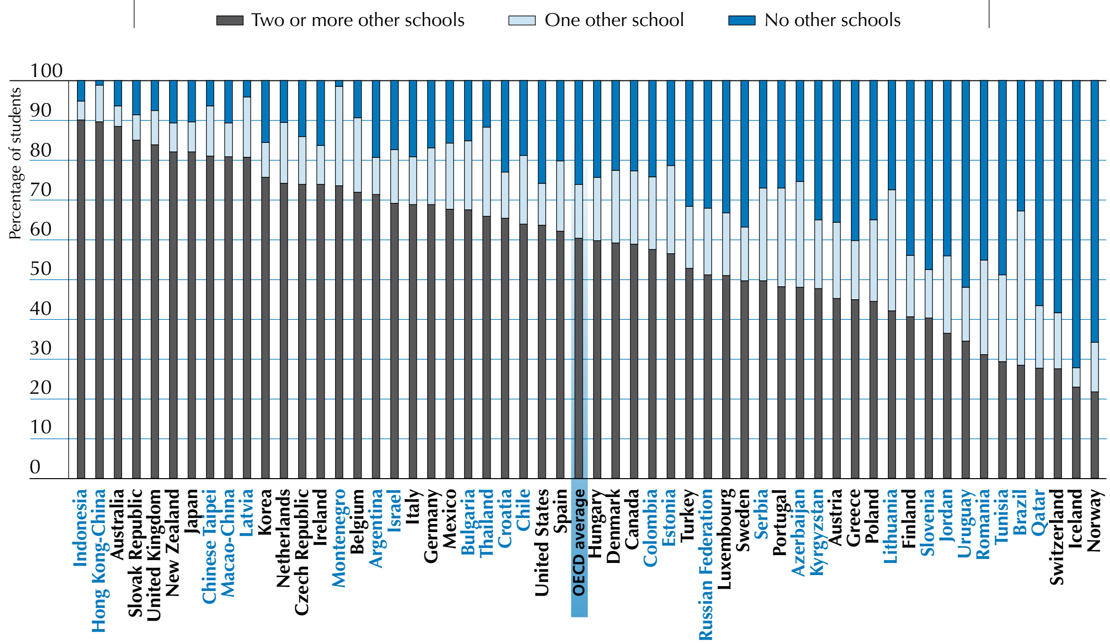
Apart from the direct influence that parent groups have gained in some countries with respect to being an integral body in decision making at school (see section "Approaches to school management and the involvement of stakeholders in decision making" below), parents may also exert indirect influence on schools, most obviously when they can choose the school for their child. In recent years, some countries have increased the extent of choice, particularly in secondary education. This is partly because the demand for choice from parents appears to be increasing and partly because a market, or quasi-market, in schooling is thought to push individual schools to improve quality and contain costs (*e.g.* Hoxby, 2002).

To provide an assessment of the role of choice, school principals were asked to indicate whether there are other schools in the local area with which they compete for students. For 60% of students, on average across OECD countries, parents have, in the above sense, a choice of two or more other schools for their children (Figure 5.6). School choice is particularly prevalent in Australia, the Slovak Republic, the United Kingdom, New Zealand and Japan, as well as in the partner countries/economies Indonesia, Hong Kong-China, Chinese-Taipei, Macao-China and Latvia, where more than 80% of 15-year-olds are enrolled in schools where school principals reported a choice of at least two alternatives to their own school.

On the other hand, in Iceland, Norway, and Switzerland, and in the partner countries Qatar and Uruguay, the parents of at least one-half of the students have effectively no choice, according to school principals. However, caution is required when interpreting these results, as the existence of other schools in the local area does not automatically imply that all parents have access to these, particularly if they are privately managed. In some countries, this also depends on whether 15-year-old students are enrolled at the primary or secondary level of education.

Figure 5.6
School choice

Percentage of students in schools where the principal reported the following number of schools competing for the students in the same area



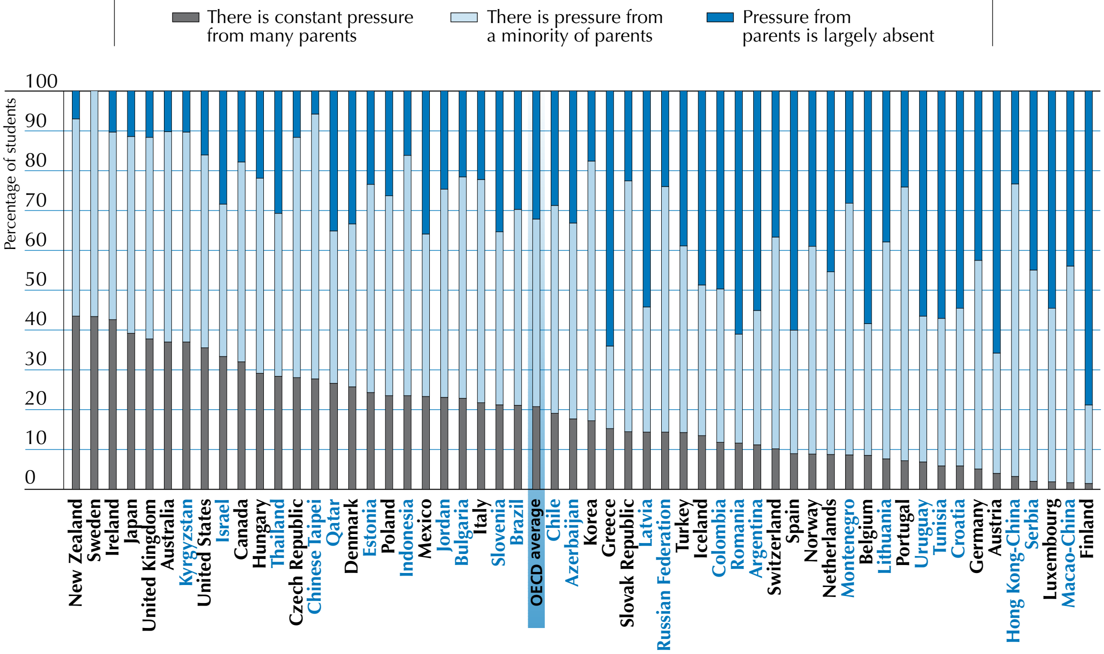
Source: OECD PISA 2006 database, Table 5.5.
StatLink http://dx.doi.org/10.1787/141887160188

To what extent do school principals experience parental pressure on the school to achieve high academic standards among students? On average, across OECD countries, 21% of students are enrolled in schools where school principals reported constant pressure from many parents who expected the school to set very high academic standards and to have the students achieve them, while 47% of students are enrolled in schools in which a minority of parents exert pressure to achieve higher academic standards among students (Figure 5.7). According to the reports from school principals, parental expectations for high academic standards are particularly high in New Zealand, Sweden and Ireland where more than 40% of students are enrolled in schools that reported constant pressure from many parents. On the other hand, parental pressure on schools is largely absent for 32% of students on average across OECD countries. In Finland – the best performing country – this is the case for 79% of students.

Figure 5.7

School principals' perceptions of parents' expectations

Percentage of students in schools where the principal reported that regarding high academic standards



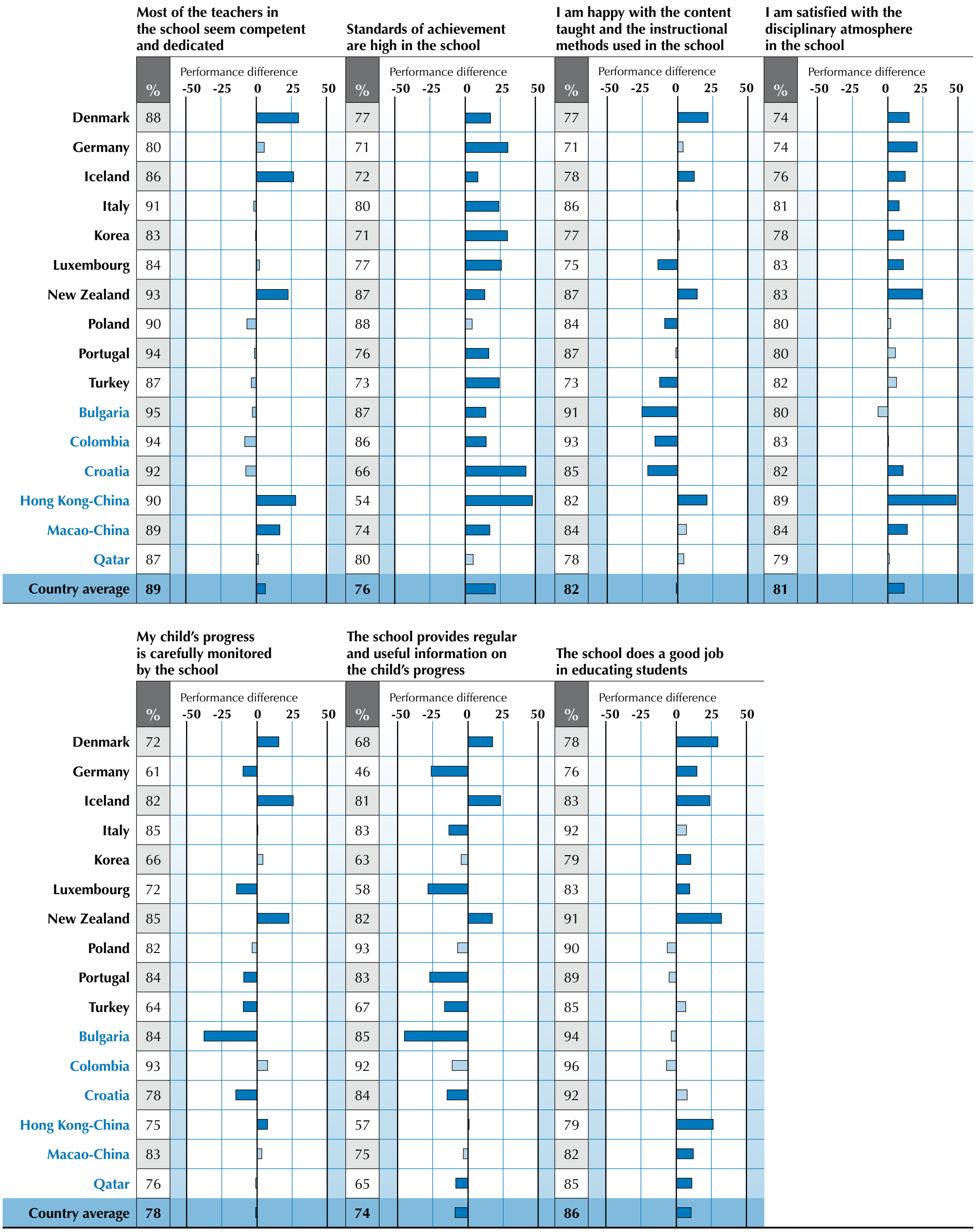
Source: OECD PISA 2006 database, Table 5.6.
StatLink http://dx.doi.org/10.1787/141887160188

As part of the PISA 2006 assessment, 16 countries complemented the perspectives of students and school principals with data collected from parents (Figure 5.8).[16] These data provide an additional perspective on the demands and expectations placed upon schools.

- On average across the 16 countries, 86% of the 15-year-olds' parents strongly agreed or agreed that their child's school did a good job in educating students, and in each of the 16 individual countries this figure is over 76%. Students whose parents agreed or strongly agreed that the school did a good job in educating students performed 11 score points higher than those students whose parents disagreed or strongly disagreed. In New Zealand, Denmark and Iceland, as well as the partner economy Hong Kong-China, this performance advantage exceeds 24 score points.
- On average, 76% of the parents strongly agreed or agreed that standards of achievement were high in their child's school, a figure which ranges from around 54% in the partner economy Hong Kong-China to more than 85% in Poland, New Zealand and the partner countries Bulgaria and Colombia. Again, students whose parents considered that their school had high standards tended to perform better, on average across the 16 countries by 21 score points. In Germany and Korea, and the partner countries/economies Hong Kong-China and Croatia, the performance advantage is between 30 and 48 score points.
- On average, 81% of the parents reported being satisfied with the disciplinary atmosphere in their child's school, and particularly so in Luxembourg and New Zealand, and in the partner countries/economies Hong Kong-China, Macao-China, Colombia and Croatia. On average, parental satisfaction with the disciplinary atmosphere in their children's school is associated with a performance advantage of 12 score points.

Figure 5.8
Parents' perceptions of school quality

Percentage of students whose parents "agree or strongly agree" and difference in science performance between students whose parents "agree or strongly agree" and those who "disagree or strongly disagree" with the following statements regarding the school their children attend[1]



	Most of the teachers in the school seem competent and dedicated (%)	Standards of achievement are high in the school (%)	I am happy with the content taught and the instructional methods used in the school (%)	I am satisfied with the disciplinary atmosphere in the school (%)
Denmark	88	77	77	74
Germany	80	71	71	74
Iceland	86	72	78	76
Italy	91	80	86	81
Korea	83	71	77	78
Luxembourg	84	77	75	83
New Zealand	93	87	87	83
Poland	90	88	84	80
Portugal	94	76	87	80
Turkey	87	73	73	82
Bulgaria	95	87	91	80
Colombia	94	86	93	83
Croatia	92	66	85	82
Hong Kong-China	90	54	82	89
Macao-China	89	74	84	84
Qatar	87	80	78	79
Country average	**89**	**76**	**82**	**81**

	My child's progress is carefully monitored by the school (%)	The school provides regular and useful information on the child's progress (%)	The school does a good job in educating students (%)
Denmark	72	68	78
Germany	61	46	76
Iceland	82	81	83
Italy	85	83	92
Korea	66	63	79
Luxembourg	72	58	83
New Zealand	85	82	91
Poland	82	93	90
Portugal	84	83	89
Turkey	64	67	85
Bulgaria	84	85	94
Colombia	93	92	96
Croatia	78	84	92
Hong Kong-China	75	57	79
Macao-China	83	75	82
Qatar	76	65	85
Country average	**78**	**74**	**86**

1. Statistically significant differences are marked in a darker tone.
Source: OECD PISA 2006 database, Table 5.7.
StatLink http://dx.doi.org/10.1787/141887160188

- On average, 89% of the parents agreed or strongly agreed that their child's teachers seemed competent and dedicated, and this ranges from around 80% in Germany, Korea and Luxembourg to more than 90% in Portugal, New Zealand, Italy and Poland, as well as the partner countries Bulgaria, Colombia and Croatia. The relationship of this measure with student performance is inconsistent across countries, but is positive on average (6 score points).
- On average, 74% of the parents agreed or strongly agreed that the school provided regular and useful information on their child's progress, but this ranges from less than 50% in Germany to over 90% in Poland and the partner country Colombia. The relationship of this measure with student performance is inconsistent across countries, but is negative on average (9 score points).

The relationship between school choice and parental influence on schools and student performance in science

Across Australia, Canada, Finland, Japan and Korea, the five OECD countries with both an above-average student performance in science and a below-average impact of socio-economic background on student performance (see the top-right quadrant in Figure 4.10), 80% of 15-year-olds are in schools which reported competing with one or more other schools in the area for students (OECD average 74%). This varies from 56% in Finland to 94% in Australia. Similarly, on average, 73% of 15-year-olds are in schools whose principals reported that the schools were receiving constant pressure from many parents or pressure from a minority of parents, but this ranges from only 21% in Finland to 90% in Australia (OECD average 68%) (Table 5.22).

Two multilevel models were employed to assess the (gross and net) association between school choice and perceived parental pressure on student performance in science (see the first table in Box 5.4). The results suggest that students in schools competing with other schools for the students in the same area tend to perform better, but this effect is no longer visible when demographic and socio-economic factors are accounted for. However, students in systems with a greater proportion of schools competing with other schools tend to perform better even after accounting for demographic and socio-economic factors. These results suggest that whether students are in competitive schools or not does not matter for their performance when socio-economic factors are accounted for, but it does matter whether school systems offer higher proportions of competitive schools. Students in education systems with 85% of schools competing with other schools tend to perform 6.7 score points higher in science than students in education systems where 75% of schools are competitive, regardless of whether the particular schools that students attend are competitive or not.[17]

Similarly, students in schools whose principals perceived themselves to be under pressure from parents to maintain high academic standards tended to perform better than students in schools without pressure, but there is no statistically significant association when demographic and socio-economic factors are accounted for.

None of the factors related to parents' pressure and choice were found to have a statistically significant association with educational equity (see the second table in Box 5.4).

It is difficult to interpret relationships between such factors as school choice, schools' admittance policies and school performance, because more selective schools may perform better simply because they do not accept poorly performing students and not necessarily because they provide better services. The last section will examine the joint impact of all the factors discussed so far on student performance in science.

Box 5.4 **Multilevel models: Parental pressure and choice**

Parental pressure and choice and student performance

	Gross		Net	
	Change in score	p-value	Change in score	p-value
School with high level of competition (1=one or more other schools compete for students; 0=no other schools compete for students)	17.9	(0.000)	1.9	(0.245)
School with high levels of perceived parental pressure (1=there is pressure from parents; 0=pressure from parent is largely absent)	11.2	(0.000)	2.0	(0.228)
System with high proportion of competitive schools (each additional 10% of competitive schools)	3.1	(0.525)	6.7	(0.076)

Parental pressure and choice and the impact of socio-economic background

	Increase in score points in science corresponding to one unit increase of the student's PISA index of the economic, social and cultural status		Increase in score points in science corresponding to one unit increase of the school average of the PISA index of the economic, social and cultural status	
	Change in relationship	p-value	Change in relationship	p-value
School with high level of competition (1=one or more other schools compete for students; 0=no other schools compete for students)	1.0	(0.083)		
School with high levels of perceived parental pressure (1=there is pressure from parents; 0=pressure from parent is largely absent)	1.0	(0.058)		
System with high proportion of competitive schools (each additional 10% of competitive schools)	-0.8	(0.291)	3.5	(0.211)

Note: See Box 5.2 for general notes.
More detailed results in the first table are presented in Table 5.19c and those in the second table are in Table 5.20c. The model is described in Annex A8.

ACCOUNTABILITY ARRANGEMENTS

The shift in public and governmental concern, away from mere control over the resources and content of education toward a focus on outcomes has, in many countries, driven the establishment of standards for the quality of the work of educational institutions. The approaches to standard-setting that countries pursue range from the definition of broad educational goals up to the formulation of concise performance expectations in well-defined subject areas.

The establishment of performance standards has, in turn, driven the establishment of accountability systems. Over the last decade, assessments of student performance have become common in many OECD countries – and often the results are widely reported and used in public debate, as well as by those concerned with school improvement. However, the rationale for assessments and the nature of the instruments used vary greatly within and across countries. Methods employed in OECD countries include different forms of external assessment, external evaluation or inspection, and schools' own quality assurance and self-evaluation efforts.

Given the importance that accountability systems now play in the policy and public debate and given the diverse accountability arrangements across OECD countries (OECD, 2007), the PISA 2006 assessment collected data on the nature of accountability systems and the ways in which the resulting information was used and made available to various stakeholders and the public at large.

Figure 5.9 [Part 1/2]
Use of achievement data for accountability purposes

Percentage of students in schools where the principal reported that achievement data were

Posted publicly (% of students)

Country	%
United Kingdom	93
United States	91
Netherlands	83
Montenegro	83
Azerbaijan	81
Russian Federation	75
Thailand	72
Romania	69
New Zealand	67
Sweden	67
Canada	64
Kyrgyzstan	61
Australia	60
Qatar	57
Hong Kong-China	56
Serbia	53
Luxembourg	52
Estonia	51
Norway	47
Czech Republic	47
Denmark	44
Poland	43
Chile	38
Mexico	38
Israel	36
Slovenia	36
Turkey	35
Colombia	35
Italy	33
Portugal	33
Croatia	33
Latvia	32
Greece	32
Chinese Taipei	32
Jordan	29
Slovak Republic	28
Hungary	28
Lithuania	27
Iceland	26
Brazil	26
Bulgaria	19
Tunisia	18
Ireland	18
Korea	17
Germany	14
Indonesia	14
Uruguay	13
Spain	11
Japan	11
Macao-China	10
Austria	8
Switzerland	7
Argentina	6
Belgium	5
Finland	4
OECD average	**38**

Used in evaluation of the principal's performance (% of students)

Country	%
United Kingdom	91
Romania	89
Russian Federation	89
Indonesia	88
Azerbaijan	87
Kyrgyzstan	85
Poland	78
Thailand	75
Israel	74
Hungary	69
Tunisia	69
Qatar	67
Czech Republic	62
Estonia	57
United States	57
Brazil	54
Turkey	51
Slovak Republic	51
Jordan	48
Australia	48
Lithuania	47
Colombia	41
Sweden	40
Chile	39
Serbia	38
New Zealand	38
Montenegro	38
Mexico	37
Latvia	36
Norway	35
Bulgaria	31
Netherlands	31
Hong Kong-China	28
Croatia	24
Slovenia	24
Korea	23
Austria	22
Canada	22
Italy	21
Germany	19
Argentina	19
Denmark	15
Uruguay	15
Portugal	14
Chinese Taipei	14
Spain	14
Japan	10
Iceland	10
Belgium	7
Greece	6
Ireland	6
Switzerland	6
Macao-China	4
Finland	3
Luxembourg	a
OECD average	**32**

Used in evaluation of teachers' performance (% of students)

Country	%
Russian Federation	100
Kyrgyzstan	99
Azerbaijan	98
Romania	97
Indonesia	97
United Kingdom	94
Israel	94
Qatar	93
Hungary	92
Czech Republic	91
Latvia	91
Poland	89
Thailand	86
Estonia	86
Lithuania	84
Mexico	83
Jordan	82
Tunisia	82
Brazil	78
Turkey	75
Slovak Republic	75
Netherlands	73
Colombia	73
Montenegro	71
Serbia	66
Hong Kong-China	63
Bulgaria	59
Chile	56
Argentina	54
Sweden	49
New Zealand	47
Uruguay	46
Australia	43
Spain	42
United States	42
Macao-China	41
Norway	40
Portugal	39
Croatia	39
Korea	34
Chinese Taipei	30
Ireland	30
Germany	28
Slovenia	27
Austria	26
Japan	26
Iceland	25
Italy	25
Denmark	22
Canada	19
Belgium	15
Finland	14
Greece	9
Switzerland	8
Luxembourg	5
OECD average	**43**

Source: OECD PISA 2006 database, Table 5.8.
StatLink http://dx.doi.org/10.1787/141887160188

Figure 5.9 [Part 2/2]
Use of achievement data for accountability purposes

Percentage of students in schools where the principal reported that achievement data were

Used in decisions about instructional resource allocation to the school (% of students: 0, 50, 100)

Country	%
Chile	87
Indonesia	86
United States	79
Romania	77
Thailand	76
Kyrgyzstan	75
Israel	72
Brazil	71
New Zealand	69
Azerbaijan	69
Russian Federation	66
Colombia	66
Tunisia	64
United Kingdom	63
Australia	58
Portugal	57
Canada	57
Italy	54
Jordan	53
Hong Kong-China	51
Ireland	47
Sweden	46
Spain	43
Qatar	42
Turkey	33
Latvia	33
Denmark	31
Argentina	31
Macao-China	31
Korea	30
Lithuania	27
Germany	26
Switzerland	25
Belgium	23
Montenegro	21
Austria	19
Chinese Taipei	19
Estonia	19
Mexico	18
Slovak Republic	15
Bulgaria	15
Netherlands	14
Serbia	14
Uruguay	14
Poland	12
Norway	11
Croatia	11
Czech Republic	9
Hungary	9
Finland	7
Luxembourg	7
Japan	6
Iceland	3
Greece	1
Slovenia	a
OECD average	**30**

Tracked over time by an administrative authority (% of students: 0, 50, 100)

Country	%
Russian Federation	100
Kyrgyzstan	98
United States	97
United Kingdom	92
New Zealand	92
Mexico	91
Canada	91
Montenegro	90
Estonia	88
Brazil	88
Australia	88
Netherlands	86
Qatar	84
Sweden	83
Croatia	83
Iceland	82
Thailand	82
Tunisia	82
Turkey	81
Jordan	81
Luxembourg	80
Colombia	80
Chile	79
Poland	78
Slovak Republic	76
Lithuania	74
Bulgaria	71
Israel	71
Romania	70
Slovenia	70
Portugal	69
Azerbaijan	69
Uruguay	66
Serbia	66
Spain	64
Indonesia	63
Hong Kong-China	62
Austria	60
Belgium	56
Czech Republic	56
Germany	55
Finland	54
Norway	53
Korea	52
Latvia	52
Macao-China	50
Argentina	50
Greece	49
Ireland	48
Hungary	40
Switzerland	36
Denmark	34
Chinese Taipei	32
Italy	22
Japan	16
OECD average	**65**

Source: OECD PISA 2006 database, Table 5.8.
StatLink http://dx.doi.org/10.1787/141887160188

Nature and use of accountability systems

There is considerable debate as to how school-performance data can best be developed and harnessed to raise educational aspirations, establish transparency over the performance of educational objectives and content, and provide a useful reference framework for teachers to understand and foster student learning while avoiding the risks of narrowing the curriculum and teaching to the test. PISA asked school principals to indicate whether achievement data were tracked over time by an administrative authority, whether such data were used in the evaluation of the teachers' or principal's performance, and whether such data were used in decisions about instructional resource allocation to and within the school.

On average across OECD countries, 65% of 15-year-olds are enrolled in schools that reported that achievement data were tracked over time by an administrative authority. However, this ranges from over 90% in the United States, the United Kingdom, New Zealand, Mexico and Canada, and in the partner countries the Russian Federation and Kyrgyzstan, to over 80% in Australia, the Netherlands, Sweden, Iceland, Turkey and Luxembourg, and the partner countries Montenegro, Estonia, Brazil, Qatar, Croatia, Thailand, Tunisia, Jordan and Colombia, to less than 36% in Switzerland, Denmark, Italy and Japan, and in the partner economy Chinese Taipei (Figure 5.9).

On average across OECD countries, 43% of 15-year-olds were enrolled in schools which reported using achievement data in the evaluation of teacher performance. In the United Kingdom, Hungary and the Czech Republic, as well as the partner countries the Russian Federation, Kyrgyzstan, Azerbaijan, Romania, Indonesia, Israel, Qatar and Latvia, this is more than 90%. In Poland and Mexico, as well as the partner countries Thailand, Estonia, Lithuania, Jordan and Tunisia, it is still more than 80%. However, in Luxembourg, Switzerland and Greece this was reported by less than 10% of the schools and in Finland, Belgium and Canada in less than 20% of the schools. In most countries, achievement data are used more frequently to evaluate the performance of teachers than of principals, sometimes considerably so (Figure 5.9).

The use of achievement data for decisions on instructional resource allocations tends to be less common. On average across OECD countries, 30% of 15-year-olds are enrolled in schools that reported such practices, but this varies from over 85% in the partner countries Chile and Indonesia to less than 10% in Greece, Iceland, Japan, Luxembourg, Finland, Hungary and the Czech Republic.

Feedback on student performance to parents and the public

There remain diverging views on how results from evaluation and assessment can and should be used. Some see them primarily as tools to reveal best practices and identify shared problems in order to encourage teachers and schools to improve and develop more supportive and productive learning environments. Others extend their purpose to support contestability of public services or market-mechanisms in the allocation of resources, *e.g.* by making comparative results of schools publicly available to facilitate parental choice or by having funds following students. A widely debated question relates to the extent and ways in which information on student performance should be made available to parents and the public at large. PISA examined both to what extent information on student performance is made available to parents, as well as to what extent information on school performance is made available to the public at large.

On average across OECD countries, the majority of students (54%) are enrolled in schools, where school principals reported giving feedback to parents on their child's performance relative to the performance of other students at the school. In the Slovak Republic and the partner countries Indonesia, Azerbaijan, Romania, Serbia, Jordan, Kyrgyzstan and the Russian Federation, this holds for more than 90% of students, while in Sweden, Finland and Italy this is only between 12 and 19% (Figure 5.10).

Figure 5.10
School accountability to parents

Percentage of students in schools where the principal reported that the school provided information to parents on student performance relative to

Other students in the same school (% of students)

Country	%
Indonesia	98
Azerbaijan	98
Romania	95
Slovak Republic	94
Serbia	92
Jordan	91
Kyrgyzstan	91
Russian Federation	91
Qatar	89
Turkey	88
Colombia	88
Mexico	88
Hong Kong-China	86
Brazil	85
Korea	84
Thailand	83
Montenegro	83
Bulgaria	81
Canada	79
Poland	79
Luxembourg	78
Tunisia	74
Chile	73
Hungary	71
Greece	70
Germany	68
Chinese Taipei	66
United States	66
Czech Republic	66
Argentina	65
Croatia	60
Australia	59
Lithuania	57
Israel	55
United Kingdom	55
Spain	50
New Zealand	50
Switzerland	49
Uruguay	48
Portugal	47
Iceland	41
Estonia	41
Japan	40
Norway	39
Macao-China	39
Ireland	39
Netherlands	35
Belgium	35
Latvia	32
Denmark	31
Austria	29
Slovenia	28
Italy	19
Finland	15
Sweden	12
OECD average	**54**

Other students in other schools (% of students)

Country	%
Indonesia	74
Turkey	74
Azerbaijan	72
Romania	67
Kyrgyzstan	65
United States	64
Russian Federation	61
Brazil	60
Slovak Republic	56
Qatar	51
Chile	48
Poland	46
Denmark	43
Thailand	43
Korea	42
Mexico	39
Jordan	38
New Zealand	37
United Kingdom	36
Czech Republic	35
Bulgaria	34
Canada	34
Iceland	32
Norway	30
Serbia	28
Germany	27
Tunisia	27
Latvia	25
Colombia	25
Lithuania	25
Israel	24
Sweden	23
Croatia	23
Argentina	22
Estonia	21
Hungary	21
Chinese Taipei	20
Australia	20
Montenegro	18
Switzerland	17
Finland	16
Luxembourg	13
Netherlands	11
Austria	10
Spain	10
Italy	8
Ireland	7
Greece	6
Hong Kong-China	6
Uruguay	4
Macao-China	4
Portugal	4
Slovenia	2
Belgium	1
Japan	a
OECD average	**27**

National or regional benchmarks (% of students)

Country	%
Sweden	94
Colombia	92
Chile	89
Indonesia	89
Azerbaijan	87
United States	86
Kyrgyzstan	81
United Kingdom	80
Japan	80
Poland	79
Korea	78
Russian Federation	74
New Zealand	74
Romania	74
Turkey	72
Argentina	67
Norway	65
Estonia	63
Slovak Republic	61
Canada	61
Brazil	60
Qatar	58
Czech Republic	57
Thailand	52
Australia	50
Denmark	49
Iceland	49
Finland	47
Bulgaria	46
Jordan	41
Slovenia	37
Mexico	36
Hungary	33
Portugal	32
Israel	32
Germany	31
Latvia	31
Tunisia	30
Serbia	28
Ireland	26
Switzerland	23
Chinese Taipei	21
Montenegro	21
Italy	20
Netherlands	19
Greece	16
Uruguay	15
Hong Kong-China	15
Belgium	14
Luxembourg	13
Spain	11
Austria	9
Macao-China	2
Croatia	a
Lithuania	a
OECD average	**47**

Source: OECD PISA 2006 database, Table 5.9.
StatLink http://dx.doi.org/10.1787/141887160188

In many OECD countries, the reporting of student performance information to parents is more commonly done relative to national benchmarks than relative to other students in the school. For example, in Sweden only 12% of 15-year-olds are enrolled in schools that reported performance data to parents relative to those of other students in the school, while 94% of 15-year-olds are enrolled in schools reporting data relative to national or regional standards or benchmarks. The pattern is similar in Japan, Finland, Norway, the United Kingdom, New Zealand, the United States as well as the partner country Estonia. Overall, in Sweden, the United States, the United Kingdom and Japan, as well as the partner countries Colombia, Chile, Indonesia, Azerbaijan and Kyrgyzstan, more than 80% of 15-year-olds are enrolled in schools that report student performance data to parents relative to national or regional standards or benchmarks, while this is below 20% in Austria, Spain, Luxembourg, Belgium, Greece, the Netherlands and Italy, as well as the partner countries/economies Macao-China, Hong Kong-China and Uruguay (Figure 5.10).

It is far less common for parents to receive information on student performance in their school relative to students in other schools. Across OECD countries, an average of 27% of students are enrolled in schools that reported providing information to parents on the academic performance of the students as a group relative to students in the same grade in other schools. Use of this practice varies, ranging from less than 10% in Belgium, Portugal, Greece, Ireland, Italy and Spain, as well as the partner countries/economies Slovenia, Macao-China, Uruguay and Hong Kong-China, to over 60% in Turkey and the United States, as well as in the partner countries Indonesia, Azerbaijan, Romania, Kyrgyzstan and the Russian Federation (Figure 5.10).

Providing assessment information to parents is one thing, but a more widely debated question in many countries is to what extent and how results from accountability systems should be made publicly available. Some contend that there should be an effort towards making public all evidence from the evaluation of public policy (with appropriate analyses) in order to provide evidence to taxpayers and the users of schools on whether the schools are delivering the expected results, to provide a basis for intervening across the systems where results in priority areas are unsatisfactory, to enhance trust in government, or to improve the quality of policy debate. Others consider that the publication of school performance data will be counterproductive as it is subject to erroneous interpretation, particularly when no adjustment for socio-economic background is made. Also debated are what types of reporting have proven most effective, in terms of raising performance and engaging teachers and schools in school improvement and to what extent the information schools and parents receive goes beyond the performance of their own school. PISA asked school principals to report whether achievement data from their school are posted publicly.

In the United Kingdom and the United States, school principals of more than 90% of 15-year-olds enrolled in school reported that school achievement data were posted publicly; in the Netherlands, as well as the partner countries Montenegro and Azerbaijan, this is still the case for more than 80%. In contrast, in Finland, Belgium, Switzerland and Austria, as well as in the partner country Argentina, this is the case for less than 10% of the students and in Japan, Spain, Germany, Korea and Ireland, and in the partner countries/economies Macao-China, Uruguay, Indonesia, Tunisia and Bulgaria it holds for less than 20% (Figure 5.9).

The existence of standards-based external examinations

Another aspect relating to accountability systems concerns the existence of external examinations. PISA collected data on the existence of standards-based external examinations, *i.e.* examinations that are keyed to a specific school subject and assess a major portion of what students studying this subject are expected to know or be able to do (Bishop 1998, 2001). [18] These define performance relative to an external standard, not relative to other students in the classroom or school. Perhaps more importantly, such examinations usually have real consequences for the students' progression or certification in the education system.

While in some countries, the standards-based external examination during or at the end of secondary education is the same for all students, in other countries, *e.g.* the United Kingdom, students have a choice between different examination levels for a given subject.

Table 5.2 provides an overview of the existence of such examinations for science in the participating countries. In federal countries, figures with decimals represent the proportion of the reporting sub-national entities that have such examinations in science. [19]

The relationship between accountability policies and student performance in science

Across Australia, Canada, Finland, Japan and Korea, the five OECD countries that show both an above-average student performance in science and a below-average impact of socio-economic background on performance (see the top-right quadrant in Figure 4.10), on average 56% of 15-year-olds attend schools that reported informing parents of children's performance relative to other students in school (this varies from 15% in Finland to 79% in Canada, and the OECD average is 54%), 63% are in schools that reported informing parents of children's performance relative to national benchmarks (this varies from 47% in Finland to 80% in Japan, and the OECD average is 47%), and 22% are in schools that reported informing parents of children's performance relative to other schools (this varies from 0% in Japan to 42% in Korea and the OECD average is 26%). On average across these five countries, 31% of 15-year-olds attend schools that reported posting achievement data publicly (this varies from 4% in Finland to 64% in Canada and the OECD average is 38%), 21% are in schools that reported using achievement data for evaluating principals (this varies from 3% in Finland to 48% in Australia and the OECD average is 31%), 27% are in schools that reported using achievement data for evaluating teachers (this varies from 14% in Finland to 43% in Australia and the OECD average is 43%), 32% are in schools that reported using achievement data for allocating resources to schools (this varies from 6% in Japan to 58% in Australia and the OECD average is 30%), and 60% are in schools that reported achievement data tracked over time (this varies from 16% in Japan to 91% in Canada and the OECD average is 65%). In all five countries, standards-based external examinations exist (Table 5.22).

How do accountability policies and practices relate to the performance of countries? This is difficult to answer, most notably because these policies and practices are often closely interrelated with other school policies and practices (see also the last section in this chapter). The models in Box 5.5 focus on the impact on student performance of regular use of school-level statistics on student performance, of feedback provided to parents and the public and of standards-based external examinations in the country.

As in preceding sections of the chapter, such factors are considered in this model both before and after accounting for the socio-economic context of students, schools and countries, which is achieved by examining the relationship between accountability systems and educational performance before and after an adjustment for demographic and socio-economic factors. The results suggest that, on average across countries and taking into account all other aspects of accountability systems examined in this model, students in countries with a standards-based external examination performed 36.1 score points higher on the PISA science scale, roughly equivalent to a school-year's progress (see the first table in Box 5.5). This association is still positive, yet no longer statistically significant,[20] once demographic and socio-economic background factors are taken into account. Students in schools posting their results publicly performed 14.7 score points better than students in schools that did not, and this association remained positive even after the demographic and socio-economic background of students and schools is accounted for. For the other aspects of accountability policies as measured by PISA, the relationships with performance are weaker and not statistically significant. None of the accountability policies have a statistically significant association with the impact that socio-economic background has on student performance.

Box 5.5 Multilevel models: Accountability policies

Accountability policies and student performance

	Gross		Net	
	Change in score	p-value	Change in score	p-value
School informing parents of children's performance relative to other students in the school (1=yes; 0=no)	4.7	(0.140)	2.8	(0.139)
School informing parents of children's performance relative to national benchmarks (1=yes; 0=no)	4.2	(0.100)	1.8	(0.228)
School informing parents of students' performance relative to other schools (1=yes; 0=no)	-5.0	(0.013)	-1.4	(0.352)
School posting achievement data publicly (1=yes; 0=no)	14.7	(0.000)	6.6	(0.000)
School using achievement data for evaluating principals (1=yes; 0=no)	-2.3	(0.354)	0.0	(0.993)
School using achievement data for evaluating teachers (1=yes; 0=no)	4.3	(0.076)	-0.5	(0.711)
School using achievement data for allocating resources to schools (1=yes; 0=no)	-4.8	(0.034)	-4.3	(0.007)
School with achievement data tracked over time (1=yes; 0=no)	-2.4	(0.327)	-1.2	(0.443)
System with standards-based external examinations (ratio of existence)	36.1	(0.028)	17.0	(0.226)

Accountability policies and the impact of socio-economic background

	Increase in score points in science corresponding to one unit increase of the student's PISA index of economic, social and cultural status		Increase in score points in science corresponding to one unit increase of the school average of the PISA index of economic, social and cultural status	
	Change in relationship	p-value	Change in relationship	p-value
School informing parents of children's performance relative to other students in the school (1=yes; 0=no)	-0.5	(0.327)		
School informing parents of children's performance relative to national benchmarks (1=yes; 0=no)	1.1	(0.058)		
School informing parents of students' performance relative to other schools (1=yes; 0=no)	-0.4	(0.557)		
School posting achievement data publicly (1=yes; 0=no)	1.3	(0.012)		
School using achievement data for evaluating principals (1=yes; 0=no)	0.2	(0.789)		
School using achievement data for evaluating teachers (1=yes; 0=no)	0.4	(0.566)		
School using achievement data for allocating resources to schools (1=yes; 0=no)	-0.3	(0.599)		
School with achievement data tracked over time (1=yes; 0=no)	-0.4	(0.514)		
System with standards-based external examinations (ratio of existence)	2.8	(0.290)	12.7	(0.120)

Note: See Box 5.2 for general notes.

More detailed results for the first table are presented in Table 5.19d and those for the second table are in Table 5.20d. The model is described in Annex A8.

APPROACHES TO SCHOOL MANAGEMENT AND THE INVOLVEMENT OF STAKEHOLDERS IN DECISION MAKING

Involvement of school staff in decision making at school

Increased autonomy over a wide range of institutional operations has been a main aim of restructuring and school reform since the early 1980s, the objective being to raise performance levels through devolving responsibility to the frontline and encouraging responsiveness to local needs. This has involved enhancing the decision-making responsibility and accountability of principals and, in some cases, the management responsibilities of teachers or department heads. Nonetheless, while school autonomy may stimulate responsiveness to local requirements, it is sometimes seen as creating mechanisms for choice favouring groups in society that are already advantaged.

In order to gauge the extent to which school staff have a say in decisions relating to school policy and management, PISA 2006 asked principals to report whether the teachers, the principal, the school's governing board, the regional or local education authorities or the national education authority had considerable responsibility for: appointing and dismissing teachers, establishing teachers' starting salaries and increases, formulating school budgets and allocating them within the school, establishing student disciplinary policies and assessment policies, approving students for admittance to school, choosing which textbooks to use, determining which courses were offered and their content. Figure 5.11 shows the percentage of students enrolled in schools whose principals reported that only schools had considerable responsibility, both schools and regional and/or national educational authorities had considerable responsibilities, or only regional and/or national educational authorities had considerable responsibilities for various aspects of school management.

Caution is required in interpreting the proportion of schools having considerable responsibility presented in Figure 5.11. First, because the arrangements for the distribution of decision making vary so widely across countries, the questions to school principals had to be kept quite general. The responses may therefore depend on how school principals interpreted the questions in their respective contexts. For example, when school principals were asked who has considerable responsibility for formulating the school budget, some school principals might have related this question to the regular budget of the school, while others may not have had any involvement in the regular budget and may therefore have related the question to supplementary budgets, *i.e.* contributions from parents or the community. In addition, school principals could identify multiple stakeholders who had a considerable responsibility. Since the degree of responsibility that each stakeholder had was not identified, the responses were given equal weight, irrespective of the actual influence the stakeholders had on the different aspects of decision making.

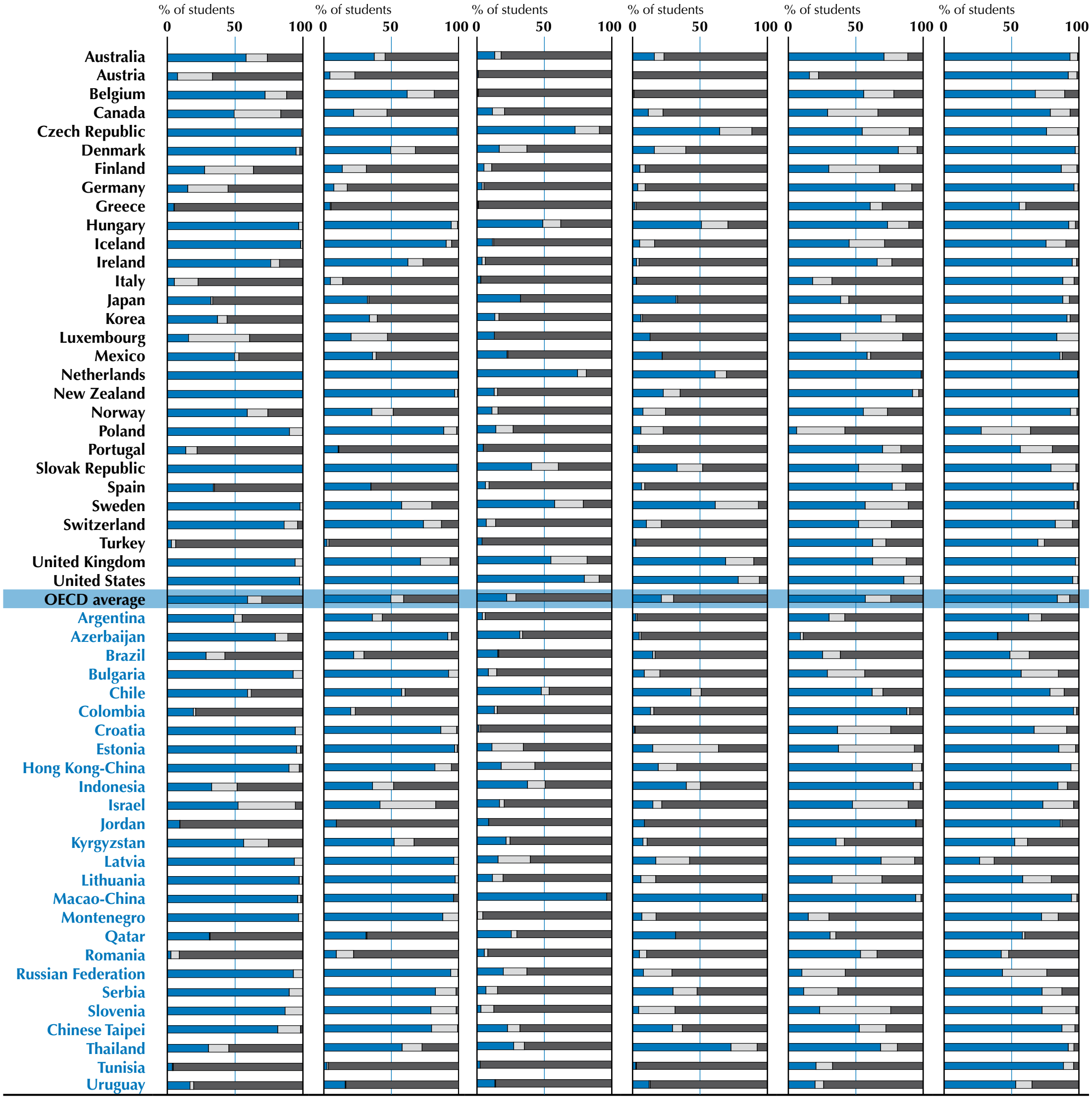
Unlike private sector enterprises, Figure 5.11 shows that schools in most countries have little say in the establishment of teachers' starting salaries. Except for the United States, the Netherlands, the Czech Republic, Sweden, the United Kingdom, Hungary, and the Slovak Republic, as well as partner countries/economies Macao-China, Chile and Indonesia, less than one-third of 15-year-olds are enrolled in schools whose principals reported that only schools had considerable responsibility for the establishment of teachers' starting salaries (OECD average 22%). The scope to reward teachers financially, once they have been hired, is likewise limited. Only in the United States and the United Kingdom, as well as in the partner countries/economies Macao-China and Thailand, are more than two-thirds of the students enrolled in schools whose principals reported that only schools had considerable responsibility for determining teachers' salary increases (OECD average 21%).

Figure 5.11 [Part 1/2]
Involvement of schools in decision making

- Only school has considerable responsibility
- Both school and government have considerable responsibility
- Only government has considerable responsibility

Percentage of students in schools where the principal reported responsibility for

	Selecting teachers for hire	Dismissing teachers	Establishing teachers' starting salaries	Determining teachers' salary increases	Formulating the school budget	Deciding on budget allocations within the school
Cross-country correlation between the percentage of schools having considerable responsibility ("school only" and "school and government") and performance in science[1]	**0.43**	**0.32**	0.20	0.22	**0.47**	**0.54**



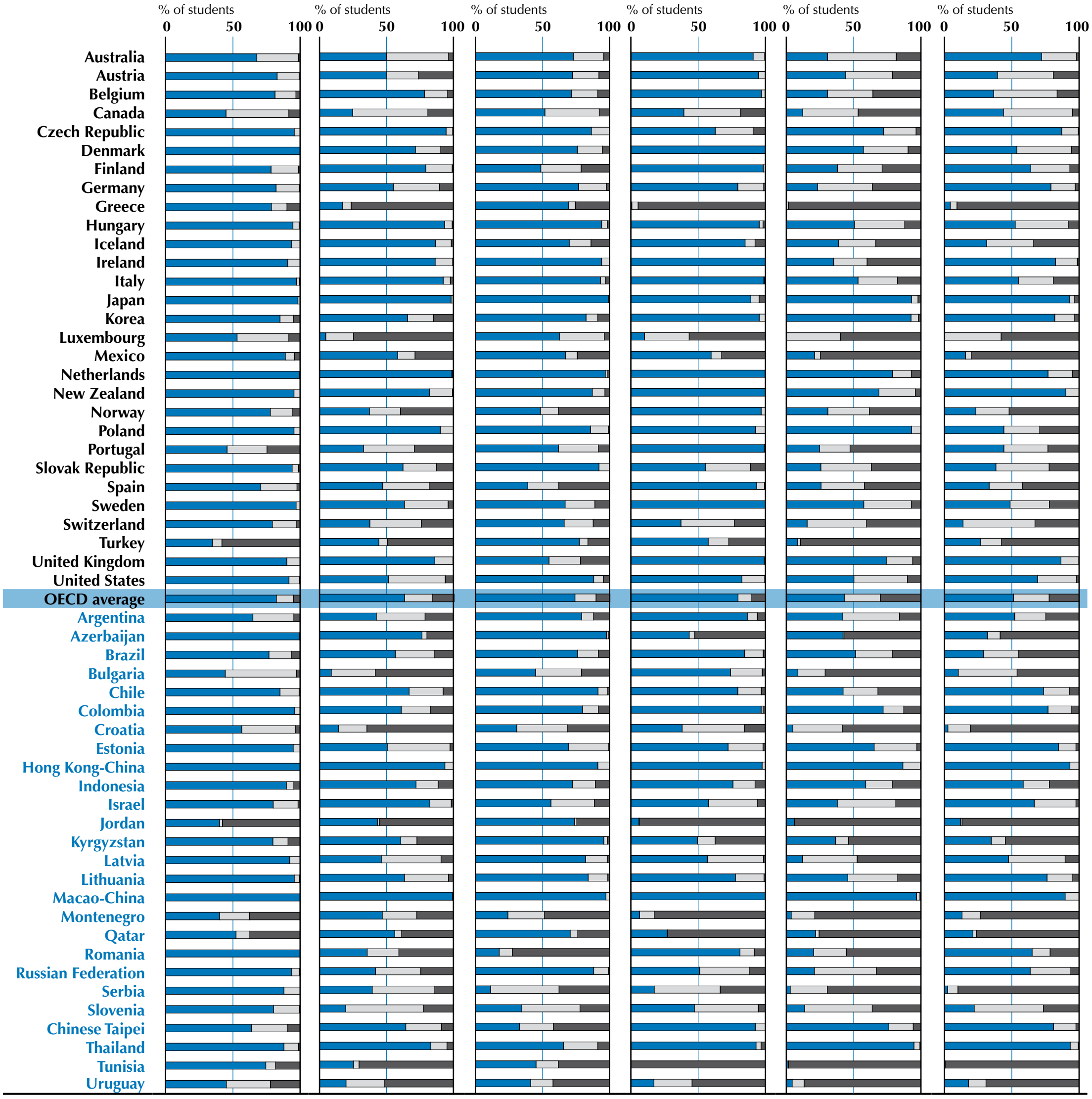
1. Values that are statistically significant at the 5% level ($p<0.05$) are indicated in bold.
Source: OECD PISA 2006 database, Table 5.10.
StatLink http://dx.doi.org/10.1787/141887160188

Figure 5.11 [Part 2/2]
Involvement of schools in decision making

- Only school has considerable responsibility
- Both school and government have considerable responsibility
- Only government has considerable responsibly

Percentage of students in schools where the principal reported responsibility for

	Establishing student disciplinary policies	Establishing student assessment policies	Approving students for admission to the school	Choosing which textbooks are used	Determining course content	Deciding which courses are offered
Cross-country correlation between the percentage of schools having considerable responsibility ("school only" and "school and government") and performance in science[1]	**0.41**	**0.43**	**0.27**	**0.51**	**0.52**	**0.58**



1. Values that are statistically significant at the 5% level (p<0.05) are indicated in bold.
Source: OECD PISA 2006 database, Table 5.10.
StatLink http://dx.doi.org/10.1787/141887160188

There is greater flexibility for schools with regard to the appointment and dismissal of teachers. On average across OECD countries, 59% of 15-year-olds are enrolled in schools whose principals reported that only schools had considerable responsibility for the appointment of teachers, and the figure is 50% for the dismissal of teachers. However, there is great variability across countries in this. In the Slovak Republic, New Zealand, the Netherlands, the Czech Republic, Iceland, Sweden, the United States and Hungary, as well as in the partner countries/economies Lithuania, Montenegro, Macao-China and Estonia, more than 95% of 15-year-olds are enrolled in schools reporting that only schools have considerable responsibility for the appointment of teachers. In Portugal, Germany and Luxembourg, as well as in the partner countries Uruguay and Colombia, this is less than 20%, while in Turkey, Greece, Italy and Austria, and the partner countries Romania, Tunisia and Jordan, it is less than 10%.

The roles that schools play in the formulation of their budgets vary significantly too. While in Poland and the partner country Azerbaijan 10% or less of students are enrolled in schools that reported that only the school has considerable responsibility for formulating their school budget, it is more than 90% in the Netherlands and New Zealand and in the partner countries/economies Jordan, Macao-China, Indonesia and Hong Kong-China (OECD average 57%). With the exception of Poland and the partner countries Brazil, the Russian Federation, Romania, Azerbaijan and Latvia, the majority of 15-year-olds are in schools that reported that only the schools had considerable responsibility for decisions concerning how money is spent. In many countries, this holds for virtually all enrolled students (OECD average 84%).

Another area where the involvement of schools varies considerably across countries concerns the setting of course content and course offerings.[21] In Japan, Poland and Korea, as well as in the partner countries/economies Macao-China and Thailand, over 90% of 15-year-olds are enrolled in schools reporting that only schools have considerable responsibility for the determination of course content. This is 10% or less in Greece, Luxembourg and Turkey and in the partner countries Tunisia, Serbia, Montenegro, Uruguay, Croatia, Jordan and Bulgaria (OECD average 43%). Concerning decisions in offering courses, in Japan and New Zealand, as well as in the partner countries/economies Thailand and Hong Kong-China, over 90% of 15-year-olds are in schools whose principals reported that only schools had considerable responsibility for this. This figure is less than 10% in Luxembourg and Greece and the partner countries Tunisia, Serbia and Croatia (OECD average 51%). Both schools and regional and/or national educational authorities tend to have considerable responsibility for the determination of course content and course offerings (OECD average 27%), compared to other aspects of school management.

The picture shows less variability when it comes to disciplinary policies, the choice of textbooks and admission policies, where schools in most countries tended to report having considerable responsibility. On average, across OECD countries, 82, 80 and 74% of students, respectively, are enrolled in schools reporting that only schools have considerable responsibility in these areas (Figure 5.11).

Also assessment policies are an area where the majority of students are in schools whose principals reported that only schools had considerable responsibility (OECD average: 63%). However, in Luxembourg and Greece and the partner countries Bulgaria, Croatia, Slovenia and Uruguay, this is true for less than one-fifth of the students. Moreover, in most OECD countries, the majority of 15-year-olds are enrolled in schools whose principals reported that national authorities had a direct influence on decision making in student assessment. In Greece and Luxembourg, as well as in the partner country Tunisia, this figure is 70% or more.

While in Greece and Turkey, as well as in the partner countries Tunisia, Jordan and Uruguay, school involvement[22] tended to be low across the various areas of decision making, in others, such as the Netherlands, the United States, the Czech Republic, the United Kingdom, Sweden, Hungary and New Zealand, and the partner countries/economies Macao-China, Estonia and Hong Kong-China, it tended to be high.

There are some countries where the involvement of schools varies considerably across the different areas of decision making. For example, in Turkey only 6 and 11% of 15-year-olds are enrolled in schools that reported having considerable responsibility for the appointment of teachers, and for determining course content, respectively, whereas 84% reported considerable responsibility for approving student admittance and 72% for formulating the school budget. Conversely, in Austria only 23% of 15-year-olds are in schools whose principals reported considerable responsibility for formulating the school budget, whereas the percentages are high for decisions on course offerings (81%), course content (79%) and approving admittance (92%).

The association between the different aspects of school autonomy and student performance within a given country is often weak, in many cases simply because decision-making responsibilities are established at national levels so that there is little variation on these measures within countries. However, when looking at the relationships across countries, the data suggest that in those countries in which principals reported, on average, higher degrees of autonomy in most of the above aspects of decision making, the average performance in science tends to be higher, as indicated by the cross-country correlations shown in the top of Figure 5.11. For example, the percentage of schools that reported having considerable responsibility for decisions on course content accounts for 27% of the cross-country performance differences in science performance. For decisions on budget allocations within the school it is 29%, for decisions on the choice of textbooks it is 26%, and for decisions on formulating the school budget it is 22%. For the remaining aspects of decision making the cross-country relationship is weaker but it remains statistically significant except for the aspects concerning teacher starting salaries and salary increases. Obviously, these cross-country relationships can also be affected by many other factors.

Involvement of stakeholders in decision making

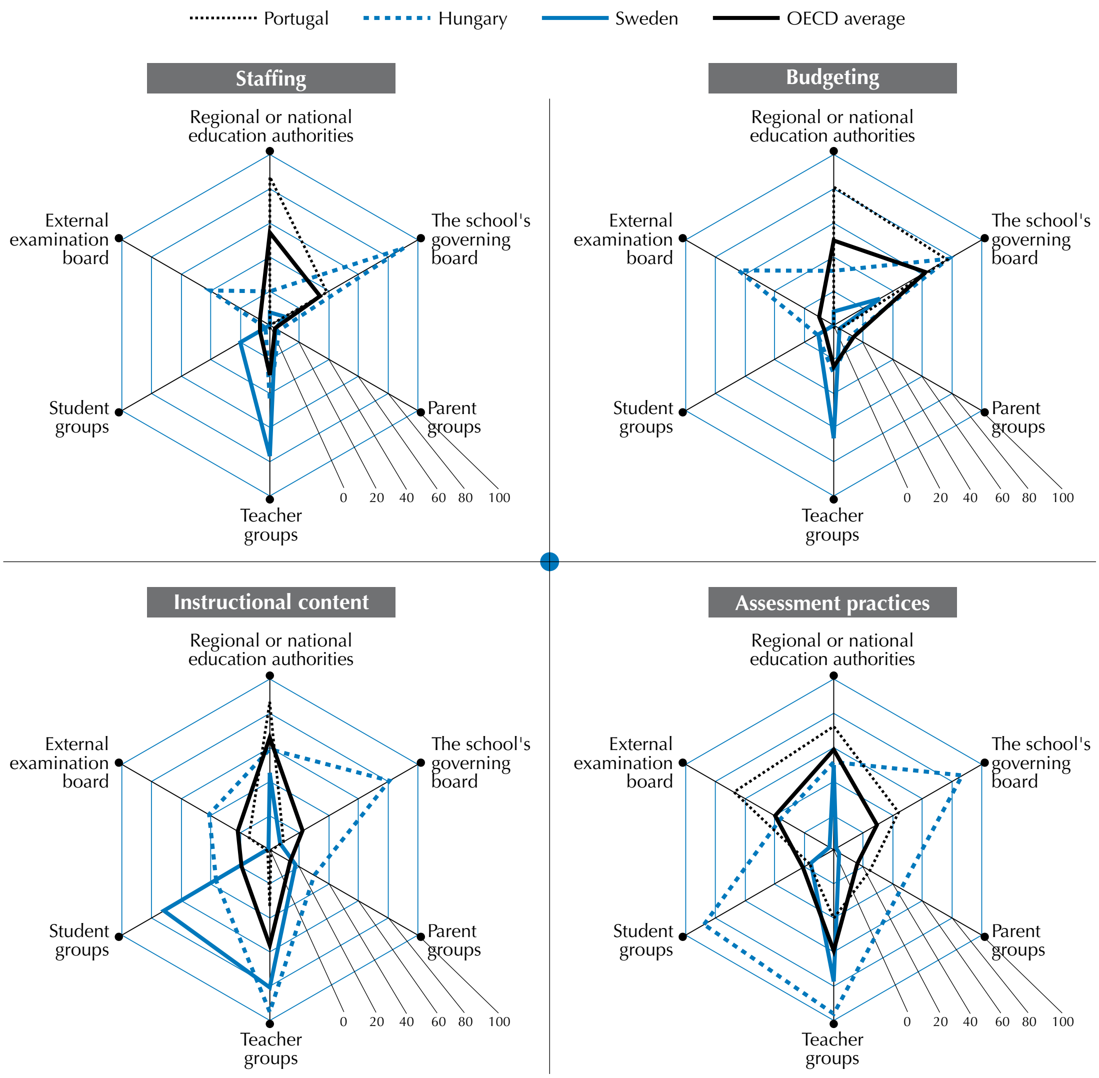
Important differences among countries also emerge in the ways in which stakeholders outside and inside the school are involved in decision making. Across the four decision-making areas of staffing, budgeting, instructional content and assessment practices, and among seven stakeholder groups that were considered, school principals most frequently reported that regional or national education authorities exerted a direct influence on decision making, followed by school governing boards, teacher groups, external examination boards and then by employers in the enterprise sector, parent groups and student groups (Tables 5.12a-d).[23] However, across OECD countries the frequency with which school principals reported the direct influence on decision making of a certain stakeholder varies across the four areas of decision making. The involvement of schools' governing boards is predominantly related to budgeting (62%), and to a lesser extent to staffing (34%), assessment practices (29%) and instructional content (22%). Naturally, external examination boards have most of their influence on assessment practices (40%), and to a lesser extent on instructional content (22%). Teacher groups tend to have significant influence over assessment practices (59%) and instructional content (56%) and to a lesser extent on staffing (29%) and budgeting (24%). The direct influence of parent and student groups on the different areas of decision making seems generally very limited.

Figure 5.12 shows that decision-making patterns clearly vary considerably across countries. For example, while the direct influence of regional or national education authorities tends to be most frequently cited in all four areas of decision making, there are exceptions: in Sweden, Iceland, Norway, the Slovak Republic and Hungary, and in the partner countries Estonia, Bulgaria, Montenegro and the Russian Federation, for example, only between 7 and 20% of 15-year-olds are enrolled in schools whose school principals reported that regional or national authorities exerted a direct influence on decisions relating to staffing (OECD average 54%) (Table 5.12a). Similarly, in Iceland, Sweden, Turkey and Greece, and the

partner countries Colombia and Jordan, the corresponding percentage of decisions relating to budgeting is only between 5 and 20% (OECD average 50%) (Table 5.12b); in Denmark, Poland and Korea, the percentage for decisions relating to instructional content is only 12, 29 and 31%, respectively (OECD average 66%) (Table 5.12c); and in Italy and Japan, and the partner country Azerbaijan, the percentage for decisions relating to assessment practices is only 17, 23 and 21% respectively (OECD average 59%) (Table 5.12d).

Figure 5.12
Direct influence of stakeholders on decision making at school

Percentage of students enrolled in schools where the principals reported that the respective stakeholders exert a direct influence on decision making at achool



Note: Portugal is shown as an example of a country where school principals tended to report that regional or national education authorities exert a direct influence on all four areas of decision making; Hungary is an example of a country where school principals tended to report that the school's governing board exerts a direct influence on all four areas of decision making; and Sweden is an example of a country where school principals tended to report that teacher groups exert a direct influence on all four areas of decision making.
Source: OECD PISA 2006 database, Tables 5.12a, 5.12b, 5.12c and 5.12d.
StatLink http://dx.doi.org/10.1787/141887160188

Also with regard to the involvement of teacher groups, such as staff associations, curriculum committees and trade unions, there tends to be considerable variation across countries. For example, while in Hungary, Poland, Japan, Finland, the Czech Republic, the United States, Sweden, the Netherlands, Italy and Germany, as well as in the partner countries/economies Estonia, Colombia, Indonesia, Thailand, Slovenia, Latvia, Lithuania, Hong Kong-China, the Russian Federation and Croatia, more than 70% of 15-year-olds are enrolled in schools whose principals reported a direct influence of teacher groups on decisions relating to instructional content, this is 10% or less in Iceland and the partner countries Tunisia and Israel (OECD average 56%). In the areas of assessment practices, staffing and budgeting, the OECD averages are 59, 29 and 24%, respectively (Tables 5.12a - d).

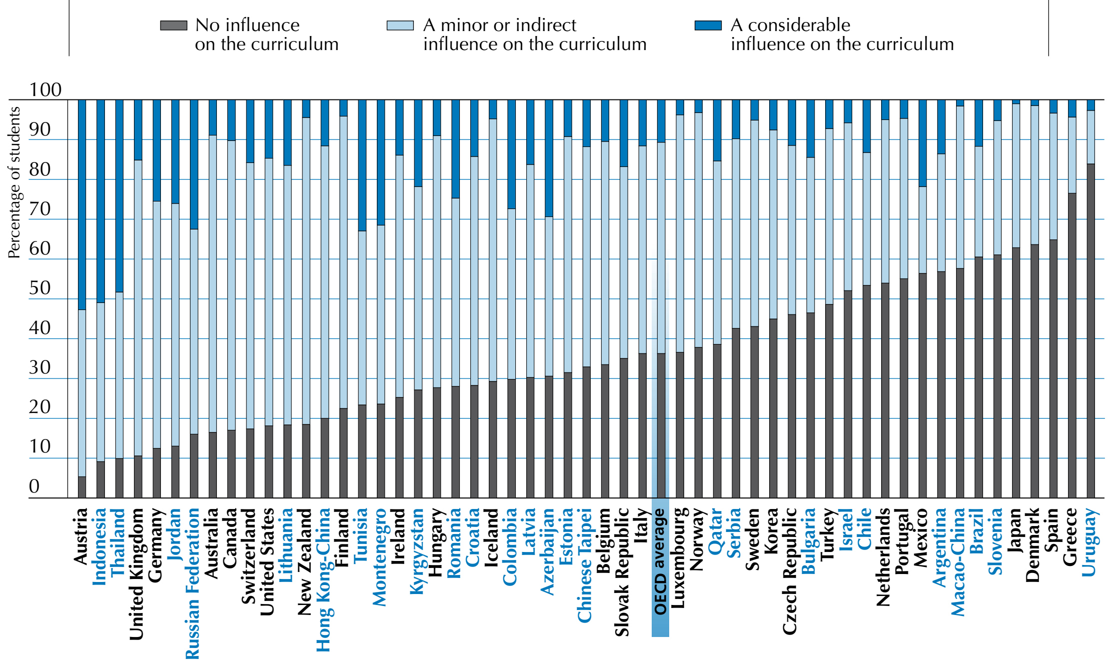
In New Zealand, the United States, the United Kingdom, Italy, Belgium, Greece, Luxembourg, Korea and Spain, as well as in the partner countries/economies Hong Kong-China and Croatia, more than 80% of 15-year-olds are enrolled in schools whose principals reported that the school's governing board exerted a direct influence on decisions regarding budget (OECD average 62%). However, in Denmark and Poland, and the partner countries/economies Azerbaijan and Chinese Taipei, this is the case for less than 5%. On average across OECD countries, 34% of students are in schools that reported the school governing board having a direct influence on staffing, but this figure varies widely across countries. In New Zealand, the Netherlands and Ireland, as well as the partner countries/economies Chile, Macao-China and Liechtenstein, between one half and three quarters of the students are in schools where school principals reported that the governing board exerted a direct influence on decision making on staff matters; in the United Kingdom, the United States, Switzerland and Belgium, and the partner countries/economies Chinese Taipei, Serbia and Hong Kong-China, the proportion is more than 80%, and it is up to 91% in Hungary. At the other extreme, the school governing board influences staffing decisions for less than 10% of 15-year-olds enrolled at schools in Greece, Italy, Turkey, Denmark, Austria, Norway, Korea and Germany, as well as in the partner countries Tunisia, Colombia, Bulgaria and Jordan, and for less than 1% in Poland. In the areas of instructional content and assessment practices, the school governing board's role is comparatively more limited with the proportions being 22 and 29%, respectively, on average, across OECD countries (Tables 5.12a - d).

The role of external examination boards is naturally strongest in relation to assessment practices, but in some countries, schools also frequently reported that examination boards have a direct influence on matters relating to instructional content. However, countries differ widely in this area. In New Zealand, the United Kingdom, Ireland, Australia and the Netherlands, as well as the partner countries/economies Hong Kong-China and Thailand, more than three-quarters of 15-year-olds are enrolled in schools whose principals reported that external examination boards exerted a direct influence on decisions relating to assessment practices. In Austria, Greece, Spain, Sweden, Japan and Germany, and the partner country Israel, such examination boards either do not exist or do not have a significant role (OECD average 40%). In the areas of instructional content, budgeting and staffing, the respective OECD averages are 22%, 10% and 7% (Tables 5.12a - d).

In order to identify institutional connections that may exist between schooling and the labour market, principals were also asked to what extent business and industry have a direct influence on the students' curriculum. On average across OECD countries, 11% of 15-year-olds are in schools in which business and industry exert considerable influence on the curriculum, for 53%, the influence is considered to be minor or indirect, and for 36%, business and industry have no influence on the curriculum. While these figures also vary considerably across countries there are 50% or more students enrolled in schools in Austria and the partner country Indonesia who reported that business and industry influence the curriculum considerably (Figure 5.13).

Figure 5.13
Influence of business and industry on the school curriculum

Percentage of students in schools where the principal reported that business and industry have



Source: OECD PISA 2006 database, Table 5.11.
StatLink http://dx.doi.org/10.1787/141887160188

The relationship between school autonomy and student performance in science

To analyse the association between different aspects of school autonomy and student outcomes in science, three indices of school autonomy have been developed by using principal component analysis: school autonomy in staffing, school autonomy in budgeting and school autonomy in educational content.[24] So, are there any common features in Australia, Canada, Finland, Japan and Korea, the five OECD countries that show both above-average student performance in science and a below-average impact of socio-economic background on student performance (see the top-right quadrant in Figure 4.10). First, schools in all five countries are characterised by a relatively low degree of autonomy in staffing (OECD average -0.02). In contrast, all five countries (except for Canada) are characterised by a high degree of autonomy in educational content, compared to the average of 55 countries (OECD average 0.15). The picture varies concerning autonomy in budgeting: schools in Australia and Korea have, on average, a high degree of autonomy, while schools in Canada and Japan have a low degree of autonomy in budgeting matters, compared to the average of 55 countries (OECD average 0.19) (Table 5.22).

The associations between the different aspects of school autonomy and student performance have been examined in a multilevel model. After accounting for demographic and socio-economic background factors, school level autonomy indices in staffing, educational content, and budgeting do not show a statistically significant association with student performance (see the first table in Box 5.6). However, a system-level composition effect appears with regard to school autonomy in educational content as well as budgeting. Students in educational systems giving more autonomy to schools to choose textbooks, to determine course

content, and to decide which courses to offer, tend to perform better regardless of whether the schools which individual students attend have higher degrees of autonomy or not (an increase of one unit on the index corresponds to an increase of 20.3 score points in science). Similarly, students in educational systems that give more autonomy to schools to formulate the school budget and to decide on budget allocations within the school tend to perform better regardless of whether the schools that individual students attend have higher degrees of autonomy or not (an increase of one unit on the index corresponds to an increase of 22.5 score points in science). School autonomy variables do not appear to have an impact on the relationship between socio-economic background and science performance, that is, greater school autonomy is not associated with a more inequitable distribution of learning opportunities (see the second table in Box 5.6).

Box 5.6 **Multilevel models: School autonomy**

School autonomy and student performance

	Gross		Net	
	Change in score	p-value	Change in score	p-value
School autonomy index in staffing (effect of one standard deviation of the index)	9.5	(0.000)	-3.4	(0.005)
School autonomy index in educational content (effect of one standard deviation of the index)	0.9	(0.573)	-0.8	(0.368)
School autonomy index in budgeting (effect of one standard deviation of the index)	1.1	(0.457)	1.5	(0.045)
System average of school autonomy index in staffing (effect of one standard deviation of the index)	0.7	(0.936)	1.5	(0.829)
System average of school autonomy index in educational content (effect of one standard deviation of the index)	22.1	(0.019)	20.3	(0.004)
System average of school autonomy index in budgeting (effect of one standard deviation of the index)	27.2	(0.056)	22.5	(0.048)

School autonomy and the impact of socio-economic background

	Increase in score points in science corresponding to one unit increase of the student's PISA index of the economic, social and cultural status		Increase in score points in science corresponding to one unit increase of the school average of the PISA index of the economic, social and cultural status	
	Change in relationship	p-value	Change in relationship	p-value
School autonomy index in staffing (effect of one standard deviation of the index)	0.0	(0.943)		
School autonomy index in educational content (effect of one standard deviation of the index)	0.4	(0.394)		
School autonomy index in budgeting (effect of one standard deviation of the index)	0.1	(0.675)		
System average of school autonomy index in staffing (effect of one standard deviation of the index)	1.8	(0.311)	2.8	(0.683)
System average of school autonomy index in educational content (effect of one standard deviation of the index)	1.3	(0.495)	-1.3	(0.806)
System average of school autonomy index in budgeting (effect of one standard deviation of the index)	1.0	(0.765)	6.6	(0.436)

Note: See Box 5.2 for general notes.

More detailed results for the first table are presented in Table 5.19e and those for the second table are in Table 5.20e. The model is described in Annex A8.

SCHOOL RESOURCES

Effective schools require the right combination of trained and talented personnel, adequate educational resources and facilities and motivated students ready to learn. In the public debate, resources such as class and school sizes, the quality of the school's materials, perceived staff shortages, and teacher quality are frequently associated with performance. This section describes important school resources including human, material and educational resources and then examines their relationship with student performance and with the impact that socio-economic background has on student performance. When examining school resource factors within the framework of PISA, it is important to keep in mind the challenges that were outlined in Box 5.1.

Human resources reported by school principals

In order to gauge the extent to which schools were able to employ an adequate supply of science teachers, school principals were asked if their school had any science teacher vacancies in the academic year in which PISA 2006 was conducted, and, if yes, whether the vacancies had been filled. The results show that, on average, across OECD countries, 3% of students are in schools which reported that one or more science teaching positions remained vacant, 59% are enrolled in schools which reported that all vacant science teaching positions had been filled either with newly appointed staff or by reassigning existing staff, and 38% are in schools with no vacancies in science teaching positions. However, the proportion of 15-year-olds in schools with vacant science teacher positions ranged from less than 1% in Portugal, Greece, Poland, Italy, Spain, Ireland, the Slovak Republic, Sweden and Switzerland as well as the partner countries Bulgaria, Hong Kong-China, Tunisia, Lithuania and Romania, to between 5 and 10% in Turkey, the United Kingdom, as well as the partner countries/economies Colombia, Jordan, Slovenia, Israel, Chinese Taipei and Brazil, and to over 10% in Germany and Luxembourg and in the partner countries Indonesia, Kyrgyzstan and Azerbaijan (Figure 5.14).

In addition, PISA 2006 sought school principals' views on the extent to which instruction was hindered by a lack of qualified teachers in key subject areas. Not surprisingly, the principals of schools where all the science teaching positions were filled were less likely to report that the lack of qualified science teachers hindered the school's capacity to provide instruction compared to the school principals of schools where there were vacancies in science teaching positions. For example, on average across OECD countries 65% of principals in schools where there were vacancies reported that instruction was hindered by a lack of qualified science teachers, but only 16% of principals in schools where there were no vacancies reported the same. However, in some countries school principals considered that instruction was hindered by a lack of science teachers even in schools where there were no vacancies. For example, in Turkey, Mexico and Germany, as well as in Kyrgyzstan, Azerbaijan, Jordan, Chile and the Russian Federation, 30% or more of those schools with all science teaching positions filled reported that instruction was hindered by the lack of qualified science teachers to a greater or lesser extent. Some of the differences in the level of vacancies across countries may be due to differences in required qualifications for being a science teacher (Figure 5.14).

In examining human resources, it is important to assess not only average levels of human resources, but also how these are distributed within countries. PISA established an index of teacher shortage by using responses from school principals to questions about the extent to which the shortage or inadequacy of teachers in science, languages, mathematics and other subjects hindered the school's capacity to provide instruction. The index has a mean value of zero and a standard deviation of one across OECD countries. Positive values indicate that school principals more frequently reported that the lack of qualified teachers hinders instruction than is the case on average across OECD countries, while negative values suggest the reverse. In Finland, the Czech Republic, Austria and Sweden, as well as in the partner countries Bulgaria and Croatia, school principals' perceptions about the impact of teacher shortage vary relatively little across schools, while in Turkey and Belgium, as well as in the partner countries/economies Kyrgyzstan, Qatar, Jordan, the Russian Federation, Macao-China, Colombia, Brazil and Azerbaijan, there is considerable between-school variation (Figure 5.14).

Figure 5.14

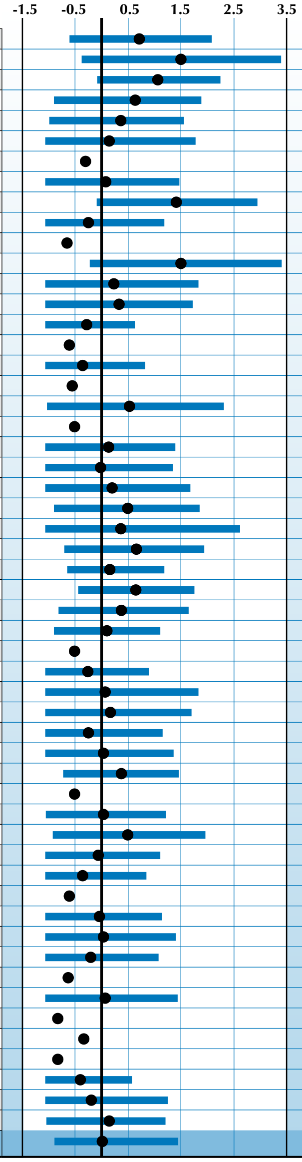
School principals' reports on vacant science teaching positions and their perceptions of the supply of qualified science teachers

Percentage of students in schools where the principal reported

	No vacant science teaching positions to be filled	All vacant science teaching positions filled	One or more vacant science teaching positions not filled
Indonesia	6	60	34
Kyrgyzstan	3	72	25
Luxembourg	38	43	19
Azerbaijan	55	32	13
Germany	40	48	12
Brazil	9	81	10
Chinese Taipei	19	71	10
United Kingdom	19	73	9
Turkey	63	30	7
Israel	23	69	7
Slovenia	23	70	7
Jordan	9	85	6
Colombia	56	39	5
Australia	22	75	4
Finland	59	37	4
Serbia	41	56	3
Austria	56	41	3
Hungary	57	40	3
Russian Federation	7	90	3
Japan	11	86	3
Netherlands	34	63	3
United States	27	71	3
Uruguay	45	52	3
Chile	35	62	3
Qatar	20	78	3
Mexico	49	49	2
Czech Republic	54	44	2
Thailand	41	57	2
Estonia	55	43	2
Denmark	37	61	2
Montenegro	48	50	2
Croatia	27	71	2
Macao-China	14	84	2
Canada	18	80	2
Argentina	37	61	2
Iceland	31	67	2
New Zealand	19	79	2
Korea	80	19	1
Latvia	34	65	1
Belgium	25	74	1
Switzerland	42	57	1
Sweden	27	72	1
Romania	41	58	1
Slovak Republic	3	97	1
Lithuania	54	45	1
Ireland	55	44	1
Spain	36	64	0
Italy	33	66	0
Poland	73	27	0
Greece	31	69	0
Portugal	25	75	0
Bulgaria	69	31	0
Hong Kong-China	50	50	0
Tunisia	69	31	0
OECD average	**38**	**59**	**3**

No vacant science teaching positions or all vacant science teaching positions filled — of which a lack of qualified science teachers hinders instruction to some extent or a lot

Index of teacher shortage



1. Range between top and bottom quarter of students is not presented for the countries where more than 50% of students have the same value on the index.
Source: OECD PISA 2006 database, Table 5.13 and 5.14.
StatLink http://dx.doi.org/10.1787/141887160188

As another indicator of the quality of human resources in schools, the average number of students per teacher was computed, based on the school principals' reports on the number of male and female students and the number of full-time and part-time teachers in their schools. The total number of students was divided by the total number of full-time equivalent teachers. There are 10 or less 15-year-old students per full-time equivalent teacher in Portugal, Greece, Belgium, Italy, Luxembourg, as well as in the partner country Azerbaijan, while there are over 20 students per full-time equivalent teacher in Mexico, as well as in the partner countries/economies Chile, Colombia, Thailand and Macao-China, and over 30 students in the partner country Brazil (Table 5.14).

Material resources reported by school principals

Ensuring the availability of an adequate physical infrastructure and supply of educational resources does not guarantee good learning outcomes, but the absence of such resources could negatively affect learning. School principals were asked to report on the extent to which the school's capacity to provide instruction was hindered by the shortage or inadequacy of several types of resources, including: science laboratory equipment, instruction materials such as textbooks, computers for instruction, Internet connectivity, computer software for instruction, library materials and audio-visual resources (see Figure 5.15). On average across OECD countries, only a minority of 15-year-olds are in schools where school principals reported that a shortage or inadequacy of these educational resources hindered the school's capacity to provide instruction to a greater or lesser extent. There was particularly little concern about the shortage or inadequacy of Internet connectivity or instructional materials: 20 and 25% of students, respectively, were enrolled in schools where school principals reported that instruction was hindered by a shortage of these resources. In contrast, school principals expressed more concern about the supply of laboratory equipment, particularly in the Slovak Republic, Turkey, Mexico, Iceland, Poland, Norway and Hungary, as well as in many of the partner countries, where the majority of 15-year-olds were enrolled in schools where school principals reported that a shortage or inadequacy of laboratory equipment hindered learning.

A composite index of educational resources summarises principals' responses to the seven questions on the adequacy or shortage of educational resources. The index was inverted so that positive values on the index reflect a below-average concern among school principals that the shortage or inadequacy of educational resources hinders the capacity to provide instruction. This index shows that few principals in Switzerland, Japan and Australia, as well as the partner economy Chinese Taipei perceived inadequacy of educational resources as hindering their schools' capacity to provide instruction, while in the partner countries Kyrgyzstan, Indonesia, Azerbaijan, Montenegro, the Russian Federation, and Colombia, many school principals expressed such concern (Figure 5.15). However, when interpreting these figures, it should be borne in mind that school principals did not provide an objective measure of the condition of educational resources, but rather their perceptions of whether a shortage or inadequacy of educational resources hindered the capacity to provide instruction in their schools. Caution is therefore required in comparing responses across schools and countries. Still, principals' perceptions can shape their behaviour in important ways and should therefore be considered.

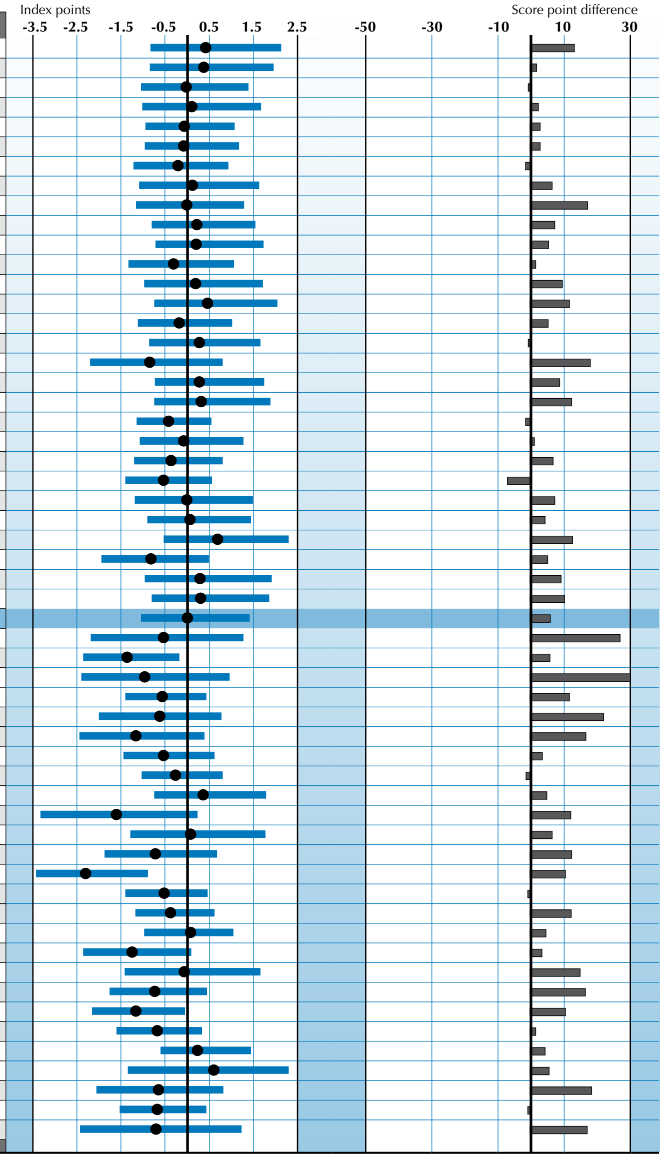
The variation in school principals' assessments regarding these educational resources, expressed as the difference between the bottom and top quarters of the index, was particularly low in Norway and the Slovak Republic, as well as in the partner countries Lithuania, Estonia, Bulgaria, Latvia, Serbia, and Tunisia, while in Mexico and Australia, as well as in the partner countries/economies Uruguay, Chinese Taipei, Indonesia, Argentina, Brazil, Qatar and Israel, school principals' perceptions differed most considerably across schools (Figure 5.15).

Figure 5.15
Material resources – index of the quality of schools' educational resources

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

Percentage of students in schools whose principals reported that the capacity to provide instruction was hindered by the following

	A	B	C	D	E	F	G
Australia	17	16	26	17	34	14	23
Austria	23	21	20	11	24	22	40
Belgium	36	38	32	24	42	22	38
Canada	30	27	32	19	38	25	36
Czech Republic	41	34	31	15	39	30	40
Denmark	37	19	31	15	39	34	34
Finland	46	40	40	19	37	25	42
Germany	31	32	30	19	27	20	39
Greece	46	54	56	13	24	10	35
Hungary	24	25	24	12	15	32	52
Iceland	19	17	0	8	24	37	58
Ireland	52	57	54	30	55	15	49
Italy	31	24	34	13	21	16	45
Japan	34	24	29	16	19	0	25
Korea	54	52	36	17	32	15	49
Luxembourg	30	38	0	0	42	0	0
Mexico	65	54	62	60	59	43	67
Netherlands	21	12	33	23	39	12	34
New Zealand	26	12	25	0	42	16	18
Norway	42	47	65	24	46	39	56
Poland	39	38	48	7	33	35	56
Portugal	50	37	70	33	52	26	48
Slovak Republic	59	66	53	23	39	66	75
Spain	42	36	51	23	43	13	40
Sweden	36	30	41	14	46	26	28
Switzerland	15	17	16	11	16	14	30
Turkey	71	63	56	36	61	61	72
United Kingdom	24	24	26	19	37	21	28
United States	20	20	24	15	33	17	33
OECD average	**37**	**34**	**38**	**20**	**37**	**25**	**42**
Argentina	51	33	56	56	51	33	55
Azerbaijan	86	66	88	85	81	58	84
Brazil	57	58	73	61	76	45	77
Bulgaria	66	56	51	29	48	40	77
Chile	47	53	55	24	50	44	72
Colombia	64	69	77	69	70	72	71
Croatia	62	44	66	28	46	50	76
Estonia	53	39	47	10	44	37	66
Hong Kong-China	23	22	30	6	23	15	11
Indonesia	79	76	68	83	59	59	75
Israel	39	33	27	15	37	25	40
Jordan	61	47	66	70	67	39	51
Kyrgyzstan	93	90	94	95	90	95	93
Latvia	49	39	42	20	49	45	78
Lithuania	49	29	53	18	51	28	67
Macao-China	29	33	27	16	21	19	17
Montenegro	76	69	71	65	79	70	87
Qatar	58	35	38	40	43	21	38
Romania	64	40	67	38	59	63	76
Russian Federation	84	77	83	64	80	64	87
Serbia	61	52	57	50	58	50	67
Slovenia	21	12	24	7	21	21	26
Chinese Taipei	23	24	22	13	17	14	26
Thailand	58	54	53	40	45	40	59
Tunisia	65	70	62	52	78	26	43
Uruguay	52	46	58	57	60	50	42



1. Higher mean value indicates that school principals perceived that the quality of schools' educational resources hindered instruction to a lesser extent.
Source: OECD PISA 2006 database, Table 5.15.
StatLink http://dx.doi.org/10.1787/141887160188

School principals also reported the number of computers available for instruction in their schools, which, divided by the total number of students in the school, provides an indicator of the availability of computers for instruction per student. The number of computers available for instruction per student varies widely across countries. Five or less students share one computer for instruction in the United Kingdom, Australia, Luxembourg, Austria, the United States and Norway, while 25 or more students share one computer for instruction in the partner countries Azerbaijan, Kyrgyzstan, Tunisia, Brazil, Montenegro, Indonesia and the Russian Federation (Table 5.15).

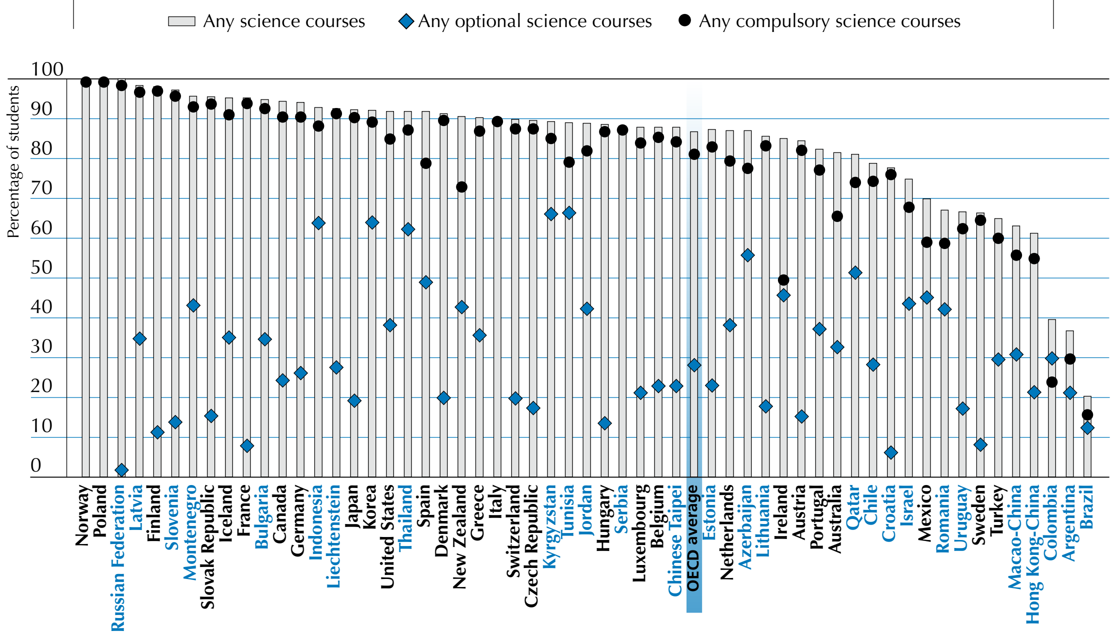
Learning time and educational resources reported by students and school principals

Students reported on whether or not they were learning science in 2006 and, if so, how these courses were delivered. For example, students may have been following compulsory or optional courses in general science, biology, physics or chemistry in any number of combinations or even no longer learning science at school. An aged-based sample, such as in PISA, implies that students can be drawn from a number of different grades and in some countries science may be a compulsory subject up to a certain number of years in school, but not after. In 43 out of 56 countries where data are available, at least 80% of 15-year-old students are still following some form of science education at school, whether a compulsory course, optional course or combination of both (Figure 5.16 and Table 5.16). In 24 of the participating countries at least 90% of students are enrolled in a science class at age 15. At least 95% of 15-year-old students reported following science courses in Finland, the Slovak Republic, Iceland and France, and in the partner countries Latvia, Slovenia and Montenegro, and all students reported following science courses in Norway and Poland and the partner country Russian Federation.

There are many ways in which 15-year-olds are exposed to science at school. Important differences between countries or between regions within countries relate to the organisation of science content. In some countries, students take a general science course, sometimes called "integrated science", where they study a variety of concepts drawn from the physical, biological or earth sciences. Another type of curriculum will have separate courses in biology, physics, chemistry and earth sciences, with students taking all or some of these during a school year. In still other systems, coursework is grouped thematically and science as a separate course is not offered, with students drawing on their science knowledge and skills to answer specific problems within a theme at the same time that they draw on their skills in other disciplines, such as geography or writing. It is also possible that students might experience a combination of all of these approaches.

PISA has examined different arrangements for science instruction. Norway is the only country where all students at age 15 follow a compulsory general science course. Compulsory general science courses are also attended by between 70 and 90% of students in 13 of the participating countries and this is the case for at least 80% of the students in Korea, Japan, Finland, Iceland and Canada and in the partner countries Thailand and Indonesia. In contrast, there are no general science courses (whether compulsory or optional) offered to students at age 15 in Austria, France, Greece, Hungary, Luxembourg, Poland and the Slovak Republic, or in the partner countries Azerbaijan, Bulgaria, Croatia, Lithuania and Serbia. All students in Poland are enrolled in compulsory biology, chemistry and physics classes, while in all other 11 countries students are enrolled for the most part in compulsory biology, chemistry or physics classes. Similarly, the majority of students in the partner country the Russian Federation follow compulsory science courses in biology, chemistry and physics at age 15 and only 3% follow compulsory general science courses. Finland stands out as a country where the majority of students follow both compulsory general science courses and compulsory specific courses in biology, chemistry and physics (Figure 5.16 and Table 5.16).

Figure 5.16
Percentage of students following science courses at age 15



Source: OECD PISA 2006 database, Table 5.16.
StatLink http://dx.doi.org/10.1787/141887160188

Through exposure to science at school and out of school, students have the opportunity to explore and absorb some of the facts, principles and skills associated with science. It is therefore to be expected that the amount of time spent learning science would be associated with the level of student performance in science. In PISA 2006, students were asked to estimate the amount of time, in hours, that they spent on science in regular lessons, in out-of school lessons, and doing study or homework by themselves. The same question was asked of the students regarding reading and mathematics.

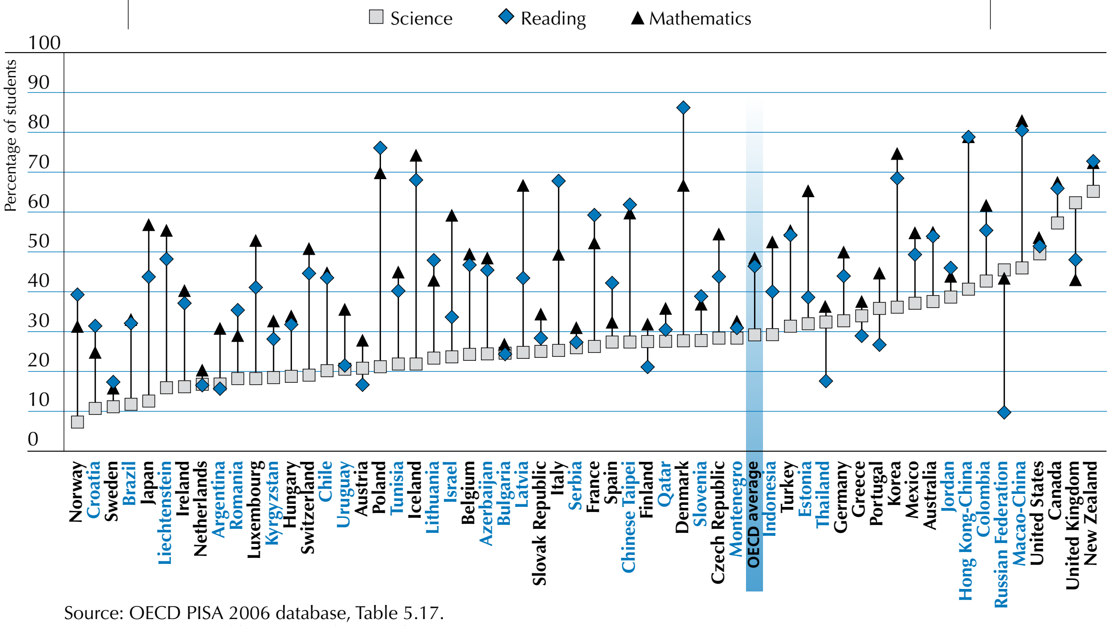
On average across OECD countries, 28.7% of students reported that they had four hours or more of regular science lessons at school. This percentage rises to 64.8% in New Zealand, 61.9% in the United Kingdom, 56.8% in Canada, and 49.1% in the United States. Among the partner countries/economies, the percentage is between 40% and 46% in Macao-China, the Russian Federation, Colombia and Hong Kong-China. In Norway, only 6.9% of students reported that they studied science at school for four hours or more per week (Figure 5.17 and Table 5.17).

There are a number of countries where the majority of students reported that they took two hours or less of science at school each week. This is the case in the Slovak Republic, the Netherlands and Luxembourg and also in the partner countries Kyrgyzstan, Romania, Chile and Argentina.

Activities external to the classroom can enhance students' learning in science, as they can provide a motivation for students and help to place science in a real-life context. In PISA 2006 school principals were asked about their schools' provision for such activities. The activities include going on excursions, participating in science competitions and science fairs, engaging in extracurricular science projects, and belonging to a science-related club. A single index was developed from principals' responses to these five individual questions.

Figure 5.17
Students' time spent on learning

Percentage of students who spend four hours or more per week in regular lessons



Source: OECD PISA 2006 database, Table 5.17.
StatLink http://dx.doi.org/10.1787/141887160188

The most common activity to promote the learning of science is taking students on excursions. Across OECD countries, 89% of students attend schools where the principals reported this activity. This figure is over 97% in the Slovak Republic, Poland and Hungary and in the partner countries Romania, Lithuania, the Russian Federation, Latvia, Qatar and Slovenia. Among OECD countries, Japan reported the least use of excursions, with 30% of the students attending schools where the principals reported this activity (Figure 5.18 and Table 5.18).

Across the OECD, 54% of students were in schools where principals reported that participation in science competitions was encouraged. Science competitions are very common in Poland, where all of the students attended schools where principals reported this activity, and the figure is still over 95% in Australia and in the partner countries Kyrgyzstan and the Russian Federation. Science competitions are not as popular in Japan, where just 6% of students were in schools where principals reported participation in them. The figure is also low in Denmark (10%) and Norway (16%).

Science clubs are less prevalent across OECD countries (on average, 38% of students were in schools where principals reported to provide these), the corresponding figure for science fairs is 39% and for extracurricular science projects, 45%.

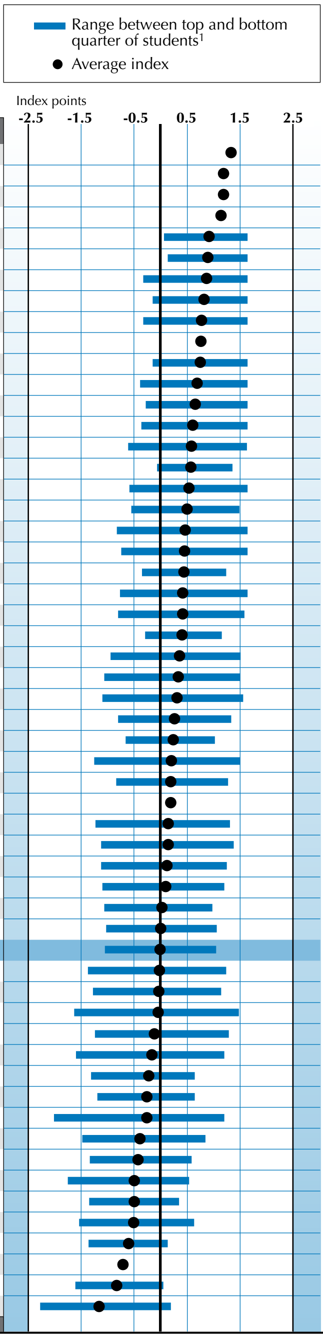
The prevalence of these activities can be summarised in an index. The countries with an index value of more than one-half of a standard deviation below the OECD average, *i.e.* the countries in which schools provide such activities to a lesser extent, are Japan (-1.16), Denmark (-0.83), Iceland (-0.71), Finland (-0.60) and the Netherlands (-0.51). Those countries with the values of over one-half of a standard deviation above the OECD average are the Slovak Republic (0.70), Portugal (0.66), Hungary (0.62), Poland (0.58), Korea (0.54) and New Zealand (0.51) and the partner countries/economies Thailand (1.34), the Russian Federation (1.19), Lithuania (1.19), Slovenia (1.15), Hong Kong-China (0.92), Estonia (0.90), Jordan (0.87), Colombia (0.82), Romania (0.77), Chinese Taipei (0.76), Kyrgyzstan (0.76) and Qatar (0.59).

Figure 5.18
Index of school activities to promote the learning of science

- A Excursions and field trips
- B Science competitions
- C Extracurricular science projects
- D Science fairs
- E Science clubs

Percentage of students in schools whose principals reported that the school promoted engagement with science using the following activities

	A	B	C	D	E
Thailand	96	93	89	97	84
Russian Federation	99	98	80	83	84
Lithuania	99	91	76	98	80
Slovenia	97	80	79	85	92
Hong Kong-China	90	91	83	52	91
Estonia	97	88	88	81	50
Jordan	90	75	84	80	67
Colombia	87	62	75	71	93
Romania	100	92	55	62	71
Chinese Taipei	89	72	71	73	76
Kyrgyzstan	94	98	36	75	79
Slovak Republic	99	81	44	70	78
Portugal	94	62	86	62	64
Hungary	97	84	38	69	72
Qatar	97	78	71	66	41
Poland	99	100	51	27	78
Korea	80	86	44	49	87
New Zealand	94	91	57	72	32
United States	92	58	65	50	73
Czech Republic	97	78	50	61	47
Macao-China	69	91	96	34	46
Canada	95	64	64	55	48
United Kingdom	87	72	60	35	73
Australia	97	98	70	31	31
Tunisia	78	49	51	56	83
Montenegro	83	81	57	31	68
Serbia	65	84	43	41	83
Azerbaijan	91	79	29	42	68
Brazil	84	39	86	82	5
Israel	87	62	65	32	53
Spain	95	37	36	57	69
Latvia	99	91	86	6	14
Croatia	90	75	58	49	21
Luxembourg	93	41	56	69	33
Ireland	93	54	53	64	21
Argentina	80	51	65	72	16
Bulgaria	86	78	52	20	a
Italy	96	34	75	16	39
OECD average	**89**	**54**	**45**	**39**	**38**
Uruguay	83	32	60	57	33
Mexico	75	72	54	39	21
Indonesia	74	63	45	25	60
Germany	95	43	34	29	47
Turkey	78	54	48	29	39
Belgium	91	52	48	35	5
Switzerland	95	22	29	47	35
Chile	74	36	47	44	39
Austria	91	35	30	27	27
Greece	87	67	23	9	11
Sweden	81	56	29	24	7
Norway	94	16	42	36	1
Netherlands	89	35	40	21	8
Finland	94	37	23	9	9
Iceland	95	25	23	7	5
Denmark	87	10	18	25	3
Japan	30	6	19	11	49



1. Range between top and bottom quarter of students is not presented for the countries where more than 50% of students have the same value on the index.
Source: OECD PISA 2006 database, Table 5.18.
StatLink http://dx.doi.org/10.1787/141887160188

The relationship between school resources and student performance in science

Across Australia, Canada, Finland, Japan and Korea, the five OECD countries that show above-average student performance in science and a below-average impact of socio-economic background on student performance (see the top-right quadrant in Figure 4.10), there is considerable variation in school resources. On average across the five countries, for example, there are 14.1 students per teacher, but this varies from 11.3 in Finland to 16.7 in Canada (OECD average 13.4). Across the five countries, five students share one computer for instruction, which varies from 4 students in Australia to 7 students in Finland (OECD average 7). The extent of school principals' perception of a lack of qualified teachers hindering instruction is below the OECD average in Japan, Korea and Finland, but higher than the OECD average in Australia and Canada. School principals tend to perceive school educational resources as adequate in Japan and Australia, but this is not the case in Finland and Korea. Across the five countries, the average students' learning time for regular lessons in school per week is 11.5 hours, varying from 9.7 hours in Finland to 12.9 hours in Canada (OECD average 10.6); the average students' learning time for out-of school lessons is 2.3 hours, varying from 1.1 hours in Finland to 4.8 hours in Korea (OECD average 2.4); and the average students' learning time for self-study or homework is 4.3 hours per week, varying from 3.1 hours in Japan to 5.3 hours in Canada (OECD average 4.9). School principals in Korea, Canada and Australia tended to more frequently report that schools provided activities to promote students' learning of science than the OECD average, while this was less frequently the case in Japan and Finland (Table 5.22).

This remainder of this section examines the relationship between school principals' views on human, material and educational resources and science performance. Since the various aspects of school resources are interrelated, it is not possible to estimate the total impact of the school resources on student performance by simply adding up the factors examined in the previous section. Only a joint examination of the various factors makes it possible to estimate their collective impact on student and school performance.

As in previous sections of this chapter, the relationships between school resources and student performance are analysed before and after taking demographic and socio-economic factors into account. Examining the impact of school-resource factors after an adjustment for the demographic and socio-economic factors allow a comparison of schools that are operating in similar contexts. Conversely, the interpretation of the school factors without an adjustment for the contextual factors ignores differences in the composition of schools and the country context. That said, the unadjusted gross effects may give a more realistic picture of the choices that parents face if they wish to select a school for their children. Parents and other stakeholders, for example, are naturally most interested in the overall performance results of schools, including any effects that are conferred by the socio-economic intake of schools, whereas the added value that schools provide may only be a secondary consideration for them.

The following model incorporates both aspects providing both gross effects (prior to an adjustment for socio-economic factors) and net effects (after an adjustment for demographic and socio-economic factors). For methodological reasons, composite indices have been used rather than single-item statements wherever these could be constructed. The following factors are included in the model: the index of teacher shortage, the student-teacher ratio, the index of the school's educational resources and the ratio of computers used for instructional purposes to the number of students at school, the learning time in school (over all subjects), and the time spent on homework assignments, the time spent in taking out-of-school lessons, as well as the presence of school activities promoting science and the science courses taken by the school's students in the current or previous school year.

As shown in the first table in Box 5.7, the school average students' learning time in science, mathematics and language during regular lessons in school, the school average students' learning time for self-study or homework, the school average level of providing learning opportunity in science, and the index of school

Box 5.7 **Multilevel models: School resources**

School resources and student performance

	Gross		Net	
	Change in score	p-value	Change in score	p-value
Human resource indicators				
School average number of students per teacher (one additional student per teacher)	0.33	(0.121)	-0.16	(0.304)
School-level index of teacher shortage (effect of one standard deviation of the index)	-4.14	(0.000)	-1.55	(0.073)
Material resource indicators				
School average number of computers for instruction per student (one additional computer per student)	-12.5	(0.359)	2.5	(0.817)
School-level index of quality of school educational resources (effect of one standard deviation of the index)	5.14	(0.000)	0.17	(0.798)
Educational resource indicators				
School average students' learning time for regular lessons in school (one additional hour per week)	14.3	(0.000)	8.7	(0.000)
School average students' learning time for out-of-school lessons (one additional hour per week)	-12.9	(0.000)	-9.0	(0.000)
School average students' learning time for self-study or homework (one additional hour per week)	3.8	(0.004)	3.1	(0.001)
School providing opportunity of learning science (each additional 10% of students taking any science course)	1.7	(0.080)	1.4	(0.016)
School average index of school activities to promote students' learning of science (effect of one standard deviation of the index)	7.07	(0.000)	2.89	(0.000)

School resources and the impact of socio-economic background

	Increase in score points in science corresponding to one unit increase of the student's PISA index of economic, social and cultural status	
	Change in relationship	p-value
Human resource indicators		
School average number of students per teacher (one additional student per teacher)	0.00	(0.909)
School-level index of teacher shortage (effect of one standard deviation of the index)	-0.04	(0.865)
Material resource indicators		
School average number of computers for instruction per student (one additional computer per student)	-6.6	(0.004)
School-level index of quality of school educational resources (effect of one standard deviation of the index)	0.35	(0.141)
Educational resource indicators		
School average students' learning time for regular lessons in school (one additional hour per week)	0.6	(0.003)
School average students' learning time for out-of-school lessons (one additional hour per week)	-0.8	(0.020)
School average students' learning time for self-study or homework (one additional hour per week)	-0.1	(0.850)
School providing opportunity of learning science (each additional 10% of students taking any science course)	0.1	(0.438)
School average index of school activities to promote students' learning of science (effect of one standard deviation of the index)	0.49	(0.117)

Note: See Box 5.2 for general notes.

More detailed results for the first table are presented in Table 5.19f and those for the second table are in Table 5.20f. The model is described in Annex A8.

activities to promote students' learning of science are all positively associated with science performance both before and after accounting for contextual factors.[25] After accounting for background factors and all other factors in the model, students in schools with one additional hour of regular lessons per week tend to perform 8.7 score points higher; students in schools with one additional hour of self-study and homework perform 3.1 score points higher; and students in schools with one unit more in the index of school activities to promote students' learning of science tend to perform 2.9 score points higher.

In the gross models, the index of teacher shortage is negatively related to science performance, *i.e.* students in schools that reported a higher incidence of teacher shortage tended to perform worse, while the index of the quality of the school's educational resources is positively related to science performance. However, the effect of both factors disappears when accounting for contextual factors in the net model.

There is a statistically significant association between average learning time in school and the impact which socio-economic background has on student performance (see the second table in Box 5.7). One unit increase in students' PISA index of economic, social and cultural status is equivalent to an advantage of 16.1 score points in science performance in schools with the average in-class learning time (10 hours), but this association increases to 16.7 score points in schools with 11 hours in-class learning time per week (Table 5.20f). The results also suggest that the higher the number of computers for instruction per student, the lower the impact which individual socio-economic background has on science performance. In schools with longer average learning time there could be a large gap in the students' learning time among students within schools and students with more advantaged socio-economic backgrounds might study for longer hours in schools than their schoolmates with less advantaged socio-economic background; this would be reflected in the greater impact of socio-economic background on student performance in schools with longer average learning time. Also, students in schools with a greater number of computers per students schools might have opportunities to access educational resources in their school that enhance their learning regardless of their socio-economic backgrounds; this would be reflected in the lesser impact of socio-economic background on student performance in schools with a greater number of computers per student. However, the nature and causality in such relationships are not established.

THE JOINT IMPACT OF SCHOOL AND SYSTEM RESOURCES, PRACTICES, AND POLICIES ON STUDENT PERFORMANCE

The preceding sections examined various aspects of school systems. These aspects can also be interrelated. For example, it is possible that schools that are well resourced also tend to be the ones that use the most effective teaching practices. A next step in the analysis is therefore to look at these factors jointly. This analysis provides valuable insights in two ways. First, it shows the overall amount of variation in student performance that is associated with the school and system-level factors considered in this chapter. Second, it allows for discernment of the extent to which the individual policies and practices have unique effects – an association with performance that is not explained only by their association with other factors that tend to go together with strong performance, including socio-economic background. As before, it needs to be taken into account that some of these factors have been measured more extensively than others and that many other factors that potentially have an influence on learning outcomes have not been measured by PISA. For example, much of the current research on school effectiveness concludes that teacher quality is a powerful predictor of learning outcomes (Wright, Horn and Sanders, 1997; Wayne and Youngs, 2001; and Loeb, 2003) but it has not been possible to establish measures on this in PISA. Readers should also keep in mind the methodological caveats described in Box 5.1.

The model examined below is based on student data from 55 participating countries, with each country given equal weight. Because the number of systems was small compared to the number of factors measured

by PISA, the model was constructed in two steps. First, the relationship between science performance and six groups of school factors was examined, group-by-group, simultaneously at student, school and system-levels. The six factors were those discussed in preceding sections of this chapter: policies of admitting, grouping and selecting students, the role of public and private stakeholders in school management and funding, parental pressure and choice, accountability policies, school autonomy, and school resources. Afterwards, the individual factors from the different groups that had a statistically significant relationship with science performance[26] (see the first table in Boxes 5.2 to 5.7) in these analyses were jointly examined in a combined multilevel model (Table 5.19g). The relationship between these factors and science performance was estimated both before and after accounting for socio-economic variables at student, school and system-levels. As in the preceding sections, the former are referred to as gross effects while the latter are referred to as net effects (Box 5.8).[27]

Box 5.8 **Combined multilevel model for student performance**

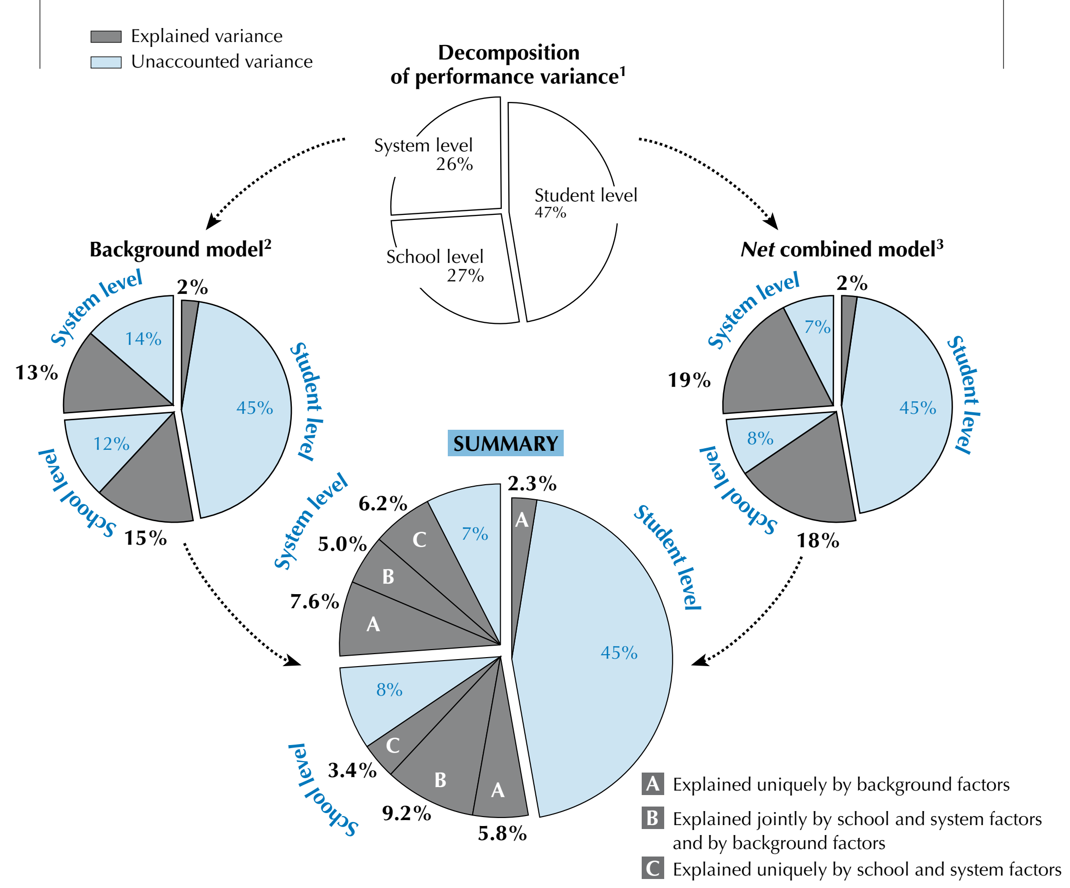
	Gross		Net	
	Change in score	p-value	Change in score	p-value
Admitting, grouping and selecting				
School with ability grouping for all subjects within school (1=ability grouping between and/or within classes for all subjects; 0=no ability grouping or ability grouping for some subjects within school)	-7.6	(0.000)	-4.5	(0.000)
School with high academic selectivity of school admittance (1=academic records and/or feeder school recommendations are a prerequisite for student admittance; 0=others)	18.5	(0.000)	14.4	(0.000)
School with low academic selectivity of school admittance (1=neither academic records nor feeder school recommendations are considered for student admittance; 0=others)	-7.0	(0.002)	-1.3	(0.378)
School management and funding				
School with high proportion of school funding from government sources (each additional 10% funding from government sources)	-2.1	(0.000)		
Parental pressure and choice				
School with high level of competition (1=one or more other schools compete for students; 0=no other schools compete for students)	6.0	(0.002)		
System with high proportion of competitive schools (each additional 10% of competitive schools)	-4.6	(0.178)		
Accountability policies				
School posting achievement data publicly (1=yes; 0=no)	5.3	(0.000)	3.5	(0.001)
School autonomy				
School autonomy index in budgeting (effect of one standard deviation of the index)	1.4	(0.155)	0.9	(0.188)
System average of school autonomy index in budgeting (effect of one standard deviation of the index)	28.6	(0.023)	25.7	(0.008)
School resources				
School-level index of teacher shortage (effect of one standard deviation of the index)	-3.5	(0.000)		
School-level index of quality of school educational resources (effect of one standard deviation of the index)	3.9	(0.000)		
School average students' learning time for regular lessons in school (one additional hour per week)	14.0	(0.000)	8.8	(0.000)
School average students' learning time for out-of-school lessons (one additional hour per week)	-11.7	(0.000)	-8.6	(0.000)
School average students' learning time for self-study or homework (one additional hour per week)	3.8	(0.002)	3.1	(0.000)
School average index of school activities to promote students' learning of science (effect of one standard deviation of the index)	6.7	(0.000)	2.9	(0.000)

Note: See Box 5.2 for general notes.
More detailed results are presented in Table 5.19g. The detailed model is described in Annex A8.

The net combined model, which includes demographic and socio-economic background factors, as well as the school and system-level factors in the net model shown in Box 5.8, explains 40% of the total performance variance (Figure 5.19a). Of the 40% of explained variance, 19% lies between countries/economies (equivalent to almost three-quarters of total variance between countries), 18% lies between schools within countries/economies (equivalent to over two-thirds of the total variance between schools) and 2% lies between students within schools (equivalent to one-twentieth of the total variance between students).

Figure 5.19a

Variance and explained variance in science performance at student, school, and system levels



1. This model shows how much of the overall performance variation lies between students, schools, and countries/economies (see Model 0a in Table 5.19g.)
2. This model includes only the demographic and socio-economic background factors such as the PISA index of of economic, social and cultural status (ESCS) of students, the squared term of the ESCS, the gender, immigrant status, language spoken at home, the school location, the school size, the squared term of school size and the school average ESCS, and system average ESCS (see Model 0b in Table 5.19g).
3. This model includes school and system level factors such as ability grouping for all subjects within the school, high and low academic selectivity for school admittance, school accountability (posting achievement data publicly), school autonomy in budgeting (and percentage of schools with autonomy in budgeting in a country), school average students' learning time for regular lessons in school, for out-of-school lessons, and for self-study or homework, and school activities to promote students' learning of science, in addtion to the demographic and socio-economic background factors included in the background model (see Model 2N in Table 5.19g).
Source: OECD PISA 2006 database, Table 5.19g.
StatLink http://dx.doi.org/10.1787/141887160188

It is also possible to examine how much of the performance variation between schools factors in the net model shown in Box 5.8 explain in each country. The performance variation uniquely explained by the selected set of school factors, the performance variation uniquely explained by the demographic and socio-economic factors, the performance variation jointly explained by the school factors and the demographic and socio-economic factors, and the unexplained performance variation between schools is shown in Figure 5.19b. The overall length of the bar in the figure represents the performance variation between schools expressed as a percentage of the average performance variation between schools across OECD countries. The percentages in the second column reflect the percentage of the performance variation between schools that is explained by the model relative to the total performance variation between schools in each country. On average across OECD countries, 81% of the between-school variation in performance within countries is explained by the model[28] and this exceeds 90% in Luxembourg, New Zealand and Germany,but is less than 60% or less in Canada, Norway and Finland, and the partner country Indonesia and 31% in the partner country Azerbaijan. In most countries, more than half of the performance variation between schools is jointly explained by the school factors and the demographic and socio-economic factors (Figure 5.19b).

Beyond showing what proportion of the performance variation the school factors explain, the models also estimate the size of their effect on school performance. The first five school factors and the one system factor listed below have effects on science performance both before and after accounting for the socio-economic context. In contrast, the last four school factors listed below have effects on science learning before accounting for the socio-economic contextual factors, but the effects are no longer statistically significant after accounting for the socio-economic context (Box 5.8):

School factors that are associated with performance even after accounting for demographic and socio-economic background

- School principals' reports regarding the practice of ability grouping for all subjects within schools (students in schools practicing ability grouping for all subjects within schools score 4.5 points lower than students in school practicing no ability grouping or ability grouping only for some subjects, all other things being equal).
- School principals' reports regarding high academic selectivity of school admittance (students in schools in which academic records or feeder school recommendations were a prerequisite for school admittance score 14.4 points higher than students in schools applying a moderate selective admittance policy, all other things being equal).
- School principals' reports regarding whether the school's achievement data are posted publicly (students in schools posting achievement data publicly score 3.5 points higher compared with students in schools not posting achievement data publicly, all other things being equal).
- School principals' reports regarding the school average time students invest in learning for science, mathematics and language at school (students in schools with one additional average hour per week score 8.8 points higher, all other things being equal), out-of school lessons (students in schools with one additional average hour per week score 8.6 points lower, all other things being equal), and self-study (students in schools with one additional average hour per week score 3.1 points higher, all other things being equal).
- School principals' reports regarding school activities to promote students' learning of science (one additional unit of this index is equivalent to an advantage of 2.9 score points in student performance, all other things being equal).

System factor that is associated with performance even after accounting for demographic and socio-economic background

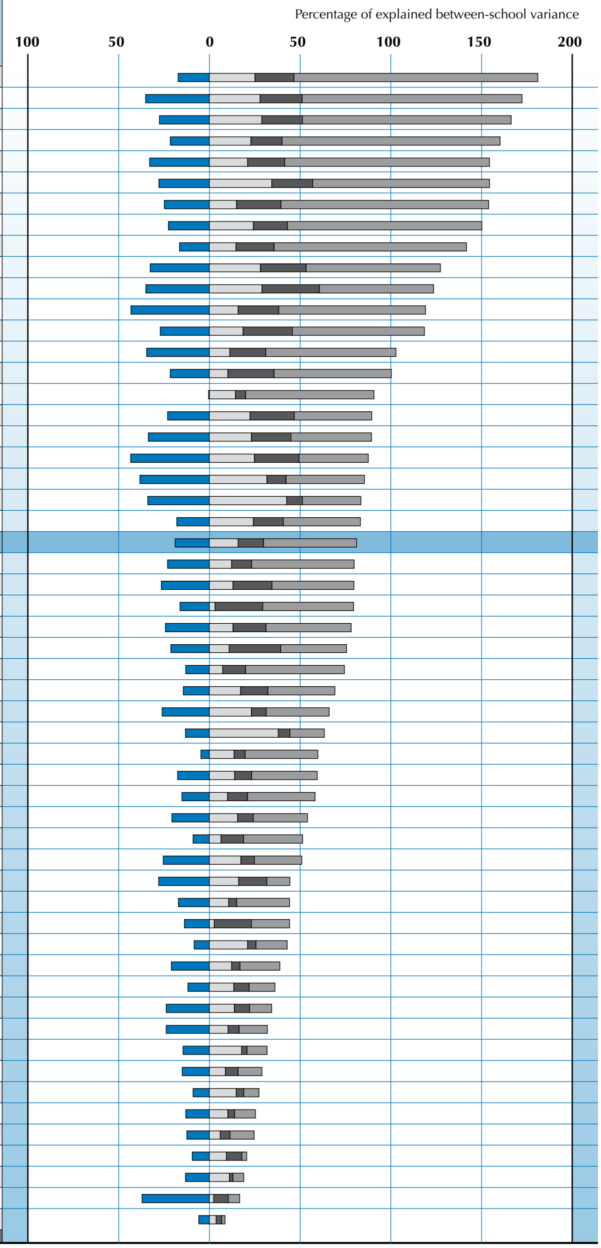
- Education systems where schools have a higher degree of autonomy in budgeting (students in education systems with one additional standard deviation on the index of autonomy in budgeting score 25.7 points higher, all other things being equal).

Figure 5.19b
School-level variance and explained variance in science performance, by country

- Unaccounted between-school variance
- Between-school variance uniquely accounted for by demographic and socio-economic factors
- Between-school variance uniquely accounted for by school factors
- Between-school variance jointly accounted for by demographic and socio-economic factors and school factors

	Between-school variance as a percentage of the total variance within each country	Explained between-school variance as a percentage of the total between-school variance within each country
Germany	57	91
Bulgaria	54	83
Slovenia	60	86
Hungary	61	88
Czech Republic	53	82
Austria	55	85
Netherlands	60	86
Belgium	52	87
Chile	50	90
Argentina	48	80
Italy	50	78
Japan	47	73
Greece	47	81
Chinese Taipei	47	75
Turkey	53	82
Luxembourg	30	99
Switzerland	36	80
Slovak Republic	42	73
Israel	31	67
Brazil	47	69
Uruguay	40	71
Croatia	40	82
OECD average	**33**	**81**
Serbia	41	78
Romania	49	75
Korea	35	83
Hong Kong-China	37	76
Tunisia	42	78
United States	24	85
Portugal	32	83
Kyrgyzstan	39	72
Thailand	37	83
New Zealand	17	93
Lithuania	28	77
United Kingdom	20	79
Colombia	30	72
Montenegro	28	85
Mexico	40	67
Russian Federation	27	61
Australia	18	72
Macao-China	26	76
Ireland	17	84
Jordan	23	65
Estonia	21	75
Indonesia	43	59
Canada	19	57
Denmark	16	69
Latvia	19	66
Sweden	12	75
Spain	15	66
Poland	14	67
Iceland	9	69
Norway	11	59
Azerbaijan	50	31
Finland	6	60

Between-school variance in student performance in science as a percentage of the average between-school variance across OECD countries



Source: OECD PISA 2006 database, Table 5.21a.
StatLink http://dx.doi.org/10.1787/141887160188

School factors that are associated with performance only before taking demographic and socio-economic background into account

- School principals' reports regarding the level of funding from government (students in schools with an additional 10% of public funding score 2 points lower, all other things being equal).
- School principals' reports regarding whether there is one or more other schools in the area that compete for the students (students in schools competing with other schools score 6.0 points higher compared to students in schools not competing with other schools for students, all other things being equal).
- School principals' perceptions of the lack of qualified teachers hindering instruction (students in schools with one additional unit of this index score 3.5 points lower, all other things being equal);
- School principals' positive evaluations of the quality of educational materials at their school (students in schools with one additional unit of this index score 3.9 points better, all other things being equal);

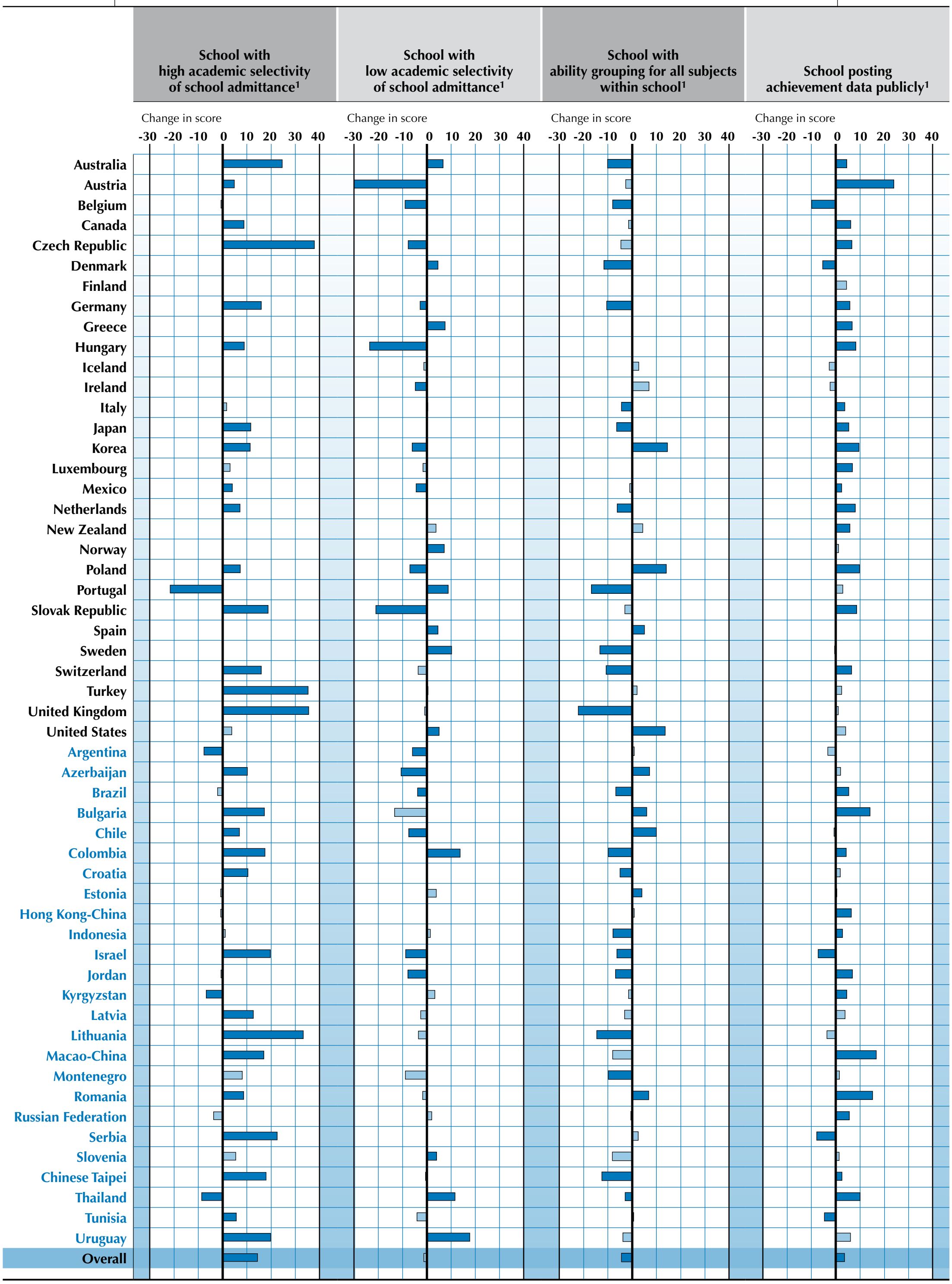
The school and system-level factors with statistically significant effects in both the gross and net models (Box 5.8 and Model 2G and Model 2N in Table 5.19g) present an interesting story about the association of school and system characteristics with science performance. Even after accounting for a host of salient student, school, and country background factors, some specific factors remain important predictors of student performance. These factors provide some clues to policy amenable practices that schools and countries are undertaking that could enhance performance beyond the standard set of educational resources.

The above analysis shows that, in terms of school resources, the schools that enhance their students' science performance are ones that manage resources in such a way as to increase in-school learning time, encourage students' self-study, and provide extra learning activities that promote science including science clubs, science fairs, science competitions, extracurricular science projects, and excursions and field trips. Although separately these additional resources are only modestly associated with enhanced student performance, taken together they point to a substantial impact (Box 5.8 and Table 5.19g).

The school factors in the net combined model were also examined country by country with a two-level model consisting of student and school levels. The net effects on science performance of school factors as well as the demographic and socio-economic background of students and schools are presented in Table 5.21b and Figure 5.20. The results show that the net effects of additional learning time in science, mathematics and language during regular school lessons are significantly positive in all countries except in Iceland and Sweden. The net effect varies from 2 to 17 score points, and one additional in-school learning hour per week is associated with an increase of over 10 score points in science performance in Greece, Turkey, Portugal, Hungary and the Czech Republic and in the partner countries/economies Tunisia, Argentina, Romania, Israel, the Russian Federation, Macao-China, Hong Kong-China, Montenegro, Chile, Latvia and Brazil. The net effect of additional learning time for self-study or homework is statistically significantly positive in 21 OECD countries and 11 partner countries/economies. The net effect is between 10 and 12 score points in Switzerland, Sweden, Japan, the United States and the partner economy Hong Kong-China, and between 15 to 20 score points in Belgium, Korea and the Netherlands and in the partner economy Chinese Taipei. The net effect is slightly negative but statistically significant in Greece, Austria and Turkey and in the partner country Tunisia. Schools with activities that promote students' learning in science tend to perform better, even after accounting for the demographic and socio-economic background of students and schools. The net effect associated with a one unit increase in this index is statistically significantly positive in 15 OECD countries and 12 partner countries/economies with the variation of the effect between 2 to 12 score points in science. The net effect is over 7 score points in science in Poland, Switzerland and Germany and in the partner countries/economies Macao-China, Bulgaria and Azerbaijan. The net effect is negative in the following three countries: Iceland (-6.5), Luxembourg (-6.3) and Finland (-4.5) (Figure 5.20 and Table 5.21b).

Figure 5.20 [Part 1/2]

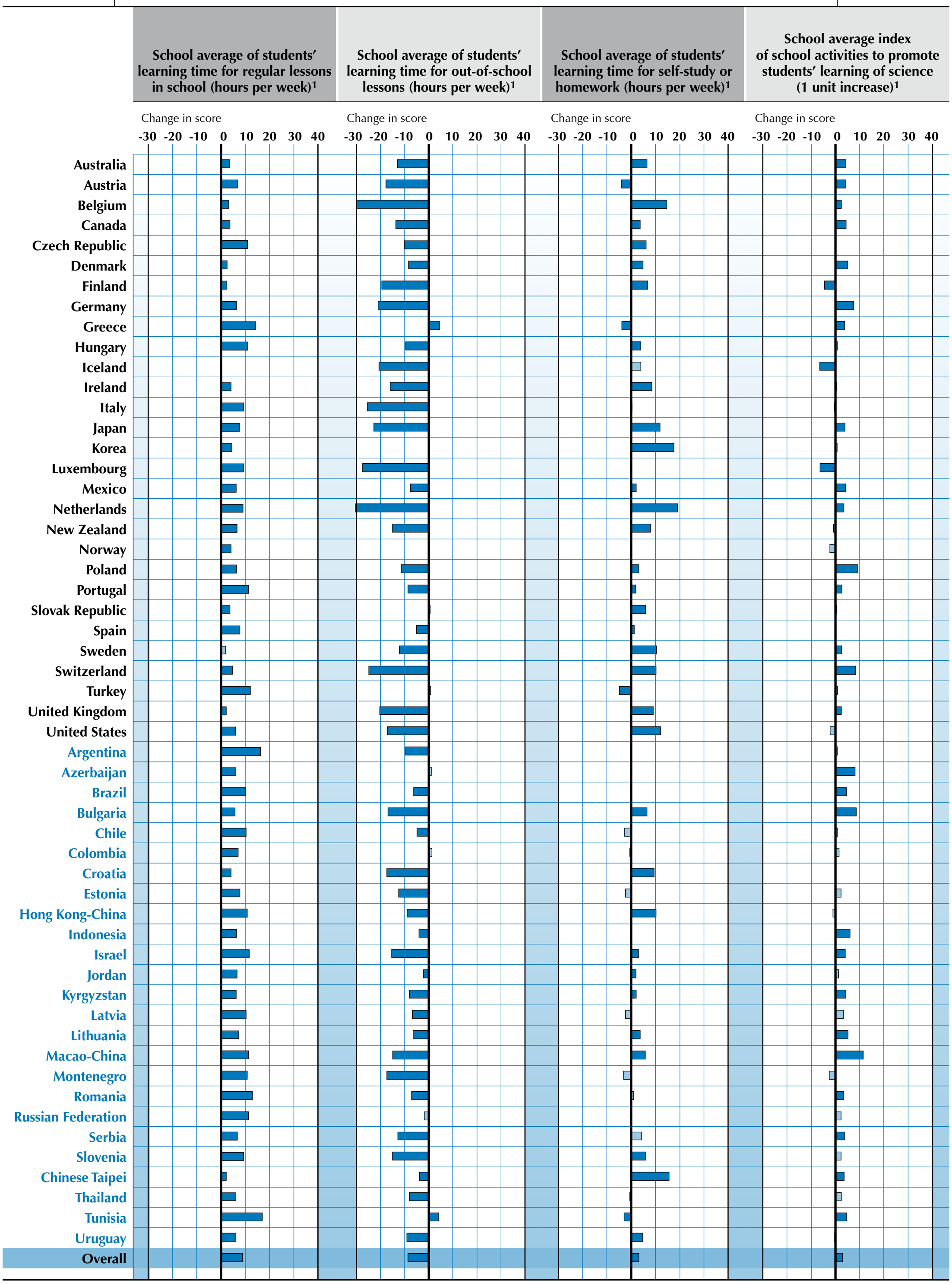
Net association of school factors with student performance in science



1. Statistically significant differences are marked in a darker tone.
Source: OECD PISA 2006 database, Table 5.19g and Table 5.21b.
StatLink http://dx.doi.org/10.1787/141887160188

Figure 5.20 [Part 2/2]

Net association of school factors with student performance in science



1. Statistically significant differences are marked in a darker tone.

Source: OECD PISA 2006 database, Table 5.19g and Table 5.21b.

StatLink http://dx.doi.org/10.1787/141887160188

The results of the model illustrated in Box 5.8 also shed light on other education policy issues. For example, when the 55 countries are examined jointly, schools that publicly communicate students' performance have a gross performance advantage of 5.3 score points and of 3.5 score points after accounting for socio-economic factors (Box 5.8 and Table 5.19g). This association can be observed in 17 OECD countries and 12 partner countries and economies: the net effect of schools is greatest in Austria at 23.9 score points, but is also between 8 to 17 score points in the Netherlands, Hungary, the Slovak Republic, Korea and Poland and in the partner countries/economies Thailand, Bulgaria, Romania and Macao-China (Figure 5.20 and Table 5.21b).

Students in schools that do not use ability grouping or use ability grouping only for some subjects but not for all subjects within the school score 7.6 points higher than students in other schools and the net effect is 4.5 score points when jointly examining the 55 countries (Box 5.8 and Table 5.19g). The net effect of practicing ability grouping for all subjects is negative in 11 OECD countries and 10 partner countries and economies, varying from -4 to -22 score points. The net effect is between -11 and -22 score points in Switzerland, Denmark, Sweden and Portugal and the Unitde Kingdom, and in the partner economy Chinese Taipei and the partner country Lithuania. However, in nine countries, there is a positive net effect, which ranges between 4 and 10 score points in Spain and in the partner countries Estonia, Bulgaria, Romania, Azerbaijan and Chile, and amounts to over 11 score points in Korea (14.5), Poland (14.1) and the United States (13.6) (Figure 5.20 and Table 5.21b).

Students in schools in which academic records or feeder school recommendations were a prerequisite for school admittance score 18.5 score points higher than students in other schools. This effect barely decreases when socio-economic contextual factors are accounted for. It is, however, important to note that if in one country highly selective schools are performing better than non-selective schools, it does not follow that if more schools became selective, overall results would improve.[29]

Students in systems with more schools having autonomy in formulating the school budget and deciding on budget allocations within school tend to perform better in science, even after accounting for the background factors (Box 5.8 and Table 5.19g).

In the gross combined model, students in schools with adequate science teachers and educational materials perform better than students in other schools. However, these effects are not statistically significant when socio-economic context factors are accounted for. This suggests that some school material resources and the background factors are strongly interrelated; for example in some countries students with more advantaged socio-economic backgrounds attend schools with better qualified science teachers and educational materials. Similarly, the performance difference between students in publicly and privately funded schools as well as the performance advantage for students in schools with competing other schools in the same area for students disappear after accounting for demographic and socio-economic background factors.

THE JOINT IMPACT OF SCHOOL AND SYSTEM RESOURCES, PRACTICES, AND POLICIES ON THE RELATIONSHIP BETWEEN SOCIO-ECONOMIC BACKGROUND AND STUDENT PERFORMANCE IN SCIENCE

As shown in Chapter 4, the extent to which the performance of students and schools depends on socio-economic factors varies considerably across schools and education systems. In some schools or educational systems, students' academic performances are strongly related to socio-economic background, while in others, learning outcomes depend much less on socio-economic background conditions.

This section examines the joint influence of the various school policies and practices that have been discussed in this chapter on the strength of the association between students' socio-economic background on science performance, with the objective to identify school and system-level factors that potentially enhance equity in the distribution of learning opportunities.

Because the number of school factors measured by PISA far exceeds the number of participating education systems, a two-step modelling process was applied. First, indicators from each of the six groups of factors considered in this chapter (policies of admitting, grouping and selecting students, the role of public and private stakeholders in the governance and financing of schools, parental school choice and performance pressure on schools, accountability arrangements, school autonomy, and school resources) are examined separately as to their impact on the relationship between students' socio-economic background and performance (see the second tables in Box 5.2 to 5.7 and Tables 5.20a-f). Afterwards, the individual factors from the different groups that had a statistically significant impact on the relationship between socio-economic background and student performance in these analyses are examined jointly (see Box 5.9 and Table 5.20g).[30]

Box 5.9 **Combined multilevel model for the impact of socio-economic background**

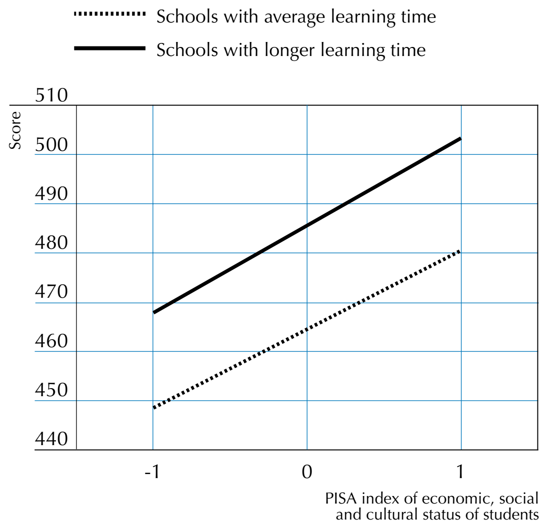
	Increase in score points in science corresponding to one unit increase of the student's PISA index of economic, social and cultural status		**Increase in score points in science corresponding to one unit increase of the school average of the PISA index of economic, social and cultural status**	
	Change in relationship	**p-value**	**Change in relationship**	**p-value**
System with early selection (each additional year between the first age of selection and the age of 15)	-1.9	(0.004)	8.9	(0.000)
School average students' learning time for regular lessons in school (one additional hour per week)	0.7	(0.000)		

Note: See Box 5.2 for general notes.
More detailed results are presented in Table 5.20g. The model is described in Annex A8.

There are two factors among those tested in the model that are closely related to equity in the distribution of learning opportunities even after accounting for other school and system-level factors. These are consistent with the results from the models examining institutional characteristics separately. These are the school average of student learning time for science, mathematics and language at school, and the age at which students are placed into distinct school types (Box 5.7 and Box 5.2). One additional hour per week of student learning time at school is equivalent to an increase in the within-school relationship between the students' socio-economic background and science performance by 0.7 score points for a one-unit increase in the student's PISA index of economic, social and cultural status. In education systems where students are placed into different types of schools or distinct educational programmes at an early stage in their educational career, the impact of student socio-economic background on performance within a school is slightly weakened, but the impact of socio-economic composition of the school that students attend on student performance is considerably strengthened beyond the impact of the students' own socio-economic background on science performance. For instance, each additional year spent in separate school types is associated with a decrease in the within-school relationship between the students' socio-economic background and science performance by 1.9 score points for a one-unit increase in the PISA index of economic, social and cultural status. On the other hand, when educational tracking is brought forward by one year, the impact of schools' socio-economic composition on student performance increases by 8.9 for a one-unit increase in the school average PISA index of economic, social and cultural status, beyond the impact of the individual students' socio-economic background. These results suggest that educational tracking tends to reinforce socio-economic segregation between schools.

Comparing students across countries according to the time they spend learning in class, it can been seen that no matter where students come from in terms of their socio-economic background, those in schools with longer average in-class learning time tend to perform better than students in schools with average in-class learning time (Figure 5.21). Therefore, even though the effect of socio-economic background on performance is stronger in schools with longer in-class learning, this does not suggest that learning time should be reduced for these students, as students from all socio-economic contexts benefit from being in schools with longer in-class learning.

Figure 5.21
Relationship between student's economic, social and cultural status and student performance in science, by learning time at school



Note: Across the 55 countries, the average regular lesson hours per week is 10.2 and the standard deviation is 2.4. "Schools with average learning time" corresponds to schools with 10.2 hours regular lessons per week. "Schools with longer learning time" corresponds to schools with 12.6 hours regular lessons per week (one standard deviation longer than the average).

Source: OECD PISA 2006 database, Table 5.20g.

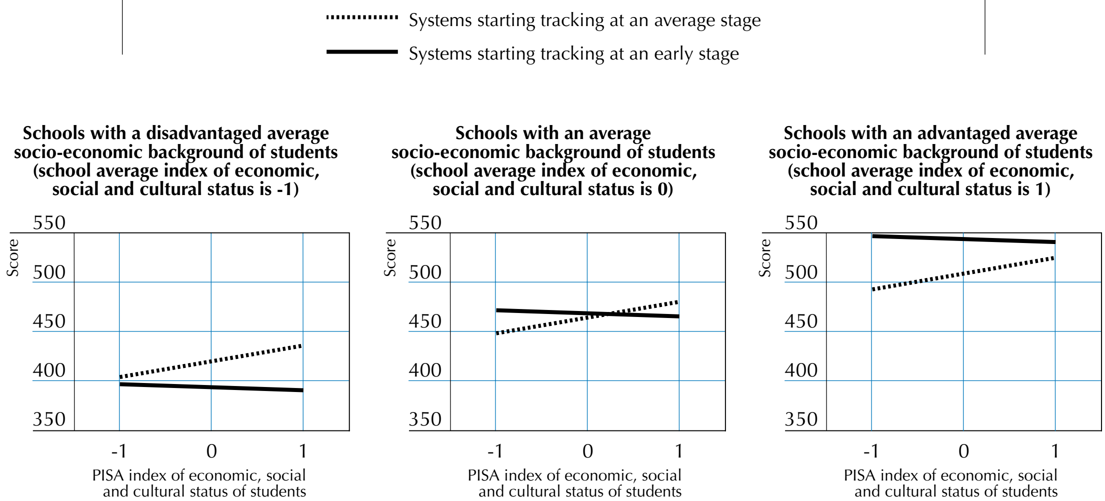
StatLink http://dx.doi.org/10.1787/141887160188

The same can be done by examining the impact of early tracking (Figure 5.22). The left panel in Figure 5.22 presents the relationships between the individual student's socio-economic background (on the horizontal axis) and student performance (on the vertical axis) for schools with a disadvantaged socio-economic intake; the middle panel represents schools with a socio-economic intake that is similar to the OECD average, and the right panel represents schools with an advantaged socio-economic intake.

On the surface, it seems that the relationship between the individual socio-economic background of students and performance is weaker in the institutionally stratified systems, as mirrored in the relatively flatter socio-economic gradients within schools. However, in the socio-economically disadvantaged schools, students tend to perform equally poorly in systems that are stratified at early stages in their education, whatever

Figure 5.22

Relationship between student economic, social and cultural status and student performance in science, by tracking system



Note: Across the 55 countries, the average years spent between the first age of selection in the education system and the age of 15 is 1.2 and the standard deviation is 1.6. "Systems starting tracking at an average stage" corresponds to systems starting tracking at the age of 13.8 (subtracting 1.2 years from the age of 15). "Systems starting tracking at an early stage" corresponds to systems starting tracking at the age of 12.2 (one standard deviation earlier than the average).

Source: OECD PISA 2006 database, Table 5.20g.

StatLink http://dx.doi.org/10.1787/141887160188

their individual socio-economic background (solid line in the left panel), while all students, whatever their individual socio-economic background, tend to show equally high performance in the socio-economically advantaged schools (solid line in the right panel). This gap between schools in the systems with early tracking is much larger than the gap in more comprehensive systems even though there is no difference in the overall level of performance between systems starting tracking early and comprehensive systems. Systems starting tracking early thus tend to be associated with larger socio-economic inequalities, while not showing to gains in average performance.

IMPLICATIONS FOR POLICY

This chapter has identified a range of school characteristics that have a bearing on learning outcomes, on differences in these outcomes across schools and on the extent to which differences are associated with the uneven distribution of students across schools according to their socio-economic background.

Such findings cannot provide precise policy prescriptions based on direct measurement of the effects of various policy measures on achievement. This is partly because of the methodological caveats listed in Box 5.1, and partly because a large-scale survey like PISA cannot look at the details of policy and practice within schools at a micro level.

Conversely, the findings can start to answer some types of questions that national surveys cannot address. These include questions about the overall effects of school system differences, questions about which of a broad range of school factors seem to have a consistent, measurable association with performance and questions about the extent to which these associations interact with socio-economic background.

PISA can thus help inform broad strategies in the pursuit of quality and equity within school systems, by showing which factors seem to be most closely connected with performance and to what extent socio-economic differences in results are linked to socio-economic differences in access to resources and to schools with positive features.

A number of groups of school characteristics show a relationship with performance. When each group is looked at separately, the effect tends to be modest, yet where it is statistically significant across thousands of schools in dozens of countries, it is worth examining further. At this level, the main sections of this chapter identify:

- *Differences in patterns of results according to how students are admitted to schools, grouped across schools and grouped within schools.* Most importantly, in school systems where students are divided into different school groups at relatively early ages, the socio-economic differences in results by age 15 are relatively large through school compositional effects, while the average level of performance is not higher compared to comprehensive education systems. This suggests that countries practising early tracking need to pay particular attention to the students grouped into schools with a disadvantaged socio-economic background and the extent to which this may increase differences in performance without leading to gains in overall level of performance. A smaller effect is the slightly lower overall performance of schools that group students by ability for all subjects internally, suggesting that such a policy might potentially hinder learning of certain students more than it enhances learning of others.
- *Higher performance in privately funded schools and in schools that compete for students, but no statistically significant effect in either case once the combined effect of individual student socio-economic background and the average socio-economic background of all students in the school are taken into account.* There is no statistically significant difference in the impact of student's socio-economic difference on performance between public and private schools, nor between schools competing with other schools and schools not competing. That said, while the performance of private schools does not tend to be superior once demographic and socio-economic factors have been accounted for, in many countries they may still pose an attractive alternative for parents looking to maximise the benefits for their children, including those benefits that are conferred on students through the socio-economic level of schools' intake.
- *Higher performance in schools that keep track of student performance at a public level.* The public posting of results by schools continues to have an effect on performance even after all other school and demographic and socio-economic factors that were measured have been accounted for. The strength of these effects across so many countries suggests that the impetus provided by external monitoring of standards, rather than relying principally on schools and individual teachers to uphold them, can make a real difference to results. PISA itself has encouraged countries not to take internally assessed education standards for granted, and is now indicating a strong effect within countries of the discipline provided by subjecting schools to external assessment with publicly visible results.
- *Higher performance in countries giving more autonomy to schools to formulate the school budget and to decide on budget allocations within the school even after accounting for other school and system level factors as well as demographic and socio-economic factors.* Similarly, students in educational systems that give more autonomy to schools in educational matters such as text books and courses offered, tend to perform better, but this effect is not significant after accounting for some other school and system level factors. These results suggest that greater autonomy has a general impact within school systems, perhaps deriving from the greater independence of school managers in systems that authorise choice of responses to local conditions.

- *A modest relationship between certain aspects of school resources and student outcomes.* However, much of this relationship disappears when one accounts for the socio-economic status of students, suggesting that the resources themselves may not be causing the better results since in many cases schools with better material and human resources also have students from relatively favourable socio-economic backgrounds. Of the resource factors that remain statistically significant net of socio-economic status, the most noticeable is learning time in class. Students who spend more time in class tend to do somewhat better. Schools providing activities enhancing students' science learning perform better.

A larger question is whether specific policy interventions responding to these effects are likely to be overshadowed by the high number of other influences on student performance, whether in terms of the multiple aspects of the school learning environment and organisation not covered by any given policy or in terms of contextual influences including the socio-economic background of the students attending each school. The later section of the above analysis addresses this issue by looking at the combined influence of selected school factors each of which appears to have an impact beyond its association with students' socio-economic background and with other school factors. These factors are:

- Student learning time, most importantly in school classes, but also out of school classes and private study
- Activities to promote science learning in schools
- Public posting of achievement data
- Ability grouping for all subjects within schools (which appears to have a small negative effect)
- The degree to which a school selects its students
- The system providing schools with more autonomy in budgeting

An overall measure of the combined effect of these six factors suggests that about one-quarter of variation in students' science performance can be associated with the ways in which these factors vary across countries and across schools, once the variation explained by demographic and socio-economic differences has been taken into account. However, most of this effect is not attributable to the school factors acting wholly independently of demographic and socio-economic factors, but rather a combined effect of the two. For example, schools that have longer learning hours also tend to enrol more socio-economically advantaged students, and while the higher predicted performance of such students can only partially account for the superior performance of such schools, the effects of longer hours and higher intake appear to reinforce each other. At a policy level, this suggests that the potential for improving results through such school factors needs to be considered in combination with the extent to which schools with favourable characteristics are being accessed mainly by more advantaged students. The challenge is to find ways of spreading such characteristics to a wider section of the student population.

In this context, a crucial question for school systems is whether there are policies that can systematically improve equity without threatening quality. In terms of the distribution of finite resources, this is not straightforward, since it is difficult to calculate whether lowering resources for socio-economically advantaged students and schools might harm students' performance more than improving resources for socio-economically disadvantaged students and schools would improve results. Even if this were not to lower the average score, it is possible that it would reduce the number of high-performing students, which in itself is undesirable. However, what is noticeable about the strongest effects measured in this chapter is that they are not the ones most closely associated with finite material resources, such as the distribution of good teachers. Rather, such effects are related to how schools and the school system are run – for example, the amount of time that students spend in class and the extent to which schools are accountable for their results. Delivering such advantages to one student is not obviously at the expense of another.

A more complex issue relates to the effects of selection and differentiation. It is clearly not possible for every school to raise its students' performance by becoming more selective about its intake. However, one clear-cut finding from PISA is that differentiation at an early age damages equity without any discernible benefit for quality. That is to say, in systems that separate children early in secondary school, their results by the age of 15 differ more than average according to socio-economic background, with no systematic benefit in terms of the average performance. A number of countries with early differentiation of students by institution have already delayed or reduced the degree of separation in recent years. This evidence suggests that others should consider doing so.

Notes

1. In the countries with multiple school systems, the results presented in this chapter relate to the overall picture, not necessarily to the features of individual school systems.

2. For instance, in some countries some of the schools in the PISA sample were defined as administrative units even if they spanned several geographically separate institutions, as in Italy; in some they were defined as those parts of larger educational institutions that serve 15-year-olds; in others they were defined as physical school buildings; and in yet others they were defined from a management perspective (*e.g.* entities having a principal). The *PISA 2006 Technical Report* (OECD, forthcoming) provides an overview of how schools were defined.

3. The proportion of explained variation is obtained by squaring the correlation shown in Figure 5.2.

4. Before 1999, the school system provided three tracks following eight years of primary education, an academic secondary track, an academic track with a practical orientation, and a vocational track oriented towards direct entry into the labour market. The system introduced in 1999 provided six years of primary education followed by three years of subject-oriented general lower secondary education, followed by a tracked system of upper secondary education.

5. The term “grouping” often refers to an instructional strategy that can be used effectively in any class, irrespective of the existence of tracking or streaming. Students can be grouped according to interests, capabilities on particular tasks, group or collective projects, and so on. However, in the context of PISA, “ability grouping” refers to tracking or streaming, which means students being assigned to classes with different levels of academic challenge or content according to their perceived or measured abilities. School principals were asked to report on whether students were grouped by ability into different classes as well if students were grouped by ability within their classes. Therefore, the ability grouping analysed in this section does not include grouping on the basis of different curricula.

6. These opposite effects of ability grouping may be partly due to different forms of grouping. For example, high performing students are grouped in some schools or countries, while low-performing students are grouped in others.

7. At the student level, the following variables were taken into account: the parental occupation and education, as well as students’ access to home educational and cultural resources, as expressed in the PISA index of economic, social and cultural status, gender, the country of birth of the student and his or her parents, as well as the language spoken at home. At the school level, the socio-economic intake of the school, as measured by the school-level aggregate of the economic, social and cultural status of the 15-year-olds attending this school, the school location and the school size were taken into account. At the country level, the national occupational profile and the country average of students’ family and home background as measured by the country average PISA index of economic, social and cultural status were taken into account. Separate models were also estimated with GDP per capita instead of the country average PISA index of economic, social and cultural status in order examine the robustness of the index. Both models led to very similar results.

8. France and Qatar were not included in this analysis. France did not provide data from school principals. Qatar had a large number of missing observations in the factors used to construct the index of economic, social and cultural status.

9. Results of the model including the proportion of highly selective schools in the country show that this variable does not have a statistically significant association with student performance (the change in score is 2.6 and the p-value is 0.918).

10. The gradient between the PISA index of economic, social and cultural status and student performance in science is used as a measure of equity. All of the models for the impact of socio-economic background in this chapter also control for other background factors such as students’ gender, migration status, and language spoken at home as well as school location, school size, school average socio-economic background and the country wealth indicator.

11. In accordance with OECD standards, public schools are defined as educational instructional institutions that are accounted for and managed directly by a public education authority or agency; or controlled and managed either by a government agency directly or by a governing body (council, committee, etc.), most of whose members were either appointed by a public authority or elected by public franchise. Private schools are defined as educational instructional institutions that are accounted for and managed by a non-governmental organisation (*e.g.* a church, a trade union or a business enterprise) or if their governing board consisted mostly of members not selected by a public agency.

12. For the comparisons in this section, government-dependent and government-independent private schools were combined as otherwise the number of schools would have been too small to allow for reliable comparisons. Moreover, only countries with at least 3% of students enrolled in private schools were included in these comparisons.

13. It is important to note that over 96% of 15-year-olds are in private schools in Macao-China.

14. The score point difference between public and private schools in Table 5.4 is the result of a comparison of these two different school types within each country, while the effect of private management in this multilevel model is the effect after controlling for the funding source (public/private). This explains why the average of the score point difference between public and private schools in Table 5.4 is larger than the effect of public management found in the multilevel model.

15. An examination at the level of the education system shows that countries with a higher proportion of privately managed schools tend to perform slightly better, even after controlling for demographic and socio-economic factors. In other words, students in education systems with a higher proportion of privately managed schools tend to perform better, regardless of whether the schools that they attend are privately managed or not.

16. These countries were Denmark, Germany, Iceland, Italy, Korea, Luxembourg, New Zealand, Poland, Portugal and Turkey, and the partner countries/economies Bulgaria, Colombia, Croatia, Hong Kong-China, Macao-China and Qatar. In examining the results from the PISA parent questionnaire, it should be noted that in some countries non-response was considerable. Countries with considerable missing data in the parent questionnaire are listed in the following together with the proportion of missing data in brackets: Portugal (11%), Italy (14%), Germany (20%), Luxembourg (24%), New Zealand (32%), Iceland (36%) and Qatar (40%).

17. Across the 55 countries, on average, students are in education systems where 75% of schools are competitive.

18. Standards-based external examinations are defined according to John Bishop's definition of "curriculum-based external examination system" (CBEES). CBEES has the following characteristics: it produces signals of student accomplishments that have real consequences for the student and it defines achievement relative to an external standard, not relative to other students in the classroom or the school. To enable fair comparisons of achievement across schools and across students at different schools, it is organised by discipline and keyed to the content of specific course sequences, which focuses the responsibility for preparing the student for particular exams on one or a small group of teachers; it signals multiple levels of achievement in the subject and not only a pass-fail signal, and it covers almost all secondary school students (Bishop 1998, 2001).

19. Data were collected through the OECD's Programme on Indicators of Education Systems (INES). In partner countries/ economies, the National Project Managers for PISA were asked to complete a questionnaire. For the partner countries, decimals given represent the proportion of academic and vocation programmes, when a standards-based external examination exits only in some programmes.

20. It is statistically significant at the 12% level.

21. It is important to note that schools' decisions in determining course content and course offerings could be affected by the existence of external standards-based examinations, even if schools have a considerable responsibility in this area.

22. This covers responses to both the category "only school has a considerable responsibility" and the category "both school and government have a considerable responsibility" in the corresponding question to school principals.

23. The relative influence of the seven stakeholder groups was determined by averaging the percentage of 15-year-olds whose school principals reported that the stakeholder group in question has a direct influence across the four decision-making areas of staffing, budgeting, instructional content and assessment practices.

24. The index of school autonomy in staffing consists of the following components: school's relative responsibility in selecting teachers for hire (0.811), dismissing teachers (0.833), establishing teachers' starting salaries (0.797), and determining teachers' salary increases (0.791). The index of school autonomy in budgeting consists of the following components: school relative responsibility in formulating the school budget (0.827) and deciding on budget allocations within the school (0.827). The index of school autonomy in educational content consists of three components: school's relative responsibility in choosing which textbooks are used (0.794), determining course content (0.837), and deciding which course are offered (0.824). The figures in brackets are the respective factor loadings. The school's relative responsibility is computed by assigning the value 1 when only schools ("principals or teachers" and/or "school governing board") have a considerable responsibility and governments

("regional or local education authority" and/or "national education authority") have no responsibility; assigning the value 0 when both schools and governments have considerable responsibilities; and assigning the value -1 when only governments have considerable responsibilities.

25. The variable "learning time at out-of-school lessons" is not included in the discussion here even though it is included in the model. The reason for this is that this factor cannot be regarded as a school resource, and it was included in the model as a control variable in order to interpret the in-school and homework learning time in a comprehensive framework of total learning time. In the model, out-of-school lessons, such as tutoring and other shadow education, have a negative association with performance. This may be because students with poor performance in science seek remediation through learning outside of school resources (Baker *et al.,* 2001).

26. The criteria for inclusion of factors was a p-value below 10% for system-level factors, and a p-value below 0.5% for school level factors, in order to balance the Type I and Type II statistical errors at the two levels, taking into account the fact that data from around 14,000 schools enter the analysis at school level, whereas 55 observations are processed at the system-level.

27. Since the gross models and the net models were built up independently, the final gross combined model and the final net combined model include different sets of school and system-level factors.

28. This figure is different from the explained variance in Model 2N (69%) as the former is based on the two-level model consisting of the student and school levels, while the latter is based on the three-level model including the system level in addition to the student and school levels.

29. See note 9.

30. See note 26.

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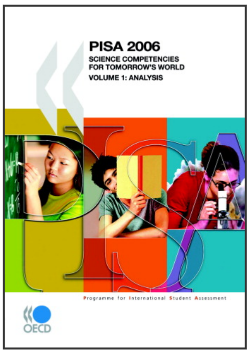

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