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Overview: Policies and practices for successful schools

A note regarding Israel

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

Most 15-year-olds learn about scientific principles and theories at school. As with any other subject, the way science is taught in school can influence not just whether students do well in science, but whether students become interested enough in the subject to want to pursue it later on, in further education or in a career.

Australia, Canada, Ireland, Portugal, Singapore, Slovenia and the United Kingdom are high performers in science. Their 15-year-old students hold strong beliefs about the value of scientific enquiry, and larger-than-average proportions of students in these countries expect to work in a science-related occupation later on.

What are the policies, or combinations of policies, that are common to these school systems? All of these countries score near or above the OECD average on most of the indices concerning resources devoted to education and teaching practices, including quality and quantity of teaching staff, learning time, approaches to teaching science and extracurricular activities (Figure II.2.3). PISA results also show the different combinations of resources and practices that are associated with these countries' success.

Some 6% of 15-year-old students across OECD countries reported that they are not required to attend a science class.

If time is a necessary condition for learning, students who do not attend science lessons are probably those who enjoy the fewest opportunities to acquire competencies in science. PISA 2015 asked students how many regular science lessons they were required to attend per week. On average across OECD countries, 94% of students reported that they attend at least one science course per week. But that means that at least one million 15-year-old students are not required to attend any science lesson (Table II.2.3).

Why does this matter? Across OECD countries, students who are not required to attend science lessons score 25 points lower in science than students who are required to attend at least one science lesson per week, after accounting for the socio-economic profile of students and schools (Figure II.2.4). Even if their poor performance in science is one of the reasons why these students do not take science courses in the first place, these findings indicate the extent to which student performance in science may suffer when students do not attend science classes. The requirement to attend at least one science course is more common in socio-economically advantaged schools than in disadvantaged schools (Figure II.1.1).

On average across OECD countries, students in schools that offer science competitions score 36 score points higher in science and are 55% more likely to expect to work in a science-related occupation than students in schools that do not offer such activities; those in schools offering a science club score 21 score points higher and are 30% more likely to expect to pursue a career in science.

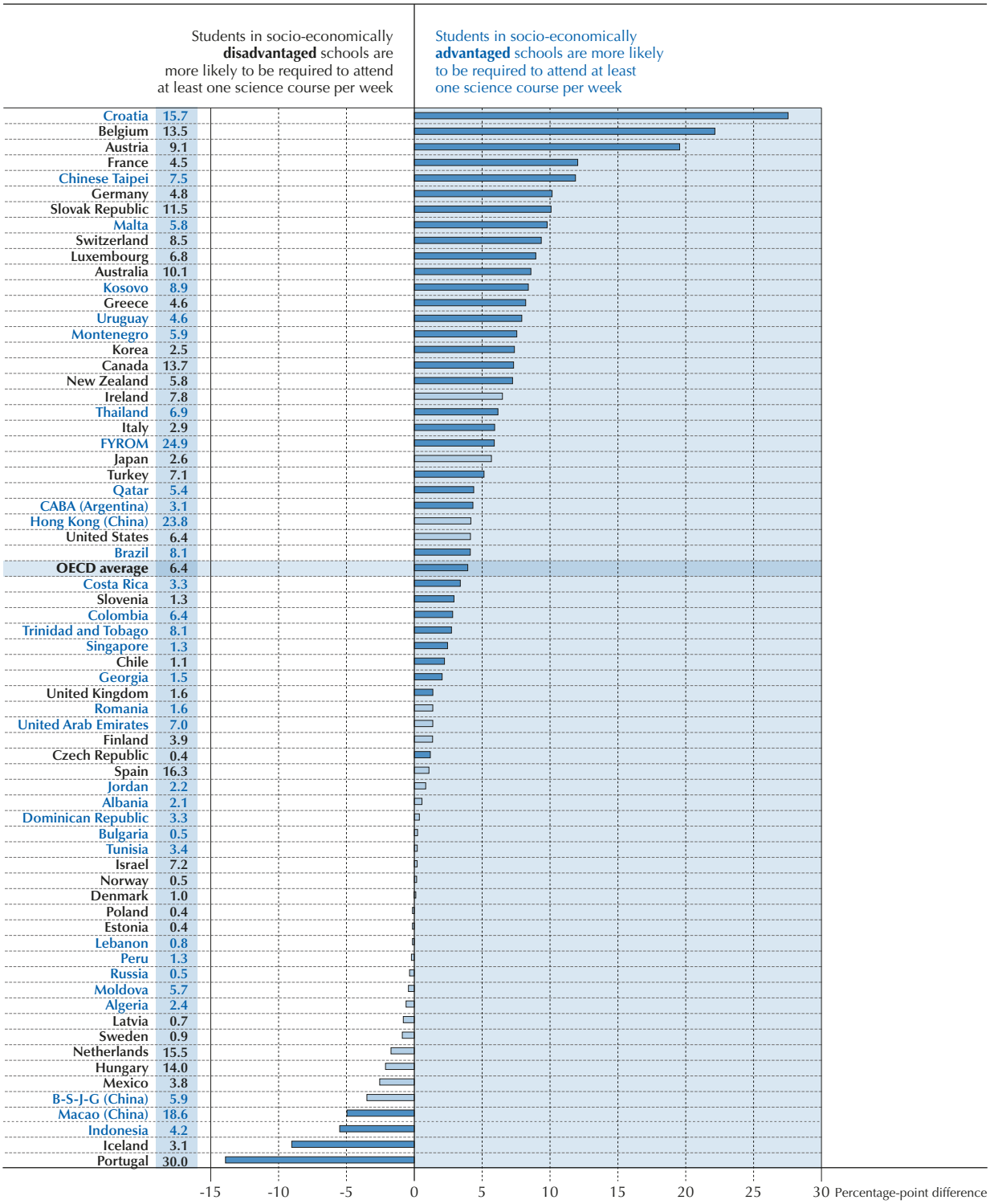
Students in schools whose principals reported a well-equipped and well-staffed science department generally perform better in science – by about three score points for every positive statement concerning the school's science department, on average across OECD countries – after accounting for the socio-economic profile of students and schools (Table II.2.6). In 24 education systems, students in schools whose principal reported that the science department enjoys more resources were more likely to report that they expect to work in a science-related occupation in the future.

Laboratories and experiments are not the only ways through which schools can engage students in learning science. Extracurricular activities, such as science clubs and competitions, can help students understand scientific concepts, raise interest in science and even nurture future scientists. PISA 2015 asked principals if their school offers a science club or science competitions at the school. Across OECD countries, 39% of students are enrolled in schools that offer a science club and 66% attend schools that offer science competitions (Figure II.2.9).

In 42 of 70 PISA-participating countries and economies, students in advantaged schools are more likely to be offered science competitions than students in disadvantaged schools (Table II.2.13). The largest differences are observed mainly in education systems with early tracking, including Austria, Germany, the Netherlands and Switzerland. Disadvantaged students may thus have fewer opportunities to acquire scientific competencies; and this is reflected in their performance.

Figure II.1.1 ■ **Differences in the requirement to attend regular science lessons, by schools' socio-economic profile**

Results based on students' reports



Notes: Statistically significant differences are marked in a darker tone (see Annex A3).

The percentage of students who are not required to attend any science course is shown next to the country/economy name.

Countries and economies are ranked in descending order of the percentage-point difference between students in socio-economically advantaged and disadvantaged schools who are required to attend at least one science course per week.

Source: OECD, PISA 2015 Database, Table II.2.3.

StatLink http://dx.doi.org/10.1787/888933435485

PISA results show that, in most education systems, the percentage of qualified science teachers is not related to students' science scores. But the way science is taught is related to students' performance in science, their expectations of working in a science-related occupation, and their beliefs about the value of scientific enquiry.

Across OECD countries, 84% of science teachers are fully certified and 74% have a university degree with a major in science (Table II.2.8). The percentage of science teachers with a university degree and a major in science ranges from more than 95% of teachers in Bulgaria, Costa Rica and Montenegro, to less than 25% in Italy, Peru and Uruguay.

But it is the way science is taught, rather than the qualifications of the teacher, that appears to have a stronger association with student performance, students' beliefs about science and their expectations of pursuing a science-related career. Even if there is no single "best" way of teaching, students need teachers who are challenging and innovative in the way they combine different instructional practices, and who can reach all types of learners by adapting the lessons to students' needs and knowledge.

PISA results show that when teachers frequently explain and demonstrate scientific ideas, and discuss students' questions (known, collectively, as teacher-directed instruction), students score higher in science (except in Indonesia, Korea and Peru), they have stronger beliefs in the value of scientific enquiry (what are known as epistemic beliefs) and are more likely to expect to work in a science-related occupation later on. Adapting instruction to students' needs, such as by providing individual help to struggling students or changing the structure of a lesson on a topic that most students find difficult to understand, is also related to higher scores in science and stronger epistemic beliefs.

Perhaps surprisingly, in no education system do students who reported that they are frequently exposed to enquiry-based instruction (when they are encouraged to experiment and engage in hands-on activities) score higher in science. After accounting for students' and schools' socio-economic profile, in 56 countries and economies, greater exposure to enquiry-based instruction is associated with lower scores in science. However, across OECD countries, more frequent enquiry-based teaching is positively related to students holding stronger epistemic beliefs and being more likely to expect to work in a science-related occupation when they are 30 (Tables II.2.16, II.2.22, II.2.26).

High performance in science is most strongly related to the time students devote to learning science and how their teachers teach science.

PISA results show that the quality of the material and human resources of a science department, and the kinds of science activities offered to students have a weaker impact on student performance than how much time students devote to learning science and the methods their teachers use to teach the subject. Students perform better in science than in the other subjects that PISA assesses (reading and mathematics) when they spend more time learning science than learning the other two subjects (both in regular lessons and after school), and particularly when their teachers frequently explain and demonstrate scientific ideas, support students in their learning and expose them to more enquiry-based instruction. These two factors – time invested and teaching methods used – are also more strongly related to students' expectations to pursue a science-related career than the quality of the material and human resources available to a school's science department.

Pervasive truancy in a school seems to affect even students who may not be truants themselves.

The environment at school influences students' engagement and performance, and teachers' desire to continue working in the school. Student truancy has a discernible effect on the learning environment and, ultimately, on student performance and engagement.

On average across OECD countries, 26% of students said they had skipped classes at least once and 20% reported that they had skipped a whole day of school at least once in the two weeks prior to the PISA test. In PISA-participating countries and economies, skipping a whole day of school is more common in disadvantaged schools than in advantages schools (Figure II.3.3). This is observed in 44 countries and economies, compared to only 4 education systems where students in advantaged schools are more likely to have skipped a day of school.

Missing opportunities to learn because of truancy matters: in all countries and economies except Turkey and the United Arab Emirates, students who had skipped a whole day of school are more likely to score lower in science, and a large part of that relationship remains even after accounting for socio-economic status. On average across OECD countries, students who had skipped a whole day of school at least once in the two weeks prior to the PISA assessment score 45 points lower in the science assessment than students who had not skipped a day of school (33 points lower after accounting for the socio-economic profile of students and schools) (Table II.3.4).

The percentage of students who reported that they had skipped a day of school in the two weeks prior to the PISA test increased between 2012 and 2015 by at least 25 percentage points in Brazil, Colombia, Finland, Montenegro, Peru, the Slovak Republic and Uruguay, and decreased the most in Australia, Canada, Spain, Turkey and the United Arab Emirates (Figure II.1.2).

And student truancy has broader ramifications. In all countries and economies, there are some schools with higher concentrations of students who have skipped a school day than found in other schools. In 40 PISA-participating education systems, students score lower in science when more of their peers had skipped a day of school in the two weeks prior to the PISA test, after accounting for the socio-economic status; nowhere do students perform better in those circumstances (Figure II.3.5). And on average across OECD countries, students reported a better disciplinary climate in school when more of their peers attend school regularly (Figure II.3.6).

According to students' reports, teachers in disadvantaged schools support students in their learning more frequently than teachers in advantaged schools.

Disadvantaged students are in greater need of teacher support. Across OECD countries, support from teachers is not associated with student performance in science before accounting for the socio-economic status of students and schools; but after accounting for socio-economic status, the association becomes positive, on average across OECD countries and in 27 countries and economies (Figure II.3.12). These results indicate that teachers not only respond to struggling students, but that their support may improve student performance.

Similarly, based on responses to the parents' and principals' questionnaires, parents participate more where they are needed more – such as in schools where student problems, such as poor discipline, truancy or disengagement, cannot be solved without them – and school principals school leaders may (need to) show more active leadership when the learning environment deteriorates and student problems arise.

Responsibilities for school governance are shared, to different degrees, among teachers, principals, school boards, local/regional education authorities and national authorities.

On average across OECD countries, 39% of the responsibility for school resources lies with principals, 3% with teachers, 12% with school boards, 23% with local or regional authorities, and the remaining 23% with national authorities (Figure II.4.3). For the curriculum, 22% of the responsibility lies with principals, 44% with teachers, 8% with school boards, and the remaining 27% shared between local, regional and national authorities (Figure II.4.4). And responsibility for student assessment policies lies mainly with school principals (32%) and teachers (36%), with a minor role played by the other actors (Figure II.4.5).

Between 2009 and 2015, principals in Lithuania gained considerable responsibility for most tasks, particularly for teachers' salaries and the school budget. These responsibilities appear to have been transferred mainly from national education authorities. In Finland, school principals exercised greater autonomy over selecting and firing teachers in 2015 than in 2009, but had less responsibility for the curriculum and for assessment and disciplinary policies. By contrast, school principals in Qatar indicated that national education authorities assumed considerably more responsibility for all tasks between 2009 and 2015. In Turkey, national education authorities gained responsibility for all tasks except those related to school resources and textbooks; and in Slovenia, national education authorities gained greater responsibility for selecting and firing teachers, for the curriculum, and for disciplinary and admissions policies.

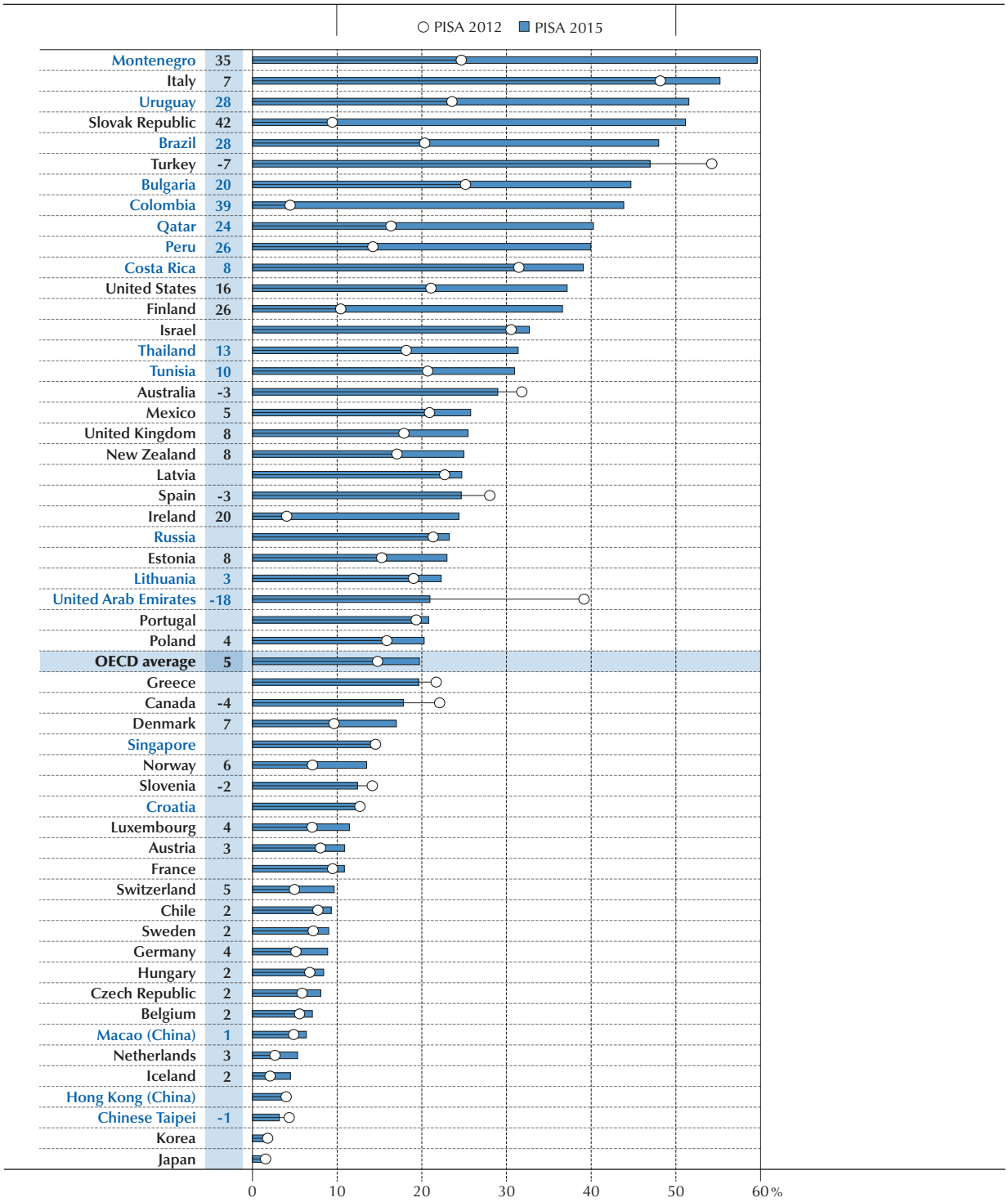
In education systems where school principals hold greater responsibility for school governance, students score higher in science; and this relationship is stronger across school systems where the percentage of students whose achievement data are tracked over time and posted publicly is higher than the OECD average.

According to school principals, schools in the Czech Republic, Lithuania, Macao (China), the Netherlands and the United Kingdom enjoy the greatest autonomy while those in Greece, Jordan, Tunisia and Turkey are granted the least autonomy. On average across OECD countries and in 32 education systems, socio-economically advantaged schools enjoy greater autonomy than disadvantaged schools; and, on average across OECD countries and in 15 other education systems, urban schools are granted more autonomy than rural schools. Not surprisingly, in almost all education systems, private schools exercise greater autonomy than public schools.

In 29 education systems and on average across OECD countries, students in schools whose principal reported that more responsibility for school management lies with schools score higher in science (Figure II.4.7). But after accounting for the socio-economic profile of students and schools, there is no association between school autonomy and student performance in science, on average across OECD countries.

Figure II.1.2 ■ **Change between 2012 and 2015 in student truancy**

Percentage of students who reported having skipped a day of school at least once in the two weeks prior to the PISA test



Notes: Only countries/economies that participated in both 2012 and 2015 PISA assessments are shown.

Only percentage-point differences between PISA 2012 and PISA 2015 that are statistically significant are shown next to the country/economy name (see Annex A3).

Countries and economies are ranked in descending order of the percentage of students who had skipped a whole day of school at least once in the two weeks prior to the PISA test, in 2015.

Source: OECD, PISA 2015 Database, Tables II.3.1, II.3.2 and II.3.3.

StatLink http://dx.doi.org/10.1787/888933435655

At the level of the school system, science scores and equity in science performance are unrelated to the percentage of students who are enrolled in public schools (Figure II.4.15), and there is no association between equity in science performance and attendance at either government-dependent or government-independent private schools.

About 84% of 15-year-old students attend public schools, on average across OECD countries, about 12% attend government-dependent private schools, and slightly more than 4% attend government-independent private schools (Table II.4.7). Across OECD countries, of the 12% of students who are enrolled in private government-dependent schools, around 38% of them attend schools run by a church or other religious organisation, 54% attend schools run by another non-profit organisation, and 8% attend schools run by a for-profit organisation. Across the education systems that participated in PISA 2015, socio-economically disadvantaged schools and rural schools are more likely to be public (Figure II.4.14). In fact, only in Montenegro and Chinese Taipei are advantaged schools more likely than disadvantaged schools to be public, and only in Slovenia are urban schools more likely to be public than rural schools.

On average across OECD countries and in 32 education systems, students enrolled in public schools score lower in science than students in private schools do (Figure II.4.14). But as has been noted in previous PISA reports, this is no longer the case after accounting for socio-economic status. In 22 education systems and across OECD countries, students in public schools score higher than students in private schools, after students' and schools' socio-economic profile is taken into account. This is because students in public schools are considerably more disadvantaged than students in private schools. In Italy, Japan, Singapore, Chinese Taipei, Thailand, Tunisia, Turkey and Viet Nam, students in public schools score more than 40 points higher in science than students in private schools, after accounting for the socio-economic status of students and schools (Table II.4.10).

Student assessments and teacher appraisals are more widely used than commonly believed.

Standardised tests are used extensively across PISA-participating countries and economies. In about five out of six school systems, more than one in two students are assessed at least once a year with mandatory standardised tests (Figure II.4.21), and in about three out of four countries, more than one in two students are assessed at least once a year with non-mandatory standardised tests (Table II.4.21).

On average across OECD countries, 81% of students attend schools whose principals reported that tests or assessments of student achievement and principal or senior staff observations of lessons were used to monitor the practice of teachers (Figure II.4.31). But the practice of monitoring teachers is far from universal. Based on principals' reports, all schools in Macao (China) use teacher peer reviews, but in Finland, Iceland and Spain, fewer than one in three students attends such schools. In 49 education systems, at least nine out of ten students attend schools whose principal or senior staff observe lessons, but in Greece, Italy and Spain, fewer than one in three students attends such schools.

Grade repetition is more prevalent in school systems where students score lower on the PISA science assessment and where students' socio-economic status is most strongly associated with science performance; but fewer students in 2015 than in 2009 reported that they had repeated a grade.

Not all 15-year-olds are enrolled in the same grade in school. Students might have been kept back to repeat course content that they had not fully mastered; or they might have been invited to skip a grade when their teachers felt they were capable of taking on more challenging schoolwork. Japan and Norway have established policies whereby students in compulsory schooling are promoted automatically to the next grade at the end of each school year, a practice known as "social promotion". In these two countries, grade repetition rates have traditionally been negligible. The incidence of grade repetition is also minimal in Iceland and Chinese Taipei (Table II.5.9). But in 13 countries and economies, at least 30% of students had repeated a grade at least once in primary or secondary education. For example, in Algeria, 69% of 15-year-old students had repeated a grade at least once, and in Colombia, 43% of students had done so. In Brazil, 36% of students had repeated a grade; in Uruguay 35% of students had done so; in Belgium, the Dominican Republic, Macao (China) and Tunisia, 34% of students had repeated a grade; in Trinidad and Tobago, 33% of students had done so; and in Costa Rica, Luxembourg, Portugal and Spain, 31% of students had repeated a grade.

Results from PISA show that grade repetition is about the same in primary and in secondary education, regardless of whether the country's/economy's repetition rate is high or low. On average across OECD countries, 7% of 15-year old students had repeated a grade in primary school, 6% had repeated a grade in lower secondary school and 2% had repeated a grade in upper secondary school at least once. At any of the three levels, those students who had repeated a grade were usually retained for one grade only; multiple repetition (i.e. more than once) affected less than 1% of students (Table II.5.9).

Many people would agree that performance, behaviour and motivation are legitimate reasons for deciding which students repeat a grade; and the data clearly show these associations. What is more troubling is that, even after accounting for students' academic performance, behaviour and motivation, in many education systems, a student with certain characteristics is more likely to have repeated a grade than other students. For instance, across OECD countries, boys are more likely than girls, socio-economically disadvantaged students are more likely than advantaged students, and students with an immigrant background are more likely than students with no immigrant background to have repeated a grade. In some countries, like Austria, Colombia, Korea, New Zealand and Thailand, advantaged and disadvantaged students are equally likely to have repeated a grade, after accounting for their academic performance, behaviour and motivation (Figure II.5.7). However, in others, including Bulgaria, Canada, the Czech Republic, Poland, Portugal, the Russian Federation (hereafter "Russia"), the Slovak Republic, Spain and Uruguay, disadvantaged students are more likely to have repeated a grade than advantaged students.

One promising finding is that, across OECD countries, the percentage of students who reported that they had repeated a grade at least once decreased by almost 3 percentage points between 2009 and 2015 (Figure II.1.3). The percentage of students who had repeated a grade in either primary, lower secondary or upper secondary school dropped significantly and by a margin of 10 percentage points or more in Costa Rica, France, Indonesia, Latvia, Macao (China), Malta, Mexico and Tunisia. By contrast, in Austria, Colombia, Qatar, Romania and Trinidad and Tobago, the percentage of students who reported that they had repeated a grade was higher in 2015 than it was in 2009.

Selecting students into different programmes or schools, especially when students are young, is strongly associated with less academic inclusion across schools and less equity in science performance.

On average across OECD countries, school systems begin selecting students for different programmes at the age of 14. Some OECD countries, including Austria and Germany, start selecting students as early as age 10; but the most common age at selection is 16. Among partner countries and economies with available data, the most common practice, observed in 19 countries, is to start selection into different programmes at the age of 15. A few countries select students earlier: Argentina, Croatia and Romania begin selecting students for different programmes at age 14, Bulgaria begins at age 13, and Singapore starts as early as age 12. The Dominican Republic, Jordan, Lithuania, Malta, Peru, Qatar and Russia delay selection into different study programmes until students are 16 years old (Table II.5.27).

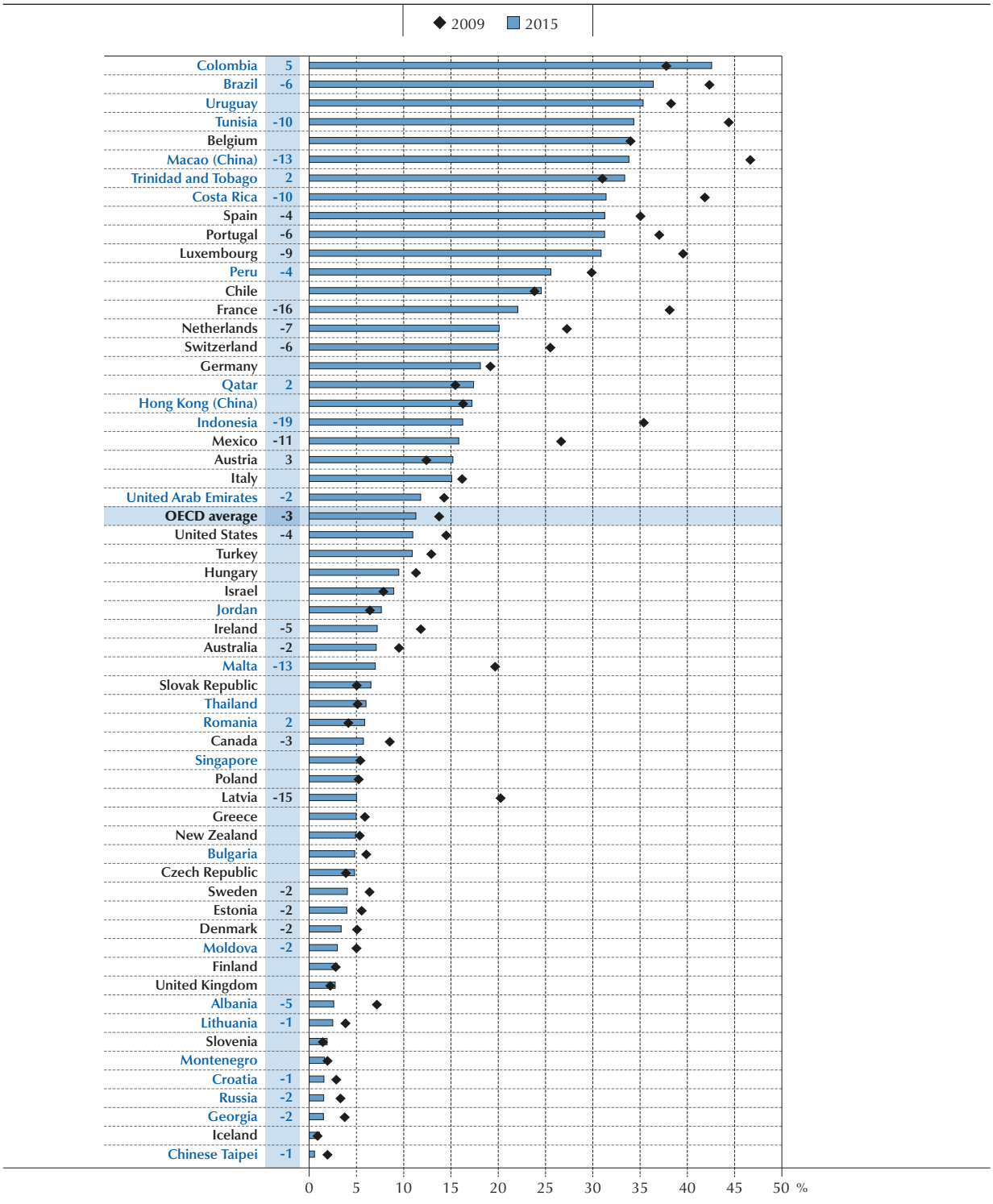
In 2015, 82% of 15-year-old students, on average across OECD countries, were enrolled in a programme with a general curriculum, 14% were enrolled in a programme with a pre-vocational or vocational curriculum, and 4% were in modular programmes that combine any or all of these curricula. In 27 countries, including OECD countries Chile, Denmark, Estonia, Finland, Iceland, Ireland, Israel, Latvia, New Zealand, Norway, Poland, Spain, Sweden, the United Kingdom and the United States, more than 99% of 15-year-old students were enrolled in a general programme. Enrolment in vocational or pre-vocational programmes is largest in Austria, Croatia, the Former Yugoslav Republic of Macedonia, (hereafter "FYROM"), Montenegro and Slovenia, where more than one in two students follow this curricular orientation. The largest proportions of students enrolled in modular programmes are found in Canada, with all students enrolled in such programmes, and the Slovak Republic, with one in four students enrolled in such programmes (Table II.5.14).

In countries and economies with large enrolments in pre-vocational or vocational programmes, these enrolments vary markedly according to schools' socio-economic profiles. On average across OECD countries, the proportion of 15-year-old students enrolled in a vocational track is 21 percentage points larger among students in disadvantaged schools than among students in advantaged schools. The relationship between schools' socio-economic profile and enrolment in pre-vocational or vocational programmes is strongest in Austria, Croatia, Italy, the Netherlands and Slovenia (Figure II.5.9). In these countries/economies, the difference in enrolment in these programmes between students in advantaged and disadvantaged schools is 60 percentage points or larger.

On average across OECD countries, students in general programmes score 22 points higher on the PISA 2015 science assessment than those enrolled in pre-vocational or vocational programmes, on average across OECD countries after accounting for students' and schools' socio-economic profile (Figure II.5.10). However, among countries and economies where enrolment rates in vocational programmes are higher than 10%, these performance differences can amount to as much as 91 score points, as in the Netherlands, approximately 60 score points, as in Greece, or between 40 and 60 score points, as in Belgium, Croatia, France, Portugal and Turkey. In Brazil, Colombia, Costa Rica, the Dominican Republic, Japan, Luxembourg, Mexico and Switzerland, students in pre-vocational or vocational programmes score higher in science than students in general or academic programmes.

Figure II.1.3 ■ **Change between 2009 and 2015 in grade repetition rates**

Percentage of students who had repeated a grade in primary, lower secondary or upper secondary school



Notes: Statistically significant differences are shown next to the country/economy name (see Annex A3).
Only countries and economies with comparable data from PISA 2009 and PISA 2015 are shown.
For Costa Rica, Georgia, Malta and Moldova, the change between PISA 2009 and PISA 2015 represents the change between 2010 and 2015 because these countries implemented the PISA 2009 assessment in 2010 as part of PISA 2009+.
Countries and economies are ranked in descending order of the percentage of students who had repeated a grade in 2015.
Source: OECD, PISA 2015 Database, Tables II.5.9, II.5.10 and II.5.11.

StatLink http://dx.doi.org/10.1787/888933436111

Individual schools' admissions policies are only weakly related to students' performance in science.

Results from PISA 2015 suggest that, on average across OECD countries, the association between different school admissions criteria and student performance in science is modest, after accounting for students' and schools' socio-economic profile. For example, students attending schools that consider prior academic performance as a criterion for admission tend to score five score points higher on the science assessment than students enrolled in schools that never use this criterion, after accounting for socio-economic status. But score-point differences in performance related to this policy can be as large as 20 points or more in Austria, Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]"), Hungary, Qatar, Tunisia and the United Arab Emirates (Table II.5.21). In Finland, Greece, Norway, Spain and Sweden, students' previous academic performance is rarely used for school admissions; in Croatia, Hong Kong (China), Japan, Macao (China), Singapore and Thailand, it is almost always considered (Table II.5.18). Residence as a criterion for admitting new students to school is particularly important in Greece, Norway, Poland and Switzerland, where at least 70% of students are in schools where residence is always considered.

How resources for education are allocated is just as important as the amount of resources available.

A first glance at PISA results gives the impression that students in high-income countries and economies – and countries/economies that can and do spend more on education – perform better. High-income countries and economies (defined here as those with a per capita GDP above USD 20 000) have more resources to spend on education. These countries and economies cumulatively spend, on average, USD 87 292 on each student from age 6 to 15, while countries that are not considered to be in that group spend, on average, USD 28 071 per student (Tables II.6.58 and II.6.59).

On average, students in high-income countries and economies score 79 points higher in science than students in countries whose per capita GDP is below the USD 20 000 benchmark. Yet the relationship among a country's/economy's income per capita, its level of expenditure on education per student, and its PISA score is far more complex. Among the countries and economies whose cumulative expenditure per student is under USD 50 000, higher expenditure on education is strongly associated with higher PISA science scores. But this is not the case among high-income countries and economies, which include most OECD countries. It seems that for this latter group of countries and economies, factors other than the level of investment in education are better predictors of student performance.

Among these countries and economies, it is common to find some with substantially different levels of spending per student yet similar science scores. For example, Poland and Denmark score 501 and 502 points in science, respectively, but the cumulative expenditure per student in Denmark is more than 50% greater than that in Poland. Similarly, although countries and economies might have similar levels of expenditure on education, they can perform very differently. For example, while Iceland and Finland both spend roughly USD 100 000 per student from the age of 6 to 15, Iceland's science score in PISA 2015 is 473 points and Finland's score is 531 points (Figure II.6.2). Whatever the reason for the lack of a relationship between spending per student and learning outcomes, at least in the countries and economies with larger education budgets, excellence in education requires more than money.

Collaboration among teachers is positively associated with student performance.

Offering higher salaries for teachers can help school systems attract the best candidates to the teaching profession, and signal that teachers are regarded and treated as professionals. But paying teachers well is only part of the equation. The relationship between science performance and teachers' salaries relative to per capita national income is not statistically significant across PISA-participating countries and economies (Figure II.6.7). This finding suggests that other factors, such as the quality of teaching, may be more closely associated with students' performance at the system level. For example, if countries do not have enough resources to invest in education, paying relatively high salaries might attract good teachers, but it also might limit the number of teachers the system can afford, thus contributing to shortages of teaching staff.

Like practitioners in any other profession, teachers need to keep up-to-date with advances in their field. That requires participation in some form of professional development. Across OECD countries, almost all 15-year-old students (96%) are enrolled in schools where teachers in the school co-operate by exchanging ideas or material when teaching specific units or series of lessons. A great majority of students attends schools that invite specialists to conduct in-service training for teachers (80%), that organise in-service workshops that address specific issues facing the school (80%) or that organise in-service workshops for specific groups of teachers (69%) (Figure II.6.11). In general, in-house professional development activities are more frequently offered in advantaged than in disadvantaged schools, in urban than in rural schools, and in private than in public schools (Tables II.6.21, II.6.22, II.6.23 and II.6.24).

On average across OECD countries, only professional collaboration among teachers in the school is positively associated with student performance in science after accounting for the socio-economic profile of students and schools. When school principals reported that teachers co-operate by exchanging ideas or material, the average 15-year-old student in OECD countries scores 9 points higher in science; in Slovenia, the average student scores 36 points higher.

One of the most valuable resources for education is time. On average across OECD countries, and in three out of four education systems, students who spend more time in science lessons score higher in science, even after accounting for the socio-economic profile of students and schools.

PISA 2015 asked students to report the average number of minutes per class period, the total number of class periods per week, and the number of class periods for science, language-of-instruction and mathematics. Across OECD countries, students reported spending 26 hours and 54 minutes per week in lessons, of which 3 hours and 30 minutes per week are spent in science lessons, 3 hours and 36 minutes per week in language-of-instruction classes, and 3 hours and 38 minutes per week in mathematics lessons (Figure II.6.18).

Students in B-S-J-G (China), Chile, Costa Rica, Korea, Chinese Taipei, Thailand and Tunisia spend more than 30 hours per week in regular lessons (all subjects combined), while students in Brazil, Bulgaria, Finland, Lithuania, the Slovak Republic and Uruguay spend less than 25 hours per week. In B-S-J-G (China), Chile, Qatar, Russia, Singapore and the United Arab Emirates, 15-year-old students spend more than five hours in regular science lessons per week, while in Iceland, Ireland, Montenegro and Norway, they spend less than half of that time in science class. In Chile, Peru and Singapore, students spend more than five hours in regular mathematics lessons, whereas in Austria, Bulgaria, Croatia and Montenegro students spend less than half of that time in mathematics class. In Canada, Chile, Denmark and Hong Kong (China), 15-year-olds spend five hours per week in language-of-instruction classes, while students in Austria, Finland and Russia spend less than 2 hours and 30 minutes per week in these classes.

Even within individual school systems, the amount of learning time in regular lessons can vary considerably, especially across schools with different socio-economic profiles (Table II.6.36). Across OECD countries, students in advantaged schools spend 27 hours and 15 minutes per week in regular lessons, while students in disadvantaged schools spend 26 hours and 33 minutes per week. This difference is observed in 31 out of 56 countries for which data are available and exceeds 3 hours per week of extra instruction in advantaged schools in B-S-J-G (China), Chinese Taipei, the United States and Uruguay. Part of the reason for this difference could be that advantaged 15-year-old students are more likely to attend upper secondary schools, where there are more hours of intended learning time than in lower secondary schools.

On average across OECD countries, and in 14 out of 49 countries and economies, students in private schools spend more time in regular science lessons than students in public schools. In Brazil, Croatia and New Zealand, for instance, there is a difference, in favour of private schools, of more than 80 minutes per week (Figure II.6.19 and Table II.6.33).

PISA examined the relationship between the intended time in science, language-of-instruction and mathematics classes with student performance in the corresponding PISA assessment – science, reading and mathematics. On average across OECD countries, and in three out of four education systems, students who spend more time in science lessons score higher in science, even after accounting for the socio-economic profile of students and schools (Figure II.6.19). For every additional hour spent in science lessons, students in OECD countries score five points higher in science – and eight points higher before accounting for the socio-economic profile of students and schools (Table II.6.33).

Students score lower in the PISA assessment when they reported spending more time studying after school.

Across OECD countries, students spend 3.2 hours per week studying science after school, 3.8 hours studying mathematics, 3.1 hours studying the language of instruction, 3.1 hours studying a foreign language, and almost 4 hours studying other subjects (Figure II.6.20). All subjects combined, in B-S-J-G (China), the Dominican Republic, Qatar, Tunisia and the United Arab Emirates, students reported that they study more than 25 hours per week in addition to the required school schedule; in Finland, Germany, Iceland, Japan, the Netherlands, Sweden and Switzerland, they study less than 15 hours per week (Table II.6.41).

Across OECD countries, students in disadvantaged schools spend more time studying after school than students in advantaged schools – 18 hours compared to 17 hours per week (Figure II.6.21). In most education systems, these differences should be interpreted as a compensatory measure, whereby struggling students, who are more likely to come from a disadvantaged background, are offered the possibility to narrow the performance gap between them and their better-performing peers.

Probably greater attention to and support for students in disadvantaged schools is needed in Croatia, Italy, Japan, Korea, Macao (China) and Chinese Taipei: only in these countries and economies do students in advantaged schools spend more time studying after school, probably widening the performance gap between rich and poor students. If these differences are the result of private tutoring and a pervasive shadow education system, it could undermine the principle of quality (and free) education for all.

When it comes to learning time, more is not necessarily better.

By combining the total number of hours that students spend learning or studying in and outside of school, and their scores in science, reading and mathematics, it is possible to get a rough idea of how efficient students are in their learning. Of course, the learning time measured in this way cannot adequately capture the accumulated learning time during the entire academic life of students, but it does say something about how much time students across different countries generally devote to learning and studying.

The ratio between PISA scores and learning time in and outside of school (how many score points are related to each hour spent learning) does not necessarily reflect the efficiency of the education system. Students learn mainly at school and in studying for school, but they also learn by interacting with knowledgeable others, such as family members and peers. For these reasons, the ratios can be interpreted in various ways. They can be an indication of the quality of a school system; they can also be indicative of the differences in learning time across education levels. For example, 15-year-olds in some education systems may be compensating for (or reaping the benefits of) the time spent learning in earlier stages of their education. The ratio between learning time and PISA scores can also indicate that, to succeed academically, students in some education systems need to spend more time in "planned" or "deliberate" learning because they have fewer opportunities to learn informally outside of school. The low ratios between learning time and PISA scores observed in some countries and economies with high PISA scores can also signal decreasing returns to learning time or greater difficulty in attaining higher PISA scores.

According to this analysis, students in Finland, Germany, Japan and Switzerland devote less time to learning in relation to their PISA scores in science, while those in the Dominican Republic, Peru, Qatar, Thailand, Tunisia and the United Arab Emirates spend more time learning relative to their academic performance (Figure II.6.23). In the Dominican Republic, for instance, the ratio between the science score and total learning time – in and outside of school – is 6.6 score points per hour, while in Finland it is 14.7 score points per hour.

Across OECD countries, 15-year-old students in socio-economically advantaged schools had attended about four months more of pre-primary school than students in disadvantaged schools.

Most students in most education systems reported that they had attended pre-primary education. But in B-S-J-G (China), Croatia, Lithuania, Montenegro, Poland and the United States, at least 17% of students – and in Turkey, almost half of students – reported that they had never attended pre-primary school (Table II.6.50).

PISA has consistently shown that students who had attended pre-primary school for more than one year score higher than students who had attended for less time. Indeed, students who had attended between 2 and 3 years of pre-primary school score 35 points higher than students who did not attend and 50 score points higher than students who had attended less than one year, on average (Table II.6.52).

But PISA finds that disadvantaged students are more likely to have spent less time – if any time at all – in pre-primary school. In B-S-J-G (China), Croatia, the Dominican Republic, Lithuania, Poland and Russia, the difference between the two groups of students in time spent in pre-primary school is at least one year. There is no country/economy where students in disadvantaged schools had spent significantly more time in pre-primary education, even if students in disadvantaged and advantaged schools in Belgium, Iceland, Japan, Korea and Macao (China) show similar levels of attendance.

What PISA results imply for policy

Whether students are selected into academic programmes that offer little or no science instruction, or students themselves decide not to take science courses, depriving students of school science may only widen the gap with their better-performing peers. Every 15-year-old student should have the opportunity to learn science in school. But access to learning opportunities is only the beginning.

Students learn more in a positive learning environment, where they and their peers attend school regularly and treat other students with respect and dignity, teachers co-operate with each other and support struggling students, school principals

react swiftly to behaviour and academic problems, parents participate in a range of school activities, and governments provide assistance to schools with serious student-behaviour problems.

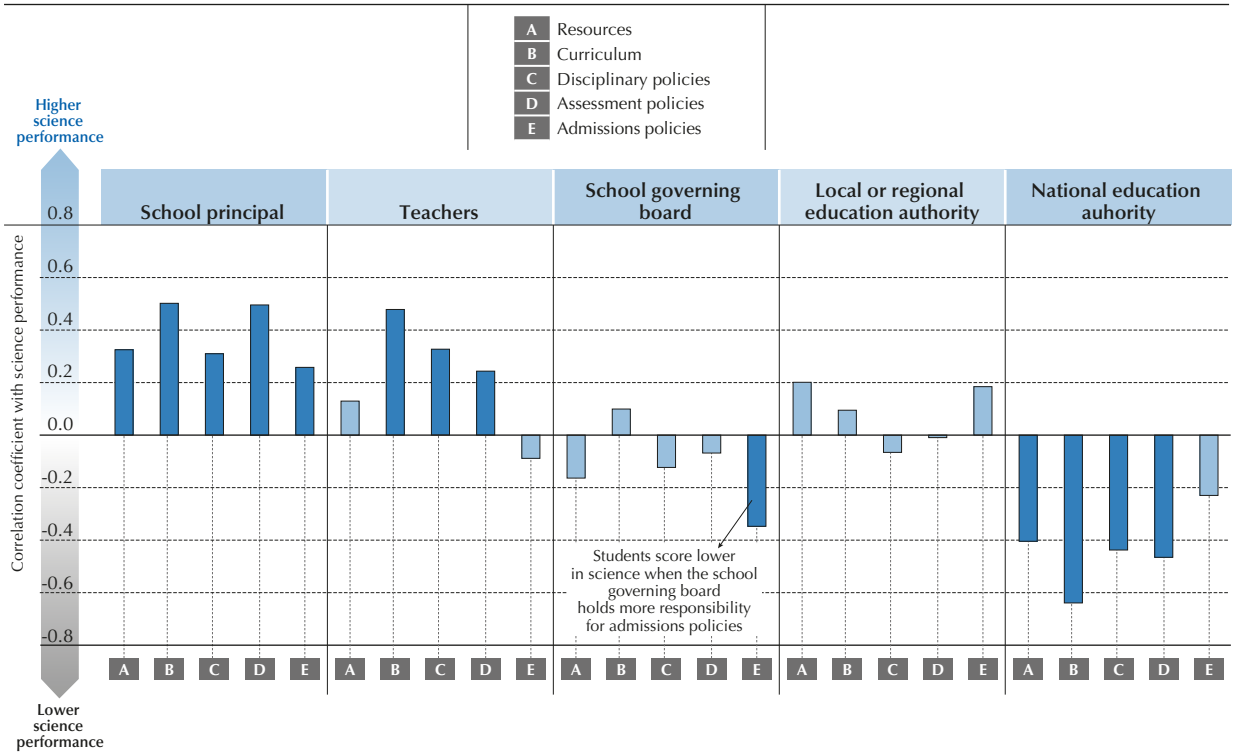
Giving schools greater control over budgetary, staffing and instructional matters has been advocated on the grounds that local actors understand their students' needs better than higher administrative bodies. PISA 2015 offers a nuanced picture of the relationship between greater school autonomy and students' performance, which seems to depend not only on the particular areas of school management delegated to principals and teachers, but also on how these areas are related to certain accountability measures and to the capacity of local actors.

In particular, students score higher in science when principals exercise greater autonomy over resources, curriculum and other school policies (Figure II.1.4), but especially so in countries where achievement data are tracked over time or posted publicly or when principals show higher levels of educational leadership. To some degree, these findings also suggest that when principals lack the preparation and capacity to exercise leadership, transferring authority to schools may inadvertently work against students, since school staff might then be deprived of the resources and expertise available at higher levels of the system. Students also score higher in science in countries where more teachers have autonomy over the curriculum. This finding underscores the importance of tapping into teachers' expertise.

The most successful education systems select the best candidates for the teaching profession, retain qualified teachers and ensure that they are constantly improving by participating in professional development activities. In these systems, education and the teaching profession are greatly valued by society, teachers are adequately compensated, the teaching career is transparent and clearly structured, teachers are given many opportunities – and encouragement – to learn, and they receive feedback on their teaching regularly, such as through mentoring programmes organised by schools.

Figure II.1.4 ■ **Correlations between the responsibilities for school governance[1] and science performance**

Results based on system-level analyses



1. The responsibilities for school governance are measured by the share distribution of responsibilities for school governance in Table II.4.2.

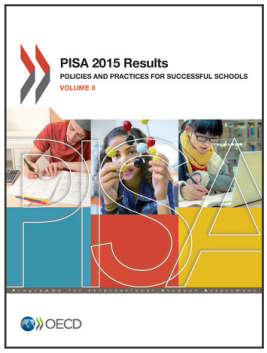
Notes: Results based on 70 education systems.

Statistically significant correlation coefficients are shown in a darker tone (see Annex A3).

Source: OECD, PISA 2015 Database.

StatLink http://dx.doi.org/10.1787/888933435864

PISA results show that more inclusive and fairer school systems are those that provide access to quality early education for all children, offer additional support to struggling students, rather than require them to repeat grades, and delay the age at which students are selected into different programmes or schools. These systems also strive to have excellent schools located in every neighbourhood and ensure that they are accessible to all students, and provide additional support to disadvantaged schools. Students in disadvantaged schools need to learn as much as they can while at school. This means spending more time in regular lessons with better teaching, which is what their counterparts in advantaged schools already enjoy. These schools also need to ensure that the time their students spend studying after school is more productive, by providing greater support in the form of tutoring, mentoring or remedial lessons, for example, and combining this additional learning time with enriching extracurricular activities.



From:

PISA 2015 Results (Volume II)

Policies and Practices for Successful Schools

Access the complete publication at:

https://doi.org/10.1787/9789264267510-en

Please cite this chapter as:

OECD (2016), "Overview: Policies and practices for successful schools", in *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264267510-5-en

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