2

Students Who Excel

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WHO ARE TOP PERFORMING STUDENTS IN SCIENCE?

This chapter aims to shed light on the type of students who are top performers in science in PISA. Are they, for example, good all-round students, or do they excel just in science? Are males and females equally represented among the top performers? How well represented are students with an immigrant background or students speaking a language at home different to the language they use at school? Are students from less advantaged socio-economic backgrounds excelling?

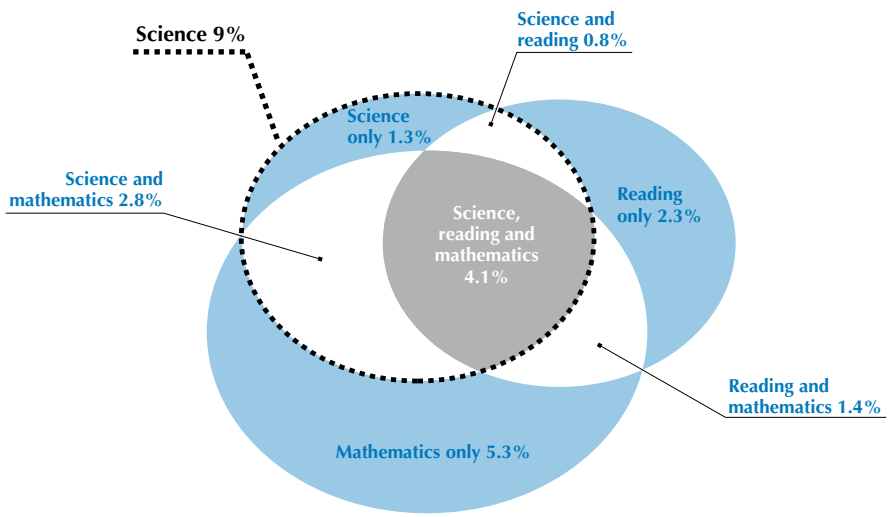
Understanding who top performers in science are and whether or not they share some individual characteristics within and across countries can provide stakeholders and policy makers with valuable insights for effective policy design and implementation for educational excellence.

Are top performers in science also top performers in mathematics and reading?

A common stereotype, running from folk culture on Albert Einstein to fictional characters such as boy-genius Jimmy Neutron, holds that students who are proficient in science are narrowly specialised in that field. That is, they may have special performance and talents in science, but this capability has come about because of a sacrifice in other subjects. As noted earlier, although PISA 2006 focused on science, it also assessed reading and mathematics. It is therefore possible to examine the portion of top performers in science that are also among top performers in reading and mathematics.[1]

Figure 2.1 provides some of these results across OECD countries. The parts in the Venn diagram shaded in blue represent the percentage of the 15-year-old students who were top performers in just one of the three assessment subject areas, that is, in either science, reading or mathematics. The white parts in the diagram show the percentage of students who were top performers in two of the assessment subject areas. The part shaded in grey in the middle of the diagram shows the percentage of the 15-year-old students who were top performers in all three assessment subject areas.

Figure 2.1
Overlapping of top performers in science, reading and mathematics on average in the OECD



Note: Non top performers in any of the three domains: 82.1%.
Source: *OECD PISA 2006 Database,* Table A2.1a.

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Across OECD countries, 4% of 15-year-old students were top performers in all three assessment subject areas: science, reading and mathematics. About 3% of students were top performers in both science and mathematics but not in reading, while just under 1% of students were top performers in both science and reading but not in mathematics and more than 1% were top performers in both reading and mathematics but not in science. The percentage of students who are top performers in both science and mathematics is greater than the percentages who are top performers in science and reading or in reading and mathematics. This is not a surprising finding: the complementarities between science and mathematics learning are widely discussed in the literature (Rutherford and Ahlgren, 1990; Goldman and Greeno, 1998).[2]

It is noteworthy that not all countries show the same patterns. There was substantial variation among countries, for example, in the percentages of top performers in science who are also top performers in both reading and mathematics. Such students comprised 9.5% of 15-year-old students in Finland, 8.9% in New Zealand, 7.8% in Korea, 7.0% in Canada, 7.7% in the partner economy Hong Kong-China, and 7.2% in the partner country Liechtenstein, while in four OECD countries and 17 partner countries, less than 1% of students are top performers in all three domains (Table A2.1a).

These results highlight the diversity of top performers in science. Across subject areas, a significant proportion of top performers in science excel in some other subject area. On average across OECD countries, for example, nearly 45% of science top performers are also top performers in both mathematics and reading (Table A2.1a). In six OECD countries, 50% or more of science top performers are also top performers in the other two subject areas; the proportion in Korea is 76%. While on average across OECD countries there are more top performers in science who excel also in mathematics but not reading, the proportion that excels in all three subject areas is significantly larger. The variation across countries in all these proportions highlights that different educational systems result in different kinds of top performers.

Are males and females equally represented among top performers?

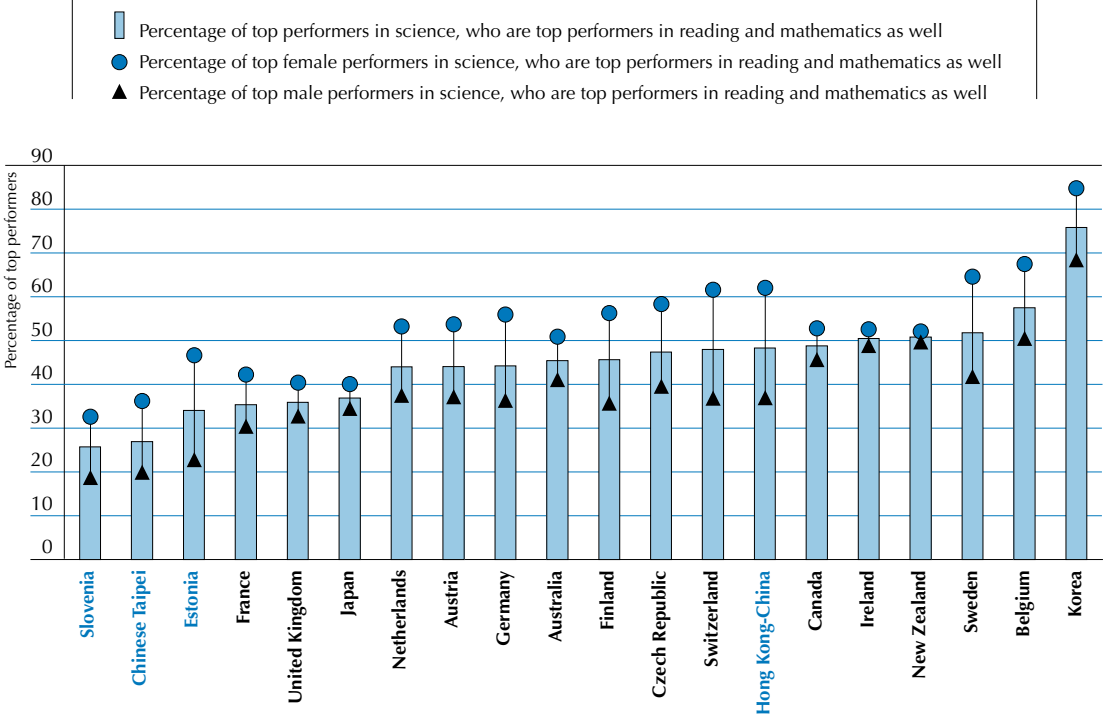
Gender gaps are important from an equity point of view and because their analysis can provide insights on why some students perform better than others. One of the main messages emerging from previous analyses of PISA assessments is that student engagement explains a large part of the performance advantage in favour of female students in reading and a large part of the performance advantage in favour of males in mathematics.

In science gender patterns are more nuanced. While the data show small or no gender gaps on the overall science PISA scale, significant gender differences emerge on the science subscales. Female students perform better than males in the *identifying scientific issues* (which explores the capacity of students to recognise issues that are possible to investigate scientifically, to identify keywords to search for scientific information, and to recognise the key features of a scientific investigation) and males do better than females in *explaining phenomena scientifically* (which explores the capacity of students to apply *knowledge of science* in a given situation, describe or interpret phenomena scientifically and predict changes, and identify appropriate descriptions, explanations, and predictions). There is no significant difference for the competency *using scientific evidence* (which explores the capacity of students to interpret scientific evidence and make and communicate conclusions, identify the assumptions, evidence and reasoning behind conclusions, and reflect on the societal implications of science and technological developments). Across different areas of science-related knowledge, males tend to outperform females in the areas of "Physical systems" and "Earth and space systems", while no gender pattern emerges in the area of "Living systems". *Gender Matters: a comparison of performance and attitudes in PISA* (OECD, 2009c) and the *PISA Data Analysis Manual* (OECD, 2009d) also show that in all areas and for all countries, males had a greater variation of performance than females, that is, they tend to have comparatively higher proportions of top performers but also of students at risk.

While there is no difference in the average performance of males and females, males tend to show a marked advantage among the top performers. In eight of the 17 OECD countries at least 3% of both males and females among the top performers in science, there are significantly higher proportions of males than females among the top performers in science (Table A2.2). There are no countries where there are significantly higher proportions of females than males among the top performers in science.

On average across the OECD countries, 44% of the top performers in science were also top performers in reading and mathematics, but this was the case for 50% of females and 37% of males (Tables A2.1a and A2.1b). Figure 2.2 shows results for countries with available data. These results indicate that males do seem to be somewhat more specialised than females in their science expertise.

Figure 2.2
Overlapping of top performers by gender



Countries are ranked in ascending order of the percentage of top performers in science.
Source: *OECD PISA 2006 Database,* Table A2.1b.

Also in mathematics a higher proportion of top performers can be found among males than among females in all OECD countries except the Czech Republic, Iceland and Sweden. In contrast, in reading, the opposite pattern prevails. Females are more likely to be top performers than males in reading in all OECD countries except Japan where the difference between males and females is not significant. For example, in Finland, 23.7% of females are top performers in reading, while this is 9.6% for males (Table A2.2). In sum, across three subject subject areas, females are as likely to be top performers as males. Across the OECD, 17.3% of females and 18.6% of males are top performers at least one of the three subject areas (Table A2.1b).

How well represented are students with an immigrant background among the top performers?

In some countries a significant proportion of students (or their parents) were born outside of the country. Students who do not speak the language of instruction at home constitute another important minority of students. As the report *Where Immigrant Students Succeed – A Comparative Review of Performance and Engagement in PISA 2003* (OECD, 2005) shows, an immigrant background can have a significant impact on student performance. While the proportion of students with an immigrant background does not seem to relate to the average performance of countries, from an equity perspective it is important to understand the effect of these background characteristics on excellence.

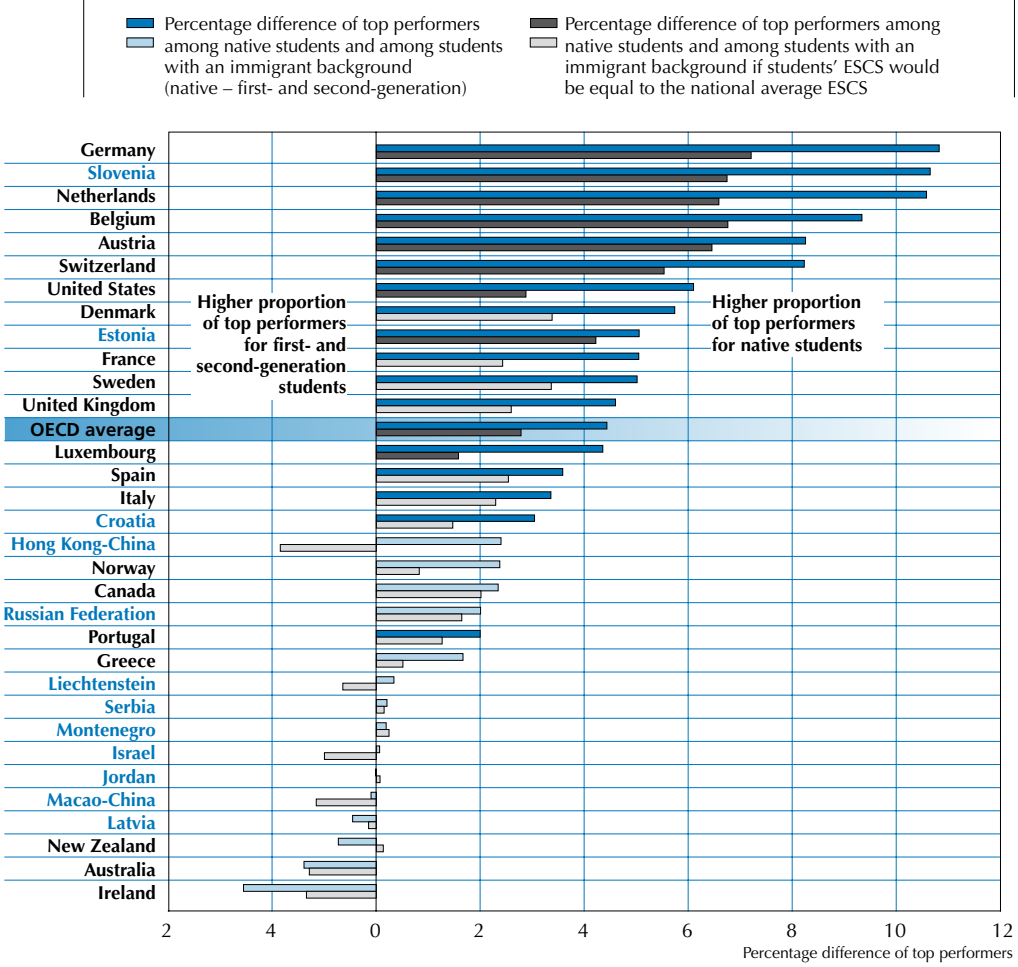
This section analyses the percentages of top performers by their immigrant status and the language they speak at home. In some of the OECD and partner countries and economies only a negligible proportion of students (less than 30 students or less than 3% of students) have an immigrant background or speak a language at home that is different from the language they use at school. Estimates based on such a small number of observations are not reliable and therefore data for these countries are not examined here. Native students are students who were born in the country of assessment and have at least one parent who was also born in the country of assessment. Students with an immigrant background are students whose parents were born in a foreign country. This group includes both first-generation students and second-generation students. First-generation students are those born outside of the country of assessment whose parents are also foreign-born. Second-generation students are those born in the country of assessment with both parents foreign-born.

In general, for those countries with sufficient numbers for analysis to be valid, there are more top performers in science among native students than among students from an immigrant background but in part this just reflects differences in socio-economic backgrounds. Indeed, this difference is no longer significant after accounting for students' socio-economic background in half of the countries being compared.

The comparison of top performers between students with an immigrant background and native students shows different results across countries (Table A2.3 and Figure 2.3). In some countries, students from an immigrant background are as likely to be higher performers as native students. For example, in Australia, Canada, Greece, Ireland, Norway and New Zealand, as well as in the partner countries and economies Hong Kong-China, Israel, Liechtenstein, Latvia, Macao-China and the Russian Federation, there are no significant differences in the proportion of top performers among native students and students with an immigrant background.[3]

The excellence gap between students from an immigrant background and native students reflects in part different immigration patterns and policies. Top performing immigrants are generally found in countries with relatively selective immigrant policies favouring more educated and resource-endowed families. For example, families moving to Australia, Canada and New Zealand are often selected according to characteristics that are considered important for integration, such as educational qualifications and language skills (OECD, 2006b). Other countries however do not or cannot impose such restrictions. Another reason for the gap is differences in socio-economic backgrounds. In fact, in most countries the difference between native students and students with an immigrant background is not significant once students' socio-economic backgrounds are taken into account.

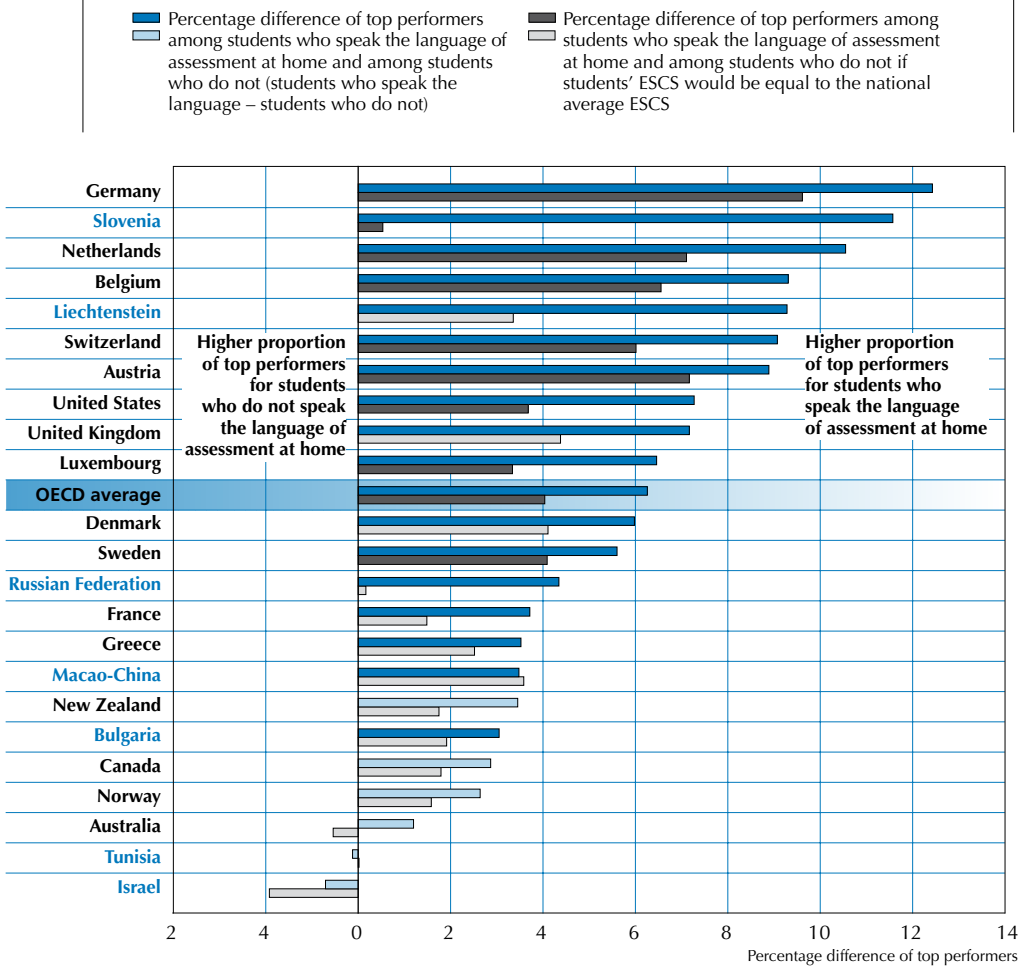
Figure 2.3
Percentage difference of top performers by immigrant status



Countries are ranked in descending order of the percentage difference of top performers among native students and among students with an immigrant background.
Note: Significant differences are highlighted with a darker tone.
Source: *OECD PISA 2006 Database,* Table A2.3.

Speaking the national language or an official language recognised by schools is clearly an advantage in learning and testing. In these cases, the student's home language is aligned with the medium of instruction. Thus, it is no surprise that students in homes where a different language is spoken than the national or an official language face additional learning challenges and a smaller proportion of these students tend to be top performers. To a large extent, this pattern follows the distinctions between native students and students with an immigrant background (Table A2.4 and Figure 2.4). In most of the countries with available data there are significantly fewer students that do not speak the language of assessment at home represented among science top performers. The largest differences in favour of both native students and students who speak the language of assessment at home occur in Germany, the Netherlands and partner country Slovenia (Tables A2.3 and A2.4). In Australia, Canada, Norway, New Zealand and the partner countries Israel and Tunisia there are similar proportions of students not speaking the language of assessment at home and students who do speak the language of assessment at home represented among the top performers.

Figure 2.4
Percentage difference of top performers by language spoken at home



Countries are ranked in descending order of the percentage difference of top performers among students who speak the language of assessment at home and among students who do not.
Note: Significant differences are highlighted with a darker tone.
Source: *OECD PISA 2006 Database,* Table A2.4.

As the evidence presented highlights, some countries succeed better than others in promoting excellence among linguistic and immigrant minorities. There are lessons to be learnt from these countries that may help improve excellence and equity in educational outcomes.

Students' socio-economic background

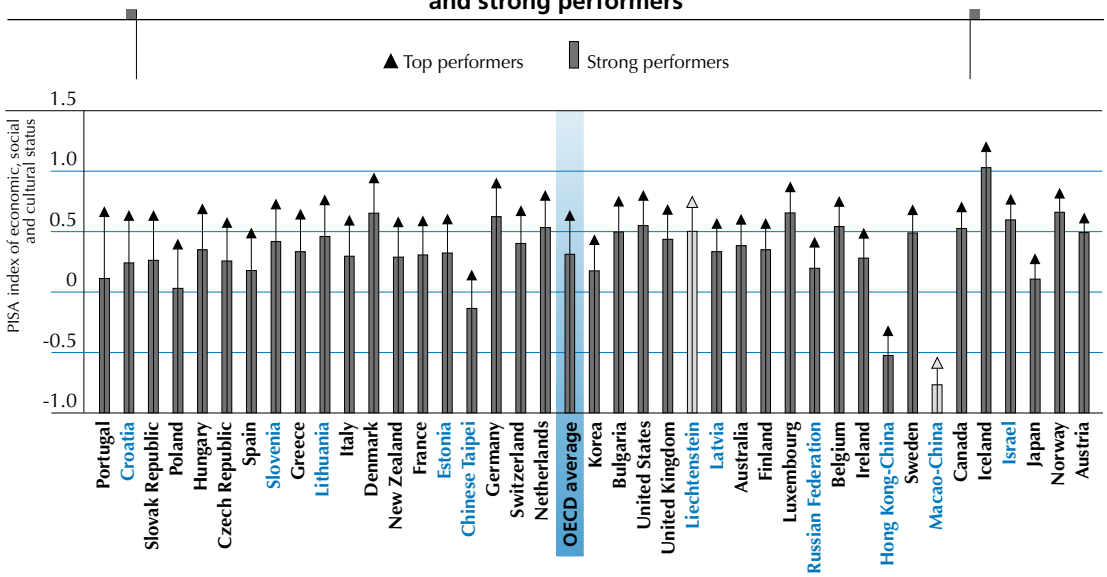
The PISA *index of economic, social and cultural status (ESCS)*[4] provides a comprehensive measure of student socio-economic background. This index was derived from information comprising the highest educational level of parents, the highest occupational status of parents, and possessions in the home (see Box 2.1 for further information on PISA indices). The PISA data from all three administrations to date have shown that socio-economic background and performance are closely related.

Box 2.1 **Comparing top performers with other students using PISA indices**

This report compares top performers with students from other performance groups using a range of different measures, known as PISA indices. Students completed a questionnaire on themselves and their learning. The information reported by students is summarised into several PISA indices. On each index, the average OECD student was given an index value of zero and about two-thirds of the OECD student population were given index values between -1 and 1 (*i.e.* the index has a standard deviation of 1). It is therefore possible to have both negative and positive mean index values. It should be noted that when a performance group has a negative mean index value, this does not necessarily mean that students in that group responded negatively to the underlying questions, but rather that these students responded less positively on average to such questions compared to students in other performance groups (for more detailed information, see *PISA 2006 Technical Report* [OECD, 2009b]).

Socio-economic background is related to performance for at least two reasons. First, students from families with more educated parents, higher income and greater material, educational and cultural resources are better placed to provide superior educational advantages in the home environment as well as richer learning opportunities outside of the home relative to students from less-advantaged backgrounds. Such families typically are in a better position to provide their children with certain educational experiences that enhance their learning. Second, such families often have much more choice over where they can enrol their children. They may be in a position to choose between public and private schools, and have greater access to schools where the student body is drawn from a more advantaged socio-economic background. Evidence on the extent to which private management of the schools matters is examined in the following section.

Figure 2.5a
Difference in socio-economic background between top performers and strong performers

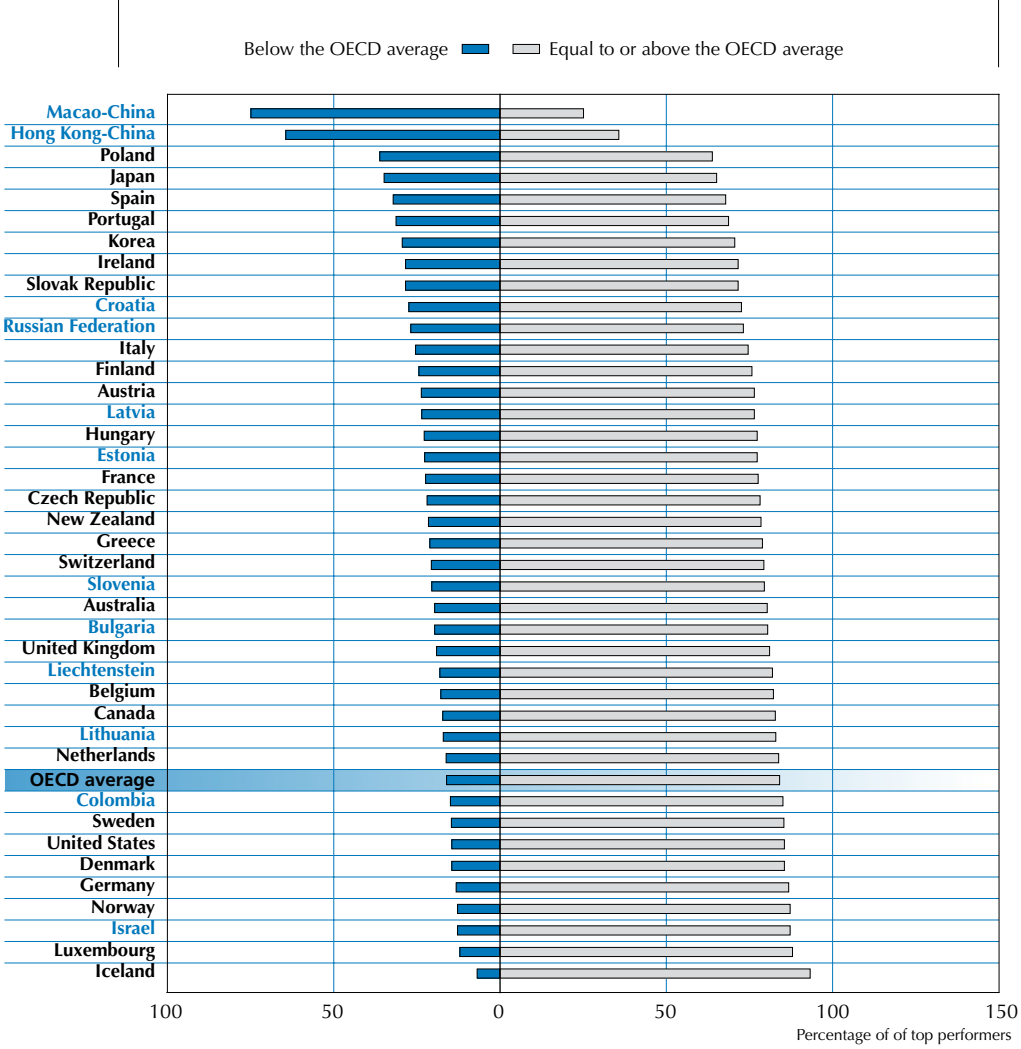


Countries are ranked in descending order of the difference in the PISA index of economic, social and cultural status (ESCS) between the top and the strong performers.
Note: Significant differences are highlighted with a darker tone.
Source: *OECD PISA 2006 Database,* Table A2.5a.

Top performers tend to come from a relatively advantaged socio-economic background. (Table A2.5a). In virtually every country for which there are adequate data, students in the top performing category are drawn from families with comparatively advantaged socio-economic backgrounds, differences that are always statistically significant meaning that they are not likely to be found by chance. Across the OECD, the average socio-economic background of top performers is slightly more than half a standard deviation above the average OECD socio-economic background. Figure 2.5a shows that even when comparing top performers to strong performers (the performance group from which the most likely future top performers might emerge), the differences in socio-economic background in favour of top performers are statistically significant in all OECD countries (on average across the OECD countries the difference is 0.26 of a standard deviation).

Figure 2.5b

Percentage of top performers with socio-economic background (ESCS) "below" or "equal to or above" the OECD average of ESCS



Countries are ranked in descending order of the percentage of top performers with socio-economic background who are below the OECD average.
Source: *OECD PISA 2006 Database,* Table A2.5c.

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That is, top performers tend to come from significantly more advantaged socio-economic backgrounds than students who are not among the top performers, but are closest to reaching those levels. In general, differences in socio-economic background between different performance groups are marked – the more advantaged the socio-economic background, the higher the performance.

Yet, not all top performers come from an advantaged socio-economic background. Figure 2.5b shows more than a fifth of top performers across the OECD countries come from a background below the OECD average. In Poland, Portugal, Spain or Japan the proportion of top performers in science whose socio-economic background is below the OECD average exceeds 30%. That proportion reaches 64% and 75% in partner economies Hong Kong-China and Macao-China respectively (Table A2.5c).

While a disadvantaged background is not an insurmountable barrier to excellence, how much of an obstacle it becomes varies from country to country. Looking at the national average in the typical OECD country about a quarter of top performers in science come from a socio-economic background below the country's average (Table A2.5b). Some systems however are more conducive for students from a relatively disadvantaged background to become top performers in science. For example, in Japan, Finland, Austria, and the partner economies Macao-China and Hong Kong-China, one third or more of top performers come from a socio-economic background more disadvantaged than the average of the country or economy. On the other hand, in Luxembourg, Portugal, Greece, France, and the United States, as well as the partner countries Bulgaria, Israel and Lithuania, 80% or more of top performers come from a socio-economic background more advantaged than the average of the country.

So far, the chapter has shown that top performers in science share some individual characteristics but it also stresses their diversity within and across countries. The next and final section of the chapter turns to the analysis of the characteristics of the schools attended by top performers in science. The evidence in PISA shows that school policies have an impact on performance (OECD, 2007). While a comprehensive analysis of the interactions between school policies and system characteristics is outside the scope of this report, the next section explores the relationship between school policies and students' top science performance.

WHICH SCHOOLS DO TOP PERFORMERS IN SCIENCE ATTEND?

PISA 2006 collected school data through a survey of school principals. Caution is required in interpreting these data. Science learning in schools depends upon the entire cumulative experience over many years; not just what individual students learned in the current school environment, but also previous schooling and experiences outside of school.

A great deal of information is available in PISA about teaching and learning experiences at the school level. It is therefore worthwhile to analyse whether or not these experiences vary for top performers in science and how they relate to the school they attend. For example, are top performers in science concentrated in a few schools or can they be found in every school? Do top performers in science tend to attend schools with high average socio-economic background? What type of schools, public or private, do top performers in science attend? These questions among others are addressed in the remainder of this chapter.

Are top performers in science in schools that only serve other top performers in science?

Figure 2.6 shows the percentage of students in each country who attend schools where there are no top performers in science. It depicts where top performers are spread across schools and where they are concentrated in a few schools. In Finland, Australia, New Zealand, and the partner economy Macao-China,

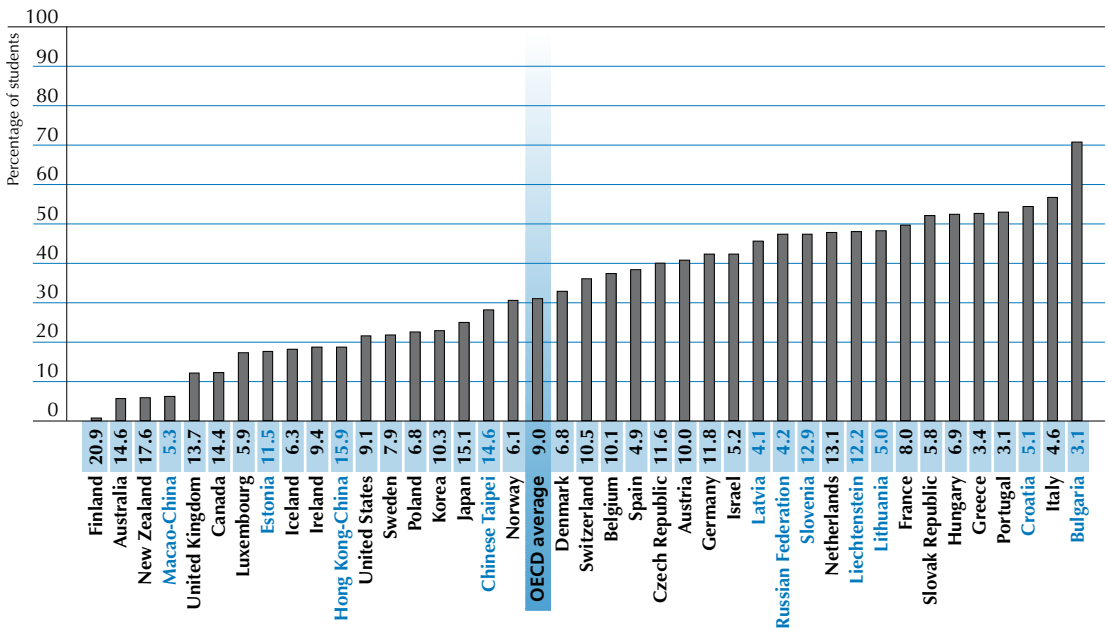
more than 90% of students are in schools attended by top performers, while in Italy, Portugal, Greece, Hungary, the Slovak Republic and the partner countries Bulgaria and Croatia more than half of the students are in schools with no top performers.

How students are grouped into different schools, intentionally or unintentionally, is related to the extent to which top performers are concentrated in schools. For example, although the United Kingdom and the Netherlands have a similar proportion of top performers (13.7% and 13.1% respectively), 88% of students are in schools with top performers in the United Kingdom versus 52% in the Netherlands. However, the evidence also suggests that a concentration of top performers in certain schools is not a pre-requisite for achieving high performance levels. Notably some of the countries with the highest proportions of top performers also show the smallest disparities in average socio-economic background across schools (Figure 2.6).

Table A2.6b shows the school average science performance for the four performance groups of students. It provides a different indicator of the concentration of top performers in schools. Virtually all countries show a pattern where students at higher levels of science performance are attending schools with higher average science performance than students at lower levels of science performance.

The size of the gap in school average performance between performance groups varies considerably from country to country. Across OECD countries the average difference in science scores between schools attended by top performers and schools attended by the lowest performers in science was about 104 points. (Note that the standard deviation of students' science performance is 100 score points).

Figure 2.6
Percentage of students in schools with no top performers



Note: Data on blue background are percentages of top performers.
Source: *OECD PISA 2006 Database,* Table A2.6.

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This gap was much less in Finland (30 score points) and in Iceland, Norway, Sweden and Poland (between 40 and 51 score points). This is consistent with data from PISA 2000, 2003 and 2006 which found that some countries, notably the Nordic countries, show particularly little performance variation between schools (OECD, 2001, 2004, 2007). In contrast, in the Netherlands, Germany, Hungary, France, Austria, the Czech Republic, Belgium and Japan, as well as in the partner countries Slovenia, Bulgaria and Liechtenstein, the difference in school average science performance between top performers and the lowest performers is more than three times this amount (1.5 standard deviations or more, a very substantial difference). For this group of countries, top performers are in schools where the average student is also performing very well.

The general concentrations of top performers in science in high average performance schools can be explained in part by system characteristics. In Finland and the first group of countries, students at different levels of performance are attending schools that are relatively similar in terms of their average science performance. In contrast, for the latter group of countries, top performers tend to be in schools where other students tend to performing well too. Educational systems differ in the extent to which schools are tracked as well as in terms of the age at which students are assigned to different school types.

Further evidence on patterns of excellence is examined in the remainder of this section. The goal is to gain insight into some possible factors contributing to the performance disparities between schools attended by top performers and those attended by the lowest performers. Is there evidence of significant socio-economic differences across schools? To what extent do top performers come from families who choose private education? To what extent do top performers attend schools that select students based on their academic record? These and other factors, such as residential location, may play a role in shaping schooling outcomes. A subsequent section examines more how students' science learning is organised at school.

Differences in socio-economic background across schools

Top performers in science are typically found in schools where the student body on average comes from a more advantaged socio-economic background than schools attended by lower performing students. Table A2.7 provides estimates of average socio-economic background for schools attended by top performers in science and schools attended by the three other performance groups. For example, across OECD countries, the difference in the average socio-economic background of schools attended by top performers and schools attended by strong performers (at the adjacent Level 4 in science) is about 0.15 index points. This difference is particularly small for countries with relatively high proportions of top performers such as Finland, Canada, and New Zealand, where the difference in each of these is 0.09 index points or less. Indeed, in Finland, the difference is 0.03 index points or one-fifth of the average difference for the OECD countries.

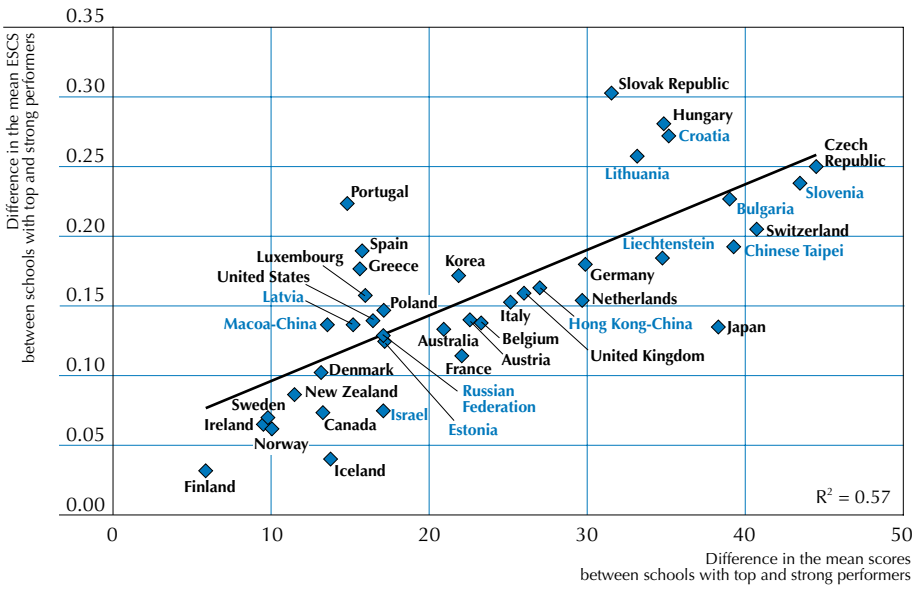
Countries with a greater variation of socio-economic backgrounds across schools tend to have particularly pronounced differences in the socio-economic context of schools with top performers and the schools with lowest performers.[5] For example, Finland, one of the countries with the highest (0.91) index of inclusion among OECD countries (2006), is also one of the countries with the smallest difference in average socio-economic background between schools with top performers in science and those with strong performers (0.03 or less than 3% of a standard deviation).

A relatively advantaged socio-economic background at the school level provides students with many benefits. For example, PISA shows a high correlation between schools with a more advantaged socio-economic background and stronger disciplinary climate (OECD, 2004).[6] Schools with a larger proportion of their students from more advantaged backgrounds often provide a learning programme with a more demanding curriculum and instruction. The stronger instructional programme benefits all students in the school, a programme that would not be normally provided to a less-advantaged student body (Levin, 2007).

Such schools will also attract the best teachers who seek teaching environments that are likely to produce high performance. Finally, research shows that schools with greater concentrations of comparatively advantaged socio-economic student populations provide student peers with lofty educational and occupational aspirations, and those attitudes pervade peer interactions and activities and support the general environment of high expected student accomplishments and student futures (Vandenberghe, 2002; Zimmer and Toma, 2000; Hanushek *et al*, 2003).

In fact, PISA shows a strong relationship between the differences in school average performance and the school average socio-economic background when comparing schools with top performers in science and those with strong performers (Figure 2.7). The figure shows that those countries where the differences in socio-economic background are higher tend to be those where the differences in performance are higher as well.

Figure 2.7
Relationship between socio-economic and performance differences between schools with top and strong performers



Source: *OECD PISA 2006 Database*, Table A2.6b and Table A2.7.

Beyond the individual characteristics of their student intake, schools often differ in the involvement of public and private stakeholders in their management, in their admittance, selection and grouping policies, or in the amount of information they provide publicly. The chapter now turns to the analysis of differences in policies among schools attended by different student performance groups.

Do top performers mainly attend schools that are privately managed?

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. Private education can be a way of mobilising resources from

a wider range of funding sources. At the same time, 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. 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.

What type of school (public or private) is associated with high concentrations of top performers? This is a question which requires considerable attention to underlying detail and it is a good example of the kind of careful analysis necessary when studying the impact of school characteristics and policies in students' excellence. For one, the definition of private schools differs from country-to-country, and even the sources of financial support for both types of schools may defy generalisation. For example, in some countries private schools are heavily supported by public funding; in others their funding is strictly from parents and other private sources. In some countries public schools, particularly at the secondary level, charge fees and require other types of family contributions. Thus, the distinctions between public and private schools differ among countries.

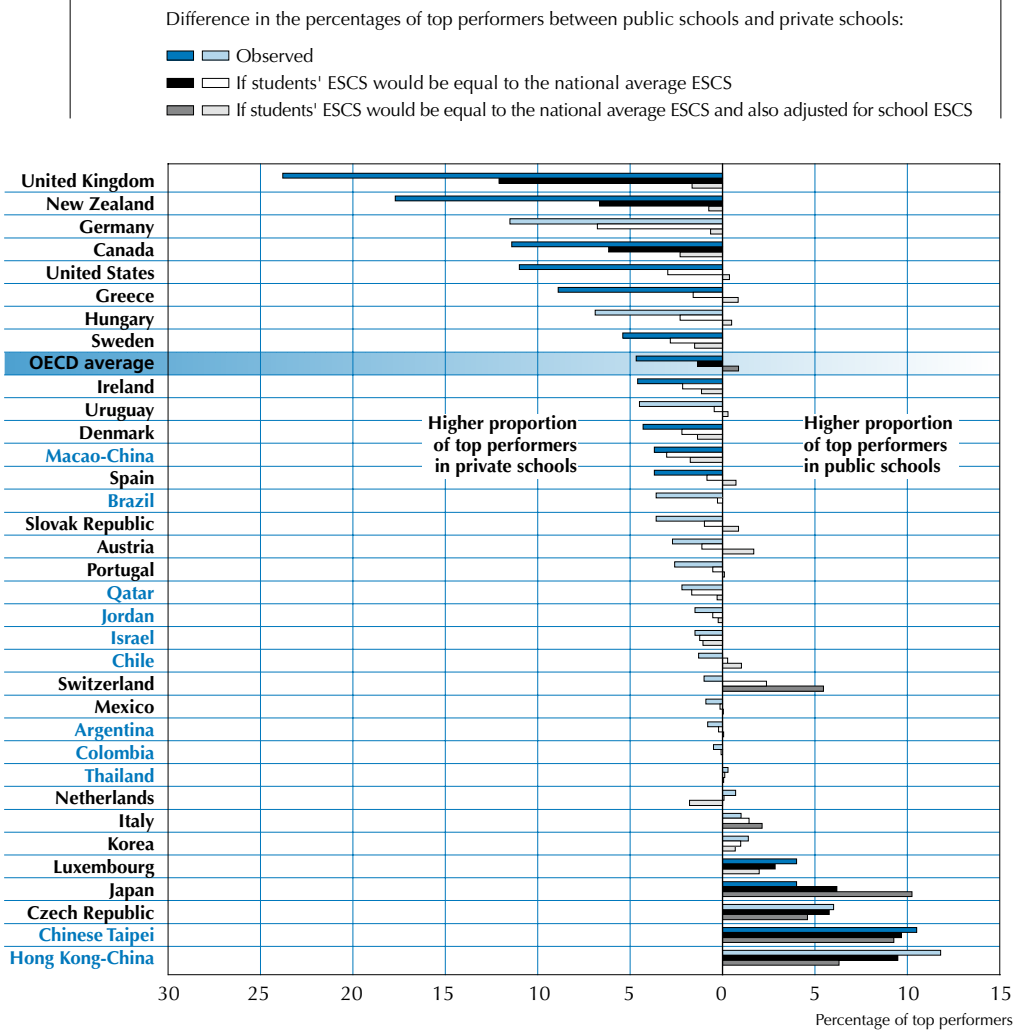
The PISA approach is to identify public schools as those managed by a public authority, government agency, or a publicly elected or authorised governing board and private schools as those managed by a non-governmental organisation. According to this definition the average percentage of top performers across the OECD countries is about 9% for public schools and about 14% for private schools. However, an important and coinciding factor compromises the ability to infer potential causation of one type of school having stronger effects on producing top performers relative to the other type of school. The two sectors enrol students from different socio-economic backgrounds (Table A2.8b). It has been shown that both the socio-economic background of individual students and the average socio-economic background of a school are highly related to the science performance of students (OECD, 2007). Thus, it is not appropriate to infer from this limited information on representation of top performers between the two types of schools whether the larger percentage of top performers among private schools is due to differential school effectiveness or differential socio-economic selection.

Figure 2.8 shows that in most countries there are larger proportions of top performers in private schools than there are in public schools, but it also shows that there are important exceptions to this rule. A few countries such as Japan, Luxembourg and the partner economy Chinese Taipei show higher proportions of top performers among public school students than among private school students.

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 of attempting to separate out the unique differential impacts of public and private schools on producing top performers in science is to estimate statistically the representation of top performers in each type of school if the socio-economic background of the individual student and the average socio-economic background for the two types of schools were identical. Such a statistical adjustment would make the student populations of the two types of schools comparable in terms of social intake and allow for an assessment of science performance in the two types of schools. Figure 2.8 shows the results after accounting for the student and school socio-economic background.

Looking at the differences between public and private schools without taking account of student and school socio-economic background, it can be observed that a greater proportion of private school students are top performers compared to public school students, with some individual countries being exceptions to this pattern. The average percentage of top performers in private schools across OECD countries is about 14% and in public schools about 9% with a differential in favour of private schools of about 5 percentage points (Table A2.8a and Figure 2.8). However, after an adjustment for differences in the socio-economic intake between public and private schools, there is a small significant advantage to public schools.

Figure 2.8
Top performers in public and private schools



Countries are ranked in descending order of the observed percentage difference between public and private schools.
Note: Significant differences are highlighted with darker tone.
Source: *OECD PISA 2006 Database,* Table A2.8a.

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The evidence presented above implies that on average, across the OECD countries, the differences in proportions of top performers in private and public schools is fully explained by socio-economic differences of individual students and social composition of those schools, and the policies and practices that come with these. Once individual and school socio-economic backgrounds are accounted for, top performers in science are as likely to be found in public or private schools. 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.

Do top performers mainly attend schools that select students based on their academic record?

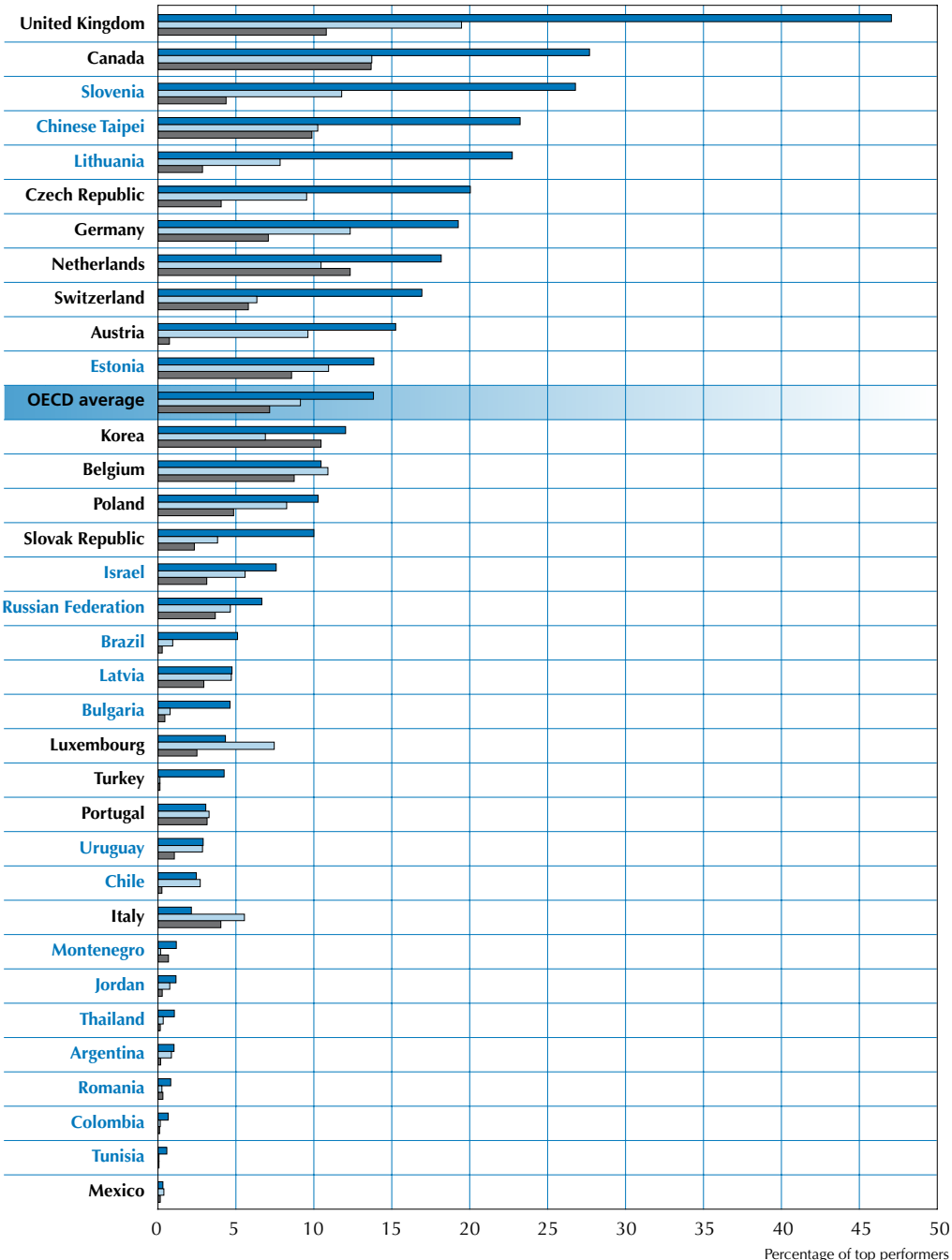
Admission and placement policies establish frameworks for the selection of students for academic programmes and for streaming students according to career goals and educational needs. In countries with large performance differences between programmes and schools or where socio-economic segregation is 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 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. Another question that arises with respect to the schools that top performers are attending is how selective such schools are regarding students' previous academic performance. Are most top performers in schools that are highly selective choosing only students who meet strong academic criteria? The PISA 2006 school questionnaire asked school principals about the selection criteria used for their schools. Specifically they were asked to indicate whether the student's academic record is a prerequisite for admission, is given high priority or considered for admission, or is not considered for admission. Table A2.9 and Figure 2.9 show the results for each performance group.

In general, schools where the student's academic record is a prerequisite for admittance have more top performers than schools where it is not. Across the OECD countries on average, of the schools where previous academic records were a prerequisite for admission 14% of the students were top performers, while 25% were strong performers and 46% of students were moderate performers. For schools where previous academic records were not considered for admission only 7% of the students were top performers, while 17% were strong performers and 52% were moderate performers. However, there are large differences among countries along this dimension. For example, in United Kingdom schools using previous academic performance as a prerequisite for admission almost half of the students were top performers (47%). For schools where previous academic records were not used for admission there were 11% of top performers in the United Kingdom. Results for Canada (with its relatively homogeneous distribution of top performers among schools with different average levels of performance) indicate that in schools where previous academic records were used for admission 28% of students were top performers and in schools where previous academic records were not used for admission 14% of students were top performers. Italy is an exception to this general pattern, because the proportion of top performers is higher among schools that do not consider the student's academic record than among those for which it is a prerequisite (Figure 2.9).

It is noteworthy that these differences at the school level are not at the system level. That is, there is no advantage for systems with a higher proportion of students in academically selective schools and the national proportion of top performers in science.[7]

Figure 2.9
Top performers, according to schools' use of selecting students by their academic record

Percentage of top performers in school where students' academic record is:
- "prerequisite" for admittance to school
- "high priority" or "considered" for admittance to school
- "not considered" for admittance to school



Source: *OECD PISA 2006 Database,* Table A2.9.

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IMPLICATIONS FOR EDUCATIONAL POLICY AND PRACTICE

Countries vary significantly in the proportion of students who demonstrate excellence in science performance. Interestingly, scientific excellence is only weakly related to average performance in countries, that is, while some countries show large proportions of both high and poor performers, other countries combine large proportions of 15-year-olds reaching high levels of scientific excellence with few students falling behind. While on average across OECD countries there are more top performers in science who excel also in mathematics but not reading, the proportion that excels in all three subject areas is significantly larger. The variance across countries highlights that different educational systems result in different kinds of top performers.

The talent pool of countries differs not just in its relative and absolute size, but also in its composition. Student characteristics such as gender, origin, language, or socio-economic status are related to top performance in science but none of these student characteristics impose an insurmountable barrier to excellence. It is particularly encouraging that in some education systems significant proportions of students with disadvantaged backgrounds achieve high levels of excellence, which suggests that there is no inevitable trade-off between excellence and equity in education. Interestingly, although in most countries native students are more likely to be high performers than students with an immigrant background, this difference is no longer significant after accounting for students' socio-economic background in half of the countries being compared. Some countries succeed better than others in promoting excellence among linguistic and immigrant minorities. There are lessons to be learnt from these countries that may help improve excellence and equity in educational outcomes.

Notes

1. When interpreting these results, one ought to keep in mind that science performance is accounted for when computing performance in mathematics and reading. For more information see OECD (2009b), *PISA 2006 Technical Report,* OECD, Paris.

2. Given that the cut-off points for top performance differ for each subject area, these findings should be interpreted with caution.

3. Note however that in some countries students from an immigrant background confounds very different groups of students. In some cases, in Ireland for example, about half of the immigrant students report speaking the language of instruction at home; that is they are not Irish but they speak English.

4. For details on the index please refer to pages 332 to 337 of *PISA 2006: Science Competencies for Tomorrow's World, Volume 1 Analysis.*

5. Intra-class correlation coefficient for students' socio-economic background (ESCS) and the differences in the school mean ESCS between schools with top performers and schools with strong performers are strongly related (R^2=0.45).

6. This research also shows that a stronger disciplinary climate is linked to better performance even when controlling for the school and student socio-economic background (OECD, 2004).

7. In 37 countries with available data, the variance in the proportion of top performers across the systems were explained by the proportion of students in academically selective schools (R^2= 0.0075).

Table of contents

LIST OF BOXES

LIST OF FIGURES

LIST OF TABLES

TOP OF THE CLASS – HIGH PERFORMERS IN SCIENCE IN PISA 2006 – ISBN 978-92-64-06068-5 – © OECD 2009