The ABC of Gender Equality in Education

APTITUDE, BEHAVIOUR, CONFIDENCE

Programme for International Student Assessment

OECD

The ABC of Gender Equality in Education

APTITUDE, BEHAVIOUR, CONFIDENCE

OECD
BETTER POLICIES FOR BETTER LIVES

Please cite this publication as:
OECD (2015), *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence,* PISA, OECD Publishing.
http://dx.doi.org/10.1787/9789264229945-en

ISBN 978-92-64-23002-6 (print)
ISBN 978-92-64-22994-5 (PDF)

Photo credits:
© Flying Colours Ltd/Getty Images
© Jacobs Stock Photography/Kzenon
© khoa vu/Flickr/Getty Images
© Mel Curtis/Corbis
© Shutterstock/Kzenon
© Simon Jarratt/Corbis

Corrigenda to OECD publications may be found on line at: *www.oecd.org/publishing/corrigenda*.

Foreword

To compete successfully in today's global economy, countries need to develop the potential of all of their citizens. They need to ensure that men and women develop the right skills and find opportunities to use them productively. Many countries are working towards achieving gender parity at the workplace and in access to jobs. In education, too, many countries have been successful in closing gender gaps in learning outcomes. Yet, as this report reveals, even when boys and girls are equally proficient in mathematics and science, their attitudes towards learning and aspirations for their future are markedly different – and that has a significant impact on their decisions to pursue further education and their choice of career.

The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence tries to determine why 15-year-old boys are more likely than girls, on average, to fail to attain a baseline level of proficiency in reading, mathematics and science, and why high-performing 15-year-old girls still underachieve in areas such as mathematics, science and problem solving when compared to high-performing boys. In 2012, 14% of boys and 9% of girls surveyed by the PISA exercise did not attain the PISA baseline level of proficiency in any of the three core subjects. On the other hand, in the top-performing economies in PISA, such as Shanghai-China, Singapore, Hong Kong-China and Chinese Taipei, girls perform on a par with their male classmates in mathematics and attain higher scores in mathematics than boys in most other countries and economies around the world.

As the evidence in the report makes clear, gender disparities in performance do not stem from innate differences in aptitude, but rather from students' attitudes towards learning and their behaviour in school, from how they choose to spend their leisure time, and from the confidence they have – or do not have – in their own abilities as students. In fact, the report shows that the gender gap in literacy proficiency narrows considerably – and even disappears in some countries – among young men and women in their late teens and 20s. Giving boys and girls an equal opportunity to realise their potential demands the involvement of parents, who can encourage their sons and daughters to read; teachers, who can encourage more independent problem solving among their students; and students themselves, who can spend a few more of their after-school hours "unplugged".

This report is a valuable contribution to the OECD's work on gender issues, which examines existing barriers to gender equality in education, employment and entrepreneurship with the aim of improving policies and promoting gender equality in both OECD and partner countries. It shows clearly that we cannot rest complacent. We can provide a better future to our children if we act upon the evidence presented in this report.

Angel Gurría
OECD Secretary-General

Acknowledgements

This report is the product of a collaborative effort between the countries participating in PISA and the OECD Secretariat. The report was drafted by Francesca Borgonovi and Marilyn Achiron, with contributions from Giannina Rech and Angelica Salvi del Pero. Andreas Schleicher, Michael Davidson, Yuri Belfali, Monika Queisser, Francesco Avvisati and Joel Rapp provided valuable feedback at various stages of the report. François Keslair, Louise Caron, Lorena Ortega Ferrand, Célia Braga-Schich, Sophie Limoges, Alfonso Echazarra, Daniel Salinas, Miki Tadakazu, Juliet Evans, Claire Chetcuti, Elisabeth Villoutreix and Louise Binn provided statistical, editorial and administrative support. The development of the report was steered by the PISA Governing Board, which is chaired by Lorna Bertrand (United Kingdom).

Table of Contents

BOX

FIGURES

Executive Summary

Over the past century, OECD countries have made significant progress in narrowing or closing long-standing gender gaps in many areas of education and employment, including educational attainment, pay and labour market participation. This one fact implies another: that aptitude knows no gender. Given equal opportunities, boys and girls, men and women have equal chances of achieving at the highest levels.

But new gender gaps in education are opening. Young men are significantly more likely than young women to be less engaged with school and have low skills and poor academic achievement. They are also more likely to leave school early, often with no qualifications. Boys in OECD countries, for example, are eight percentage points more likely than girls to report that school is a waste of time. Meanwhile, in higher education and beyond, young women are under-represented in the fields of mathematics, physical science and computing. In 2012, only 14% of young women who entered university for the first time chose science-related fields of study, including engineering, manufacturing and construction. By contrast, 39% of young men who entered university that year chose to pursue one of those fields of study.

Underachievement among boys

PISA finds that 15-year-old boys are more likely than girls of the same age to be low achievers. In 2012, 14% of boys and 9% of girls did not attain the PISA baseline level of proficiency in any of the three core subjects measured in PISA – reading, mathematics and science. In fact, six out of ten students who did not attain the baseline level of proficiency in any of those subjects were boys. There are many possible reasons for boys' poor performance in school, and many of them are connected with differences in behaviour between boys and girls. For example, boys spend one hour less per week on homework than girls – and each hour of homework per week translates into a four-point higher score in the PISA reading, mathematics and science tests. Outside of school, boys spend more time playing video games than girls and less time reading for enjoyment, particularly complex texts, like fiction. Reading proficiency is the foundation upon which all other learning is built; when boys don't read well, their performance in other school subjects suffers too.

Lack of self-confidence among girls

In the large majority of countries and economies that participate in PISA, among high-performing students, girls do worse than boys in mathematics; in no country do they outperform boys at this level. In general, girls have less self-confidence than boys in their ability to solve mathematics or science problems. Girls – even high-achieving girls – are also more likely to express strong feelings of anxiety towards mathematics. On average across OECD countries, the score-point difference in mathematics performance between high-achieving girls and boys is 19 score points. However, when comparing boys and girls who reported similar levels of self-confidence in mathematics and of anxiety towards mathematics, the gender gap in performance disappears.

PISA reveals that girls tend to do better when they are required to work on mathematical or scientific problems that are more similar to those that are routinely encountered in school. But when required to "think like scientists", girls underperform considerably compared to boys. For example, girls tend to underachieve compared to boys when they are asked to formulate situations mathematically. On average across OECD countries, boys outperform girls in this skill by around 16 PISA score points – the equivalent of nearly five months of school. Boys also outperform girls – by 15 score points – in the ability to apply their knowledge of science to a given situation, to describe or interpret phenomena scientifically and predict changes. This gender difference in the ability to think like a scientist may be related to students' self-confidence. When students are more self-confident, they give themselves the freedom to fail, to engage in the trial-and-error processes that are fundamental to acquiring knowledge in mathematics and science.

What these results mean for students' futures

PISA has consistently found that, in general, girls have higher expectations for their careers than boys; but on average across OECD countries, less than 5% of girls contemplate pursuing a career in engineering and computing. In virtually all countries, the number of boys thinking of a career in computing or engineering exceeds the number of girls contemplating such a career.

By contrast, boys seem to be better prepared to enter the work force or to look for a job than girls. PISA finds that the share of 15-year-old girls who reported that they had not learned how to prepare for a job interview is more than 10 percentage points larger than the share of boys who so reported. And larger proportions of boys than girls reported that they had participated in such "hands-on" activities as internships and job shadowing.

As boys mature and become young men, they also acquire, at work and through life experience, some of the reading skills that they hadn't acquired at school. Results from the 2012 Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies, finds that there are no significant gender differences in literacy proficiency among 16-29 year-olds. Among workers in their 30s, 40s and particularly those in their 50s and 60s, men appear to be considerably more likely than women to read, write and use problem-solving skills at work.

How to narrow – or close – the gender gaps in education

Parents can give their sons and daughters equal support and encouragement for all of their school work and aspirations for their future. PISA results show that this doesn't always happen. In all countries and economies that surveyed the parents of students who sat the PISA test, parents were more likely to expect their sons, rather than their daughters, to work in a science, technology, engineering or mathematics field – even when their 15-year-old boys and girls perform at the same level in mathematics.

Teachers can help by becoming more aware of their own gender biases that may affect how they award marks to students. They could also receive additional training in how to provide extra support to socio-economically disadvantaged students, since PISA finds that boys are more likely to underachieve when they attend schools with a large proportion of disadvantaged students. In addition, teachers can use teaching strategies that demand more of their students, since all students, but particularly girls, perform better in mathematics when their teachers ask them to try to solve mathematical problems independently.

In some of the top-performing countries and economies in PISA, such as Hong Kong-China, Shanghai-China, Singapore and Chinese Taipei, girls perform on a par with their male classmates in mathematics and attain higher scores than all boys in most other countries and economies around the world. Similarly, while in all countries and economies boys underperform in reading compared to girls – and by a wide margin – boys in the top-performing education systems score much higher in reading than girls elsewhere. These results strongly suggest that gender gaps in school performance are not determined by innate differences in ability. A concerted effort by parents, teachers, policy makers and opinion leaders is needed if both boys and girls are to be able to realise their full potential and contribute to the economic growth and well-being of their societies.

Reader's Guide

Data underlying the figures

The data tables are listed in Annex B and available on line at www.oecd.org/pisa.

Five symbols are used to denote missing data:

a The category does not apply in the country concerned. Data are therefore missing.

c There are too few observations or no observation to provide reliable estimates (i.e. there are fewer than 30 students or less than five schools with valid data).

m Data are not available. These data were not submitted by the country or were collected but subsequently removed from the publication for technical reasons.

w Data have been withdrawn or have not been collected at the request of the country concerned.

x Data are included in another category or column of the table.

Country coverage

This publication features data on 64 countries and economies: 34 OECD countries (indicated in black in the figures) and 30 partner countries and economies (indicated in blue in the figures).

Calculating international averages

An OECD average was calculated for most indicators presented in this report. The OECD average corresponds to the arithmetic mean of the respective country estimates. Readers should, therefore, keep in mind that the term "OECD average" refers to the OECD countries included in the respective comparisons.

Rounding figures

Because of rounding, some figures in tables may not exactly add up to the totals. Totals, differences and averages are always calculated on the basis of exact numbers and are rounded only after calculation. All standard errors in this publication have been rounded to one or two decimal places. Where the value 0.00 is shown, this does not imply that the standard error is zero, but that it is smaller than 0.005.

Bolding of estimates

This report discusses only statistically significant differences or changes (statistical significance at the 5% level). These are denoted in darker colours in figures and in bold in tables.

Reporting student data

The report uses "15-year-olds" as shorthand for the PISA target population. PISA covers students who are aged between 15 years 3 months and 16 years 2 months at the time of assessment and who have completed at least 6 years of formal schooling, regardless of the type of institution in which they are enrolled and of whether they are in full-time or part-time education, of whether they attend academic or vocational programmes, and of whether they attend public or private schools or foreign schools within the country.

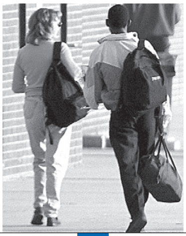
Note regarding Israel

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.

Note regarding the Russian Federation in the Survey of Adult Skills

Readers should note that the sample for the Russian Federation does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65 in Russia but rather the population of Russia excluding the population residing in the Moscow municipal area.

More detailed information regarding the data from the Russian Federation as well as that of other countries that participated in the Survey of Adult Skills can be found in the *Technical Report of the Survey of Adult Skills* (OECD, 2013).



1

Emerging Gender Gaps in Education

This chapter examines trends in achievement among girls and boys and identifies the school subjects – and the specific sets of skills associated with those subjects – in which boys and girls appear to excel – or fail.

Over the past century, OECD countries have made significant progress in narrowing or closing long-standing gender gaps in many areas of education and employment, including educational attainment, pay and labour market participation. This one fact implies another: that aptitude knows no gender. Given equal opportunities, boys and girls, men and women have equal chances of fulfilling their potential.

But new gender gaps are opening. Young men are significantly more likely than young women to have low levels of skills and poor academic achievement, and are more likely to leave school early, often with no qualifications. Meanwhile, in higher education and beyond, young women are under-represented in the fields of mathematics, physical science and computing, but dominate the fields of biology, medicine, agriculture and humanities (Osborne et al., 2003; Charles and Grusky, 2004).

Many boys find school out of sync with their interests and preferences and, as a result, often feel disaffected and not motivated to work in school. Given the findings of the 2012 Survey of Adult Skills[1] – that poor proficiency in numeracy and literacy severely limits access to better paying and more rewarding occupations, and has a negative impact on health and on social and political participation (OECD, 2013) – the underachievement of young men has severe consequences not only for their own futures (Erikson et al., 2005; Rose and Betts, 2004), but for societies as a whole (OECD, 2010). Indeed, poor performance in school is a strong predictor of early school dropout, which is related to far worse social outcomes later in life (Balfanz et al., 2007; OECD, 2010; Oreopoulos, 2007; Rumberger, 2011).

What the data tell us

- Across OECD countries in 2012, 14% of boys and 9% of girls did not attain the PISA baseline level of proficiency in any of the three core subjects.
- In 2012, boys outperformed girls in mathematics in 38 participating countries and economies by an average of 11 score points (across OECD countries) while no gender gap was observed in science performance. However, among the top 10% of students in mathematics performance, the gender gap averages 20 score points; and among the top 10% in science, boys score an average of 11 points higher than girls.
- Only 14% of young women who entered university for the first time in 2012 chose science-related fields, including engineering, manufacturing and construction; by contrast, 39% of young men who entered university that year chose to pursue one of those fields of study.

There are other, and considerable, social costs associated with low-performing students. If a large share of the workforce does not have basic skills, the long-term growth of an economy is compromised. Public finances may be squeezed to fund social benefits and higher healthcare costs. Moreover, since low-performing students are less likely to engage politically later on, the government has fewer incentives to unearth and examine the roots of their underperformance at school.

According to a recent estimate based on data from the OECD Programme for International Student Assessment (PISA), there would be massive long-term economic gains for OECD countries if reforms to reduce the number of low-performing students were implemented today (OECD, 2010).

Equality of opportunity for men and women is first and foremost a moral imperative; but it is also key to economic growth and well-being. Investments in education improve economic and social opportunities, helping to reduce poverty and foster technological progress. The overall increase in educational attainment in OECD countries over the past 50 years accounted for about 50% of the economic growth in those countries during that period; and more than half of that growth can be attributed to higher educational attainment among women. In addition, education – especially education for girls and women – reduces child mortality rates, improves individual health and, in doing so, promotes investment in the education and health of future generations (OECD, 2012).

Progress in addressing gender segregation in occupations has been far slower (Sikora and Pokropek, 2011). Yet reducing occupation segregation could pay off in a couple of important ways. First, segregation suggests that there are impediments to choosing an occupation that are related to gender. Identifying and removing such impediments may improve efficiency in the transition from school to work, since then all students will feel encouraged to pursue studies in the field that interests them and in which they can fully express their potential. As a result, participation in the labour market will grow. Dismantling such barriers can also help the economy to respond to rapid changes in the demand for skills stemming from technological change. In addition, greater occupation equality may help to eliminate gender stereotypes that have a negative impact on the status of women (Anker, 1997).

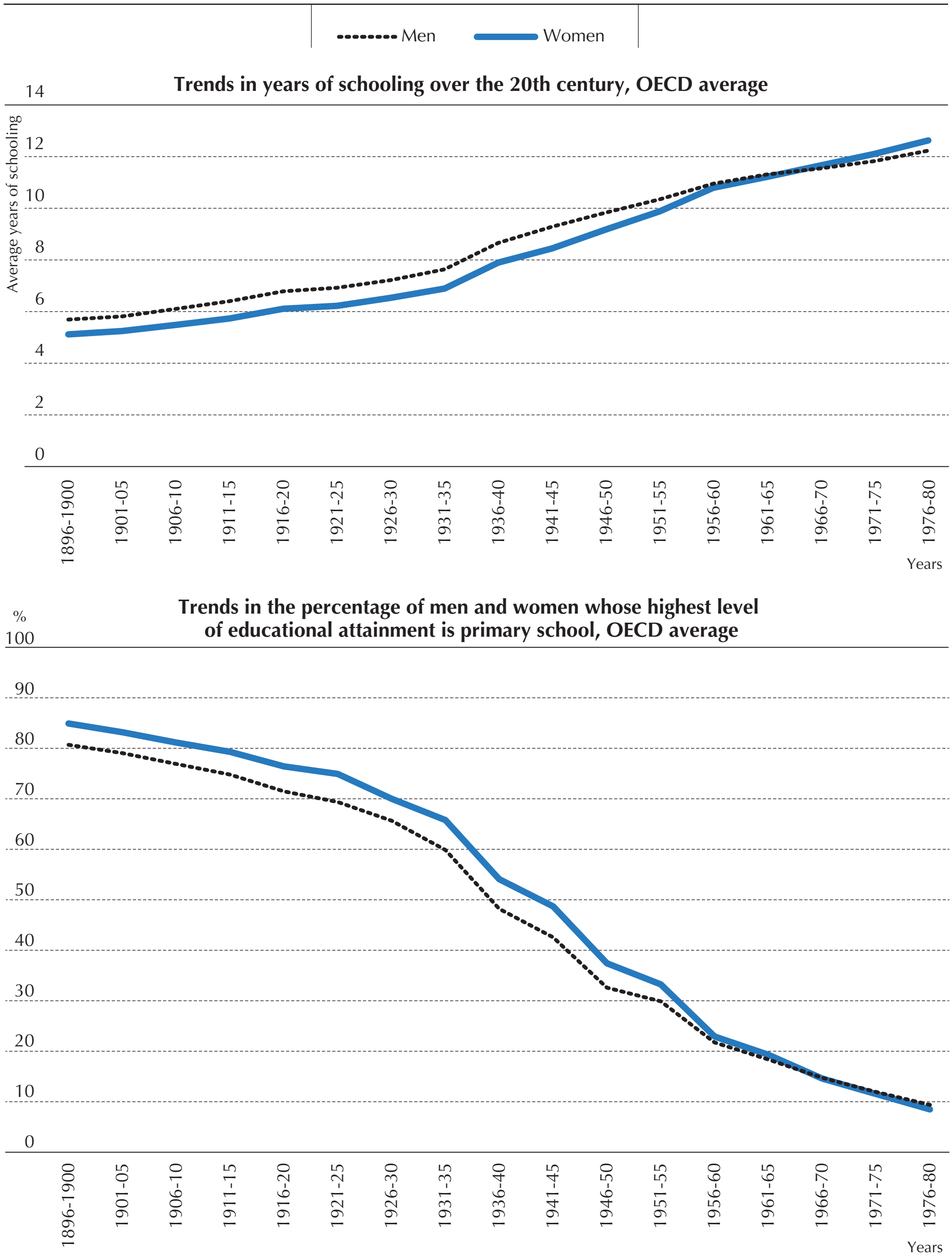
To tackle the double disadvantage of having too many boys who drop out of school or leave school with low skills and/or skills that are not well matched with labour market requirements, and not having enough students, particularly female students, enrolled in the science, technology, engineering and mathematics (STEM) fields of study, countries need first to understand why there are gender gaps in academic achievement. Knowing how boys and girls develop their skills while at school and what factors – including such intangibles as behaviour and self-confidence – influence their decisions about their future education and career pathways is critical. Only then will educators and policy makers be able to ensure that each individual has the opportunity to realise his or her potential. Only then will countries be able to develop strong, dynamic and inclusive economies, particularly as they confront the economic, demographic and fiscal challenges that are sure to arise in the years ahead.

HISTORIC PROGRESS IN YOUNG WOMEN'S EDUCATION

Figure 1.1 shows that, since the early 1900s, the average number of years spent in education among the working-age population in OECD countries increased from 6 to 12 years for men and from 5 to 13 years for women. As OECD countries have made education compulsory, usually between the ages of 5 to 7 and 14 to 16, attaining secondary education has become the norm for men and women.

■ Figure 1.1 [1/2] ■

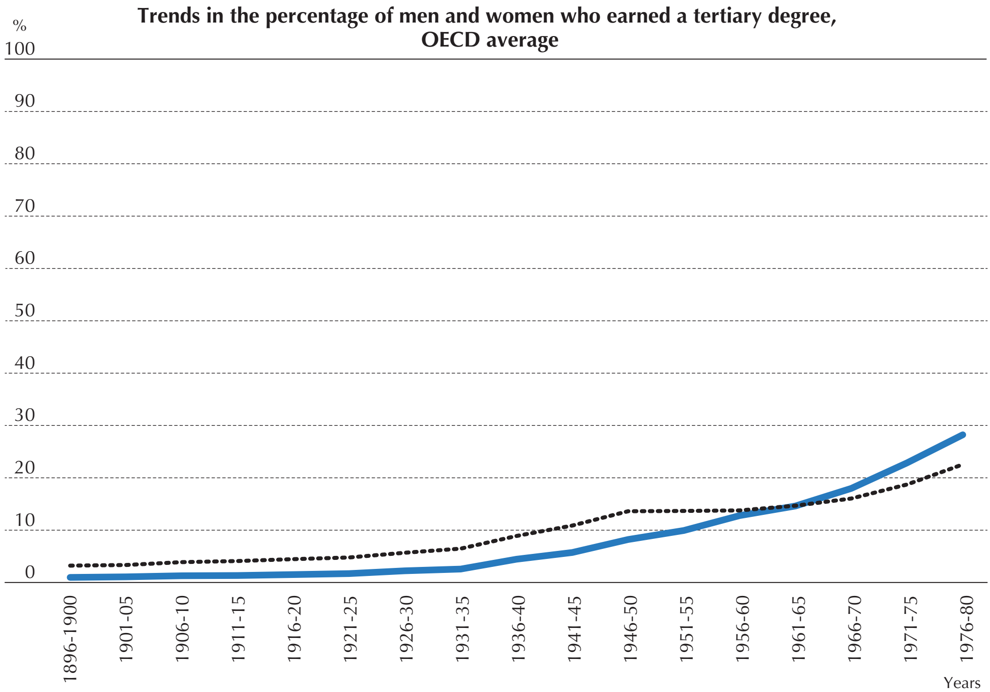
Long-term trends in gender gaps in education, 1896-1980



Source: Barro and Lee, 2013.

■ Figure 1.1 [2/2] ■

Long-term trends in gender gaps in education, 1896-1980



Source: Barro and Lee, 2013.

Not only are more young women than ever before participating in formal education and enrolling in higher education, over the past decade the gender hierarchy in educational attainment has been inverted. In 2000, adult men had higher tertiary attainment rates than adult women; but by 2012, that had changed: 34% of women across OECD countries had attained a tertiary education compared with 30% of men (Table 1.1a). That same year, more young women (87%) than young men (81%) had graduated from an upper secondary programme (Table 1.1b). This trend is even more striking among students younger than 25. In 2012, 54% of graduates from upper secondary general programmes were women and 43% were men of that age group, on average. In Austria, the Czech Republic, Italy, Poland, the Slovak Republic and Slovenia, women outnumbered men as upper secondary graduates by at least three to two (Table 1.1b). Women are also participating more in advanced research programmes. In 2010, the proportion of advanced research degrees awarded to women ranged between 40% and 50% in most OECD countries (Table 1.1c).

Young women are even making inroads into some education pathways that had traditionally attracted mostly men. Graduation rates from pre-vocational and vocational upper secondary programmes have been higher among men (50%, on average across OECD countries) than among women (46%, on average) (Table 1.1b). But in recent years, this trend has reversed in some countries. For example, in 2012 in Belgium, Denmark, Finland, Ireland, the Netherlands and Spain, the proportions of young women who graduated from upper secondary pre-vocational and vocational programmes were at least 5 percentage points larger than the proportions of men who did.

And, as results from PISA have shown, girls do very well in school, too. In all countries and economies that participated in PISA 2012, girls outperformed boys in reading by an average of 38 score points (across OECD countries) – the equivalent of one year of school – as they have done consistently throughout all the PISA cycles since 2000. Boys, however, continued to outperform girls in mathematics in 38 participating countries and economies by an average of 11 score points (across OECD countries) – equivalent to around three months of school. PISA also reveals that there is very little difference in science performance between boys and girls (Tables 1.2a, 1.3a, 1.4a).

The changing landscape in education and labour markets has been accompanied by major shifts in what young boys and girls expect for their future. Over the past decade, PISA has asked the 15-year-old students who sit the triennial test in reading, mathematics and science to describe what they expect for their future education and occupation. Their reports suggest that girls hold more ambitious educational and occupational expectations than boys. At the same time, not only do boys seem less ambitious than girls, they are also more likely – far more likely – to expect that their formal education will end after earning an upper secondary degree, even when they do just as well as girls on the PISA assessment.

What these results imply is that, in the shadow of the progress that has been made in both education and employment over the past century, other problems are festering.

LOW-PERFORMING BOYS

Among the countries and economies that showed a gender gap, in favour of boys, in mathematics performance in 2003, by 2012 the gender gap had narrowed by nine PISA score points or more in Finland, Greece, Macao-China, the Russian Federation and Sweden. In Greece, while boys outperformed girls in mathematics by 19 points in 2003, by 2012 this difference had shrunk to 8 score points. In Finland, Macao-China, the Russian Federation, Sweden, Turkey and the United States, there was no longer a gender gap in mathematics performance favouring boys in 2012 compared to 2003. In Austria, Luxembourg and Spain, the gender gap favouring boys widened between 2003 and 2012. For example, in Austria in 2003, there was no observed gender gap in mathematics performance; but by 2012 there was a 22 score-point difference in performance in favour of boys. Iceland was one of the few countries where girls outperformed boys in mathematics in 2003; in 2012, girls still outperformed boys, but the gender gap had narrowed (Table 1.3b).

While a narrower gender gap in mathematics, in favour of boys, is undeniably good news, it comes as the result of a worrying trend: many low-performing boys are failing to improve. In Latvia, Portugal, the Russian Federation and Thailand, the share of girls who perform below proficiency Level 2 shrunk between 2003 and 2012 with no concurrent change in the share of low-performing boys. In Macao-China and the Russian Federation during the period, the share of top-performing girls increased with no such increase among boys. In addition, Italy, Poland, Portugal and the Russian Federation show a reduction in the share of girls who perform below Level 2 and an increase in the share of girls who perform at Level 5 or 6 (see Table I.2.2b in OECD, 2014a).

Across all three of the core school subjects that PISA assesses – reading, mathematics and science – and across all PISA-participating countries and economies, girls are as likely as boys to be academic all-rounders, meaning that they score at PISA proficiency Level 5 or 6 in all subjects. On average across OECD countries, 4% of girls and 4% of boys are academic all-rounders, meaning that they are top performers in all three subjects. But while the gender gap among students who are top performers only in science is small (1% of boys and girls), it is large among top performers in mathematics only (3% of girls and 6% of boys) and in reading only (3% of girls and less than 1% of boys) (Table 1.7).

Stark gender differences are observed among the lowest-performing students – those who score below PISA proficiency Level 2, which is considered to be the baseline level of proficiency, in all subjects. While the proportion of girls is marginally larger than that of boys among poor performers in mathematics, in all but six countries, a larger proportion of boys than girls does not even achieve the baseline level of proficiency in any of the three PISA core subjects. In fact, six out of ten students who are low achievers in all three subjects are boys (Table 1.8).

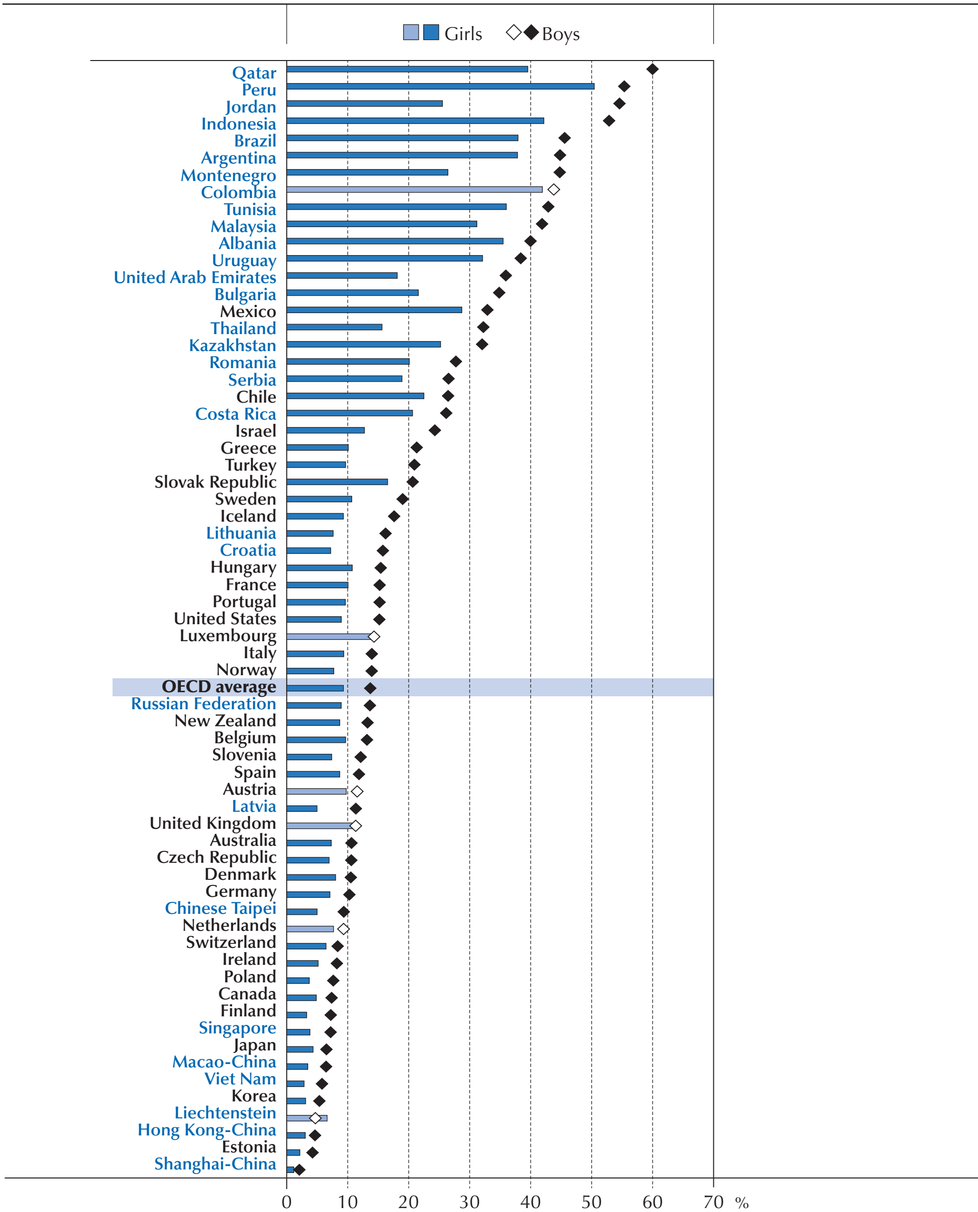
Results presented in Figure 1.2 suggest that, across OECD countries, boys are 4 percentage points more likely than girls to be low-achievers in reading, science and mathematics. In 2012, 14% of boys and 9% of girls did not attain the PISA baseline level of proficiency in any of the three core subjects. The percentage of boys who failed to reach the baseline level of proficiency in any subject is worryingly high in many countries. More than one in five students in Chile, Greece, Israel, Mexico, the Slovak Republic and Turkey failed to make the grade in any of the three core PISA subjects. Among partner countries and economies, the proportions are even larger. In Indonesia, Jordan, Peru and Qatar more than one in two students failed to make the grade.

The proportion of girls who failed to make the grade is much smaller. Peru is the only country that participated in PISA 2012 where more than one in two girls did not reach the baseline level of proficiency in any of the three subjects. In Chile and Mexico, more than one in five girls failed to make the grade in all three subjects, and in eight partner countries, more than one in three girls failed to make the grade (Table 1.8).

Among OECD countries, gender differences were particularly large in Israel, where the proportion of boys who scored below the baseline level in all three subjects was 12 percentage points larger than the proportion of girls with similar scores. The gender gap was 11 percentage points wide in Greece and Turkey, and more than 10 percentage points wide in the partner countries Bulgaria, Indonesia, Jordan, Malaysia, Montenegro, Qatar, Thailand and the United Arab Emirates.

■ Figure 1.2 ■

Gender differences in the percentage of students who are low achievers in all subjects



Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the percentage of boys who are low performers (below PISA proficiency Level 2) in reading, mathematics and science.
Source: OECD, PISA 2012 Database, Table 1.8.

The sizeable number of boys who fail to make the grade in all three core PISA subjects is a major challenge for education systems. Students who perform poorly in all subjects are hard to motivate and keep in school because there is very little that teachers, school principals and parents can build on to promote improvement. Because of their very low levels of skills, these students may also feel disconnected from and disengaged with school. It may then become easier for these students to build an identity based on rebellion against school and formal education than to engage and invest the effort needed to break the vicious cycle of low performance and low motivation.

As Chapter 2 shows, boys' behaviour, both in and outside of school, has a strong impact on their performance. Education systems in most countries appear to be unable to develop learning environments, pedagogical practices and curricula that relate to and engage the interests and dispositions of many teenage boys. What emerges from the analyses in Chapter 4 on the skills of adult men and women suggests that once young men have opportunities to practice their skills in real-world settings, they often thrive and pick up some of the skills, like reading skills, that they had failed to develop while at school.

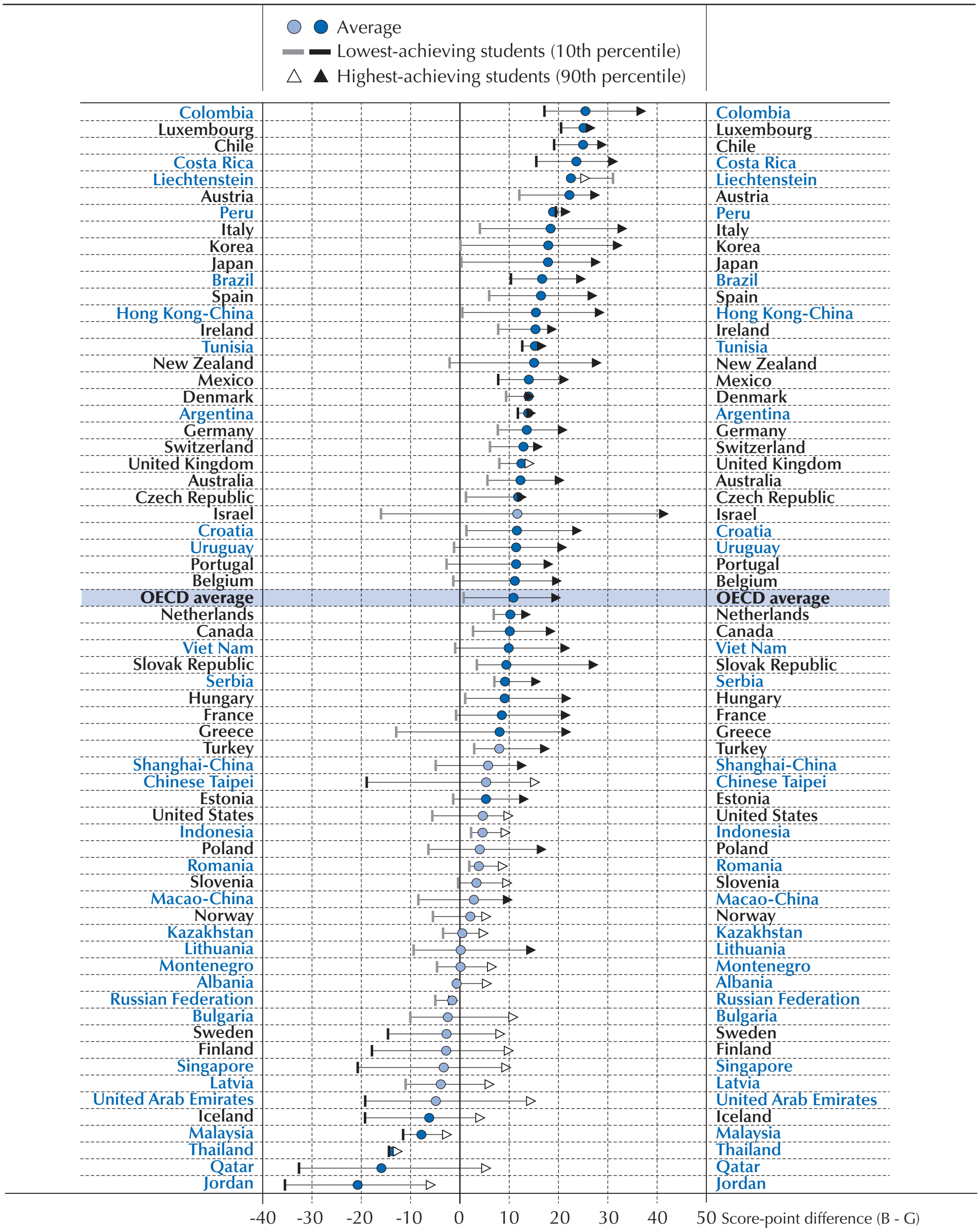
HIGH-PERFORMING GIRLS

Across OECD countries in 2012, women were awarded only a small proportion of university degrees in the fields of engineering, manufacturing and construction (28%) and computing (20%). Only in Estonia, Iceland, Italy, Luxembourg and Poland – and the partner countries Argentina and Colombia – was at least one in three graduates from these fields a woman (OECD, 2014b). This situation has changed only slightly since 2000, despite many initiatives to promote gender equality in OECD countries. In 2000, the European Union established a goal to increase the number of university graduates in mathematics, science and technology by at least 15% by 2010, and to reduce the gender imbalance in these subjects. So far, however, progress towards this goal has been marginal. The Czech Republic, Germany, Portugal, the Slovak Republic and Switzerland are the only five OECD countries in which the proportion of women in the broad field of science (which includes life sciences, physical sciences, mathematics and statistics, and computing) grew by at least 10 percentage points between 2000 and 2012. As a result, these countries are now closer to or even above the OECD average in this respect. Across OECD countries, the proportion of women in these fields has grown slightly, from 40% in 2000 to 41% in 2012 – even as the proportion of female graduates in all fields grew from 54% to 58% during the same period (Table 1.1d).

Although the proportion of women in engineering, manufacturing and construction is small, it also increased slightly, from 23% to 28%, over the past decade. But in 2012, only 14% of young women who entered university for the first time chose science-related fields, including engineering, manufacturing and construction; by contrast, 39% of young men who entered university that year chose to pursue one of those fields of study (Table 1.1e). This is significant not only because women are severely under-represented in the STEM fields of study and occupations, but also because graduates of these fields are in high demand in the labour market and because jobs in these fields are among the most highly paid (OECD, 2012).

■ Figure 1.3 ■

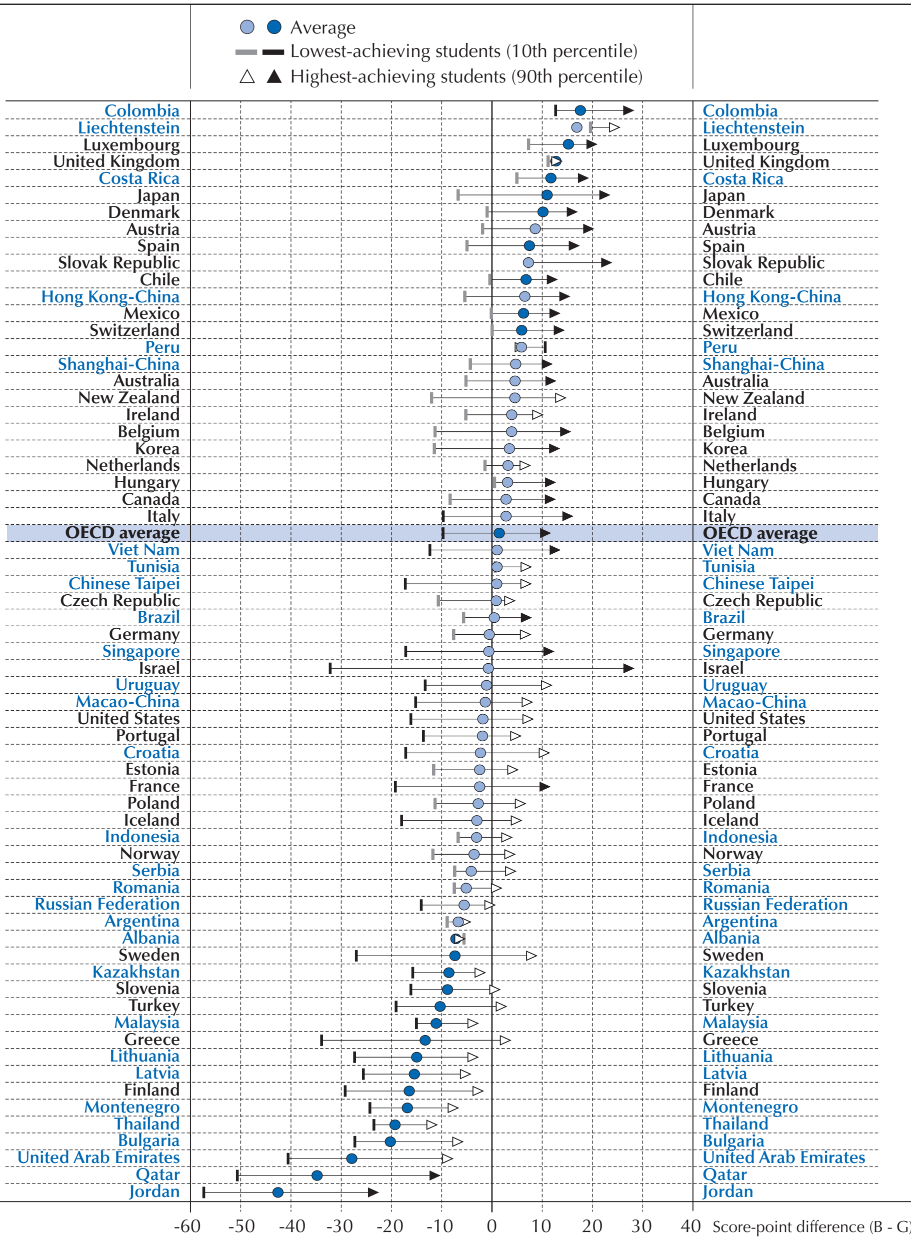
Gender differences in mathematics across the performance distribution



Note: Gender differences among each group that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the score-point difference between boys and girls (boys – girls) among average students.
Source: OECD, PISA 2012 Database, Table 1.3a.

■ Figure 1.4 ■

Gender differences in science across the performance distribution



Note: Gender differences among each group that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the score-point difference between boys and girls (boys – girls) among average students.
Source: OECD, PISA 2012 Database, Table 1.4a .

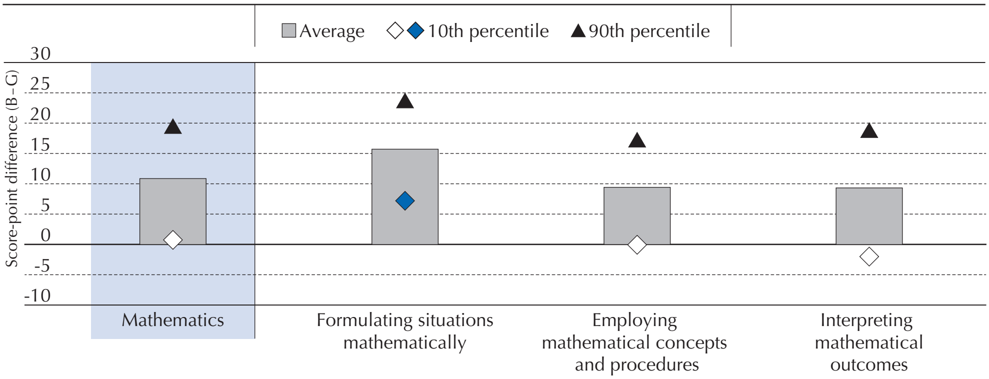
PISA results show that boys continue to perform better than girls in mathematics, particularly among the highest-achieving students. While gender differences in science and problem-solving performance are small, on average, boys tend to be over-represented among the highest achievers. As noted above, in PISA 2012 boys outperformed girls in mathematics in 38 participating countries and economies by an average of 11 score points (across OECD countries); but among the top 10% of students in mathematics performance, this gap is as wide as 20 score points, on average across OECD countries (Figure 1.3 and Table 1.3a). In science, among the best-performing 10% of students, boys have an advantage of 11 points over girls. Only in Jordan and Qatar do high-achieving girls have better scores in science than high-achieving boys. On average, however, girls outperform boys in science in 16 countries and economies, while boys outperform girls in 10 countries and economies (Figure 1.4 and Table 1.4a).

A closer look at girls' performance in mathematics and science reveals that girls still lag behind boys in being able to "think like scientists". For example, girls tend to underachieve compared to boys when they are asked to formulate situations mathematically, translating a word problem into a mathematical expression (Table 1.10a). On average across OECD countries, boys outperform girls in this skill by around 16 points, while the average gender gap in mathematics as a whole is 11 score points. The largest differences in favour of boys are observed in Luxembourg (33 points), Austria (32 points), Chile (29 points), Italy (24 points), New Zealand (23 points) and Korea (22 points). Ireland, Mexico and Switzerland show a gender difference of 20 points, while the United States shows a gender gap of 8 points. Among partner countries and economies, boys outperform girls in this skill by 33 points in Costa Rica, and by between 20 and 30 points in Brazil, Colombia, Hong Kong-China, Liechtenstein, Peru, Tunisia and Uruguay. In several partner countries and economies, the gap is less than 10 points: Macao-China (9 points), Shanghai-China (8 points), Kazakhstan (7 points) and Montenegro (6 points). Only in Qatar do girls outperform boys (by 9 points) in this specific skill (Table 1.10a).

■ Figure 1.5 ■

Boys' and girls' strengths and weaknesses in mathematics

Score-point difference between boys and girls, OECD countries

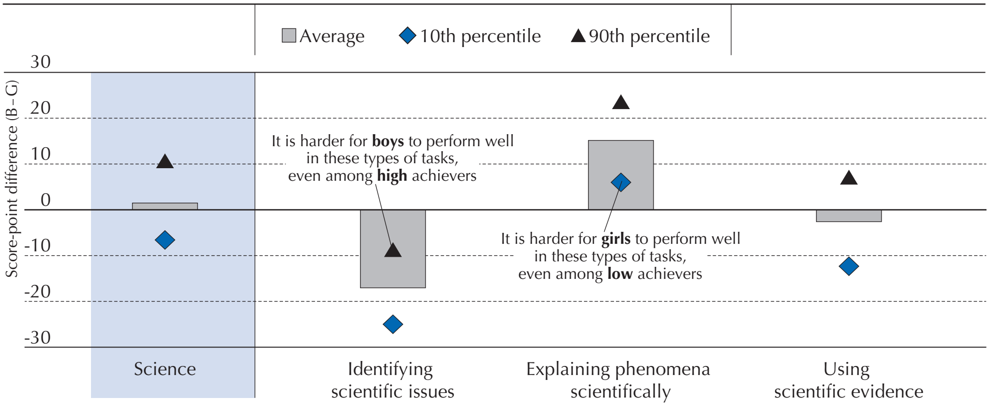


Note: Gender differences that are statistically significant are marked in a darker tone.
Source: OECD, PISA 2012 Database, Tables 1.3a, 1.10a, 1.10b and 1.10c.

■ Figure 1.6 ■

Boys' and girls' strengths and weaknesses in science

Score-point difference between boys and girls, OECD countries



Note: All gender differences are statistically significant.
Source: OECD, PISA 2006 Database, Tables 1.4b, 1.11a, 1.11b and 1.11c.

Girls also lag behind boys when they are required to explain phenomena scientifically (Table 1.11b). Boys' strength in science lies in their greater capacity, on average, to apply their knowledge of science to a given situation, to describe or interpret phenomena scientifically and predict changes. On average across OECD countries, boys outperform girls in this specific skill by 15 score points. The gender gap is particularly large in Chile (34 score points), Luxembourg (25 points), Hungary and the Slovak Republic (both 22 points), and in the Czech Republic, Denmark, Germany and the United Kingdom (21 points) (Table 1.11b).

The analysis presented in Chapter 3 suggests that high-performing girls' underachievement in mathematics and science, particularly in tasks that require them to formulate problems mathematically or to explain phenomena scientifically, may have a lot to do with girls' confidence in their own ability in these subjects. When students are more self-confident, they give themselves the freedom to fail, to engage in trial-and-error processes that are fundamental to acquiring knowledge in mathematics and science. Girls tend to be more fearful of making mistakes, perhaps because they cannot distinguish, psychologically, between "I made a mistake" and "I am mistaken".

Self-confidence is also what enables high-achieving students to reach their potential and not choke under pressure. PISA reveals that self-efficacy (the extent to which students believe in their own ability to solve specific mathematics tasks) and self-concept (students' beliefs in their own mathematics abilities) are much more strongly associated with performance among high-achieving than low-achieving students (see Chapter 3); but at every level of performance, girls tend to have much lower levels of self-efficacy and self-concept in mathematics and science. For example, among students who perform at Level 5 or 6 in mathematics, boys have much higher levels of mathematics self-efficacy and mathematics self-concept, and much less mathematics

anxiety than girls (Table 3.6c). And while girls have less self-efficacy and lower self-concept, they tend to be highly motivated to do well in school and to believe that doing well at school is important (Table 2.15). They also tend to fear negative evaluations by others more than boys do, and are eager to meet others' expectations for them. Given girls' keen desire to succeed in school and to please others, their fear of negative evaluations, and their lower self-confidence in mathematics and science, it is hardly surprising that high-achieving girls choke under (often self-imposed) pressure.

WHAT HAPPENS AS GIRLS AND BOYS PURSUE FURTHER EDUCATION OR WORK

The underachievement of boys in reading and in completing secondary and tertiary education, and the underachievement of girls in STEM subjects are particularly worrying because they are likely to have long-lasting consequences for young people's participation in the labour market and on countries' economic growth. For example, educational attainment, literacy proficiency and field of study jointly determine the likelihood that 16-29 year-olds will find themselves neither employed nor in education or training (NEET). Educational attainment and field of study also have an impact on people's wages, especially young people's wages. According to analyses conducted across countries, fields like teacher training, education science and humanities appear to carry a wage penalty for young workers (OECD, 2014b).

When individuals' potential is realised through education, people are more productive at work and their capacity to innovate may increase (Lucas, 1988; Romer, 1990; Howitt and Aghion, 1998; Nelson and Phelps, 1966; Benhabib and Spiegel, 2005; Arnold et al., 2011; Eberhardt and Teal, 2010; Canton, 2007; Thévenon et al., 2012). Conversely, economic growth is hindered when parts of the population do not reach their full potential. When young people choose to pursue a field of study based on someone else's idea of what is appropriate, rather than on their own preference, it is both a waste of individual potential and a loss for society.

Not surprisingly, PISA has consistently found that 15-year-old girls have higher expectations for their future careers than boys. But as the Survey of Adult Skills shows, by the time those students are in their late 20s, their reality looks very different. As noted in Chapter 4, in 2000, 36% of 15-year-old boys and 43% of girls that age expected to work as managers or professionals when they were 30; but in 2012, when those students were around 27 years old, only 22% of 25-34 year-old men and 23% of 25-34 year-old women worked in such occupations.

What the findings above imply is that there is something going on at the two ends of the performance spectrum, specifically among boys who are low achievers, particularly in reading, and among girls who are high achievers, particularly in mathematics. Low-achieving boys appear to be trapped in a cycle of poor performance, low motivation, disengagement with school and lack of ambition, while high-achieving girls are somehow thwarted from using their mathematical skills in more specialised higher education and, ultimately, in their careers.

What's going on? An analysis of results from PISA 2012 can try to answer that question. With a sample of more than 400 000 students from over 65 education systems around the world and data collection at regular intervals since the year 2000, PISA is invaluable for understanding the origins

of gender differences in academic achievement. PISA data indicate that students' performance varies more depending on where the student lives than on whether the student is a boy or a girl, and that, across countries, boys and girls show similar, albeit gender-specific, approaches to school and learning. PISA also collects a wealth of information about how individual students use their time, and how they feel about school and about the subjects they study in school, so that performance results can be analysed in the context of students' attitudes and behaviours. While PISA cannot measure the effect of gender stereotyping on students' academic achievement, it can go a long way towards showing how students' actions and attitudes – which are often, even unconsciously, influenced by social norms, including gender stereotypes – can make all the difference in whether or not boys and girls success in school – and beyond.

Note

1. The Survey of Adult Skills is a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC).

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.

References

Anker, R. (1997), "Occupational Segregation by Sex", *International Labour Review*, Geneva, Vol. 13.

Arnold J., A. Bassanini and **S. Scarpetta** (2011), "Solow or Lucas? Testing the speed of convergence on a panel of OECD countries", *Research in Economics*, Vol. 65, pp. 110-23.

Balfanz, R., L. Herzog, L and **D.J. Mac Iver** (2007), "Preventing student disengagement and keeping students on the graduation path in urban middle-grades schools: Early identification and effective interventions", *Educational Psychologist*, Vol. 42/4, pp. 223-235.

Barro, R. and **J.W. Lee (2013),** "A New Data Set of Educational Attainment in the World, 1950-2010", *Journal of Development Economics,* Vol. 104, pp. 184-198.

Benhabib, and **M. Spiegel** (2005), "Human capital and technology diffusion", in P. Aghion and Steven Durlauf (ed.), *Handbook of Economic Growth*, first edition, Vol. 1, Elsevier, pp. 935-966.

Canton, E. (2007), "Social returns to education: Macro-evidence", *De Economist*, Vol. 155/4, pp. 449-66.

Charles, M. and **D.B. Grusky** (2004), *Occupational Ghettos: The Worldwide Segregation of Women and Men*, Stanford University Press, Stanford, CA.

Eberhardt, M. and **F. Teal** (2010), "Aggregation versus heterogeneity in cross-country growth empirics", *CSAE Working Paper Series*, Vol. 32, University of Oxford.

Erikson, R. et al. (2005), "On class differentials in educational attainment", *Proceedings of the National Academy of Sciences*, Vol. 102/27, pp. 9730-9733.

Howitt, P. and **P. Aghion** (1998), "Capital accumulation and innovation as complementary factors in long-run growth," *Journal of Economic Growth*, Vol. 3/2, pp. 111-30.

Lucas, R.E. (1988), "On the mechanics of economic development", *Journal of Monetary Economics*, Vol. 22/3, pp. 3-42.

Nelson, R. and **E. Phelps** (1966), "Investments in human, technological diffusion, and economic growth", *American Economic Review*, Vol. 56/2, pp. 69-75.

OECD (2014a), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264208780-en.

OECD (2014b), *OECD Employment Outlook 2014*, OECD Publishing, Paris, http://dx.doi.org/10.1787/empl_outlook-2014-en.

OECD (2013), *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264204256-en.

OECD (2012), *Closing the Gender Gap: Act Now*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264179370-en.

OECD (2010), *The High Cost of Low Educational Performance: The Long-Run Economic Impact of Improving PISA Outcomes*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264077485-en.

Oreopoulos, P. (2007). "Do dropouts drop out too soon? Wealth, health and happiness from compulsory schooling," *Journal of Public Economics*, Vol. 91/11-12, pp. 2213-2229.

Osborne, J.F., S. Simon and **S. Collins** (2003), "Attitudes towards science: A review of the literature and its implications", *International Journal of Science Education,* Vol. 25/9, pp. 1049-1079.

Romer, Paul M. (1990), "Human capital and growth: Theory and evidence," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 32/1, pp. 251-286.

Rose, H. and **J.R. Betts,** (2004), "The effect of high school courses on earnings", *The Review of Economics and Statistics*, Vol. 86/2, pp. 497-513.

Rumberger, R.W. (2011), *Why Students Drop Out of High School and What Can Be Done About It*, Harvard University Press, Cambridge, MA.

Sikora, J. and **A. Pokropek** (2011), "Gendered career expectations of students: Perspectives from PISA 2006", *OECD Education Working Papers,* No. 57, OECD Publishing, Paris, http://dx.doi.org/10.1787/ 5kghw6891gms-en.

Thévenon, O. et al. (2012), "The effects of reducing gender gaps in education and labour force participation on economic growth in the OECD ", *OECD Social, Employment and Migration Working Papers*, No. 138, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k8xb722w928-en.

2

Tackling Underperformance among Boys

This chapter examines gender differences in the activities in which boys and girls engage outside of school, in their ability to regulate their behaviour and emotions, in engagement with school and attitudes towards learning, and in the marks boys and girls receive in school. All of these ultimately have an impact on students' futures, both in school and beyond.

PISA results have consistently shown that boys are more likely than girls to be overall low-achievers, meaning that they are more likely than girls to perform below the baseline level of proficiency in all three of the subjects that are tested in PISA: reading, mathematics and science. And boys are especially more likely to struggle with reading. Why do boys underachieve, particularly in reading?

Sifting through the many stories told through PISA data, the story of gender differences in 15-year-old students' performance involves two main characters: low-achieving boys – particularly in reading – and high-achieving girls – particularly in mathematics and science. How do these characters navigate their way through education while being pushed and pulled by the strong, sometimes contradictory, pressures of adolescence? To what extent do their peers shape their attitudes towards school and learning? In school, how do they behave with their teachers and their fellow students? Which education pathways do they choose, and why? And when they get home from school, how do they spend their afternoons and evenings? What do they do over the weekend and during school holidays? What do they tear themselves away from when their parents call them to the dinner table?

What the data tell us

- On average across OECD countries, only one in four boys, but more than one in two girls, reported that they had never played a one-player game on a computer; and 29% of boys but 71% of girls reported that they had never played collaborative online games.
- Across OECD countries, girls spend 5.5 hours per week doing homework, while boys spend a little less than 4.5 hours, on average. For each hour per week students spend doing homework, their score in reading, mathematics and science is 4 points higher, on average.
- Boys in OECD countries are twice as likely as girls to report that school is a waste of time, and are 5 percentage points more likely than girls to agree or strongly agree that school has done little to prepare them for adult life when they leave school.

Tackling underperformance among boys requires first examining some of the differences in how boys and girls spend their time, both in school and after school, and in their behaviour and attitudes towards each other and towards their teachers. This chapter discusses gender differences in the activities boys and girls engage in outside of school, such as the amount of time they spend on line and how they use this time, and how much they read for enjoyment rather than, for example, playing chess or programming a computer. It then examines gender differences in self-regulation, engagement with school, and attitudes towards learning, such as intrinsic motivation. All of these factors help to explain the gender gap in academic performance in a standardised assessment like PISA. They are also reflected in the marks boys and girls receive in school, which have significant consequences for students' future.

In a nutshell:
- Boys are **more** likely than girls to play video games.
- Boys are **more** likely than girls to spend time on computers and the Internet.
- Boys are **less** likely than girls to read outside of school for enjoyment.
- Boys are **less** likely than girls to enjoy activities connected with reading.
- Boys are **more** likely than girls to play chess and program computers.

- Boys are **less** likely than girls to do homework.
- Boys are **more** likely than girls to have negative attitudes towards school.
- Boys are **more** likely than girls to arrive late for school.
- Boys are **less** likely than girls to engage in school-related work out of intrinsic motivation.

The evidence emerging from PISA is that, while some after-school activities are more popular than others in certain countries, in virtually all countries boys and girls use their free time in distinctly different ways; and these differences have a significant impact on the skills that boys and girls acquire.

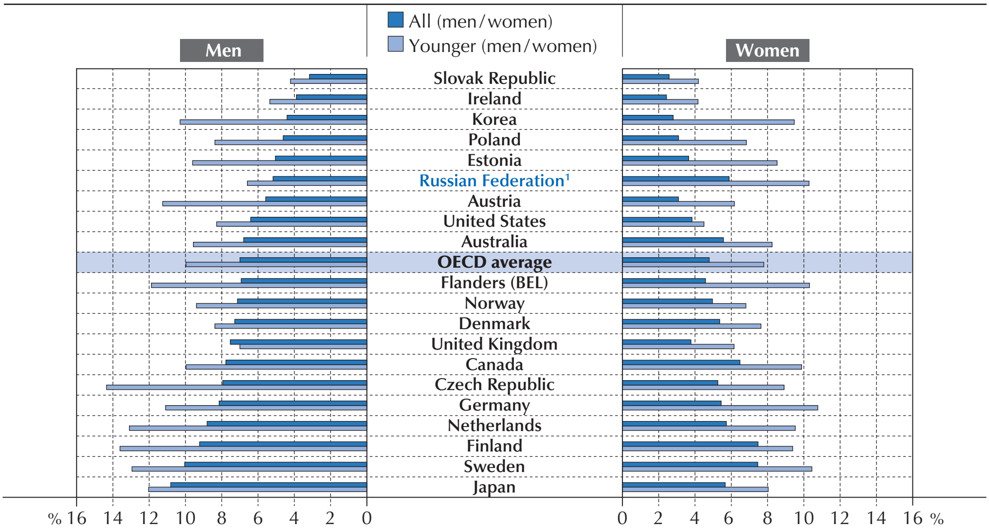
HOW DO BOYS AND GIRLS SPEND THEIR TIME OUTSIDE OF SCHOOL? WIRED AND CONNECTED

Some may joke about future generations having electronic chips implanted somewhere in their bodies to obviate the need for external gadgets, like smartphones or personal computers, but being "connected" now seems as natural a state as, well, just being. The first thing we do in the morning and the last thing we do at night is check our e-mails; our first instinct when missing some kind of information is to consult a search engine, not reach for the nearest paper-and-binding reference book; and if we want to amuse ourselves, the Internet is always available when our friends might not be.

■ Figure 2.1 ■

Differences between young and mature men and women in problem solving in technology-rich environments

Percentage of men and women who perform at the highest level, 2012



1. See note at the end of this chapter.

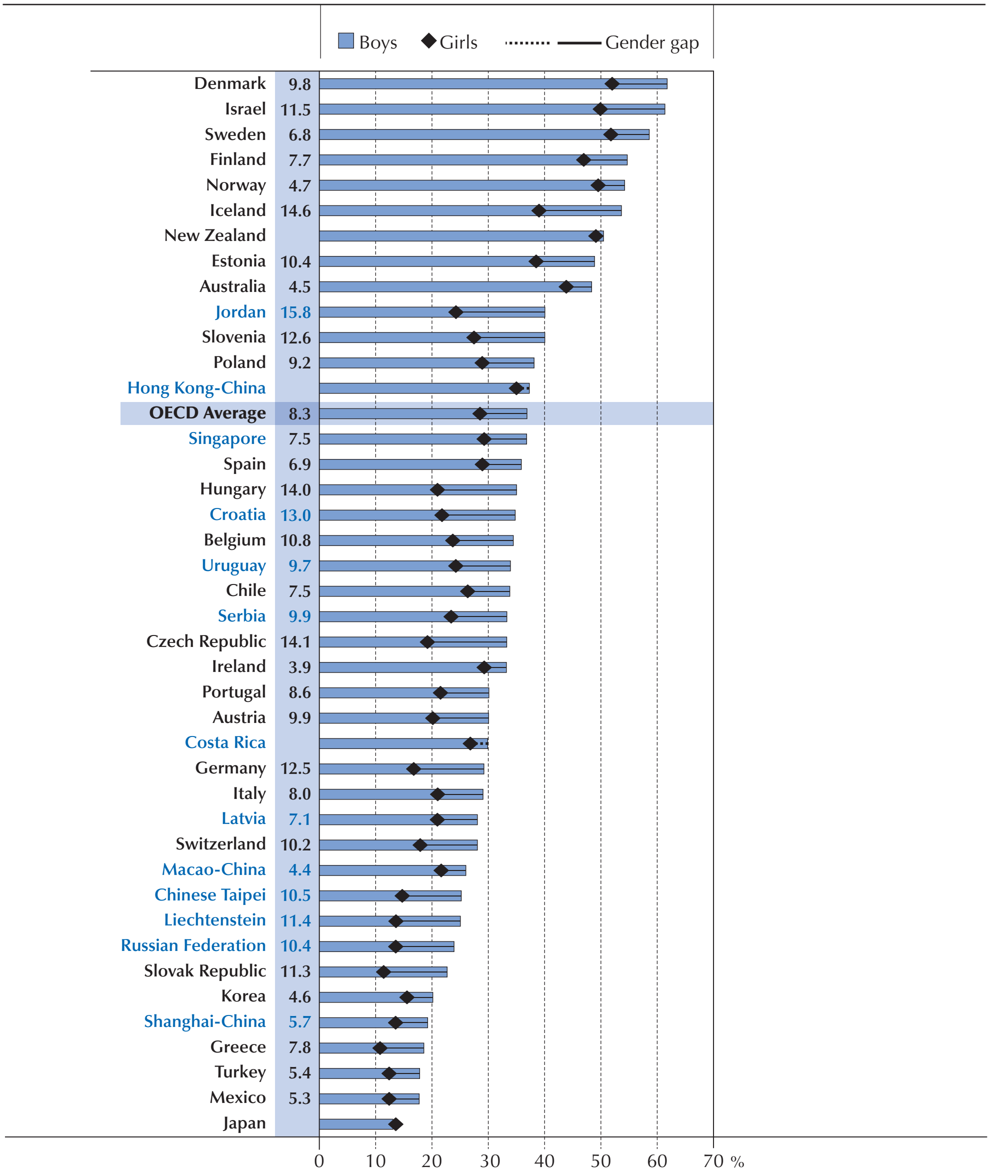
Note: Younger men and women are those aged between 16 and 24 years old.

Countries and economies are ranked in ascending order of the percentage of men (all age groups) who performed at Level 3 in problem solving in technology-rich environments in the 2012 Survey of Adult Skills (a product of the OECD Programme for the International Assessment of Adult Competencies, or PIAAC). Level 3 corresponds to a high level of proficiency.

Source: OECD, PIAAC Database, Table 2.1.

■ Figure 2.2 ■

Percentage of boys and girls who first used a computer when they were 6 years old or younger



Note: The size of the gender gap (in percentage points and when statistically significant) is shown next to the country/economy name and is indicated by a solid line (boys–girls).

Countries and economies are ranked in descending order of the percentage of boys who reported that they had used a computer when they were 6 years old or younger.

Source: OECD, PISA 2012 Database, Table 2.3.

Certainly, knowing how to use digital devices is now essential in the modern workplace and in modern societies. The first results from the Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), show that, as would be expected, young adults are more likely than older adults to know how to use computers and be able to solve problems that are presented to them on computers. However, the survey also finds that in several countries, the proportion of young men and women who can solve more complex problems in computer environments is small (Figure 2.1 and Table 2.1).

The 15-year-olds who were assessed in the most recent cycles of PISA, specifically PISA 2009 and PISA 2012, were raised with computers. Being connected is an integral part of their lives: it provides an avenue for entertainment and a way of interacting with their peers anytime, anywhere. Some of their teachers may even encourage them to use computers in class or for homework, with the assumption that learning through digital media is less about consuming knowledge and more about interacting and participating in the acquisition of knowledge (OECD, 2012).

PISA 2012 found that virtually all 15-year-old boys and girls in all participating countries and economies had used a computer and had accessed the Internet by the time they took the PISA test (Table 2.2). Results also show that boys started using computers and the Internet at an earlier age than girls (Figure 2.2 and Table 2.3). On average across OECD countries, around a third of students reported that they had started using a computer before they set foot in a classroom (33% of students reported that they had used a computer before the age of 6), and around 15% of students reported that they had first accessed the Internet before that age. For both activities, boys started earlier than girls. On average, boys are 8 percentage points more likely than girls to have used a computer before the age of 6. In only 3 of the 42 countries and economies surveyed was there no such gender gap; and in the Netherlands, girls were more likely than boys to have used a computer before the age of 6. Similarly, in all but four countries, boys started accessing the Internet at a younger age than girls.

Although computers are becoming familiar pieces of hardware in many classrooms, most 15-year-olds who use computers regularly do so outside of school, on weekends, during their leisure time, and generally not for school work. On average across OECD countries, boys use the Internet for an average of three hours (180 minutes) on a typical weekend day, 17 minutes more than girls (Figure 2.3). During the week, too, boys use the Internet more than girls. On average across OECD countries, boys reported using the Internet for 144 minutes and girls for 130 minutes on typical weekdays. Perhaps surprisingly, boys also reported using the Internet more at school than girls: in 26 countries and economies, boys reported using the Internet for longer at school on a typical weekday than girls (Table 2.4).

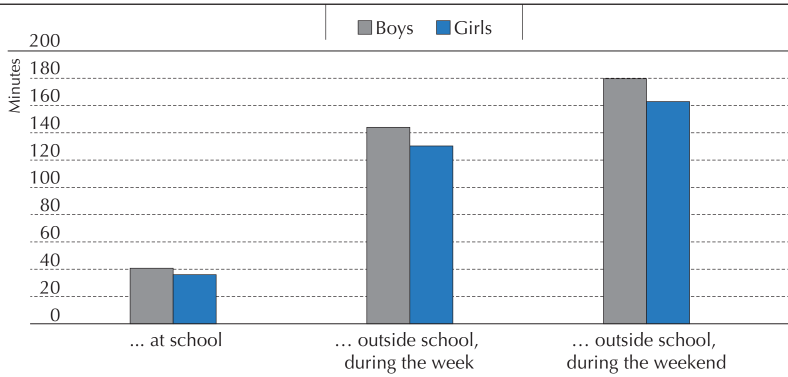
But being familiar with smartphones and computers does not necessarily mean that a student can use those devices competently or know how to critically assess the information he or she collects through them. The learning outcomes that are associated with digital technologies depend, to a great extent, on how – and how frequently – students use them.

PISA results show that boys and girls use computers differently. Boys are more likely than girls to play computer games frequently. On average across OECD countries, only one in four boys, but more than one in two girls, reported that they had never or hardly ever played a one-player game on a computer (Table 2.5a); and 29% of boys but 71% of girls reported that they had never or hardly ever played collaborative online games (Table 2.5b).

■ Figure 2.3 ■

How much time do girls and boys spend on the Internet?

Minutes spent on the Internet, OECD countries

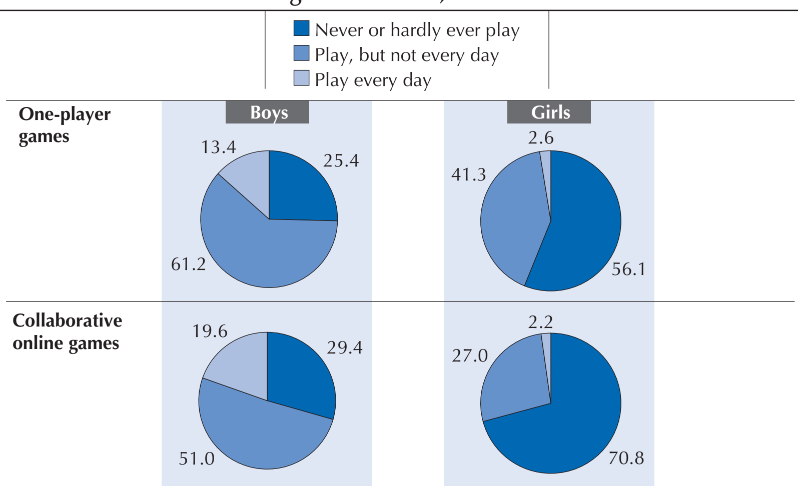


Note: All differences between boys and girls are statistically significant.
Source: OECD, PISA 2012 Database, Table 2.4.

■ Figure 2.4 ■

How often do girls and boys play video games on the computer, outside of school?

Percentage of students, OECD countries



Source: OECD, PISA 2012 Database, Tables 2.5a and 2.5b.

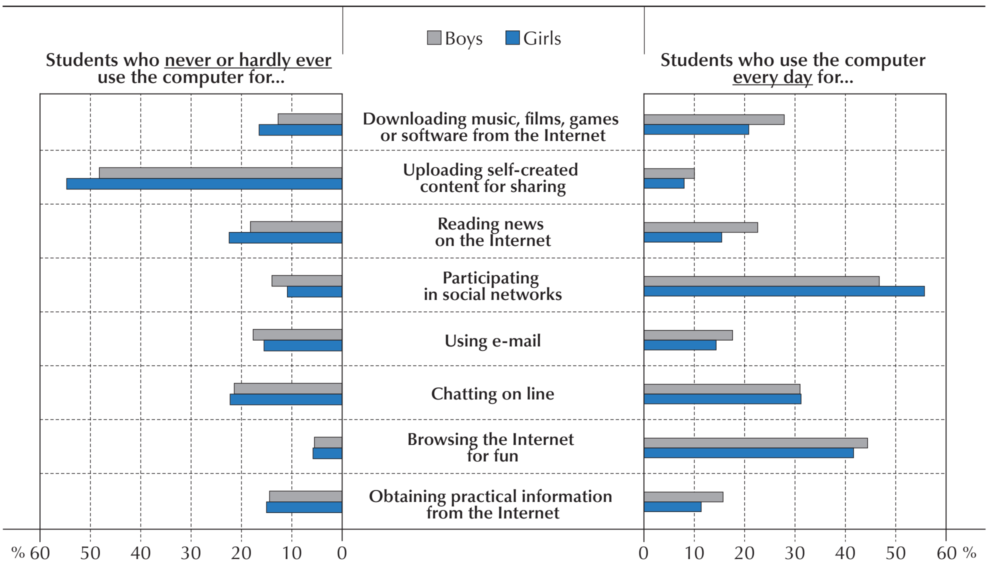
This gender gap was observed in every country and economy that participated in PISA 2012 except Jordan, where boys are more likely than girls to have never played one-player games. Boys were also more likely to report that they play video games every day. They were 11 percentage points more likely than girls to report that they play one-player online games daily (Table 2.5a) and 17 percentage points more likely than girls to report that they play collaborative online games every day (Table 2.5b).

Figure 2.5 shows that boys also download music, films, games and software from the Internet more frequently than girls do. In fact, across OECD countries, the proportion of boys who reported that they use a computer to download music, films, games or software from the Internet every day is 7 percentage points larger than that of girls who so reported (Table 2.5c). Boys were also more likely than girls to report that they upload their own digital content onto the Internet (Table 2.5d). And in 41 of 42 participating countries and economies, boys were more likely than girls to report that they use computers to read the news on the Internet every day; across OECD countries, 23% of boys and 15% of girls so reported (Table 2.5e).

■ Figure 2.5 ■

Gender disparities in how girls and boys use the computer

OECD countries



Source: OECD, PISA 2012 Database, Tables 2.5c to 2.5j.

While video gaming and uploading or downloading content is a more common activity among boys than among girls, girls are more likely than boys to use computers to participate in social networks. Across OECD countries, the proportion of girls who use the computer to participate in social networks every day is 9 percentage points larger than the proportion of boys who do (Table 2.5f). In most PISA-participating countries and economies, differences in the proportions

of boys and girls who reported that they use digital technologies to check e-mails and chat on line, to browse the Internet for fun or to obtain practical information through the Internet are small or non-existent (Tables 2.5g to 2.5j), though boys tend to display more polarised behaviours and be either heavy users or not use technologies at all.

Perhaps not surprisingly, PISA finds no significant differences in how boys and girls use computers for and at school. Gender differences in the extent to which boys and girls use e-mail outside of school to communicate with other students about schoolwork, communicate with teachers, and/or submit homework or other schoolwork are negligible. Gender differences are also nearly non-existent in students' use of computers outside of school to download, upload or browse material from their school's website, to check the school's website for announcements, or to share school-related materials with other students. In general, none of these activities is common; in many countries, more than one in two boys and girls reported that they never or hardly ever engage in these activities (Tables 2.6a to 2.6g).

There are also no overall differences in the ways boys and girls use computers at school to chat on line, use e-mail, browse the Internet for schoolwork, download, upload or browse material from the school's website, post their own work on the school's website, practice drilling, such as for foreign-language learning or mathematics, do homework while at school or use computers for group work and to communicate with other students. And while there are large differences in the extent to which boys and girls use a computer at school to play simulation games, according to the students' reports, this activity is not common. On average across OECD countries, 71% of boys and 86% of girls reported that they never or hardly ever play such games (Tables 2.7a to 2.7i).

Video gaming and student performance

There is extensive research on the addictive nature of gaming and the potentially negative consequences that playing video games could have on academic performance, students' health and lifestyles (Smyth, 2007; Sharif and Sargent, 2006; Drummond and Sauer, 2014; Gentile et al., 2004; Barlett et al., 2009). If students spend more time playing video games, they may have less time to spend doing physical activities or homework, both of which are associated with better learning outcomes.

By their very nature, video games may undermine two of the attitudes that are indispensable for learning at school: focus and attention. While video games demand both, they do so in exciting and fast-paced virtual environments – unlike school curricula, which are rarely developed and delivered in ways that are primarily designed to be entertaining. As a result, students who play video games excessively might not be able to focus on their work at school (Ferguson, 2011), may be less willing to spend time on school work at home (Cummings and Vanderwater, 2007), might develop sleep problems (King et al., 2013), and might be less perseverant if there are no immediate rewards for their efforts, like those offered in gaming (Swing et al., 2010). Excessive gaming is also associated with lower social functioning, greater anxiety and mental health problems (Mentzoni et al., 2011; van Schie and Wiegman, 1997; Desai et al., 2010), and a higher incidence of obesity (Vanderwater et al., 2004); and playing violent games may also be associated with aggressive behaviour (Anderson and Bushman, 2002; Carnagey and Anderson, 2005; Carnagey et al., 2007).

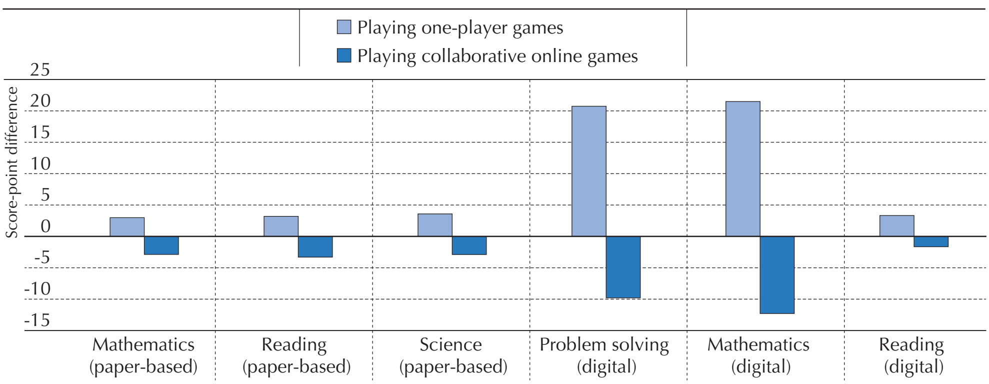
However, some research shows that video gaming could also have positive effects on learning, since video games can be effective cognitive training tools. Many games incorporate good learning principles that can stimulate students' cognitive functioning and assist in their psychosocial adjustment, as well as hone problem-solving and spatial skills (Gee, 2005; Adachi and Willoughby, 2013; Green and Bavelier, 2006; Przybylski, 2014; Subrahmanyam and Greenfield, 1994; Spence and Feng, 2010; Connolly et al., 2012).

PISA 2012 reveals that, across the world, boys are much more likely than girls to play video games and to play such games every day. Is there a link between this behaviour and the gender gap in student performance? Results from PISA suggest that the association between academic performance and video gaming depends on the kinds of games students play and how frequently they play them. Students who play one-player video games between once a month and almost every day perform better in mathematics, reading, science and problem solving, on average, than students who play one-player games every day. They also perform better than students who never or hardly ever play such games. By contrast, collaborative online games appear to be associated with lower performance, regardless of the frequency of play (Figure 2.6 and Table 2.8a). Because boys tend to be daily users of video games and are much more likely than girls to play online collaborative games, the gender gap in video gaming translates into a performance advantage for girls.

■ Figure 2.6 ■

Relationship between performance and video gaming

OECD countries



Note: All performance differences are statistically significant.
Source: OECD, PISA 2012 Database, Table 2.8a.

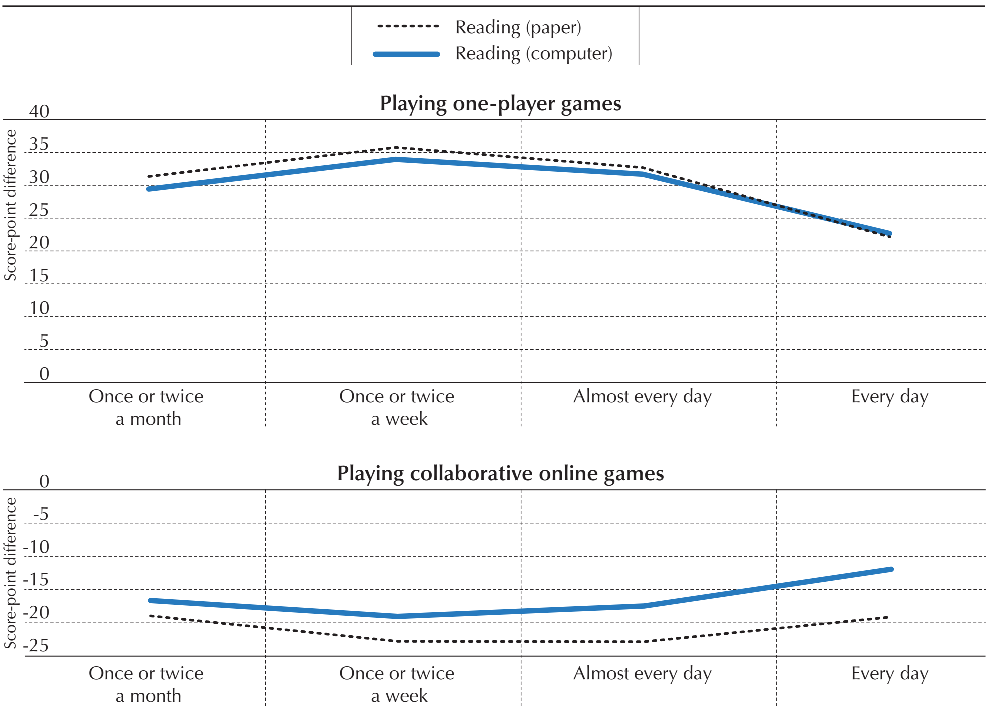
In PISA 2012, students in 26 countries and economies not only answered questions about video gaming in addition to sitting the main paper-based tests, they also sat an additional mathematics and reading assessment that was delivered on computer. The computer-based assessment required students to interact with the test questions. For example, in the computer-based reading assessment, students had to navigate through a set of pages and search for information in a pseudo-online space. In mathematics, students could use the computer to explore three-dimensional shapes or sort datasets according to different criteria. In other words, the computer-based mathematics and

reading assessments differed from the paper-based tests not only because they were delivered on a computer, but also because they assessed a different set of skills – some of which, such as spatial reasoning, have been shown to be associated with video gaming (Feng et al., 2007).

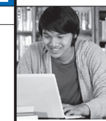
Results in Table 2.8a suggest that boys tend to do better in both mathematics and reading when they sit a computer-based test, compared to their performance on paper-based tests – and that this advantage is largely a by-product of boys' familiarity with video games. The more frequently students play one-player video games and collaborative online games, which boys tend to play more than girls, the worse their relative performance on paper-based tests (Table 2.8b). Very frequent video-gaming appears to "crowd out" other activities, such as doing homework regularly, that help students to acquire reading and mathematics skills. In computer-based tests, the negative effects of video-gaming may be counterbalanced by the positive effect video-gaming may have on acquiring the specific set of skills that is assessed in such tests. And students who frequently play video games will, necessarily, be more at ease – and may even prefer – sitting a test using a computer.

■ Figure 2.7 ■

Performance difference between computer-based and paper-based reading assesments, by the frequency of playing video games



Note: The figure shows the score-point difference between students who never play video games and students who play video games with different levels of frequency.
Source: OECD, PISA 2012 Database, Table 2.8a.



HOW DO BOYS AND GIRLS SPEND THEIR TIME OUTSIDE OF SCHOOL? UNPLUGGED

Reading for enjoyment

It should come as no surprise that results from the PISA 2009 assessment found that students who enjoy reading the most perform significantly better in reading than students who enjoy reading the least (Table 2.9a). Better readers tend to read more because they are more motivated to read, which, in turn, leads to improved vocabulary and comprehension skills.

PISA 2009 asked students how much time they usually spend reading for enjoyment. Students could choose from "I do not read for enjoyment", "I read for up to 30 minutes a day", "I read for more than 30 minutes but less than 60 minutes a day", "I read for between 1 and 2 hours a day" and "I read for more than 2 hours a day".

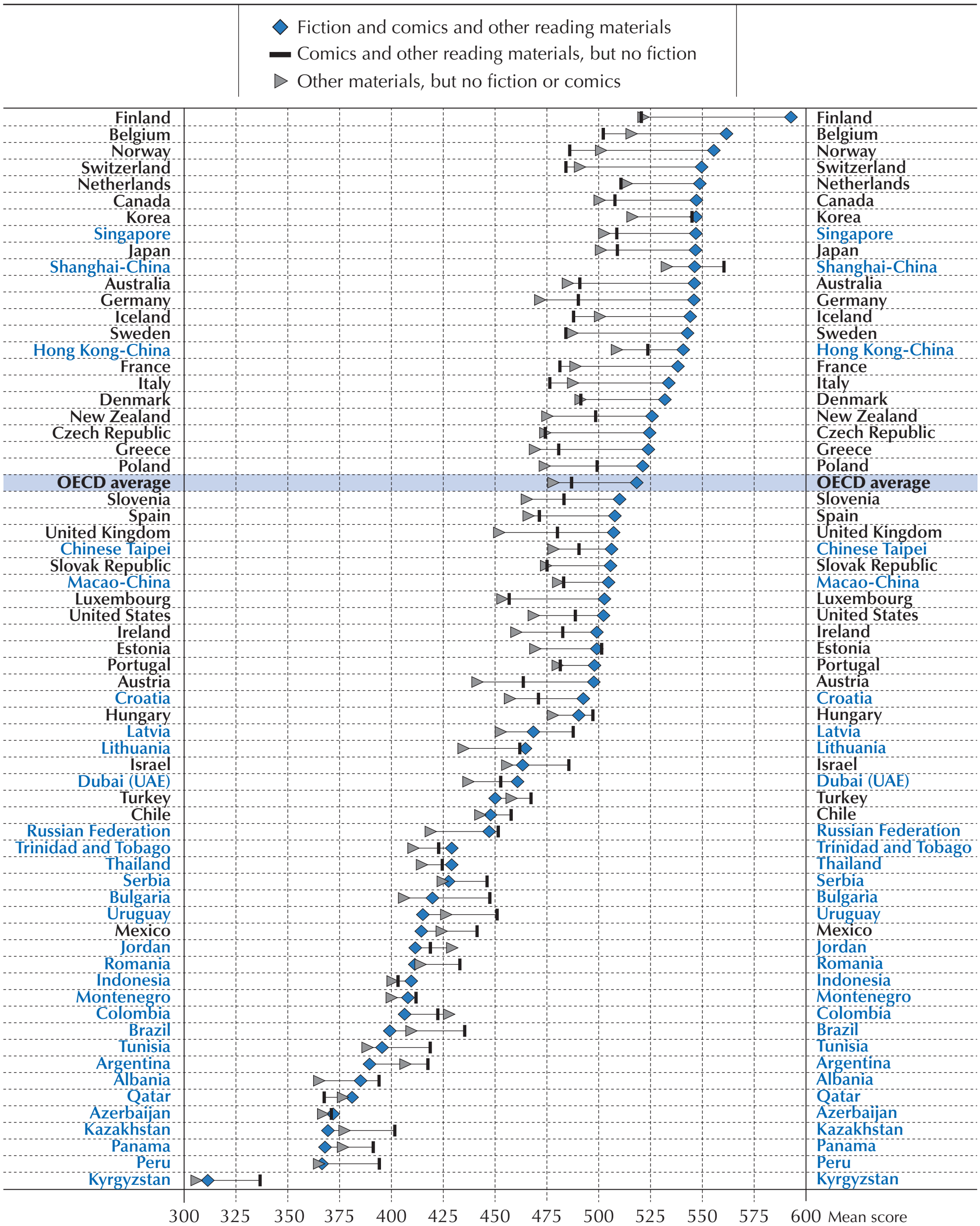
On average across OECD countries, over one-third of students – and 40% or more in Austria, Belgium, the Czech Republic, Germany, Ireland, Japan, Luxembourg, the Netherlands, Norway, the Slovak Republic, Switzerland, the United States, and in the partner countries Argentina and Liechtenstein – reported that they did not read for enjoyment at all (Table 2.9a). On average, these students scored 460 points on the reading assessment, well below the OECD average of 493 points. Another one-third of students across OECD countries read for 30 minutes per day or less. Their mean score of 504 points is above the OECD average. A further 17% of students across OECD countries read for between half-an-hour and one hour per day. They scored 527 points, on average in reading. Students who reported that they read for between one and two hours per day, and assiduous readers, who read for enjoyment for more than two hours daily, scored 532 and 527 points, respectively (Table 2.9a).

PISA 2009 found that, in most countries, the difference in reading scores between students who spend less than 30 minutes per day reading for enjoyment and students who do not read for enjoyment at all is greater than the difference in scores between students who spend half an hour to an hour reading for enjoyment and students who spend less than 30 minutes. In general, the score-point difference between different groups of students shrinks as students spend more time reading for enjoyment. This may mean that the returns on the time students spend reading for enjoyment decrease as time invested by students increases, or that poor readers need more time to read a text (Table 2.9a).

Of course, it is not just how long students spend reading, but also the types and complexity of reading materials that make a difference. PISA 2009 asked students to indicate how often they read magazines, comic books, fiction (novels, narratives, stories), non-fiction and newspapers, because they want to. Students could indicate that they read each type of material "Never or almost never", "A few times a year", "About once a month", "Several times a month" or "Several times a week". Students who reported that they read fiction and who may have also reported that they read other material, excluding comic books, attained the highest scores in the reading assessment (Figure 2.8). In most countries, these students perform more than one PISA proficiency level in reading above their peers who do not read any material regularly – the equivalent of around 60 score points (Table 2.9d).

■ Figure 2.8 ■

Reading performance, by the materials students read



Note: Liechtenstein does not feature in this figure because of its small sample size.

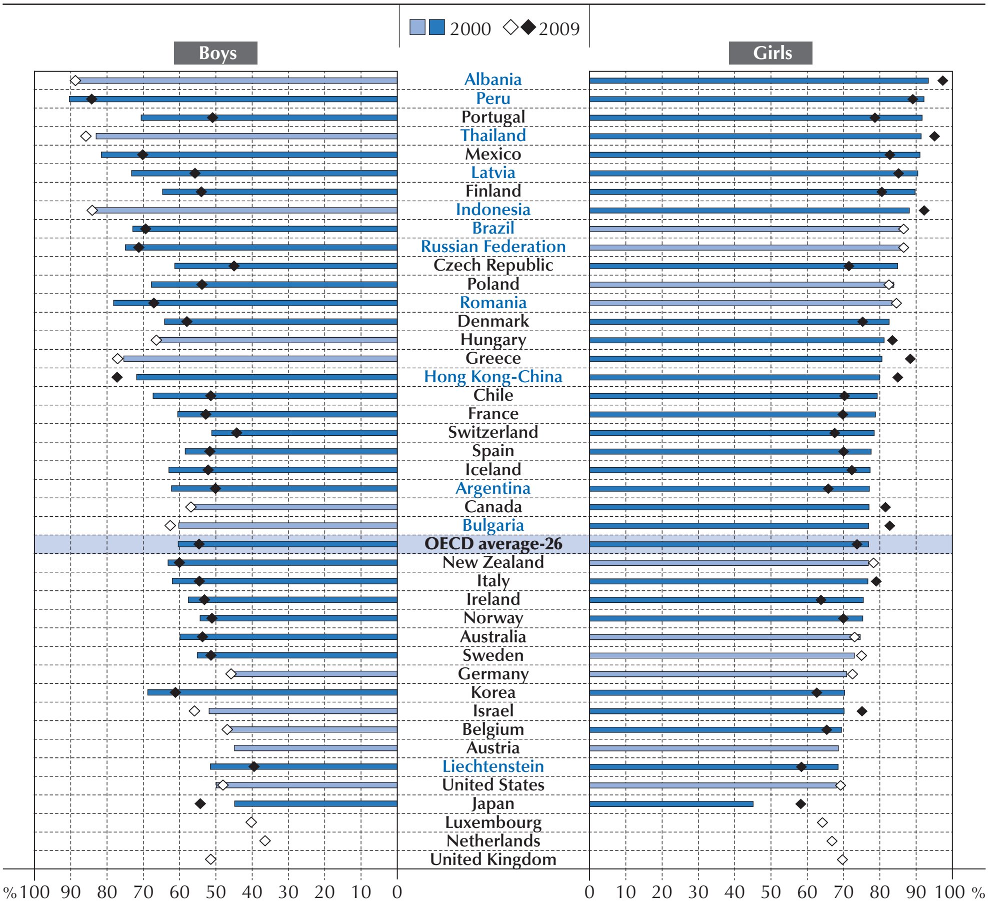
Countries and economies are ranked in descending order of the mean performance of students who read fiction, comics and other reading materials.

Source: OECD, PISA 2009 Database, Table 2.9d.

To read, or not to read, there's really no question: reading anything for enjoyment is better for student performance than reading nothing. Compared with not reading for enjoyment at all, reading fiction for enjoyment is associated with the largest score difference in the PISA 2009 reading assessment, but reading magazines or comic books is also associated with higher reading proficiency (Table 2.9i). PISA 2009 found that, in all countries and economies except Korea, girls read more for enjoyment than boys (Table 2.9a). In fact, PISA found that the gender gap in reading for enjoyment is widening: between 2000 and 2009, both boys and girls lost interest in reading; but the drop in the proportion of boys who read for enjoyment was greater than the decline in the proportion of girls who read for enjoyment (Figure 2.9 and Table 2.9c).

■ Figure 2.9 ■

Change between 2000 and 2009 in the percentage of boys and girls who read for enjoyment



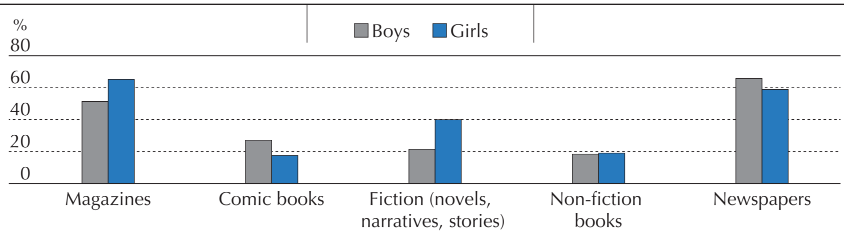
Note: All statistically significant changes are marked in a darker tone (PISA 2009 - PISA 2000).
Countries and economies are ranked in descending order of the percentage of girls who read for enjoyment in 2000.
Source: OECD, PISA 2009 Database, Table 2.9c.

In almost all countries, boys were not only less likely than girls to report reading for enjoyment, they also have different reading habits. On average across OECD countries, 66% of boys read newspapers for enjoyment regularly, while only 59% of girls do. Although reading comic books regularly is much less common, on average across OECD countries, boys are much more likely than girls to read comic books several times a month or several times a week (27% for boys and 18% for girls). By contrast, in every participating country, girls are more likely than boys to be frequent readers of fiction; and in almost all countries, girls are more likely than boys to read magazines (65% for girls and 51% for boys) (Figure 2.10 and Table 2.9d).

■ Figure 2.10 ■

What boys and girls read for enjoyment

Percentage of boys and girls who reported that they read the following materials because they want to "several times a month" or "several times a week", OECD average

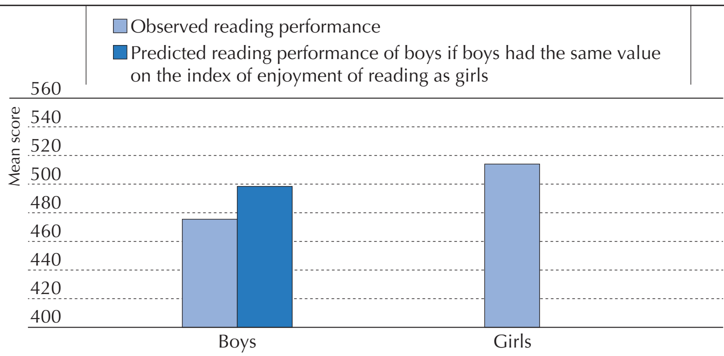


Note: All gender differences are statistically significant.
Source: OECD, PISA 2009 Database, Table 2.9d.

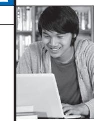
Results from the PISA 2009 assessment of reading suggest that a large share of gender differences in reading performance may stem from disparities in how much boys and girls read for enjoyment and in how much boys and girls engage in reading activities. Indeed, the assessment found that if boys enjoyed reading to the same extent as girls do their reading scores would be 23 points higher, on average across OECD countries (Figure 2.11 and Table 2.9k).

■ Figure 2.11 ■

Boys' reading performance if they enjoyed reading as much as girls do



Source: OECD, PISA 2009 Database, Table 2.9k.



While PISA results suggest that any reading is better than no reading, teachers and parents often discourage boys from reading such material as sports magazines or comic books in the belief that these materials are not the best for developing reading skills. But, for a variety of reasons, boys may not like or choose to read fiction, and discouraging them from reading what they prefer may alienate them from the habit of reading altogether.

Doing homework

PISA 2012 asked students to report how much time per week they spend doing homework or other study set by teachers. Figure 2.12 shows that boys are overwhelmingly less likely than girls to spend time doing homework. On average across OECD countries, girls spend 5.5 hours per week doing homework while boys spend a little less than 4.5 hours (Table 2.10a). In Croatia, Estonia, Italy, Latvia, Lithuania, Poland, the Russian Federation and Singapore, boys spend over 2 hours less than girls, on average, doing homework. In Italy, for example, boys spend an average of 7 hours doing homework while girls spend an average of over 10 hours. And while in Poland boys spend an average of 5 hours doing homework, girls clock in around 8 hours per week. Albania, Korea, Liechtenstein and Viet Nam are the only countries where girls do not spend more time than boys doing homework or other study set by teachers.

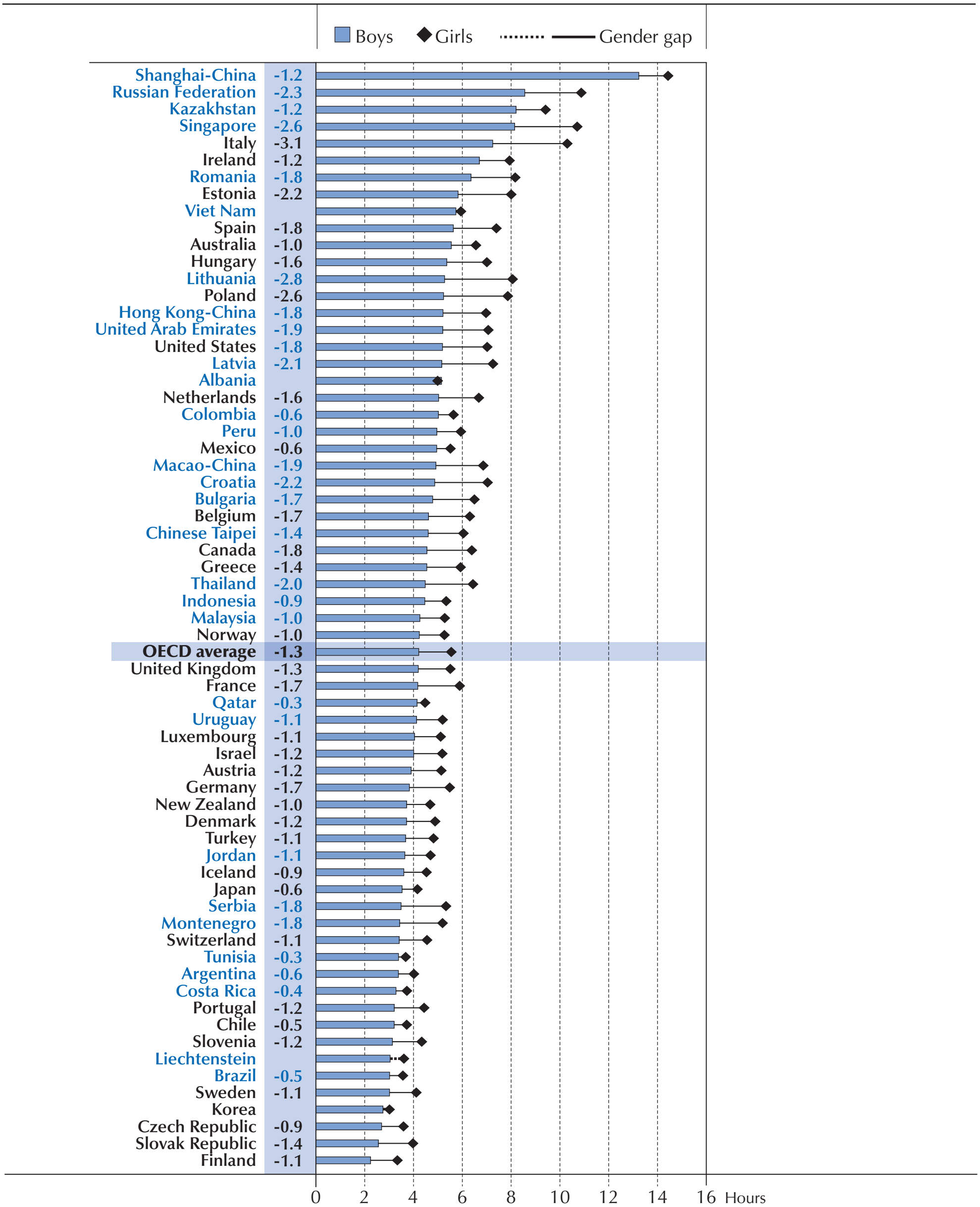
No general patterns emerge in how much time boys and girls spend working with personal tutors, attending after-school classes, studying with parents, and/or repeating and practicing school lessons by working on a computer. According to their reports, boys and girls spend much less time on these activities, on average, than the amount of time they spend doing homework. Korea and Viet Nam are notable exceptions. In these countries, boys and girls spend a considerable amount of time attending after-school classes organised by a commercial company, paid for by parents. In Korea, boys spend 3.8 hours and girls spend 3.4 hours in such classes; in Viet Nam, boys spend as many as 4.6 hours while girls spend 5.1 hours in after-school classes (Table 2.10a).

Table 2.10b suggests that doing homework or other study set by teachers is associated with better performance in mathematics, reading and science. On average across OECD countries, for each hour per week students spend doing homework, they score 4.5 points higher in reading and mathematics and 4.3 points higher in science. Because boys spend less time than girls doing homework, their performance suffers. For example, when considering boys and girls who spend the same amount of time doing homework, the gender gap in mathematics is wider, the gender gap in reading is narrower, and the gender gap in science favours boys (Figure 2.13 and Table 2.10b).

Among OECD countries, in Belgium, France, Italy, the Netherlands and the United States, where homework is strongly associated with performance and where the gender gap in time spent doing homework is large, gender differences in time spent doing homework have a strong impact on gender differences in performance. As shown in Table 2.10c, except for a small number of countries, the association between homework and student performance is similar regardless of the level of student achievement. That means that gender-specific patterns of working on homework have a negligible effect on gender gaps among low achievers and top performers.

■ Figure 2.12 ■

Time spent by boys and girls doing homework assigned by their teachers



Note: The size of the gender gap (in hours and when statistically significant) is shown next to the country/economy name and is indicated by a solid line (boys–girls).

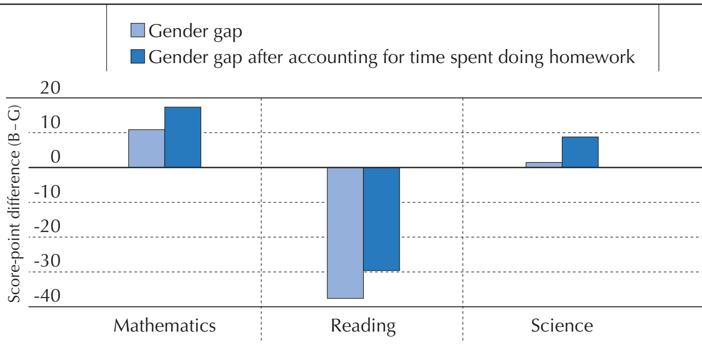
Countries and economies are ranked in descending order of the number of hours, on average, boys reported doing homework assigned by their teachers.

Source: OECD, PISA 2012 Database, Table 2.10a.

■ Figure 2.13 ■

Gender gap in performance related to time spent doing homework

Performance difference between boys and girls (boys-girls), OECD countries



Note: All gender differences are statistically significant.
Source: OECD, PISA 2012 Database, Table 2.10b.

ATTITUDES TOWARDS SCHOOL AND LEARNING

Fifteen-year-olds are in the middle of adolescence – a time when children start to claim their independence from their parents and when social acceptance by one's peers can have a powerful influence on behaviour (Baumeister and Leary, 1995; Rubin, et al., 1998). Other students can encourage and support their classmates in their drive to achieve; they can also undermine students' motivation (Ladd et al., 2012).

Around this time, too, gender differences in attitudes towards school and learning become evident. These seem to be strongly related to how girls and boys have absorbed society's notions of "masculine" and "feminine" behaviour and pursuits as they were growing up. For example, several research studies suggest that, for many boys, it is not acceptable to be seen to be interested in school work. Boys adopt a concept of masculinity that includes a disregard for authority, academic work and formal achievement. For these boys, academic achievement is not "cool" (Salisbury et al., 1999). Although an individual boy may understand how important it is to study and achieve at school, he will choose to do neither for fear of being excluded from the society of his male classmates (Van Houtte, 2004). Indeed, some have suggested that boys' motivation at school dissipates from the age of eight onwards, and that by the age of 10 or 11, 40% of boys belong to one of three groups: the "disaffected", the "disappointed" and the "disappeared". Members of the latter group either drop out of the education system or are thrown out (Salisbury et al., 1999). Meanwhile, studies show that girls seem to "allow" their female peers to work hard at school, as long as they are also perceived as "cool" outside of school (Van Houtte, 2004). Other studies suggest that girls get greater intrinsic satisfaction from doing well at school than boys do (DiPrete and Buchmann, 2013).

While most of the students who were assessed in PISA 2012 acknowledge the value of education (93% of students reported that they believe that trying hard at school is important; only 12%

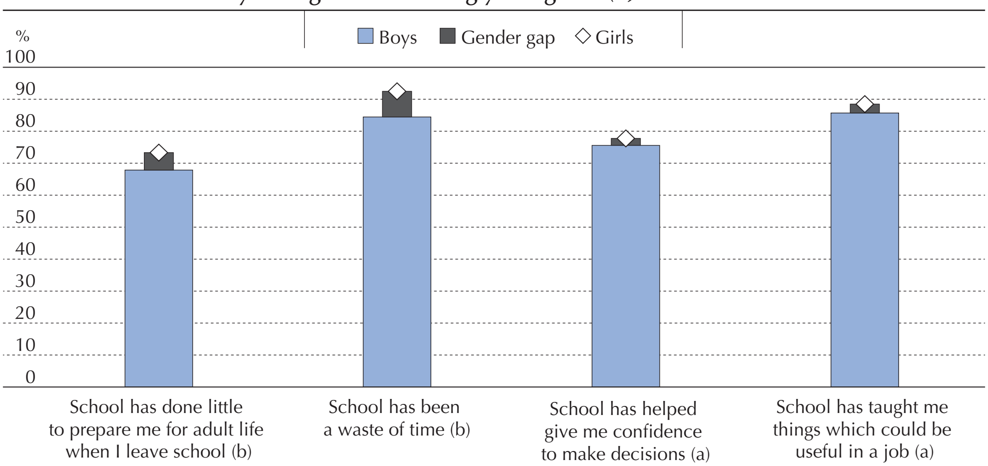
believe that school has been a waste of time), many students are not engaged with school; and boys are more likely than girls to belong to this latter group. When students are disengaged with school, they act out their disengagement with bad behaviour: they arrive late for school or skip classes or days of school. In doing so, they miss out on learning opportunities, fall behind in class and earn low marks – all of which then feed back into their discouragement and disaffection, completing a vicious circle.

Across most countries and economies that participated in PISA 2012, boys were more likely than girls to express negative attitudes towards school and learning (Figure 2.14). For example, across OECD countries, boys were 8 percentage points more likely than girls to report that school is a waste of time, and were 5 percentage points more likely to agree or strongly agree that school has done little to prepare them for adult life when they leave school. They were also 5 percentage points less likely than girls to agree or strongly agree that trying hard at school is important, and 3 percentage points less likely to report that they enjoy receiving good marks (Table 2.15).

■ Figure 2.14 ■

How boys and girls feel about school

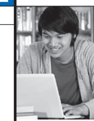
OECD average percentage of students who reported that they "agree" or "strongly agree" (a) or that they "disagree" or "strongly disagree" (b) with the statements:



Note: All gender differences are statistically significant.
Source: OECD, PISA 2012 Database, Table 2.15.

Boys also appear to be more likely than girls to arrive late for school (Table 2.11a) and skip classes or days of school (Table 2.12), although between 2003 and 2012 the proportion of both boys and girls who arrived late for school shrank (Table 2.11b).

In 36 countries and economies, girls were less likely than boys to have reported that they had arrived late for school in the two weeks before the PISA test. Although the difference in the proportion of boys and girls who reported that they had arrived late is small – 3 percentage points,



on average across OECD countries – it is larger than ten percentage points in Lithuania and Thailand (Table 2.11a). On average across OECD countries, boys and girls were less likely in 2012 than in 2003 to report that they had arrived late. Still, the improvement was greater among girls than among boys (Table 2.11b).

Trends between 2003 and 2012 show better punctuality among girls than boys in Denmark, Korea and Turkey, where the gender gap in punctuality widened by around five percentage points or more, in favour of girls. In Korea in 2003, girls were more likely than boys to have arrived late for school in the two weeks prior to the PISA test; by 2012, girls and boys were similarly punctual. In Turkey, boys and girls in 2003 reported at a similar rate that they had arrived late for school; but by 2012, boys were eight percentage points more likely than girls to have reported that they had arrived late for school (Table 2.11b).

Students who reported that they had arrived late for school at least once in the two weeks prior to the PISA test scored lower than students who reported that they had not arrived late for school during that period. Across OECD countries, the difference in performance that is associated with arriving late for school among students of the same gender is 19 points in mathematics and reading and 20 points in science (Table 2.11a). Performance differences associated with a lack of punctuality are particularly large among low achievers. On average across OECD countries, the gap in scores that is associated with arriving late for school is wider among the lowest-achieving students than it is among the highest-achieving students (OECD, 2013a). Since boys tend to be more likely than girls to be low performers (see Chapter 1) and are also more likely to arrive late for school, their performance is more likely to suffer because arriving late for school means that these students miss out on learning opportunities.

GENDER DIFFERENCES IN SELF-REGULATION

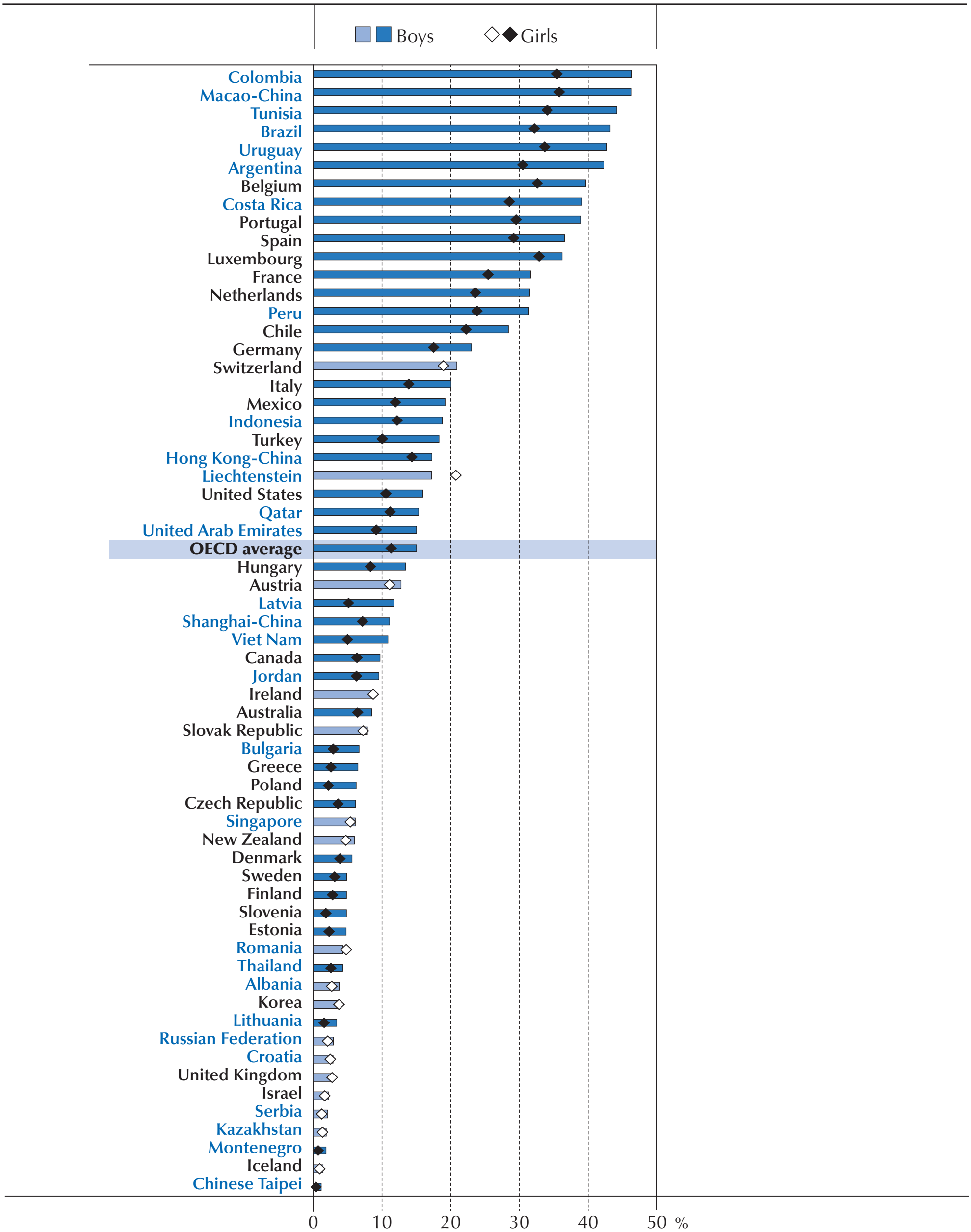
Study after study suggests that the best-performing students are "good" students. A good student is one who is disciplined, follows rules, acts appropriately and respectfully towards teachers and fellow students, recognises authority, can sit for long periods of time, and follows instructions. In general, individuals who have high levels of self-regulation – the ability to control, direct, and plan one's thinking, emotions and behaviours (Schunk and Zimmerman, 1997) – are better students than those who have low levels of self-regulation.

Grade repetition and marks

Whether because of socialisation or innate differences, boys are more likely than girls, on average, to be disruptive, test boundaries and be physically active – in other words, to have less self-regulation (Matthews et al., 2009). From a young age, boys are less likely to raise their hand in class to ask to speak, they are worse at waiting their turn to speak or engage in an activity, they are less likely to listen and pay attention before starting a project and, as a result, they have a harder time following teachers' instructions. As boys and girls mature, gender differences grow even wider as boys start withdrawing in class and becoming disengaged. As teenagers, boys tend to be less self-disciplined than girls: they are less likely than girls to be able to delay gratification, plan ahead, set goals, and persist in the face of frustrations and setbacks (Duckworth and Seligman, 2006; Kenney-Benson et al., 2006).

■ Figure 2.15 ■

Grade repetition, by gender

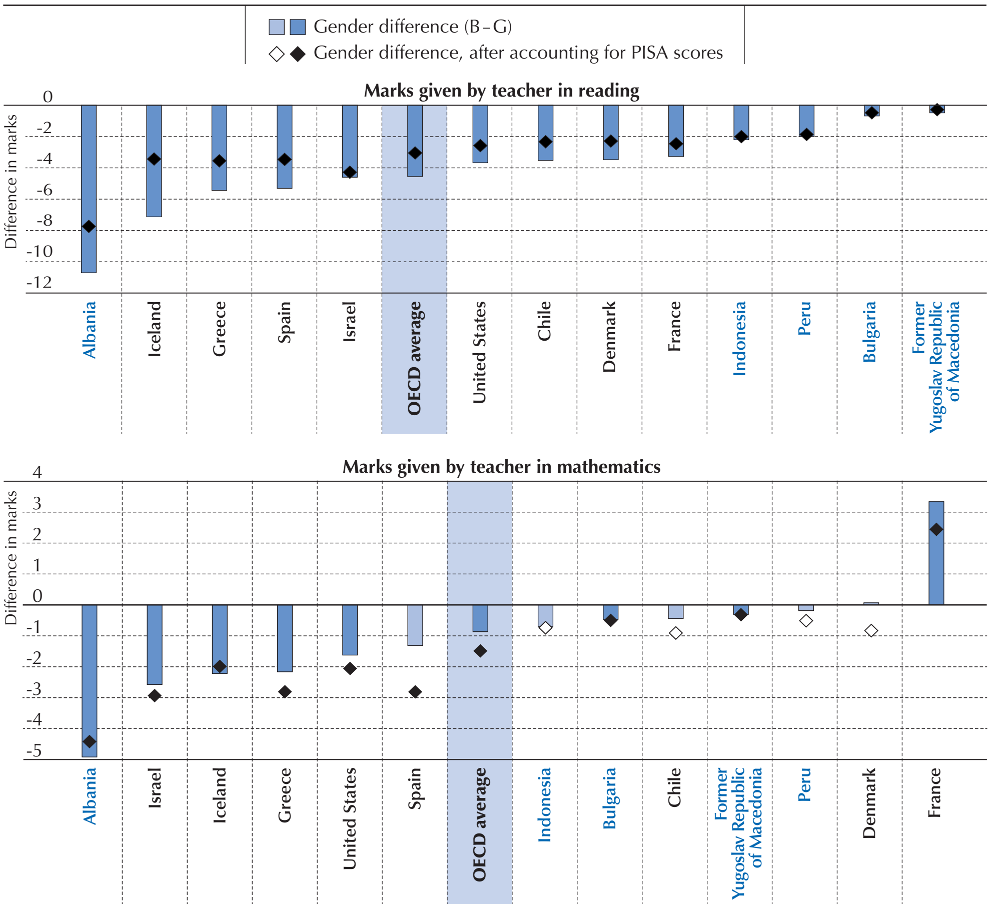


Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the percentage of boys who repeated a grade at least once.
Source: OECD, PISA 2012 Database, Table 2.13b.

Many teachers reward organisational skills, good behaviour and compliance with their instructions by giving higher marks to students who demonstrate these qualities. As Figures 2.15 and 2.16 suggest, teachers and school personnel may sanction boys' comparative lack of self-regulation by giving them lower marks and requiring them to repeat grades. When comparing students who perform equally well in reading, mathematics and science, boys were more likely than girls to have repeated at least one grade before the age of 15 and to report that they had received lower marks in both language-of-instruction classes and mathematics (Table 2.13a). But it is unclear how "punishing" boys with lower grades or requiring them to repeat grades for misbehaviour will help them; in fact, these sanctions may further alienate them from school.

■ Figure 2.16 ■

Students' marks



Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the difference between boys and girls in the mark they reported having received from their teacher, before accounting for PISA scores.
Source: OECD, PISA 2000 Database, Table 2.13a.

An analysis of students' marks in reading and mathematics reveals that while teachers generally reward girls with higher marks in both mathematics and language-of-instruction courses, after accounting for their PISA performance in these subjects, girls' performance advantage is wider in language-of-instruction than in mathematics. This suggests both that girls may enjoy better marks in all subjects because of their better classroom discipline and better self-regulation, but also that teachers hold stereotypical ideas about boys' and girls' academic strengths and weaknesses. Girls receive much higher-than-expected marks in language-of-instruction courses because teachers see girls as being particularly good in such subjects. Teachers may perceive boys as being particularly good in mathematics; but because boys have less ability to self-regulate, their behaviour in class may undermine their academic performance, making this hypothesis difficult to test.

Investing effort

Findings from psychological experiments conducted in laboratory settings suggest that, among boys and girls of similar academic ability, girls tend to be more reluctant to compete than boys, while boys are more responsive to extrinsic motivation than girls. Within countries, girls tend to report higher levels of motivation to do their best in a test (DeMars et al., 2013), although it appears that gender differences in motivation related to test-taking may vary across countries (Eklöf et al., 2014), and the relationship between reported motivation and performance may be stronger among boys (Eklöf, 2007; Eklöf et al., 2014; Eklöf and Nyroos, 2013; Karmos and Karmos, 1984).

When students participating in PISA 2012 finished the test, they were asked how much effort they thought they had put into it, and to hypothesise how much effort they would have put into the test if their performance had counted towards their school marks. The question appeared on the last page of their assessment booklet.

■ Figure 2.17 ■

The PISA effort thermometer

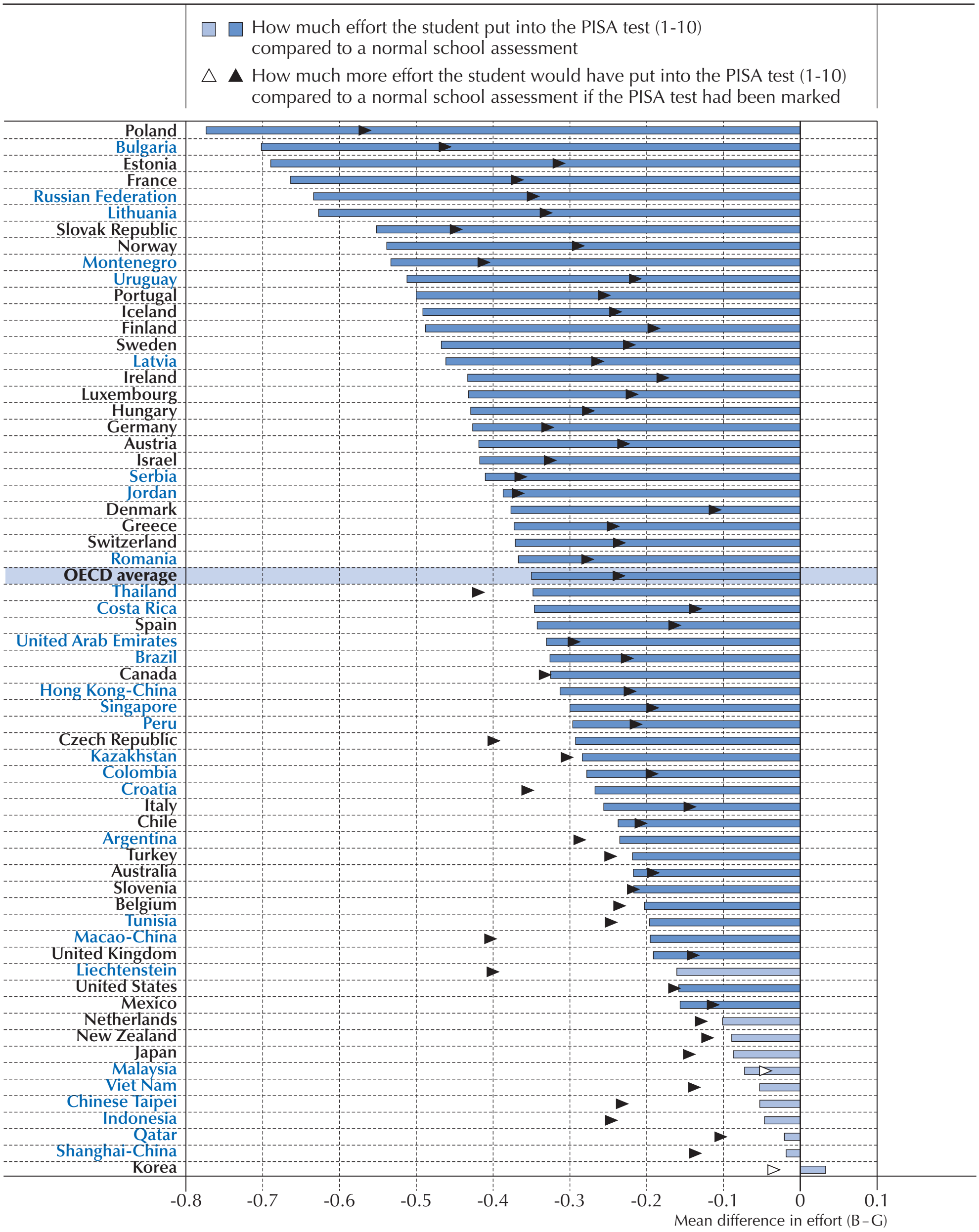
How much effort did you invest ?

Please try to imagine an actual situation (at school or in some other context) that is highly important to you personally, so that you would try your very best and put in as much effort as you could to do well.

In this situation you would mark the highest value on the "effort thermometer" as shown below	Compared to the situation you have just imagined, how much effort did you put into doing this PISA test?	How much effort would you have invested if your marks from the test were going to be counted in your school marks?
☐ 10	☐ 10	☐ 10
☒ 9	☐ 9	☐ 9
☐ 8	☐ 8	☐ 8
☐ 7	☐ 7	☐ 7
☐ 6	☐ 6	☐ 6
☐ 5	☐ 5	☐ 5
☐ 4	☐ 4	☐ 4
☐ 3	☐ 3	☐ 3
☐ 2	☐ 2	☐ 2
☐ 1	☐ 1	☐ 1

■ Figure 2.18 ■

Gender differences in effort



Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the gender difference in how much effort students put into the PISA test compared to a normal school assessment.
Source: OECD, PISA 2012 Database, Table 2.14.

According to students' reports, girls invest greater effort than boys, on average, both in the low-stakes testing situation that PISA represents, and in the hypothetical scenario in which the PISA test had direct consequences for them because it counted in their school marks. But the gender gap is relatively narrow within each of the two scenarios (Figure 2.18 and Table 2.14). On a scale ranging from 1 to 10, where 1 represents minimum effort and 10 maximum effort, girls reported an effort of 7.67 in the low-stakes PISA test while boys reported an effort of 7.32, on average across OECD countries. Girls reported an effort of 9.36 in the hypothetical high-stakes PISA test while boys reported an effort of 9.13, on average. When performance in the PISA test had an impact on school marks, the gender gap in favour of girls shrank by 0.11 point on the scale, on average. In Denmark, Estonia, Finland, France, Iceland, Ireland, Lithuania, Norway, the Russian Federation and Uruguay, the gender gap in effort invested between the low-stakes assessment and the hypothetical high-stakes scenario is larger than 0.25 point on the scale. In all these countries, the large difference between boys and girls appears to be primarily due to the fact that boys reported investing far less effort in the test in the absence of external rewards.

The ability to regulate one's own thinking and emotions is a product of both innate characteristics and home and school environments. While many of these skills have been acquired by the early teens (Bronson, 2000), the capacity to regulate behaviour to achieve long-term goals takes longer to develop, and only emerges at the end of adolescence (Demetriou, 2000).

Young boys not only tend to be less self-regulating than girls, they also tend to respond more strongly to their environment: when they are in disruptive, chaotic and disorganised settings, their capacity for self-regulation suffers (Wachs et al., 2004); when they are in classrooms with teachers who are well-organised and able to establish a good disciplinary climate, the improvement in their learning is greater than that of girls (Ponitz, et al., 2009). Boys appear to be particularly sensitive to environmental factors, while girls are comparatively less affected by a lack of discipline, disorganisation and chaos in the classroom.

Because technological innovations make it so much easier for people to act on their impulses, individuals who are highly self-regulating may be at a greater advantage, particularly in settings that demand that individuals control their thinking, emotions and behaviour, such as school. Moreover, as the flow of information has increased dramatically over the past decades, individuals who are organised and can understand, summarise and filter large amounts of written material may be at an advantage. In most societies, these individuals are usually female, though why that is so remains a mystery.

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.

Note regarding the Russian Federation in the Survey of Adult Skills

Readers should note that the sample for the Russian Federation does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65 in Russia but rather the population of Russia excluding the population residing in the Moscow municipal area.

More detailed information regarding the data from the Russian Federation as well as that of other countries that participated in the Survey of Adult Skills can be found in the *Technical Report of the Survey of Adult Skills* (OECD, 2013).

References

Adachi, P.J. and **T. Willoughby** (2013), "More than just fun and games: The longitudinal relationships between strategic video games, self-reported problem solving skills, and academic grades", *Journal of Youth Adolescence,* Vol. 42, pp. 1041-1052.

Anderson, C.A. and **B.J. Bushman** (2002). "The effects of media violence on society", *Science*, Vol. 295, pp. 2377-2378.

Barlett, C.P., C.A. Anderson and **E.L. Swing** (2009), "Video game effects – Confirmed, suspected, and speculative. A review of the evidence", *Simulation and Gaming,* Vol. 40, pp. 377-403.

Baumeister, R. and **M.R. Leary** (1995), "The need to belong: Desire for interpersonal attachments as a fundamental human motivation", *Psychological Bulletin*, Vol. 117, pp. 497-529.

Bronson, M. (2000), *Self-regulation in early childhood: Nature and nurture*. The Guilford Press, New York, NY.

Carnagey, N.L., C.A. Anderson and **B.J. Bushman** (2007)," The effect of video game violence on physiological desensitization to real-life violence", *Journal of Experimental Social Psychology*, Vol. 43, pp. 489-496.

Carnagey, N.L. and **C.A. Anderson** (2005), "The effects of reward and punishment in violent video games on aggressive affect, cognition, and behavior", *Psychological Science*, Vol. 16, pp. 882-889.

Connolly, T.M. et al. (2012), "A systematic literature review of empirical evidence on computer games and serious games", *Computers and Education*, Vol. 59, pp. 661-686.

Cummings, H.M. and **E.A. Vanderwater** (2007), "Relation of adolescent video game play to time spent in other activities", *Archives of Pediatric and Adolescent Medicine,* Vol. 161, pp. 684-689.

DeMars, C.E., B.M. Bashkov and **A.B. Socha** (2013), "The role of gender in test-taking motivation under low-stakes conditions", *Research and Practice in Assessment*, Vol. 8/2, pp. 69-82.

Demetriou, A. (2000), "Organization and development of self-understanding and self-regulation: Toward a general theory", in M. Boekaerts, P.R. Pintrich, and M. Zeidner (eds.), *Handbook of Self-Regulation*, Academic Press, Waltham, MA, pp. 209-251.

Desai, R.A. et al. (2010), "Video-gaming among high school students: Health correlates, gender differences, and problematic gaming", *Pediatrics*, Vol. 126, pp. 1414-1424.

DiPrete, T. and **C. Buchmann** (2013), *The Rise of Women: The Growing Gender Gap in Education and What it Means for American Schools*, Russell Sage Foundation, New York, NY.

Drummond, A. and **J.D. Sauer** (2014), "Video-games do not negatively impact adolescent academic performance in science, mathematics or reading", *PlosOne*, Vol. 9.

Duckworth, A.L. and **M.E.P. Seligman** (2006), "Self-discipline gives girls the edge: Gender in self-discipline, grades, and achievement test scores", *Journal of Educational Psychology*, Vol. 98/1, pp. 198-208.

Eklöf, H. (2007), "Test-taking motivation and mathematics performance in TIMSS 2003", *International Journal of Testing*, Vol. 7/3, pp. 311-326.

Eklöf, H., B. Japelj Pavešič and **L.S. Grønmo** (2014), "A cross-national comparison of reported effort and mathematics performance in TIMSS Advanced", *Applied Measurement in Education,* Vol. 27/1, pp. 31-45.

Eklöf, H. and **M. Nyroos** (2013), "Pupil perceptions of national tests in science: perceived importance, invested effort, and test anxiety", *European Journal of Psychology of Education,* Vol. 28/2, pp. 497-510.

Feng, J., I. Spence and **J. Pratt** (2007), "Playing an action video game reduces gender differences in spatial cognition", *Psychological Science,* Vol. 18, pp. 850-855.

Ferguson, C.J. (2011), "The influence of television and video game use on attention and school problems: A multivariate analysis with other risk factors controlled", *Journal of Psychiatric Research,* Vol. 45, pp. 808-813.

Gee, J.P. (2005), "Good video games are good learning", *Phi Kappa Phi Forum*.

Gentile, D.A. et al. (2004), "The effects of violent video game habits on adolescent hostility, aggressive behaviors, and school performance", *Journal of Adolescence,* Vol. 27, pp. 5-22.

Green, C.S. and **D. Bavelier** (2006), "Enumeration versus multiple object tracking: The case of action video game players", *Cognition*, Vol. 101, pp. 217-245.

Karmos, A.H. and **J.S. Karmos** (1984), "Attitudes towards standardized achievement tests and their relation to achievement test performance", *Measurement and Evaluation in Counseling and Development,* Vol. 17, pp. 56-66.

Kenney-Benson, G.A. et al. (2006), "Sex differences in math performance: The role of children's approach to schoolwork", *Developmental Psychology*, Vol. 42/1, pp. 11-26.

King, D.L. et al. (2013), "The impact of prolonged violent video-gaming on adolescent sleep: An experimental study", *Journal of Sleep Research*, Vol. 2, pp. 137-143.

Ladd, G.W. et al. (2012), "Classroom peer relations and children's social and scholastic development: Risk factors and resources", in A.M. Ryan and G.W. Ladd (eds.), *Peer Relationships and Adjustment at School*, Information Age Press, Charlotte, NC, pp. 11-49.

Matthews, J.S., C.C. Ponitz and **F.J. Morrison** (2009), "Early gender differences in self-regulation and academic achievement", *Journal of Educational Psychology,* Vol. 101/3, pp. 689-704.

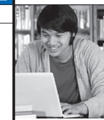
Mentzoni, R.A. et al. (2011), "Problematic video game use: Estimated prevalence and associations with mental and physical health", *Cyberpsychology, Behavior, and Social Networking,* Vol. 14, pp. 591-596.

OECD (2013a), *PISA 2012 Results: Ready to Learn (Volume III): Students' Engagement, Drive and Self-Beliefs,* PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264201170-en.

OECD (2013b), *Technical Report of the Survey of Adult Skills (PIAAC),* OECD, Paris, www.oecd.org/site/piaac/_Technical%20Report_17OCT13.pdf.

OECD (2012), *Connected Minds: Technology and Today's Learners*, Educational Research and Innovation, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264111011-en.

Ponitz, C.C. et al. (2009), "Early adjustment, gender differences, and classroom organizational climate in first grade", *The Elementary School Journal,* Vol. 110/2, pp. 142-162.



Przybylski, A.K. (2014), "Electronic gaming and psychosocial adjustment", *Pediatrics,* Vol. 134, pp. 716-722.

Rubin, K.H., W. Bukowski and **J.G. Parker** (1998). "Peer interactions, relationships, and groups", in W. Damon and N. Eisenberg (eds.), *Handbook of Child Psychology*, Vol. 3: *Social, emotional, and personality development,* 5th ed., Wiley, Hoboken, NJ, pp. 619-700.

Salisbury, J., G. Rees and **S. Gorard** (1999), "Accounting for the differential attainment of boys and girls: A state of the art review", *School Leadership and Management*, Vol. 19/4.

Sharif, I. and **J.D. Sargent** (2006), "Association between television, movie, and video game exposure and school performance", *Pediatrics,* Vol. 118, pp. 1061-1070.

Schunk, D.H. and **B.J. Zimmerman** (1997), "Social origins of self-regulatory competence", *Educational Psychologist*, Vol. 32, pp. 195-208.

Smyth, J.M. (2007), "Beyond self-selection in video game play: an experimental examination of the consequences of massively multiplayer online role-playing game play", *Cyberpsychology, Behavior, and Social Networking,* Vol. 10/5, pp. 717-721.

Spence, I. and **J. Feng,** (2010), "Video games and spatial cognition", *Review of General Psychology*, Vol. 14/2, pp. 92-104.

Subrahmanyam, K. and **P.M. Greenfield** (1994), "Effect of video game practice on spatial skills in girls and boys", *Journal of Applied Developmental Psychology*, Vol. 15/1, pp. 13-32.

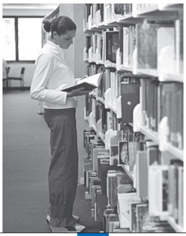
Swing, E.L. et al. (2010), "Television and video game exposure and the development of attention problems", *Pediatrics,* Vol. 126, pp. 214-221.

Vanderwater, E.A., M. Shim and **A.G. Caplovitz** (2004), "Linking obesity and activity level with children's television and video game use", *Journal of Adolescence,* Vol. 27, pp. 71-85.

Van Houtte, M. (2004), "Why boys achieve less at school than girls: The difference between boys' and girls' academic culture", *Educational Studies*, Vol. 30/2, pp. 159-173.

Van Schie, G.M. and **O. Wiegman** (1997), "Children and videogames: Leisure activities, aggression, social integration, and school performance", *Journal of Applied Social Psychology*, Vol. 27/13, pp. 1175-1194.

Wachs, T.D., P. Gurkas and **S. Kontos** (2004), "Predictors of preschool children's compliance behavior in early childhood classroom settings", *Journal of Applied Developmental Psychology*, Vol. 25, pp. 439-457.



3

Girls' Lack of Self-Confidence

This chapter examines how girls' lack of self-confidence in their own ability in science and mathematics may be responsible for the observed underachievement among girls in these subjects, particularly among high-achieving girls.

Taken together, the difference in boys' and girls' interests outside of school, and how these interests and skills are rewarded – or not – by teachers and by students' peers, can lead to differences in performance between boys and girls that have little to do with ability (Salisbury et al., 1999).

One factor that may hold girls back is confidence in their own abilities in mathematics. Studies show that the learning environment plays a significant role in fostering, or undermining, girls' sense of self-confidence. Take this example: in one study, Asian-American girls performed better on a mathematics assessment when they were told the reason for doing the test was to identify ethnic differences in performance – because of the stereotype that Asians have higher quantitative skills than other ethnic groups (Steen, 1987) – but worse when they were told that the reason they were asked to take the assessment was to identify gender differences – because of the common stereotype that women are inferior to men in quantitative skills (Aronson, 2002; Benbow, 1988; Hedges and Nowell, 1995) – when compared with a control group that was not given any reason for taking the assessment (Shih et al., 1999).

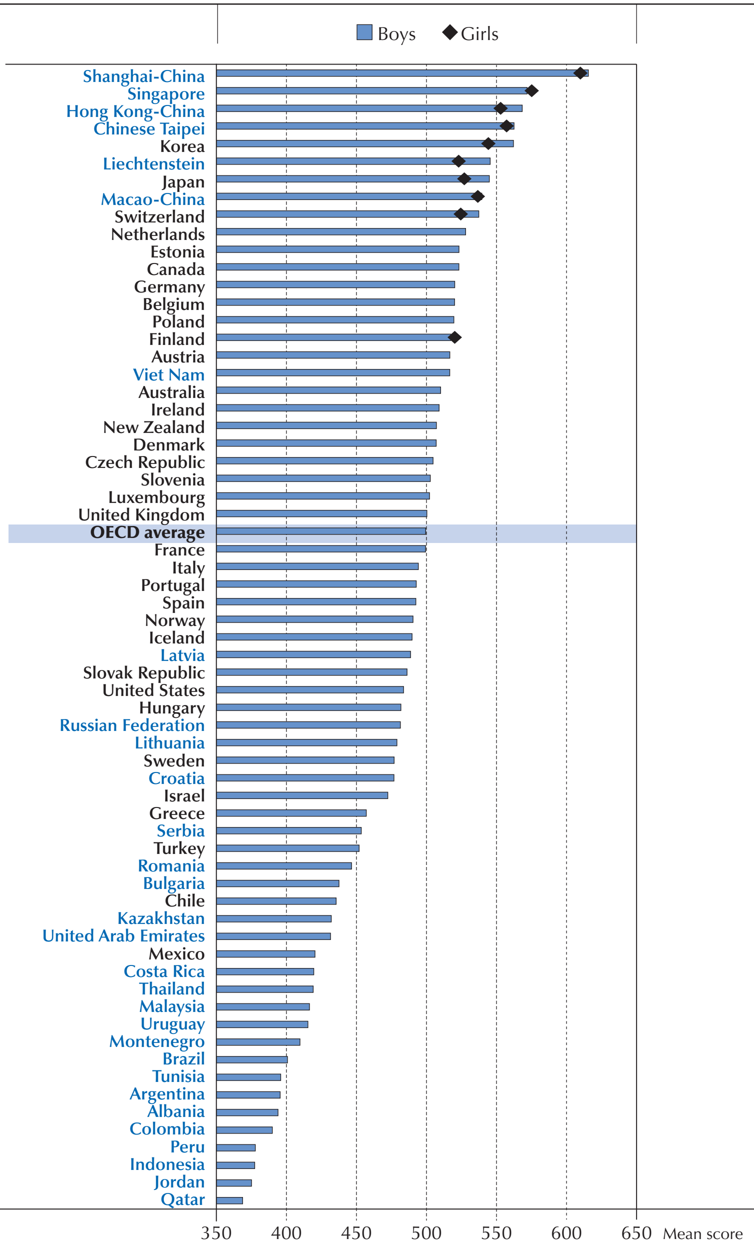
What the data tell us

- On average across OECD countries, mathematics and science self-efficacy (students' beliefs that they can successfully perform given mathematics and science tasks at designated levels) is associated with a difference of 49 score points in mathematics and 37 score points in science – the equivalent of between half and one additional year of school.
- In all countries and economies that participated in PISA 2012, except Albania, Bulgaria, Indonesia, Kazakhstan, Malaysia, Montenegro, Romania, Serbia and Turkey, girls reported stronger feelings of anxiety towards mathematics than boys; and greater mathematics anxiety is associated with a decline in performance of 34 score points – the equivalent of almost one year of school.
- Girls appear to underperform considerably when they are required to "think like scientists". While girls tend to outperform boys on tasks where they are required to identify scientific issues, boys outperform girls in tasks that require them to apply knowledge of science in a given situation, to describe or interpret phenomena scientifically and predict changes, and to identify appropriate scientific descriptions, explanations and predictions.

Results from PISA 2012 confirm that there is no innate reason why girls should not be able to do as well as boys in mathematics. While boys outperform girls in mathematics in 38 participating countries and economies, the average girl in Shanghai-China scores 610 points in mathematics – well above boys' average performance in every other country and school system that participated in PISA and, crucially, just as well as the average boy in Shanghai-China. Similarly, girls in Finland, Macao-China, Singapore and Chinese Taipei perform as well as boys in mathematics – despite the fact that (or maybe because) standards of performance in these countries and economies are among the highest in the world.

■ Figure 3.1 ■

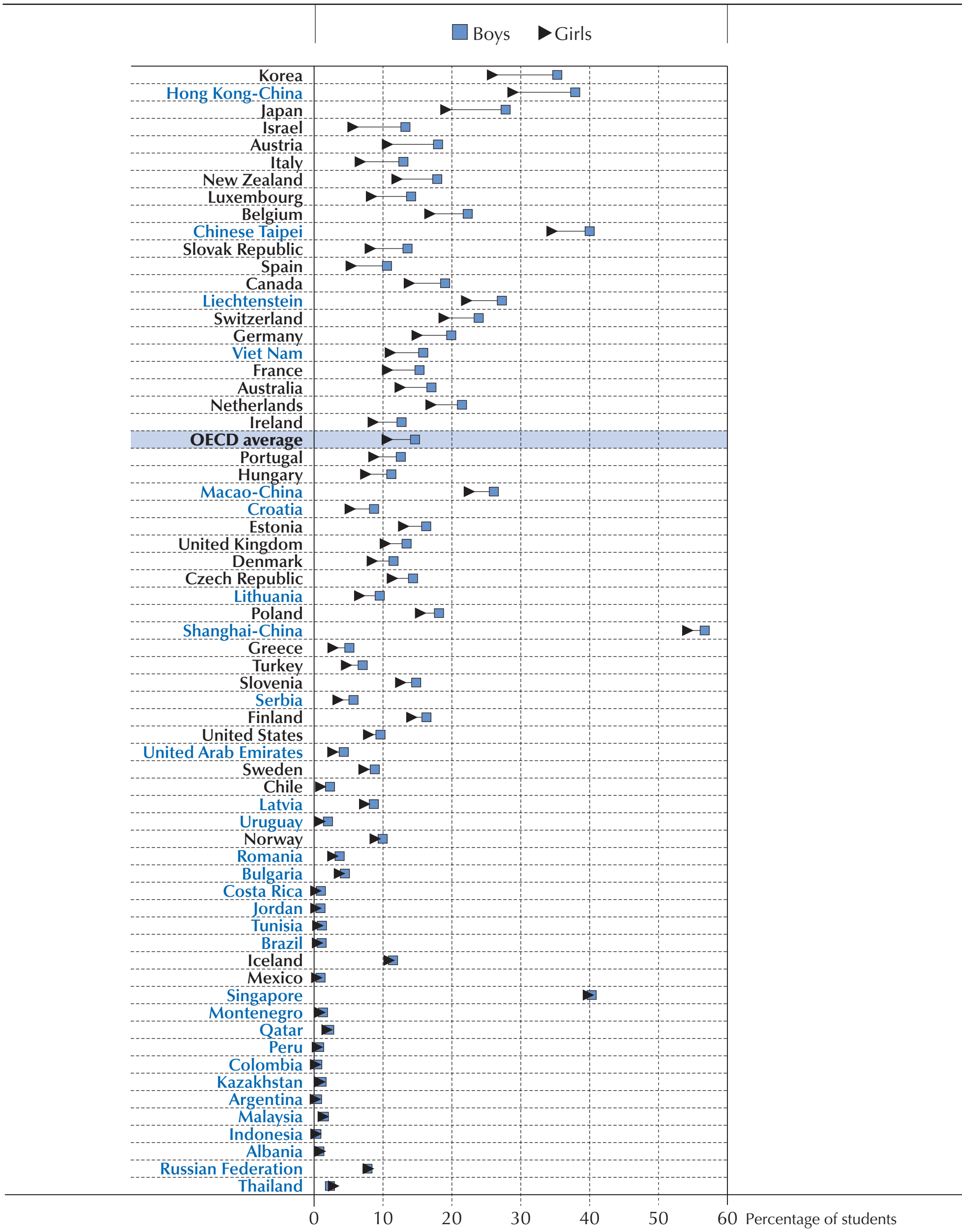
Girls' and boys' average performance in mathematics in the ten countries with the highest average performance among girls



Countries and economies are ranked in descending order of the mean score in mathematics among boys.
Source: OECD, PISA 2012 Database, Table 1.3a.

■ Figure 3.2 ■

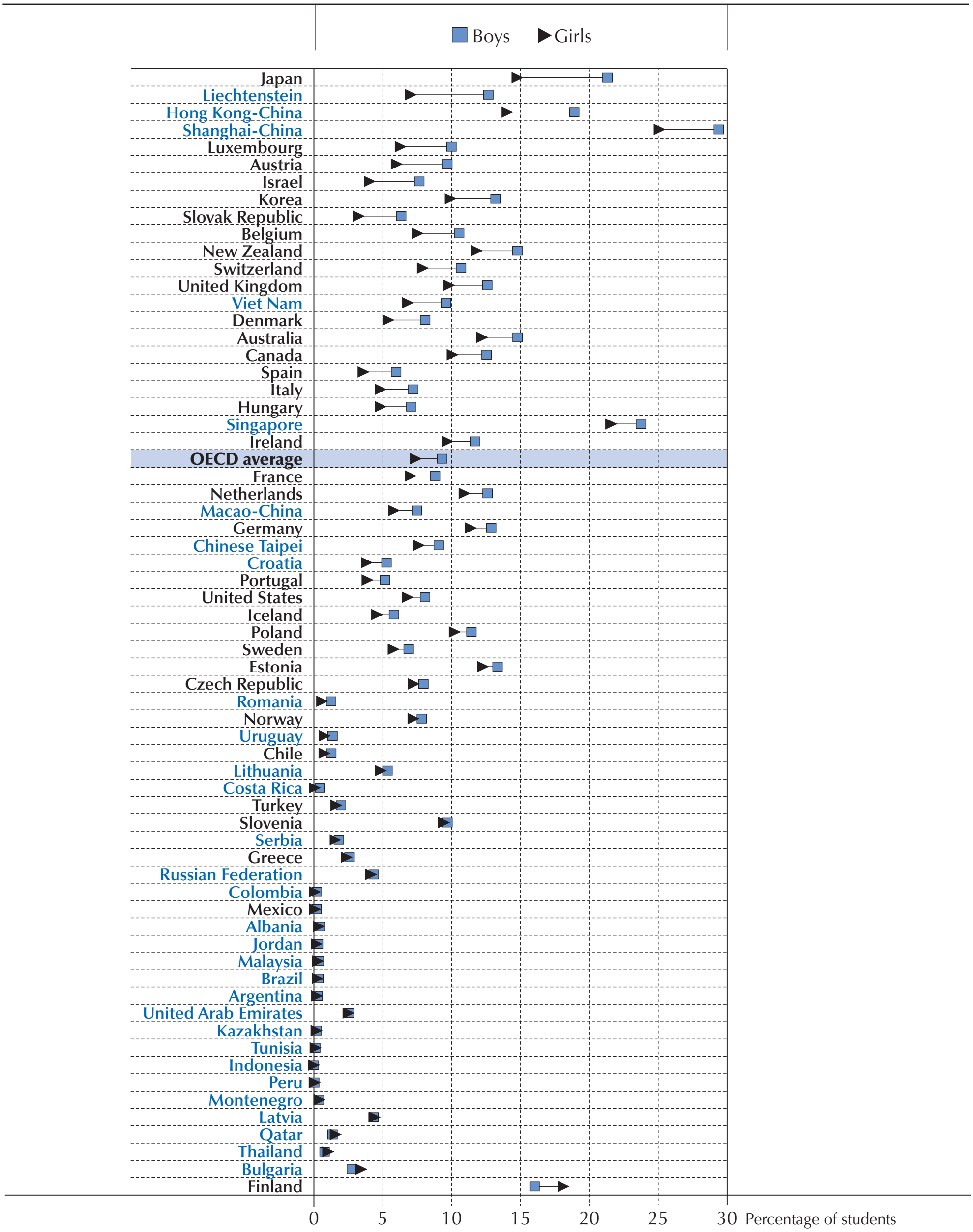
Gender gap among top performers in mathematics



Countries and economies are ranked in descending order of the percentage-point difference between the percentages of boys and girls among top performers in mathematics.
Source: OECD, PISA 2012 Database.

■ Figure 3.3 ■

Gender gap among top performers in science



Countries and economies are ranked in descending order of the percentage-point difference between the percentages of boys and girls among top performers in science.
Source: OECD, PISA 2012 Database.

However, PISA finds that while boys outperform girls in mathematics, on average, in many countries and economies the gender gap is much wider among top-performing students than among low-performing students (Table 1.3a). In the large majority of countries and economies, high-performing girls do worse in mathematics compared to boys; in no country do they outperform boys at this level, and the magnitude of the gender gap is much greater than it is among students at an average level of performance. In science, the highest-achieving boys outperform the highest-achieving girls by an average of 12 score points in as many as 17 OECD countries (Table 1.4a). This is a troubling finding that may be related to the under-representation of women in science, technology, engineering and mathematics (STEM) occupations (Summers, 2005; National Academy of Sciences, 2006; Hedges and Nowell, 1995; Bae et al., 2000). Yet, there are some countries and economies that buck this trend. In Macao-China, Singapore and Chinese Taipei, all of which are high-performers in mathematics, girls perform just as well as boys, even at the highest levels of proficiency. In these countries/economies, there is no gender gap in mathematics performance among the 5% highest-performing students (Table 1.3a).

STUDYING THE "INTANGIBLES" THAT AFFECT LEARNING

So what's going on? To find out, PISA homed in on some of the intangibles that could have an impact on learning, such as students' drive, motivation and self-beliefs. Do these differ significantly between boys and girls? And how are they related to student performance? Some of the starkest differences between boys and girls are only revealed when students express their feelings about their own abilities. PISA and other studies find that girls have less belief in their own abilities in mathematics and science, and are plagued with greater anxiety towards mathematics, than boys – even when they perform just as well as boys. Some studies have found that girls rate their own ability as lower than that of boys as early as the first year of primary school – even when their actual performance does not differ from that of boys (Fredericks and Eccles, 2002; Herbert and Stipek, 2005). What all of this evidence suggests is that gender disparities in drive, motivation and self-beliefs are more pervasive and more firmly entrenched than gender differences in mathematics performance.

How boys and girls think and feel about themselves shapes their behaviour, especially when facing challenging circumstances (Bandura, 1977). Education systems are successful when they equip all students, both boys and girls, with the ability to influence their own lives (Bandura, 2002). Self-beliefs have an impact on learning and performance on several levels: cognitive, motivational, affective and decision-making. They determine how well students motivate themselves and persevere in the face of difficulties, they influence students' emotional life, and they affect the choices students make about coursework, additional classes, and even education and career paths (Bandura, 1997; Wigfield and Eccles, 2000).

This section builds on insights from PISA 2006 in discussing students' self-beliefs in science, and PISA 2012 in discussing students' self-beliefs in mathematics. In 2006, science was the main assessment domain, so the background questionnaire contained a large number of questions on students' attitudes and dispositions towards science. Similarly, in 2012, the main assessment domain was mathematics, and the background questionnaire contained a large number of questions on students' attitudes and dispositions towards mathematics. The science

and mathematics self-beliefs examined include self-efficacy (the extent to which students believe in their own ability to handle mathematical and scientific tasks effectively and overcome difficulties); self-concept (students' beliefs in their own mathematics and science abilities); and intrinsic and instrumental motivation to learn mathematics and science (how much students enjoy learning mathematics and science, and whether they see a value in what they learn for their future careers).

Mathematics and science self-beliefs illustrate students' personal convictions. While they are built into how well students perform in mathematics and science over the course of their lives, once established, they play a determining and independent role in individuals' continued growth and in the development of their mathematical and scientific skills and competencies (Bandura, 1997; Markus and Nurius, 1986). While they are partly the product of a student's past performance in mathematics, biology, physics and chemistry, mathematics and science self-beliefs influence how students function when confronted with mathematical and scientific problems. In addition, they have an independent effect on life choices and decisions. Students who perform similarly in mathematics and in science classes usually choose different courses, education pathways, and ultimately different careers, partly depending on how they perceive themselves as mathematics and science learners (Bong and Skaalvik, 2003; Wang et al., 2013).

Self-efficacy in mathematics and science

Self-efficacy in mathematics and science was measured by asking students about their confidence in being able to solve a series of scientific and mathematical problems. In PISA 2006, students were asked to report whether they believed they could perform a series of tasks either easily or with a bit of effort. These tasks included explaining why earthquakes occur more frequently in some areas than in others; recognising the science question that underlies a newspaper report on a health issue; interpreting the scientific information provided on packages of food; predicting how changes to an environment will affect the survival of certain species; identifying the science question associated with the disposal of garbage; describing the role of antibiotics in treating disease; identifying the better of two explanations of how acid rain is formed; and discussing how new evidence can lead to a change of understanding about the possibility of life on Mars. Students' responses to questions were used to create an *index of science self-efficacy*, which identifies students' level of self-efficacy in science. The index was standardised to have a mean of 0 and a standard deviation of 1 across OECD countries.

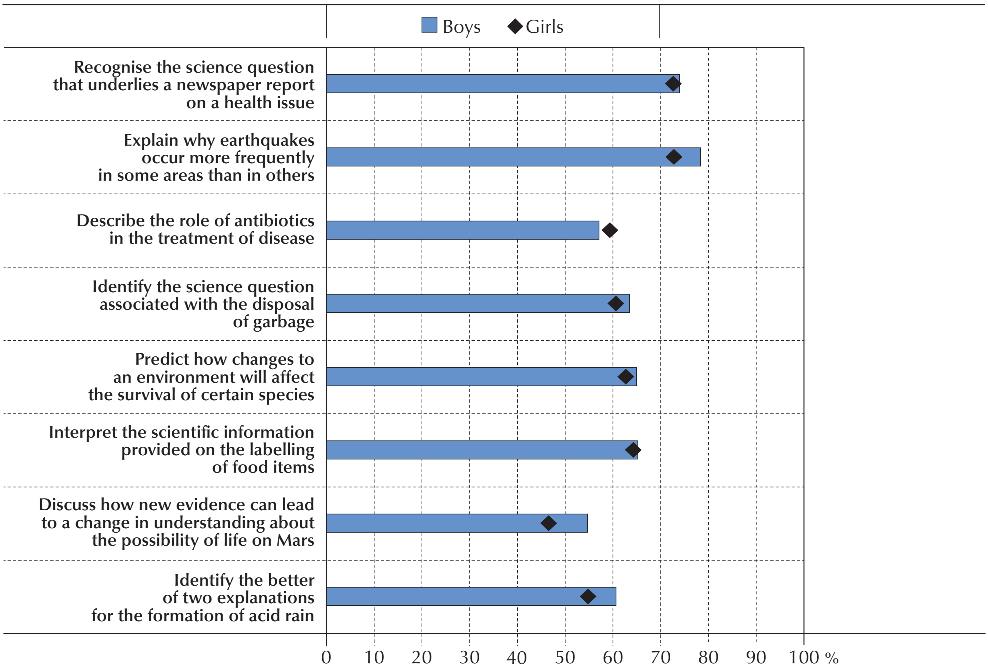
In PISA 2012, students were asked to report on whether they would feel confident doing a range of pure and applied mathematical tasks involving some algebra, such as using a train timetable to work out how long it would take to get from one place to another; calculating how much cheaper a TV would be after a 30% discount; calculating how many square metres of tiles would be needed to cover a floor; calculating the petrol-consumption rate of a car; understanding graphs presented in newspapers; finding the actual distance between two places on a map with a 1:10 000 scale; and solving equations like $3x+5=17$ and $2(x+3)=(x+3)(x-3)$. Students' responses to questions about whether they feel very confident, confident, not very confident or not at all confident were used to create an *index of mathematics self-efficacy*, which identifies students' level of self-efficacy in mathematics. The index was standardised to have a mean of 0 and a standard deviation of 1 across OECD countries.

Tables 3.1b and 3.2b show that while girls, in general, have lower levels of self-efficacy than boys in both mathematics and science, the difference is much wider in mathematics than in science, and the gender gap in feelings of confidence depends greatly on the type of problem or situation boys and girls encounter. For example, boys were more likely than girls to feel confident that they would be able to discuss how new evidence can lead to a change of understanding about the possibility of life on Mars, that they could identify the better of two explanations for how acid rain is formed, and that they could explain why earthquakes occur more frequently in some areas than in others. However, girls reported being more confident than boys in describing the role of antibiotics in treating disease; and there were no large gender differences in how confident boys and girls feel about being able to recognise the science question that underlies a newspaper report on a health issue. Gender differences in science self-efficacy were smaller or even inverted, with girls reporting greater confidence, when scientific issues were framed in the context of health problems (Figure 3.4 and Table 3.1a).

■ Figure 3.4 ■

Gender differences in science self-efficacy

OECD average percentage of students who reported that they can:



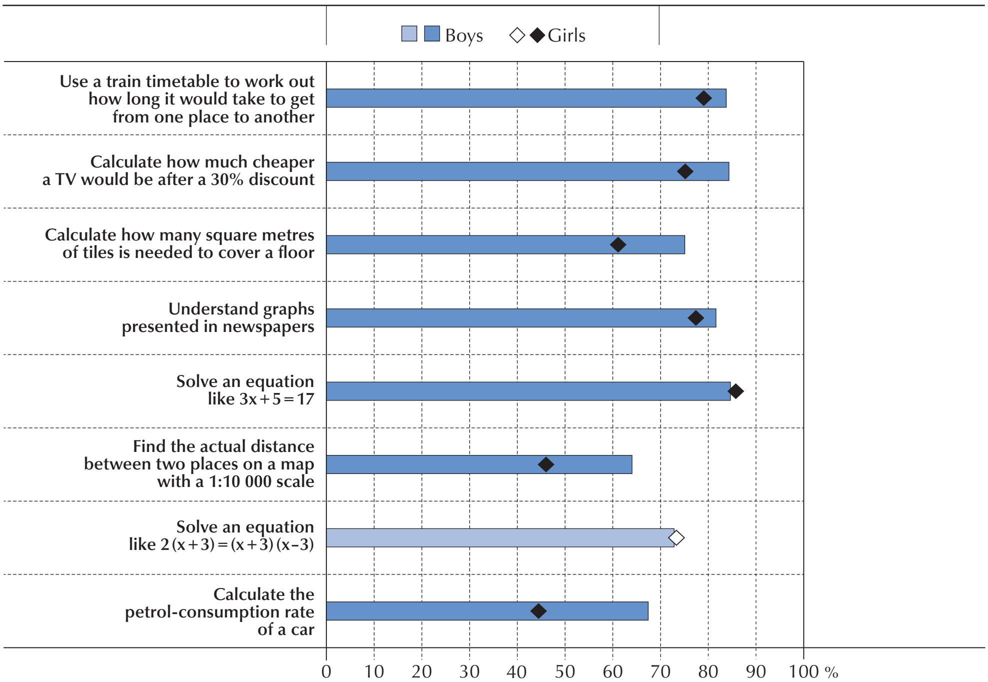
Note: All differences between boys and girls are statistically significant.
Source: OECD, PISA 2006 Database, Table 3.1a.

The same pattern is observed in students' mathematics self-efficacy. Gender differences in self-confidence are particularly large when considering the ability to solve applied mathematics tasks that have gender-stereotypical content. For example, across OECD countries, 67% of boys but only 44% of girls reported feeling confident about calculating the petrol-consumption rate of a car, and 75% of girls (compared to 84% of boys) reported feeling confident or very confident about calculating how much cheaper a TV would be after a 30% discount. However, no gender differences in confidence were observed when students were asked about doing tasks that are more abstract and clearly match classroom content, such as solving a linear or a quadratic equation (Figure 3.5 and Table 3.2a).

■ Figure 3.5 ■

Gender differences in mathematics self-efficacy

OECD average percentage of students who reported that they can:

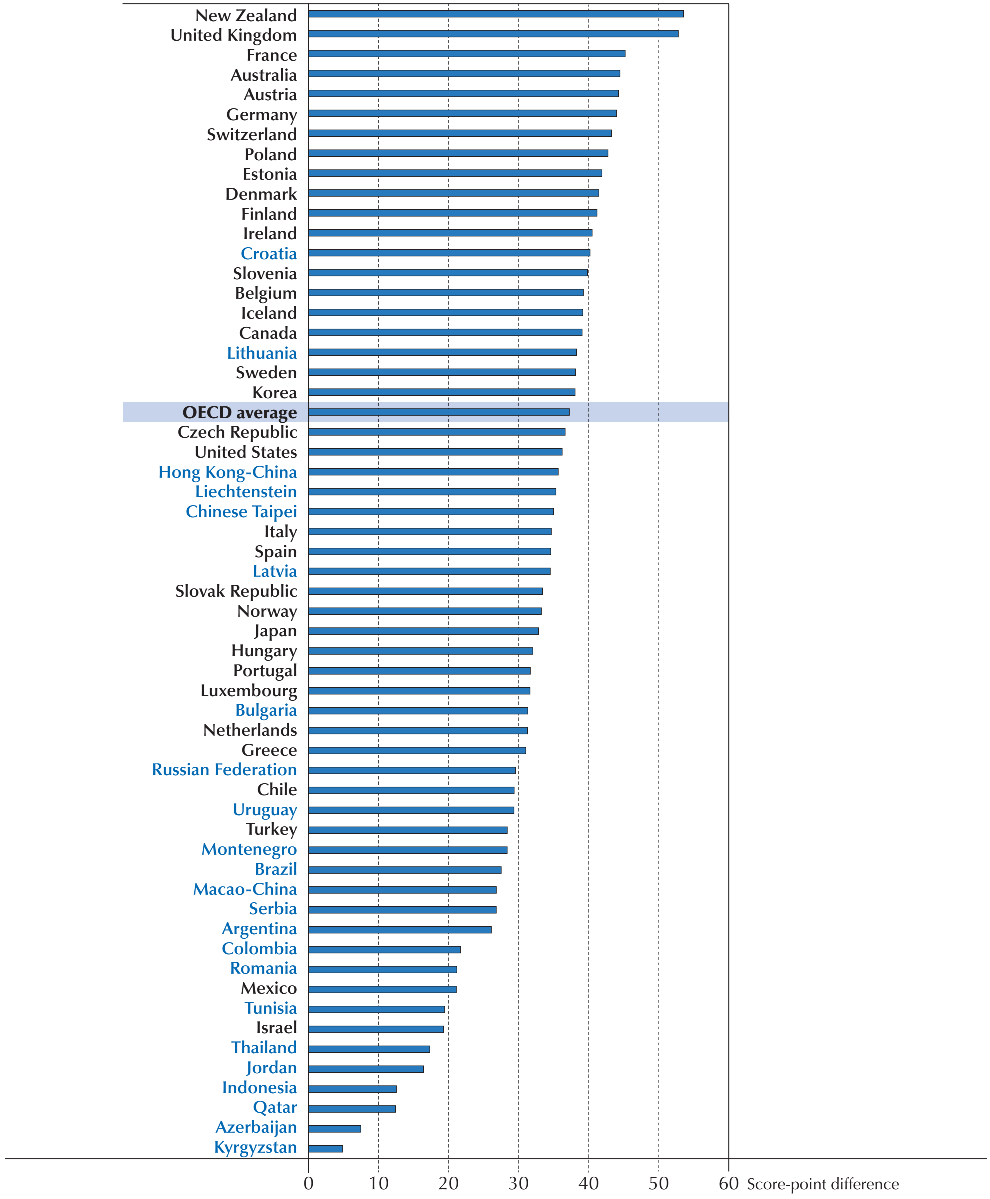


Note: Differences between boys and girls that are statistically significant are marked in a darker tone.
Source: OECD, PISA 2012 Database, Table 3.2a.

While gender differences in mathematics and science self-efficacy, and related beliefs about competence, have long been a subject of study (Eccles, 1984; Jacobs et al., 2002; Pajares and Miller, 1994), there has been no systematic attempt to understand what girls' lack of confidence in their own mathematics abilities means for their countries' future. In fact, PISA reveals that students who have low levels of mathematics and science self-efficacy perform worse in mathematics and science than students who are confident about their ability to handle mathematics and science tasks (Tables 3.1c and 3.2c). On average across OECD countries, mathematics and science self-efficacy are associated with a difference of 49 score points in mathematics and 37 score points in science – the equivalent of between one year and six months of school, respectively.

■ Figure 3.6 ■

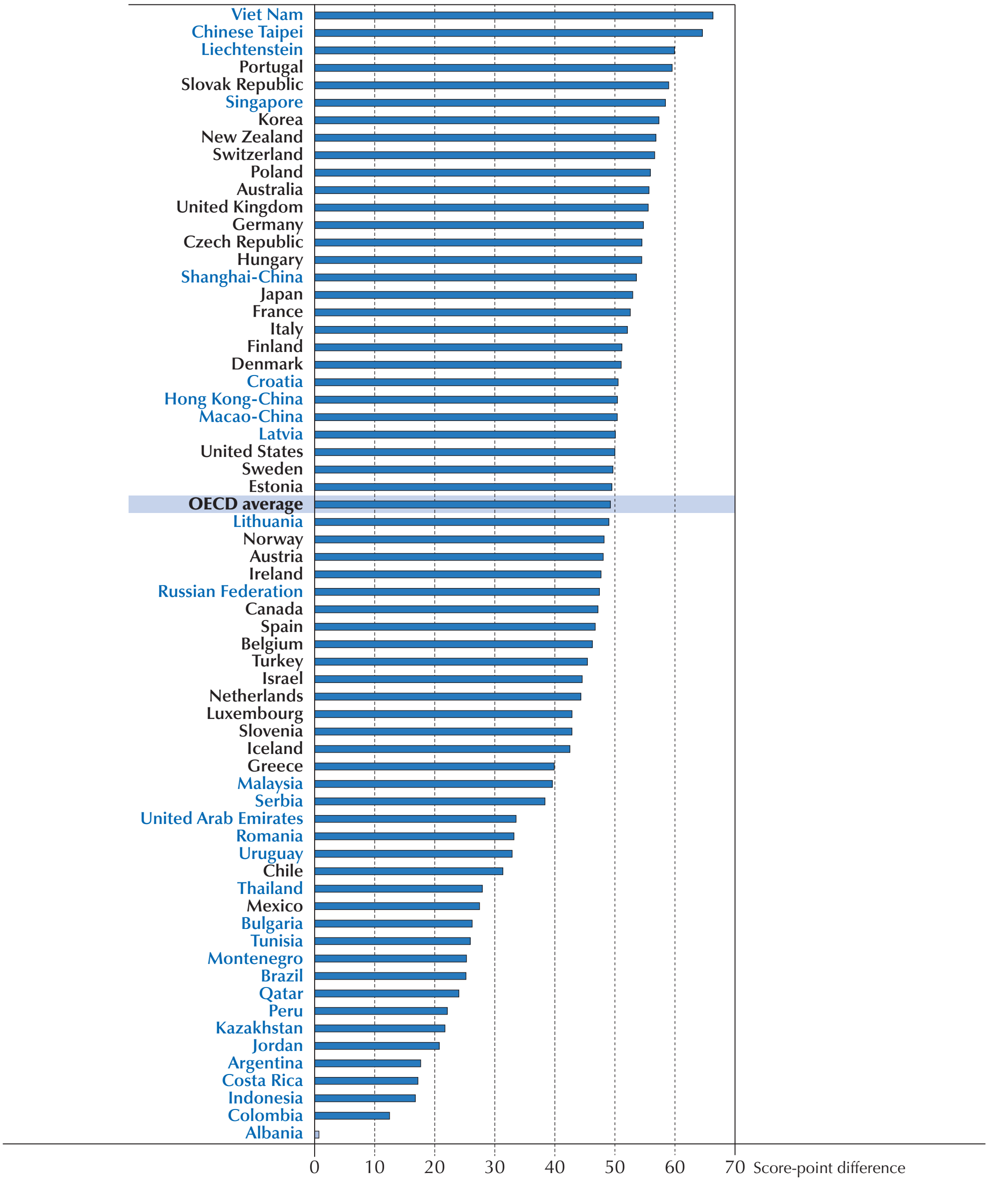
Relationship between science self-efficacy and science performance



Note: All score-point differences are statistically significant.
Countries and economies are ranked in descending order of the score-point difference associated with a one-unit change in the index of science self-efficacy.
Source: OECD, PISA 2006 Database, Table 3.1c.

■ Figure 3.7 ■

Relationship between mathematics self-efficacy and mathematics performance



Note: Score-point differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the score-point difference associated with a one-unit change in the index of mathematics self-efficacy.
Source: OECD, PISA 2012 Database, Table 3.2c.

Self-concept in mathematics and science

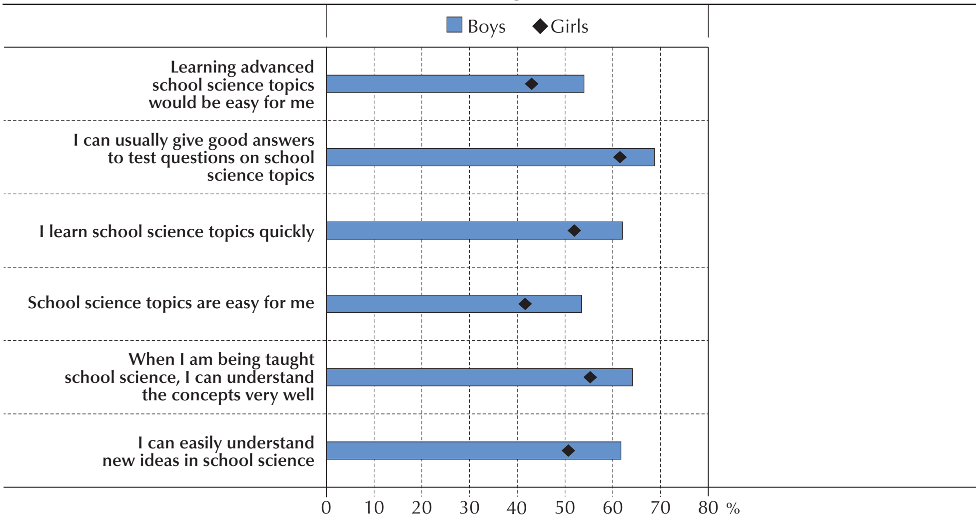
Students' self-concept, or their belief in their own abilities, is an important outcome of education and strongly related to successful learning (Marsh, 1986; Marsh and O'Mara, 2008). Longitudinal studies of self-concept and achievement show that they are reciprocally related over time (Marsh et al., 2012; Marsh and Martin, 2011). Self-concept can also affect well-being and personality development. PISA 2006 measured students' science self-concept through self-reports on whether students strongly agreed, agreed, disagreed or strongly disagreed that they can usually give good answers to test questions on school science topics; that when they are being taught school science, they can understand the concepts very well; that they can learn school science topics quickly; that they can easily understand new ideas in school science; that learning advanced school science topics would be easy for them; and that school science topics are easy for them. Student responses were used to create the *index of science self-concept*, which was standardised to have a mean of 0 and a standard deviation of 1 across OECD countries.

PISA 2012 measured students' mathematics self-concept by using students' responses as to whether they strongly agreed, agreed, disagreed or strongly disagreed that they are just not good in mathematics; that they get good marks in mathematics; that they learn mathematics quickly; that they have always believed that mathematics is one of their best subjects; and that they understand even the most difficult concepts in mathematics class. Student responses were used to create the *index of mathematics self-concept*, which was standardised to have a mean of 0 and a standard deviation of 1 across OECD countries.

■ Figure 3.8 ■

Gender differences in science self-concept

OECD average percentage of students who agreed or strongly agreed with the following statements:



Note: All differences between boys and girls are statistically significant.
Source: OECD, PISA 2006 Database, Table 3.3a.

Figures 3.8 and 3.9 suggest that girls have much lower levels of science and mathematics self-concept. For example, on average across OECD countries, boys were 11 percentage points more likely than girls to agree or strongly agree that learning advanced school science topics would be easy for them; 12 percentage points more likely than girls to agree or strongly agree that school science topics are easy for them; and 11 percentage points more likely than girls to agree or strongly agree that they can easily understand new ideas in school science and easily learn advanced school science topics (Table 3.3a).

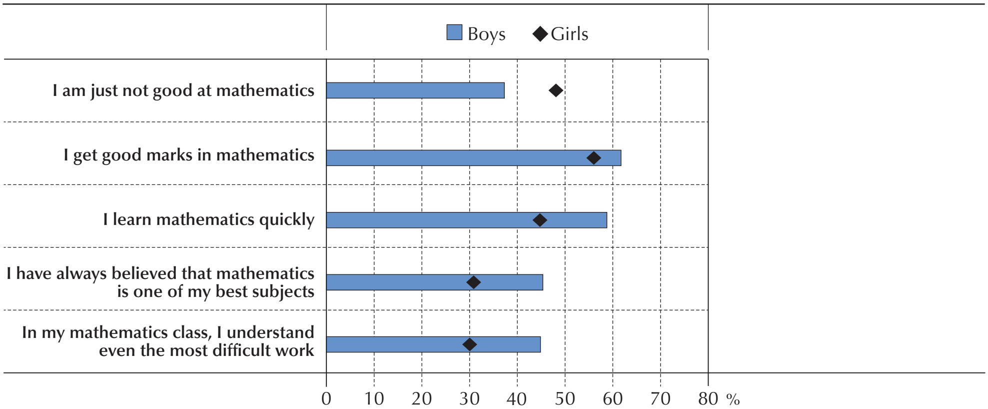
The same pattern is observed in students' mathematics self-concept. Gender disparities in students' mathematics self-concept closely mirror gender disparities in mathematics self-efficacy: 63% of boys, but only 52% of girls, reported that they disagree that they are just not good at mathematics. Conversely, across OECD countries, 30% of girls, but 45% of boys, reported that they understand even the most difficult work in mathematics classes (Table 3.4a). Gender differences in mathematics self-concept are particularly wide in Denmark, Germany, Liechtenstein, Luxembourg, Macao-China and Switzerland, while no such gender differences can be observed in Albania, Kazakhstan and Malaysia (Table 3.2b).

Gender differences in mathematics and science self-efficacy and self-concept remain large even among students who perform at the same level in mathematics and science. Girls who perform as well as boys reported much lower levels of mathematics and science self-efficacy and lower levels of mathematics and science self-concept. These results are in line with previous empirical estimates (Jacobs et al., 2002). On average across OECD countries, girls are over one-quarter of a standard deviation lower on the self-beliefs indices than boys.

■ Figure 3.9 ■

Gender differences in mathematics self-concept

OECD average percentage of students who agreed or strongly agreed with the following statements:



Note: All differences between boys and girls are statistically significant.
Source: OECD, PISA 2012 Database, Table 3.4a.

Anxiety towards mathematics

While many students worry about their performance in school and are anxious when they have to take exams, large proportions of students report feeling anxious about mathematics in particular (Ashcraft and Ridley, 2005; Hembree, 1990; Wigfield and Meece, 1988). Students who have high levels of mathematics anxiety generally report feeling tense, apprehensive and fearful of mathematics (Richardson and Suinn, 1972; Ma, 1999; Zeidner and Matthews, 2011; Tobias, 1993); and they tend to underperform in mathematics tasks compared to students with no or low levels of mathematics anxiety (Hembree, 1990; Ma, 1999; Tobias, 1985).

While poor performance in mathematics tends to be associated with high mathematics anxiety (Ma and Kishor, 1997; Ma and Xu, 2004), evidence indicates that part of the performance gap between students with high and low levels of mathematics anxiety is directly related to the adverse effect of anxiety on cognitive resource activation (Ashcraft and Kirk, 2001). In other words, when students are anxious, in general, and are anxious about mathematics, in particular, their brains cannot devote sufficient attention to solving mathematics problems because they are, instead, occupied with worrying about such tasks (Beilock et al., 2004; Hopko et al., 1998; Hopko et al., 2002; Kellogg et al., 1999). Mathematics anxiety is not merely a psychological phenomenon; students who experience mathematics anxiety generally avoid mathematics, mathematics courses and career paths that require the mastery of some mathematical skills (Hembree, 1990; Ashcraft and Ridley, 2005; Beasley, Long and Natali, 2001; Ho et al., 2000).

PISA 2012 asked participating boys and girls to report whether they agree or strongly agree that they often worry that mathematics classes will be difficult for them; that they get very tense when they have to do mathematics homework; that they get very nervous doing mathematics problems; that they feel helpless when doing a mathematics problem; and that they worry that they will get poor marks in mathematics. Student responses about their feelings of stress associated with anticipating mathematical tasks, anticipating their performance in mathematics, and while attempting to solve mathematics problems were used to identify students' specific level of anxiety about mathematics and to construct an *index of mathematics anxiety*, standardised to have a mean of 0 and a standard deviation of 1 across OECD countries. Positive values on the index indicate that students reported higher levels of anxiety about mathematics than the average student across OECD countries, while negative values indicate that students reported lower levels of anxiety about mathematics than the average student across OECD countries.

While a considerable proportion of 15-year-olds reported feelings of helplessness and emotional stress when dealing with mathematics, girls were consistently more likely than boys to report feelings of anxiety towards mathematics (Table 3.2b). In all countries and economies that participated in PISA 2012, except Albania, Bulgaria, Indonesia, Kazakhstan, Malaysia, Montenegro, Romania, Serbia and Turkey, girls reported stronger feelings of mathematics anxiety than boys. Only in Jordan, Qatar and the United Arab Emirates did boys report greater feelings of anxiety than girls (Table 3.2b). Gender differences in mathematics anxiety tended to be particularly wide in Denmark and Switzerland. Overall, the gender difference in mathematics anxiety appears to be largest in those countries that have comparatively low levels of mathematics anxiety.

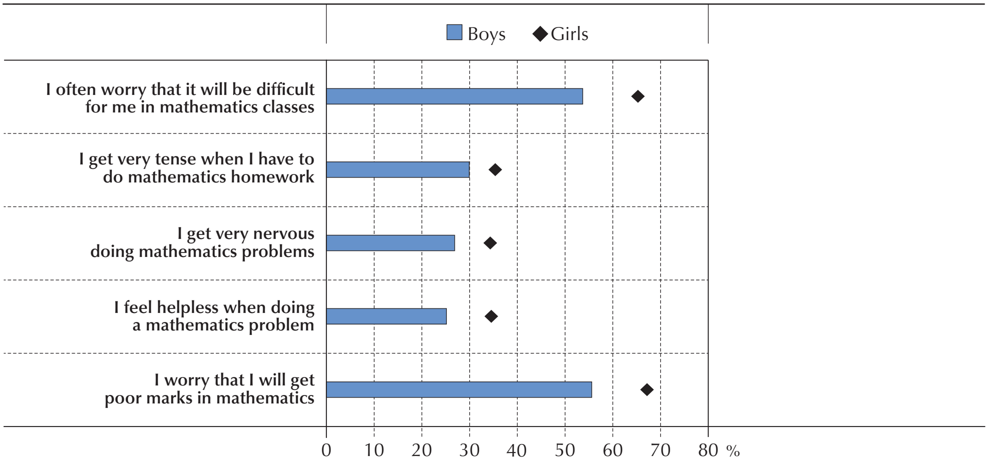
This means that while some education systems have been able to reduce greatly the number of boys who feel anxious towards mathematics, they have not been as successful with girls.

On average across OECD countries, greater mathematics anxiety is associated with a decline in performance of 34 score points – the equivalent of almost one year of school – and the gap in scores is even larger among high achievers.

■ Figure 3.10 ■

Gender differences in mathematics anxiety

OECD average percentage of students who agreed or strongly agreed with the following statements:



Note: All differences between boys and girls are statistically significant.
Source: OECD, PISA 2012 Database, Table 3.5a.

UNDERPERFORMING AT THE TOP

PISA cannot determine cause, but the strong relationship among self-beliefs, gender and performance in mathematics and science hints that countries may be unable to develop a sufficient number of individuals with strong mathematics and science skills partly because of girls' lack of confidence in their abilities. This may be exacerbated by the fact that the relationship between greater mathematics and science self-belief and higher performance is particularly strong among the highest-performing students. Greater self-efficacy, for example, is less closely related to the performance of the lowest-achieving students than to that of the highest-achieving students. A difference of one unit on the *index of mathematics self-efficacy* is associated with a 43 score-point difference in performance among the 10% lowest-performing students, but with a 53 score-point difference in performance among the 10% highest-performing students (Table 3.2c). Similarly, a difference of one unit on the *index of science self-efficacy* is associated with a 30 score-point difference in performance among the 10% lowest-performing students, but with a 41 score-point difference in performance among the 10% highest-performing students (Table 3.1c).

What emerges from these analyses is particularly worrying. Even many high-achieving girls have low levels of confidence in their ability to solve science and mathematics problems and express high levels of anxiety towards mathematics. Results presented in Tables 3.1b and 3.2b indicate that even among boys and girls who are equally capable in mathematics and science, girls tend to report lower levels of subject-specific self-efficacy and self-concept. This means that while girls' lower performance in mathematics and science among the highest-achieving students may reflect lower levels of self-confidence and higher levels of anxiety, the differences in levels of self-confidence and anxiety between boys and girls are greater than differences in mathematics and science performance.

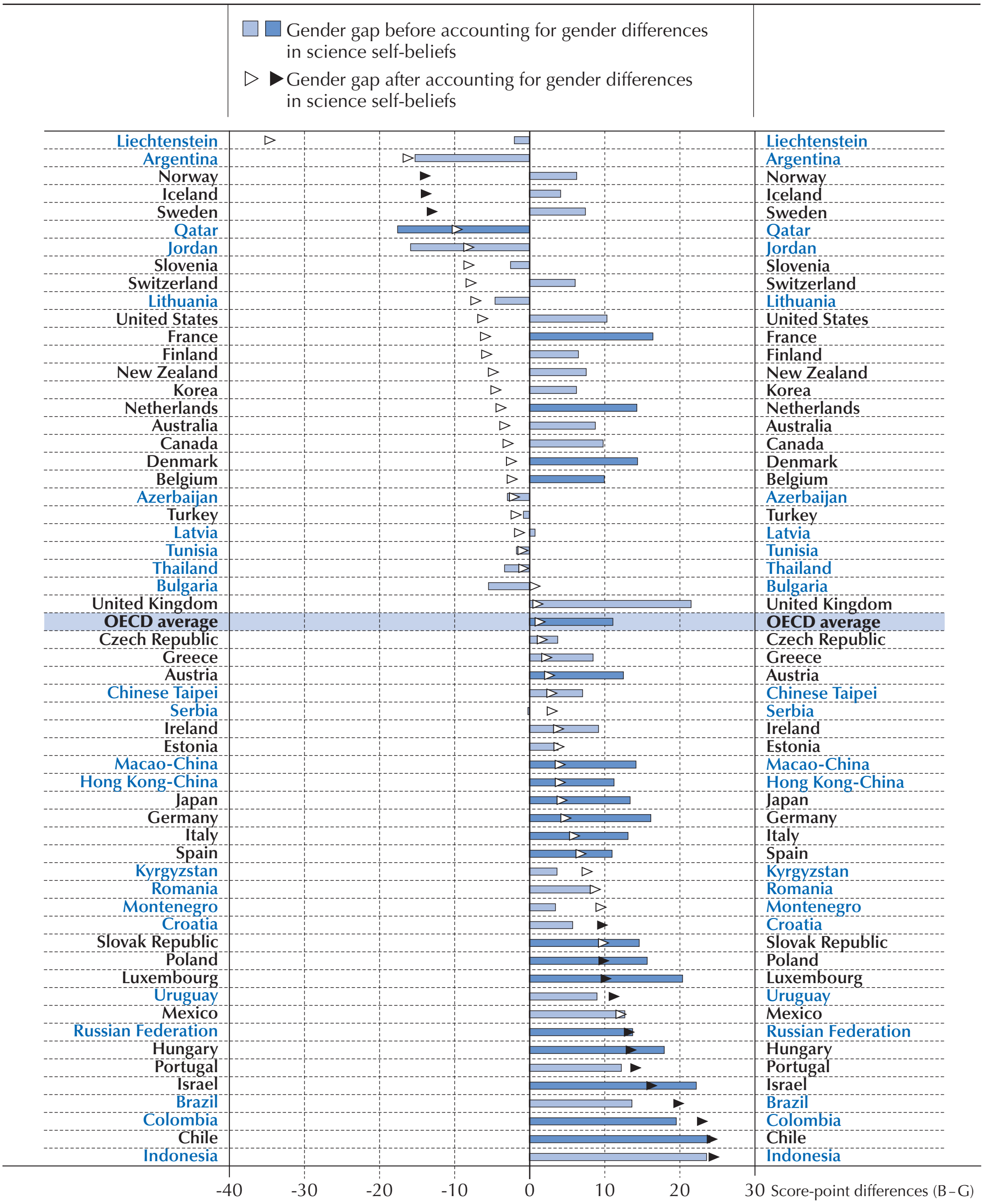
Results in Chapter 1 of this report and Tables 3.1c, 3.2c, 3.3b and 3.4b show that while boys outperform girls in mathematics, on average, in many countries and economies, the gender gap in science performance between the average boy and the average girl differs across countries. However, even in science there is a sizeable gap in favour of boys among top-performing students. This is a troubling finding, as some believe it is responsible for the under-representation of women in STEM occupations (Summers, 2005; National Academy of Sciences, 2006; Hedges and Nowell, 1995; Bae et al., 2000).

The findings shown in Figure 3.11 also suggest that differences in students' reported levels of science self-beliefs, such as science self-efficacy and science self-concept, also explain a large share of the gender gap in science performance among the highest-achieving students (Table 3.6a). This gender gap is significant in only 12 countries and economies after differences in science self-efficacy and self-concept are taken into account. In most of the remaining countries, the gender gap in science scores shrinks considerably after accounting for differences in self-reported levels of science self-beliefs. In Iceland, Norway and Sweden, high-achieving girls outperform high-achieving boys with similar levels of science self-concept and self-efficacy. On average across OECD countries, before accounting for gender differences in science self-concept and self-efficacy, there is an 11 score-point difference in performance between high-achieving girls and high-achieving boys. But when comparing high-achieving boys and girls who reported similar levels of science self-beliefs, there is no performance gap.

The data shown in Figure 3.12 suggest that differences in students' reported levels of mathematics self-beliefs explain a large share of the gender gap in performance among the highest-achieving students, and show a similar relationship between science self-beliefs and science performance. On average across OECD countries, the score-point difference in mathematics performance between high-achieving girls and boys is 20 score points. However, when comparing boys and girls who also reported similar levels of mathematics self-efficacy, self-concept and mathematics anxiety, there is no performance gap. The data shown in Figure 3.12 indicate that, when the highest-achieving students have similar levels of mathematics self-beliefs, girls underperform compared to boys in only six countries. By contrast, before these differences in self-beliefs are taken into account, 40 countries and economies show a gender gap in mathematics performance. Even in those countries where high-achieving girls underperform compared with high-achieving boys, the gender gap is considerably narrower when comparing boys and girls who reported the same levels of mathematics self-beliefs (Table 3.6b).

■ Figure 3.11 ■

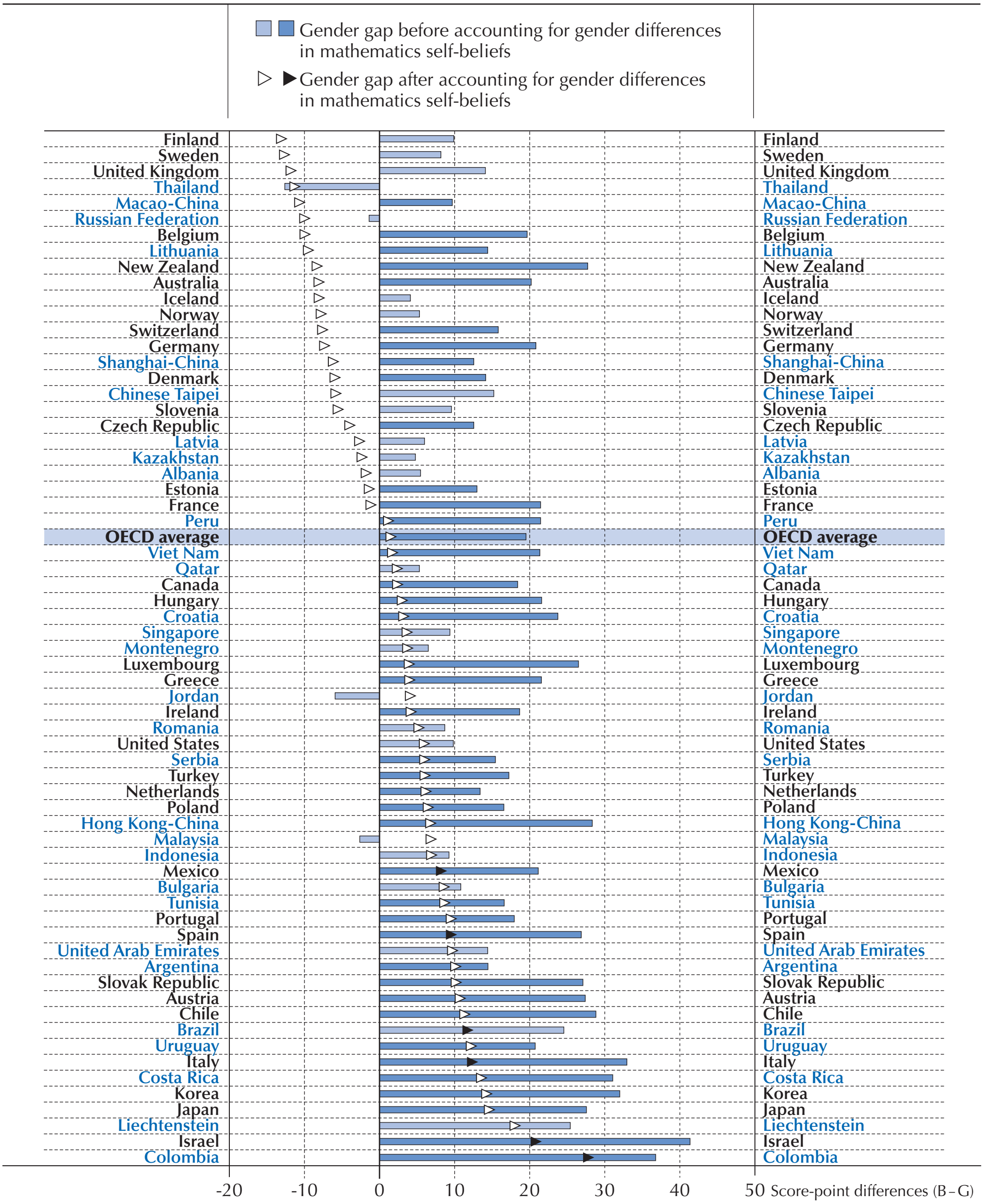
Role of science self-beliefs in reducing the gender gap among the highest-achieving students



Note: Score-point differences between boys and girls that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the score-point difference after accounting for gender differences in science self-beliefs.
Source: OECD, PISA 2006 Database, Table 3.6a.

■ Figure 3.12 ■

Role of mathematics self-beliefs in reducing the gender gap among the highest-achieving students



Note: Score-point differences between boys and girls that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the score-point difference after accounting for gender differences in mathematics self-beliefs.
Source: OECD, PISA 2012 Database, Table 3.6b.

Gender disparities in mathematics and science achievement might also result from differences in the opportunities boys and girls have to practice their math and science skills, such as in mathematics-related work outside of school (Fryer and Levitt, 2010; Wang, 2012), or from differences in the schools in which they are enrolled, and the courses they choose or are streamed into while at school. If girls invest less time than boys studying mathematics and science because they hold negative self-beliefs about these subjects, or because they are less encouraged by teachers and parents to invest their effort in mathematics and science rather than in other subjects, then a gender gap in mathematics and science performance could open by the time students reach adolescence.

Results presented in Tables III.4.5c and III.7.4 in Chapters 4 and 7 of *Ready to Learn: Students' Engagement, Drive and Self-Beliefs* (OECD, 2013) indicate that participation in mathematics-related activities, such as playing chess, programming computers, taking part in mathematics competitions, or helping friends with mathematics problems, does not explain why boys and girls are not equally likely to perform at high levels in mathematics. The gender gap, whether at the mean, bottom or top of the performance distribution, remains unchanged, whether or not gender differences in participation in mathematics-related activities are taken into account. This might simply indicate that these are not the types of activities that could help girls achieve at higher levels. While PISA data cannot be used to measure the amount of time boys and girls invested in studying mathematics and science up until the moment they took the PISA test, they can be used to identify gender differences in participation in the kinds of courses and activities that may help students to become more familiar with the two subjects.

OPPORTUNITY TO LEARN MATHEMATICS

One of the reasons why boys and girls may develop different levels of mathematics skills may be because they are offered, or take advantage of, different opportunities to learn mathematics in and outside of school. For example, girls are less likely than boys to play chess, program computers, take part in mathematics competitions, or do mathematics as an extracurricular activity (Table 3.7). On average across OECD countries, the proportion of girls who play chess is 12 percentage points smaller than the proportion of boys who do, and the proportion of girls who program computers is 14 percentage points smaller that the share of boys who do. These activities stimulate logical thinking and can be a fun way of using mathematical skills and abilities in play-like situations.

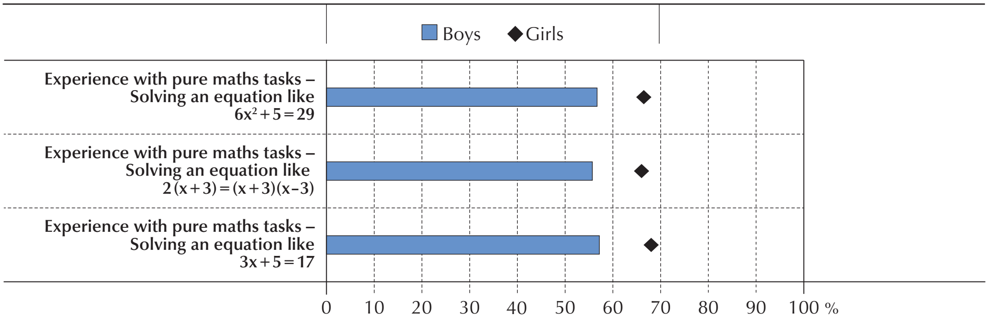
Girls and boys appear to have different levels of exposure to certain mathematics problems and concepts. As Tables 3.8a, 3.8b, and 3.8c show, girls appear to be overwhelmingly more likely than boys to report that they frequently encounter pure mathematics problems. On average across OECD countries, in 2012, 66% of girls but only 57% of boys reported that they frequently encounter a quadratic equation like $6x^2+5=29$. In all countries and economies except Albania, Colombia, Liechtenstein and New Zealand, girls were more likely than boys to have reported that they encounter this type of quadratic equation. Similarly, girls were more likely than boys, on average across OECD countries, to have reported that they had to solve the following equation: $2(x+3)=(x+3)(x-3)$. While 66% of girls, on average, reported that they have frequently been asked to solve such an equation at school, only 56% of boys reported the same.

Gender differences are also very large in how frequently boys and girls are asked to solve a linear equation like 3x+5=17. While 68% of girls, on average, reported that they have frequently been asked to do so, only 57% of boys reported the same.

■ Figure 3.13 ■

Gender differences in students' experience with pure mathematics tasks

OECD average percentage of students who reported:

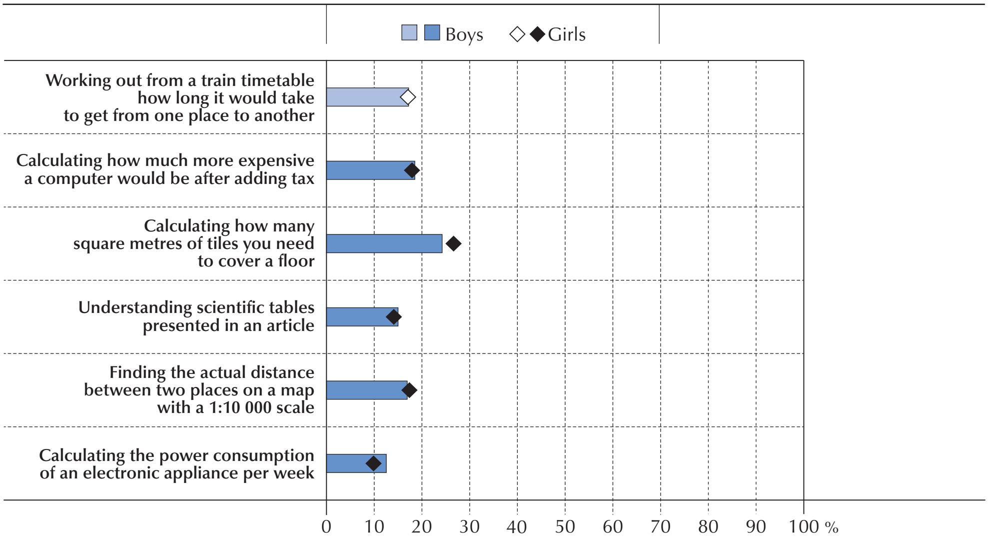


Note: All differences between boys and girls are statistically significant.
Source: OECD, PISA 2012 Database, Table 3.8a.

■ Figure 3.14 ■

Gender differences in students' experience with applied mathematics tasks

OECD average percentage of students who reported having experience in:



Note: Differences between boys and girls that are statistically significant are marked in a darker tone.
Source: OECD, PISA 2012 Database, Table 3.8a.

Figure 3.13 and Table 3.8a show that while girls appear to be overwhelmingly more likely than boys to have reported that they have encountered pure mathematics tasks, such as solving quadratic and linear equations, gender differences in reported experience with applied mathematics tasks are generally very small; in fact, in the large majority of countries and economies there is no difference in boys' and girls' exposure to such tasks. On average across OECD countries, in 2012, 17% of boys and girls reported that they have frequently encountered a problem like one requiring them to look at a train timetable and determine how long it would take to get from one place to another (Figure 3.14 and Table 3.8a). Similarly, the gender gap in the percentage of boys and girls who reported that they have frequently been asked to calculate how much more expensive a computer would be after adding tax is less than 1 percentage point, on average across OECD countries.

PISA 2012 asked participating students to report how familiar they are with a number of mathematics concepts and terms. Students were asked to report whether they never heard the concept, heard it only once or twice, heard it a few times, heard it often, or know it well and understand the concept. Among a series of geometry, algebra and statistics terms, students were asked to report their level of familiarity with three concepts that do not exist, to capture potential differences in response style and "overclaiming", since some students may report being familiar with some concepts when they are not.

Figure 3.15 and Table 3.8b show the percentage of boys and girls who reported that they have heard often or know and understand a concept well. Results indicate that girls were much more likely than boys to report that they heard often and are familiar with most concepts, except for the three concepts that do not exist. For example, on average across OECD countries, 68% of girls and 65% of boys reported a high level of familiarity with *divisors*. Similarly, 54% of both girls and boys reported a high level of familiarity with *quadratic functions*. However, 15% of boys and 11% of girls reported being familiar with the non-existent item *declarative fractions*, and 12% of boys but only 7% of girls reported being very familiar with the non-existent item *subjunctive scaling*.

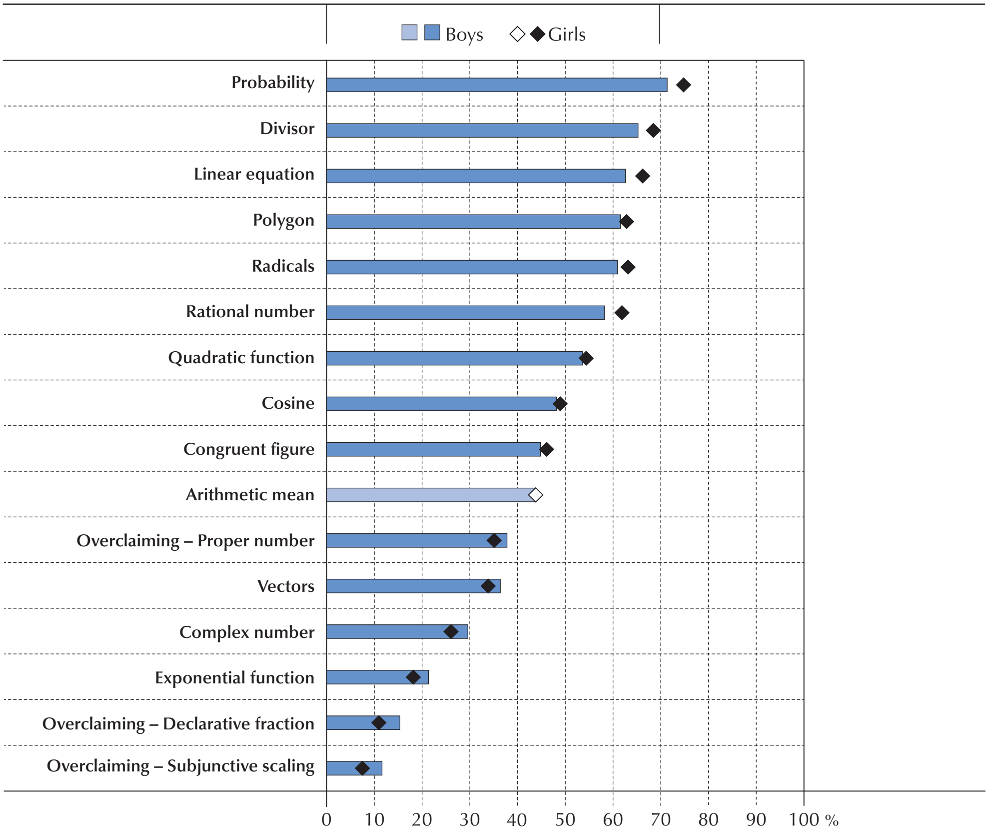
Differences in overclaiming between boys and girls suggest that gender differences in levels of familiarity with mathematics concepts may be more profound than what students' self-reports suggest, because boys have a tendency to report that they are familiar with topics even though they are not. Table 3.8c shows aggregate results on gender differences in the three indices that were developed based on students' responses to questions concerning exposure to pure and applied mathematics tasks and familiarity with mathematics concepts, after accounting for overclaiming by individual students. All indices are standardised to have a mean of 0 and a standard deviation of 1 across OECD countries.

Girls are more likely than boys to be familiar with a broad array of formal mathematics concepts, ranging from algebra to geometry, and to have been asked to solve pure mathematics tasks, such as solving a linear or a quadratic equation. Gender differences in students' reports of the frequency with which they encounter applied mathematics tasks are much smaller and differ across countries.

■ Figure 3.15 ■

Gender differences in students' familiarity with formal mathematics

OECD average percentage of students who reported being familiar with the following concepts:

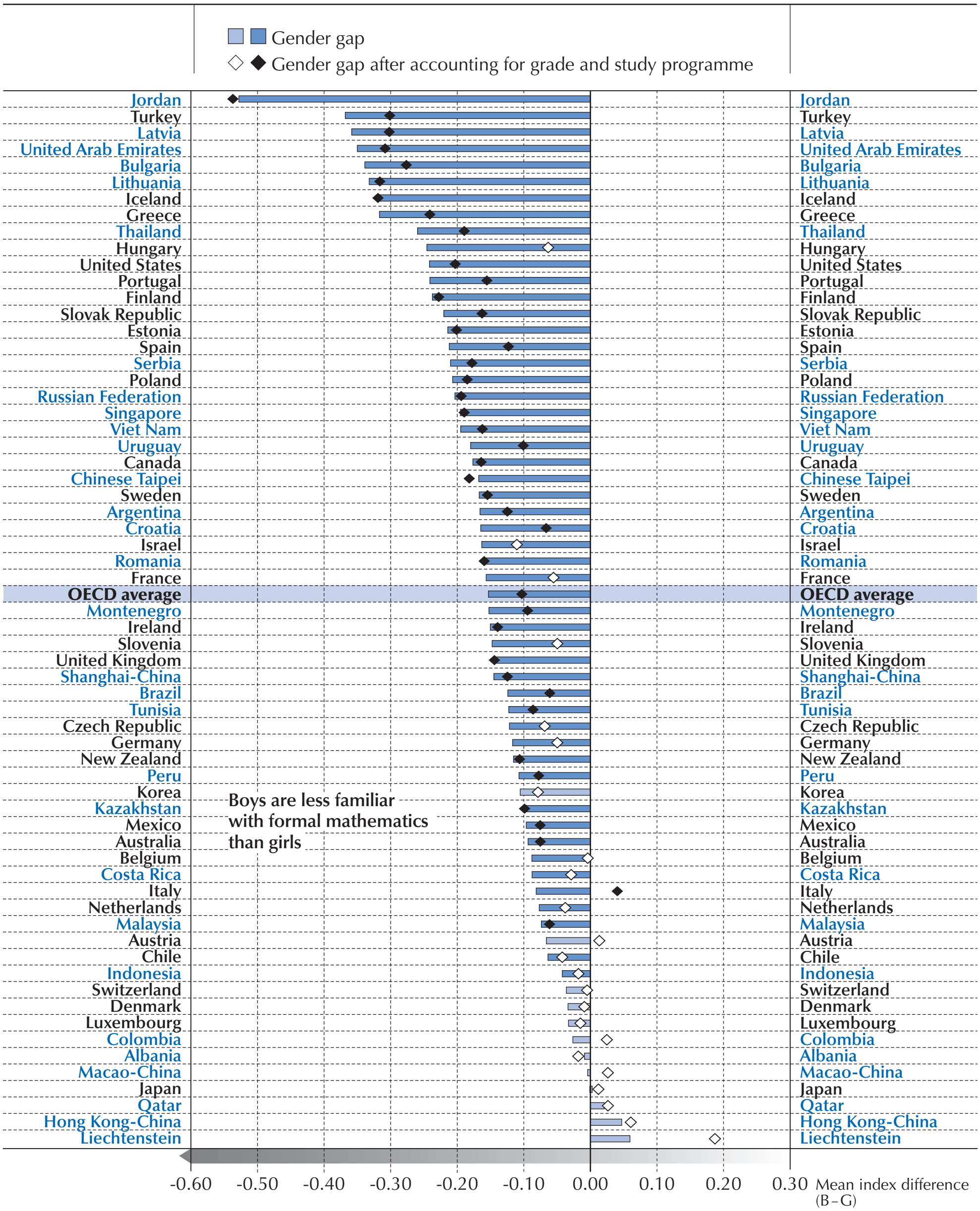


Note: Differences between boys and girls that are statistically significant are marked in a darker tone.
Concepts are ranked in descending order of the percentage of boys who reported that they are very familiar with each (have either heard often or know well and understand a given concept).
Source: OECD, PISA 2012 Database, Table 3.8b.

Differences between boys and girls in exposure to pure mathematics tasks and familiarity with formal mathematics concepts may be due to the fact that boys are more likely than girls to repeat grades (see Table 2.13b) such that, at the same age, they may be less likely than girls to have covered specific mathematical concepts and problems. Boys are also more likely than girls to attend vocational schools (see Table 4.1), and these schools may favour a more applied approach to the study of mathematics (as well as other subjects). Results presented in Table 3.8c show the gender gap in familiarity with formal mathematics, and experience with pure and applied mathematics, when controlling for the grade students are in, and whether students attend vocational or pre-vocational programmes rather than academic-oriented or modular programmes.

■ Figure 3.16 ■

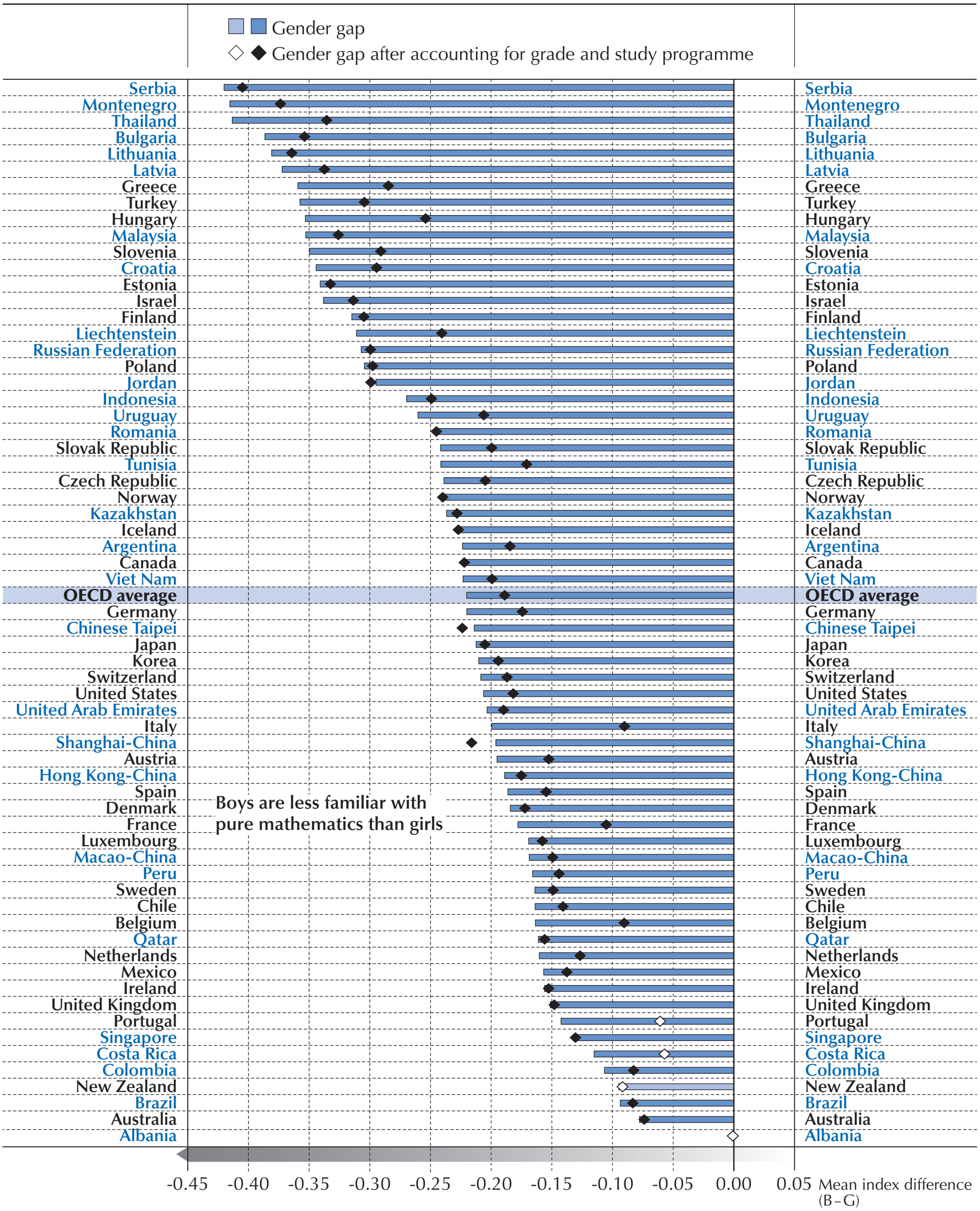
Role of grade repetition and study programme in explaining gender differences in students' familiarity with formal mathematics



Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the gender gap related to students' familiarity with formal mathematics (before accounting for grade and study programme).
Source: OECD, PISA 2012 Database, Table 3.8c.

■ Figure 3.17 ■

Role of grade repetition and study programme in explaining gender differences in students' experience with pure mathematics tasks



Note: Gender differences that are statistically significant are marked in a darker tone.

Countries and economies are ranked in ascending order of the gender gap related to students' experience with pure mathematics tasks (before accounting for grade and study programme).

Source: OECD, PISA 2012 Database, Table 3.8c.

Results indicate that differences in students' grade level and study programme explain only a small part of the differences between boys and girls in how familiar they are with formal mathematics and with pure mathematics tasks. On average across OECD countries, around one-third of the gender gap in students' level of familiarity with formal mathematics is explained by grade and study programme. Similarly, even though grade and study programme explain some of the gender gap in students' experience with pure mathematics tasks, this gap remains large and significant after accounting for these factors. Girls in all OECD countries, except New Zealand and Portugal, and in all partner countries and economies, except Albania and Costa Rica, reported having had greater experience with pure mathematics problems, such as solving a linear or a quadratic equation (Table 3.8c). Similarly, in 17 OECD countries girls reported greater familiarity with a range of mathematics concepts; Italy is the only OECD country in which boys reported greater familiarity with mathematics concepts than girls.

These differences are important because familiarity with formal mathematics and experience with pure mathematics are strongly and positively associated with performance in mathematics. Table 3.8d shows the change in mathematics score that is associated with a one-unit change on the *index of familiarity with formal mathematics*, the *index of experience with pure mathematics problems*, and the *index of experience with applied mathematics problems*. When not considering other factors, a difference of one unit on the *index of familiarity with formal mathematics* is associated with a difference of 41 score points in mathematics, on average across OECD countries, and a difference of one unit in the *index of experience with pure mathematics problems* is associated with a difference of 30 score points (Table 3.8d). When considering all aspects of opportunity to learn in mathematics simultaneously, the score-point difference associated with familiarity with mathematics concepts is 36 points and that associated with experience with pure mathematics is 23 points.

What is particularly interesting is that the gender gap in mathematics performance is considerably larger when boys' and girls' different levels of familiarity with mathematics concepts, and their experience with pure and applied mathematics, are considered (Table 3.8d). On average across OECD countries, the gender gap in mathematics performance stands at 11 score points, but is 22 points among boys and girls who reported similar levels of familiarity with mathematics concepts and experience with pure and applied mathematics problems.

The difference in the gender gap before and after taking into account opportunities to learn mathematics is large (11 score points, on average across OECD countries) and is significant in as many as 30 OECD countries and 25 partner countries and economies. These results suggest that, in many countries, girls' performance in mathematics is closer to that of boys thanks to the greater effort they invest in their mathematics studies. In Jordan, Lithuania and Turkey, the gender gap narrows by 20 score points in mathematics because of girls' greater investment in mathematics classes. Albania, Austria, Costa Rica, Denmark, Japan, Liechtenstein, Macao-China and Romania are the only countries/economies where the difference in the gender gap before and after accounting for opportunities to learn mathematics is not significant (Table 3.8d).

Results presented in Table 3.8e, however, reveal that in the large majority of countries and economies, students' familiarity with mathematics concepts and experience with pure mathematics tasks are as strongly associated with mathematics performance among low-achieving students as they are among high-achieving students. On average across OECD countries, a change of one unit on the *index of familiarity with formal mathematics* is associated with a difference of 32 score points in mathematics performance among the 10% lowest-performing students and a difference of 36 score points among the 10% highest-performing students. Similarly, a change of one unit on the *index of experience with pure mathematics tasks* is associated with a difference of 24 score points in mathematics performance among the 10% lowest-performing students and a difference of 20 score points among the 10% highest-performing students. Interestingly, differences in experience with pure and applied mathematics tasks and familiarity with formal mathematics concepts do not explain why girls perform worse in mathematics than boys, particularly among the highest-achieving students.

CHOKING UNDER PRESSURE

As discussed above, girls at every proficiency level in mathematics and science tend to report greater anxiety towards mathematics and lower levels of self-efficacy and self-concept. Chapter 2 also suggests that girls are more likely than boys to be engaged with school, put effort into their studies, and believe that school is important. It is possible that girls' greater motivation to do well in school and the greater investment they make to achieve this goal are undermined by their lack of self-confidence in scientific subjects, particularly when girls are capable of achieving at the highest levels (Beilock and Carr, 2001).

In professional sports, the phenomenon is known as choking under pressure. Paradoxically, a supportive environment, such as being the home team in a crucial game, can sap top athletes of precisely the skills that make them great (Baumeister and Steinhilber, 1984; Baumeister, 1984). The fear of letting others down, making mistakes and underachieving may lead some high-achieving individuals to focus on the minutiae of what they're doing rather than on the situation at hand and how best to respond to it (Beilock and Carr, 2001; Oudejans et al., 2011). While self-awareness and step-by-step control of actions are associated with better performance among low- and average-achieving individuals, they actually disrupt performance among the highest achievers.

Girls may be "choking under pressure" in mathematics. High-achieving girls are more likely to suffer from high levels of anxiety than high-achieving boys, even when they have greater intrinsic motivation to learn mathematics. PISA measures students' intrinsic motivation to learn mathematics through their responses ("strongly agree", "agree", "disagree" or "strongly disagree") to statements asserting that they enjoy reading about mathematics; that they look forward to mathematics lessons; that they do mathematics because they enjoy it; and that they are interested in the things they learn in mathematics.

Results presented in Table 3.10 suggest that individuals who are anxious about mathematics tend to have less intrinsic motivation to learn mathematics, and vice-versa; but among boys and girls who have similar levels of intrinsic motivation to learn mathematics, girls tend to be consistently more anxious towards mathematics than boys. On average across OECD countries, among boys and girls with similar levels of intrinsic motivation to learn mathematics, girls are one-tenth of a standard deviation higher on the *index of mathematics anxiety* than boys. Crucially, these results also indicate that when students are intrinsically motivated to learn mathematics, but are anxious towards the subject, their performance suffers.

THINKING LIKE A SCIENTIST

Results from the PISA 2012 mathematics and problem-solving assessments and the PISA 2006 science assessment suggest that girls' performance tends to be better in areas where they are required to apply mathematics concepts, facts, procedures and reasoning, and to recognise scientific issues. However, girls appear to underperform considerably when they are required to think like scientists – meaning when they are asked to formulate problems mathematically, interpret phenomena scientifically and predict changes, solve interactive problems, or understand and solve problems where the way of solving the problem is not immediately obvious and the problem evolves over time.

Gender differences in mathematics performance, in favour of boys, are particularly pronounced when students are required to translate a word problem into a mathematical expression. On average across OECD countries, boys outperform girls on the *formulating* subscale by around 16 points, while the average gender gap in the PISA mathematics test as a whole is 11 score points. Among OECD countries, the largest differences in favour of boys are observed in Austria, Chile, Italy, Korea, Luxembourg and New Zealand. In the United States, the gender difference was less than 10 points. Only one country shows a performance difference in favour of girls: Qatar (9 points) (Tables 1.3a and 1.10a).

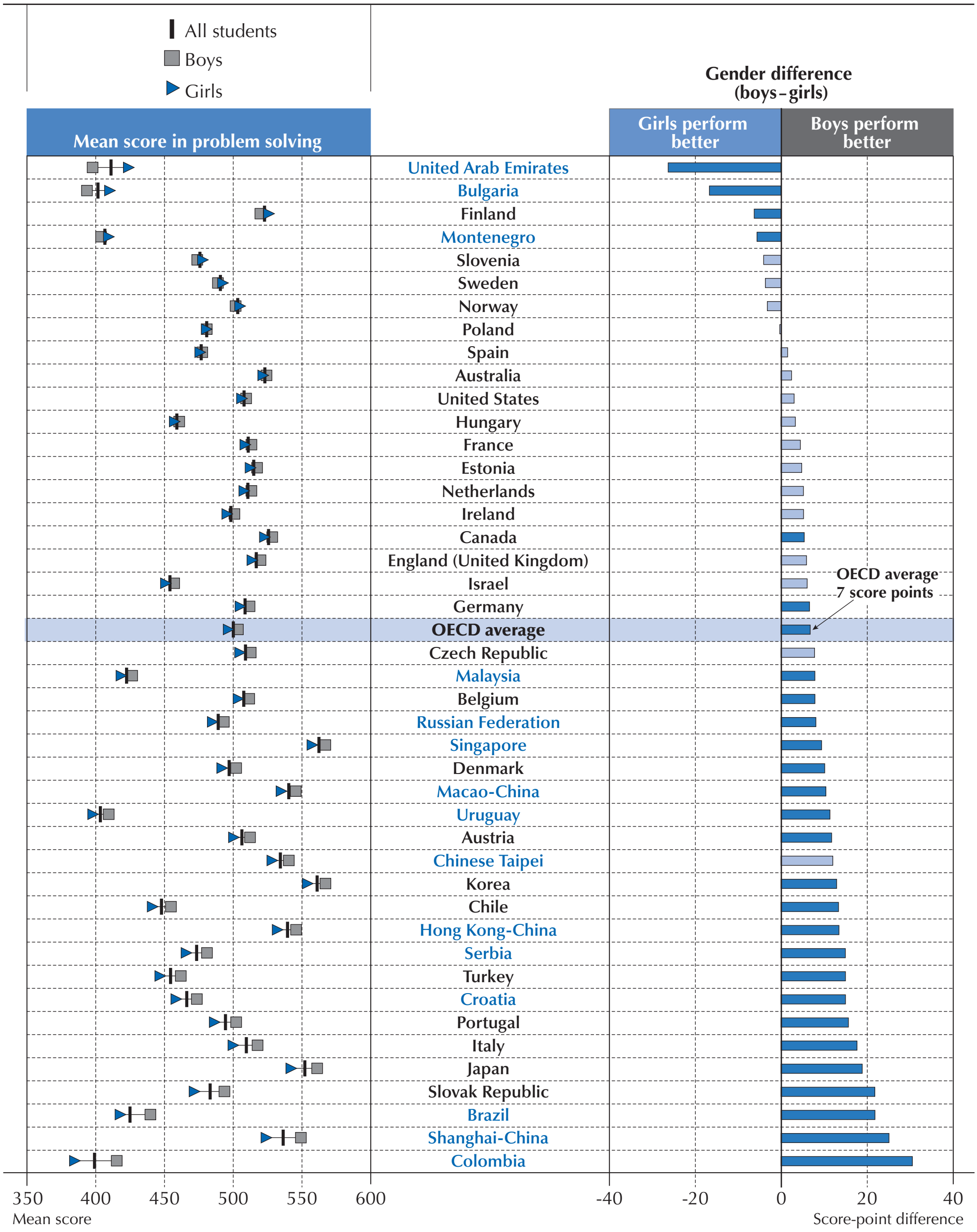
When students are required to employ mathematics concepts, facts, procedures and reasoning to solve a problem, gender differences are much narrower. On average across OECD countries, boys still outperform girls on the *employing* subscale, but by a much smaller margin than on the *formulating* subscale: 9 points compared to 16 points. Gender differences are even narrower when students are asked to carry out a calculation, substitute values into a formula, solve an equation, or apply their knowledge of the conventions of graphing to extract data or present information mathematically. In only one OECD country, Iceland, do girls outperform boys in the *employing* subscale (by 7 points); among partner countries and economies, girls outperform boys on the *employing* subscale in six countries: Jordan, Latvia, Malaysia, Qatar, Singapore and Thailand (Table 1.10b).

Gender differences in favour of boys are also smaller when students are required to interpret, apply and evaluate mathematics outcomes. In interpreting mathematics outcomes, students need to make links between the outcomes and the situation from which they arose. For example, in a problem requiring a careful interpretation of some graphical data, students would have to make connections among the objects or relationships depicted in the graph. The answer to the question might involve interpreting those objects or relationships. On average across OECD countries, boys score 9 points higher than girls in this subscale (Table 1.10c).

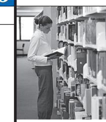
Results from PISA 2006 show even larger variations in the relative strengths and weaknesses of boys and girls in performing science-related tasks. Girls tend to outperform boys (by an average of 17 score points, across OECD countries) on tasks where they are required to identify scientific issues, but boys outperform girls in tasks that require them to apply knowledge of science in a given situation, to describe or interpret phenomena scientifically and predict changes, and to identify appropriate scientific descriptions, explanations and predictions.

■ Figure 3.18 ■

Gender differences in problem-solving performance



Note: Statistically significant gender differences are marked in a darker tone.
Countries and economies are ranked in ascending order of the score-point difference (boys – girls).
Source: OECD, PISA 2012 Database, Table 3.11a.



On average across OECD countries, boys outperform girls by 15 score points in these tasks; in Chile, boys outperform girls by 34 score points. The gender difference in score is larger than 20 points in the Czech Republic, Denmark, Germany, Hong Kong-China, Hungary, Luxembourg, the Slovak Republic and the United Kingdom (Tables 1.11a and 1.11b).

By contrast, performance differences between boys and girls are small or non-existent when students are required to interpret scientific evidence, and make and communicate conclusions, identify the assumptions, evidence and reasoning behind conclusions, or reflect on the social implications of science and technological developments (Table 1.11c).

In 2012, PISA conducted a computer-based problem-solving assessment. Problem solving here refers to "students' capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen" (OECD, 2014). Given the advances in understanding the cognitive processes involved in problem solving, and the possibility of using computer-based simulated scenarios, the assessment highlights so-called "interactive" problems.

Figure 3.18 shows that boys score seven points higher than girls in problem solving, on average across OECD countries (Table 3.11a), and that the variation observed among boys is larger than the variation observed among girls (100 points vs. 91 points). In more than half of the countries and economies that participated in the problem-solving assessment, boys outperformed girls, on average. The largest advantages in favour of boys (more than 20 score points) were observed in Brazil, Colombia, Shanghai-China and the Slovak Republic. Only in Bulgaria, Finland, Montenegro and the United Arab Emirates did girls outperform boys, on average. In 16 countries/economies, the difference in performance between boys and girls was not statistically significant.

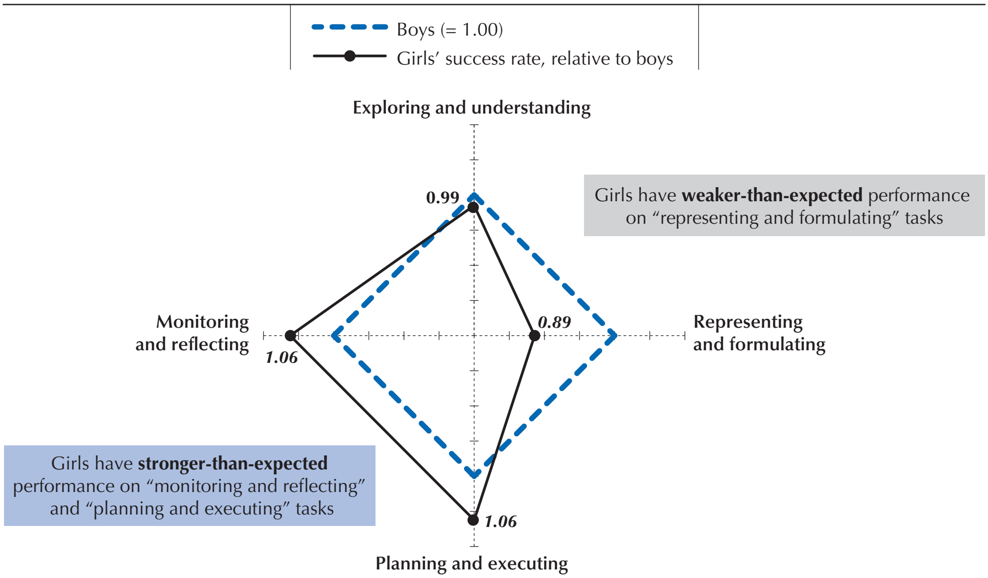
Performance differences between boys and girls vary across the problem-solving assessment, depending on the type of task involved. Boys generally outperform girls on cognitive tasks that require a greater amount of abstract information processing (Halpern and LaMay, 2000). They tend to outperform girls in their ability to transform a visual-spatial image in working memory, and generate and manipulate the information in a mental representation. In the PISA assessment of problem solving, this ability is particularly important for success on *representing and formulating* tasks. Boys' and girls' performance across problem-solving processes differs significantly in 27 of the 43 countries and economies that participated in the assessment. In all but three of these countries/economies, girls scored below their expected level of performance, particularly on items measuring *representing and formulating* processes (Table 3.11c).

In Korea, girls score lower than boys on the problem-solving assessment as a whole. An analysis by families of tasks shows that girls' performance is much weaker than boys' on tasks that measure *exploring and understanding* and *representing and formulating* processes, but is close to boys' performance (and thus stronger than expected) on tasks that measure *planning and executing* and *monitoring and reflecting* ability. As a result of its students' – particularly boys' – strong performance in tasks that measure knowledge acquisition, Korea is a high performer in problem solving.

■ Figure 3.19 ■

Girls' strengths and weaknesses, by problem-solving process

Relative likelihood of success in favour of girls, after accounting for overall performance differences on the test



Notes: Gender differences that are statistically significant are marked in italic.
This figure shows that girls' success rate on items measuring the process of "representing and formulating" is only 0.89 time as large as that of boys, after accounting for overall performance differences on the test and on average across OECD countries.
Source: OECD, PISA 2012 Database, Table 3.11c.

Hong Kong-China and Macao-China show similar patterns: boys outperform girls in problem solving, and particularly in knowledge-acquisition tasks, but not in tasks that measure how well they use the knowledge they have acquired. By contrast, in many European countries, including those with above-average performance in problem solving, such as France, Germany, Italy and the Netherlands, boys and girls perform similarly across the various problem-solving processes (Table 3.11c).

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.

References

Aronson, J. (2002), "Stereotype threat: Contending and coping with unusual expectations", in J. Aronson (ed.), *Improving Academic Achievement: Impact of Psychological Factors on Education*, Academic Press, San Diego, CA, pp. 279-301.

Ashcraft, M.H. and **E.P. Kirk** (2001), "The relationships among working memory, math anxiety, and performance", *Journal of Experimental Psychology-General*, Vol. 130/2, pp. 224-237.

Ashcraft, M.H. and **K.S. Ridley** (2005), "Math anxiety and its cognitive consequences", in J.I.D. Campbell (ed.), *Handbook of Mathematical Cognition*, Psychology Press, New York, NY, pp. 315-327.

Bae, Y. et al. (2000), *Trends in Educational Equity of Girls and Women*, National Center for Education Statistics, Washington, DC.

Bandura, A. (2002), "Growing primacy of human agency in adaptation and change in the electronic era", *European Psychologist,* Vol. 7/1, pp. 2-16.

Bandura, A. (1997), *Self-Efficacy: the Exercise of Control,* Freeman, New York, NY.

Bandura, A. (1977), *Social Learning Theory*, General Learning Press, New York, NY.

Baumeister, R.F. (1984), "Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance", *Personality and Social Psychology*, Vol. 46/3, pp. 610-620.

Baumeister, R.F. and **A. Steinhilber** (1984), "Paradoxical effects of supportive audiences on performance under pressure: The home field disadvantage in sports championships", *Journal of Personality and Social Psychology*, Vol. 47/1, pp. 85-93.

Beasley, T.M., J.D. Long and **M. Natali** (2001), "A confirmatory factor analysis of the Mathematics Anxiety Scale for Children", *Measurement and Evaluation in Counseling and Development*, Vol. 34, pp. 14-26.

Beilock, S.L. et al. (2004), "More on the fragility of performance: Choking under pressure in mathematical problem solving", *Journal of Experimental Psychology-General*, Vol. 133/4, pp. 584-600.

Beilock, S.L. and **T.H.Carr** (2001), "On the fragility of skilled performance: what governs chocking under pressure?", *Journal of Experimental Psychology: General,* Vol. 130/4, pp. 701-725.

Benbow, C.P. (1988), "Sex differences in mathematical reasoning ability in intellectually talented preadolescents: Their nature, effects, and possible causes", *Behavioral and Brain Science*, Vol. 11, pp. 169-232.

Bong, M. and **E.M. Skaalvik** (2003), "Academic self-concept and self-efficacy: How different are they really?", *Educational Psychology Review*, Vol. 15, pp. 1-40.

Eccles, J. (1984), "Sex differences in mathematics participation", in M. Steinkamp and M. Maehr (eds.), *Women in Science*, Vol. 2, JAI Press, Greenwich, CT, pp. 93-137.

Fredericks, J.A. and **J.A. Eccles** (2002), "Children's competence and value beliefs from childhood through adolescence: growth trajectories in two make-sex-typed domains", *Developmental Psychology*, Vol. 38/4, pp. 519-533.

Fryer, R.G. and **S.D. Levitt** (2010), "An empirical analysis of the gender gap in mathematics", *American Economic Journal: Applied Economics*, Vol. 2/2, pp. 210-240.

Halpern, D.F. and **M.L LaMay** (2000), "The Smarter Sex: A Critical Review of Sex Differences in Intelligence", *Educational Psychology Review,* Vol. 12/2, pp. 229-246.

Hedges, L.V. and **A. Nowell** (1995), "Sex differences in mental test scores, variability, and numbers of high scoring individuals", *Science*, Vol. 269, pp. 41-45.

Hembree, R. (1990), "The nature, effects, and relief of mathematics anxiety", *Journal of Research in Mathematics Education,* Vol. 21, pp. 33-46.

Herbert, J. and **D.T. Stipek** (2005), "The emergence of gender differences in children's perceptions of their academic competence", *Journal of Applied Developmental Psychology*, Vol. 26/3, pp. 276-295.

Ho, H. et al. (2000), "The affective and cognitive dimensions of math anxiety: A cross-national study", *Journal for Research in Mathematics Education,* Vol. 31/3, pp. 362-380.

Hopko, D.R. et al. (2002), "The emotional stroop paradigm: Performance as a function of stimulus properties and self-reported mathematics anxiety", *Cognitive Therapy and Research,* Vol. 26/2, pp. 157-166.

Hopko, D.R. et al. (1998), "Mathematics anxiety and working memory: Support for the existence of deficient inhibition mechanism", *Journal of Anxiety Disorders,* Vol. 12/4, pp. 343-355.

Jacobs, J. et al. (2002), "Ontogeny of children's self-beliefs: Gender and domain differences across grades one through 12", *Child Development,* Vol. 73, pp. 509-527.

Kellogg, J.S., D.R. Hopko and **M.H. Ashcraft** (1999), "The effects of time pressure on arithmetic performance", *Journal of Anxiety Disorders,* Vol. 13/6, pp. 591-600.

Ma, X. (1999), "A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics", *Journal for Research in Mathematics Education*, Vol. 30/5, pp. 520-540.

Ma, X. and **N. Kishor** (1997), "Assessing the relationship between attitude toward mathematics and achievement in mathematics: A meta-analysis", *Journal for Research in Mathematics Education*, Vol. 28/1, pp. 26-47.

Ma, X. and **J.M. Xu** (2004), "The causal ordering of mathematics anxiety and mathematics achievement: A longitudinal panel analysis", *Journal of Adolescence,* Vol. 27/2, pp.165-179.

Marsh, H.W. (1986), "Verbal and math self-concepts: An internal/external frame of reference model", *American Educational Research Journal*, Vol. 23, pp. 129-149.

Marsh, H.W. and **A.J. Martin** (2011), "Academic self-concept and academic achievement: Relations and causal ordering", *British Journal of Educational Psychology*, Vol. 81, pp. 59-77.

Marsh, H.W. and **A.J. O'Mara** (2008), "Self-concept is as multidisciplinary as it is multidimensional: A review of theory, measurement, and practice in self-concept research", in H.W. Marsh, R.G. Craven and D.M. McInerney (eds.), *Self-Processes, Learning, and Enabling Human Potential: Dynamic New Approaches,* Vol. 3*,* Information Age Publishing, Charlotte, NC, pp. 87-115.

Marsh, H.W., K. Xu and **A.J. Martin** (2012), "Self-concept: A synergy of theory, method, and application", in K. Harris, S. Graham and T. Urdan (eds.), *APA Educational Psychology Handbook*, *Vol. 1: Theories, Constructs, and Critical Issues*, American Psychological Association, Washington, DC, pp. 427-458.

Markus, H. and **P. Nurius** (1986), "Possible selves", *American Psychology*, Vol. 41, pp. 954-969.

National Academy of Sciences (2006), *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering,* National Academies Press, Washington, DC.

OECD (2014), *PISA 2012 Results: Creative Problem Solving (Volume V): Students' Skills in Tackling Real-Life Problems,* PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264208070-en.

OECD (2013), *PISA 2012 Results: Ready to Learn (Volume III): Students' Engagement, Drive and Self-Beliefs,* PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264201170-en.

Oudejans, R.R.D. et al. (2011), "Thoughts and attention of athletes under pressure: Skill-focus or performance worries?", *Anxiety, Stress & Coping,* Vol. 24/1, pp. 59-73.

Pajares, F. and **M.D. Miller** (1994), "Role of self-efficacy and self-concept beliefs in mathematical problem solving: a path analysis", *Journal of Educational Psychology*, Vol. 86, pp. 193-203.

Richardson, F.C. and **R.M. Suinn** (1972), "The mathematics anxiety rating scale: psychometric data", *Journal of Counseling Psychology*, Vol. 19/6, pp. 551-554.

Salisbury, J., G. Rees and **S. Gorard** (1999), "Accounting for the differential attainment of boys and girls: A state of the art review", *School Leadership and Management* , Vol. 19/4.

Shih, M., T.L. Pittinsky and **N. Ambady** (1999), "Stereotype susceptibility: Identity salience and shifts in quantitative performance", *Psychological Science*, Vol. 10/1, pp. 80-83.

Steen, I.A. (1987), "Mathematics education: A predictor of scientific competitiveness", *Science*, Vol. 237, pp. 251-253.

Summers, L.H. (2005), "Remarks at NBER conference on diversifying the science and engineering workforce", www.harvard.edu/president/speeches/summers_2005/nber.php.

Tobias, S. (1993), *Overcoming Math Anxiety* (revised and expanded edition), W.W. Norton and Company, New York, NY.

Tobias, S. (1985), "Test Anxiety: Interference, Defective Skills, and Cognitive Capacity", *Educational Psychologist*, Vol. 20, pp. 135-142.

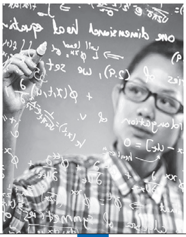
Wang, M., J.S. Eccles and **S. Kenny** (2013), "Not lack of ability but more choice: Individual and gender difference in choice of careers in sciences, technology, engineering, and mathematics", *Psychological Sciences,* Vol. 24/5, pp. 770-775.

Wang, M.T. (2012), "Educational and career interests in math: A longitudinal examination of the links between perceived classroom environment, motivational beliefs, and interests", *Developmental Psychology*, Vol. 48, pp. 1643-1657.

Wigfield, A. and **J.S. Eccles** (2000), "Expectancy - value theory of motivation", *Contemporary Educational Psychology*, Vol. 25, pp. 68-81.

Wigfield, A. and **J. Meece** (1988), "Math anxiety in elementary and secondary school students", *Journal of Educational Psychology,* Vol. 80, pp. 210-216.

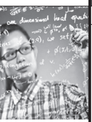
Zeidner, M. and **G. Matthews** (2011), *Anxiety 101,* Springer, New York, NY.



4

Expectations and Reality for School-Leavers

This chapter explores the differences between 15-year-old boys' and girls' expectations for further education and their careers, and their preparedness to search for a job – and reveals whether adolescent expectations become reality after teenagers become adults. The chapter also describes young men's and women's levels of proficiency in literacy and numeracy after they leave compulsory schooling and examines gender differences in how adults use their skills at work. Financial literacy among 15-year-olds is also discussed.



PISA data offer compelling evidence of the differences in how boys and girls approach learning, how they feel about their own abilities to learn, and how they perform in reading, mathematics, science and problem solving. Information gathered through an Educational Career questionnaire that is distributed along with the PISA assessment also reveals that boys and girls hold different expectations for their futures and that they tend to prepare themselves for life after compulsory education in very different ways.

Those differences might have something to do with what and how students study at school. In comprehensive school systems, all 15-year-old students follow the same programme, while in differentiated school systems, students are streamed into different programmes. Some of these programmes may be primarily academic, others offer primarily vocational components, and yet others may offer combinations of academic and vocational programmes (Kerckhoff, 2000; LeTendre et al., 2003). Figure 4.1 indicates that, in many countries and economies, boys are more likely than girls to be enrolled in technical and vocational programmes when such programmes are available in a given school system (Table 4.1).

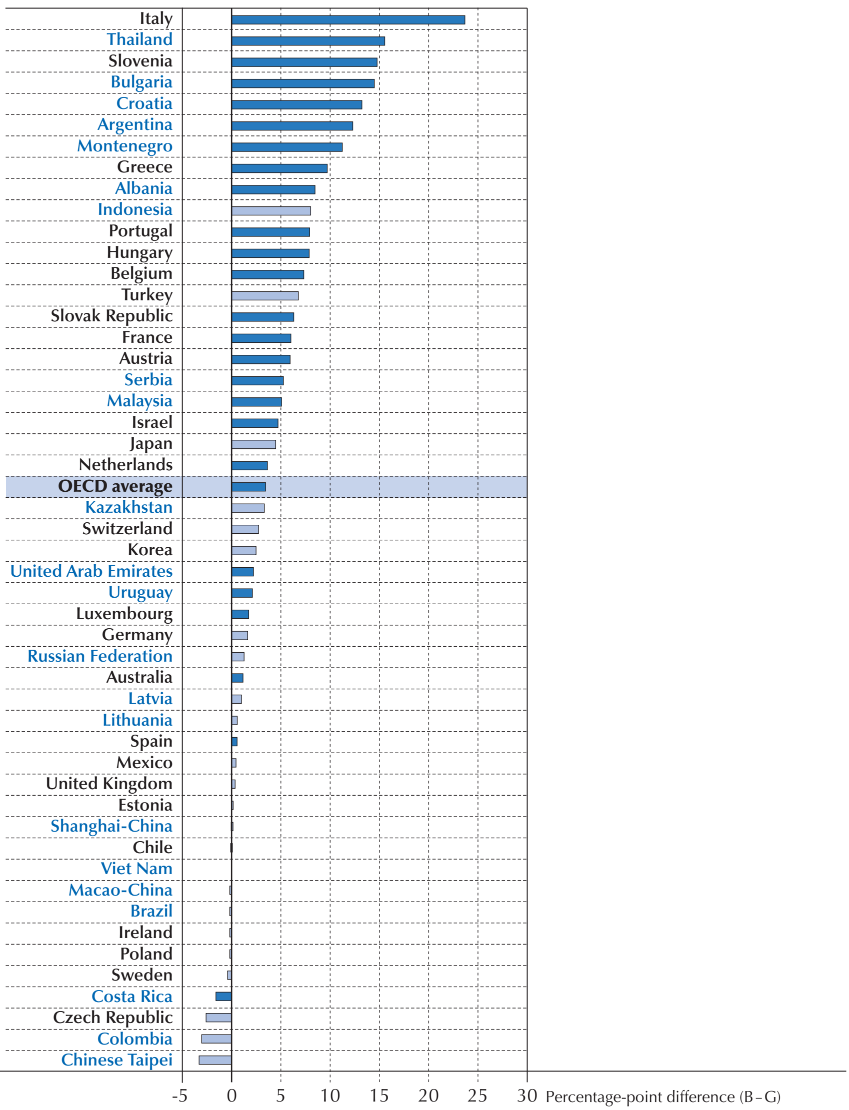
What the data tell us

- On average across countries and economies that distributed the Educational Careers questionnaire in 2012, 43% of girls and 37% of boys reported that they had not mastered the skills needed to perform well at a job interview. In Croatia, Italy, Serbia, the Slovak Republic and Slovenia, the share of girls who reported that they had not learned how to prepare for a job interview is over 10 percentage points larger than the share of boys who so reported; in Australia, Denmark and Hong Kong-China, there are no gender differences in this regard.
- Less than 5% of girls in OECD countries, on average, contemplate pursuing a career in engineering or computing (and the definition of computing and engineering includes such gender-neutral fields as architecture), while 16% of girls expect a career in health (excluding nurses and midwives) but only 7% of boys do.
- In 2000, 36% of 15-year-old boys and 43% of girls that age expected to work as managers or professionals when they were 30; but in 2012, only 22% of 25-34 year-old men and 23% of 25-34 year-old women worked in such occupations.
- While PISA reveals large gender differences in reading, in favour of 15-year-old girls, the Survey of Adult Skills suggests that there are no significant gender differences in literacy proficiency among 16-29 year-olds.
- Among workers in their 30s, 40s and particularly workers in their 50s and 60s, men appear to be considerably more likely than women to read and write at work, as well as to use numeracy, ICT and problem-solving skills.

Students who participated in PISA 2012 were asked to report on the kind of programme in which they were enrolled. As shown in Table 4.1, on average across OECD countries, 82% of 15-year-old students 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 Denmark, Finland, Hong Kong-China, Iceland, Jordan, Liechtenstein, New Zealand, Norway, Peru, Qatar, Romania, Singapore, Tunisia and the United States, all 15-year-old students were enrolled in a general programme.

■ Figure 4.1 ■

Gender differences in participation in pre-vocational and vocational programmes



Notes: Differences that are statistically significant are marked in a darker tone.
The figure only shows countries and economies where students have the option of enrolling in pre-vocational or vocational programmes.
Data for the Slovak Republic do not consider gender differences in participation in modular programmes.
Countries and economies are ranked in descending order of the percentage-point difference between boys and girls who are enrolled in pre-vocational or vocational programmes rather than general programmes.
Source: OECD, PISA 2012 Database, Table 4.1.

In Austria, Croatia, Montenegro, Serbia and Slovenia, more than one in two students were enrolled in a vocational or pre-vocational programme. In Canada, all 15-year-olds, and in the Slovak Republic one out of four students, were enrolled in a modular programme.

Admission and placement policies establish frameworks for selecting students for academic programmes and for streaming students according to their career goals, education needs and academic performance. On average across OECD countries, 16% of boys and 13% of girls attend pre-vocational and vocational schools. However, in many of the countries where large proportions of students are enrolled in pre-vocational and vocational programmes, boys are heavily over-represented in these programmes (Figure 4.1). For example, in Italy 50% of students are enrolled in pre-vocational and vocational programmes. However, while 61% of boys attend such programmes, only 37% of girls do (Table 4.1). In part, this disparity might reflect the fact that boys are more likely to be low achievers than girls, and low achievers are over-represented among technical and vocational school students. But boys' over-representation in these tracks might also reflect a greater awareness among boys for the need to be prepared for the labour market, the need to acquire more practical skills, or simply the fact that boys might enjoy the content and ways of learning in vocational programmes more than girls.

PREPARING FOR A JOB

In a subset of countries and economies that participated in PISA 2012, boys and girls were asked what they did to find out more about future studies or work. According to their own reports, boys are generally more likely than girls to become interns in a workplace, "shadow" workers in their jobs or visit job fairs, while girls are more likely than boys to have completed a questionnaire to find out about their interests and abilities, and to have browsed the Internet for information about careers (Figure 4.2 and Table 4.2).

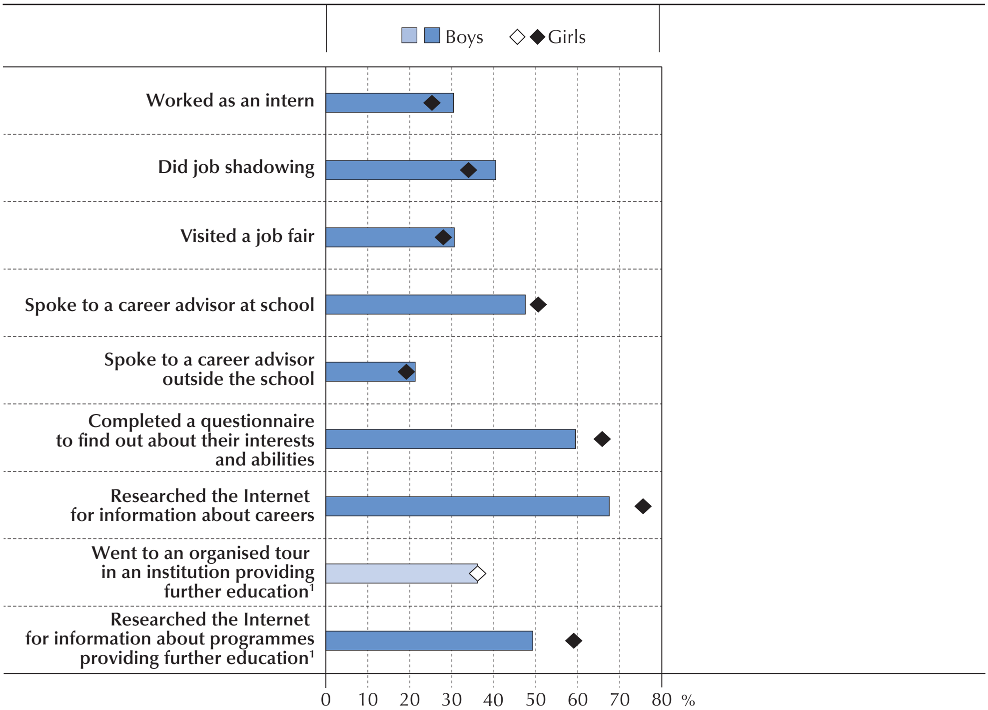
On average across the 15 OECD countries where students were asked about what they did to find out more about possible future studies or careers, 30% of boys but only 25% of girls reported that they had participated in an internship programme, and 40% of boys but only 34% of girls reported that they had "shadowed" a worker at his or her job. By contrast, 66% of girls but 59% of boys reported that they had completed a questionnaire to determine their interests and abilities, 76% of girls but 67% of boys browsed the Internet for information about careers, and 59% of girls but only 49% of boys researched the Internet for information about education programmes in which they could enrol (Table 4.2).

The data shown in Figures 4.2 and 4.3 thus suggest that girls tend to do more of the easy, less hands-on activities that could provide them with information about different career options. By contrast, boys appear to be not only more likely to be enrolled in education pathways that are more "practical" and work-related, but also, when considering a possible occupation, they are more apt to try to work in a related job. Being interns and shadowing workers in their jobs not only help boys to gain a better understanding of the labour market, but these practical activities are the first steps towards building the networks and connections that could be useful when the job search becomes serious. It is as if boys ask themselves, "Could I do this?" while girls ask themselves, "Would I be appropriate for such a position? Would others see me as suitable for this job or to pursue this occupation?"

■ Figure 4.2 ■

What boys and girls do to find out more about future studies or careers

OECD countries



1. Institutions providing further education are ISCED 3-5 in the PISA 2012 questionnaire.
Note: Gender differences that are statistically significant are marked in a darker tone.
Source: OECD, PISA 2012 Database, Table 4.2.

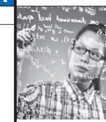
The Educational Career questionnaire was also used to find out which skills students had acquired in or outside of school that could help them enter the labour market or make decisions about continuing their education. For example, the questionnaire asked students to report whether, at or outside of school, they had acquired skills related to: finding information about jobs they are interested in; searching for a job; writing a resumé, CV or a summary of their qualifications; preparing for a job interview; finding information about upper secondary and higher education programmes in which they are interested; and finding information about financing higher education (e.g. student loans or grants).

Based on the students' reports, PISA finds that, on average, boys are more likely than girls to have acquired a set of skills that could help them to navigate the job-search process, to apply for a particular job, and to succeed in job interviews. But a sizeable proportion of both boys and girls appears to be unprepared to take the next steps towards either further education or the labour market. Across the OECD countries that distributed the questionnaire, almost one in four girls and one in five boys reported that they did not know how to search for a job. Girls and boys feel even less prepared for job interviews: 43% of girls and 37% of boys reported that they had not mastered the skills needed to perform well at a job interview (Table 4.3b). Almost one in three boys and girls reported that they had not acquired the skills that are necessary to write a CV or a summary of their qualifications, while 14% of boys and 15% of girls reported that they did not know how to find information about the jobs that interest them (Table 4.3a). While boys were more likely than girls to report that they do not know how to find information about education and training programmes that they could pursue upon finishing their current studies,[1] 26% of boys and 23% of girls, on average, reported that they had never acquired such skills. Boys were also less likely than girls to report that they do not know how to find information about financing higher education: 52% of girls and 46% of boys reported that they had not acquired those skills (Table 4.3b).

■ Figure 4.3 ■

Gender differences in students' preparation for future studies and careers

1. Institutions providing further education are ISCED 3-5 in the PISA 2012 questionnaire.
Source: OECD, PISA 2012 Database, Table 4.2.

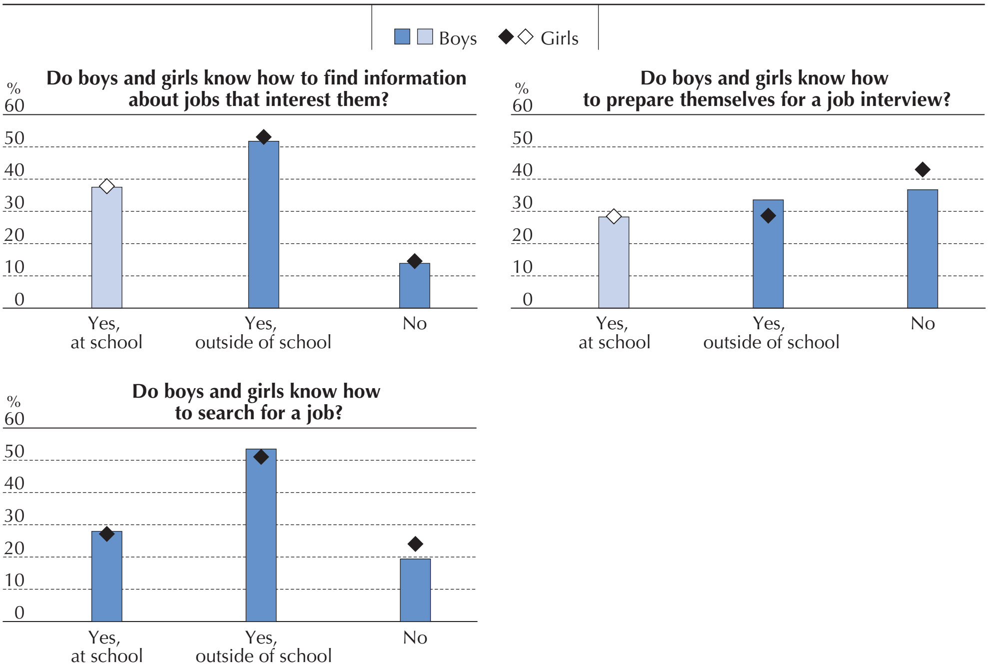


In some countries, the gender differences in the acquisition of skills that could help students make a smooth transition into further study or work are striking. For example, in Croatia, Italy, Serbia, the Slovak Republic and Slovenia, the share of girls who reported that they had not learned how to prepare for a job interview is over 10 percentage points larger than the share of boys who so reported. By contrast, in Australia, Denmark and Hong Kong-China, there are no gender differences in this respect (Table 4.3b). In Austria, Hungary and Luxembourg, the proportion of girls who reported that they do not know how to find information on student financing (i.e. student loans or grants) is also over 10 percentage points larger than the share of boys who so reported, while in Finland and Macao-China, no gender gap is observed in this respect.

■ Figure 4.4 ■

Gender differences in whether, and where, students reported that they had acquired different skills

OECD countries



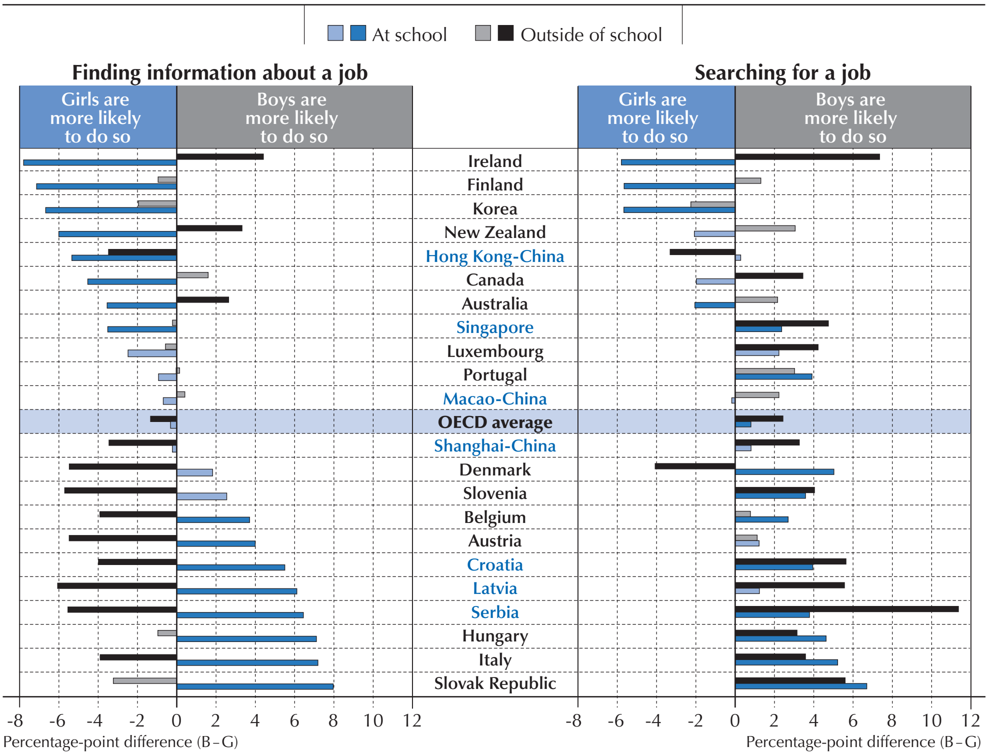
Note: Gender differences that are statistically significant are marked in a darker tone.
Source: OECD, PISA 2012 Database, Tables 4.3a and 4.3b.

In the large majority of countries, students, particularly boys, reported that any skills that could help them make a smooth transition from compulsory schooling to a job or higher education were acquired outside of school. More than one in two students reported that they had learned how to find information about jobs that interest them outside of school, while only 38% of students reported that they had acquired such skills at school. Students in Australia, Canada and Finland appear to receive a lot of this kind of practical training in compulsory education.

In these three countries, more than one in two 15-year-old boys and girls reported that they had learned, at school, how to find information about jobs that interest them (Table 4.3b). Some 53% of boys and 51% of girls reported that they had learned – outside of school – how to look for a job, while only 28% of boys and 27% of girls reported that they had acquired those skills at school. Differences in the proportions of boys and girls who reported that they had learned, outside of school, how to look for a job are particularly large in Croatia, Ireland, Latvia, Serbia and the Slovak Republic (Table 4.3a).

■ Figure 4.5 ■

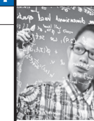
Where students acquire the skills to find information about a job or searching for a job



Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the percentage-point difference between boys and girls who reported they learned how to find information about a job at school.
Source: OECD, PISA 2012 Database, Table 4.3a.

FORMING EXPECTATIONS ABOUT FURTHER EDUCATION AND WORK

PISA 2000, 2003 and 2006 asked students what occupation they expected to be working in by the time they were 30 years old. Responses to this open-ended question were re-classified according to the International Standard Classification of Occupations 88 (ISCO88; International



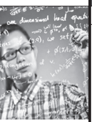
Labour Office, 1988). PISA 2000, 2003 and 2009 asked students about their expectations for continuing education. In 2009, this question was part of the Educational Career questionnaire; only 21 PISA-participating countries and economies distributed that questionnaire.

Students' expectations about their future education and work not only reflect their academic successes and skills; they also create the conditions conducive to academic excellence and the acquisition of skills. For example, students who expect to complete a university degree or to work in demanding jobs are more likely to choose more demanding courses and to invest greater effort in school than students who expect to complete their studies after less schooling, and with lower qualifications, or to land jobs that do not require high-level skills. Students who hold high expectations for their education and careers are more likely than those who do not to complement their school work with additional courses or related activities during their free time. Students' expectations are partly self-fulfilling prophecies, as the effort students invest to meet their expectations usually pays off. When comparing students of similar socio-economic backgrounds and academic achievement, students who expect to graduate from university are more likely to earn that degree than their peers who do not hold such high expectations (Campbell, 1983; Morgan, 2005; Perna, 2000; Sewell, et al., 2003).

In some PISA-participating countries, many students did not answer the question on career and education expectations (Table 4.4). This could indicate that students are uncertain about their future. It could also, however, reflect students' lack of interest in answering the question about their career expectations, particularly because it is an open-ended question that requires students to formulate an answer. To determine why, in fact, students did not answer this question, the percentage of unanswered career-expectations questions (missing values) was compared to the percentage of unanswered questions concerning the occupation of the students' mother and father. The result of this comparison suggests that many students did not answer the career expectations because of their indecision (i.e. there are many more missing values for this question than for the question concerning their parents' occupations), and that boys tend to be more undecided than girls, as there are more missing values in the questionnaires completed by boys than in those completed by girls.

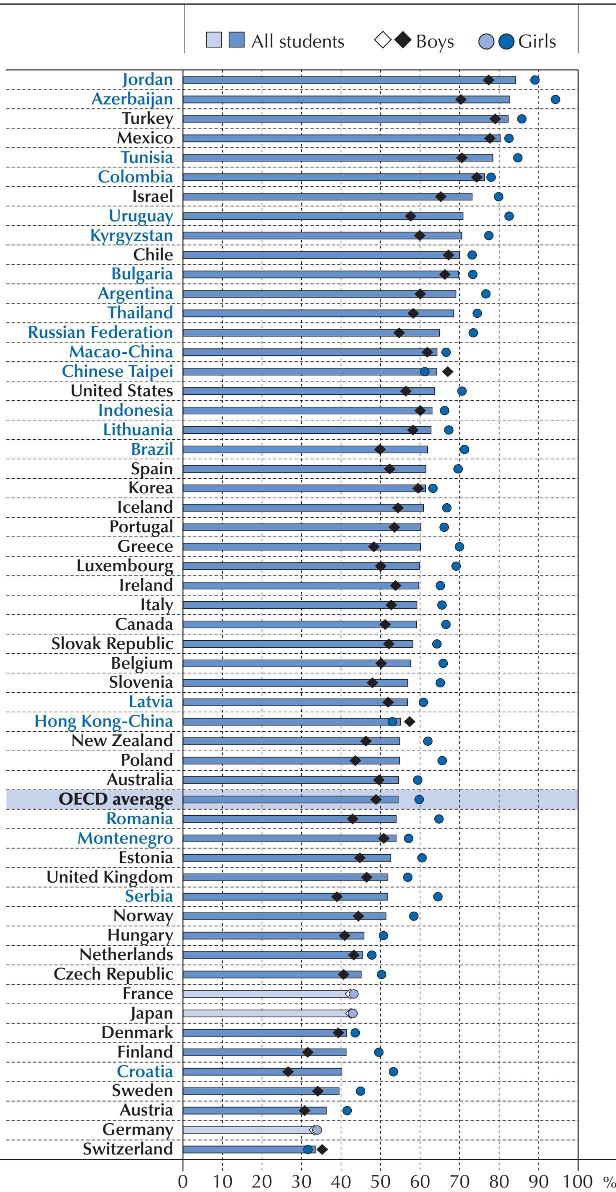
Differences in ambition

Studies based on PISA and other youth surveys over the past 30 years consistently find that upper secondary students tend to set ambitious goals for their education and occupation (Marks, 2010; McDaniel, 2010; Sikora and Saha, 2007; Sikora and Saha, 2009; Croll, 2008; Goyette, 2008; Little, 1978; Reynolds et al., 2006). PISA 2006 and PISA 2009 data suggest that across OECD and partner countries and economies, a substantial share of students holds ambitious education and career goals, particularly the latter. Figure 4.6 shows that, in most countries, the majority of students expects to work as professionals, managers, senior officials or legislators (which correspond to groups 1 and 2 in the ISCO88 coding; International Labour Office, 1988). Professional and managerial occupations generally require university-level education, superior proficiency in numeracy and literacy, and excellent personal communication skills. Figure 4.8 shows that a large proportion of girls expects to complete a university degree.

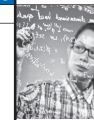


■ Figure 4.6 ■

Percentage of students who plan to work as managers or professionals, by gender



Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the percentage of students who expect to work in ISCO88 major occupational groups 1 and 2 at the age of 30.
Source: OECD, PISA 2006 Database, Table 4.5a.

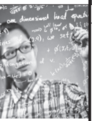


In 2006, around 55% of students across OECD countries expected to work as legislators, senior officials, managers or professionals. In Greece, Iceland, Korea, Portugal, Spain and the United States, 60% of students held similar expectations, while in Chile, Israel, Mexico and Turkey, 70% of students or more did. At the other end of the scale, in Sweden and in the highly stratified education systems of Austria, Germany and Switzerland, only 40% of 15-year-olds or less expected to work in high-status careers (Figure 4.6 and Table 4.5a). Countries such as Austria, Germany and Switzerland have well-organised and highly successful vocational education and training (VET) systems with a clear emphasis on labour market prospects and the opportunities available. Moreover, in these countries associate professionals may be highly skilled and rewarded because of the training opportunities they receive within the VET sector (see also OECD, 2012). Therefore students in these education systems may be particularly likely to hold realistic expectations and to aspire to work in occupations that are less socially valued and rewarded in other countries.

PISA 2006 also reveals that students in partner countries and economies are generally more ambitious than those in OECD countries. On average, 65% of students in the partner countries and economies that participated in PISA 2006 reported that they intend to work as legislators, senior officials, managers or professionals, and over 70% of students in Azerbaijan, Colombia, Jordan, Kyrgyzstan and Uruguay reported that they expect to be working in these occupations. The exception to this general pattern was Croatia, where only 40% of students expected to become professionals or managers (Figure 4.6 and Table 4.5a).

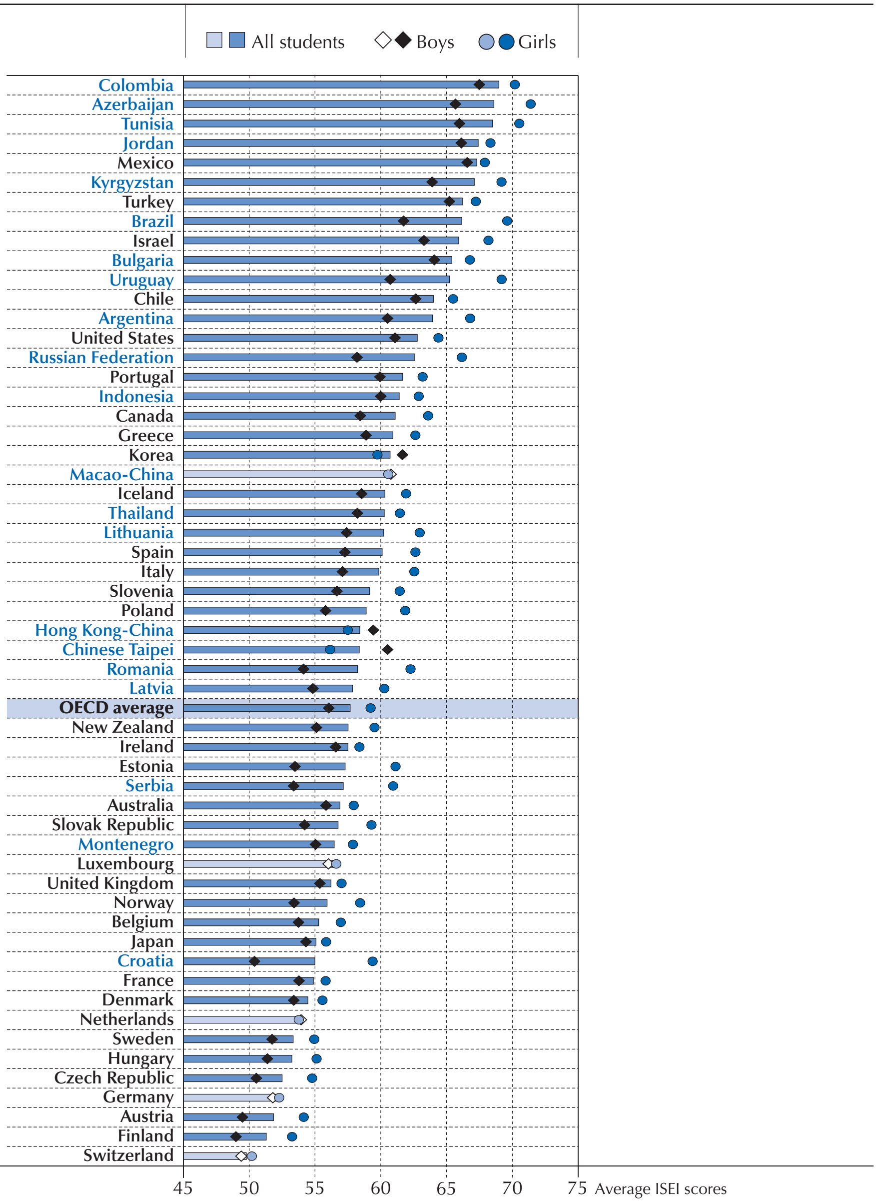
Differences in ambition among students across countries can be attributed to several factors, including family background, academic performance, labour-market conditions and the features of national education systems (Sikora and Saha, 2009). For example, Figure 4.7 shows that in countries where students are sorted into separate tracks before they are 15 years old, students hold particularly low expectations for their future occupations. This may be because those who are already in education tracks that do not lead to professional and managerial jobs tend to adjust their expectations accordingly and align their expectations to fit what is expected of them (Buchmann and Park, 2009). In contrast, students in more open, comprehensive systems can nurture hopes to be employed in jobs that require high skills, even if they have no real chance of attaining their goals. Students who hold high expectations may be more motivated and ready to put time and effort into their studies because they can see purpose and meaning in their pursuit of excellence.

Results presented in Figure 4.6 indicate that, across almost all countries and economies that participated in PISA 2006, girls held more ambitious career expectations than boys. On average across OECD countries, girls were 11 percentage points more likely than boys to expect to work as legislators, senior officials, managers and professionals. France, Germany and Japan were the only OECD countries where similar proportions of boys and girls aspired to these occupations, while in Switzerland and the partner economies Hong Kong-China and Chinese Taipei, boys generally held slightly more ambitious expectations than girls. The gender gap in career expectations was particularly wide in Greece, Poland and the partner countries Azerbaijan, Brazil, Croatia, Romania, Serbia and Uruguay. In all of these countries, the proportion of girls who expected to work as legislators, senior officials, managers or professionals was 20 percentage points larger than the proportion of boys who expected to work in those occupations (ISCO88 groups 1 and 2).



■ Figure 4.7 ■

Average status of the occupations boys and girls expect to work in at the age of 30



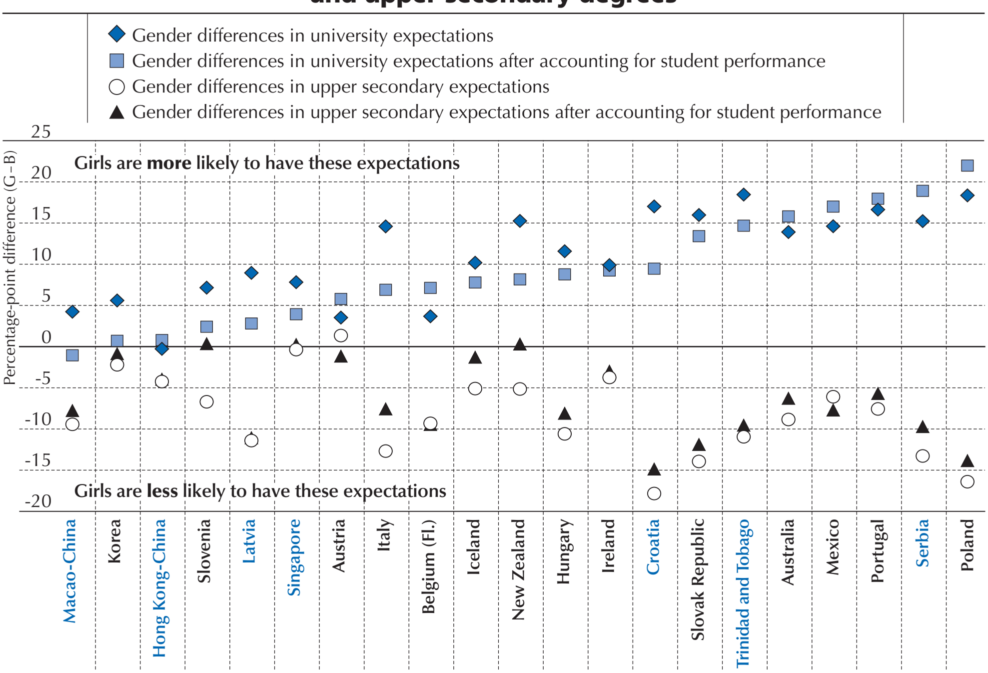
Notes: Gender differences that are statistically significant are marked in a darker tone.
ISEI stands for the *International Socio-Economic Index* (higher values indicate higher status).
Countries and economies are ranked in descending order of the average ISEI score for all students.
Source: OECD, PISA 2006 Database, Table 4.5a.

The data shown in Figure 4.7 confirm that a larger proportion of girls than boys generally aspires to higher-status occupations. This is determined using an indicator of the status of the expected occupation (as defined by the ISEI scale)[2] rather than by major occupational groups (as indicated by the ISCO88 classification). Information on expected occupational status was derived by using students' reported career expectations and then matching individual answers to the ISEI scale (Ganzeboom and Treiman, 1996).

The ISEI scale of occupational status ranges from 10 to 90, with low values on the scale denoting low-status occupations and high values denoting high-status occupations. The advantage of the ISEI scale over broad occupational groups is that, since it can convey information about differences in the education required for, and typical financial returns to, a particular occupation, it is more precise. For instance, judges in courts of law receive the top score of 90, medical doctors stand at 88, while university professors are given the score of 77. This contrasts with dancers and choreographers, who rank at 64 and social-work professionals at 51. In 2006, girls in OECD countries expected to work in occupations with an average value of 59 points on the ISEI scale of expected occupational status while boys expected to work in occupations with an average value of 56 points on the scale (Table 4.5a).

■ Figure 4.8 ■

Gender differences in expectations of completing university and upper secondary degrees



Countries and economies are ranked in ascending order of the gender difference (girls – boys) in the percentage of students who expect to earn a university degree, after accounting for students' reading and mathematics performance.
Source: OECD, PISA 2009 Database, Tables 4.6a and 4.6b.

While relatively few – one in four – 15-year-old students in Latvia said that they expect to complete a university degree, in most other countries and economies that distributed the Educational Career questionnaire in 2009, large proportions of students reported that they expect to earn a university degree. University degrees include liberal arts and professional degrees, but not degrees from technical or vocational tertiary institutions. The proportion of students who expected to complete a university-level education was largest in Korea (81%) and exceeded 60% in Australia, Singapore and Trinidad and Tobago. This proportion was smallest in Latvia (25%) and smaller than 40% in Austria, the Flemish Community of Belgium, Macao-China and Slovenia (Table 4.6a).

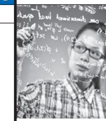
Differences in choice of preferred occupations

Figure 4.9 presents a selection from the list of occupations that boys and girls expect to work in as young adults. While it contains no information on where a particular occupation ranks in the choice of 15-year-olds, it presents a mosaic of careers that were particularly popular among PISA 2006 respondents. It shows the 22 occupations that were among the 10 most popular occupations for boys and for girls, and shows the number of OECD countries and the number of partner countries and economies in which each of these occupations were among the top 10 occupations cited by boys and by girls.

The data represented in Figure 4.9 suggest that boys and girls generally expect careers in different fields, and that gender differences in career expectations vary greatly across countries. "Medical doctor" is the only occupation mentioned by boys and girls alike in more than 25 OECD countries. The career of lawyer was chosen by girls in 25 OECD countries and 17 partner countries and economies, but chosen by boys in only 10 OECD countries and 10 partner countries and economies. Similarly "architects, town and traffic planners" were among the most popular occupations chosen by boys in as many as 13 OECD countries and in 2 partner countries and economies, and by girls in 10 OECD countries and 2 partner countries and economies.

A large number of girls in many PISA-participating countries expect to have a career as hairdresser or beautician, while such occupations are not ranked among the 10 most popular occupations among boys in any OECD or partner country or economy. Other professions favoured by girls include nursing, midwifery, teaching, veterinary medicine, childcare and psychology – often referred to as "nurturance-oriented" careers. In contrast, the data shown in Figure 4.9 suggest that boys prefer professional sport, car mechanics, computing, engineering and law enforcement as careers. Cooking also appears on the list of the ten most popular occupations among boys. In Hong Kong-China, Indonesia, Japan and Korea, government-related careers are particularly popular among both genders. In these Asian countries, public service is an occupational choice that trumps even the universally coveted law and medicine in popularity (Sikora and Pokropek, 2011).

These data suggest that, with few exceptions, not only do boys and girls have very different career expectations, but students in different countries tend to see their future careers in very different occupations. Teenagers generally tend to choose careers from a relatively well-defined spectrum. A concentration of interest in relatively few careers may indicate little knowledge of the options available in the labour market and could create a potential skills mismatch between what the labour market needs and the availability of suitable workers.



■ Figure 4.9 ■

Selected occupations from the lists of the ten most popular career choices among students in a particular country

Boys				Girls			
ISCO88 code		Number of OECD countries	Number of partner countries	ISCO88 code		Number of OECD countries	Number of partner countries
3475	Athletes, sports persons	27	13	**2221**	**Medical doctors**	32	21
2221	**Medical doctors**	26	15	5141	Hairdressers, barbers, beauticians, etc.	28	10
7231	Motor vehicle mechanics and fitters	25	6	**2421**	**Lawyers**	25	17
2140	Architects, engineers	14	11	2445	Psychologists	25	10
5162	Police officers	14	9	**2451**	**Authors, journalists and other writers**	20	8
2141	**Architects, town and traffic planners**	13	2	**3471**	**Decorators and commercial designers**	16	8
5122	Cooks	12	7	2230	Nursing and midwifery professionals	13	6
7137	Building trades, electricians	10	1	**2300**	**Teaching professionals**	12	10
7124	Carpenters and joiners	10	0	2331	Primary education teaching professionals	12	4
2132	Computer programmers	10	10	2223	Veterinarians	12	5
2421	**Lawyers**	10	10	**2141**	**Architects, town and traffic planners**	10	2
2130	Computing professionals	8	1	3231	Nursing associate professionals	9	2
2131	Computer systems designers and analysts	7	5	**2320**	**Secondary education teaching professionals**	7	3
2411	**Accountants**	6	5	2332	Pre-primary education teaching professionals	9	1
2149	Architects engineers	6	11	3226	Physiotherapists, associate professionals	7	0
3121	Computer assistants	6	1	5220	Shop salespersons and demonstrators	6	2
1310	Small enterprise general managers	6	11	**2411**	**Accountants**	5	9
2300	**Teaching professionals**	6	5	3320	Pre-primary education teaching associate professionals	5	0
7136	Plumbers and pipe fitters	5	1	4100	Office clerks	4	3
2451	**Authors, journalists and other writers**	4	0	5131	Childcare workers	4	0
3471	**Decorators and commercial designers**	4	1	2211	Biologists, botanists, zoologists, etc.	3	3
2320	**Secondary education teaching professionals**	4	2	2321	Secondary teachers, academic track, incl. middle school	4	6

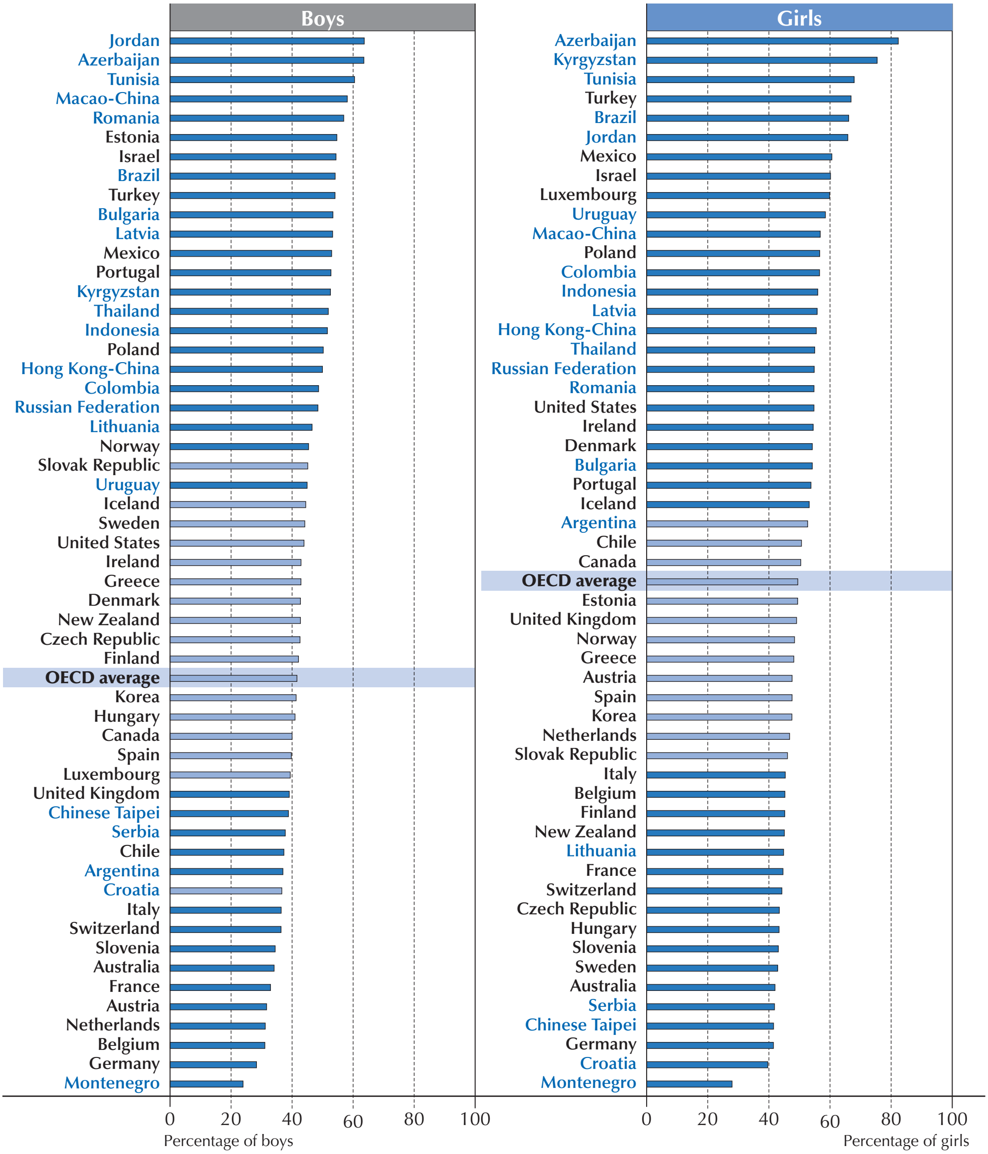
Notes: ISCO88 refers to the International Standard Classification of Occupations. The most popular occupations among both boys and girls are indicated in bold.
Source: OECD, PISA 2006 Database.

Figure 4.10 shows the proportion of students who cited, as their expected career, one of the ten most popular occupations among their peers of the same gender. When this proportion is large, students' career expectations can be considered to be highly concentrated; when this proportion is small, students' career expectations can be considered to be not very concentrated. Overall, concentration tends to be lower in OECD countries than among partner countries and economies, where students' plans appear to focus more on the secure and well-rewarded managerial and professional careers, even though for many students the chances of realising such ambitious goals are slim, at best.

Figure 4.10 also indicates that there are systematic differences in the concentration of career plans between boys and girls. In most countries, a larger proportion of girls is attracted to the ten most popular career choices among peers of the same gender (the OECD average is about 50%).

■ Figure 4.10 ■

Where boys and girls are more likely to expect to work in one of the ten most popular careers in their country



Note: Differences that are statistically significant compared to the OECD average are marked in a darker tone.
Countries and economies are ranked in descending order of the percentage of boys (left panel) and girls (right panel) who expect to work in one of the ten most popular occupations among boys (and girls).
Source: OECD, PISA 2006 Database, Table 4.5b.

In contrast, boys' career plans tend to be less concentrated (the OECD average is 42%). It is possible to attribute these differences to the fact that, historically, women have been concentrated in the non-manual sector of employment in which only high-level professional occupations are attractive employment options. In contrast, boys in many PISA-participating countries can look forward to attractive employment opportunities in both manual and non-manual sectors, where men work as managers and professionals as well as tradesmen and craftsmen who are often well-rewarded and enjoy considerable work autonomy.

Expectations of careers in computing and engineering

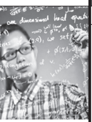
Figure 4.11 shows the proportion of boys and girls who plan to enter engineering and computing careers while Figure 4.12 shows the proportion of boys and girls who plan to enter health science-related careers.[3] Careers in engineering and computing attract relatively few girls. On average among OECD countries, less than 5% of girls contemplate pursuing these careers. This is remarkable, especially because the definition of computing and engineering used in this report includes such fields as architecture, which is hardly considered to be a quintessentially "masculine" job. There is much variation across countries in the numbers of students opting for future employment in this field, ranging from relatively large proportions in Chile, Colombia, Jordan, Mexico, Poland, Slovenia and Thailand, to very small proportions in Azerbaijan, Finland, Kyrgyzstan, Macao-China, Montenegro and the Netherlands.

Yet, the most striking feature of these data is that in almost no country does the number of girls thinking of computing and engineering as their future career exceed the number of boys contemplating such a career. The only exceptions to this rule are Bulgaria, Indonesia and Montenegro. And the ratios of boys to girls who expect to enter a career in computing and engineering are relatively large in most OECD countries and in many partner countries and economies. On average, there are almost four times as many boys as girls who expect to be employed in engineering and computing in OECD countries, and close to three times as many boys as girls in partner countries and economies (Figure 4.11 and Table 4.5c).

Expectations of careers in health services

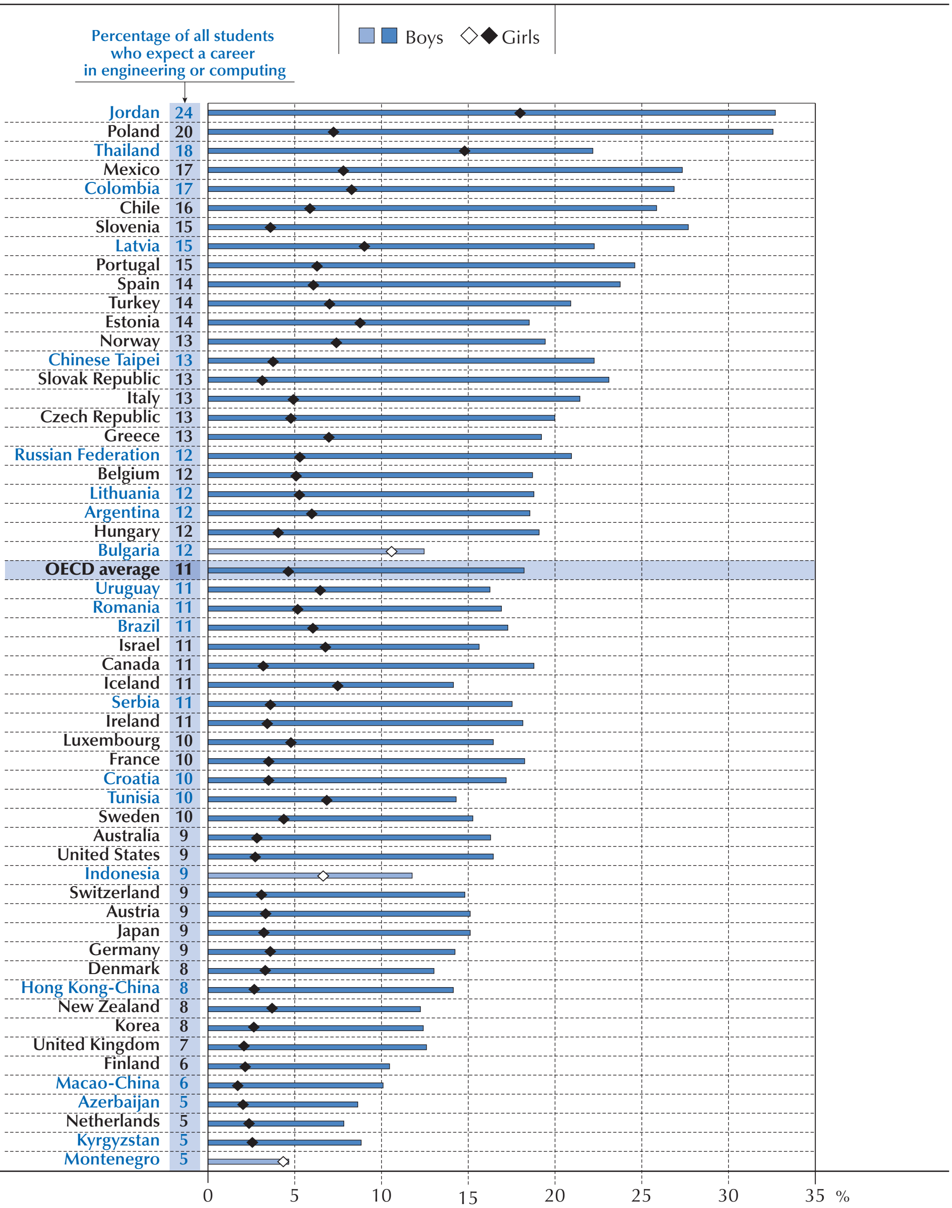
The pattern of preferences for health-science careers by gender is a mirror image of the expectations related to employment in engineering and computing. Just as boys outnumbered girls in their enthusiasm for careers in computing and engineering, girls who yearn for a career in health and medicine outnumber boys in every country. This pattern holds even after nurses and midwives are excluded from the list of health-related careers, demonstrating that the gender imbalance in preference for health-related careers is not solely the result of the traditional over-representation of women in nursing and midwifery.

On average across OECD countries, the proportion of girls who expect to work in health services – excluding nurses and midwives – is 9 percentage points larger than that of boys (16% of girls expect a career in health while only 7% of boys do). Girls in Portugal and the United States and the partner countries Brazil and Kyrgyzstan are particularly more likely to expect to pursue a career in health than boys. In contrast, girls and boys in the partner countries and economies Bulgaria, Hong Kong-China, Jordan and Chinese Taipei hold similar expectations of a career in health services (Figure 4.12 and Table 4.5d).

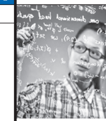


■ Figure 4.11 ■

Proportion of boys and girls expecting a career in engineering or computing

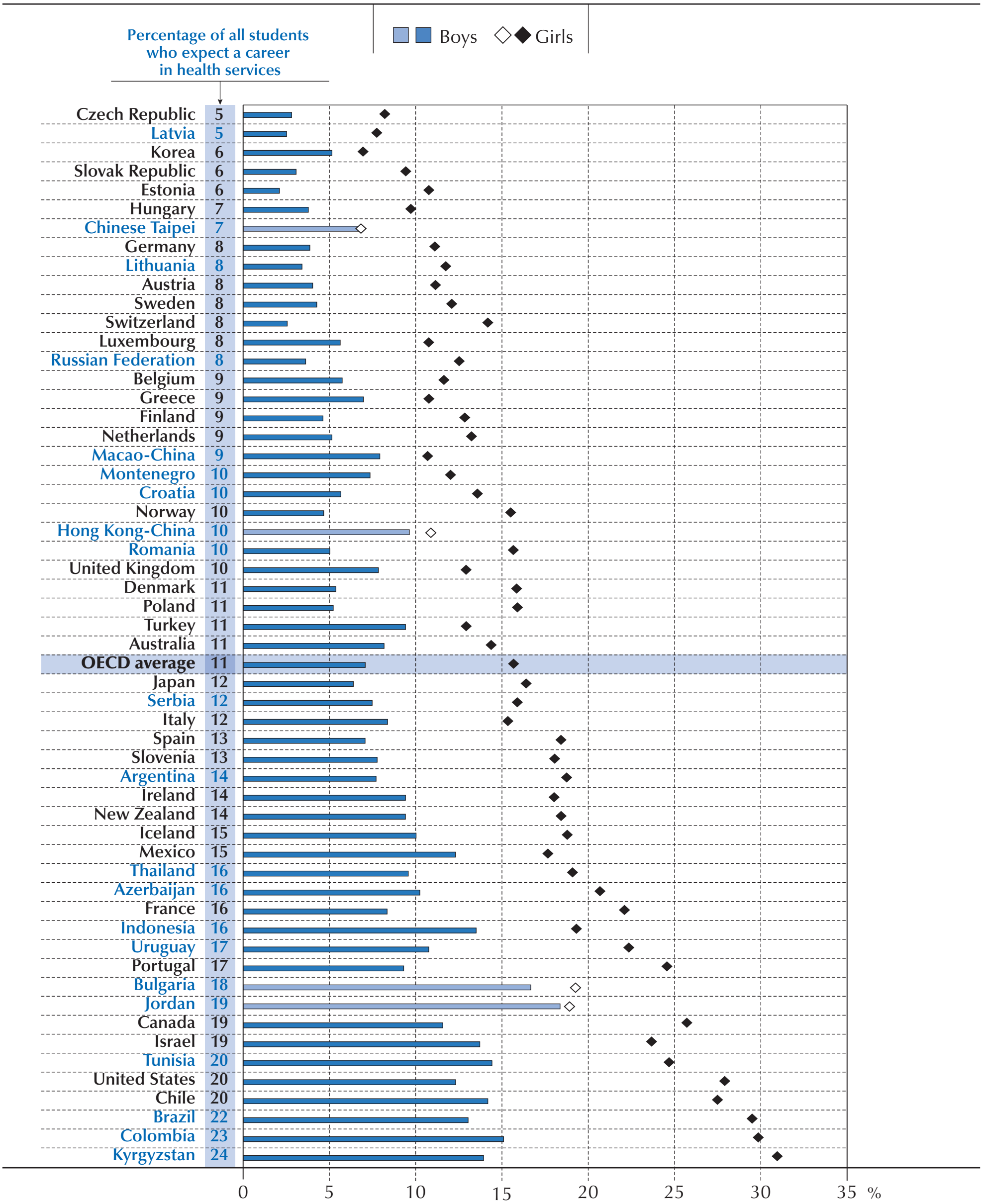


Note: Differences between the percentages of boys and girls that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the percentage of all students who plan a career in engineering or computing, including architecture.
Source: OECD, PISA 2006 Database, Table 4.5c.

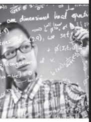


■ Figure 4.12 ■

Proportion of boys and girls expecting a career in health services



Note: Differences between the percentages of boys and girls that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the percentage of all students who plan a career in health services, excluding nurses and midwives.
Source: OECD, PISA 2006 Database, Table 4.5d.



Expectations vs. reality

As noted above, holding high expectations for one's future can instil the motivation that, in turn, spurs students to work hard at school with the aim of achieving the goals they set for themselves. But to what extent are adolescent expectations fulfilled by the time those adolescents have become young adults? Data from Tables 4.8a and 4.8b show in which careers boys and girls who participated in PISA 2000 and PISA 2003 expected to work by the time they were 30, and the education qualifications they would hold. The tables also show what the corresponding cohort of young adults actually achieved, according to the 2012 Survey of Adult Skills. Results indicate that both boys and girls generally hold unrealistic expectations for their careers. In 2000, 34% of boys and 41% of girls expected to work as managers or professionals when they were 30; but in 2012, only 21% of 25-34 year-old men and 23% of 25-34 year-old women worked in such occupations (Table 4.8a). This suggests that girls tend to hold particularly ambitious, but unrealistic, expectations, and that they may thus be particularly disappointed when they fail to achieve their career goals. On a more positive note, the young men and women who participated in the Survey of Adult Skills in 2012 tended to hold jobs of similar perceived social status, as measured by the ISEI score of occupational prestige. This could be a first step towards more equal career opportunities for men and women in the future.

Box 4.1. Key facts about the Survey of Adult Skills (PIAAC)

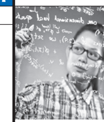
What is assessed

The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adults Competencies (PIAAC), assesses the proficiency of adults from age 16 onwards in literacy, numeracy and problem solving in technology-rich environments. These skills are "key information-processing competencies" that are relevant to adults in many social contexts and work situations, and necessary for fully integrating and participating in the labour market, education and training, and social and civic life. In addition, the survey collects a range of information on the reading- and numeracy-related activities of respondents, the use of information and communication technologies at work and in everyday life, and on a range of generic skills, such as collaborating with others and organising one's time, required of individuals in their work. Respondents are also asked whether their skills and qualifications match their work requirements and whether they have autonomy over key aspects of their work.

Methods

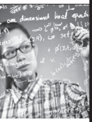
- Around 166 000 adults from 16 to 65 years old were surveyed in 24 countries and sub-national regions: 22 OECD member countries – Australia, Austria, Flanders (Belgium), Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, the Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland) and the United States; and two partner countries. Data collection for the Survey of Adult Skills took place from 1 August 2011 to 31 March 2012 in most participating countries. In Canada, data collection took place from November 2011 to June 2012; and France collected data from September to November 2012.

...



- The language of assessment was the official language or languages of each participating country. In some countries, the assessment was also conducted in widely spoken minority or regional languages.
- Two components of the assessment were optional: the assessment of problem solving in technology-rich environments and the assessment of reading components (see below). Twenty of the 24 participating countries administered the problem-solving assessment and 21 administered the reading components assessment.
- The target population for the survey was the non-institutionalised population, aged 16-65 years, residing in the country at the time of data collection, irrespective of nationality, citizenship or language status.
- Sample sizes depended primarily on the number of cognitive domains assessed and the number of languages in which the assessment was administered. Some countries boosted sample sizes in order to have reliable estimates of proficiency for the residents of particular geographical regions and/or for certain sub-groups of the population, such as indigenous inhabitants or immigrants. The achieved samples ranged from a minimum of approximately 4 500 to a maximum of nearly 27 300.
- The survey was administered under the supervision of trained interviewers either in the respondent's home or in a location agreed between the respondent and the interviewer. The background questionnaire was administered in Computer-Aided Personal Interview format by the interviewer. Depending on the situation of the respondent, the time taken to complete the questionnaire ranged between 30 and 45 minutes.
- After having answered the background questionnaire, the respondent completed the assessment either on a laptop computer or by completing a paper version using printed test booklets, depending on their computer skills. Respondents could take as much or as little time as needed to complete the assessment. On average, the respondents took 50 minutes to complete the cognitive assessment.
- Respondents with very low literacy skills bypassed the full literacy, numeracy and problem solving in technology-rich environment assessments and went directly to a test of basic "reading component" skills instead. This test assessed vocabulary knowledge, the ability to process meaning at the level of the sentence, and to fluently read passages of text. The test had no time limit, but the time taken by respondents to complete the tasks was recorded. The reading components assessment was also taken by all respondents taking the paper version of the assessment.

In 2012 the OECD conducted its first Survey of Adult Skills, which extends the assessment of skills pioneered in PISA to the entire adult population. The survey, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), focuses on skills – literacy, numeracy and problem solving – similar to those assessed in PISA; but the two studies use different assessment tasks, reflecting the different contexts in which 15-year-old students and older adults live.



The surveys have complementary goals: PISA seeks to identify ways in which students can learn better, teachers can teach better, and schools can operate more effectively; the Survey of Adult Skills focuses on how adults develop their skills, how they use those skills, and what benefits they gain from using them. To this end, the Survey of Adult Skills collects information on how skills are used at home, in the workplace and in the community; how these skills are developed, maintained and lost over a lifetime; and how these skills are related to labour market participation, income, health, and social and political engagement.

When looking at the social status of the careers boys and girls expect for themselves, PISA 2000 reveals that girls tended to see themselves as working in careers that are more highly valued by society than those cited by boys. On average, the careers that boys cited had a value of 54 on the ISEI index of occupational prestige, while the careers that girls cited had an average value of 57 on the index. The 2012 Survey of Adult Skills found that the occupations in which young women were working at the time of the survey were of slightly higher status (an average score on the ISEI index of 49) than those in which men were working (an average score of 45 on the index) (Table 4.8a).

Adolescent expectations for further schooling also tend to bear only slight resemblance to reality later on. PISA 2003 found that girls tended to be more likely than boys to expect to complete a tertiary degree and less likely than boys to expect to complete their formal education before upper secondary school (Table 4.8b). On average across OECD countries in 2003, 59% of girls but only 51% of boys expected to earn a university degree; but in 2012, only 47% of 25-29 year-old women and 35% of 25-29 year-old men held such a qualification. These differences could partly reflect men's greater propensity to complete a university-level degree at a later age than women. While most women will have completed their tertiary studies by the age of 25, many men will not have done so until their late 20s (DiPrete and Buchmann, 2013). And while, in 2003, 8% of girls and 10% of boys expected to drop out of school with, at most, a lower secondary degree, only 2% of 25-29 year-old women and 3% of 25-29 year-old men who participated in the 2012 Survey of Adult Skills had actually done so.

The dramatic expansion of access to tertiary education over the past decades – and the gender balance in access – is clearly apparent when considering educational attainment among the 50-59 year-olds who participated in the Survey of Adult Skills. As noted above, girls are more likely than boys to expect to earn a tertiary degree, and young women are more likely than young men to hold such a degree. But among people born in the 20 years following the end of World War II, the rates of graduation from university-level educational institutions are lower than those among younger people, and women were, on average, as likely as men to earn a tertiary degree. However, in some countries women were significantly less likely to do so. In Germany and Korea, for example, the proportion of 50-59 year-old women who had earned a tertiary degree by 2012 is 15 percentage points smaller than the proportion of men the same age who had completed university-level education (Table 4.8b).

USING MATHEMATICS IN THE FUTURE

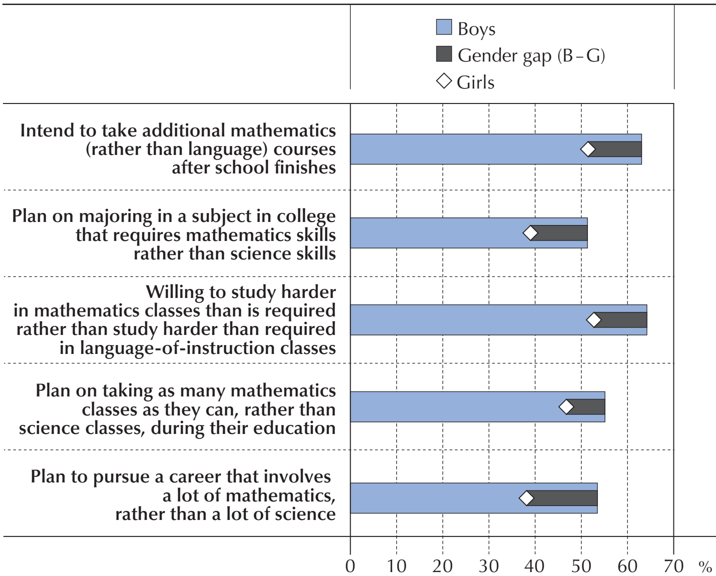
In 2012, PISA asked students about their intentions to use mathematics in their future studies and careers. Students were presented with five pairs of statements and were asked to choose the one of each pair that best described their intentions and desires for their futures. Students were first asked whether they intend to take additional mathematics courses or additional language courses after their compulsory schooling ends.

In all countries and economies except Albania, Costa Rica, Indonesia, Jordan, Kazakhstan, Malaysia, the Netherlands, Portugal, Shanghai-China, Thailand, Turkey and the United Arab Emirates, boys were more likely than girls to report that they intend to take additional mathematics courses (rather than additional language courses) after school finishes. Across OECD countries, 63% of boys, but only 51% of girls, intend to take additional mathematics courses (Table 4.7).

■ Figure 4.13 ■

Gender disparities in whether future studies or careers will contain a lot of mathematics, rather than science or language of instruction

OECD average percentage of students



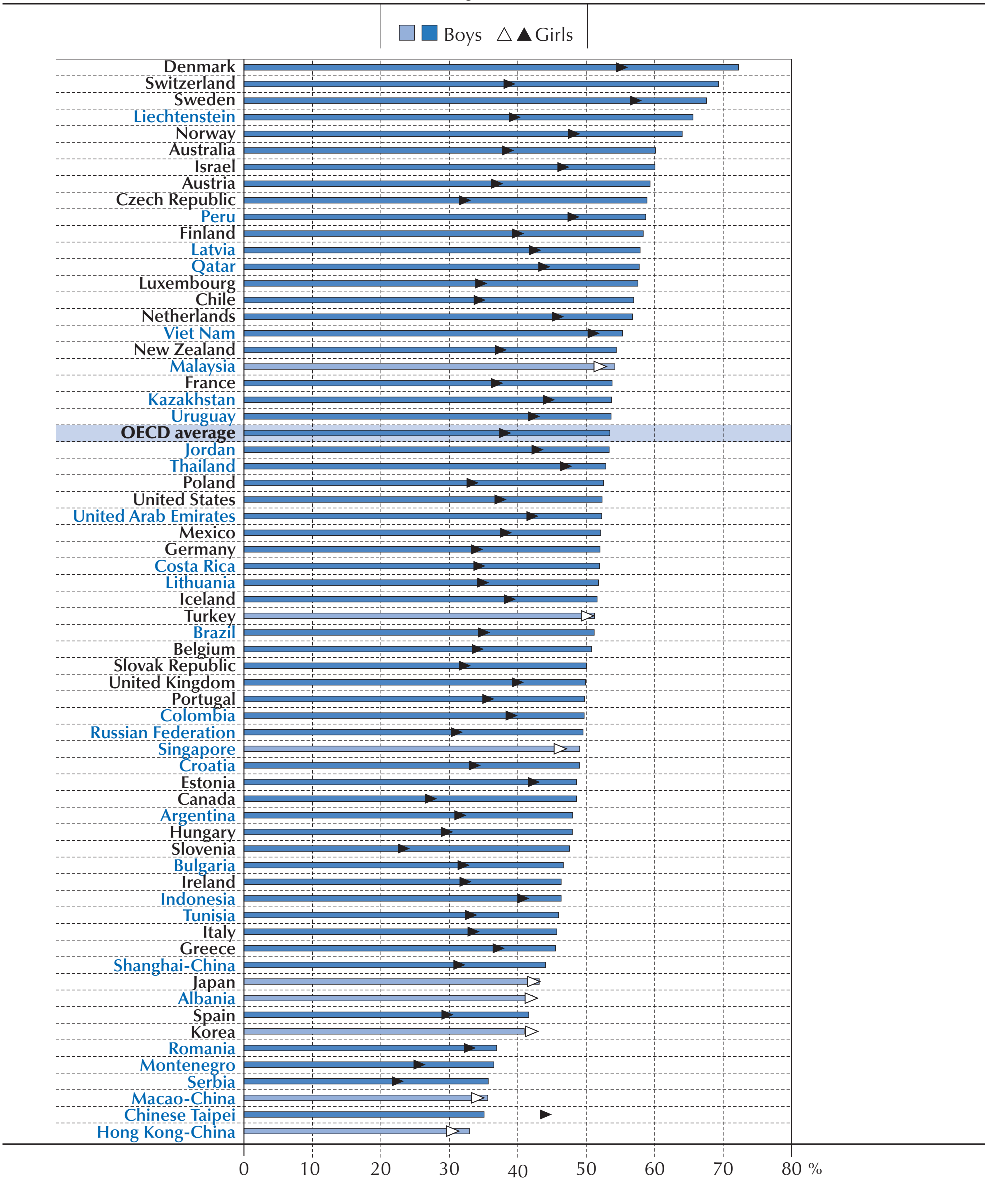
Note: All gender disparities are statistically significant.
Source: OECD, PISA 2006 Database, Table 4.7.

Similarly, boys and girls are not equally likely to plan a career that involves a lot of mathematics, compared to careers that involve more science. On average, 53% of boys, but only 38% of girls, plan to pursue a career that involves a lot of mathematics rather than one that involves a lot of science (Figures 4.13 and 4.14). In addition, evidence from previous PISA cycles – when students were asked about the kind of career they expect to pursue as young adults – suggests that even those girls who envision pursuing scientific careers expect to work in fields that are different from those boys expect to pursue. Girls are, in fact, over-represented among students who expect to work in the health and social fields, while boys are over-represented among 15-year-olds who expect to work as engineers or computer scientists.

■ Figure 4.14 ■

Gender disparities in whether future careers will contain a lot of mathematics, rather than science, by gender

Percentage of students



Note: Differences between the percentages of boys and girls that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the percentage of boys who reported that their future careers will contain a lot of mathematics, rather than science.
Source: OECD, PISA 2006 Database, Table 4.7.

WHAT HAPPENS AFTER COMPULSORY EDUCATION

Previous sections have shown differences between boys and girls in their expectations for their future. But what do we know about the circumstances that young adults face after they have left school? How proficient are young adults in some fundamental skills, like literacy and numeracy? How do boys and girls make the transition from compulsory schooling into further education, training or the labour market? Can countries maintain and build on the skills children acquire in school? Results from the Survey of Adult Skills can answer some of these questions.

The Survey of Adult Skills differs in some significant ways from PISA. First, the sample size for specific age groups is relatively small, so that it may be difficult to accurately estimate differences in proficiency between young men and women. Second, while the main assessments of PISA, up to 2012, were delivered in paper booklets that were completed by students in pen or pencil, the Survey of Adult Skills was conducted on computer. Chapter 2 in this report suggests that males may have an advantage in computer-based assessments because those assessments generally ask respondents to navigate through connected web pages, scroll down pages, use hyperlinks, etc. These tasks require the kinds of spatial skills in which males tend to excel.

Gender differences in literacy and numeracy among young adults

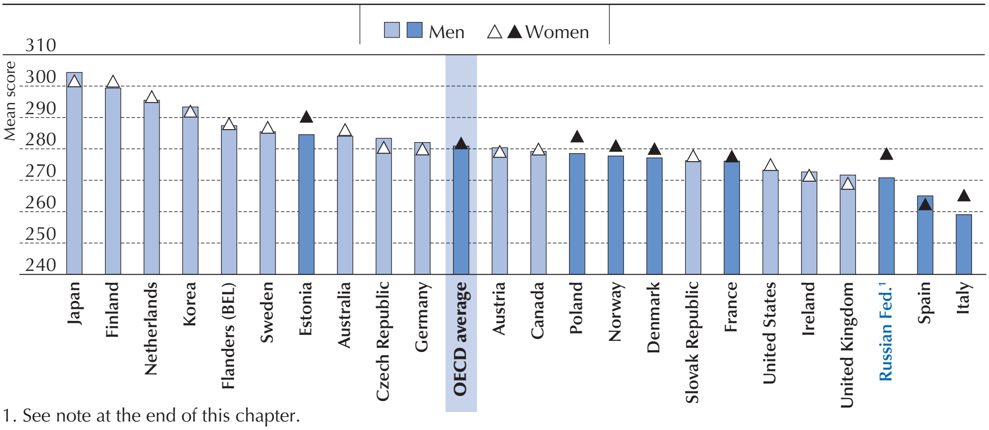
The Survey of Adult Skills finds that, on average among 16-29 year-olds, young women outperform young men in literacy by an average of one score point – meaning that there is, effectively, no gender difference in literacy proficiency. In as many as 15 countries, young men and women show similar levels of literacy proficiency; but in Denmark, Estonia, France, Italy, Norway, Poland and the Russian Federation, young women outperform young men in literacy. Spain is the only country where young men outperform young women in literacy, although the difference (three score points) is small (Table 4.10a). Figure 4.15 shows that, while gender differences in literacy proficiency among 16-29 year-olds are either small or non-existent, among the lowest performers (the 10th percentile), young women tend to outperform young men, while among the highest performers (the 90th percentile), young men tend to outperform young women (Table 4.10d).

At the same time, the data in Table 4.10a show that young men outperform young women by a larger margin in numeracy. On average across the OECD countries with available data, 16-29 year-old men outperform 16-29 years old women by eight score points (16% of a standard deviation). This gender gap in numeracy proficiency in favour of young men is observed in all countries and economies that participated in the 2012 Survey of Adult Skills, except Italy, where there is no gender gap, and the Russian Federation, where young men underperform compared to young women. The gender gap is particularly pronounced in Canada, Finland, France, Ireland, the United Kingdom and the United States, where the difference in numeracy proficiency between the genders is over 10 score points (or one fifth of a standard deviation).

Young men's advantage in numeracy tends to be particularly large among the highest-achieving students (90th percentile). On average across OECD countries with available data, young men score 11 points higher than young women in numeracy; in the United States, they score an average of 20 points higher. Conversely, the gender gap in numeracy proficiency favouring young men among the lowest achievers (10th percentile) is statistically significant only in Canada, Finland, France, Germany, Spain and Sweden. In the Russian Federation, among the lowest performers, young women score an average of 9 points higher than young men (Table 4.10a).

■ Figure 4.15 ■

Gender differences in literacy proficiency among 16-29 year-olds

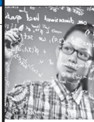


1. See note at the end of this chapter.
Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of men's mean score in literacy.
Source: OECD, PIAAC Database, Table 4.10a.

These data confirm evidence emerging from PISA on boys' overachievement in mathematics, particularly among top performers; but the data also indicate that, as boys and girls leave compulsory schooling and enter either further education and training or work, the gap in literacy proficiency narrows considerably. Indeed, if anything, young men tend to outperform young women.

Inter-generational differences

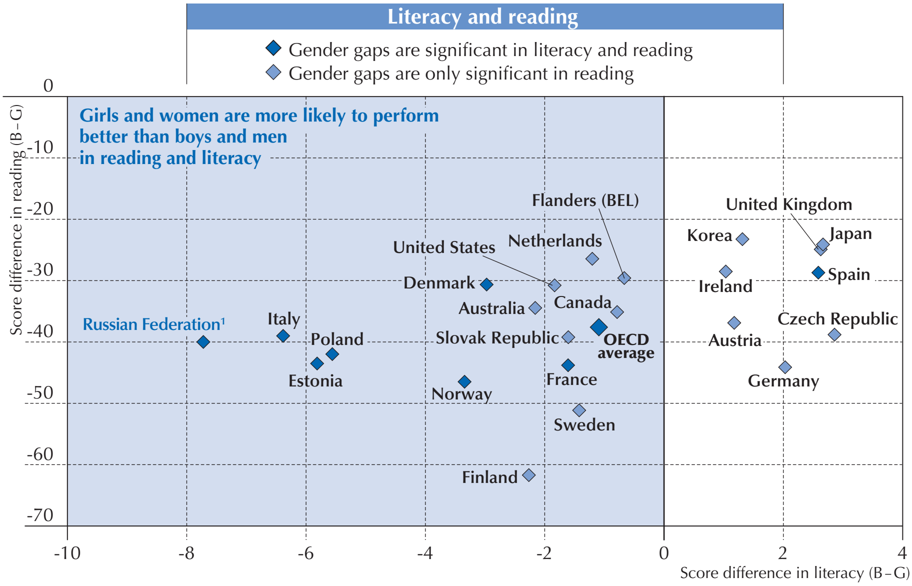
Chapter 1 discusses the evolution of education and labour market opportunities for men and women over the past 50 years. Tables 4.10a, 4.10b, 4.10c and 4.10d show that, in every country with available data (except the United Kingdom and the United States), 50-65 year-olds tend to have lower numeracy and literacy proficiency than 16-29 year-olds, and that the difference between the two age groups in both numeracy and literacy proficiency tends to be much more pronounced among women than among men. For example, in Korea, 16-29 year-old men score 285 points and women the same age score 280 points in numeracy, while 50-65 year-old men score 247 points and women the same age score an average of 228 points in numeracy. The difference in performance between the two age groups is 37 score points among men and 52 score points among women. This means that the age effect on the difference between men's and women's proficiency in numeracy is 14 score points. The gender gap in numeracy proficiency is also considerably narrower between younger men and women than it is between older men and women in Germany, where the age effect on the difference between men's and women's numeracy proficiency is 16 score points, in Flanders (Belgium), where it is 14 points, and in Australia, Canada, the Netherlands, Norway and Sweden, where it is 8 points or more (Figure 4.18 and Table 4.10d).

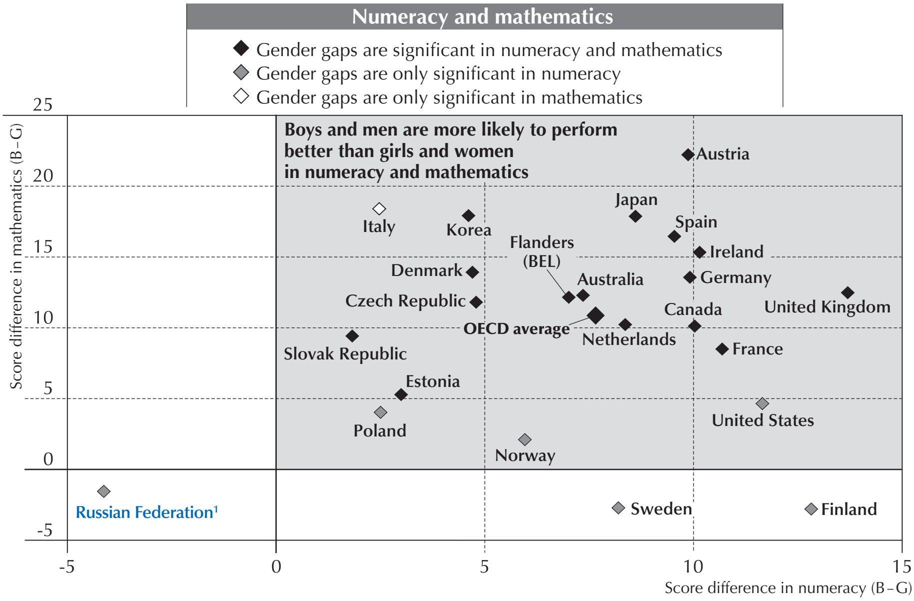


■ Figure 4.16 ■

Gender differences in performance among young adults and among 15-year-olds

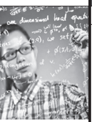
As measured by the 2012 Survey of Adult Skills (16-29 year-olds) and PISA 2012 (15-year-olds)





1. See note at the end of this chapter.

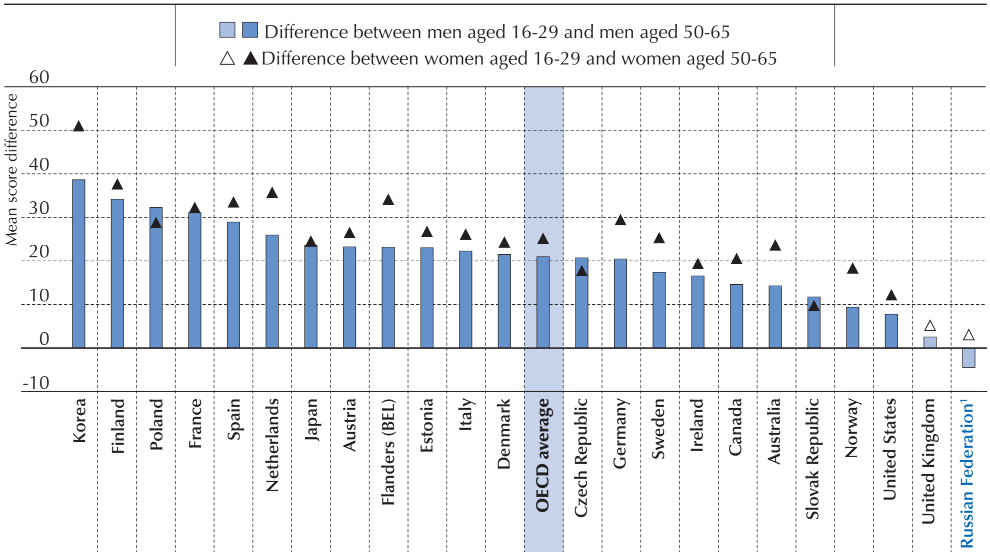
Source: OECD, PISA 2009, PISA 2012 and PIAAC Databases, Tables 1.2a, 1.3a and 4.10a.



The difference in literacy proficiency between younger and older women compared to the difference between younger and older men – four score points – is similar to that in numeracy proficiency – five score points. However, the difference is large – more than 10 score points – in Korea and Flanders (Belgium). In Flanders (Belgium), 16-29 year-old women score 288 points, on average, in literacy while 50-65 year-old women score 254 points, on average – a difference of 34 points, the equivalent of nearly five years of formal schooling (OECD, 2013a). Among men, 16-29 year-olds score 287 points, on average, while 50-65 year-olds score 264 points, on average – a difference of 23 points (Figure 4.17 and Table 4.10d).

■ Figure 4.17 ■

Gender differences in literacy proficiency between younger and older adults



1. See note at the end of this chapter.

Note: Differences among men and differences among women that are statistically significant are marked in a darker tone.

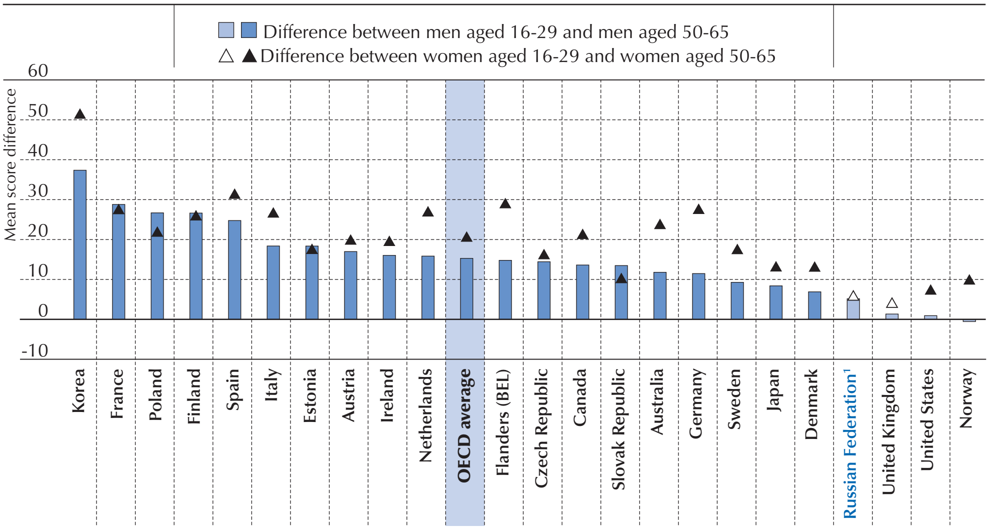
Countries and economies are ranked in descending order of the mean score difference in literacy between men aged 16-29 and men aged 50-65 (men aged 16-29 – men aged 50-65).

Source: OECD, PIAAC Database, Table 4.10d.

These results suggest that young men tend to be more proficient in literacy than would be expected given how they perform in reading, compared to girls, at the age of 15. The results also suggest that young women do not catch up with young men in numeracy proficiency after they leave compulsory schooling. Results from the Survey of Adult Skills indicate that the gender gap in both numeracy and literacy proficiency differs greatly among different age groups, such that among people in their 30s, 40s, 50s and 60s, men outperform women in both literacy and numeracy by a considerable margin, while among younger age groups, there is no or only a small gap in literacy proficiency in favour of women while the gender gap in numeracy in favour of men is even smaller.

■ Figure 4.18 ■

Gender differences in numeracy proficiency between younger and older adults



1. See note at the end of this chapter.

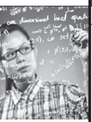
Note: Differences among men and differences among women that are statistically significant are marked in a darker tone.

Countries and economies are ranked in descending order of the mean score difference in numeracy between men aged 16-29 and men aged 50-65 (men aged 16-29 – men aged 50-65).

Source: OECD, PIAAC Database, Table 4.10d.

The comparatively lower literacy and numeracy proficiency among women in their 50s and 60s (compared to men in their 50s and 60s and compared to younger women) may be partly due to the fact that women who were born in the decades immediately after the Second World War had fewer education opportunities compared to men their age and especially compared to younger women (see Chapter 1 on the long-term trends in educational attainment). Moreover, women who were born between the late 1940s and the late 1950s had fewer opportunities than men and younger women to enter the labour market, remain employed once they started a family, and occupy positions that enabled them to practice and maintain the level of skills they had acquired while in school. Because of family responsibilities and the unequal distribution of housework, these women may also have enjoyed fewer opportunities to maintain their skills while at home.

The fact that the Survey of Adult Skills is conducted on computers may account for at least some of the improvement in reading/literacy performance between 15-year-old boys and 16-29 year-old young men. However, 15-year-old boys also underachieve in digital reading – and again by a large margin – compared to 15-year-old girls (although this difference in performance is narrower than the gender gap in print reading). Similarly, the types of texts to be read and the construction of the questions asked also differ between PISA and the Survey of Adult Skills (see the PISA and PIAAC Assessment Frameworks for more details). But again, 15-year-old boys underachieve compared to girls – and by a wide margin – on the types of PISA reading tasks that are most similar to the literacy questions used in the Survey of Adult Skills (Tables 1.9a, 1.9b, 1.9c, 1.9d and 1.9e).



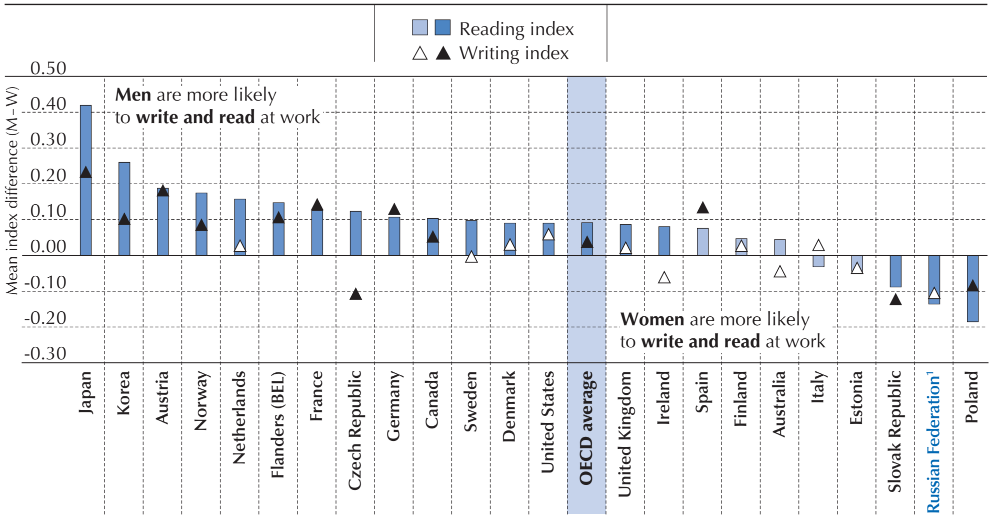
These results imply that it is not the difference between the two surveys that accounts for the narrowing of the gender gap in reading between 15-year-olds and 16-29 year-olds. Rather, it may be that boys develop cognitively and emotionally more slowly than girls, and this may be reflected in the data that show young men "catching up" with young women's proficiency in literacy. In addition, the school environment may not cater particularly well to boys' interests and dispositions. So while boys in school are considerably less likely than girls to engage in activities that help them to become more proficient in literacy, such as reading for enjoyment, young men may be much more inclined pursue these activities at work or at home.

Gender differences in using skills

The Survey of Adult Skills contains detailed information on whether respondents read or write at home or at work, the type of reading and writing activities in which they are engaged (Tables 4.13a, 4.13b and 4.13c), and the types of skills they use at work (Tables 4.11a, 4.11b, 4.11c, 4.12a, 4.12b and 4.12c). On average among 16-29 year-olds, there are no gender differences in how much reading or writing young men and women do at work, although young men are more likely than young women to use numeracy, information and communication technologies (ICT) and problem-solving skills at work (Table 4.11a). However, among workers in their 30s, 40s and particularly workers in their 50s and 60s, men appear to be considerably more likely than women to read and write at work, as well as to use numeracy, ICT and problem-solving skills.

■ Figure 4.19 ■

Differences in reading and writing activities at work, by gender

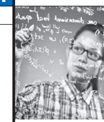


1. See note at the end of this chapter.

Note: Gender differences in reading or writing activities at work that are statistically significant are marked in a darker tone.

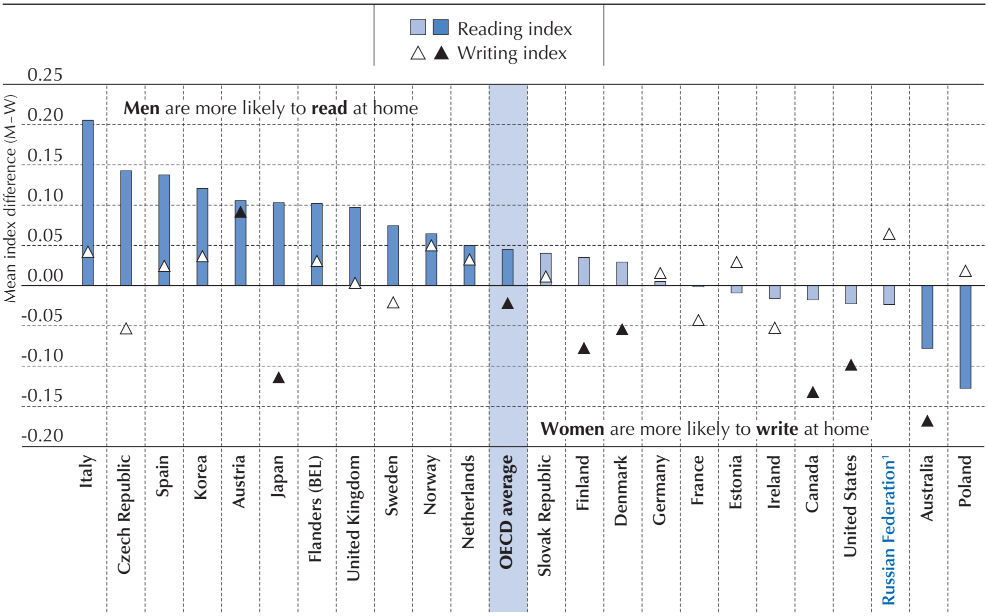
Countries and economies are ranked in descending order of the mean index difference in reading at work between men and women (M–W).

Source: OECD, PIAAC Database, Table 4.13a.



■ Figure 4.20 ■

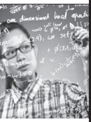
Differences in reading and writing activities at home, by gender



1. See note at the end of this chapter.
Note: Gender differences in reading or writing activities at work that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the mean index difference in reading at home between men and women (M-W).
Source: OECD, PIAAC Database, Table 4.13a.

While teenage boys may be less likely than teenage girls to engage in activities that allow them to practice and build their literacy skills, as they mature they are required to read and write in their work as much as, if not more than, women are. Thus they are often able to catch up with, if not surpass, women's skills in literacy. The data shown in Figures 4.19 and 4.20 suggest that not only do men and women read and write to different degrees at work, they also read and write different materials. At work, men are more likely to read directions and instructions, professional journals or publications, manuals or reference materials, diagrams, maps or schematics, and to write reports or fill in forms. By contrast, women are more likely to read letters, memos or e-mails and books at work, and they are more likely to write letters, memos or e-mails. At home, men are also more likely to read professional journals or publications, manuals or reference materials, diagrams, maps or schematics, while women are more likely to read directions or instructions, letters, memos or e-mails, books and financial statements, and they are more likely to write letters, memos or e-mails.

These findings reveal that reading and writing patterns vary much more at work than at home, and that women are more involved in the interpersonal communication aspects of reading and writing. Even though women now have far more professional opportunities open to them

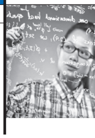


than ever before, they are still responsible for most secretarial tasks at work, as is evident in the frequency with which they read and write letters, memos and e-mails. Men, on the other hand, tend to have more opportunities to engage with and decipher a variety of texts and to perform more complex tasks, such as writing reports.

Data presented in Table 4.14 and Figure 4.21 suggest that, just as 15-year-old boys and girls hold different expectations for the field in which they expect to be working as young adults (boys are significantly more likely to expect to work in science, technology, engineering and mathematics [STEM] occupations), men and women who were surveyed in the 2012 Survey of Adult Skills reported that they studied different subjects. Men are, on average, 32 percentage points more likely than women to have studied engineering, manufacturing and construction (38% of men reported that they had studied these subjects while only 7% of women so reported) and are 3 percentage points more likely to have studied science, mathematics and computing (10% of men reported that they had studied these subjects while 7% of women so reported). By contrast, women are 13 percentage points more likely than men to have studied health and welfare (15% of women and 4% of men so reported), 6 percentage points more likely to have studied education science and to have enrolled in teacher training (9% of women and 3% of men so reported), and 8 percentage points more likely to have studied social sciences, business and law (23% of women and 15% of men so reported).

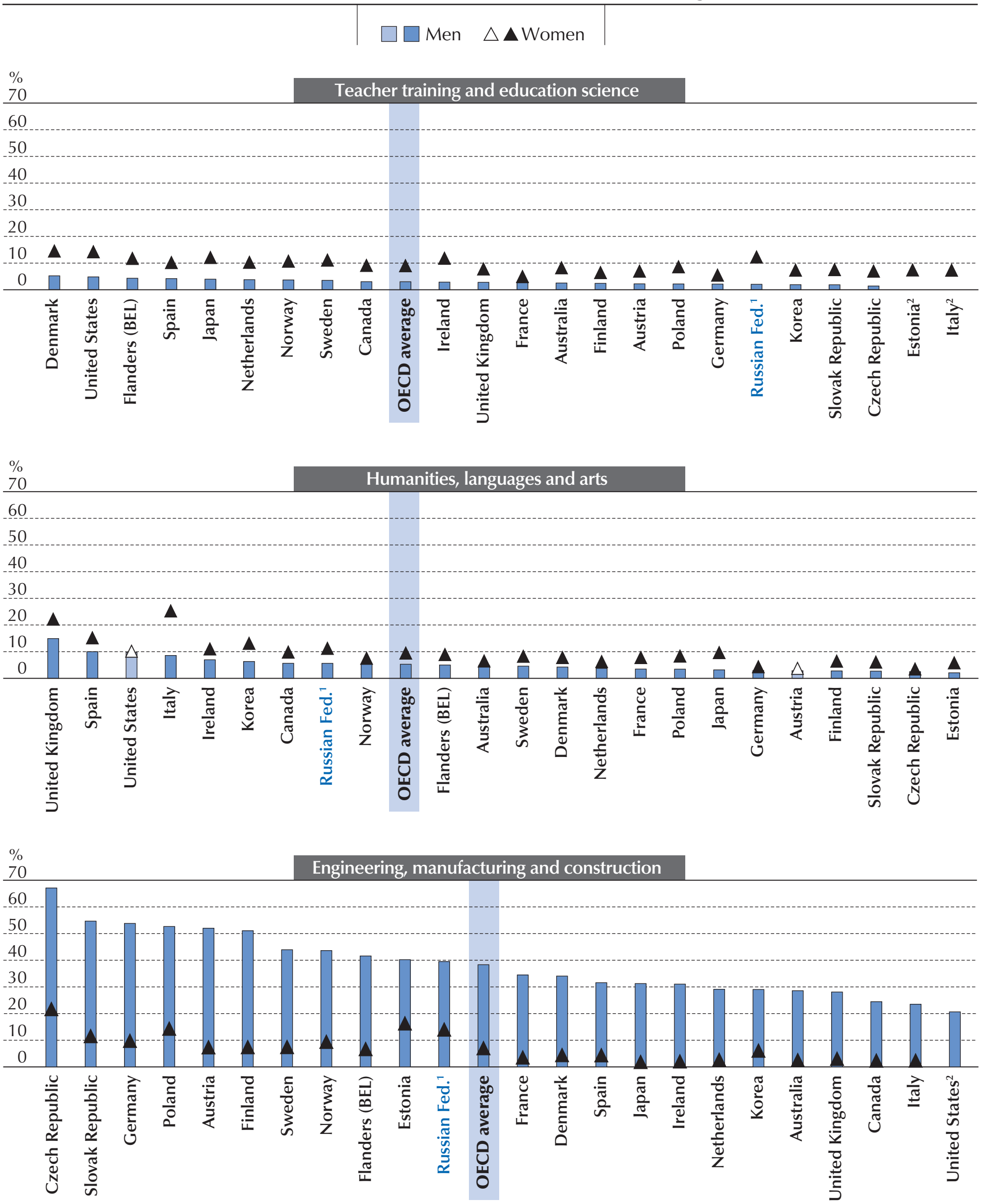
Differences in the percentage of men and women who reported that they had studied engineering, manufacturing and construction are larger than 20 percentage points in all countries and economies examined. These differences are particularly wide in the Czech Republic, Finland, Germany and the Slovak Republic, where men are over 40 percentage points more likely than women to have studied these subjects, according to their reports. Differences are smallest in Canada, Estonia, Italy, Korea and the United Kingdom. In all of these countries, except Estonia, the absolute gender difference is smaller because fewer individuals have studied these fields, not because there is greater gender equity in enrolment in these fields. Similarly, countries showing a small difference in the percentage of men and women who reported that they had studied health and welfare tend to be those where these programmes attract comparatively fewer candidates. For example, Italy, Korea, Poland and the Russian Federation show a small or no gender gap in these fields – but also relatively few adults reported that they had studied these subjects.

Dimensional comparison theory suggests that, since boys and girls hold different career expectations, and that the fields of study men and women reported having pursued are in line with gender-stereotypical notions of what females and males "normally" study, women may need to have considerably better numeracy skills than their male counterparts before they would choose to enrol in STEM courses and opt to work in STEM professions. Results presented in Table 4.15 suggest that, contrary to expectations, women who work in STEM occupations tend to have lower numeracy scores than men who work in the same occupations. On average, men working in STEM occupations score 311 points in numeracy while women score 302 points. This 10 score-point difference is the equivalent of around one-fifth of a standard deviation. The difference is particularly large in Denmark and Spain, where men who work in STEM occupations score 20 points higher in numeracy than women who work in the same occupations.



■ Figure 4.21 ■

Gender differences in field of study

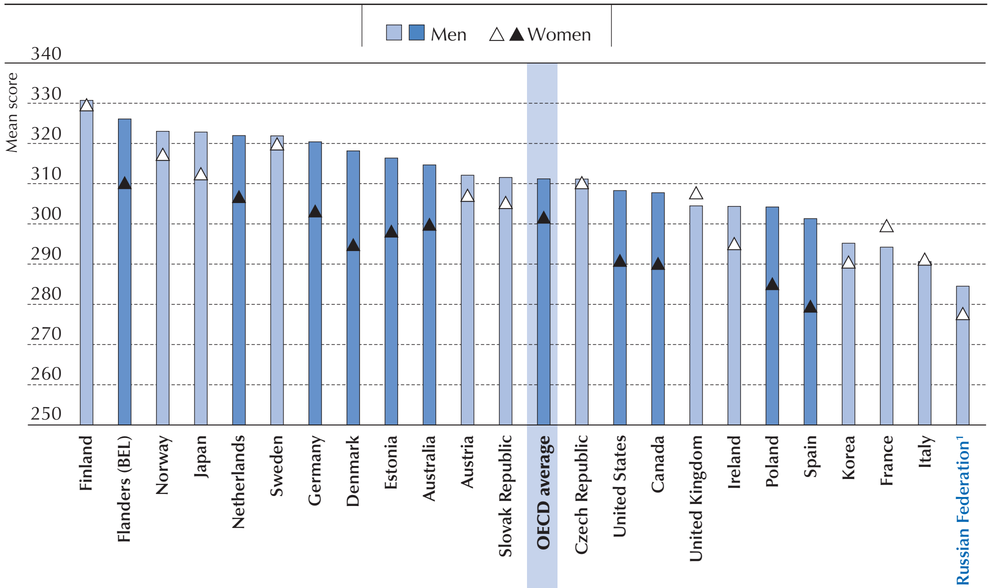


1. See note at the end of this chapter.
2. Sample size too small.
Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the percentage of men in each field of study.
Source: OECD, PIAAC Database, Table 4.14.

There is no such difference observed in Austria, the Czech Republic, Finland, France, Ireland, Italy, Japan, Korea, Norway, the Russian Federation, the Slovak Republic, Sweden and the United Kingdom. In no country do women who work in STEM fields have higher numeracy scores than men who work in STEM fields (Figure 4.22 and Table 4.15).

■ Figure 4.22 ■

Gender differences in numeracy proficiency among men and women who work in STEM occupations



1. See note at the end of this chapter.

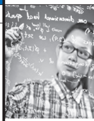
Note: Gender differences that are statistically significant are marked in a darker tone.

Countries and economies are ranked in descending order of the numeracy score (in the 2012 Survey of Adult Skills) of men who work in STEM occupations.

Source: OECD, PIAAC Database, Table 4.15.

FINANCIAL LITERACY

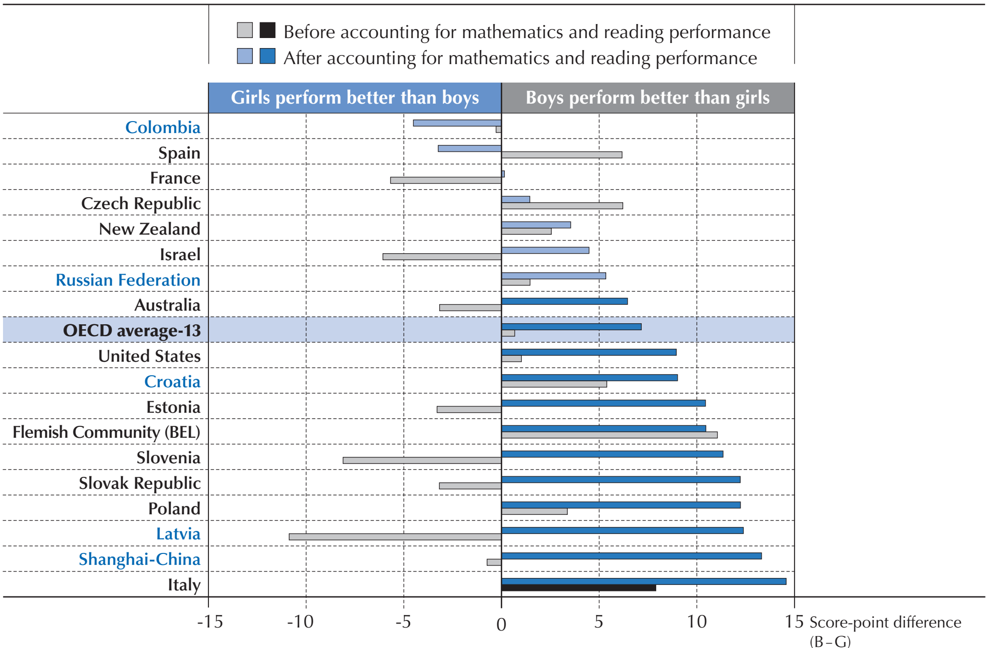
Financial literacy has become an essential skill for full participation in society. The complexity of the financial products, services and systems now available means that young men and women need to be able to make the most of the opportunities these offer, but also to understand the risks and uncertainties inherent in different products and services. Young men and women will probably bear more financial risks in adulthood due to increased life expectancy, a decrease in welfare and occupational benefits, and uncertain economic and job prospects. In addition, 15-year-old boys and girls face immediate financial decisions: some may already be consumers of financial services, such as bank accounts, and most will have to decide, with their parents, whether to continue with post-compulsory education or enter the labour market, and how to finance further education and/or training if they decide to pursue that option.



Results presented in Table 4.16a suggest that there are no gender differences in financial literacy scores in most countries and economies. Only in Italy do boys perform better than girls, but only by 8 score points, which is a relatively small difference (one proficiency level in financial literacy is the equivalent of 75 points). However, the results in Table 4.16c suggest that boys tend to perform better than girls in financial literacy after accounting for students' competencies in other subjects. After accounting for students' performance in mathematics and reading, for example, boys perform slightly better than girls in Australia, Croatia, Estonia, the Flemish Community of Belgium, Italy, Latvia, Poland, Shanghai-China, the Slovak Republic, Slovenia and the United States. This means that among boys and girls of similar ability in mathematics and reading, boys perform better in financial literacy than girls. However, these differences are not very large. Only in Italy is the score-point difference between boys and girls relatively large (15 score points), after accounting for mathematics and reading performance (Table 4.16c).

■ Figure 4.23 ■

Gender differences in financial literacy performance



Note: Score-point differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the score-point difference in financial literacy performance between boys and girls, after accounting for mathematics and reading performance.
Source: OECD, PISA 2012 Database, Table 4.16c.

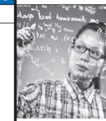
Girls and boys are not equally represented among high- and low-performing students (Table 4.16b). Results in Table 4.16b show that, on average across the 13 participating OECD countries and economies, 11% of boys and 8% of girls perform at proficiency Level 5 in financial literacy (the highest level), while 17% of boys and 14% of girls perform at or below Level 1.

The fact that there are more boys than girls among the lowest performers (at or below Level 1) and among the top performers (at Level 5) also means that the distribution of financial literacy proficiency is more dispersed among boys than among girls. (This is confirmed by a higher standard deviation of financial literacy performance among boys than among girls; Table 4.16a.) In mathematics, on average across OECD countries and economies, there are more boys than girls among the top performers (17% of boys and 11% of girls perform at or above Level 5), but there are about as many boys as girls among the lowest performers. In reading, on average across OECD countries and economies, there are more girls than boys among the top performers (11% girls and 7% boys perform at or above Level 5) and more boys than girls among the lowest performers (22% boys and 12% girls score at or below Level 1).

Another way of assessing gender differences in financial literacy is to look at the performance distribution. In France, Israel, Italy, New Zealand and Poland, among students performing at or above the 90th percentile (top performers), boys perform better than girls, while among students performing at or below the 25th and 10th percentiles (low performers), girls in Australia, France, Israel and Slovenia tend to perform better than boys. In other words, among the highest achievers, boys outperform girls in five countries, while among low and the lowest achievers, girls outperform boys in four countries (Table 4.16a). Overall, these results suggest that when targeting students with poor financial literacy, it is important to keep in mind that low-performing boys are likely to lack proficiency in several skills, while girls may need targeted help to develop the specific skills needed to attain the highest levels of proficiency in financial literacy.

While PISA shows comparatively small gender differences in financial literacy, several studies do find gender differences in financial literacy among adults (Agnew et al., 2013; Arrondel et al., 2013; Fornero and Monticone, 2011; Crossan et al., 2011; Lusardi and Mitchell, 2011). The fact that gender differences are consistently reported among adults but not among 15-year-old students may be due to the fact that, at least to some extent, gender differences in adulthood are related to the different socio-economic characteristics of men and women (OECD, 2013b). For example, as boys and girls grow up, they may be exposed to different opportunities to learn and improve their financial competencies, such as different access to labour and financial markets, and therefore they may develop different levels of financial knowledge and different financial strategies over time.

The finding that girls in many countries now surpass boys not only in educational attainment but also in the hopes and plans they have for high-status careers holds the promise of narrowing the gender gap in the labour market in the not-too-distant future (Shavit and Blossfeld, 1993; Marks, 2008). But gender inequalities are also created because of persistent occupational segregation by gender. Men and women not only reach different positions in the workplace hierarchy, and are asked to use their skills differently when they get there, they also occupy different niches in the labour market. Women are predominantly employed in fields where they have fewer opportunities to express their potential, and develop and maintain their skills – often at the price of lower wages and slower career paths (Charles and Grusky, 2004).



Ambition and educational attainment are only two of the elements that affect the gender balance in the labour market. Perhaps as younger generations move into the workforce, the gender disparities observed in the results of the 2012 Survey of Adult Skills will gradually narrow. But without interventions to tackle boys' underperformance in reading and girls' lack of confidence in their ability to solve mathematical problems, gender equality in society at large will remain elusive.

Notes

1. The questionnaire asks students about ISCED 3-5 programmes they are interested in.

2. See Sikora and Pokropek (2011) for a detailed description of how this index was calculated.

3. It is important to bear in mind that the categories of engineering/computing and health used in this analysis do not include all science-related occupations. These two categories account for about 75% of plans for science-related employment. Some science-related occupations, such as "mathematician", "physicist" or "psychologist", are neither in the engineering/computing nor in the health category. Nevertheless, it is possible to relate gender differences in these two fields to the overall patterns of segregation previously found in studies of employment and tertiary enrolments.

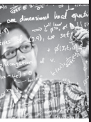
Note regarding Israel

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.

Note regarding the Russian Federation in the Survey of Adult Skills

Readers should note that the sample for the Russian Federation does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65 in Russia but rather the population of Russia excluding the population residing in the Moscow municipal area.

More detailed information regarding the data from the Russian Federation as well as that of other countries that participated in the Survey of Adult Skills can be found in the *Technical Report of the Survey of Adult Skills* (OECD, 2013c).



References

Agnew, J., H. Bateman and **S. Thorp** (2013), "Financial literacy and retirement planning in Australia", *Numeracy*, Vol. 6/2.

Arrondel, L., M. Debbich and **F. Savignac** (2013), "Financial literacy and planning in France", *Numeracy*, Vol. 6/2.

Buchmann, C. and **H. Park** (2009), "Stratification and the formation of expectations in highly differentiated educational systems", *Research in Social Stratification and Mobility*, Vol. 27/4, pp. 245-267.

Campbell, R. (1983), "Status attainment research: End of the beginning or beginning of the end?", *Sociology of Education,* Vol. 56/1, pp. 47-62.

Charles, M. and **D.B. Grusky** (2004), *Occupational Ghettos: The Worldwide Segregation of Women and Men,* Stanford University Press, Stanford, CA.

Croll, P. (2008), "Occupational choice, socio-economic status and educational attainment: A study of the occupational choices and destinations of young people in the British household panel survey", *Research Papers in Education,* Vol. 23, pp. 243-268.

Crossan, D., D. Feslier and **R. Hurnard** (2011), "Financial literacy and retirement planning in New Zealand", *Journal of Pension Economics and Finance*, Vol. 10, pp. 619-635.

DiPrete, T. and **C. Buchmann** (2013), *The Rise of Women: The Growing Gender Gap in Education and What it Means for American Schools*, Russell Sage Foundation, New York, NY.

Fornero, E. and **C. Monticone** (2011), "Financial literacy and pension plan participation in Italy", *Journal of Pension Economics and Finance*, Vol. 10, pp. 547-564.

Ganzeboom, H.B.G. and **D.J. Treiman** (1996), "Internationally comparable measures of occupational status for the 1988 international standard classification of occupations", *Social Science Research*, Vol. 25, pp. 201-239.

Goyette, K. (2008), "College for some to college for all: Social background, occupational expectations, and educational expectations over time", *Social Science Research*, Vol. 37, pp. 461-84.

Kerckhoff, A. (2000), "Transition from school to work in comparative perspective" in M. Hallinan (ed.), *The Handbook of the Sociology of Education*, Kluwer Academic/Plenum Publishers, New York, NY.

LeTendre, G., B. Hofer and **H. Shimizu** (2003), "What is tracking? Cultural expectation in the United States, Germany, and Japan", *American Educational Research Journal*, Vol. 40/1, pp. 43-89.

Little, A. (1978), *The Occupational and Educational Expectations of Students in Developed and Less-Developed Countries*, Sussex University, Institute of Development Studies, Sussex.

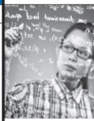
Lusardi, A. and **O.S. Mitchell** (2011), "Financial literacy and retirement planning in the United States", *Journal of Pension Economics and Finance*, Vol. 10, pp. 509-525.

Marks, G.N. (2010), "Meritocracy, modernization and students' occupational expectations: Cross-national evidence", *Research in Social Stratification and Mobility*, Vol. 28, pp. 275-289.

Marks, G.N. (2008), "Gender differences in the effects of socioeconomic background: Recent cross-national evidence", *International Sociology*, Vol. 23/6, pp. 845-863.

McDaniel, A. (2010), "Cross-national gender gaps in educational expectations: The influence of national-level gender ideology and educational systems", *Comparative Education Review,* Vol. 54, pp. 27-50.

Morgan, S. (2005), *On the Edge of Commitment: Educational Attainment and Race in the United States,* Stanford University Press, Stanford, CA.



OECD (2013a), *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264204256-en.

OECD (2013b), *Women and Financial Education: Evidence, Policy Responses and Guidance*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264202733-en.

OECD (2013c), *Technical Report of the Survey of Adult Skills (PIAAC)*, OECD, Paris, www.oecd.org/site/piaac/_Technical%20Report_17OCT13.pdf.

OECD (2012), *Grade Expectations: How Marks and Education Policies Shape Students' Ambitions*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264187528-en.

Perna, L. (2000), "Differences in the decision to attend college among African Americans, Hispanics, and Whites", *The Journal of Higher Education,* Vol. 71/2, pp. 117-141.

Reynolds, J. et al. (2006), "Have adolescents become too ambitious? High school seniors' educational and occupational plans, 1976 to 2000", *Social Problems,* Vol. 53, pp. 186-206.

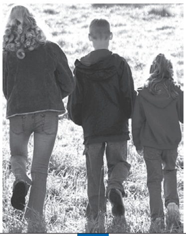
Shavit, Y. and **H.P. Blossfeld** (1993) *Persistent Inequality: Changing Educational Attainment in Thirteen Countries*, Westview Press, Boulder, CO.

Sewell, W. et al. (2003), "As we age: A review of the Wisconsin longitudinal study, 1957-2001", *Research in Social Stratification and Mobility,* Vol. 20, pp. 3-111.

Sikora, J. and **A. Pokropek** (2011), "Gendered career expectations of students: Perspectives from PISA 2006", *OECD Education Working Papers*, No. 57, OECD Publishing, Paris, http://dx.doi.org/10.1787/5kghw6891gms-en.

Sikora, J. and **L.J. Saha** (2009), "Gender and professional career plans of high school students in comparative perspective", *Educational Research and Evaluation*, Vol. 15, pp. 387-405.

Sikora, J. and **L.J. Saha** (2007), "Corrosive inequality? Structural determinants of educational and occupational expectations in comparative perspective", *International Education Journal: Comparative Perspectives*, Vol. 8, pp. 57-78.



5

How Family, School and Society Affect Boys' and Girls' Performance at School

This chapter examines various factors in the family, the school and throughout society that may be related to gender differences in student performance. These factors include the socio-economic status of a family and parents' expectations for their child, the socio-economic profile of schools and teaching practices at school, and the level of gender equality in society.

Previous chapters detailed some of the attitudes and behaviours that may shape gender differences in reading and mathematics performance, to the extent that many boys underperform in school and many high-achieving girls do not fully realise their potential. Boys are significantly more likely to be among the lowest-performing students – those who score below the PISA baseline level of proficiency in all subjects – largely because of their much greater likelihood of being low-achievers in reading, while girls are less likely to be top performers in mathematics, science and problem solving. Research finds that some family, school and country-level factors can influence boys' and girls' achievement in school.

What the data tell us

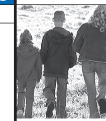
- In all countries and economies that distributed the parent questionnaire, parents were more likely to expect their sons, rather than their daughters, to work in a STEM field, even when boys and girls perform at the same level in mathematics.
- PISA does not provide strong evidence that the gender gap in mathematics performance is narrower in households where the mother works in a STEM occupation.
- Boys tend to underachieve when they attend disadvantaged schools.
- In eight countries, teachers' use of cognitive-activation strategies in mathematics courses (when students are required to solve problems themselves) is associated with better performance among girls.
- Greater female participation in the labour market is associated with better mathematics performance among girls.

THE ROLE OF FAMILIES

Research has suggested that boys may be particularly likely to fare poorly at school when they come from socio-economically disadvantaged households (DiPrete and Buchmann, 2013). Because both gender and socio-economic status are risk factors related to achievement and to attitudes towards school and learning, it is important to examine whether each of these risks adds to or amplifies the other.

Results presented in Tables 5.1a, 5.1b, 5.1c, 5.1d and 5.1e show the performance of boys and girls and the gender gap in mathematics, reading, science and problem solving, according to the students' socio-economic status. Results suggest that gender gaps tend to be broadly the same among disadvantaged and advantaged households (socio-economic advantage and disadvantage are defined by whether students are among those in the bottom quarter of the *PISA index of economic, social and cultural status* [ESCS] or in the top quarter of the ESCS index within their country).

PISA also examines whether gender differences in mathematics, reading, science and problem-solving performance are associated with parents' educational attainment and occupation, family wealth and/or household possessions. The results shown in Table 5.2 suggest that in some countries, boys may be at a particular disadvantage when their parents are low-educated



and work in low-skilled jobs, and when the family has few possessions. For example, in Bulgaria, the Czech Republic, Finland, Greece, Israel, Jordan, Lithuania, Montenegro, Qatar and the United Arab Emirates, the gender gap in reading, in favour of girls, is at least 10 score points narrower when comparing boys and girls who come from similar households (Table 5.2).

Having an immigrant background is also associated with differences in performance. The gender gap in mathematics, reading and science tends to be similar among students who have at least one parent who was born outside of the country where they sat the PISA test and among students whose two parents were born in the country (Table 5.3). But in some countries/economies – notably Argentina, Chile and Macao-China – the gender gap in mathematics, in favour of boys, tends to be less pronounced among the children of immigrants. Similarly, in Argentina, Chile, the Netherlands, Peru, Qatar and the United Arab Emirates, the gender gap in reading, in favour of girls, tends to be wider among the children of immigrants.

Parents' expectations for their children

Results presented in Table 5.4 suggest that parents still hold different expectations for their sons and daughters. This could be because parents still harbour stereotypical notions of what women and men excel at and the career they can pursue when they enter the labour market – which is, in turn, related to occupational segregation in the labour market.

In Chile, Croatia, the Flemish Community of Belgium, Germany, Hong Kong-China, Hungary, Italy, Korea, Macao-China, Mexico and Portugal, students who participated in PISA 2012 were asked to take home a questionnaire for their parents to complete. The responses collected allow for more in-depth analyses of parents' attitudes and perceptions. Among other things, parents were asked what occupation they expected their 15-year-old child to work in when he or she is 30 years old.

Figure 5.1 shows that, in all countries and economies that distributed the parent questionnaire, parents were more likely to expect their sons, rather than their daughters, to work in a science, technology, engineering or mathematics (STEM) field (Table 5.4). For example, in Chile, 50% of 15-year-old boys' parents expected that they would work in STEM occupations; only 16% of girls' parents reported so. The gender gap in the percentage of 15-year-old boys and girls whose parents expected them to work in STEM occupations is larger than 30 percentage points in Chile, Hungary and Portugal. In Korea, relatively few students have parents who expected them to work in STEM occupations – 17% of boys and 9% of girls; but even so, the gender gap is a substantial 7 percentage points (Table 5.4). Because STEM occupations generally require a university degree and command high wages, these results are limited to those parents who expected their children to work as managers, professionals or associate professionals, in careers of similar prestige and with similar requirements as STEM occupations.

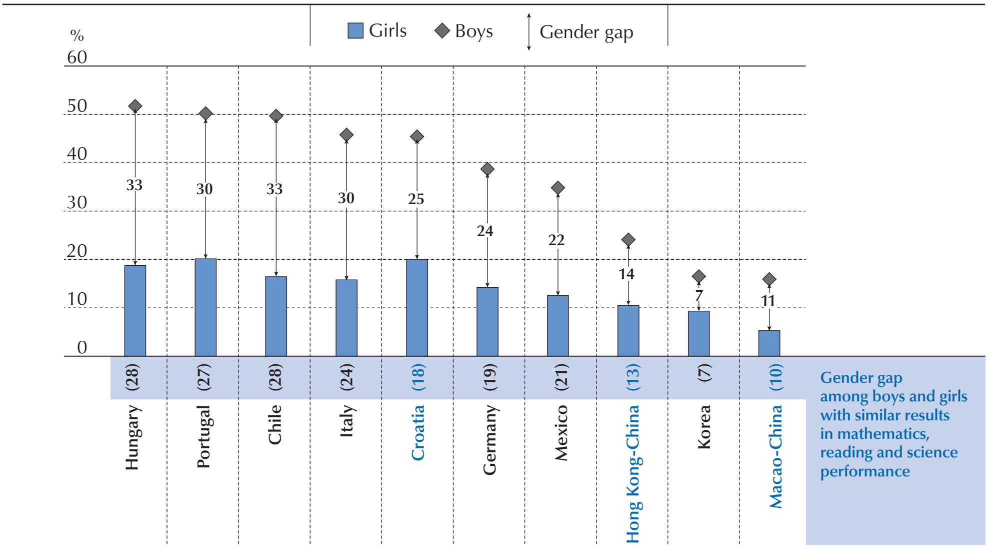
Results presented in Figure 5.1 and Table 5.4 suggest that gender differences in academic performance do not explain the observed differences in parents' expectations for their sons and daughters to work in STEM fields. These differences are large and significant in all participating countries and economies, even when accounting for students' performance in reading, mathematics and science. As expected, results indicate that parents are more likely to expect that their children will work in STEM fields if they perform better in mathematics. In Croatia and Italy, parents are less likely to expect their children to work in STEM occupations if they perform better in reading.

PISA results also suggest that in Hong Kong-China, Korea, Macao-China, Mexico and Portugal, when comparing students of similar performance in reading, mathematics and science, students from socio-economically advantaged households are more likely than students from disadvantaged households to have parents who expect them to work in STEM occupations. Italy is the only country where advantaged students are less likely to have parents who expect them to work in STEM occupations. In fact, Table 5.4 reveals that in Croatia and Italy, while boys are more likely than girls to have parents who expect that they will work in STEM occupations, the gender gap in parents' expectations is narrower in advantaged households.

■ Figure 5.1 ■

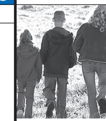
Parents' expectations for their children's careers

Percentage of students whose parents expect that they will work in STEM occupations



Notes: All gender differences are statistically significant. STEM stands for science, technology, engineering, and mathematics.
Countries and economies are ranked in descending order of the percentage of boys whose parents expect that they will work in STEM occupations when they are 30 years old.
Source: OECD, PISA 2012 Database, Table 5.4.

The literature often suggests that girls' lack of confidence in their abilities in mathematics and science may be due to an absence of role models. The paucity of women scientists means that young girls have little in the way of tangible evidence to disprove the stereotypical notion that mathematics and science are somehow more "masculine" disciplines. PISA results show that few mothers of 15-year-olds, worldwide, work in STEM occupations; indeed, in all countries and economies there are far fewer women than men employed in these sectors (Table 5.5).



But PISA does not provide strong evidence that the gender gap in mathematics performance is narrower in households where the mother does work in a STEM occupation (Table 5.6). In fact, in Belgium, Bulgaria, Canada, France, Greece, the Netherlands, Qatar, the Slovak Republic, Turkey and Uruguay, the gender gap in mathematics performance, in favour of boys, appears to be much wider among students whose mother works in a STEM field. This apparent paradox may arise from the fact that STEM occupations are generally prestigious and well-paid, and require university-level qualifications. In some countries, advantaged boys perform better across the board. And given the fact that relatively few mothers work in STEM fields, those families with a mother who does work in one of those fields tend to be particularly keen to see their children excel in mathematics. In these cases, both boys and girls benefit from such an environment.

What these results suggest is that many parents still expect their sons and daughters to pursue different occupations, even when they perform similarly in mathematics. While having positive role models is important for girls, many girls who have parents, and mothers in particular, who work in science- and mathematics-related fields often underperform in mathematics compared to boys from similar households. One reason may be the much higher level of anxiety towards mathematics that girls report, and the fact that girls are often more driven to perform well in school and achieve at a high level. High anxiety coupled with high expectations often lead to choking under pressure.

THE ROLE OF SCHOOLS

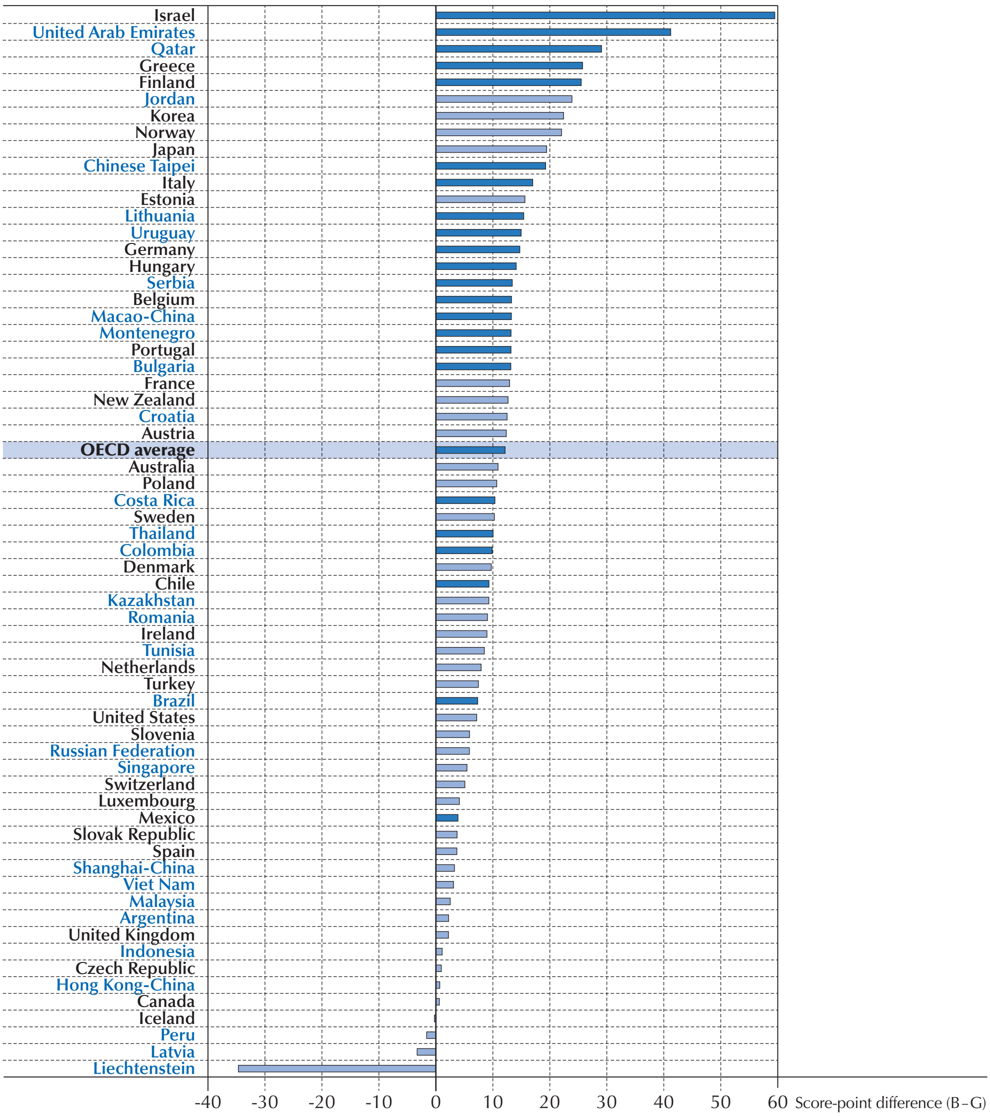
Results presented in the previous section suggest that, in some countries, disadvantaged boys may be at a particularly high risk of underachieving in school, and that parents' expectations and attitudes are related to the gender of their child. This section focuses on schools, and whether the socio-economic composition of their student bodies, the learning environment they establish, and the practices adopted by teachers are associated with gender gaps in performance. The literature suggests that the socio-economic composition of schools and the learning environment are related to the underperformance of boys in reading (Legewie and DiPrete, 2012; Legewie and DiPrete, 2014), and that girls in same-sex schools may perform better in mathematics and be more willing to take risks in their school work (Booth and Nolen, 2012; Pahlke et al., 2014).

There is a large body of evidence on how classmates and friends can influence the academic achievement and the behaviour of individual students (Coleman, 1961; Dornbusch,1989; Akerlof and Kranton, 2002). Peer influence may operate differently among boys and among girls. Some observational and interview studies, for example, indicate that boys often feel that it is "inappropriate" and "contrary to their masculine identity" to show interest in school (Francis, 2000; Paechter, 1998; Warrington et al., 2000). Boys also appear to confront – and succumb to – greater peer pressure to conform to gender identities more than girls do (Younger and Warrington, 1996; Warrington et al., 2000). For boys, this identity is marked by a relative lack of interest in school, in general, and in reading, in particular (Clark, 1995; Smith and Wilhelm, 2002). Girls, on the other hand, may be less likely to be affected by low-achieving peers; but their likelihood of excelling in mathematics and choosing mathematics courses may be influenced by the performance of other girls around them (Crosnoe et al., 2008; Correll, 2001).

■ Figure 5.2 ■

Relationship between schools' socio-economic composition and the gender gap in reading

Additional score points for boys when students attend more advantaged schools

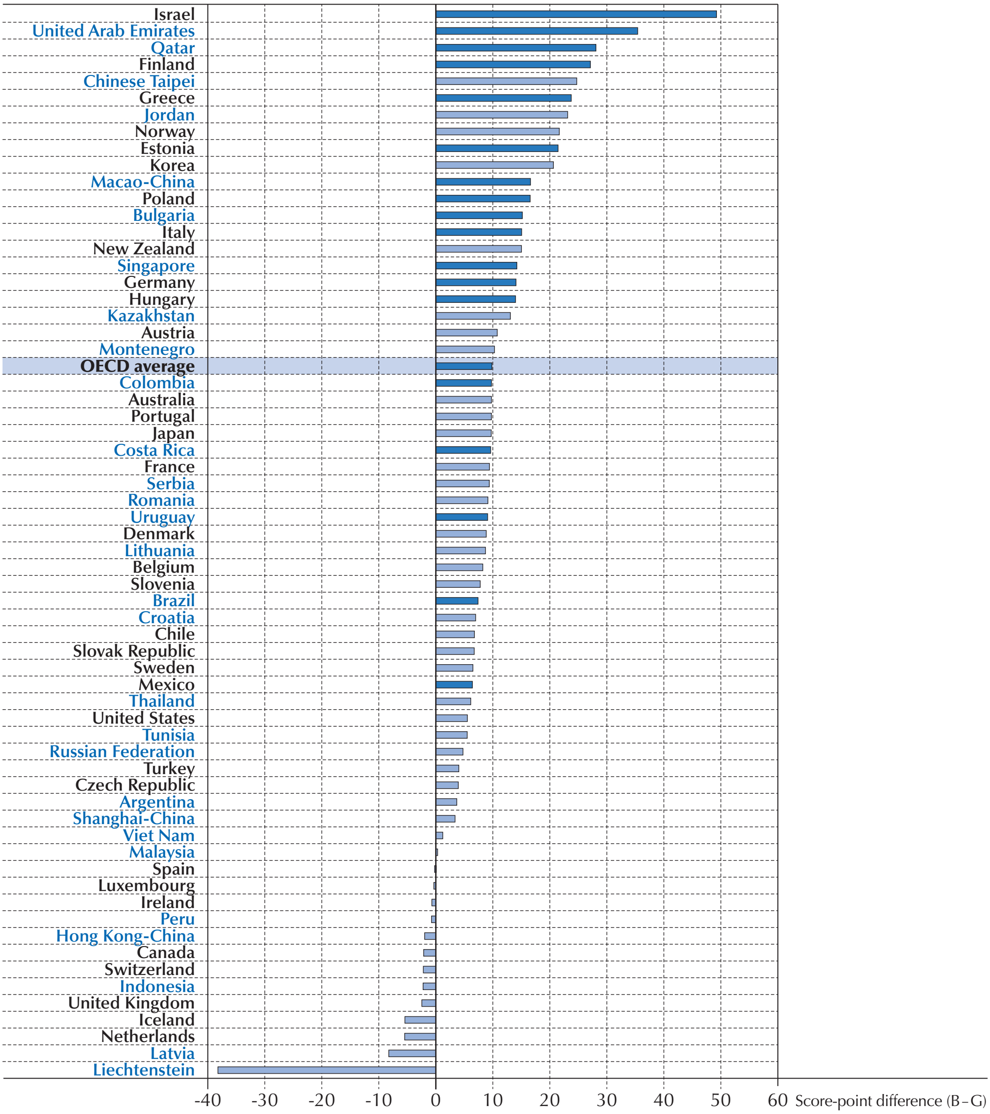


Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the score points in reading added for boys when they attend more advantaged schools (corresponding to a one-unit difference in the PISA index of economic, social and cultural status *of the school).*
Source: OECD, PISA 2012 Database, Table 5.7e.

■ Figure 5.3 ■

Relationship between schools' socio-economic composition and the gender gap in mathematics

Additional score points for boys when students attend more advantaged schools



Note: Gender differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the score points in mathematics added for boys when they attend more advantaged schools (corresponding to a one-unit difference in the PISA index of economic, social and cultural status *of the school).*
Source: OECD, PISA 2012 Database, Table 5.7e.

Results presented in Tables 5.7a, 5.7b, 5.7c, 5.7d and 5.7e suggest that the socio-economic composition of the school a student attends may be more important for a boy's performance than his socio-economic status. Table 5.7e shows that while both boys and girls tend to benefit from attending schools with more advantaged peers, the performance difference that is associated with the socio-economic composition of schools is much more pronounced among boys than it is among girls. In nine OECD countries and in nine partner countries and economies, the gender gap in mathematics performance, in favour of boys, is much wider in advantaged schools (Figure 5.3). Meanwhile, in 10 OECD countries and 13 partner countries and economies, boys' underachievement in reading is less pronounced if their schoolmates are more socio-economically advantaged (Figure 5.2).

The relationship between what happens in the classroom and the gender gap in achievement

Teachers can play a significant role in shaping students' attitudes towards learning, and in encouraging them to work to the best of their abilities, through the teaching strategies they use (Hipkins, 2012; Wigfield, Cambria and Eccles, 2012). Students who participated in PISA 2012 were asked to think about the mathematics teacher who taught their most recent mathematics class and to report the frequency with which the following eight actions occur: the teacher asks questions that make students reflect on the problem; the teacher gives problems that require students to think for an extended time; the teacher asks students to decide, on their own, procedures for solving complex problems; the teacher presents problems in different contexts so that students know whether they have understood the concepts; the teacher helps students to learn from mistakes they have made; the teacher asks students to explain how they solved a problem; the teacher presents problems that require students to apply what they have learned in new contexts; and the teacher gives problems that can be solved in different ways.

Students were asked to report whether these actions occurred always or almost always, often, sometimes, or never or rarely. Student responses were used to develop the *index of teachers' use of cognitive-activation strategies*, which was standardised to have a mean of 0 and a standard deviation of 1 across OECD countries. Higher values on the index suggest that students reported that their most recent mathematics teacher more frequently used cognitive-activation strategies than the most recent mathematics teacher of the average student in OECD countries.

Students were also asked to report how often a series of situations arises during their mathematics lessons. Students' reports on whether these situations arise in every lesson, in most lessons, in some lessons, or never or hardly ever, were used to develop three indices reflecting teachers' use of different strategies to foster student learning: the *index of teacher-directed instruction*, the *index of teachers' student orientation*, and the *index of teachers' use of formative assessment*.

- The *index of teacher-directed instruction* was constructed using students' reports on the frequency with which, in mathematics lessons, the teacher sets clear goals for student learning; the teacher asks students to present their thinking or reasoning at some length; the teacher asks questions to check whether students understood what was taught; and the teacher tells students what they have to learn.

- The *index of teachers' student orientation* was constructed using students' reports on the frequency with which, in mathematics lessons, the teacher gives different work to classmates who have difficulties learning and/or to those who can advance faster; the teacher assigns projects that require at least one week to complete; the teacher has students work in small groups to come up with a joint solution to a problem or task; and the teacher asks students to help plan classroom activities or topics.
- The *index of teachers' use of formative assessment* was constructed using students' reports on the frequency with which, in mathematics lessons, the teacher tells students how well they are doing in mathematics class; the teacher gives students feedback on their strengths and weaknesses in mathematics; and the teacher tells students what they need to do to become better in mathematics.

Results shown in Figure 5.4 and Table 5.8a suggest that teachers' use of cognitive-activation strategies in mathematics courses is associated with better performance in mathematics. In eight countries, the performance difference tends to be particularly wide among girls, while among boys in these countries it is either not associated with performance at all or the association is much weaker than it is among girls. For example, in Germany, a one-unit change in the *index of teachers' use of cognitive-activation strategies* is associated with a difference of 11 points in mathematics among girls but no difference among boys. In Italy, the difference is 10 score points among girls and 5 points among boys, while in Poland it is 17 points among girls and 8 points among boys. By contrast, teachers' use of formative assessment and student orientation in mathematics class was not positively associated with mathematics performance (Tables 5.8b and 5.8c).

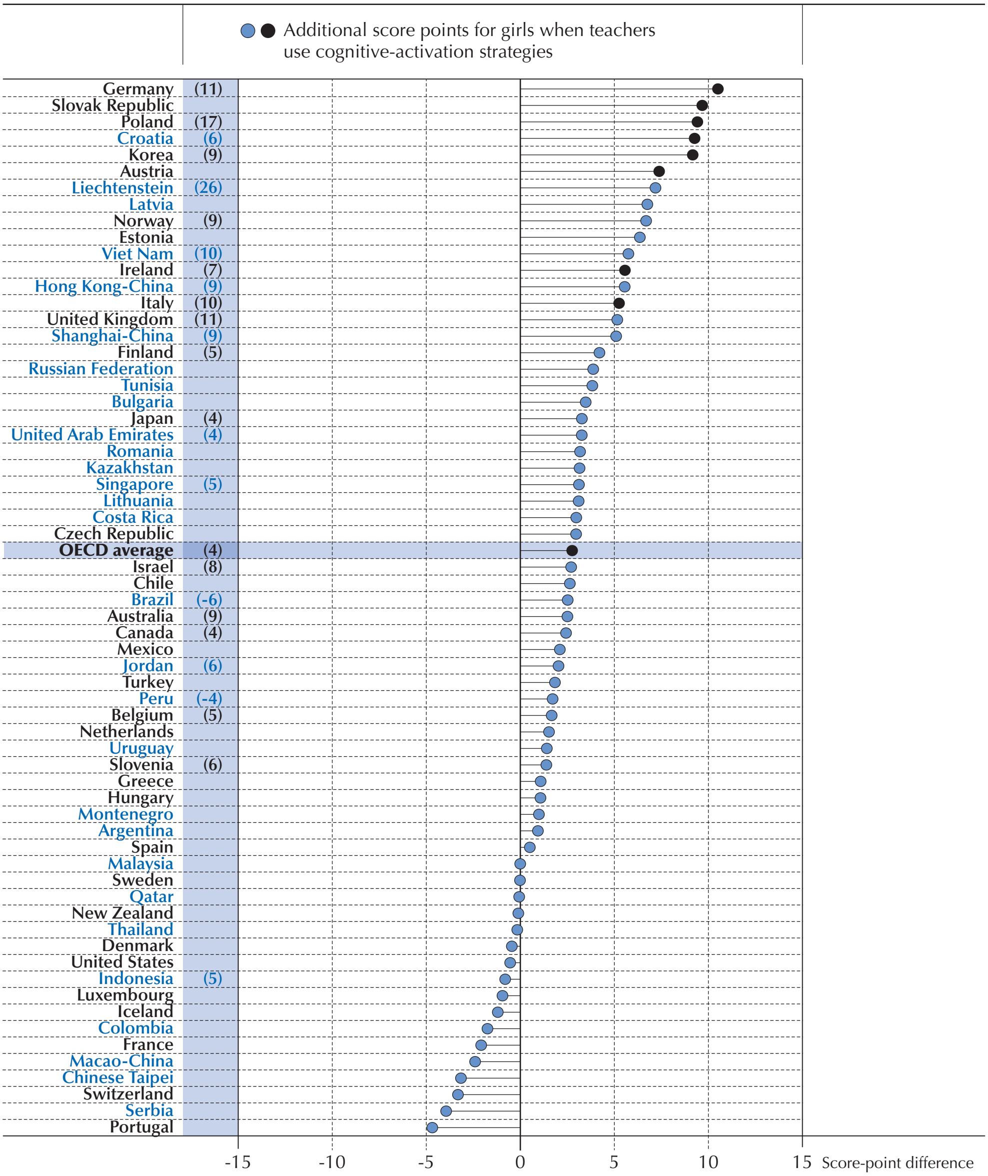
Data from PISA 2009 reveal that teachers' use of practices aimed at stimulating their students' enjoyment of reading – such as asking students the meaning of a text, asking questions that challenge students to get a better understanding of a text, giving students enough time to think about their answers, recommending a book or author to read, encouraging students to express their opinion about a text, helping them relate the stories they read to their own lives, and showing students how the information in texts builds on what they already know – is positively associated with reading achievement in 42 countries and economies. That positive relationship is as strong among girls as it is among boys in all but three countries (Table 5.9).

THE IMPACT OF SOCIAL NORMS

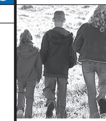
PISA results show how students' attitudes towards learnings, their beliefs in their own abilities, and their parents' encouragement can all influence how they perform at school. But do the broader norms in society – the kinds of practices and attitudes that create and perpetuate gender stereotypes – have an impact on gender differences in student performance? If a society discourages women from working outside the home, for example, will young girls in that society be more likely to abandon their studies or be unwilling to work hard to achieve at school? If boys see that being a star at sports is a more lucrative pursuit than being able to read the contract they hope one day to sign, will they choose to spend their afternoons at the sports field instead of with their books?

■ Figure 5.4 ■

Role of teachers' use of cognitive-activation strategies in narrowing the gender gap in mathematics performance



Notes: Gender differences that are statistically significant are marked in a darker tone.
Statistically significant gender differences in mathematics associated with the *index of teachers' use of cognitive-activation strategies* are indicated next to the country/economy name.
Countries and economies are ranked in descending order of the score points added for girls when teachers use cognitive-activation strategies.
Source: OECD, PISA 2012 Database, Table 5.8a.



Previous studies (Guiso et al., 2008; González de San Román and De la Rica Goiricelaya, 2012) find that countries with greater gender equality – as measured by the level of women's participation in the labour force, women's political empowerment, gender differences in who does the housework, and general attitudes towards women's equality – also tend to have narrower gender gaps in mathematics performance, although still in favour of boys, and wider gender gaps in reading, in favour of girls.

Table 5.10a examines the relationship between the level of gender equality at the country level and student performance by looking at two factors: women's participation in the labour force and an index of gender-equal attitudes in the country. The former uses the rate of labour force participation among women aged 35 to 54 to reflect gender equality in employment within the generation of individuals who are the parents of the students who sat the PISA test in 2012. The latter is an index of attitudes towards women based on data gathered through the World Value Survey.

The World Value Survey is an international survey that examines people's values and beliefs across countries. It was first conducted in 1981 and included six waves in 2014, with a different set of countries surveyed over the various waves. The index measures the level of disagreement with the following four statements that appear in the World Value Survey: "When jobs are scarce, men should have more right to a job than women"; "Being a housewife is just as fulfilling as working for pay"; "Men make better political leaders than women do"; and "A university education is more important for a boy than a girl". The level of disagreement varies between 1 and 4 with higher values indicating more gender-equal attitudes.

An analysis of PISA data from the 41 countries with information on relevant country-level indicators finds that students in more economically developed countries do better in reading, mathematics and science than those in less-developed countries, and this association is particularly strong among boys. After accounting for a country's level of economic development and women's participation in the country's labour force, those countries with greater gender equality tend to perform worse in reading, mathematics and science, but this negative association is less pronounced among girls. At the same time, in countries where a larger proportion of women participates in the labour force, girls perform better in mathematics – even to the extent that the gender gap in mathematics performance narrows considerably – while boys' performance in mathematics is little, if at all, affected.

A wealth of studies have shown a positive association between women's empowerment, gender-equal social norms, labour force participation and economic development (Guiso et al., 2008; González de San Román and De la Rica Goiricelaya, 2012; McDaniel 2012; Nollenberger et al., 2014; OECD, 2012a). The results suggest that the economic, social and political payoffs stemming from greater gender equality and participation of women in the labour market are good for students too; but they also imply that when women assume a more active role outside the home, men are not necessarily filling the void.

For example, previous PISA analyses have revealed the importance of parents reading to their children at an early age (OECD, 2012b). Boys tend to be lower performers in reading and tend to be less likely than girls to read for enjoyment. They may need more encouragement than girls to become better readers. When women play a more active role in the labour market, parents may have less time at home to devote to parent-child activities, such as reading together. In these societies, boys may be most at risk of underperforming, particularly in reading. These results may mean that, even though full gender equality in society and the labour market has yet to be achieved, there is even more work to be done to build societies in which both men and women can play an active role in the labour market *and* be fully engaged in the lives of their children.

The finding that girls' performance in school tends to benefit from greater gender equality in the society as a whole, while boys' performance is little, if at all, affected may mean that standard measures of gender equality reflect women's empowerment rather than truly gender-neutral attitudes and norms. Just because more women work outside the home doesn't mean that men and women (or boys and girls) enjoy equal opportunities – at work, at school or in society, in general. Achieving gender equality in education thus requires more gender-neutral attitudes: encouraging both boys and girls to read more, encouraging both boys and girls to solve mathematics problems, and encouraging both men and women to share care responsibilities at home more equitably (OECD, 2012a).

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.

References

Akerlof, G.A. and **R.E. Kranton** (2002), "Identity and schooling: some lessons for the economics of education", *Journal of Economic Literature,* pp. 1167-1201.

Booth, A.L. and **P. Nolen** (2012), "Gender differences in risk behaviour: Does nurture matter?" *Economic Journal*, Vol. 122, pp. F56-F78.

Clark, A. (1995), "Boys into modern languages: An investigation of the discrepancy in attitudes and performance between boys and girls in modern languages", *Gender and Education*, Vol. 7, pp. 315-325.

Coleman, J. (1961), *The adolescent society,* Free Press, Glencoe, IL.

Correll, S.J. (2001), "Gender and the career choice process: The role of biased self-assessments", *American Journal of Sociology,* Vol. 106/6, pp. 1691-1730.

Crosnoe, R. et al. (2008), "Peer group contexts of girls' and boys' academic experiences", *Child Development*, Vol. 79(1), pp. 139-155.

DiPrete, T. and **C. Buchmann** (2013), *The Rise of Women: The Growing Gender Gap in Education and What it Means for American Schools,* Russell Sage Foundation, New York, NY.

Dornbusch, S.M. (1989), "The sociology of adolescence", *Annual Review of Sociology,* Vol. 15, pp. 233-259.

Francis, B. (2000), *Boys, Girls, and Achievement: Addressing the Classroom Issue,* Routledge/Falmer Press, London.

Guiso, L. et al. (2008), "Culture, gender and math", *Science*, Vol. 320/5880, pp. 1164-1165.

González de San Román, A. and **S. de la Rica Goiricelaya** (2012), "Gender gaps in PISA test scores: The impact of social norms and the mother's transmission of role attitudes", *IZA*, Discussion Paper No. 6338.

Hipkins, R. (2012), "The engaging nature of teaching for competency development", in S.L. Christenson, A.L. Reschly and C. Wylie (eds.), *Handbook of Research on Student Engagement,* Springer, New York, NY, pp. 441-456.

Legewie, J. and **T.A. DiPrete** (2014), "The high school environment and the gender gap in science and engineering", *Sociology of Education*, Vol. 87/4, pp. 259-280.

Legewie, J. and **T.A. DiPrete** (2012), "School context and the gender gap in educational achievement", *American Sociological Review*, Vol. 77/3, pp. 463-485.

McDaniel, A. (2012), "Cross-national gender gaps in educational expectations: The influence of national-level gender ideology and educational systems", *Comparative Education Review*, Vol. 54/1, pp. 27-50.

Nollenberger, N., N. Rodríguez-Planas and **A. Sevilla** (2014) "The math gender gap: The role of culture", *IZA*, Discussion Paper No. 8379.

OECD (2012a), *Closing the Gender Gap: Act Now*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264179370-en.

OECD (2012b), *Let's Read Them a Story! The Parent Factor in Education*, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264176232-en.

Paechter, C. (1998), *Educating the Other: Gender, Power, and Schooling*, Falmer, London.

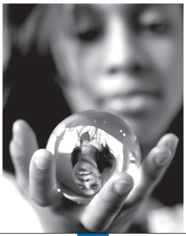
Pahlke, E., J.S. Hyde and **C.M. Allison** (2014), "The effects of single-sex compared with coeducational schooling on students' performance and attitudes: A meta-analysis", *Psychological Bulletin*, Vol. 140/4, pp. 1042-1072.

Smith, M.W. and **J.D. Wilhelm** (2002), *Reading Don't Fix No Chevys: Literacy in the Lives of Young Men*, Heinemann, Portsmouth.

Warrington, M., M. Younger and **J. Williams** (2000), "Students' attitudes, image, and the gender gap", *British Educational Research Journal*, Vol. 26/3, pp. 393-407.

Wigfield, A., J. Cambria and J.S. Eccles (2012), "Motivation in education", in R.M. Ryan (ed.), *The Oxford Handbook of Motivation,* Oxford University Press, New York, NY, pp. 463-478.

Younger, M. and **M. Warrington** (1996), "Differential achievement of girls and boys at GCSE", *British Journal of Sociology of Education,* Vol. 17/3, pp. 299-313.



6

Policies and Practices to Help Boys and Girls Fulfil their Potential

This chapter examines gender gaps in reading and mathematics performance from wider perspectives: across countries and over time. It also discusses the policy implications of the PISA findings that boys tend to underachieve in reading and high-performing girls tend to underachieve in mathematics and some areas of science and problem solving.

An analysis of results from all waves of PISA and the 2012 Survey of Adult Skills[1] suggests that, in general, there is a positive relationship between performance in PISA and the corresponding age group's performance in the Survey of Adult Skills (OECD, 2014a).[2] Countries that had high, middling or low mean scores in a given wave of PISA also tend to have high mean, middling or low mean scores for the corresponding age group in the adult survey. For example, in 2000, 15-year-olds in Finland, Japan, Korea and Sweden performed above average; 12 years later, 26-28 year-olds in these countries also performed above average in the Survey of Adult Skills. Similarly, Austria, Germany, Italy, Poland and Spain performed below average in PISA 2000 and did again in the adult survey for the corresponding age group (OECD, 2014a).

Why does this relationship matter? The Survey of Adult Skills finds that proficiency in literacy – how well people read and understand what they read – is associated with the likelihood of being employed and well-paid. For example, about 57% of those individuals who scored at or below Level 1, the lowest proficiency level in the survey's assessment of literacy, were employed when they took the survey – compared with 79% of those who scored at Level 4 or 5, the highest proficiency levels. Proficiency in literacy is also strongly associated with wages. On average across countries that participated in the survey, the median hourly wage of workers who scored at Level 4 or 5 in literacy proficiency was 61% higher than that of workers scoring at or below Level 1 (OECD, 2013).

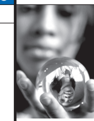
The survey also finds that proficiency in literacy and numeracy is strongly associated with social and emotional well-being. In all countries that participated in the survey, adults who were less proficient in literacy were more likely than highly skilled adults to report poor health, believe that they have little impact on the political process, and not participate in volunteer activities. In most countries, these adults also tended to report that they had little trust in others (OECD, 2013).

The link between reading and mathematics skills and economic and social well-being couldn't be clearer – which makes it all the more urgent that parents and schools work in concert to give boys and girls an equal chance at realising their full potential. Where there are differences in student performance that are related to gender, either boys or girls are not being given that chance.

RELATIONSHIP BETWEEN THE GENDER GAP IN READING AND THE GENDER GAP IN MATHEMATICS

Figure 6.1 illustrates the strong relationship observed across countries between the gender gap in reading and the gender gap in mathematics. Results from PISA 2012 reveal that countries where girls tend to do particularly well in reading are also those where girls tend to do as well as boys in mathematics, or where the gap in mathematics in favour of boys is small. For example, in Finland, girls score 62 points higher in reading than boys, on average, and they perform just as well as boys in mathematics. Similarly, in Iceland, girls score 51 points higher in reading, and they outperform boys in mathematics by 6 points (Tables 1.2a and 1.3a).

By contrast, in countries where the gender gap in reading, in favour of girls, is narrowest, the gender gap in mathematics performance, in favour of boys, is widest. For example, in Chile, girls score 23 points higher than boys in reading, on average, while boys score 25 points higher than

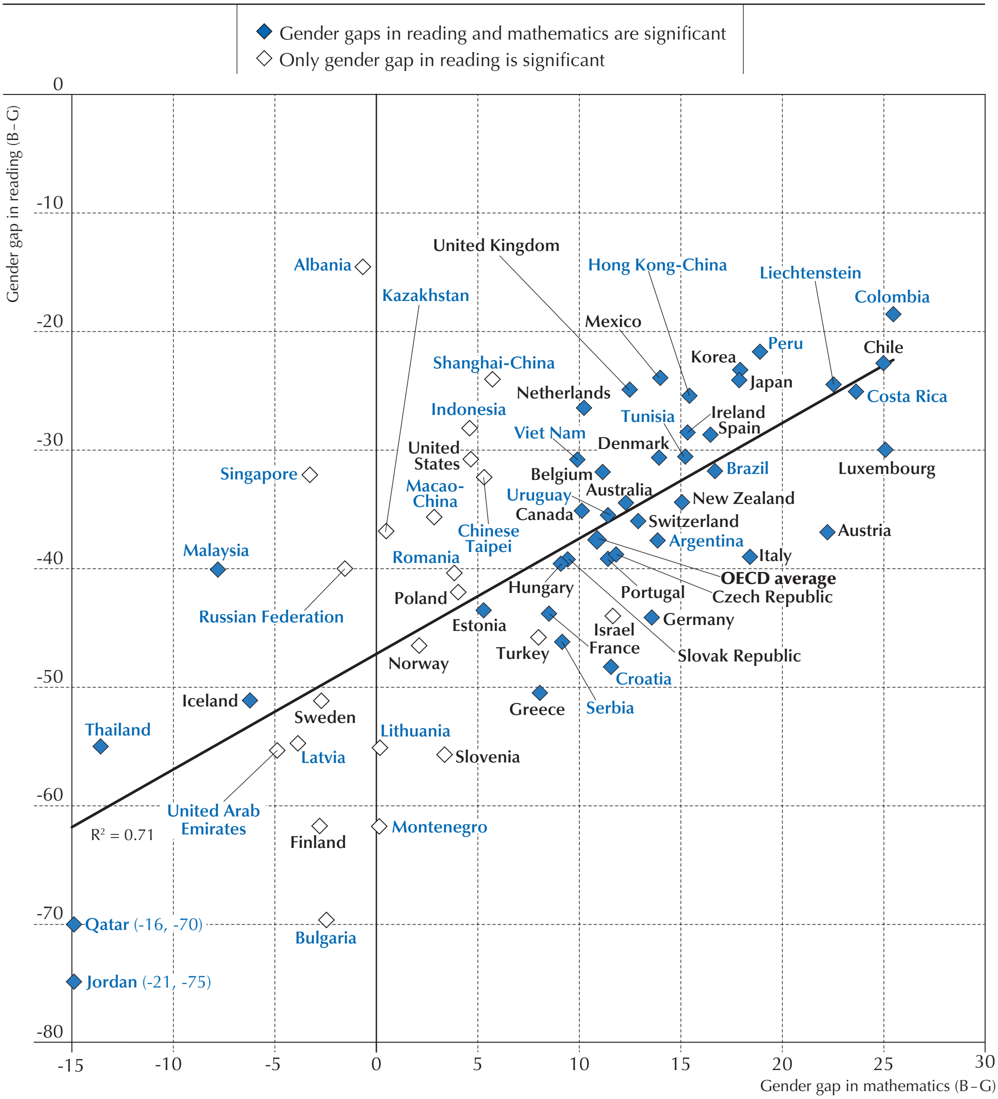


girls in mathematics. East Asian countries and economies, such as Shanghai-China, Singapore and Chinese Taipei, are notable exceptions to this pattern. In these countries, girls do as well as boys in mathematics (both at the average and among the highest-performing students), and the gender gap in reading, in favour of girls, is narrower than the OECD average (Tables 1.2a and 1.3a).

■ Figure 6.1 ■

Cross-country variation in gender gaps in reading and mathematics

Score-point difference between boys and girls

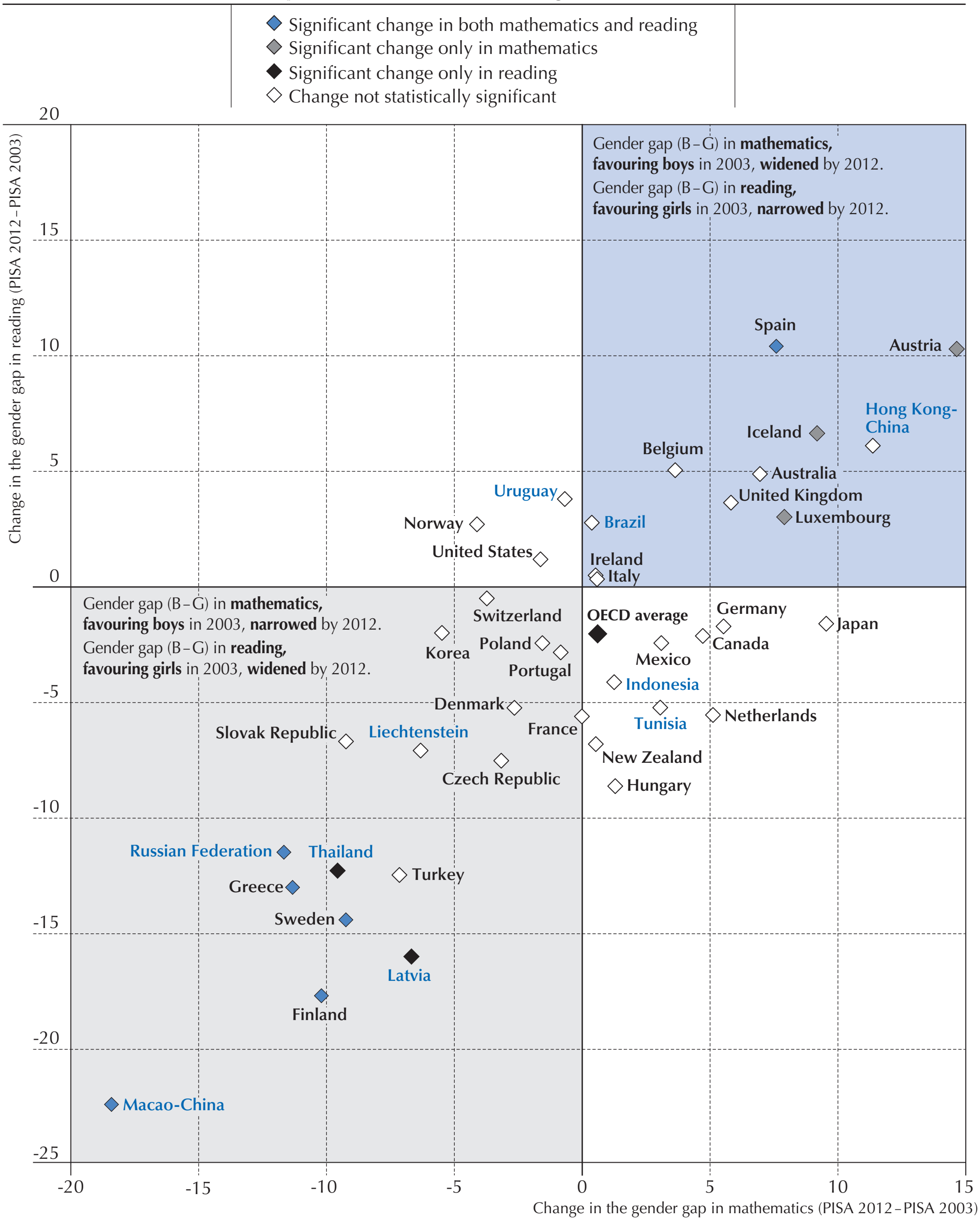


Source: OECD, PISA 2012 Database, Tables 1.2a and 1.3a.

■ Figure 6.2 ■

Trends in gender gaps in reading and mathematics between 2003 and 2012

Score-point difference in reading and mathematics



Source: OECD, PISA 2012 Database, Tables 1.2b and 1.3b.

The data in Figure 6.2 suggest that trends in the gender gap in performance in different subjects are associated. Countries where girls became better readers between 2003 and 2012 are also generally the same countries where girls improved in mathematics during the same period. For example, in Finland, the gender gap in mathematics, in favour of boys, narrowed by 10 score points between 2003 and 2012. Over the same period, the gender gap in reading, in favour of girls, widened by 18 score points. In Greece, between 2003 and 2012, the gender gap in mathematics, in favour of boys, narrowed by 11 score points while the gender gap in reading, in favour of girls, widened by 13 score points. Similarly, in Sweden during the same period, the gender gap in mathematics, in favour of boys, narrowed by 9 score points while the gender gap in reading, in favour of girls, widened by 14 score points. Among partner countries and economies, similar trends were observed in Macao-China and the Russian Federation (Tables 1.2b and 1.3b).

These results, and the evidence developed in the context of Chapters 2 and 3, suggest that, in general, the gender gap in mathematics tends to be narrow when girls are good students in all subjects. But the factors that help to narrow the gender gap in mathematics also tend to enlarge the gender gap in reading, in favour of girls. Are gender gaps a "zero sum game", in which education systems, schools and families have to choose whether to create an environment that promotes either boys' performance or girls' performance; or are there policies and practices that manage to narrow – or eliminate – all gender gaps in performance simultaneously?

POLICY IMPLICATIONS

Results from Chapter 1 suggest that differences in performance among boys or among girls are much wider than differences across the genders. In fact, when it comes to mathematics performance, girls in top-performing countries and economies, such as Hong Kong-China, Shanghai-China, Singapore and Chinese Taipei, perform on a par with their male classmates and attain higher scores than all boys in most other countries and economies around the world. Similarly, while boys underperform in reading, by a large margin, compared to girls in all countries and economies, boys in top-performing education systems score much higher in reading than girls elsewhere. This evidence strongly suggests that gender gaps in academic performance are not determined by innate differences in ability.

Give students a greater choice in what they read

The report identifies clear behavioural differences between boys and girls, and how such differences are associated with performance in different academic subjects. In particular, PISA shows that boys tend to be far less engaged in reading than girls. They are less likely to read for enjoyment every day, they tend to enjoy reading less, are less likely to read fiction, and are less likely to read a range of materials. PISA finds that enjoying reading, reading widely, and reading fiction, in particular, are the factors most closely associated with high performance in reading.

The strong link between reading fiction and high reading performance indicates that some material may be far too complex for weak readers to grasp. Obliging poor readers, who are overwhelmingly boys, to read texts that they may find too challenging – and perhaps uninteresting to them as well – may alienate them from reading altogether.

PISA does not measure students' responses to the *content* of the material they read. However, it is also possible, for example, that if boys were assigned to read fiction they found interesting (the *Harry Potter* series, for example, is popular among both boys and girls) or books about sports stars they admire, they might be more easily persuaded to spend time reading both fiction and long non-fiction, material that they might otherwise reject. What this implies is that, even though reading simpler material may not lead to high proficiency in reading, any reading is better than no reading. To some extent, PISA results support this notion. After accounting for other background characteristics, students who read comic books, magazines and newspapers are better at reading than those who do not read any material.

Efforts to promote reading should thus take into account differences in students' reading preferences as well as differences in students' current reading abilities. Parents and teachers can use comic books, magazines and newspapers to help boys develop the habit of reading for enjoyment. A structured approach that entices disengaged readers with easy and appealing texts, then gradually introduces more complex tasks and texts, could spark boys' interest in reading and ultimately improve their performance.

Boys – and girls too – spend less time reading for enjoyment than they used to. This could threaten efforts to improve reading skills and could exacerbate disparities in reading performance. To break, or at least slow, this downward trend, schools could consider organising book clubs, letting students use school facilities after school hours to access material online, under the supervision of responsible adults, and/or incorporating into school curricula those reading materials that are favourites among students who read for enjoyment, according to PISA results, namely magazines and newspapers.

Allow some video gaming, but homework comes first

The report also reveals that doing homework has an impact on student performance. Students who spend more time doing homework tend to have better results in reading, mathematics and science. Homework helps students practice what they have learned in class and crystallises acquired knowledge into long-term memory. The very process of devising and organising a homework plan can help students develop self-regulation and perseverance, learn how to set goals and sub-goals for themselves, and follow through. It also teaches students about the perils of procrastination when facing binding deadlines.

Boys spend less time than girls doing homework or other independent study set by their teachers. At the same time, boys spend considerably more time than girls playing video games, both one-player games and online collaborative games. PISA shows that moderate video gaming is not associated with poorer performance in school, and may even help students acquire useful skills, such as spatial judgement and the ability to navigate through web-based material. Parents and teachers often chastise boys for the amount of time they devote to gaming and the amount of time they do not devote to doing their homework. Instead, they could forge a "learning contract" with both boys and girls: parents and teachers could allow children to play video games, in moderation, recognising that those games can help children acquire important skills, but children would have to complete their homework too.[3] Excessive video gaming late in the evening can disrupt sleep patterns (King et al., 2013), so it should be avoided.

PISA finds that boys are more likely than girls to arrive late for school. Arriving late disrupts not only the individual student's learning, but that of his or her classmates, too. Parents can help to ensure that their children arrive for school on time – for example, by prohibiting video games late at night – and schools could try to encourage more students to arrive for school on time by, for example, scheduling the most fun activities at the beginning of the day. No matter what subject is taught first in a school day, teachers can use innovative teaching techniques to engage students so that they will be reluctant to arrive late for school and miss the lesson.

Train teachers to be aware of their own gender biases

The report also shows that teachers generally award girls higher marks than boys, given what would be expected after considering their performance in PISA. This practice is particularly apparent in language-of-instruction courses. Girls' better marks may reflect the fact that they tend to be "better students" than boys: they tend to do what is required and expected of them, thanks to better self-regulation skills, and they are more driven to excel in school. In addition, girls appear to be stronger in displaying the knowledge they have acquired (i.e. solving an algebraic equation) than in problem solving, the latter of which is a central component of the PISA test. But this report reveals that the gender gap observed in both school marks and PISA scores is not the same in both language-of-instruction classes and mathematics. The fact that it is much wider in the language-of-instruction courses suggests that teachers may harbour conscious or unconscious stereotyped notions about girls' and boys' strengths and weaknesses in school subjects, and, through the marks they give, reinforce those notions among their students and their students' families. For example, PISA also reveals that parents are more likely to expect their teenage sons rather than their daughters to work in science, technology, engineering and mathematics (STEM) occupations – even when their daughters perform just as well as their male classmates in mathematics, science and reading.

Training teachers to recognise and address any biases they may hold about different groups of students – boys and girls, socio-economically advantaged or disadvantaged students, students from different ethnic or cultural traditions – will help them to become more effective teachers and ensure that all students make the most of their potential. Private-sector companies provide similar training for human resource managers, and research into the results of these programmes suggests that simple training programmes can lead to changes in practices (Diverseo, 2012; Kahneman, 2011).

Disruptive behaviour and lack of engagement with school among boys affects not only the boys themselves, but often the entire class. Teachers may need further training in class management and discipline to ensure that the work of the entire class does not suffer because of the bad behaviour of a few.

Build girls' self-confidence

Crucially, the report finds that girls are under-represented among top-performers in mathematics, science and problem solving, and that girls' lack of self-confidence in and anxiety towards mathematics may be largely responsible for this situation. A wealth of research has examined how self-beliefs are formed and the key role played by both interpersonal and intrapersonal comparisons (Moeller and Marsh, 2013). Students' beliefs about their own competence in mathematics are related to how well they perform compared to their classmates, and also to how well they perform in mathematics compared to their performance in other subjects. Because girls tend to perform so well in reading, they may, unconsciously, believe that they are underperforming in other subjects. As a result, they have less confidence in other subjects, like mathematics, which, in turn, could undermine their performance.

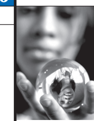
Teachers and parents can stop the corrosive effects of these comparisons and help girls to build their confidence by evaluating girls' actual abilities – noting the tasks they can accomplish relatively easily and those with which they struggle. They can provide positive reinforcement for the work girls do well and offer girls opportunities to "think like scientists" in low-stakes situations, where making mistakes does not have consequences for their marks.

The report also highlights that, in many countries, teachers' use of cognitive-activation strategies in mathematics classes is associated with better performance in the PISA mathematics test, and that the use of such strategies may be particularly beneficial for girls. There is evidence on the role of metacognitive pedagogies in acquiring strong problem-based mathematics skills (Mevarech and Kramarski, 2014). This report suggests that certain methods of teaching mathematics can help narrow the gender gap in performance. For example, PISA reveals that girls in Croatia, Germany, Ireland, Italy, Korea, Poland and the Slovak Republic benefit the most when teachers ask students questions that make them reflect on a given problem; give them problems that require the students to think for an extended time; ask students to decide, on their own, on which procedures to use to solve complex problems; present problems in different contexts so that students know whether they have understood the concepts; help them learn from the mistakes they have made; ask them to explain how they solved a problem; present problems that require students to apply what they have learned in new contexts; and assign problems that can be solved in different ways.

Help students look ahead

As the report notes, schools in many education systems appear ill-equipped to help students make a smooth transition from compulsory education to further education and training or the labour market. On average, boys are more likely than girls to have acquired a set of skills that could help them to navigate the job-search process, to apply for a particular job, and to succeed in job interviews. But a sizeable proportion of both boys and girls appears to be unprepared to take the next steps towards either further education or the labour force. In the large majority of countries, students reported that they had acquired these types of skills outside of school.

Education systems could strengthen their career advice and orientation services by forming consortia across different schools and creating partnerships with local business groups and trade associations, and by inviting parents to offer job-shadowing opportunities and "bring your child to work" programmes. They could also encourage parents to speak to classes, explaining their work and the skills most valued and developed in their jobs. By creating consortia of interested schools, particularly schools serving diverse student populations, local authorities and school principals can ensure that all students, regardless of the socio-economic profile of the school



or the individual student, are exposed to the breadth of opportunities that are available in the local labour market. Partner trade associations, civil society groups and the business community can ensure that students also develop a broader perspective about work, as they will likely be competing in a highly integrated global economy when they ultimately enter the labour market.

PISA reveals that girls generally hold more ambitious career and education expectations than boys. They are more likely to expect to attend and complete university and to work as managers or professionals. However, 15-year-old girls are considerably less likely than 15-year-old boys to expect to work as engineers, mathematicians or computer scientists, even when they score just as well as boys in the PISA mathematics and science tests. This represents a significant loss not only to these careers, but to countries' economies, in general.

Science, technology, engineering and mathematics are the backbone of modern economies. They are integral to health care, infrastructure, energy and the environment. These STEM fields are also the source of innovation, which has been shown to increase productivity in an economy, which, in turn, helps to improve competitiveness, increase exports in high value-added products, and raise standards of living. While science and technology-based innovation cannot be achieved without a STEM-educated workforce (OECD, 2010), research also suggests that an exclusive focus on STEM disciplines in education is too narrow. In fact, businesses rely on a mix of skills to thrive, including workers who are specialised in the arts and humanities. Indeed, innovation, even in STEM sectors, also involves marketing, sales, support services, human-resource management, logistics and procurement – a broad array of knowledge and skills that graduates in the humanities, social sciences and the arts can offer (Hughes et al. 2011).[4]

While advancing STEM education appears to be a common objective in many countries, it remains unclear what approach is best suited to promote STEM skills for economic growth. Generally, proposals for reform of STEM education maintain that because STEM is so important, every student should be given the best-quality STEM education (Atkinson and Mayo, 2010). Greater exposure to these subjects, it is assumed, will prompt more young people to choose STEM careers. But as this report makes clear, unless major efforts are devoted to helping students, particularly girls, overcome their anxiety towards mathematics and their lack of confidence in their own abilities in science and mathematics, then providing even the highest-quality STEM education will do nothing to narrow the gender gap in STEM studies and careers. At the same time, an "all STEM for some" approach, as argued by Atkinson and Mayo, that aims to provide STEM education only to those students who are most interested in and capable of doing well in STEM, runs the risk of reinforcing current gender inequalities and not tapping the vast skills potential among high-achieving girls.

Learn from experience

Analyses of data from the 2012 Survey of Adult Skills reveals that even though 15-year-old boys underachieve in reading compared to girls, by a substantial margin, the gender gap in literacy among 16-29 year-olds is small or non-existent. This partly reflects the fact that the adult survey was delivered on computer, and males, even at age 15, tend to be more proficient using computers than females.[5]

But this advantage cannot explain the striking difference between the reading performance of 15-year-old boys and girls and literacy proficiency among 16-29 year-olds. While 15-year-old boys are considerably less likely to read than girls the same age, there are no gender differences in how much reading or writing young adults do at work or at home. These data suggest that while teenage boys may be less likely than teenage girls to engage in activities that allow them to practice and develop their literacy skills, as they mature they are required to read and write in their work as much as, if not more than, women are. They are also able to choose for themselves the material they want to read, without being told by their parents and teachers what is good and what is not good for them. Thus young men are often able to catch up with, if not surpass, women in literacy skills. These results underscore the importance for families and teachers to understand boys' reading preferences and to suggest reading materials that, while catering to their interests, also gradually build their reading skills.

Notes

1. The Survey of Adult Skills is a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC).

2. But PISA performance isn't destiny; performance can change over subsequent years. As noted in Chapter 4, for example, as boys and girls leave compulsory schooling and enter either further education and training or work, the gap in literacy proficiency narrows considerably.

3. Results from PISA show that homework can perpetuate differences in performance related to socio-economic status. In every country and economy that participated in PISA 2012, socio-economically advantaged students spent more time doing homework or other study required by their teachers than disadvantaged students (OECD [2014b]. Schools and teachers should look for ways to encourage struggling and disadvantaged students to complete their homework. They could, for example, offer to help parents motivate their children to do their homework and provide facilities so that disadvantaged students have a quiet place to complete assigned homework if none is available in their homes.

4. This report does not examine all the factors that may shape gender differences in expectations to enter STEM fields of study and careers. Certainly girls – and boys – choose careers based on various considerations, such as the ability to balance work and family life, as well as relative job standing and wages. PISA does not contain relevant data on students' knowledge about different careers.

5. Maybe because males find computers more enjoyable and therefore put more effort in completing the assessment; maybe because digital reading requires proficiency in a different set of skills.

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.

References

Atkinson, R. and **M. Mayo** (2010), *Refueling the U.S. Innovation Economy: Fresh Approaches to Science, technology, Engineering and Mathematics (STEM) Education*, The Information Technology & Innovation Foundation, Washington, DC, available at www.itif.org/files/2010-refueling-innovation-economy.pdf.

Beilock, S. et al. (2010), "Female teachers' math anxiety affects girls' math achievement" *Proceedings of the National Academy of Sciences,* Vol. 107/5, pp. 1860-1863.

Cho, I. (2012), "The effect of teacher-student gender matching: Evidence from OECD countries" *Economics of Education Review*, Vol. 31, pp. 54-67.

Dee, T. S. (2007), "Teachers and the gender gaps in student achievement", *Journal of Human Resources*, Vol. 42/3, pp. 528.

Diverseo (2012), "Women in leadership: The unconscious sealing" *Women's Forum white paper* available at http://diverseo.com/share/documents/Diverseo-Unconscious-Sealing-Women-in-Leadership.pdf.

European Commission (2012), *Exchange of Good Practices on Gender Equality. Gender Training in Education*, Portugal, 18-19 October 2012, conference summary report.

European Commission (2010), *Gender differences in educational outcomes: Study on Measures Taken and the Current Situation in Europe*, Education, Audio-visual and Culture Executive Agency, available at http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/120en.pdf.

Hill, C., C. Corbett and **A. St Rose** (2010), *Why So Few? Women in Science, Technology, Engineering, and Mathematics*, American Association of University Women, Washington, DC.

Hughes, A. et al. (2011), *Hidden Connections : Knowledge Exchange between the Arts and Humanities and the Private, Public and Third Sectors,* Arts and Humanities Research Council, and the Centre for Business Research, Cambridge, United Kingdom.

Ipsos Reid (2010), "Canadian Youth Science Monitor", Canada Foundation for Innovation, May.

Kahneman, D. (2011), *Thinking, Fast and Slow*, Farrar, Straus and Giroux, New York, NY.

King, D.L. et al. (2013), "The impact of prolonged violent video-gaming on adolescent sleep: An experimental study", *Journal of Sleep Research*, Vol. 2, pp. 137-143.

Legewie, J. and **T. DiPrete** (2012), "School Context and the Gender Gap in Educational Achievement", *American Sociological Review*, Vol. 77/3, pp. 463-485.

Mevarech, Z. and **B. Kramarski** (2014), *Critical Maths for Innovative Societies: The Role of Metacognitive Pedagogies*, Educational Research and Innovation, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264223561-en.

Moeller, J. and **H.W. Marsh** (2013), "Dimensional comparison theory", *Psychological Review*, Vol. 120/3, pp. 544-560.

OECD (2014a), "Do countries with higher mean performance in PISA maintain their lead as students age?", *PISA in Focus,* No. 45, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jxszm0bzxnn-en.

OECD (2014b), "Does homework perpetuate inequities in education?", *PISA in Focus,* No. 46, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jxrhqhtx2xt-en.

OECD (2013), *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264204256-en.

OECD (2012), *Education at a Glance 2012: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2012-en.

OECD (2011), *Lessons from PISA for the United States*, Strong Performers and Successful Reformers in Education, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264096660-en.

OECD (2010), *Measuring Innovation: A New Perspective*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264059474-en.

OECD (2008), *Encouraging Student Interest in Science and Technology Studies*, Global Science Forum, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264040892-en.

Parvin, J. and **C. Porter** (2008), *Learning to Love Science: Harnessing Children's Scientific Imagination*, Report from the Chemical Industry Education Centre, University of York, United Kingdom.

Salvi Del Pero, A. and **A. Bytchkova** (2013), "A bird's eye view of gender differences in education in OECD countries", *OECD Social, Employment and Migration Working Papers*, No. 149, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k40k706tmtb-en.

Annex A

WHAT SOME COUNTRIES ARE DOING TO PROMOTE GENDER EQUALITY IN EDUCATION

ANNEX A
WHAT SOME COUNTRIES ARE DOING TO PROMOTE GENDER EQUALITY IN EDUCATION

In 2014, the OECD circulated a *Questionnaire on Policies to Promote Gender Equality in Education* to all PISA-participating countries and economies. The questionnaire gathered information on publicly funded policies, programmes and initiatives that address gender discrimination and stereotyping in education. The questionnaire asked countries to provide information on the objectives and characteristics of each initiative, the amount of public funding provided, and the duration of the programme. Figure A.1 lists the types of policies surveyed.

■ Figure A.1 ■

OECD Questionnaire on Policies to Promote Gender Equality in Education: Surveyed policies

SECTION 1	▪ Policies for keeping boys and girls at school and prevent dropout.
SECTION 2	▪ Policies for teachers to promote teaching and school practices that address gender discrimination and stereotyping.
	▪ Policies to remove gender discrimination and stereotypes from students' textbooks.
	▪ Policies to promote the development of stronger reading habits among boys.
	▪ Policies to make arts, humanities, social sciences and caring sectors attractive for boys.
	▪ Policies to make the study of science, technology, engineering and mathematics (STEM) attractive for girls in primary and secondary education.
	▪ Policies to promote women into STEM studies in higher education.
SECTION 3	▪ Policies to promote male teachers up to secondary education.
	▪ Policies to promote female teachers in tertiary education.

Source: OECD Questionnaire on Policies to Promote Gender Equality in Education.

The questionnaire did not focus on the issue of gender equality in access to school, as school participation is now compulsory up to around age 16 in most PISA-participating countries and economies. Gender-equality provisions in general law and in anti-discrimination law, policies to tackle gender-based violence and harassment in schools, and policies to raise awareness of gender-equality issues among parents are also not addressed.

The response rate to the questionnaire was limited; only 12 PISA-participating countries responded: Australia,[1] Belgium, Brazil, Canada, the Czech Republic, Germany, the Netherlands, Poland, Scotland (United Kingdom), Sweden, Switzerland and the United States. The Czech Republic, Poland and Scotland (United Kingdom) reported no support for any of the policies included in the questionnaire. The Netherlands is also not discussed in detail because, while the country provides support for some of the policies included in the survey, it did not submit information about them. Therefore, the examples cited below cannot be considered as representative of the policies and practices implemented by PISA-participating countries and economies in general, but rather as examples of the approaches taken by different education systems.

In some of the surveyed countries, gender equality in education is interpreted as equal treatment of girls and boys. In these cases, policy prescriptions mostly focus on eliminating discrimination and in providing teaching tailored to individual students, regardless of their gender. Equal treatment in this context does not mean that countries adopt a uniform approach to education; rather, it means that gender is not a factor shaping how schools attempt to provide high-quality education to individual students.

Other countries adopt policies differentiated by gender with the aim of achieving gender equality as an outcome. This approach reflects the idea that, even in the absence of outright discrimination, stereotyped expectations of boys' and girls' attitudes towards specific school subjects can negatively affect their performance in those subjects and their choices for further education. Among the countries that responded to the OECD questionnaire, the Czech Republic, Poland, Sweden and Scotland (United Kingdom) appear to follow the first approach, while Belgium, Brazil, Canada, Germany, the Netherlands, Sweden, Switzerland and the United States seem to follow the second approach. A study by the European Commission reports that other countries adopting a gender-differentiated approach in Europe include Austria, Finland, France, Iceland, Ireland, Liechtenstein, Luxembourg, Norway and Slovenia (European Commission, 2010). Because of its multiple education systems in different states and territories, and its mix of public and private education, Australia uses a combination of the two approaches across education systems and policy areas.

Surveyed countries that adopt the equal treatment approach do not implement policies specifically targeted at boys and/or girls – the policies targeted by the questionnaire. Among countries that adopt a gender-differentiated approach to education policies, some countries embed the gender-equality objective among wider goals of non-discrimination and equality of outcomes, without establishing more specific programmes. The rest of the countries provide support to various types of more specific gender-differentiated programmes. The activities included in these programmes are generally designed by the participating institutions, within established guidelines. Only in a few cases are educational institutions required to participate in these programmes; rarely are institutions required to adopt policy actions whose content is designed by policy makers.

In general, this review of policy practices, while limited to a small group of PISA-participating countries, suggests that programmes are often temporary and not replicated. Participation in the programmes tends to be voluntary. These types of programmes could be launched as part of a more systematic evaluation to better assess their effectiveness. Randomised control trials are fairly easily applied in education and could be one way forward.

Policies to keep girls and boys in school

As noted earlier, in many countries, girls are less likely than boys to drop out of upper secondary education, girls are more likely than boys to complete their upper secondary education within the stipulated time, and young women attain higher levels of education than young men.

The OECD Questionnaire on Policies to Promote Gender Equality in Education asked whether countries have policies to prevent dropout to keep boys and girls in school. Among the countries surveyed, Australia, Belgium, Brazil, Canada and the United States reported that they have such policies. These policies may include monitoring students who are considered more at risk of not graduating, providing mentors for students in difficulty, and offering flexible learning solutions for disengaged students. In **Australia's Northern Territory**, girls' academies have been established to strengthen engagement and increase girls' attendance at school and completion of year 12 (Clontarf Academies and Girls Academies).

Despite clear gender patterns in educational attainment and school completion rates, none of the surveyed countries implements system-level, gender-specific policies to address inequality in attainment rates. In **Australia**, many schools establish and operate their own gender-specific programmes to meet the needs of their students.

Gender equality in performance and field-of-study choice

As earlier chapters discussed, young women are much less likely than men to pursue certain science, technology, engineering and mathematics (STEM) fields in their education or as a career, while young men are less likely than women to graduate from the fields of health, welfare and the humanities. The longitudinal component of the PISA surveys conducted in Australia, Canada, the Czech Republic, Denmark, Switzerland and Uruguay show that performance in mathematics, science and reading is strongly correlated to the subjects students choose to study in post-secondary education (Salvi Del Pero and Bytchkova, 2013). But the role of performance in this relationship is mediated by gender differences in motivation, enjoyment of these subjects, and students' belief in their own abilities (self-concept) in these subjects.

A number of studies (Ipsos Reid, 2010; Parvin and Porter, 2008; OECD, 2008) reveal the importance of teachers' attitudes in shaping students' dispositions towards school subjects. At the same time, students' interest in the sciences appears to decline significantly as they grow up. Given these findings, it is important for educators to provide an engaging context for these subjects early on, and throughout all levels of education, to address gender-related attitudes in the classroom, and to introduce gender-neutral concepts in teaching material.

Various studies (European Commission, 2010; Hill et al., 2010; OECD, 2008) highlight the importance of career opportunities in generating interest among students, especially among students who are under-represented in certain fields. Raising the profile of career opportunities and role models, and improving the work-life balance, particularly in STEM fields, can help to promote greater gender equality in all fields of study.

Teaching material and practices

Since the language and images used in school textbooks and teaching materials influence students' perceptions of social norms, these materials should avoid conveying a stereotyped representation of the role of men and women. Research has shown that men appear more often and in a wider set of roles as workers, whereas women are often depicted in domestic and "romantic" roles (European Commission, 2010). Teachers' attitudes are also essential in shaping students' self-image. Even when teachers believe students are, in principle, equally proficient in school subjects, they may unconsciously treat boys and girls differently, which can have a profound effect on students' behaviour.

Some countries have programmes in place to help teachers become more aware of gender-sensitive teaching practices. In **Brazil**, for example, the 2004 National Plan of Policies for Women calls for an education system that does not reproduce stereotypes based on gender, race and ethnicity. As part of this goal, the Plan specifically calls for textbooks to be free of discriminatory content.

Some countries support programmes to review teaching materials and practices to ensure that they are free of gender stereotypes. In 2012, **Germany** launched a training tool to help eradicate stereotypes based on gender, culture and religion in textbooks. In the **French Community of Belgium**, the Direction of Equal Opportunity and the school inspectorate have produced a manual[2] to help education providers detect gender stereotypes in textbooks (up to upper secondary education). The Department of Education of **Alberta, Canada** has produced guidelines to help education staff to review educational resources to ensure that they foster diversity, including gender diversity. Through the Women's Educational Equity Act, the **United States** Department of Education has supported research and development of innovative curricula and teaching and learning strategies to promote gender equality. Washington and Alaska are two states that require that local school districts eliminate gender bias from their instructional materials.

Training tools and programmes have also been developed to help teachers eliminate gender stereotypes in their teaching practices. Among programmes to promote gender equality in school, **Sweden** offers gender-awareness training to teachers, reflecting the gender equality objective in the curriculum. **The French Community of Belgium** funds a website that provides tools to help education staff address gender stereotypes in their work.

The **Flemish Community of Belgium** also offers educational tools to address gender stereotypes in education. These include the "Gender click for boys", an interactive website[3] targeting boys and girls in upper secondary school that helps raise awareness of stereotypes about men, and the "Gender click in pre-school", a brochure on how to address gender stereotyping among pre-schoolers. In the **United States**, grants are allocated, under the Women's Educational Equity Act, to training programmes for teachers and other school personnel to encourage gender equality in the classroom. The **state of Queensland in Australia** supports online courses on inclusive education, and **Switzerland** provides funding for programmes, targeted at teachers, students and school principals, to reduce gender stereotypes in vocational education and training. In **Brazil**, the "Inclusive Education Programme" was expanded in 2011 to include support for teacher training to help teachers promote diversity, including gender diversity, in primary to upper secondary education.

Encouraging boys to read

When students can't read well, they struggle in other school subjects too. Helping girls and boys to develop the habit of reading for pleasure pays dividends throughout students' school years and far beyond. Yet many boys do not read for enjoyment and are poor readers.

Some countries support specific initiatives to foster better reading habits among students, particularly boys. The "Lesestart" programme in **Germany** distributes books and reading guides to children aged one to three, in co-operation with paediatricians and local libraries. Various Australian states and territories offer programmes to encourage good reading habits. Some of these initiatives aim to improve reading skills by challenging and encouraging students to read more, while others focus on raising awareness of the benefits of reading among parents and encouraging them to participate in reading activities with their children. The **Australian state of Victoria** funds a programme, specifically targeted at boys, called "Boys, Blokes, Books & Bytes" that promotes learning styles that are appealing to boys, and involves adult men as positive role models and reading partners.

In **Sweden**, the National Agency for Education offers the "Boost for reading and writing development", a programme to increase students' reading comprehension and writing skills by developing and strengthening the quality of teaching. The programme is based on peer learning, as teachers learn from and with each other with the support of a tutor. Once fully developed, the programme will be offered to teachers from pre-school to upper secondary school.

In the **United States**, the White House initiative "My Brother's Keeper" connects boys and young men of colour with mentors at five key stages – one of which is early literacy – on the path to adulthood. New York City's Young Men's Initiative includes reading and math classes for young black and Latino men who are not yet ready to take the General Education Development (high school equivalency) test.

Developing interest in school subjects and careers, early childhood to upper secondary education

Many countries use career guidance for students, awareness-raising campaigns, contests and competitions to stimulate students' interest in a wider set of academic subjects and careers than they might otherwise consider. National Boys' Days and Girls' Days are organised in several countries, including **Belgium, Germany** and **Switzerland**, among countries surveyed in the *OECD Questionnaire on Policies to Promote Gender Equality in Education*. As part of these programmes, universities and businesses usually invite students to spend a day on their premises and learn more about academic degrees and occupations in sectors in which their gender is under-represented. In the **French Community of Belgium**, boys' and girls' days are preceded by discussions about gender issues during class.

There are also various programmes that, in different ways, promote interest in the study of STEM subjects among female students. In the **United States**, the Department of Education's "Race to the Top" programme[4] prioritises improving STEM achievement overall and within under-represented groups – including women and girls – in awarding grants to states. The same approach is used in the Department of Education's "Investing in Innovation" programme, which focuses on increasing the number of individuals from groups traditionally under-represented in STEM – including minorities, individuals with disabilities, and women – among those who teach STEM subjects, and provide them with high-quality preparation and professional development.

In **Canada**, two regions support programmes specifically aimed at promoting non-traditional jobs among girls. The "Futures in Skilled Trades and Technology Programme" supports greater participation of women in skilled trades in the Newfoundland and Labrador Province by piloting modules targeted at girls in grade school. The Ontario "Youth Apprenticeship Programme" reserves some of its funding to promote skilled trades among women through conferences and hands-on activities.

As one of four key elements under its "Restoring the focus on STEM in schools" initiative, the **Australian government** is expanding summer schools for STEM students with the aim of increasing the number of girls and disadvantaged students participating in these activities.

Other organisations operating in STEM fields can also support programmes to attract more talent, particularly female talent. The National Aeronautics and Space Administration (NASA) in the **United States** has two programmes that focus on girls. Through the NASA/Girls Scouts of the USA partnership, NASA scientists provide training sessions, led by NASA scientists, for girl scouts. Some 100 000 girls have participated in these sessions to date. Under the "NASA G.I.R.L.S" programme, female NASA professionals provide online lessons in STEM fields to girls selected through a competitive process. Surveyed countries support many other programmes that foster interest in STEM careers, but these are not specifically targeted to women.

Some countries also support initiatives to attract interest among male students in female-dominated professions. **Germany**, for example, funds a nation-wide network and information platform to support gender-sensitive career and life orientation for boys through the programme "New Paths for Boys and Boys' Day". The programme provides information and material to education and social work professionals, career advisers, human resource teams, education and training specialists, and parents. Nationwide conferences and meetings are also organised to facilitate exchanges between researchers and practitioners.

Developing interest in school subjects and careers, tertiary education

In many countries, universities and other higher education institutions sponsor programmes to attract more women to STEM subjects and more men to the fields of education, health and welfare. Some of these programmes involve monitoring the gender composition of students and teaching staff, others aim to improve work-life balance in these fields, and still others focus on offering financial support to students from demographic groups that are under-represented in the fields.

In **Switzerland**, the seven public Universities of Applied Sciences are required to submit action plans to address gender inequality in subject choice (*Chancengleichheit von Frauen und Männern an den Fachhochschulen programme*). The programmes address gender balance among students – and among teachers – and often also include actions to improve work-life balance. The universities fund the programmes themselves and receive a matching contribution from the federal government. The federal government evaluates the programme based on a number of objective measures, outlined in the action plan, such as the proportion of male and female students by field of study and degree level.

Universities in the **French Community of Belgium** are also asked to monitor gender equality within their institution, covering such issues as the gender composition of students, teachers and staff; the policies in place to promote gender equality; and how gender issues are addressed in teaching and research. In the **United States**, the National Science Foundation plans to expand the right to delay or suspend their grants to researchers who need to take parental or family leave to help eliminate some of the barriers to women's

advancement and retention in STEM careers. The **Australian Research Council** provides paid maternity leave and part-time appointments for all fellowships. It also introduced selection criteria that help applicants whose careers have been interrupted because of childbirth and caring responsibilities.

Other programmes provide research funds or fellowships to support female students and researchers in STEM fields. In the **United States**, the National Science Foundation's ADVANCE programme provides research grants to projects that specifically aim to increase the participation and advancement of women in STEM academic careers. In **Queensland, Australia**, scholarships are made available to women studying in priority fields, such as agricultural and environmental studies, engineering and information technology. The **Australian** Research Council allocates at least two Australian Laureate Fellowships to women researchers, with recipients awarded additional funding to promote women in research and mentor female researchers who are just starting out in their careers. A current fellowship recipient has recently launched the "Science 50:50" campaign to increase the participation of girls in science and technology through internship opportunities, an innovation scholarship, school visits and online resources.

In **Germany**, the National Pact for Women in STEM Careers (Go MINT) aims to encourage more girls and women to pursue training, university degrees and careers in STEM fields. It presents positive role models in these areas of work and attracts numerous partners from industry, science, research, politics and the media.

The White House's Educate to Innovate Campaign (**United States**) aims to expand STEM education and career opportunities, in part by broadening the participation of under-represented groups, including women. The initiative works through public-private partnerships between the federal government and businesses, foundations, non-profit organisations, and science and engineering societies. Besides raising funds for research and improving the quality of teaching in science, the goal of the initiative is to appoint female role models to lead the initiative and reach out to students. Many of the women who serve as role models for the Educate to Innovate Campaign also serve as role models in the Women in STEM Speakers Bureau, which engages women scientists at the top of their field to spark interest in STEM subjects among girls in grades 6 through 12.

Some countries also use mentoring programmes to support women in STEM fields in tertiary education. The **United States** Department of Energy, for example, offers mentoring to female undergraduate STEM students with female employees who specialised in the relevant subject. In **Ontario, Canada**, women in skilled trades or information and communications technology offer gender-sensitive classes and on-the-job training to disadvantaged women.

Some countries surveyed in the *OECD Questionnaire on Policies to Promote Gender Equality in Education* reported that they implement programmes that focus on promoting research on gender equality. The research activity is often not confined to studying gender equality in education, but extends to employment and economic empowerment more generally. Examples of initiatives to support research on promoting gender equality in education in the **United States** include the Research on Education and Learning programme, sponsored by the National Science Foundation, to facilitate research on learning and teaching practices in STEM education, and research financed by the National Institutes of Health to understand the factors that influence the careers of women in biomedical and behavioural science and engineering. In **Brazil**, the programme *Premio Construindo a Igualdade de Genero* provides funding for research on discrimination, including gender discrimination. **Germany**'s Ministry of Education also supports research on how to promote women to the highest level in science, scientific research and the economy.

Gender equality among teachers and researchers

In OECD countries, the teaching profession, up to secondary education, is dominated by women. On average across OECD countries, about two out of three teachers and academic staff members are women (OECD, 2012), but the share of women declines as the level of education increases. At the tertiary level,

most teachers are men. Some 97% of teachers in early childhood education are women, as are 83% of teachers in primary education, 68% of teachers in lower secondary education, 56% of teachers in upper secondary education, and 41% of teachers at the tertiary level (Salvi Del Pero and Bytchkova, 2013).

A number of the countries that participated in the *OECD Questionnaire on Policies to Promote Gender Equality in Education* indicated that they have developed specific policies to improve the gender balance in the teaching profession at the tertiary level. Some countries have also adopted policies to increase the representation of men in early childhood and primary education.

In **Switzerland**, the programme *Chancengleichheit von Frauen und Männern an den Fachhochschulen*, supports universities in their efforts to achieve gender equality in their teaching staff. In order to increase the number of female professors in higher education, **Germany**'s Federal Ministry of Education and Research, in collaboration with regional authorities, launched a Programme for Women Professors that focuses on increasing the number of women in leadership positions and improving the work-life balance. Almost two-thirds of all public higher education institutions in Germany have submitted an equality policy and 260 professorships have been financed.

In addition, **Germany**'s *Mehr Männer in Kitas* ("More Men in Early Childhood Education and Care") project aims to increase the number of men working in this field. The initiative tries to encourage boys and men (at all levels of education, from lower secondary to advanced research programmes) to make career choices based on their personal interests and abilities rather than on gender stereotypes. The programme offers strategic counselling to political decision makers and service providers, research, monitoring, and dissemination of information. In 2013, **Sweden** launched a national information campaign to encourage men to consider careers in pre-school education. The campaign was organised by the National Agency for Education which also organised conferences discussing related good practices. The **Flemish Community of Belgium** also provided funding between 2008 and 2011 to attract under-represented groups, such as men, students with an immigrant background, and students with disabilities, to the teaching profession.

Notes

1. The information provided by Australia does not include policies adopted by New South Wales, the Northern Territory and the Australian Capital Territory.

2. Fédération Wallonie-Bruxelles, *Sexes et Manuel. Promouvoir l'égalité dans les manuels scolaires*, www.egalite.cfwb.be/index.php?id=9454.

3. www.genderklikvoorjongens.be and www.genderatwork.be/wp-content/uploads/GENDERKLIKvoorWEB2.pdf.

4. The main priorities of the United States Department of Education's Race to the Top programme are developing rigorous standards and better assessments; supporting effective teachers and school leaders; providing schools, teachers, and parents with student progress data by adopting better data systems; and increasing resources and focus to implement programmes with the aim of improving achievement in the lowest-performing schools.

References

European Commission (2010), *Gender differences in educational outcomes: Study on Measures Taken and the Current Situation in Europe,* Education, Audio-visual and Culture Executive Agency, available at http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/120en.pdf.

Hill, C., C. Corbett and **A. St Rose** (2010), *Why So Few? Women in Science, Technology, Engineering, and Mathematics,* American Association of University Women, Washington, DC.

Ipsos Reid (2010), "Canadian Youth Science Monitor", Canada Foundation for Innovation, May.

OECD (2012), *Closing the Gender Gap: Act Now,* OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264179370-en.

OECD (2008), *Encouraging Student Interest in Science and Technology Studies,* Global Science Forum, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264040892-en.

Parvin, J. and **C. Porter** (2008), *Learning to Love Science: Harnessing Children's Scientific Imagination,* Report from the Chemical Industry Education Centre, University of York, United Kingdom.

Salvi Del Pero, A. and **A. Bytchkova** (2013), "A bird's eye view of gender differences in education in OECD countries", *OECD Social, Employment and Migration Working Papers,* No. 149, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k40k706tmtb-en.

Annex B

LIST OF TABLES AVAILABLE ON LINE

ANNEX B

LIST OF TABLES AVAILABLE ON LINE

The following tables are available in electronic form only at www.oecd.org/pisa.

Chapter 1 Emerging gender gaps in education

Chapter 2 Tackling underperformance among boys

...

...

Chapter 3 Girls' lack of self-confidence

Chapter 4 Expectations and reality for school-leavers

...

These tables, as well as additional material, may be found at: www.oecd.org/pisa.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where governments work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Union takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

OECD PUBLISHING, 2, rue André-Pascal, 75775 PARIS CEDEX 16
(98 2015 01 1P) ISBN 978-92-64-23002-6 – 2015

The ABC of Gender Equality in Education

APTITUDE, BEHAVIOUR, CONFIDENCE

Many countries have been successful in closing gender gaps in learning outcomes. But even when boys and girls are equally proficient in mathematics and science, their attitudes towards learning and aspirations for their future are markedly different – and that has a significant impact on their decision to pursue further education and on their choice of career.

The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence tries to determine why 15-year-old boys are more likely than girls, on average, to be overall low achievers, and why high-performing 15-year-old girls underachieve in mathematics, science and problem solving compared to high-achieving boys. As the evidence in the report makes clear, gender disparities in school performance stem from students' attitudes towards learning and their behaviour in school, from how they choose to spend their leisure time, and from the confidence they have – or do not have – in their own abilities as students.

Contents

Consult this publication on line at: ***http://dx.doi.org/10.1787/9789264229945-en***

This work is published on the *OECD iLibrary,* which gathers all OECD books, periodicals and statistical databases.
Visit ***www.oecd-ilibrary.org*** and do not hesitate to contact us for more information.

2015

OECD*publishing*
www.oecd.org/publishing

ISBN 978-92-64-23002-6
98 2015 01 1P