4

Closing the Gap? Enhancing the Performance of Socio-Economically Disadvantaged Students

INTRODUCTION

Chapters 2 and 3 analysed and compared different groups of socio-economically disadvantaged students defined by their performance on the PISA science scale. Chapter 2 classified them according to their performance and studied the main individual characteristics of two groups: resilient students (high achievers) and low achievers. Chapter 3 analysed whether differences in approaches to learning, hours spent and courses taken to learn science and in the types of schools disadvantaged students attend are associated with differences in performance and with an increased likelihood that disadvantaged students will be resilient.

This chapter compares socio-economically disadvantaged students with their more advantaged peers. In particular, it examines whether factors associated with better performance differ for socio-economically advantaged and disadvantaged students. The chapter analyses the same factors that were examined in Chapter 3. The central goal of this chapter is to assess whether these factors play a differential role in promoting performance improvements among disadvantaged students and by doing so to identify which policies may help disadvantaged students close their performance gap with students from more advantaged backgrounds.

The chapter presents results based on regression models estimating the change in the PISA science score that is associated with a one unit change in approaches to learning, hours and courses and school characteristics while controlling for gender, immigrant background, language spoken at home, socio-economic background, grade attended and the socio-economic background of the average student attending the same school as the respondent.[1]

MODELS OF STUDENT RESILIENCE

A crucial issue for school administrators and policy makers is to understand the role different sets of factors play in helping disadvantaged students overcome the adverse circumstances determined by their socio-economic background. Relevant educational factors highlighted by the literature include: student motivation and approaches to learning and the type of school students attend. The literature identifies two potential mechanisms through which educational resources may contribute to successful outcomes for students who are at a high risk of performing poorly at school (Luthar *et al.*, 2000; Schoon, 2006).

The first mechanism is summarised by the "cumulative effects model" (Masten *et al.*, 1990; Fergusson and Horwood, 2003) which predicts that the contribution of resources students can rely on to excel at school is independent of the circumstances of individual students. The cumulative effects model therefore suggests that students who are at a high risk of performing poorly at school and students who face no such risk will enjoy a similar benefit from possessing resources that promote academic performance.

The second mechanism is summarised by the "protective model" (Garmezy *et al.*, 1984; Rutter, 1985; Rutter, 1987). This model predicts that the contribution of resources students can rely on to excel at school depends on the circumstances of individual students. It suggests that students who are at a high risk of performing poorly at school benefit more from resources that promote academic performance than students who face no such risk.

The analyses developed in this chapter are aimed at: *i*) assessing whether the following three sets of factors – approaches to learning, hours and courses and learning environment at school – contribute to improving students' performance in the PISA science assessment and if so, *ii*) whether the relationship follows the cumulative effects model or the protective model.

The rest of the chapter is structured as follows: for each of the three sets of factors considered, the chapter first identifies the overall association each of these has with performance and then explores whether such associations are stronger for disadvantaged students.

STUDENT APPROACHES TO LEARNING

Disadvantaged students tend to have less positive attitudes towards science and themselves, engage less in science activities, feel less prepared for science careers, attend fewer science courses and spend less time in science lessons at school (see Tables 4.1a and 4.2a). For example, disadvantaged students report being less interested in science and having lower levels of self-efficacy than their more advantaged peers in every OECD country and in most partner countries and economies. The differences in the extent to which disadvantaged students and their more advantaged peers report having low levels of instrumental motivation to learn science, participation in science-related activities, self-concept and information on science-related careers, as well as enrolment in fewer science courses and spending less time in science lessons at school are also significant in most OECD and partner countries and economies. Estimates presented in Table A3.1a on the other hand suggest that in almost a third of OECD countries and in all but six partner countries and economies there is no difference between disadvantaged students and their more advantaged peers in the extent to which they believe their schools prepare them for science careers.

Improved Performance

This section presents estimates of the associations between performance and the ten indices used in Chapter 3 to characterise students' approaches to learning and hours spent and courses taken.

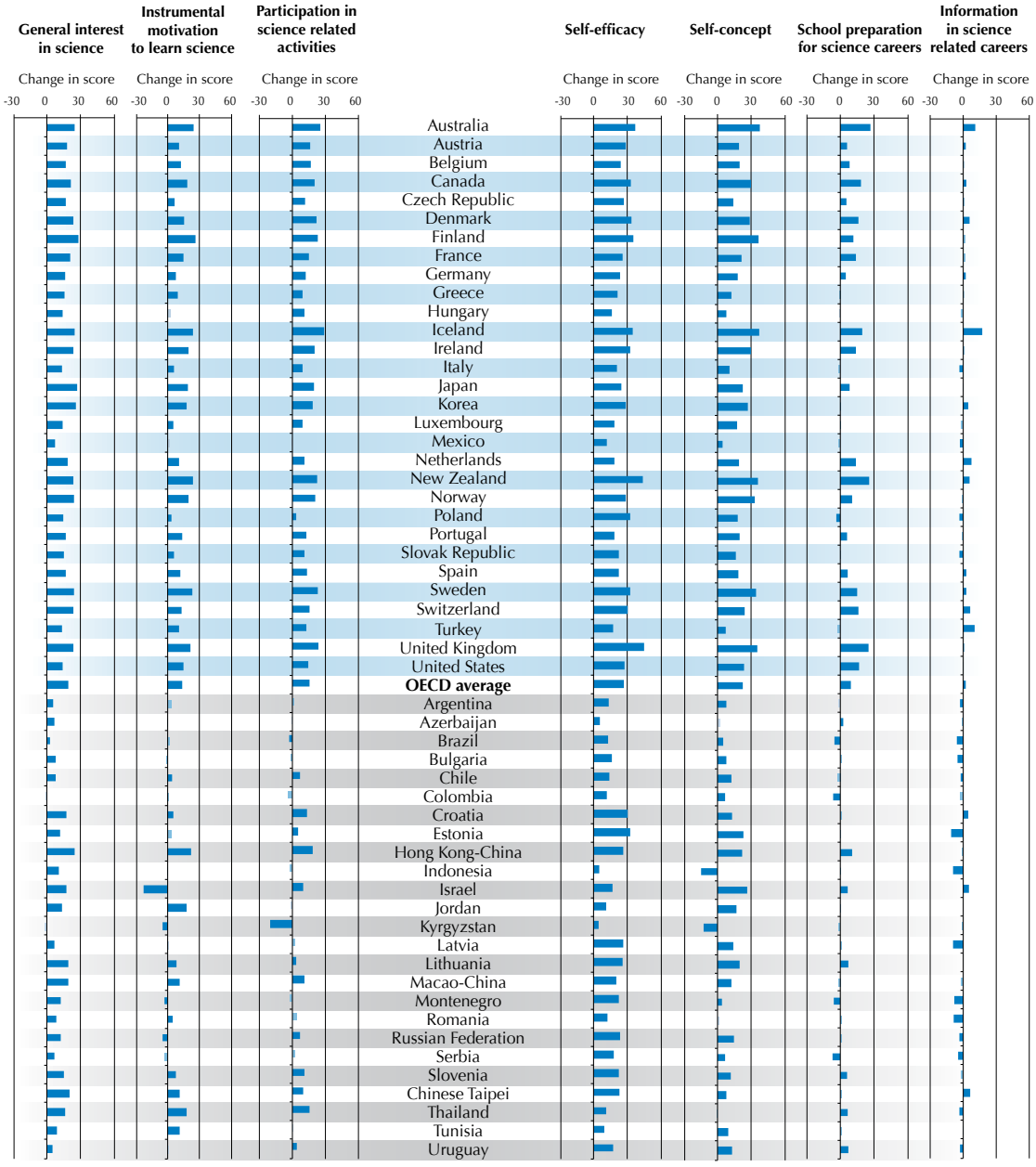
Overall, students who have positive attitudes and approaches towards science learning on average perform better on the PISA science assessment than students who have less positive attitudes and approaches (Figure 4.1a and Table A3.1b).

The following student approaches to learning are associated with increased performance in the PISA science assessment in virtually all OECD countries: general interest (internal motivation) and instrumental (external) motivation to learn science, participation in science-related activities, self-efficacy and science self-concept, with self-efficacy having the strongest association. Across OECD countries, students who have values on the index of student self-efficacy that are one standard deviation above the OECD mean score 28 points higher on average than students with average levels of self-efficacy. The score point differences associated with one standard deviation rises in the index of general interest in science and in the index of student self-concept in science are also close to 20 points. The differences are lower in relation to both the index of student participation in science-related activities and the index of instrumental motivation to learn science (16 and 14 points respectively).

Figure 4.1A shows that the index of school preparation for science careers and the index of information on science-related careers are both positively associated with science performance in some countries but not in others. Across OECD countries, an increase of one standard deviation in the school preparation index is associated on average with a 9 point increase in the PISA science score, while a similar increase on the information index is associated with a 2 point increase in the PISA science score. The score point differences between students with an average value on the school preparation for science careers index and students that are one standard deviation above the OECD mean ranges from 5 points in Germany to 25 points or above in Australia, New Zealand and the United Kingdom.

The school preparation for science-related careers index is not associated with science performance in eight OECD countries while the information about science-related careers index is not associated with science performance in half of the OECD countries. In Poland, increases in the school preparation for science careers and information about science-related careers indices are even negatively associated with science performance.

Figure 4.1a
Association between student approaches to learning and performance in science

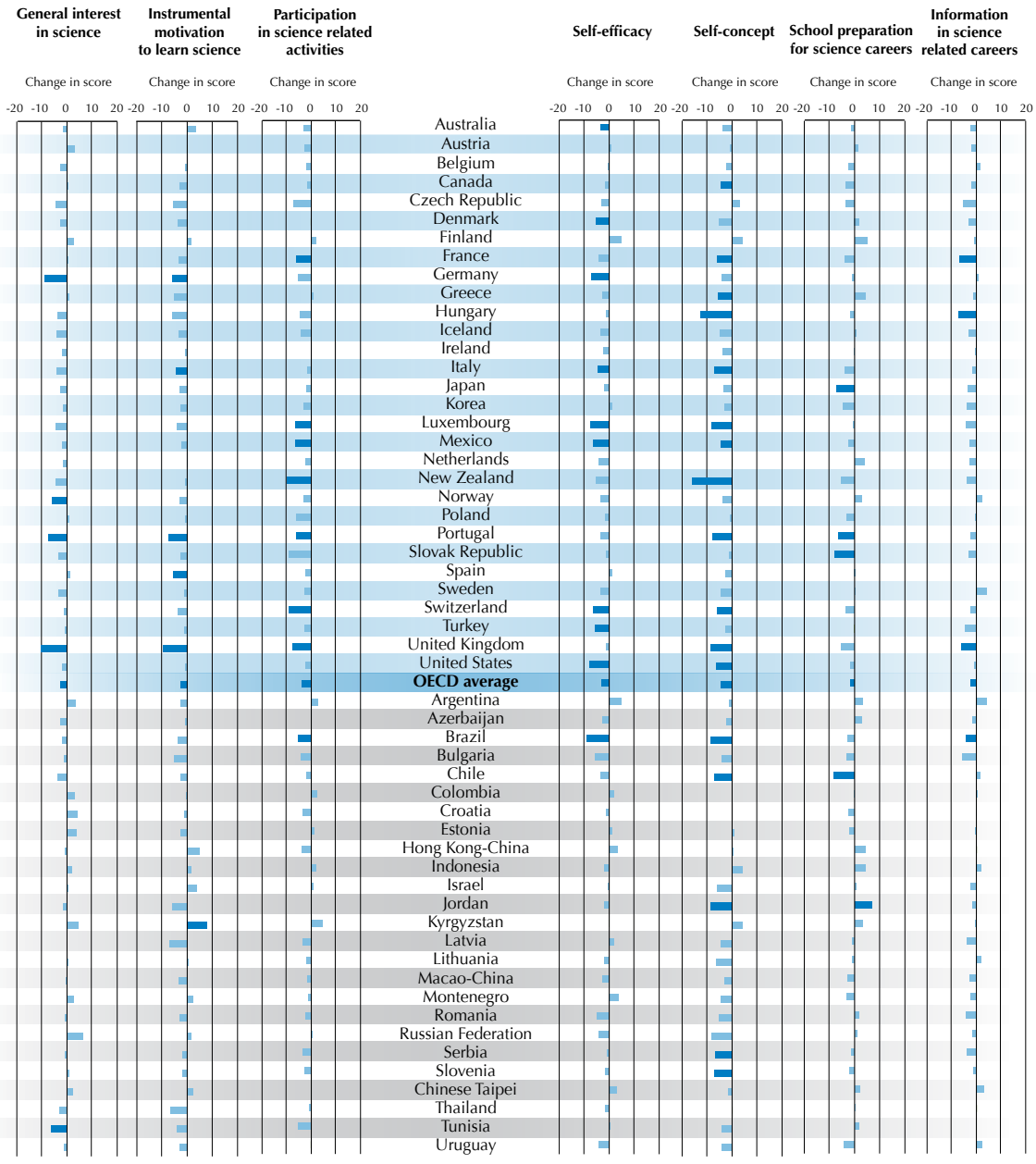


Note: Statistically significant differences are marked in a darker tone.
Source: *OECD PISA 2006 Database*, Table 4.1b.

Closing the gap

Results presented in Figure 4.1b and Table A3.1b indicate that both disadvantaged students and their more advantaged peers benefit from positive approaches to learning and high levels of motivation. With a few exceptions, disadvantaged students benefit on average as much as their more advantaged peers from having

Figure 4.1b
Differential effect for disadvantaged students of student approaches to learning



Note: Statistically significant differences are marked in a darker tone.
Source: *OECD PISA 2006 Database*, Table 4.1b

positive motivation, participation in science-related activities, confidence and perspectives future careers in science. These findings are in line with the "cumulative effects" hypothesis that both disadvantaged students and others benefit from having high levels of motivation and positive attitudes towards science learning.

There are, however, some important differences across areas. In a number of countries disadvantaged students appear to benefit less than their more advantaged peers. For example, self-efficacy and participation in science-related activities are associated with smaller gains for disadvantaged students in the PISA science score in nine and seven OECD countries respectively. In relation to self-efficacy, the difference in the PISA science assessment score between disadvantaged students and their peers is negative in 12 OECD countries. It is also negative in four OECD countries in the case of general interest, in three OECD countries in relation to each of the information on science careers and the school preparation for science careers indices, and in five OECD countries in the case of the instrumental motivation index. In almost all cases however the score point difference in the association between approaches to science learning and PISA science performance between disadvantaged and more advantaged students is below 10 points.

These results suggest that motivation to learn science and positive attitudes and approaches to science learning are associated with increases in the PISA score across all socio-economic groups, but the increases are smaller for disadvantaged students in some countries. Policies aimed at promoting greater motivation to learn science and positive attitudes and approaches to science learning may result in absolute improvements in science achievement but run the risk of contributing to wider performance gaps across social groups unless they are targeted at specific populations.

HOURS SPENT AND COURSES TAKEN TO LEARN SCIENCE

Improved Performance

Students who attend general science compulsory courses perform at higher levels in the PISA science assessment than students who do not. Results presented in Figure 4.2a show that, across OECD countries, students who report having attended at least one compulsory general science course in the year of the PISA assessment or the previous year score 26 points above students who did not attend any such course. Similarly, each additional compulsory science-related course students attended in either the PISA survey year or the previous year is associated with an average increase in the PISA science score of 7 score points.

The relationship between the indicator for having attended at least one general science compulsory course and the PISA science score is positive in 17 OECD countries, ranging from 6 points in Belgium to 66 points in Iceland (Table A3.2b). Figure 4.2a shows that the association is negative only in the case of Spain, where it may indicate a possible substitution effect: students who are interested in performing well in science may attend advanced courses such as biology, physics and chemistry while students who are less interested in performing well in science may attend general science courses.

The indicator for the number of science-related compulsory courses students attended is positively associated with the PISA science score. It is positive in all OECD countries except the United States where no association is apparent. The relationship is particularly strong in Korea where each additional compulsory course is associated with an increase of 32 score points in the PISA science score while in Canada and Portugal the change in the PISA science score associated with each additional compulsory course is below 2 score points (Table A3.2b).

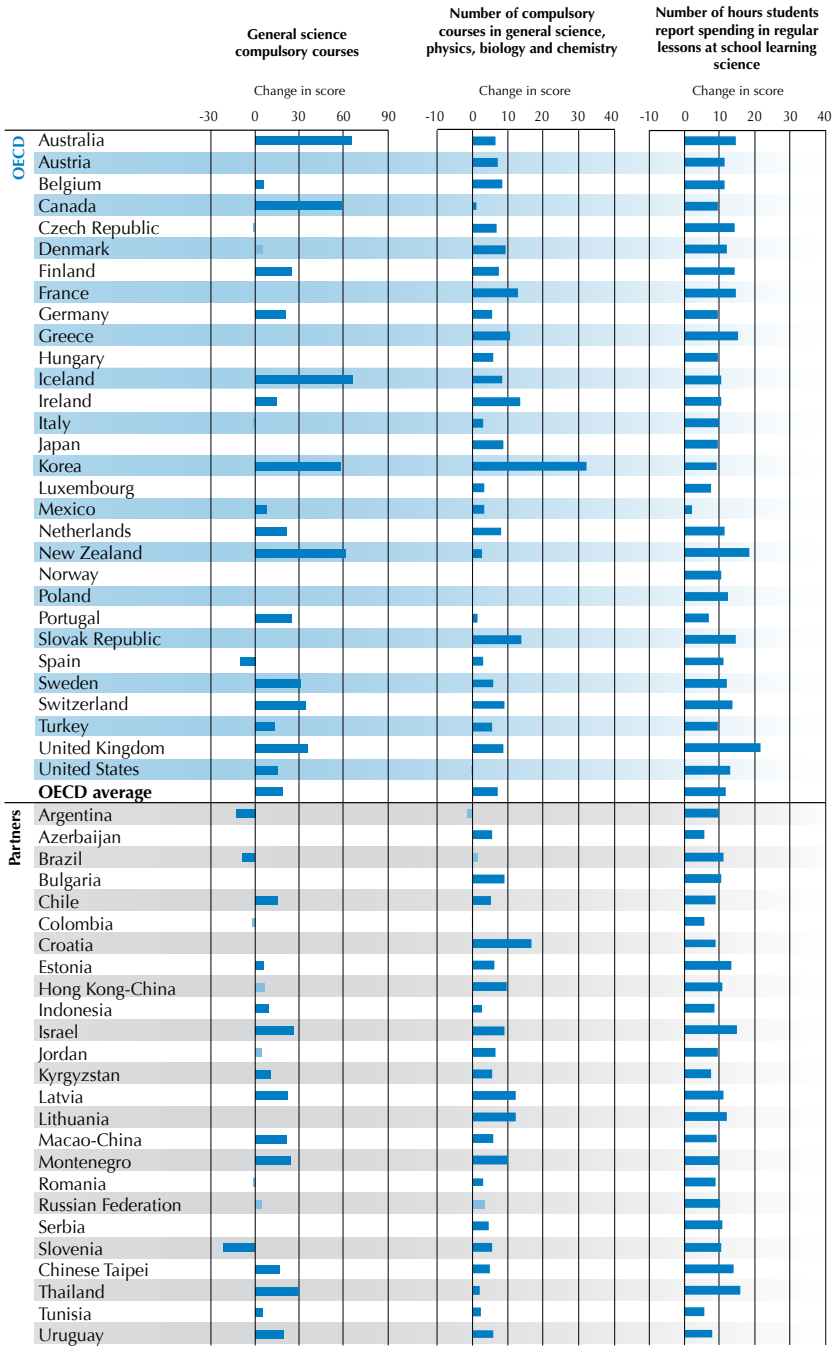
Students who spend more time studying in regular science lessons at school perform better in the PISA science assessment than students who spend fewer hours. This association exists across all countries and is generally stronger than the association with the number of compulsory courses attended. Results presented in Figure 4.2a and Table A3.2b suggest that across OECD countries each additional hour is associated with a 12 score point increase in the PISA science score, but that estimate varies across countries. For example, the change in the PISA science score that is associated with an additional hour spent in a regular science lesson at school is as much as 22 score points in the United Kingdom and as little as 2 score points in Mexico.

Closing the gap

Results presented in Figure 4.2b and Table A3.2b indicate that in several countries the differential association between attending compulsory science courses and performance in the PISA science assessment is positive.

Figure 4.2a

Association between students' participation in science courses and student performance in science

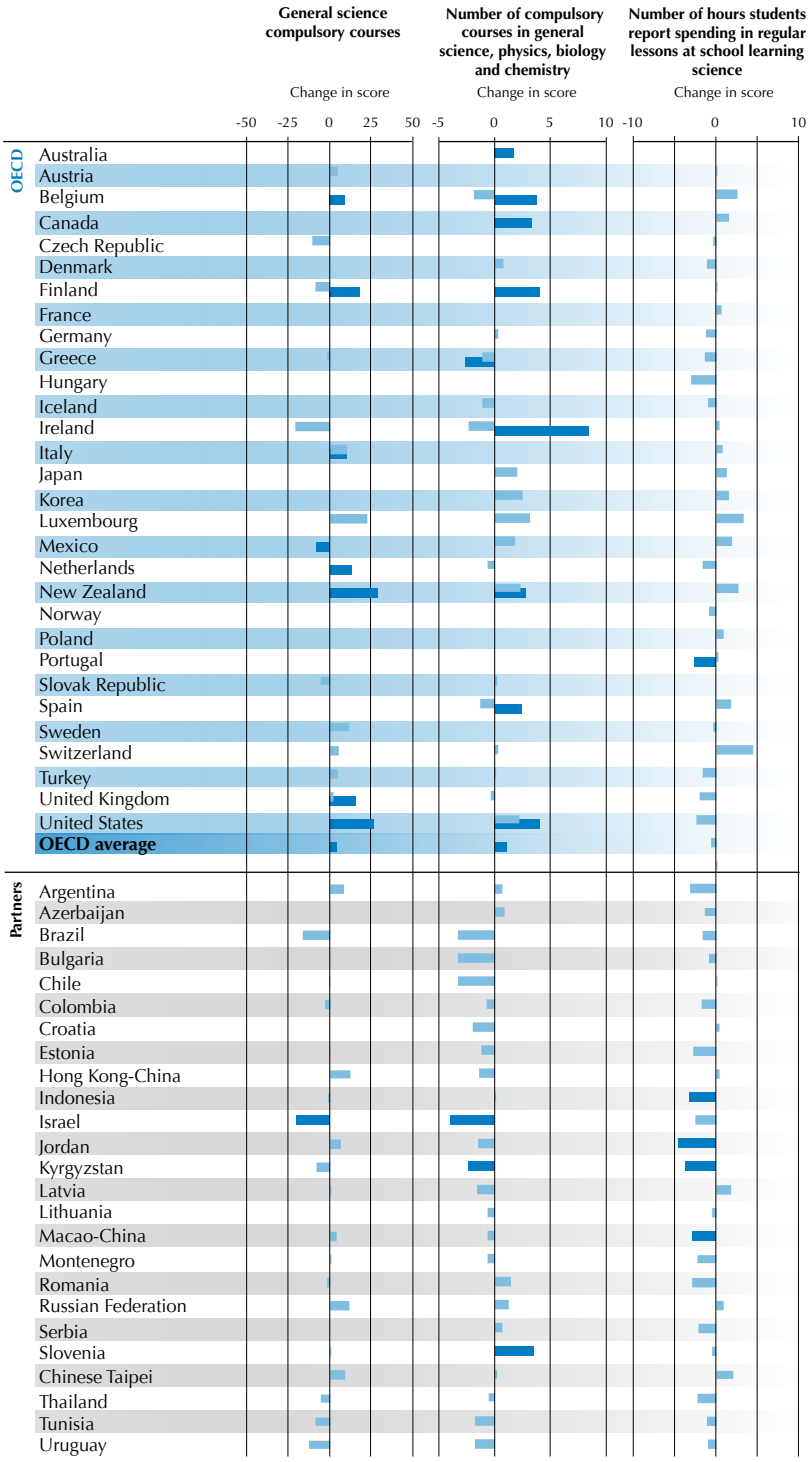


Note: Statistically significant differences are marked in a darker tone.

Source: *OECD PISA 2006 Database*, Table 4.2b

Figure 4.2b

Differential effect for disadvantaged students of students' participation in science courses



Note: Statistically significant differences are marked in a darker tone.

Source: *OECD PISA 2006 Database,* Table 4.2b

In seven OECD countries, disadvantaged students benefit more than more advantaged students from attending compulsory general science courses (Belgium, Finland, Italy, the Netherlands, New Zealand, the United Kingdom and the United States) while in eight OECD countries disadvantaged students benefit more from attending compulsory courses in physics, biology and chemistry (Australia, Belgium, Canada, Finland, Ireland, New Zealand, Spain and the United States). The findings also indicate the score point differences are substantial. For example, having attended a compulsory general science course is associated with a 29 point increase in the PISA science score in New Zealand while each additional compulsory course attended in Ireland is associated with an increase of 8 score points.

LEARNING ENVIRONMENT AT SCHOOL

Improved Performance

Disadvantaged students are somewhat less likely than their more advantaged peers to attend schools that are private, compete with other schools, select their students on the basis of academic record, organise activities that promote science learning and/or have good educational resources (see Table A3.3a). For example, the proportions of disadvantaged students that attend a private school are significantly lower than the proportions for more advantaged students in 18 OECD countries and 13 partner countries and economies. Similarly, the proportions of disadvantaged students attending schools that compete with other schools for students are significantly lower than the proportions for more advantaged students in 19 OECD countries and 12 partner countries and economies.

The performance of students in the PISA science assessment is associated with whether students attend a school that is private, competes with other schools for students, or organises activities to promote science learning in only a few countries. Attending a private school is associated with lower performance in seven OECD countries (and with higher performance in one) while academic selectivity is associated with higher performance in 11 out of 25 of OECD countries and science promotion activities are associated with higher performance in a third of OECD countries (see Figure 4.3a and Table A3.3b).

Closing the gap

Overall, school characteristics do not appear to play a major role in promoting performance in the PISA science assessment among disadvantaged students. Apart from a few exceptions, disadvantaged students and their more advantaged peers appear to perform equally well irrespective of the type of school they attend (Figure 4.3b).

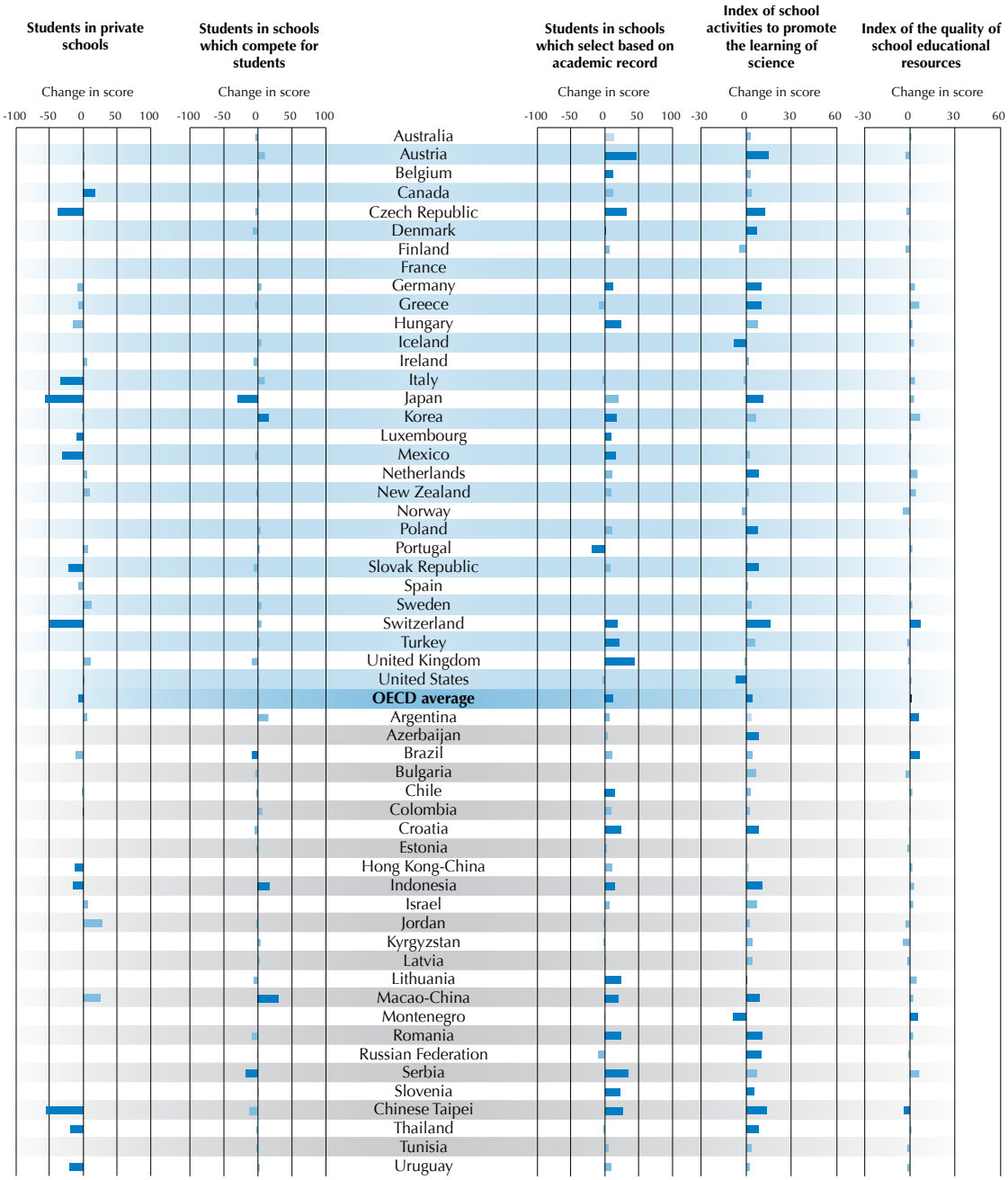
CONCLUSION

This chapter examined the role played by approaches to learning, hours spent and courses taken to learn science and school characteristics in improving students' performance in the PISA science assessment and whether these factors play a differential role in promoting performance improvements for disadvantaged students. Some key findings emerge:

a) Students who believe in themselves, who are motivated and have positive attitudes towards science learning on average perform better in the PISA science assessment than other students. In particular, a one standard deviation difference in self-confidence or general interest in science is associated with a science assessment score difference of at least 20 points across OECD countries. However in a number of countries the benefit for disadvantaged students is lower than for other students.

b) Students who attend general science compulsory courses or compulsory courses in physics, biology and chemistry perform at higher levels in the PISA science assessment than students who do not. Both disadvantaged and non-disadvantaged students benefit from attending compulsory courses, but in several

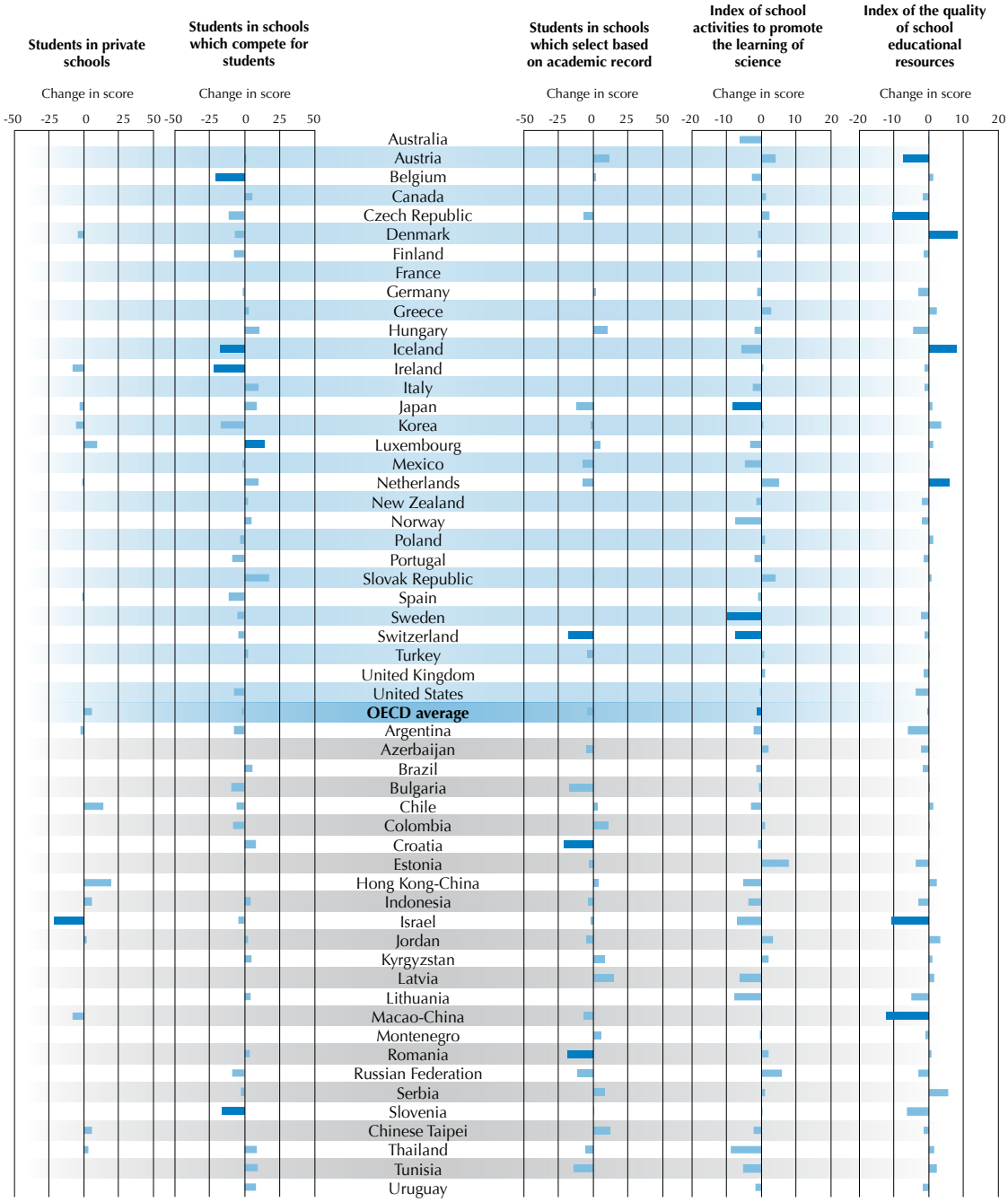
Figure 4.3a
Association between school characteristics and student performance in science



1. Statistically significant differences are marked in a darker tone.
Source: *OECD PISA 2006 Database*, Table 4.2b

countries disadvantaged students appear to benefit more than more advantaged students from attending compulsory courses. The actual number of compulsory courses taken does not show the same relationship: attending more courses does not seem to add more to close the performance gap of disadvantaged students with their more advantaged peers.

Figure 4.3b
Differential effect for disadvantaged students of school characteristics



1. Statistically significant differences are marked in a darker tone.
Source: *OECD PISA 2006 Database*, Table 4.3b

c) Students who spend more time in regular science lessons at school perform better than students who spend fewer hours and all students are equally likely to benefit from spending additional time in regular science lessons at school.

d) School characteristics such as whether the school is private, whether it competes with other schools for students, whether academic records play an important part in the school's admission criteria, whether the school provides activities that promote students' learning of science and whether the school has good educational resources do not play a significant role in promoting performance in the PISA science assessment for either disadvantaged or more advantaged students.

Overall, across most countries, disadvantaged students have lower levels of motivation and less positive approaches to learning than their more advantaged peers. Unless policies aimed at promoting greater motivation and positive attitudes to science learning are directed specifically at reducing disparities in motivation and attitudes towards science learning between social groups, this analysis suggests they will result in absolute improvements in science achievement but may contribute to widening existing inequalities in performance across social groups.

Students benefit from attending compulsory science-related courses in most countries and in some countries disadvantaged students who attend such courses benefit more than their more advantaged peers. Expanding the provision of high quality compulsory science courses therefore appears to be a promising tool for policy makers and schools administrators. Analyses presented in this chapter suggest that investing marginal funds in the provision of compulsory science-related courses should be considered as a possible policy priority as it may both help increase student achievement generally and mitigate socio-economic differences in performance.

Note

1. All models control for socio-economic background using both the PISA index of socio-economic background and an indicator of whether students are among the most disadvantaged in their country (bottom third of their country's socio-economic distribution). A detailed description of the models developed in the Chapter can be found in Annex A5.