# Foreword

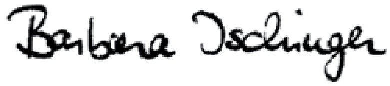
This thematic report explores results of the 2003 cycle of the Programme for International Student Assessment (PISA) in order to identify teaching and learning strategies that contribute to increased achievement, particularly in mathematics. The analysis helps to clarify an understanding of the following: *(i)* the differences between teaching and learning practices across countries that can allow countries to benchmark practices; *(ii)* the extent to which teaching and learning practices vary among schools in each country; and *(iii)* the extent to which individual aspects of teaching and learning strategies are associated with better performance in mathematics.

Teaching strategies range from the ways in which classrooms and resources are organised and used to the ways in which teachers and students engage in day-to-day activities in order to facilitate learning. Student learning strategies include the cognitive and meta-cognitive processes employed by students attempting to learn something new. PISA measures these strategies using a variety of questionnaire items, which can be combined and scaled to yield a number of composite or index variables representing broad constructs. Examples of the constructs examined here are disciplinary climate, teacher-student relations, memorisation strategies and time spent on various learning activities.

After presenting the theoretical framework, the report follows a two-stage analytical approach. It first offers an analytical description of mathematics teaching and learning in different countries and identifies similarities and differences between countries. In the second stage, the report presents findings generated from a multilevel, prediction model of the factors influencing mathematical achievement. After controlling for other factors, this model shows the "unique" effects of a particular factor on achievement. The results presented in this report are mainly based on separate analyses for each country. The within-country results are then combined to allow for comparisons across a range of countries.

The report offers useful information and analyses to education policy makers and academic researchers concerned with mathematics teaching and learning strategies. Further analysis of the effects of these strategies on student learning, particularly in reading and science, are used and will be possible to use in later PISA surveys. This report also offers suggestions on how to improve data collection and measurement of teaching and learning strategies in large international cross-sectional surveys such as PISA.

This report is the product of a collaborative effort between the countries participating in PISA, the experts and institutions working within the framework of the PISA Consortium, the OECD, and Edudata Canada at the University of British Columbia. Robert Crocker, professor emeritus at Memorial University of Newfoundland, the principal author, drafted the report with the collaboration of Christian Monseur, University of Liège, Victor Glickman, University of British Columbia, Ben Levin, University of Toronto, Linda Schachter, L. L. Schachter Research, John Anderson, University of Victoria, Charles Ungerleider, University of British Columbia, and Andreas Schleicher, Claire Shewbridge and Pablo Zoido from the OECD. Julia Tompson proposed editorial comments, Juliet Evans provided administrative guidance, Elisabeth Villoutreix, Niccolina Clements and Simone Bloem offered editorial input, and Peter Vogelpoel prepared the typesetting of the report.



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# Executive Summary

## MAIN MESSAGES

*Teaching and learning practices vary widely across educational systems and across schools within systems.*

Teaching and learning strategies are an important area of educational policy and practice. An international perspective on these issues informs students, parents, teachers, policy makers and other stakeholders about the most common patterns in their system, how these compare to other countries, and how these practices vary across schools within these systems. When examining these issues, it is important to inform students, parents, teachers, policy makers and other stakeholders about the most common patterns in their systems and how teaching and learning practices vary from school to school within these systems. An international perspective can also add important insight on how countries' education systems compare to one another. This report offers that kind of insight particularly for the countries involved in the PISA 2003 cycle. The analysis of how teaching and learning practices are linked to student performance is, however, more limited, given the international cross-sectional nature of surveys, such as PISA, and the need for very fine and detailed data for the analysis of these issues.

*Teaching and learning strategies are complex processes that interact with one another, suggesting that in-depth, context-specific analyses are necessary to fully understand each strategy's role in enhancing student performance.*

With a few interesting exceptions, most teaching and learning strategies do not have a direct, robust and consistent relationship with student performance across countries. The relationship between the strategies and performance tends to be moderated by other factors such as student attitudes and background, suggesting that these issues cannot be analysed separately.

*Disciplinary climate is the main teaching-related variable that shows a robust and consistent association with better performance, both at the individual and school levels.*

Across most countries, a strong disciplinary climate is consistently and robustly associated with better performance. The analysis shows that beyond the individual level, policies targeted to improve the disciplinary climate at the school level also yield positive effects. Determining how to address schools and individuals facing a challenging disciplinary climate should therefore be a priority for further in-depth, policy oriented studies.

*Student background continues to be among the main determinants of performance, even after adjusting for teaching and learning strategies, which suggests that these processes only play a limited moderating role for disadvantaged students.*

A combined analysis of teaching and learning strategies with student background and other antecedents shows that different practices, even if they vary a lot, do not significantly moderate the effect of socio-economic background. There is little evidence that teaching and learning strategies play a significant role in reducing the effect of socio-economic background on student performance.

*Student attitudes, such as confidence with or anxiety towards mathematics, play a mediating role with respect to some teaching and learning strategies, and maintain their strong association with student performance even after adjusting for these strategies.*

The relationship between student performance and many of the teaching and learning strategies, in particular, meta-cognitive strategies, is mediated by student attitudes. A potential area of further research, these mediating effects may explain the lack of evidence for a direct relationship between performance and these strategies, in particular, meta-cognitive strategies or student preferences for a cooperative or a competitive environment. It is, however, hard to evaluate how much of this research can be accomplished with international, cross-sectional studies such as PISA.

## OVERVIEW OF THE REPORT'S APPROACH

This thematic report presents new evidence on teaching and learning strategies for mathematics that emerges from the PISA 2003 assessment and complements the results discussed in other PISA reports (*e.g.* OECD, 2004, 2005). The report's analysis clarifies understanding of the following: the differences across countries between teaching and learning practices, which allow countries to benchmark practices; the extent to which teaching and learning practices vary from school to school within each country; and the extent to which individual aspects of teaching and learning are associated with better or worse performance in mathematics.

The report will be useful for education policy makers and other stakeholders and concerned with the study of teaching and learning. It will also prove insightful for academic researchers wanting to identify research questions for follow-up studies. This report may thus help stimulate a new round of research designed to gather more detailed information on teaching and learning strategies. Recent examples include the OECD Teaching and Learning International Survey (TALIS) (OECD, 2009), which takes a large step in this direction, as well as the upcoming PISA 2012, which will again focus on mathematics and be another opportunity to build on the methodology and results presented in this report. In addition, this report may be of interest to teacher educators and officials within national and local educational authorities who are responsible for the professional development of teachers, programmes, and school boards and parent advisory bodies.

The report first surveys the theory and measurement of teaching and learning strategies. Teaching strategies refer to a broad range of processes, from the way in which classrooms are organised and resources are used to the daily activities engaged in by teachers and students to facilitate learning. Student learning strategies refer to cognitive and meta-cognitive processes employed by students as they attempt to learn new topics. In PISA, teaching and learning strategies are measured using a variety of questionnaire items, which in turn are combined and scaled to yield a number of composite or index variables representing broad constructs. Examples of these constructs include disciplinary climate, teacher-student relations, memorisation strategies and time spent on various learning activities. In PISA 2003 these measures were specifically geared towards the learning of mathematics. The TALIS survey extends the analysis of these strategies, their relationship to each other and their links to teacher beliefs. Further analysis on the effects of these strategies on student learning, particularly in reading and science, will be possible in later PISA surveys.

Most of the results presented in this report are based on separate analyses for each country. The within-country results are then combined to allow for comparisons across a range of countries. The

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report follows a two-stage analytical approach. The first stage involves a comparative analysis of mathematics teaching and learning in order to describe how mathematics is taught in different countries. The report then examines variations across schools within countries and, on the basis of these analyses, presents a broad profile of commonalities and differences in mathematics teaching and learning strategies. While limited in their ability to provide explanations for differences in teaching methodology, the results can inform policy makers in individual countries how their situation might relate to or differ from that of other countries in terms of consistency or variety among schools.

The second stage of the analysis utilises a comprehensive two-level, student and school, prediction model of the factors influencing mathematics achievement. Here the primary emphasis is on the teaching and learning strategy variables. The analysis adjusts for a number of antecedents, which are introduced into in stages before entering the teaching and learning variables. This approach allows the predictive power of the model to be determined as groups of variables are inserted. The basis of the final reporting of the effects of each of the main variables is the full model. This approach offers a more complete picture of the real world of teaching and learning, compared to that provided by the intermediate models, and may be of more interest from a policy perspective. The report then examines mediating effects, in part by the use of bivariate analysis, to compare effects using the full model versus each variable independently.

## ORGANISATION OF THIS REPORT

Chapter 2 depicts a complex and widely varying picture of mathematics instruction, both within and across participating countries. It examines the characteristics of students, schools and countries in terms of various teaching and learning strategies, as well as the distribution of these characteristics. The chapter notes observed associations between various aspects of teaching and learning strategies and mathematics performance, as well as the extent to which these associations correlate with higher student achievement.

Chapter 3 examines how selected features of teaching and learning affect performance in mathematics after other characteristics of students and schools are taken into account. The features measured cover the antecedents to learning, the effects of teaching and learning, and teaching strategies. The analysis divides the total variation in students' performance in mathematics into "between-student" and "between-school" components. The chapter presents results for each country separately. In addition to examining the observed association between various factors and performance, and the unique effects of these factors once other factors have been accounted for, the chapter discusses the interactions between the different measures.

Chapter 4 summarises the report's main results, identifies relevant educational policy and practice issues, and examines the extent to which the available results respond to these issues. The chapter also considers the design of PISA in light of the interpretation issues encountered in this study. It seems that the use of teaching and learning strategies does not significantly mitigate the disadvantaged social backgrounds of some students. PISA shows that teaching and learning factors are related to mathematics achievement, but this relationship is not necessarily bi-directional or of similar magnitude across all the countries and economies studied. Country differences stand out for many of these variables, a finding which suggests that effects may be best interpreted within countries or clusters of countries with similar cultural backgrounds or school systems.

Chapter 5 concludes this report and summarises the main policy insights that can be drawn from the evidence presented in the previous chapters.

# References


**OECD** (2004), *Learning for Tomorrow's World: First Results from PISA 2003*, OECD, Paris.

**OECD** (2005), *Are Students Ready for a Technology-Rich World? What PISA Studies Tell Us*, OECD, Paris.

**OECD** (2009), *Creating Effective Teaching and Learning Environments: First Results from TALIS*, OECD, Paris.


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# Reader's Guide

## ABBREVIATIONS USED IN THIS REPORT

### Organisations

The following abbreviations are used in this report:

| | |
|---|---|
| ACER | Australian Council For Educational Research |
| OECD | Organisation for Economic Co-operation and Development |
| PISA | Programme for International Student Assessment |
| TCMA | Test-Curriculum Match Analysis |
| TIMSS | Trends in Mathematics and Science Study |

### Country codes

| OECD Countries | | | |
|---|---|---|---|
| CODE | COUNTRY | CODE | COUNTRY |
| AUS | Australia | MEX | Mexico |
| AUT | Austria | NLD | Netherlands |
| BEL | Belgium | NZL | New Zealand |
| CAN | Canada | NOR | Norway |
| CZE | Czech Republic | POL | Poland |
| DNK | Denmark | PRT | Portugal |
| FIN | Finland | KOR | Korea |
| FRA | France | SVK | Slovak Republic |
| DEU | Germany | ESP | Spain |
| GRC | Greece | SWE | Sweden |
| HUN | Hungary | CHE | Switzerland |
| ISL | Iceland | TUR | Turkey |
| IRL | Ireland | GBR | United Kingdom (England, Wales and Northern Ireland) |
| ITA | Italy | | |
| JPN | Japan | SCO | Scotland |
| LUX | Luxembourg | USA | United States |

| OECD Partner Countries and Economies | | | |
|---|---|---|---|
| CODE | COUNTRY | CODE | COUNTRY |
| BRA | Brazil | PER | Peru |
| HKG | Hong Kong-China | RUS | Russian Federation |
| IDN | Indonesia | YUG | Serbia |
| LVA | Latvia | THA | Thailand |
| LIE | Liechtenstein[1] | TUN | Tunisia |
| MAC | Macao-China | URY | Uruguay |

1. Liechtenstein's results are not included in results requiring a separate national scaling of item values as the sample size in the country was too small to provide an accurate result.

## TECHNICAL DEFINITIONS

*Item difficulty* – Historically, item difficulty is the proportion of those taking an item, or test, which get the item correct. Within situations employing item response theory (IRT) modelling of response to items relative to the underlying trait (*e.g. mathematical literacy* in the area being measured), item difficulty is the value on the trait scale where the slope of the item's corresponding item response function reaches its maximal value.

*Fifteen-year-olds* – The use of fifteen-year-olds in the discussion of the PISA sample population refers to students who were aged between 15 years and 3 (complete) months and 16 years and 2 (complete) months at the beginning of the assessment period and who were enrolled in an educational institutions regardless of grade level or institution type or if they were enrolled as a full-time or part-time students.

*OECD average* – Takes the OECD countries as single entities, each with equal weight. Hence, an OECD average is a statistic generated by adding the country averages and dividing by the number of OECD countries involved. The OECD average provides data on how countries rank relative to the set of countries within the OECD.

*OECD total* – Takes the OECD countries merged as a single entity to which each country contributes in proportion to the number of its students in the appropriate population. The computation of the OECD total involves the sum total of the outcome variable of interest divided by the total number of data-related students within the OECD countries. The OECD total provides a comparison statistic for the total human capital present with the OECD countries.

*Rounding of numbers* – Because of rounding, some columns or groups of numbers may not add up to the totals shown. Totals, differences, and averages are always calculated on the basis of exact numbers and then rounded after calculation.

## SYMBOLS FOR MISSING DATA

Six symbols are employed in the tables and charts to denote missing data:

*a* Data is not applicable because the category does not apply.

*c* There are too few observations to provide reliable estimates (*i.e.* there are fewer than 3% of students for this cell or too few schools for valid inferences). However, these statistics were included in the calculation of cross-country averages.

*m* Data is not available.

*n* Magnitude is either negligible or zero.

*S.E.* Standard error.

*w* Data has been withdrawn at the request of the country concerned.

*x* Data included in another category or column of the table (*e.g.* x(2) means that data are included in column 2 of the table).

## FURTHER DOCUMENTATION

For further documentation on the PISA assessment instruments and the methods used in PISA, see the PISA 2003 Technical Report (OECD, 2005), the Australian Council of Educational Research PISA site (*www.acer.edu.au/ozpisa*) and the PISA web site (*www.pisa.oecd.org*).

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# Overview and Rationale for the Study

*This chapter provides an overview and rationale for this report, situating the study in the context of PISA research endeavours for both the past and the future. It describes early research on teaching and learning strategies and lays out the theoretical framework, key index and control variables which are derived for the examination of teaching and learning strategies and associated with higher mathematics performance.*



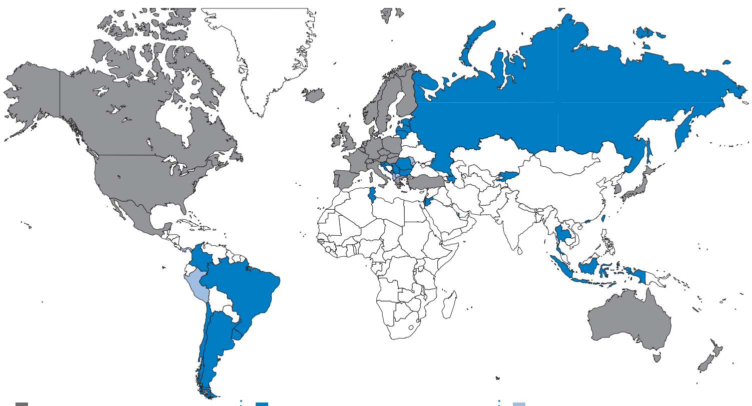
## OVERVIEW OF PISA

The Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment (PISA) began in 1997. Developed jointly by OECD member countries through the OECD's Directorate for Education, PISA measures the extent to which students are acquiring some of the knowledge and skills that are essential for full participation in today's knowledge society. PISA has an important role in the work of the OECD's Directorate for Education, which collects data and provides comparative indicators of education systems in OECD member and partner countries. PISA helps to highlight those countries which achieve both high performance and an equitable distribution of learning opportunities, and in doing so sets ambitious goals for other countries.

PISA's global span, regularity and test population are unique. More than 70 countries have taken part in one or more PISA surveys so far (see Figure 1.1). Beginning in 2000, these surveys have taken place at three-year intervals. The 2000 survey covered 32 countries and had reading as its major focus, with minor assessments in mathematics and science. The 2003 survey was carried out in 41 countries and had mathematics as its major focus, with minor assessments in reading, science and problem solving. The 2006 survey took place in 58 countries and focused on science, with minor assessments in reading and mathematics. All PISA surveys assess 15-year-old students, an age at which young adults are nearing the end of compulsory schooling in most countries.

In addition to the assessment instruments, PISA also includes detailed questionnaires to be completed by students and school principals. These questionnaires gather a variety of data on student backgrounds, behaviours and attitudes, student perceptions, teaching practices, school characteristics, the organisation of instruction and other factors that may be reported comparatively and used to help account for differences in achievement.

Figure 1.1 ■ **A map of PISA countries and economies**



**OECD countries**
Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

**Partner countries and economies in PISA 2006**
Argentina, Azerbaijan, Brazil, Bulgaria, Chile, Colombia, Croatia, Estonia, Hong Kong-China, Indonesia, Israel, Jordan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Macao-China, Montenegro, Qatar, Romania, Russian Federation, Serbia, Slovenia, Chinese Taipei, Thailand, Tunisia, Uruguay

**Partner countries and economies in previous PISA surveys or in PISA 2009**
Albania, Shanghai-China, Macedonia, Moldova, Panama, Peru, Singapore, Trinidad and Tobago

*Source:* OECD (2007).

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The OECD publishes the main results from each PISA survey in the year after the assessment has taken place. Participating countries also prepare individual country reports. In addition, the OECD publishes thematic reports drawing on the data from each PISA survey in order to present more detailed analysis of policy-relevant issues. This thematic report focuses on teaching and learning strategies and uses data from the PISA 2003 survey.

## AIM AND AUDIENCE OF THIS REPORT

The analysis in this report may help clarify understanding of: the differences between teaching and learning practices in different countries, thus allowing countries to benchmark practices; the extent to which teaching and learning practices vary from school to school within each country, and the extent of the association between individual aspects of teaching and learning and better or worse performance in mathematics. The report will be useful for policy makers and stakeholders who need to understand better how their systems and school compare with those in other countries and economies who participated in PISA 2003. It may also provide insights for the design and implementation of educational policies aiming at improving the quality of education for all students.

In addition, this report may be of interest to teacher educators and officials within national and local educational authorities responsible for the professional development of teachers or programme development, as well as members of school boards and parent advisory bodies.

The report will also be useful to researchers concerned with the study of teaching and learning, particularly in identifying research questions that warrant follow-up through more intensive studies. Indeed, this report should be useful in helping to stimulate a new round of research designed to gain more detailed knowledge of teaching and learning strategies than is possible through large-scale survey methods.

## BACKGROUND OF THIS REPORT

The report examines relationships among teaching strategies, student learning strategies and mathematics achievement, using data from the PISA 2003 survey. Figure 1.2 describes the PISA 2003 achievement scales in mathematics, reading and science. Because in 2003 mathematics was the focus of the PISA assessment and the questionnaires, this report concentrates on performance in mathematics.

The primary aim of this report is to identify instructional practices and learning strategies, both in general and within mathematics, that contribute both to increased achievement and to decreased variation in achievement. It also examines the degree to which such strategies are universal or context-specific and how these strategies may be related to the structure of school systems in different countries.

The overarching conceptual model for this report is the idea that the well-being of a modern society depends not only on capital and labour but also on the knowledge and ideas generated by individual workers. In particular, theory holds that economic benefits derive from investment in people, with education as the primary means of development of this human capital, so that educational expenditures are considered as investments (Sweetland, 1996). How then to maximise return on investment?

Long-term returns are beyond the scope of this report. Instead, it takes school achievement in mathematics as measured by PISA 2003 as a proximate outcome. Figure 1.3 gives a summary of overall student performance in different countries on the PISA 2003 mathematics scale, presented



## Figure 1.2 ■ Summary of the assessment areas covered in PISA 2003

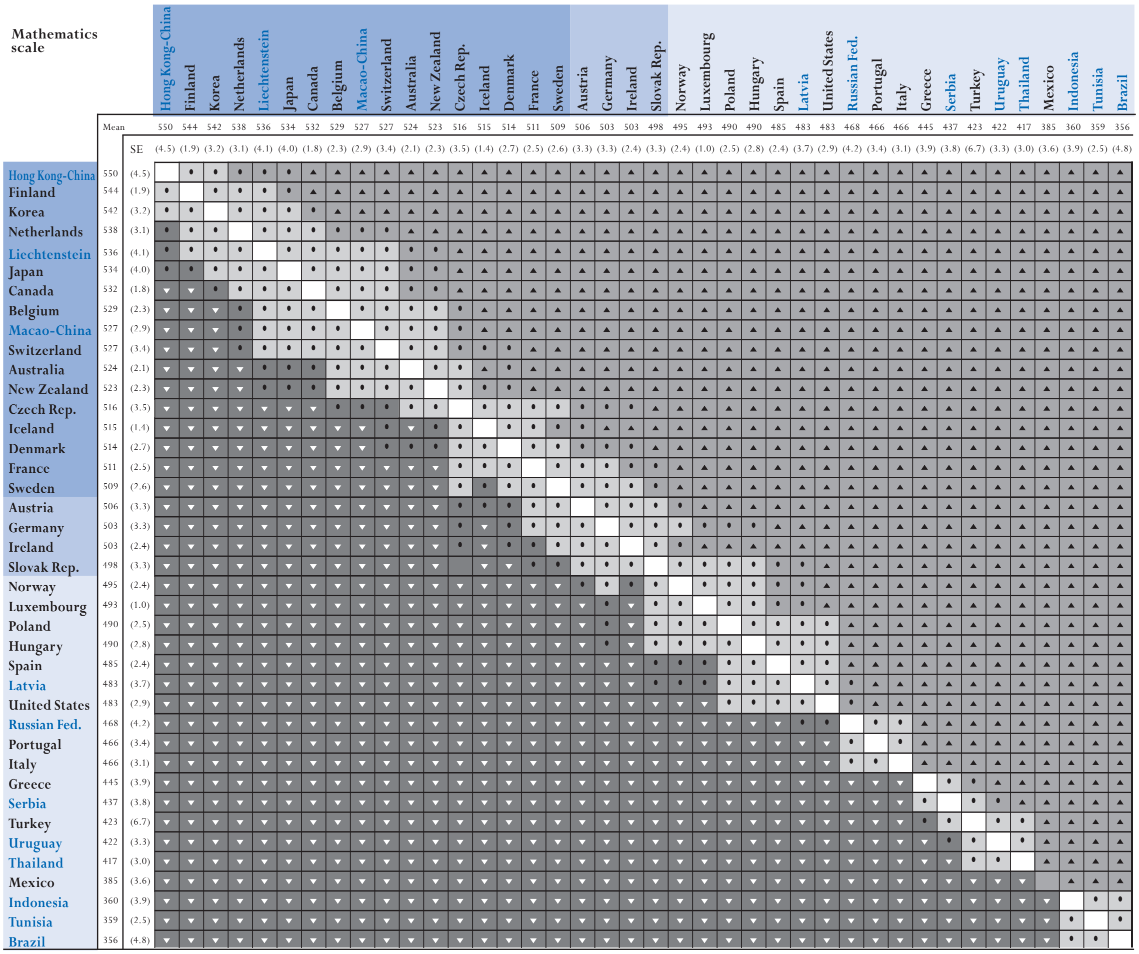
| Assessment area | Mathematics | Science | Reading |
|---|---|---|---|
| Definition and its distinctive features | "The capacity to identify and understand the role that mathematics plays in the real world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen" (OECD, 2003e).<br>Related to wider, functional use of mathematics, engagement requires the ability to recognise and formulate mathematical problems in various situations. | "The capacity to use scientific knowledge, to identify scientific questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity" (OECD, 2003e).<br>Requires understanding of scientific concepts, an ability to apply a scientific perspective and to think scientifically about evidence. | "The capacity to understand, use and reflect on written texts in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society" (OECD, 2003e).<br>Much more than decoding and literal comprehension, reading involves understanding and reflection, and the ability to use reading to fulfil one's goals in life. |
| "Content" dimension | Clusters of relevant mathematical areas and concepts:<br>• quantity;<br>• space and shape;<br>• change and relationships; and<br>• uncertainty. | Areas of scientific knowledge and concepts, such as:<br>• biodiversity;<br>• forces and movement; and<br>• physiological change. | The form of reading materials:<br>• "continuous" materials including different kinds of prose such as narration, exposition, argumentation; and<br>• "non-continuous" texts including graphs, forms, lists. |
| "Process" dimension | "Competency clusters" define skills needed for mathematics:<br>• reproduction (simple mathematical operations);<br>• connections (bringing together ideas to solve straightforward problems); and<br>• reflection (wider mathematical thinking).<br>In general these are associated with tasks of ascending difficulty, but there is overlap in the rating of tasks in each cluster. | The ability to use scientific knowledge and understanding, to acquire, interpret and act on evidence:<br>• describing, explaining and predicting scientific phenomena;<br>• understanding scientific investigation; and<br>• interpreting scientific evidence and conclusions. | Type of reading task or process:<br>• retrieving information;<br>• interpreting texts; and<br>• reflection and evaluation of texts.<br>The focus of PISA is on "reading to learn", rather than "learning to read", and hence students are not assessed on the most basic reading skills. |
| "Situation" dimension | Situations vary according to their "distance" from individuals' lives. In order of closeness:<br>• personal;<br>• educational and occupational;<br>• local and broader community; and<br>• scientific. | The context of science, focusing on uses in relation to:<br>• life and health;<br>• the Earth and the environment; and<br>• technology. | The use for which the text constructed:<br>• private (*e.g.*, a personal letter);<br>• public (*e.g.*, an official document);<br>• occupational (*e.g.*, a report);<br>• educational (*e.g.*, school related reading). |

*Source:* OECD (2004), *Learning for Tomorrow's World: First Results from PISA 2003*, OECD, Paris.



in terms of the mean student score. When interpreting mean performance, only those differences between countries that are statistically significant should be taken into account. Figure 1.3 therefore shows those pairs of countries where the difference in their mean scores is sufficient to say with confidence that the higher performance by sampled students in one country holds for the entire population of enrolled 15-year-olds.

## Figure 1.3 ■ Multiple comparisons of mean performance on the mathematics scale




Range of rank*

| | | Hong Kong-China | Finland | Korea | Netherlands | Liechtenstein | Japan | Canada | Belgium | Macao-China | Switzerland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | | 550 | 544 | 542 | 538 | 536 | 534 | 532 | 529 | 527 | 527 |
| SE | | (4.5) | (1.9) | (3.2) | (3.1) | (4.1) | (4.0) | (1.8) | (2.3) | (2.9) | (3.4) |
| OECD countries | Upper rank | | 1 | 1 | 1 | | 1 | 3 | 3 | | 3 |
| | Lower rank | | 3 | 4 | 6 | | 9 | 7 | 9 | | 10 |
| All countries | Upper rank | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 4 | 5 | 5 |
| | Lower rank | 5 | 5 | 6 | 8 | 11 | 12 | 10 | 11 | 13 | 13 |

| | | Australia | New Zealand | Czech Rep. | Iceland | Denmark | France | Sweden | Austria | Germany | Ireland |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | | 524 | 523 | 516 | 515 | 514 | 511 | 509 | 506 | 503 | 503 |
| SE | | (2.1) | (2.3) | (3.5) | (1.4) | (2.7) | (2.5) | (2.6) | (3.3) | (3.3) | (2.4) |
| OECD countries | Upper rank | 6 | 6 | 8 | 10 | 9 | 10 | 10 | 11 | 12 | 14 |
| | Lower rank | 10 | 10 | 15 | 14 | 15 | 16 | 17 | 18 | 19 | 19 |
| All countries | Upper rank | 8 | 8 | 10 | 13 | 12 | 13 | 13 | 14 | 15 | 16 |
| | Lower rank | 13 | 13 | 18 | 17 | 18 | 19 | 20 | 21 | 22 | 21 |

| | | Slovak Rep. | Norway | Luxembourg | Poland | Hungary | Spain | Latvia | United States | Russian Fed. | Portugal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | | 498 | 495 | 493 | 490 | 490 | 485 | 483 | 483 | 468 | 466 |
| SE | | (3.3) | (2.4) | (1.0) | (2.5) | (2.8) | (2.4) | (3.7) | (2.9) | (4.2) | (3.4) |
| OECD countries | Upper rank | 15 | 17 | 18 | 18 | 18 | 21 | | 21 | | 25 |
| | Lower rank | 22 | 22 | 22 | 24 | 24 | 24 | | 24 | | 26 |
| All countries | Upper rank | 18 | 20 | 21 | 21 | 21 | 24 | 23 | 24 | 28 | 29 |
| | Lower rank | 25 | 25 | 25 | 27 | 28 | 28 | 29 | 28 | 31 | 31 |

| | | Italy | Greece | Serbia | Turkey | Uruguay | Thailand | Mexico | Indonesia | Tunisia | Brazil |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | | 466 | 445 | 437 | 423 | 422 | 417 | 385 | 360 | 359 | 356 |
| SE | | (3.1) | (3.9) | (3.8) | (6.7) | (3.3) | (3.0) | (3.6) | (3.9) | (2.5) | (4.8) |
| OECD countries | Upper rank | 25 | 27 | | 28 | | | 29 | | | |
| | Lower rank | 26 | 27 | | 28 | | | 29 | | | |
| All countries | Upper rank | 29 | 32 | 32 | 33 | 34 | 34 | 37 | 38 | 38 | 38 |
| | Lower rank | 31 | 33 | 33 | 36 | 36 | 36 | 37 | 40 | 40 | 40 |

*** Because data are based on samples, it is not possible to report exact rank order positions for countries. However, it is possible to report the range of rank order positions within which the country mean lies with 95 per cent likelihood.**

### Instructions:

Read across the row for a country to compare performance with the countries listed along the top of the chart. The symbols indicate whether the average performance of the country in the row is significantly lower than that of the comparison country, significantly higher than that of the comparison country, or if there is no statistically significant difference between the average achievement of the two countries.

*Without* ***the Bonferroni adjustment:***
- Mean performance statistically significantly higher than in comparison country.
- No statistically significant difference from comparison country.
- Mean performance statistically significantly lower than in comparison country.

*With* ***the Bonferroni adjustment:***
- ▲ Mean performance statistically significantly higher than in comparison country.
- • No statistically significant difference from comparison country.
- ▽ Mean performance statistically significantly lower than in comparison country.

- Statistically significantly above the OECD average
- Not statistically significantly different from the OECD average
- Statistically significantly below the OECD average

*Source:* OECD PISA 2003 database.



In Figure 1.3, a country's performance relative to that of the countries listed along the top of the figure can be seen by reading across each row. The colour-coding indicates whether the average performance of the country in the row is either lower than that of the comparison country, not statistically different, or higher. When making multiple comparisons, *e.g.* when comparing the performance of one country with that of all other countries, an even more cautious approach is required, and only those comparisons that are indicated by the upward or downward pointing symbols should be considered statistically significant for the purpose of multiple comparisons. Figure 1.3 also shows which countries perform above, at or below the OECD average. It is not possible to determine the exact rank order position of countries in the international comparisons (see Box 2.1 in OECD, 2004 for details). However, Figure 1.3 shows, with 95% probability, the range of rank order positions within which the country mean lies, both for the group of OECD countries and for all countries that participated in PISA 2003.

Mean performance scores are typically used to assess the quality of schools and education systems. Mean performance however does not provide a full picture of student performance and can mask significant variation within an individual class, school or education system.

Achievement as measured by PISA has an impact on access to higher education and thus ultimately on economic advantage and other longer-term outcomes contributing to the well-being of both the individual and society. *Pathways to Success* (OECD, 2010), offers an example and shows for example that top performing Canadian students in PISA are twenty times more likely to access university than those performing at the bottom.

PISA results have shown that students' socio-economic background is a strong predictor of achievement (OECD, 2001; OECD, 2004; OECD, 2007). In this report, socio-economic background is a control variable in most of the models developed, to ensure that teaching and learning strategy effects are treated independently of socio-economic effects. Furthermore, the productivity model used may not be especially helpful in providing insights into the policies, strategies and practices that might allow for higher achievement and greater equity in achievement, despite the utility of such a model as an overarching way of establishing the importance of high achievement. However, theory and research on teaching and learning can prove helpful, as discussed below.

## DEFINITION AND RELEVANCE OF TEACHING AND LEARNING STRATEGIES

Teaching strategies refer to a broad range of processes, from the organisation of classrooms and resources to the moment-by-moment activities engaged in by teachers and students to facilitate learning. Student learning strategies refer to cognitive and meta-cognitive processes employed by students as they attempt to learn something new. PISA measures teaching and learning strategies using a variety of questionnaire items, which in turn are combined and scaled to yield a number of composite or index variables representing broad constructs. Examples of these constructs are disciplinary climate, teacher-student relations, memorisation strategies and time spent on various learning activities. Further, PISA 2003 gears these measures specifically towards the learning of mathematics. The recent publication of the first results from the OECD Teaching and Learning International Survey (see Box 1.1) adds considerably to the knowledge of differences in the uses of these strategies across participating countries, and affirms the importance of investigating these strategies. Although TALIS does not examine the relationship of these strategies to student learning, this would be possible using data from subsequent cycles of PISA (*e.g.* PISA 2006 and 2009).

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**Box 1.1 ■ The OECD Teaching and Learning International Survey**

The OECD Teaching and Learning International Survey (TALIS) is the first international survey in which the major focus is on the learning environment and the working conditions of teachers in schools. TALIS offers an opportunity for teachers and school principals to provide input into education analysis and policy development, by means of the issues examined in the survey. Cross-country analysis from TALIS will allow individual countries to identify other countries facing similar challenges and to learn from other policy approaches. The main study took place in 2007-08 and an initial report was published in 2009 (OECD, 2009). First results from TALIS appear below:

### Creating effective teaching and learning environments

In most countries, the large majority of teachers are satisfied with their jobs and consider that they make a significant educational difference to their students. Teachers are also investing in their professional development, both in terms of time and often also in terms of money, an investment which goes hand in hand with a wider repertoire of pedagogic strategies used in the classroom.

Better support for effective teaching is needed through teacher appraisal and feedback. The generally positive reception by teachers of the appraisal and feedback which they receive on their work indicates a willingness in the profession to move forward in this area.

TALIS highlights better and more targeted professional development as an important lever for improvement in teacher effectiveness. Relatively few teachers participate in the kinds of professional development which they find have the largest impact on their work, namely programmes leading to a qualification, and individual and collaborative research.

The hardest issues to resolve relate to the actual improvement of teaching practice. Teachers in most countries report using traditional practices aimed at transmitting knowledge in structured settings much more often than they use student-oriented practices, such as adapting teaching to individual needs.

TALIS suggests that effective school leadership plays a vital role in teachers' working lives and that it can make an important contribution to shaping the development of teachers. In schools where strong instructional leadership is present, TALIS shows that school principals are more likely to use further professional development to address teachers' weaknesses as identified in appraisals.

The close associations that TALIS shows between factors such as a positive school climate, teaching beliefs, co-operation between teachers, teacher job satisfaction, professional development, and the adoption of a range of teaching techniques provide indications that public policy can actively shape the conditions for effective learning. At the same time, the fact that much of the variation in these relationships lies in differences among individual teachers, rather than among schools or countries, underlines the need for individualised and targeted programmes for teachers to complement the whole-school or system-wide interventions that have traditionally dominated education policy.

*Source:* OECD (2009), *Creating Effective Teaching and Learning Environments: First Results from TALIS*.



In their well-known synthesis of factors influencing achievement, Wang *et al.* (1993) put forward the concept of proximity as a way of thinking about the relative effects of various factors. The general hypothesis is that, proximal factors, or those which touch the day-to-day lives of students most closely, are likely to be more influential than more distal factors, such as administrative characteristics of the education system at the national level. For example, classroom management, metacognitive processes, cognitive processes, home environment, parental support and student-teacher social interactions show stronger relationships to achievement than broad state- and district-level educational policies. This point is of crucial importance because it suggests that broad policy initiatives are likely to result in improved learning only if translated into change at the individual teacher or student level.

Among the many factors that influence scholastic proficiency, teaching and learning strategies are second only to home circumstances in their proximity to the day-to-day activities of students and hence in their potential to influence performance directly. Teaching strategies also change through educational policy initiatives and through teacher education and professional development. Determining which teaching and learning strategies are most effective in improving overall performance and reducing disparities in performance is one of the primary functions of educational research and one of the most direct ways in which policy decisions can influence learning.

From a policy perspective, it is also useful to consider briefly how strategies proved to be successful may be implemented. It is important to distinguish those that can be put into practice through teacher education from professional development or other policy initiatives within the control of educational jurisdictions, as well as to distinguish those that can be implemented at relatively low risk or low cost from those with significant risks or cost implications. Policy decisions based on relatively weak evidence can be justified if the risks are small and the costs are low, but not under other circumstances.

## EARLY RESEARCH ON TEACHING AND LEARNING STRATEGIES

Although one might expect research on teaching strategies and on learning strategies to converge, the two tend largely to follow separate paths. Much early work on teaching strategies follows a relatively simple "process-product" model, under which the primary focus is on correlations between classroom processes and student achievement. The archetypal study under this model is a small-scale classroom observational study which categorises and correlates various classroom processes with measures of achievement. During the 1970s, a number of relatively large-scale quasi-experimental field studies took this approach (*e.g.* Brophy and Evertson, 1974; Stallings and Kaskowitz, 1974; Clark *et al.,* 1979). However, research of this nature has declined in recent years.

Dunkin and Biddle's seminal volume *The Study of Teaching* (1974) summarised much of the early research on teaching. Other major syntheses of this work appeared in the third edition of the *Handbook of Research on Teaching* (Wittrock, 1986, particularly the chapters by Shulman, Brophy and Good, Rosenshine, and Stevens and Doyle). Dunkin and Biddle present a model for the study of teaching that extends beyond the dominant process-product model to include what the authors call presage and context variables. In this model, both these categories of variables have only indirect influences on outcomes. Shulman's *Handbook* chapter attempts to go beyond the process-product model to present a synoptic model that includes teacher and student backgrounds, curriculum content, classroom processes and the various contexts and agendas that impinge on teaching and



learning. The intellectual and social/organisational transactions which mediate teaching to produce learning are a major component of Shulman's model. This concept of mediation forms the basis for a broader approach that can help integrate research on teaching and learning.

Early research on teaching, especially that based on the process-product model, tends to be largely atheoretical, consisting essentially of a search for correlates of teaching variables with achievement. Research on learning has traditionally had a more theoretical orientation than research on teaching, and has grown out of either behavioural or cognitive psychology. Early studies in the behavioural tradition tend to be concerned with memory or conditioning, under a simple stimulus-response model. What goes on in the learner's mind between the stimulus and the response is not part of the model. Cognitive studies vary widely and include developmental work in the Piagetian tradition, problem solving, and learning by discovery, as well as meta-cognitive strategies, and other aspects of learning that can be identified with "active learning". Within the constructivist framework, more recent work may be considered as a logical extension of the cognitive approach. Such studies explore, at least implicitly, the intervening events between the stimulus and response or between the process and product.

Research on teaching and learning is beginning to converge in the mediating process and constructivist approaches. From this more integrated perspective, one may argue that students construct knowledge through a complex process of interaction with all of the features of their environment, including their home, peer group and school, as well as other sources of influence. Educational policy aims primarily at influencing the school environment, while other influences, such as home circumstances, may be mediated by broader social or economic policies. Nevertheless, educational policy may be designed to improve the effects of other environmental influences, particularly negative ones. Indeed, the whole concept of improving equity in educational achievement (not just in educational opportunities) may be said to stem from the need to overcome adverse influences outside the school.

Research on teaching and on learning is also converging to some degree in studies of the impact of self-concept, motivation, attention and meta-cognitive processes (strategies for learning). The work of Cronbach and Snow (1977) and others on aptitude-treatment interactions is an example of this convergence, specifically of the idea that teaching strategies can or should match learning styles. However, this research seems to offer little guidance on how such matches can be made under classroom conditions.

The well-known time-based model originally proposed by Carroll (1963) captures the notion that teaching influences learning by incorporating into the core model the components of opportunity to learn, time allocated by the teacher and quality of instruction. This model connects further with a broad approach to teaching and to educational policy in its extension by Bloom (1981) to the concept of "mastery learning". In an attempt to address directly the issue of equity in learning, Bloom proposes that the time allocated to accomplish a task vary sufficiently in order to allow almost all students to achieve specified learning outcomes. Putting this into practice, of course, requires significant variation in both school organisation and teaching strategies, to an extent that it is difficult to find examples of large-scale implementation of mastery learning, despite its strong research support.



## THE CARROLL MODEL AS A THEORETICAL FRAMEWORK

Many of the components of teaching and learning theories derive from the Carroll model (OECD, 2004). Indeed, although often cited as simply an argument for increasing time allocations, Carroll's formulation actually captures important elements of the teaching and learning process, such as quality of teaching, opportunity to learn, and student ability within the time framework. This model therefore warrants some elaboration.

In his original 1963 article in the *Teachers College Record,* Carroll sets out to propose a mathematical formulation of the common-sense notion that learning takes place in a time framework. The mathematical formulation of the Carroll model may be stated as:

> The degree of learning or achievement (*L*) is a function of the ratio of the time actually spent on learning (*Tsl*) to the time needed to learn (*Tnl*), or

$$L = f(\mathrm{Tsl}/\mathrm{Tnl})$$

Although mathematical in form, the model is essentially a conceptual one because the detailed nature of the function is unspecified in Carroll's original formulation. For example, it is not clear if the relationship is linear or if there are saturation, fatigue or other effects that might limit the value of spending more time on learning. Obviously, at some level, such limits exist. However, in practical terms, it is not at all simple to determine when individuals begin to approach these limits.

Although time is the central construct of Carroll's model, more specific components, which relate to teaching and learning, influence both time spent and time needed. The value of the model for studies such as this one derives from these components. Three components cover learner characteristics: ability, aptitude and perseverance. Ability refers to the underlying mode or style of learning relative to a particular task and hence affects time needed. Aptitude can be defined as the time needed to achieve mastery of a particular task. Perseverance is simply the amount of time the learner is willing to devote to the task. Two other components are characteristic of the learning environment: opportunity to learn and quality of instruction. Opportunity to learn is best thought of as limited by the total time available, or allocated time; quality of instruction influences time needed. Students exposed to low-quality instruction would be expected to require more time to learn than those exposed to higher-quality instruction. Although generally believed to be of crucial importance, quality of instruction is one of the most elusive constructs in the model because it involves a complex interplay of factors including teacher qualifications, resources and the nature of the moment-by-moment interactions that occur between teacher and students. Carroll's model itself offers no specific guidance as to what constitutes high- or low-quality instruction. Much of the empirical work on teaching strategies over the past few decades may be seen as a search for the essential elements that define high-quality instruction.

Caroll revisited his original 1963 model in a 1989 retrospective. He concludes that optimising academic learning time is one of the most important factors in improving student achievement. More recent reviews by Scheerens and Bosker (1997) and Marzano (2003) reinforce this conclusion. However, the problem remains of how this optimisation can be accomplished, especially within the overall constraints of conventional school years or days.

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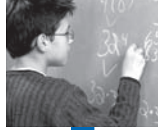



The Carroll model has been adopted to make a case for more learning time (*e.g.* Wiley and Harneschfeger, 1977) or for organising schools on a variable-time basis, in which students who need more time are given more time (*e.g.* Bloom, 1976). In practice, however, school systems are not organised explicitly in either of these ways and it is difficult to see how such changes could be implemented on a large scale within any jurisdiction. For the most part, any variations in learning time must fit within the global constraints of the school day and year by optimising use of the total time available within the school, trading off time on one subject against that spent on others, or adding to this time through appropriate out-of-school activities such as homework. The present study shifts the focus from looking directly at time to examining teaching and learning strategies that might help optimise time spent and reduce time needed. This approach provides a powerful heuristic for policy because it allows policy makers to think in terms of a broad factor over which they may have some influence.

A number of factors associated with effective mathematics instruction and effective student learning strategies also form part of the time model. These factors include time on task, homework, opportunity to learn, time lost on non-instructional activities, quality of curriculum and instructional material and quality of assessment practices. Many of the relationships identified are supported by recent research syntheses, particularly those by Wang *et al.* (1993), Scheerens and Bosker (1997) and Marzano (2003) and by a number of reports based on PISA 2000 (*e.g.* Kirsch *et al.,* 2002; Artelt *et al.,* 2003).

The Wang *et al.* synthesis is particularly useful because it supports the hypothesis that proximal variables are more closely associated with learning than distal variables. More specifically, the variables showing the strongest relationships with achievement are those in the areas of classroom management, meta-cognitive processes, cognitive processes, home environment and parental support, and student-teacher social interactions. Motivation, peer group influences, quantity of instruction, classroom climate, and other proximal variables also receive high rankings (Wang *et al*, 1994). This work also shows that variables related to broad state- and district-level educational policies are less influential. However, the Wang *et al.* formulation does not consider the possibility of indirect influences of such factors, through their more direct impact on instructional processes.

Some of the more recent syntheses have helped identify more specific positive influences on achievement. For example, Scheerens and Bosker (1997) produce a ranking of school factors found to have positive influences on learning. These include time, monitoring, pressure to achieve, parental involvement and content coverage. The type of school climate most likely to enhance learning is one with an orderly atmosphere, rules and regulations, and good student conduct and behaviour. Similarly, effective classroom management strategies include direct instruction, monitoring student progress and a positive attitude to work.

Most of the studies in the various syntheses have been small-scale and local in scope and typically cover only a few of the many variables that might be expected to influence learning. Because of the large number of variables available and the wide range of contexts used, large-scale surveys such as PISA offer the potential to uncover more robust relationships, as well as to investigate the influence of variations in context on the results. The extensive coverage of the PISA database allows the analysis of particular factors that may positively or negatively relate to students' achievement, while also taking account of other factors that may cloud or complicate this relationship.



It must also be noted that large-scale surveys have shortcomings in other ways. In particular, only partial information can be gathered on teaching strategies because of the limitations of self-report questionnaires, the inability to sample adequately at the school or classroom level and the cross-sectional nature of these studies. A particular limitation of PISA in this respect is the absence of a teacher questionnaire in both the 2000 and 2003 surveys. Such an instrument would make it possible to capture much more detailed information on instructional practices and opportunity to learn than the student and school questionnaires permit.

However, cross-sectional studies are unable to capture instructional strategies occurring over the student's whole school career. The data on teaching strategies are thus less stable and cumulative than variables on home environment or student characteristics, for example, which reflect the individual's life experience. The correlations, which are the basis of most of the analysis in this report, are therefore likely to be weaker for teaching and learning strategies than for student background variables and weaker than would be expected based on the proximal-distal hypothesis. This limitation of the data is less of a problem for student learning strategies than for teaching strategies, as one might expect the particular learning strategies used by students to be products of their long-term exposure to a particular school or school system.

PISA did not collect information on all components of interest within the Carroll model and its extensions. For example, it did not examine ability or opportunity to learn. In addition, this report does not correlate all of the measures collected in PISA with achievement. For these reasons, and to avoid having overly cumbersome models, the report provides two stages of initial selection. First, the report uses only those variables showing consistent patterns of correlation with mathematics achievement across countries. Second, the report drops variables from successive iterations of the main models if they show few significant effects in the presence of other variables in the model. Note that the report retains a few variables judged to be of particular policy relevance even if they do not meet these criteria, as it may be helpful to indicate explicitly that these variables have minimal effects.

## KEY TEACHING AND LEARNING VARIABLES

The PISA database contains observed variables representing responses by students and school principals to all questionnaire items, as well as overall assessment results. Some of the questionnaire items ask for facts (*e.g.* "Do you have a study desk at home?"). Others require estimates of time or other factors (*e.g.* "How many hours per week do you spend on homework?"). Finally, some items are intended to solicit opinions (*e.g.* "I do mathematics because I enjoy it"). These last items usually provide a four-point scale for response, from "strongly agree" to "strongly disagree" or another similar scale, such as degree of confidence.

During the initial design and analysis, many of the questionnaire items combine to form a number of derived or index variables, representing broader underlying constructs. For example, the *index of disciplinary climate in mathematics lessons* derives from student responses to five items on the student questionnaire concerning the extent to which students did not listen to the teacher, could not work well, lost time at the start of each lesson by not working or quietening down, and reported noise and disorder. For the most part, index variables representing teaching and learning strategies are the ones of most interest here. Although more abstract than the observed variables, they are more efficient in building models because they capture more information in a single scale and because

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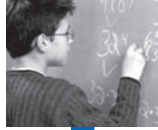




Table 1.1
**Key teaching and learning variables**

| Variable | Scale/unit | OECD average | Definition/illustrative questionnaire item |
|---|---|---|---|
| Total homework time | Hours per week | 5.89 | |
| Mathematics homework time | Hours per week | 2.43 | |
| Tutoring | Dichotomous (1,0) | *[1] | Student being tutored or not. |
| Out-of-class lessons | Dichotomous (1,0) | * | Student taking out-of-class lessons or not. |
| Memorisation/ rehearsal strategies | Standard score | 0 | When I study mathematics, I try to learn the answers to problems off by heart. |
| Elaboration strategies | Standard score | 0 | When I am solving mathematics problems, I often think of new ways to get the answer. |
| Control strategies | Standard score | 0 | When I study mathematics, I start by working out exactly what I need to learn. |
| Competitive learning preference | Standard score | 0 | I make a real effort in mathematics because I want to be one of the best. |
| Co-operative learning preference | Standard score | 0 | I do my best work in mathematics when I work with other students. |
| Teacher support | Standard score | -0.01 | The teacher helps students with their learning. |
| Student-teacher relations | Standard score | 0.01 | If I need extra help, I will get it from my teachers. |
| Disciplinary climate | Standard score | 0.01 | Students don't listen to what the teacher says. |
| School average disciplinary climate | Standard score | 0 | Disciplinary climate aggregated to the school level. |

scaling the index variables in a certain way more closely meets the underlying assumptions of the models. However, particularly at the descriptive stage, values for observed variables have also been reported because these are more intuitively clear and more directly descriptive of behaviour. For example, one may interpret the observed variable "noise and disorder in the classroom" in a straightforward way through response frequencies to the categories used in the questionnaire.

The teaching and learning variables selected for consideration in the final models are set out in Table 1.1. The actual questions that make up many of the index variables used, as well as the response proportions for these questions, appear in much greater detail in Chapter 3 of *Learning for Tomorrow's World: First Results from PISA 2003* (OECD, 2004).

## CONTROL VARIABLES

The report treats student socio-economic background, attitudes and motivations as antecedent conditions, which should be adjusted for in developing models designed to investigate the effects of teaching and learning strategies on achievement. This report recognises that the direction of causality is problematic in models based on correlational methods and that other analytical approaches could treat attitude or engagement variables either as outcomes or as attributes that might actually be taught as indirect ways of improving achievement. For example, it is commonly argued that high self-concept is a by-product of high achievement or that teaching should be designed to ensure that student self-concept is not damaged. These issues, though interesting in their own right, are not addressed here.

The control variables used in the models developed for this report appear in Table 1.2. Again, further details on the index variables appear in *Learning for Tomorrow's World: First Results for PISA 2003* (OECD, 2004).



Table 1.2
**Control variables**

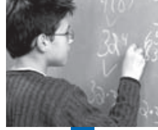
| Variable | Scale/unit | OECD average | Definition/illustrative questionnaire item |
|---|---|---|---|
| **Socio-economic status** | | | |
| Highest occupational status of parents | Standard score | 48.79 | Scaled score from student-reported parent occupations. |
| Highest educational level of parents | | 4.19 | 6-point scale of standard international educational levels (based on ISCED) from student-reported educational level of parents. |
| Books in home | | 3.50 | 6-point questionnaire scale, 0-10=1, more than 500=6 |
| **Attitudes** | | | |
| Interest and enjoyment of mathematics | Standard score | 0 | I look forward to my mathematics lessons. |
| Sense of belonging in school | Standard score | 0 | School is a place where I feel like I belong. |
| Mathematics anxiety | Standard score | 0 | I get very nervous doing mathematics problems. |
| **Perceptions of mathematics competency** | | | |
| Mathematics self-efficacy | Standard score | 0 | How confident do you feel about having to do … (selected mathematics tasks)? |
| Mathematics self-concept | Standard score | 0 | I get good marks in mathematics. |
| **Motivation** | | | |
| Instrumental motivation | Standard score | 0 | I will learn many things in mathematics that will help me get a job. |
| **School variables** | | | |
| School size | 100 students | 5.36 | Total school enrolment/100. |
| School average highest occupational status of parents | | 46.98 | Highest occupational status of parents aggregated to school. |

## OTHER VARIABLES

As already indicated, the report excludes some variables identified in the original formulation from the main models used here because in general they show non-significant correlations with achievement or small effects in early iterations of the model. Many of the school-level questionnaire variables are in this category. Some examples of these variables are those around streaming and grouping and assessment practices. The report retains total instructional time and mathematics instructional time through to the final model but these show non-significant effects throughout. Because they are useful indicators of differences between countries and between schools within countries, the report discusses some of these variables as part of the descriptive analysis presented in Chapter 2. These variables are also of policy interest and show significant effects in other studies.

## OVERVIEW OF THE ANALYTICAL APPROACH

This report follows a two-stage analytical approach. Chapter 2 reports on the first stage. It includes a descriptive/comparative analysis of mathematics teaching and learning that describes how mathematics is taught in different countries, examines variations across schools within countries, and, based on this analysis, presents a broad profile of commonalities and differences in mathematics teaching and learning. While limited in their ability to provide explanations for differences in mathematics teaching methodology, the Chapter 2 results inform policy makers in individual countries





as to how their situation might differ from that of other countries in terms of consistency or variety among schools.

Chapter 3 reports on the second stage. This stage requires the construction of a comprehensive two-level (student and school) prediction model of the factors influencing mathematics achievement. Primary emphasis is on the teaching and learning strategy variables described in Table 1.1. Following the temporal logic described earlier, the control variables as given above in Table 1.2 are antecedents to teaching and learning and hence entered into the model in stages, before the teaching and learning variables. This approach allows the predictive power of the model to be determined as groups of variables enter in stages. Nevertheless, the basis of the final reporting of the effects of each of the main variables is the full model. While this limits the ability to examine in detail the joint and mediating effects of variables, the full model gives a more complete picture of the real world of teaching and learning than do the intermediate models. The intermediate models may be of more theoretical interest while the full model is of more interest from a policy perspective. The report then examines mediating effects in part by comparing effects using the full model with those for each variable used independently (a bivariate model).

Further details on the analytic procedures used are given at the beginning of Chapters 2 and 3.

## *Note*

1 The asterisks in Table 1.1 indicate where only proportion information is available.

# References

**Artelt, C.** *et al.* (2003), *Learners for Life: Student Approaches to Learning,* OECD, Paris.

**Bloom. B. S.** (1976), *Human Characteristics and School Learning*, McGraw-Hill, New York.

**Brophy, J.** and **C. Evertson** (1974), *Process-Product Correlations in the Texas Teacher Effectiveness Study: Final Report,* Research and Development Center for Teacher Education, Austin, TX. (ERIC ED091 094)

**Carroll, J.B.** (1963), "A Model for School Learning", *Teachers College Record,* Vol. 64, No. 8, pp. 723-733.

**Carroll, J.B.** (1989), "The Carroll Model: A 25-Year Retrospective and Prospective View", *Educational Researcher*, Vol. 18, No. 1, pp. 26-31.

**Clark, C.** *et al.* (1979), "A Factorial Experiment on Teacher Structuring, Soliciting and Responding", *Journal of Educational Psychology*, Vol. 71, pp. 534-552.

**Cronbach, L.J.** and **R.E. Snow** (eds.) (1977), *Aptitudes and Instructional Methods,* Irvington, New York.

**Dunkin, M.** and **B. Biddle** (1974), *The Study of Teaching,* Holt, Rinehart and Winston, New York.

**Kirsch, I.** *et al.* (2002), *Reading for Change,* OECD, Paris.



**Marzano, R.** (2003), *What Works in Schools: Translating Research into Action,* Association for Supervision and Curriculum Development, Washington.

**OECD** (2001), *Knowledge and Skills for Life: First Results from PISA 2000*, OECD, Paris.

**OECD** (2004), *Learning for Tomorrow's World: First Results from PISA 2003*, OECD, Paris.

**OECD** (2007), *PISA 2006: Science Competencies for Tomorrow's World*, OECD, Paris.

**OECD** (2009), *Creating Effective Teaching and Learning Environments: First Results from TALIS*, OECD, Paris.

**OECD** (2010), *Pathways to Success: How knowledge and skills at age 15 shape future lives in Canada*, OECD, Paris.

**Scheerens, J.** and **R. Bosker** (1997), *The Foundations of Educational Effectiveness,* Elsevier, New York.

**Stallings, J.** and **D. Kaskowitz** (1974), *Follow-Through Classroom Observation Evaluation,* Stanford Research Institute, Stanford, CA.

**Sweetland, S.R.** (1996), "Human Capital Theory: Foundations of a Field of Inquiry", *Review of Educational Research*, Vol. 66, No. 3, pp. 341-359.

**Wang, M.C., G.D. Haertel** and **H.J. Walberg** (1993), "Toward a Knowledge Base for School Learning", *Review of Educational Research*, Vol. 63, No. 3, pp. 249-294.

**Wang, M.C., G.D. Haertel** and **H.J. Walberg** (1994), "What Helps Students Learn?", *Educational Leadership,* December 1993-January 1994, pp. 74-79.

**Wiley, D.** and **A. Harneschfeger** (1974), "Explosion of a Myth: Quantity of Schooling and Exposure to Instruction", *Educational Researcher*, Vol. 3, No. 4, pp. 7-12.

**Wittrock, M.C.** (ed.) (1986), *Handbook of Research on Teaching,* Third edition*,* Macmillan, New York.

2

# Features of Teaching and Learning

*This chapter reports on the observed associations between various aspects of teaching and learning strategies and mathematics performance. The chapter examines characteristics of students, schools and countries and studies the distribution of these characteristics. This kind of examination leads to a number of questions such as: How much do students benefit from a classroom atmosphere that is conducive to learning? To what extent do some students employ more effective learning strategies or devote more time to learning than others? Do individual countries' education systems provide different conditions for teaching and learning to different students and in different schools?*



## INTRODUCTION

To what extent do students aged 15 benefit from teaching and learning strategies associated with the acquisition of mathematical competence? This chapter looks at characteristics of students, schools and countries in terms of various features of teaching and learning. It studies in particular the distribution of these characteristics. For example, to what extent do some students benefit more than others from a classroom atmosphere conducive to learning? To what extent do some students employ more effective learning strategies or devote more time to learning than others? Do individual countries' education systems provide different conditions of teaching and learning for different students and in different schools?

This chapter reports on the extent to which there are observed associations between various aspects of teaching and learning and mathematics performance. The analysis reveals the extent to which the factors whose presence or absence is being investigated are those that tend to go together with higher student achievement. It does not describe the extent to which teaching and learning strategies leads to higher performance; this information appears in Chapter 3, which uses modelling to explore how such strategies may or may not be related to outcomes.

A compelling case can be made that mathematics is fundamentally a school subject. It is difficult to imagine that any significant level of mathematical competence, particularly in its more formalised sense, could be acquired outside of the school setting. Only the most motivated students will be able to acquire any significant level of mathematical competence, particularly in its more formalised sense, outside the school setting. In this respect, mathematics learning happens in a different way from language learning. There is no direct mathematical equivalent of the bedtime story, nor is mathematics used, in anything other than a rudimentary way, in everyday communication among people. At the same time, full participation in many modern societies requires more than a basic knowledge of mathematics, and a high level of mathematical competence is essential in many occupational areas. In addition, mathematics is the foundation of much of the scientific and technical activity that distinguishes advanced from less advanced societies. Developing students' mathematical competence at a much higher level than is required for everyday communication is thus a goal of most school programmes.

One can hypothesise that school and classroom activities should have more impact on overall mathematics achievement than on overall language achievement. Almost all students in OECD countries have exposure to mathematics teaching at least up to the age of 15, the age level assessed in PISA.[1] To what extent can differences in student performance be attributed to differences in the level of exposure to mathematics instruction? More particularly, is it possible to associate differences in performance with the various different approaches to teaching and learning? In investigating the extent of all these differences, this chapter concentrates on differences among schools and students within countries, which are greater overall than differences across countries.

## FACTORS DESCRIBING TEACHING AND LEARNING

PISA uses students' and school principals' responses to questionnaires in order to construct indicators of teaching and learning. As described in Chapter 1, PISA has developed a series of indices which are the indicators of teaching and learning strategies presented in this report, such as the *index of disciplinary climate in mathematics lessons* and the *index of co-operative learning*. Each index is

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derived from students' reports on a number of statements. For example, the *index of disciplinary climate in mathematics lessons* is derived from student responses to five statements, including how frequently there was noise and disorder in their mathematics lessons ("every lesson", "most lessons", "some lessons", "hardly ever" or "never"). This chapter presents descriptive information on student responses to each of the statements within the PISA indices. Please note that the bases of all modelling in Chapter 3, however, are the PISA indices.

While the main purpose of this chapter is to provide a profile of teaching and learning, it also supplies preliminary indications as to whether the factors described have any relationship with student performance in mathematics. This analysis is important in order to pick out those factors which might be significant in the overall picture of teaching and learning. For example, any discussion of how much homework is given in different schools should reference the investigation of whether more homework produces better learning outcomes. However, the simple effects of each factor on student performance in mathematics reported in this chapter should be treated with caution, just as first indications. First, PISA is a cross-sectional study and therefore cannot demonstrate that certain student or school characteristics lead to better performance. Rather, PISA shows associations or relationships between particular student or school characteristics and student performance. These "bivariate" associations – that is, the simple effect of the factor on student performance, not taking into account any other factors – do not indicate causality and, to a varying degree, may exist because of their correlation with other teaching and learning or background factors. For instance, if students who experience an orderly classroom environment do well in mathematics but also tend to come from socially advantaged home backgrounds, it might be their home advantages rather than the atmosphere in which they learn, or a combination of the two, which explain the relationship with performance. Indeed, there is likely to be a link between these two factors, as students from more advantaged backgrounds are probably going to be better attuned to the culture and expectations of the school. Chapter 3 explores these interactions and separates out the unique effects of each factor.

This chapter examines variation in teaching and learning strategies within countries, especially among schools within countries. The analysis therefore centres around within-country distributions as represented by percentile ranks. The wider the range of values covered in these distributions, the greater the variability in teaching and learning within countries. In particular, the analysis considers such variations across schools by looking at the distribution of school-level results. Use of time and teaching strategies may logically be seen as characteristics of a school and not of an individual student.[2] On the other hand, one may logically consider student learning strategies as characteristic of individuals, as well as being influenced by school characteristics and teaching strategies. The chapter examines student learning strategies in terms both of variation among students and of variation among schools.

The analysis below looks in turn at four broad groups of variables: time inputs, student learning strategies, teaching strategies and the learning climate.



## ALLOCATION AND USE OF TIME

### Overview

Much research on teaching and learning is grounded, at least implicitly, in the issue of allocation and use of time. The Carroll model (Carroll 1963 and 1989) and variations on this model have provided the theoretical underpinning for the investigation of time allocation and use. Researchers accept the fundamental proposition that learning is a function of time (though obviously not of time alone), although the details of that functional relationship continue to be the subject of research and debate. Many other factors that affect learning can be formulated in terms of time. For example, a positive disciplinary climate may be conceived as one that minimises lost time and maximises the time students spend on tasks. Similarly, motivation can be considered, to some degree, as time spent in perseverance, one of the factors explicitly identified in the Carroll model.

From a policy perspective, time is important because central authorities can regulate overall time allocations, such as the length of the school year and school day – and sometimes time allocations to specific subject areas. In addition, more detailed measures of time such as the length of class periods, transition times, homework and time spent on tasks in the classroom may be modified through school and district policies and through particular teaching and learning strategies. Indeed, many teaching strategy variables may be conceptualised as strategies for maximising time on task.

The PISA 2003 survey produced results on three main aspects of time use: instructional time, extra tuition and homework. These aspects cover the main identifiable time that students spend on learning activities. Table 2.1 summarises the results for these three areas. It shows that in a few countries, there are large variations in the time devoted to learning, but many countries have school systems with low variability in this respect. Norway epitomises the latter group, where instruction time is uniform, where only a tiny minority take out-of-school classes and students report doing similar amounts of homework. By contrast in Mexico, weekly instruction time varies greatly from one school to another, most students have extra tuition outside school and whereas one-quarter of students do more than seven hours of homework per week, one-quarter do less than four hours.

Are these differences important? The PISA survey can provide only limited answers to this question. Inconsistencies in the measures of instructional time (see below) have led to its relationship to performance not being modelled in this case. For example, time spent on extra tuition may help students perform better in mathematics, but since it is often weaker students who need to have this extra help, it is not associated with higher achievement. However, students spending more time doing homework overall tend to do better in mathematics in most countries, but the size of the difference is generally small. Thus, PISA provides a tool to compare variations in learning time, while offering little evidence on their effects (see also Chapter 3).

### Instructional time

The report measures total instructional time by questions on the school questionnaire about the number of weeks in the school year and questions on the student questionnaire about the length of class periods and the number of class periods per week. The product of these two constitute an *index of total minutes per week.* The product of period length and total mathematics periods per week gives an *index of total mathematics minutes per week.* Finally, the ratio of mathematics minutes to total minutes yields an *index of the proportion of total time that is spent on mathematics.*

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The distributions of number of weeks in the school year appear in Table A.1 of Annex A, Descriptive Statistics.[3] On average in the OECD countries, the school year consists of 37 weeks, with most countries within two weeks of this average. However, the Czech Republic and the partner country Brazil have a 41-week school year, while Mexico averages only 24 weeks. Indeed,

Table 2.1
**Distribution of learning time and relationship with performance**

| OECD average | How much does this vary within each country? Variability within middle half of schools (interquartile range) except where specified | How is this associated with performance? (Bivariate effect on mathematics score, significant effects only) |
|---|---|---|
| | **Instruction time** | |
| 36.7 instructional weeks per year | OECD average range = 1.9 weeks<br>Most variability: 6 to 9 weeks in Hong Kong-China, Japan, the Slovak Republic and in Indonesia<br>Least variability: 0 weeks in Denmark, Finland, Greece, Luxembourg, Norway, the United Kingdom and the United States, and in Latvia, Serbia and Thailand | No analysis |
| 24.4 instructional hours in school week | OECD average range = 3.9 hours<br>Most variability: 13 hours in Mexico and 20 hours in the United States<br>Least variability: <1 hour in Norway, the United Kingdom, Finland and Luxembourg, and <2 hours in Latvia and Poland | |
| 888 total instructional hours per year | OECD average range = 155 hours per year<br>Most variability: 702 hours in the United States, 333 to 260 hours in Austria, Hong Kong-China, Mexico, Uruguay and Japan<br>Least variability: <90 hours in Norway, Greece, Finland, Luxembourg, the United Kingdom, Denmark, the Czech Republic, Latvia, Iceland and Hungary | |
| | **Extra tuition** | |
| 20% of students report being tutored (individually) in total and 15% in mathematics | Tutoring in total and in mathematics:<br>Highest percentages: 90% of students in Mexico, 53% in Turkey (total only)<br>Lowest percentages: fewer than 10% of students in Finland, Denmark, Norway, Japan, Belgium, Sweden, Liechtenstein and Netherlands | Negative: students receiving extra help tend to be weaker performers |
| 25% of students report attending out-of-school lessons (in groups) in total and 13% in mathematics | Out-of-school lessons in total:<br>Highest percentages: 92% in Mexico, 67% in Turkey and 66% in Greece<br>Lowest percentages: <10% in Germany, Austria, Norway and France | |
| | **Homework** | |
| Students report doing 5.9 hours per week of homework or other study set by teachers in total | OECD average range = 2.7 hours<br>Most variability: 5.9 hours in Italy, 4.7 hours in Hungary, 4.4 hours in Greece and 4.2 hours in the Russian Federation<br>Least variability: 1.5 hours or less in Finland, Sweden, Denmark and Luxembourg | Positive in 24 countries: in 7 where effect is strongest, each hour of homework associated with 3 score points in mathematics. Negative in 4 countries. |
| Students report doing 2.4 hours per week of homework or other study set by mathematics teachers | OECD average range = 1 hour<br>Most variability: 2.1 hours in Macao-China and Thailand and 1.7 hours in Italy<br>Least variability: 0.5 hours or less in Luxembourg, Finland and Liechtenstein. | Positive in 10 countries, negative in 18. But performance difference small over observed range of homework practice. |

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only one-quarter of all schools in Mexico report at least 23 school weeks per year,[4] although a few Mexican schools do have much longer years, with 5% of schools reporting at least 42 weeks per year.

As the example of Mexico indicates, there are striking differences in the variation of number of instructional weeks in the school year within different countries. In one-half of the participating countries, the school year is more or less a standard length (varying by no more than one week). In Japan, the Slovak Republic, as well as the partner economies Hong Kong-China and Indonesia, the quarter of schools with the longest school years have at least six weeks more school time than the quarter of schools with the shortest school years. While this finding might relate to the degree of central direction of school systems, countries as different as the United States and the partner country Latvia are among those with little variation in the school year, while Japan and the partner economy Hong Kong-China have wide variations, despite their relatively centralised education systems.

The distributions of total weekly instructional time appear in Table A.2. Overall, the average amount of instructional time in a school week in the OECD countries is 24.4 hours. Again, the variation across countries is considerable, with the longest weeks in Korea and the partner country Thailand (around 30 hours each), and the shortest in the partner country Brazil (19 hours). In fact, the ratio of the most to the fewest hours in the school week (1.6) is similar to the ratio of the most to the fewest weeks in the school year (1.7). The United States, Austria, Mexico, Japan, Korea and Italy, as well as the partner economies Hong Kong-China, Uruguay and Brazil, show the greatest internal variation in length of week (at least 200 hours difference between the 25$^{th}$ and 75$^{th}$ percentiles).

Combining the number of weeks in the school year with the instructional time per week gives an *index of total instructional time per year.* The distributions for this index appear in Table A.3. Overall, students in the OECD countries receive an average of 888 hours of instruction per year. Most OECD countries, with the exception of Korea (1074 hours), Austria (991 hours) and Mexico (565 hours), fall within a range of 85 hours, or about 10% of the total. The partner economies Thailand, Liechtenstein and Macao-China all provide over 1000 hours of instruction per year. The amount of total instructional time per year varies substantially among schools within each country: within most countries, there is a difference of 400 or more hours between schools at the 5$^{th}$ and 95$^{th}$ percentile on this measure.

These figures are partially inconsistent with those reported by the OECD (2005). This finding raises some concern about the reliability of some of the time figures as reported by students, which may account for unusually low correlations found between some time indices and achievement. For this reason, the report excludes many of the time indices from the final model presented in Chapter 3. However, the Carroll model suggests that the large variations in time allocation between countries and between schools is likely to be of greater significance for mathematics achievement than the results here would indicate. In order to allow a more thorough investigation of this issue, a method of obtaining consistent measures of these major elements of time needs to be found.

The distributions of hours per week devoted to mathematics instruction appear in Figure 2.1. In the OECD countries, mathematics instructional time averages 3 hours and 18 minutes per week. Among countries, means vary from around 4.5 hours in the partner economies Hong Kong-China

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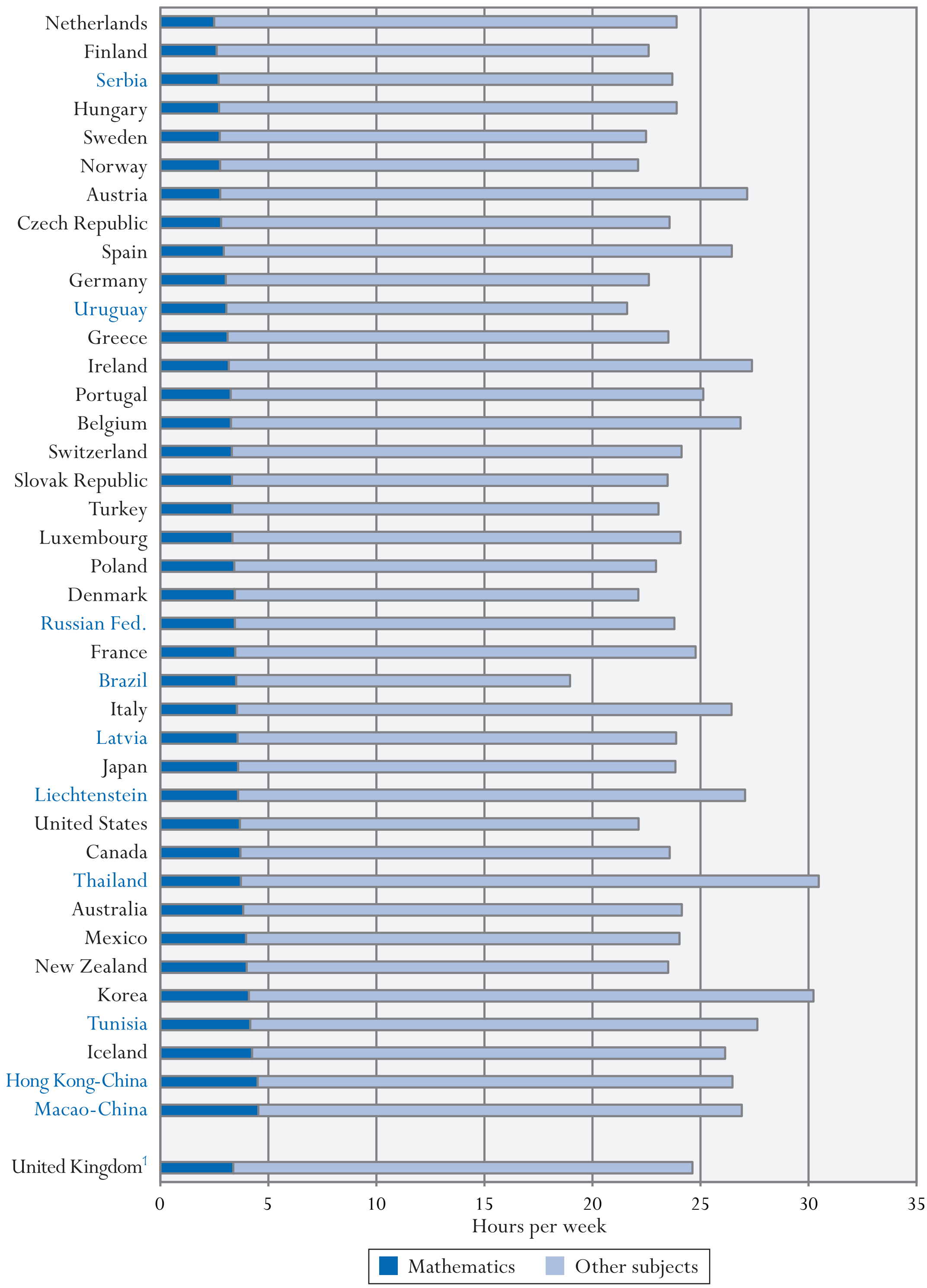
Figure 2.1 ■ **Hours per week spent on homework for mathematics and other subjects**




*Note:* Countries are ranked in ascending number of hours per week of mathematics homework.

1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.



and Macao-China to 2.5 hours in the Netherlands, close to a two-fold difference. In addition, on average in the OECD the within-country variation in mathematics teaching time per week is 1 hour (see Table A.4). However, Canada stands out as the OECD country with the most pronounced differences: a quarter of all students spend less than 1.5 hours a week learning mathematics, while another quarter spend nearly six hours or more.

### Tutoring and out-of-school classes

Some students participate in organised mathematics learning outside the regular school programme, mainly in the form of being tutored or attending additional classes in school subjects. The difference between these is essentially whether the instruction is individual or group-based. There may be many reasons for such activities. In highly competitive systems, for example, these activities may be seen by students and parents as a means of obtaining a competitive edge. Even in less competitive environments, tutoring and other out-of-school work may be a means of attaining high achievement, improving the performance of students who are not doing well or compensating for perceived limitations in what the school can provide.

In the questionnaire, students report the number of hours per week they work with a tutor and spend attending out-of-school classes, both overall and specifically in mathematics. Because relatively few students in most countries report any time at these activities, it is not meaningful to reproduce or compare average times by school. Instead, for each country the report provides a computation of the proportion of students declaring any time spent at these activities, and the most common (modal) number of hours per week for those reporting non-zero time. These results appear in Figure 2.2.

It is clear that this extra tuition plays a much greater role in some countries than others. Almost all students in Mexico report that they are both tutored and attend out-of-school classes. The proportions are also quite high in Greece and Turkey.[5] However, in most countries, the proportions of students reporting tutoring in mathematics are considerably smaller, averaging 20% overall and 15% for mathematics across the OECD countries.

It might be expected that high proportions of time spent on these activities would be associated with shorter school weeks, indicating that students find ways to compensate for limited instructional time. However, these measures are essentially uncorrelated. That being said, within most countries there is a distinct negative correlation with mathematics performance (see Chapter 3). This finding indicates that tutoring and extra classes tend to help compensate for weak performance more than to support already able students to advance further. The likelihood that students will take extra tuition if they are weak performers makes it very difficult to assess its overall value in a study that does not track individual students: in PISA, no link can be made between extra tuition and good performance.

### Homework

There is a considerable literature supporting the claim that homework is a factor contributing to achievement (Marzano, 2003). However, lack of controls for ability in many studies, and thus the possibility that lower-ability students will spend more time at homework than their higher-ability peers, confounds this relationship. The PISA student questionnaire asks two questions about

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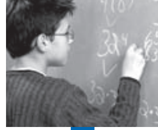
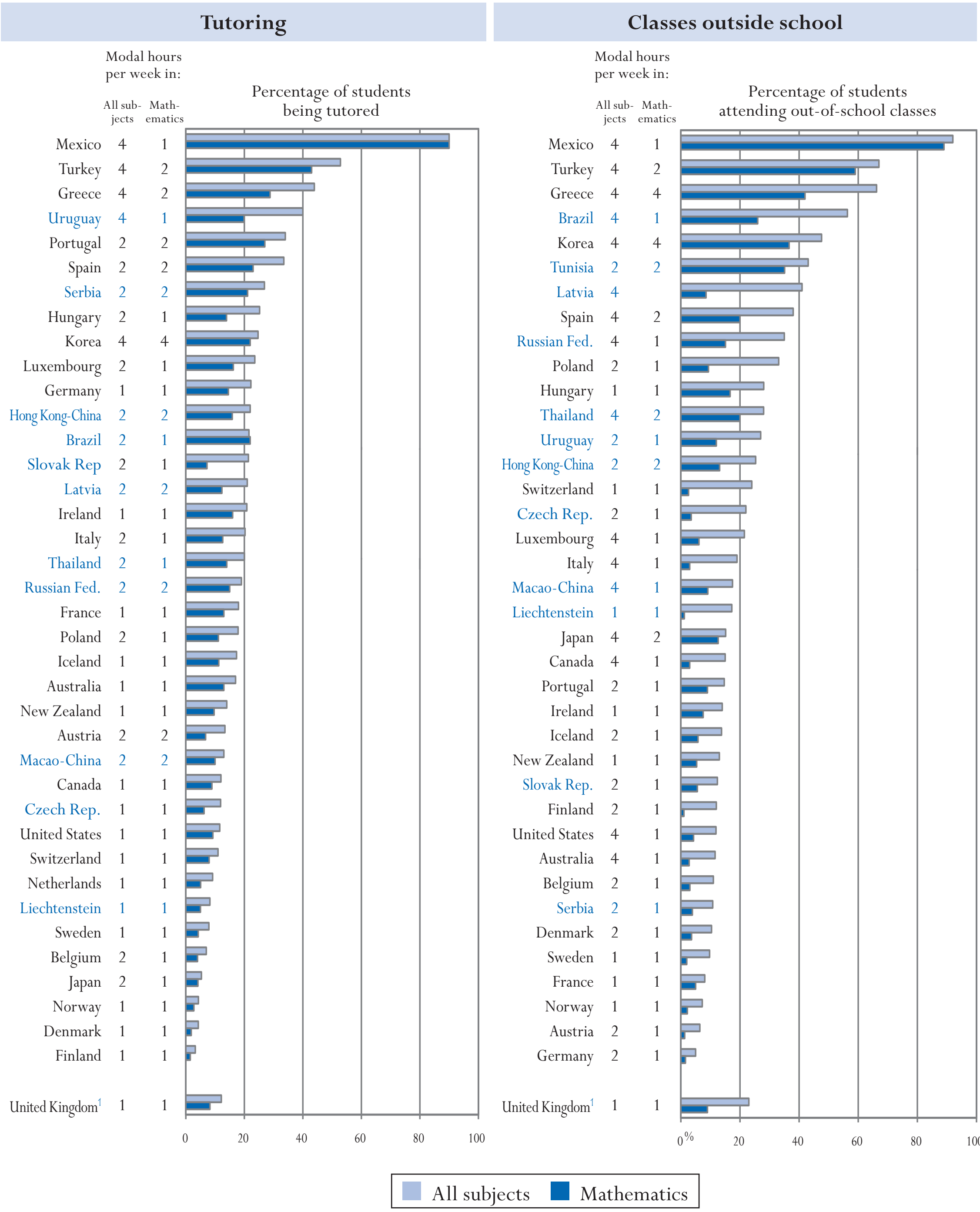




## Figure 2.2 ■ **Hours per week spent on tutoring and out-of-school classes**




*Note:* Countries are ranked in descending order of the percentage of students either being tutored or attending out-of-school classes in all subjects.

1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.



homework: the first on hours per week of homework set by all teachers and the second on hours per week of homework set by mathematics teachers. For total time spent on homework each week, there is in fact a positive correlation with performance (see Chapter 3); this is consistent with the other research showing the benefits of homework.

There are marked differences between countries in the total amount of homework reported (see Table A.5). The partner country, the Russian Federation, reports most total homework, a mean of more than 12 hours per week. In addition, Italy, Hungary, the Slovak Republic, Greece and Poland, and the partner country Latvia, also show mean homework times of between 8 and 10.5 hours. At the other extreme, mean homework times per week are less than 4 hours in Korea, Finland, Japan, the Czech Republic, Sweden and Austria.

If homework is beneficial, to what extent are students in some schools disadvantaged compared to others by doing less homework? The largest variations across the middle 50% of schools, in hours, occur in Italy, Hungary, Greece, and the partner country, the Russian Federation, as depicted in Figure 2.3. The variation is great relative to the (sometimes small) national average for homework in certain other countries as well. For example in Japan, the quarter of students with the least homework do a maximum of 1 hour and 48 minutes each week, while the quarter with the most do over 4.5 hours. In Hungary, the bottom quarter do up to 7 hours and 42 minutes, but the top quarter do over 12 hours' homework per week. Students in all schools in the top quarter do more than twice as much homework as students in the bottom quarter in Japan and the Netherlands. The ratio of the top to the bottom quarter of schools is at least 1.8 in Australia, Austria, Belgium, Canada, the Czech Republic, Italy and Mexico, and the partner economies Hong Kong-China and Thailand, showing that in general there are important differences between the homework norms of schools and that this finding does not just apply at the extremes of the distribution.

The pattern for mathematics homework times is similar to that for total homework, with close correlation between country rankings for both (see Table A.6).

### Other components of time

The PISA student questionnaire also contains a number of questions about time spent on remedial and enrichment activities and other school-related work. Unfortunately, the responses for these questions are too unreliable to report. The absence of large amounts of data for many countries suggests that many students may simply have left the response blank if the amount of time spent on such activities was zero. In addition, in many countries the same students reported participation in both remedial and enrichment activities. Since this seems implausible, it is possible that many students misinterpreted these questions.

## STUDENT LEARNING STRATEGIES AND PREFERENCES

A series of questions about how students study mathematics forms the assessment of student learning strategies. A second related set of questions asks whether students prefer a competitive or co-operative environment for learning mathematics. In both cases, students indicate, using a four-point scale, their degree of agreement or disagreement with a series of statements about how they learn mathematics. These items on learning strategies form the basis for three indices: the *index of memorisation/rehearsal,* the *index of elaboration strategies* and the *index of control strategies.* Collectively, these

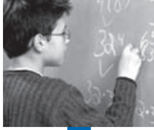
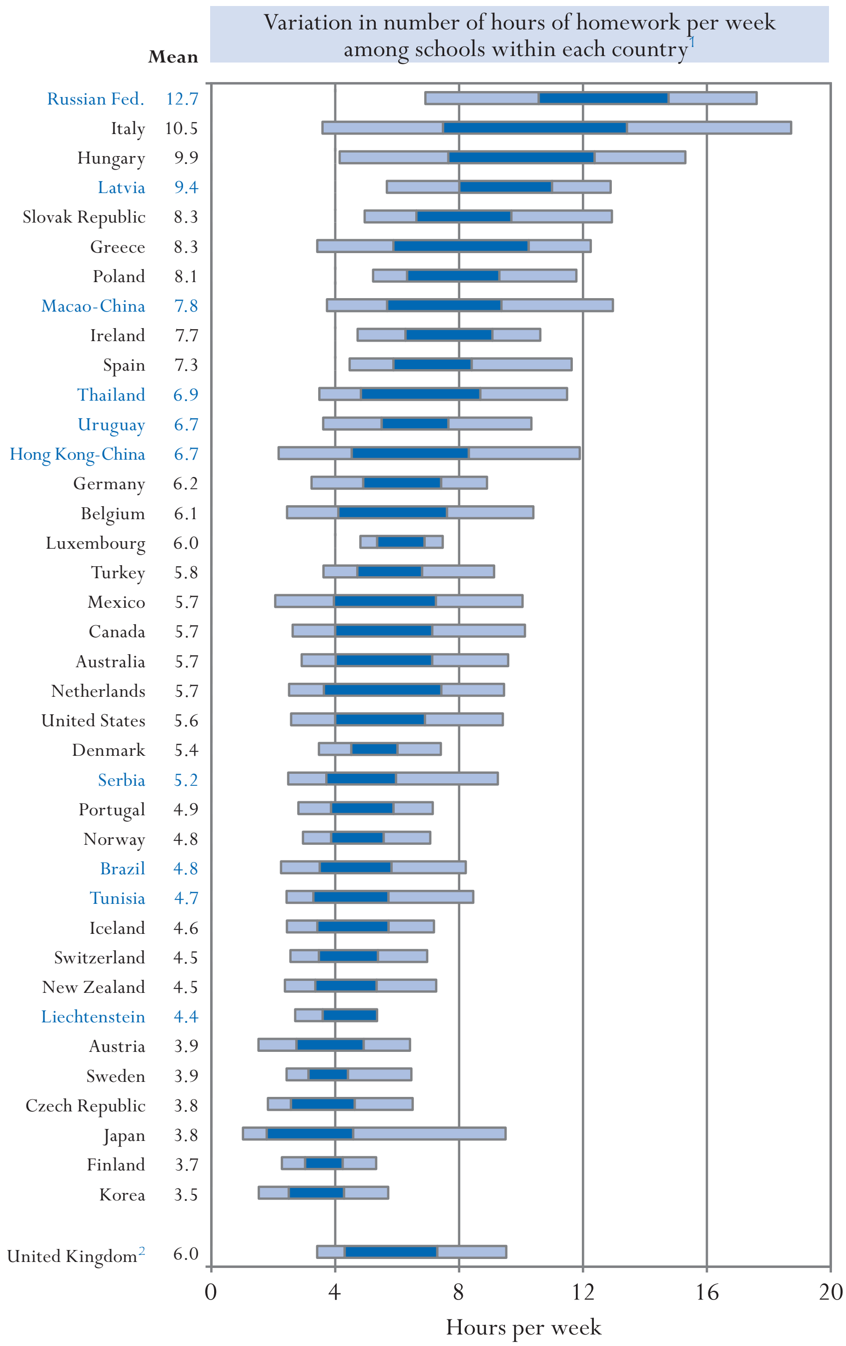




Figure 2.3 ■ **Hours per week of homework or other study set by teachers in total**




*Note:* Countries are ranked in descending order of the average number of hours spent on homework or other study set by teachers in total.

1. Bars extend from the 5th to the 95th percentile. At the 5th percentile only 5% of schools have fewer hours per week of homework. A school at the 95th percentile has more hours per week of homework than 95% of the other schools. The darker middle section denotes the variation between the middle 50% of schools (25th and 75th percentiles).
2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.



are meta-cognitive strategies because they represent general rather than content-specific approaches to the cognitive processes involved in learning. Research has shown that meta-cognitive skills and self-regulated learning strategies are important components of effective independent learning (Zimmerman and Schunk, 2001).

Readers are cautioned that the PISA 2000 analysis of student learning strategies shows limitations in comparing the overall use of these strategies across countries. Evidence suggests that in many cases students mean different things in different cultures when answering questions about their learning strategies. In this survey, there is also evidence to suggest that students in some countries reply to the same question in general with greater optimism or pessimism than do students in other countries, producing a response bias. For example, students in Finland, Japan, Korea, and the Netherlands tend to agree that they adopt various learning strategies much less than do students in Mexico and the partner countries Brazil and Tunisia, despite the much lower performance in PISA of students in the last three countries

Table 2.2
**Distribution of the use of learning strategies/preferences and relationship with performance in mathematics**

| Variable | How much does this vary within each country?<br>Variation within middle half of schools (interquartile range)<br>Measured on index scale standardised relative to international standard deviation of individual learner characteristics | How is this associated with performance?<br>(Bivariate effect on mathematics score, significant effects only) |
|---|---|---|
| | **Use of learning strategies** | |
| Memorisation/ rehearsal | OECD average range: 0.30 standard deviations<br>Most variability: 1.04 in the partner country Liechtenstein, 0.50 in Germany, 0.44 to 0.42 in Austria, Switzerland, Mexico, the United States and in the partner country Indonesia<br>Least variability: 0.17 in Luxembourg, 0.21-0.23 in Greece and Japan, and in the partner economies Thailand, Latvia and Macao-China | Positive association in 17 countries, negative in 14. (When accounting for other factors, mainly negative: see Chapter 3.) |
| Elaboration | OECD average range: 0.32<br>Most variability: 0.56 in Austria, 0.47 in Germany, 0.45 in Italy and 0.46 in the partner country Liechtenstein<br>Least variability: 0.21 in Portugal and Finland, and in the partner economies Latvia and Macao-China | Positive association in 25 countries, negative in just one. (When accounting for other factors, mainly negative: see Chapter 3.) |
| Control | OECD average range: 0.31<br>Most variability: 0.52 in Korea, 0.41 in Canada, Mexico and Germany, 0.40 in Belgium and Turkey<br>Least variability: 0.21 in Finland, 0.22 in Luxembourg, 0.23 in Hungary, 0.19 in the partner country Latvia and 0.23 in the partner country Thailand | Positive association in 21 countries, negative in just one. (Mixed picture when accounting for other factors: see Chapter 3.) |
| | **Learning preferences** | |
| Preference for competitive learning | OECD average range: 0.35<br>Most variability: 0.55 in Austria, 0.53 in Korea, 0.45 in Italy and 0.46 in the partner country Liechtenstein<br>Least variability: 0.15 in the partner economy Macao-China, 0.19 in Greece and 0.20 in the partner country Latvia | Positive association in 29 countries, negative in none. (Most countries show no effect when accounting for other factors: see Chapter 3.) |
| Preference for co-operative learning | OECD average range: 0.30<br>Most variability: 0.42 in Austria, 0.41 in Mexico, 0.40 in Korea, the United States and in the partner country Serbia<br>Least variability: 0.20 in Australia and Hungary, 0.21 in Finland, 0.22 in Greece and the partner country Thailand | Positive association in 9 countries, negative in 15. (Most countries show no effect when accounting for other factors: see Chapter 3.) |

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Students' preferences for learning situations influence learning behaviour; PISA presents two indices on this. Students who try harder to learn mathematics so that they can be the best in their class or obtain the best marks in their mathematics tests show a preference for competitive learning, while students who report that they work best with other students show a preference for co-operative learning. Preferences for competitive or for co-operative learning are not mutually exclusive and students could report a preference for both learning situations. These are relatively straightforward concepts, representing a combination of student dispositions and the climate of the school and the society in which the student functions.

Table 2.2 gives an overview of the results, in terms of the variability of the use of learning strategies/preferences in different schools and the degree to which these strategies are associated with performance. Similar patterns emerge for each learning strategy. In each case, a group of countries with the smallest school differences shows less than one-half the variability seen in countries with the greatest differences. How much this matters depends on the degree to which particular learning strategies help improve student learning, and on this question, there is a mixture of evidence. Overall, the factors that are most commonly associated with strong results are the controlling of one's own learning and a preference for competitive learning. (Note that this preference is not an alternative to a preference for co-operative learning, and it is possible to be positive about both.) But the associations shown here, and in particular that between controlling one's learning and PISA performance, appear to be weaker and less consistent for mathematics than for reading, as reported for PISA 2000 by Artelt *et al.* (2003). This evidence may indicate that different strategies have a different impact on learning in mathematics as compared to reading.

The following analysis therefore concentrates on the within-country distribution of these learner characteristics. Country-specific response bias does not necessarily affect the within-country models that form the basis for subsequent analysis. However, the possibility that various sub-groups within countries respond differently cannot be ruled out. It is impossible to be sure whether response bias contributes to these differences.

### Memorisation/rehearsal strategies

Students use memorisation strategies (*e.g.* learning facts or rehearsing examples) for many tasks; such strategies are appropriate when the learner needs to retrieve information, as presented, without any further elaboration or processing. To measure the extent to which students use memorisation strategies in participating countries, the PISA *index of memorisation strategies* derives from the following four items:

- STQ34f I go over some problems in mathematics so often that I feel as if I could solve them in my sleep (*sleep*).
- STQ34g When I study for mathematics, I try to learn the answers to problems off by heart (*heart*).
- STQ34i In order to remember the method for solving a mathematics problem, I go through the examples again and again (*examples*).
- STQ34m To learn mathematics, I try to remember every step in a procedure (*procedure*).



Figure 2.4 shows the percentage of students in each country agreeing or strongly agreeing with these statements and the distribution across schools of the memorisation index. The first point to note is that in most countries substantially more students say they go through examples and remember steps in procedures than say they learn by heart or in a way that means they can solve problems in their sleep. A large majority of students clearly use examples and procedures as memorisation tools. It is likely that the sleep and heart questions represent more extreme methods of memorisation than the examples and procedures questions.

Memorisation is the one learning strategy that appears from the PISA 2000 results to allow direct comparisons across countries. In PISA 2003, there are wide differences across countries in the extent of use of memorisation strategies. Students report a comparatively higher use of memorisation strategies in Mexico and in several of the partner countries (notably Indonesia, Brazil, Thailand and Tunisia), followed by the United States, Australia, Greece and Canada. Conversely, students in Japan, Denmark, Korea, Finland and Switzerland and in the partner country Liechtenstein report a comparatively low use of memorisation strategies. For the most part, the distribution across schools on these variables is symmetrical, with similar numbers of schools at both the high and low ends.

As shown in Figure 2.4, relatively wide differences in the use of memorisation in different schools appear in Germany, Austria, Switzerland, Mexico and the United States, and the partner countries Liechtenstein and Indonesia.

### Elaboration strategies

Elaboration is a measure of the extent to which students acquire understanding of new material by relating it to prior learning and knowledge. Elaboration strategies, unlike memorisation strategies, can help to deepen students' understanding of the knowledge and skills in use. The PISA *index of elaboration strategies* derives from the percentage of students agreeing or strongly agreeing with the following five items:

- STQ34b When I am solving mathematics problems, I often think of new ways to get the answer (*new ways*).
- STQ34e I think of how the mathematics I have learnt can be used in everyday life (*everyday*).
- STQ34h I try to understand new concepts in mathematics by relating them to things I already know (*already know*).
- STQ34k When I am solving a mathematics problem, I often think about how the solution might be applied to other interesting questions (*applied*).
- STQ34n When learning mathematics, I try to relate the work to things I have learnt in other subjects (*other subjects*).

The data for these questions and the *index of elaboration* appear in Figure 2.5. In general, learning new ways, applying mathematics to everyday events, and relating concepts to things already known are more prevalent than applying solutions to other interesting questions or relating work to learning in other subjects. Here, some of the widest differences among schools are in Austria, Germany, Italy and the partner country Liechtenstein. Very narrow differences in countries such as Portugal, Finland and Poland, and the partner economies Latvia, Macao-China, Indonesia and Thailand,

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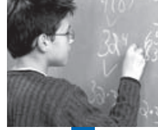


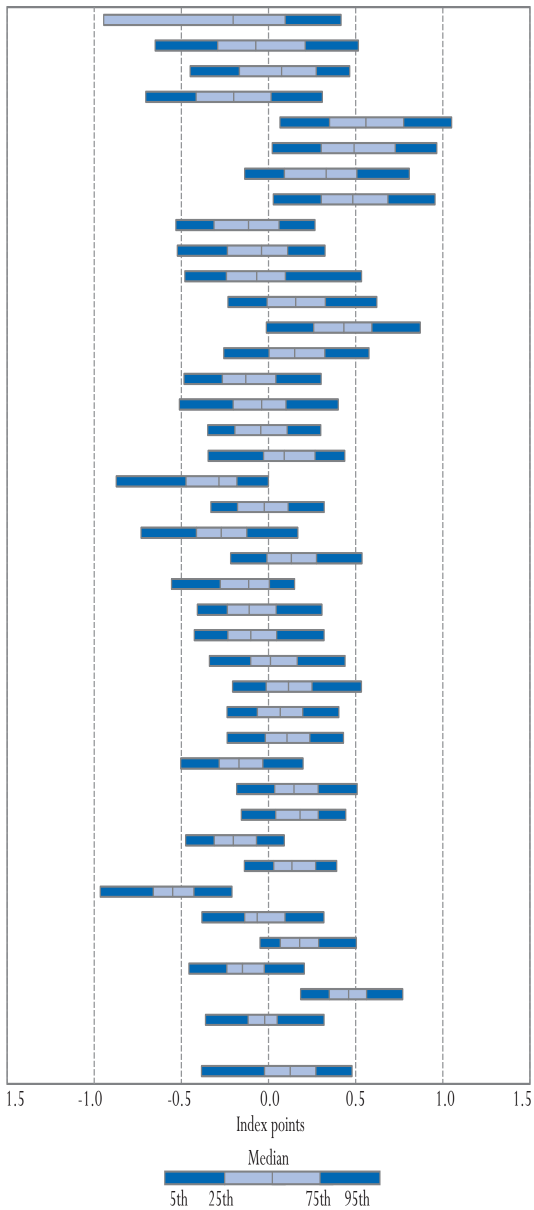


Figure 2.4 ■ **Students' use of memorisation/rehearsal strategies to learn mathematics**

A I go over some problems in mathematics so often that I feel as if I could solve them in my sleep.
B When I study for mathematics, I try to learn the answers to problems off by heart.
C In order to remember the method for solving a mathematics problem, I go through the examples again and again.
D To learn mathematics, I try to remember every step in a procedure.

| | A | B | C | D |
|---|---|---|---|---|
| Liechtenstein | 36 | 27 | 50 | 61 |
| Germany | 42 | 34 | 61 | 68 |
| Austria | 43 | 29 | 70 | 78 |
| Switzerland | 32 | 33 | 54 | 74 |
| Mexico | 41 | 82 | 68 | 92 |
| Indonesia | 68 | 52 | 88 | 79 |
| United States | 42 | 67 | 70 | 83 |
| Brazil | 30 | 62 | 88 | 88 |
| Norway | 31 | 41 | 61 | 79 |
| France | 25 | 37 | 70 | 82 |
| Serbia | 33 | 24 | 84 | 68 |
| Canada | 33 | 58 | 70 | 83 |
| Tunisia | 43 | 52 | 81 | 78 |
| Uruguay | 46 | 42 | 82 | 62 |
| Portugal | 27 | 43 | 66 | 74 |
| Czech Republic | 40 | 34 | 62 | 75 |
| Russian Fed. | 24 | 50 | 63 | 71 |
| Turkey | 44 | 30 | 78 | 75 |
| Korea | 30 | 34 | 61 | 52 |
| Iceland | 26 | 55 | 62 | 72 |
| Denmark | 19 | 45 | 50 | 69 |
| New Zealand | 31 | 66 | 70 | 74 |
| Netherlands | 41 | 34 | 61 | 61 |
| Sweden | 33 | 56 | 63 | 61 |
| Belgium | 28 | 36 | 71 | 76 |
| Italy | 30 | 32 | 79 | 84 |
| Slovak Republic | 60 | 32 | 59 | 82 |
| Spain | 31 | 40 | 76 | 85 |
| Ireland | 28 | 57 | 77 | 75 |
| Hong Kong-China | 34 | 47 | 64 | 56 |
| Hungary | 44 | 30 | 74 | 89 |
| Australia | 30 | 64 | 71 | 80 |
| Finland | 26 | 44 | 54 | 72 |
| Poland | 36 | 62 | 71 | 78 |
| Japan | 21 | 27 | 45 | 62 |
| Macao-China | 36 | 55 | 69 | 53 |
| Greece | 29 | 60 | 75 | 81 |
| Latvia | 19 | 40 | 71 | 74 |
| Thailand | 48 | 90 | 71 | 85 |
| Luxembourg | 42 | 27 | 72 | 73 |
| United Kingdom[2] | 30 | 63 | 70 | 76 |

Variation in students' use of memorisation strategies among schools within each country[1]




*Note:* Countries are ranked in descending order of variation among the middle 50% of schools in use of memorisation strategies.

1. At the 5th percentile students at only 5% of schools have less of a preference for the use of memorisation strategies. Students at a school at the 95th percentile have a stronger preference for the use of memorisation strategies than students in 95% of the other schools.
2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.



imply that learning by using elaboration strategies in these countries follows very consistent patterns across schools. Note, however, that students' average use of elaboration strategies varies greatly among these countries: comparatively fewer students in Finland report using elaboration strategies compared to other students in OECD countries, whereas in the other countries comparatively more students report that they use elaboration strategies, with the partner countries Indonesia and Thailand among the top five countries.

### Control strategies

Students who control their learning ensure that they set clear goals for themselves and monitor their own progress in reaching them. The PISA *index of control strategies* derives from the following five items:

- STQ34a When I study for a mathematics test, I try to work out what are the most important parts to learn (*important*).
- STQ34c When I study mathematics, I make myself check to see if I remember the work I have already done (*check memory*).
- STQ34d When I study mathematics, I try to figure out which concepts I still have not understood properly (*concepts*).
- STQ34j When I cannot understand something in mathematics, I always search for more information to clarify the problem (*clarify*).
- STQ34l When I study mathematics, I start by working out exactly what I need to learn (*exactly*).

As Figure 2.6 shows, students tend to agree more strongly with these statements than was the case for the other two learning strategies. There is also less variation between countries than for the other learning strategies.

Among the strategies students report that they use to learn mathematics examined in PISA 2003, the most commonly used are control strategies, along with the examples and procedures strategies of the memorisation index. In all of these cases, on average at least two-thirds of students in the OECD countries answer positively. There are therefore high latent correlations between the index of control strategies and the index of memorisation/rehearsal strategies in all countries (see Annex B, Table B.1, Correlations among selected index variables).

Some countries show large differences in the use of control strategies from one school to another. In particular, Korea has an interquartile range that is equal to the range from the 5$^{th}$ to the 95$^{th}$ percentile in Finland. In other words, the middle half of schools in Korea shows the same variability in the use of control strategies as the middle 90% of schools in Finland.

These variations in the use of control strategies are particularly important because, as will be seen in the following chapter, the use of such strategies is linked to higher performance in Korea and seven other countries.

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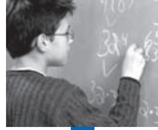
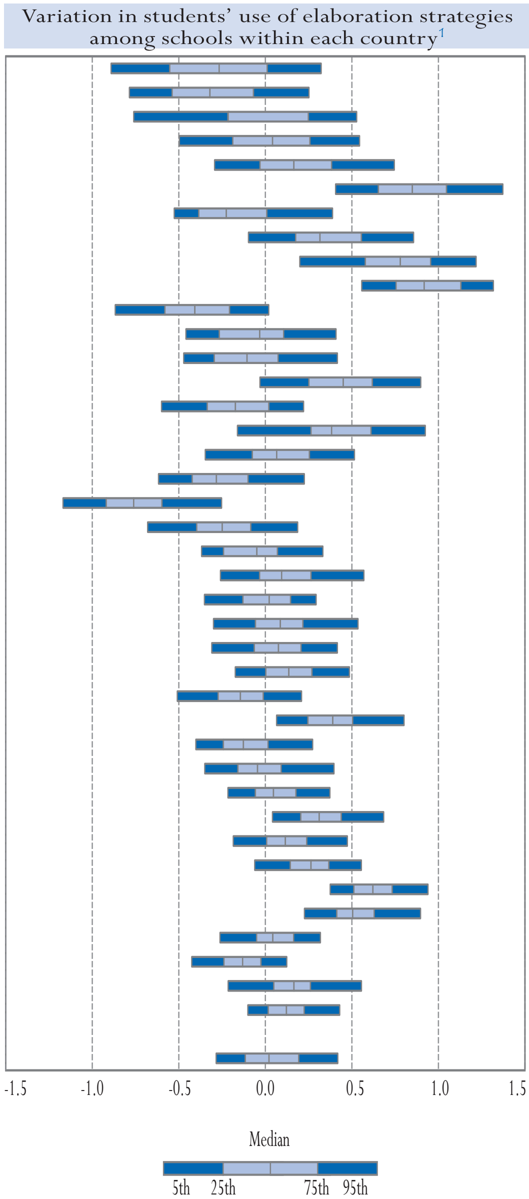




## Figure 2.5 ■ Students' use of elaboration strategies to learn mathematics

- **A** When I am solving mathematics problems, I often think of new ways to get the answer.
- **B** I think of how the mathematics I have learnt can be used in everyday life.
- **C** I try to understand new concepts in mathematics by relating them to things I already know.
- **D** When I am solving a mathematics problem, I often think about how the solution might be applied to other interesting questions.
- **E** When learning mathematics, I try to relate the work to things I have learnt in other subjects.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Austria | 41 | 41 | 60 | 29 | 40 |
| Germany | 36 | 42 | 56 | 27 | 36 |
| Liechtenstein | 44 | 44 | 70 | 35 | 41 |
| Italy | 54 | 51 | 64 | 43 | 44 |
| United States | 56 | 55 | 70 | 48 | 52 |
| Mexico | 78 | 89 | 84 | 67 | 71 |
| Belgium | 44 | 36 | 58 | 40 | 40 |
| Uruguay | 64 | 66 | 72 | 52 | 52 |
| Brazil | 78 | 83 | 85 | 68 | 57 |
| Tunisia | 74 | 79 | 78 | 85 | 72 |
| Korea | 40 | 34 | 55 | 27 | 21 |
| Switzerland | 44 | 47 | 66 | 37 | 45 |
| France | 45 | 47 | 52 | 48 | 44 |
| Turkey | 68 | 60 | 72 | 57 | 68 |
| Norway | 35 | 59 | 58 | 35 | 37 |
| Serbia | 60 | 62 | 78 | 62 | 54 |
| Canada | 53 | 52 | 64 | 43 | 47 |
| Netherlands | 40 | 27 | 56 | 36 | 41 |
| Japan | 42 | 12 | 52 | 21 | 15 |
| Luxembourg | 54 | 40 | 44 | 37 | 34 |
| Iceland | 38 | 57 | 65 | 38 | 38 |
| New Zealand | 54 | 60 | 67 | 43 | 47 |
| Hong Kong-China | 58 | 51 | 63 | 43 | 40 |
| Spain | 55 | 63 | 63 | 44 | 44 |
| Denmark | 47 | 57 | 66 | 42 | 47 |
| Russian Fed. | 32 | 68 | 68 | 48 | 57 |
| Ireland | 41 | 49 | 60 | 33 | 36 |
| Slovak Republic | 65 | 69 | 80 | 43 | 67 |
| Hungary | 34 | 56 | 65 | 31 | 38 |
| Sweden | 48 | 61 | 64 | 33 | 41 |
| Australia | 53 | 55 | 65 | 41 | 44 |
| Greece | 50 | 75 | 71 | 56 | 52 |
| Czech Republic | 33 | 77 | 76 | 38 | 49 |
| Poland | 52 | 64 | 80 | 46 | 59 |
| Thailand | 64 | 90 | 81 | 74 | 75 |
| Indonesia | 74 | 86 | 82 | 71 | 43 |
| Macao-China | 56 | 54 | 65 | 40 | 38 |
| Finland | 43 | 51 | 62 | 27 | 40 |
| Portugal | 64 | 53 | 73 | 60 | 41 |
| Latvia | 44 | 72 | 75 | 38 | 49 |
| United Kingdom[2] | 52 | 52 | 67 | 38 | 47 |




*Note:* Countries are ranked in descending order of variation among the middle 50% of schools in students' use of elaboration strategies.

1. At the 5th percentile students at only 5% of schools have less of a preference for the use of elaboration strategies. Students at a school at the 95th percentile have a stronger preference for the use of elaboration strategies than students in 95% of the other schools.
2. Response rate too low to ensure comparability.

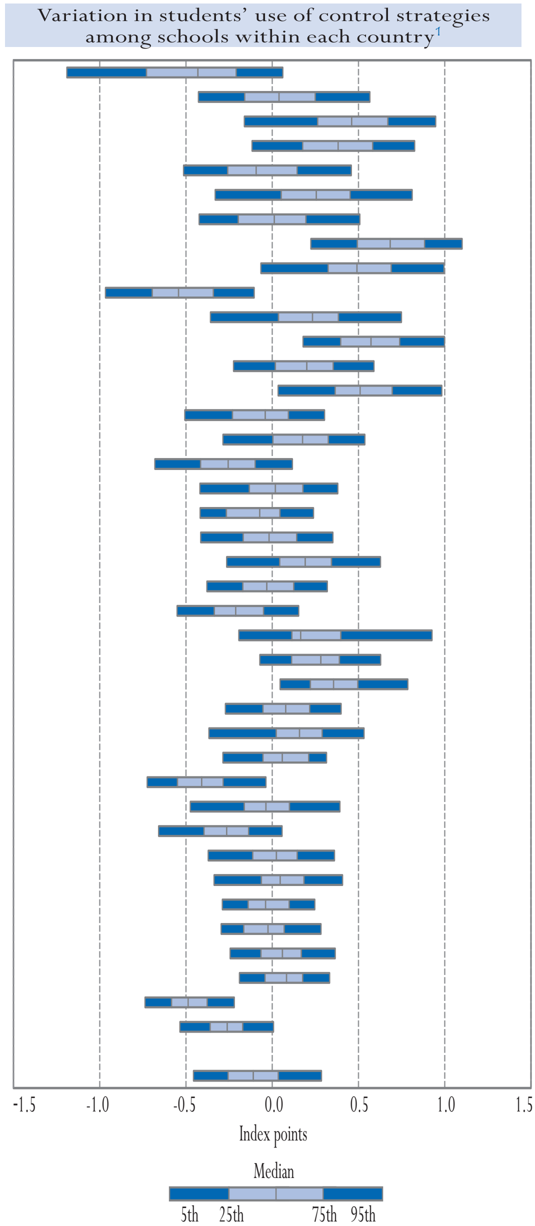
*Source:* OECD PISA 2003 Database.



## Figure 2.6 ■ Students' use of control strategies to learn mathematics

- **A** When I study for a mathematics test, I try to work out what are the most important parts to learn.
- **B** When I study mathematics, I make myself check to see if I remember the work I have already done.
- **C** When I study mathematics, I try to figure out which concepts I still have not understood properly.
- **D** When I cannot understand something in mathematics, I always search for more information to clarify the problem.
- **E** When I study mathematics, I start by working out exactly what I need to learn.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Korea | 75 | 60 | 75 | 56 | 47 |
| Canada | 87 | 75 | 87 | 74 | 77 |
| Mexico | 95 | 83 | 93 | 80 | 85 |
| Germany | 90 | 71 | 89 | 66 | 88 |
| Belgium | 85 | 71 | 85 | 67 | 80 |
| Turkey | 88 | 85 | 85 | 61 | 86 |
| United States | 86 | 72 | 83 | 74 | 79 |
| Tunisia | 91 | 80 | 86 | 88 | 83 |
| Serbia | 90 | 83 | 90 | 87 | 85 |
| Japan | 81 | 65 | 76 | 50 | 26 |
| Italy | 90 | 76 | 91 | 83 | 85 |
| Brazil | 93 | 92 | 91 | 91 | 86 |
| Uruguay | 91 | 79 | 88 | 72 | 78 |
| Austria | 86 | 81 | 91 | 70 | 84 |
| Hong Kong-China | 87 | 76 | 89 | 64 | 82 |
| France | 91 | 72 | 87 | 78 | 78 |
| Norway | 87 | 61 | 78 | 66 | 59 |
| Iceland | 89 | 73 | 84 | 58 | 76 |
| Russian Fed. | 87 | 74 | 86 | 71 | 71 |
| Spain | 84 | 79 | 84 | 66 | 82 |
| Switzerland | 89 | 63 | 89 | 72 | 80 |
| Ireland | 90 | 75 | 86 | 69 | 76 |
| Denmark | 84 | 68 | 86 | 78 | 57 |
| Liechtenstein | 85 | 60 | 89 | 72 | 81 |
| Greece | 89 | 85 | 90 | 79 | 79 |
| Indonesia | 95 | 96 | 91 | 88 | 89 |
| Slovak Republic | 91 | 79 | 90 | 78 | 83 |
| Portugal | 91 | 86 | 85 | 77 | 88 |
| Macao-China | 87 | 77 | 91 | 65 | 89 |
| Sweden | 79 | 57 | 84 | 72 | 41 |
| New Zealand | 88 | 77 | 86 | 69 | 73 |
| Netherlands | 86 | 59 | 82 | 58 | 81 |
| Australia | 89 | 77 | 86 | 69 | 79 |
| Czech Republic | 84 | 82 | 93 | 80 | 80 |
| Poland | 91 | 80 | 86 | 75 | 79 |
| Thailand | 94 | 82 | 85 | 74 | 76 |
| Hungary | 90 | 76 | 88 | 76 | 78 |
| Luxembourg | 83 | 78 | 84 | 66 | 71 |
| Finland | 88 | 46 | 82 | 48 | 59 |
| Latvia | 84 | 67 | 84 | 71 | 66 |
| United Kingdom[2] | 89 | 77 | 86 | 65 | 75 |




*Note:* Countries are ranked in descending order of variation among the middle 50% of schools in students' use of control strategies.

1. At the 5th percentile students at only 5% of schools have less of a preference for the use of control strategies. Students at a school at the 95th percentile have a stronger preference for the use of control strategies than students in 95% of the other schools.
2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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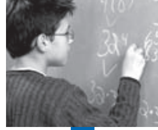




### Preference for competitive learning situations

The report classifies a second set of questions into two indices representing preference for competitive and for co-operative learning situations. These are not mutually exclusive, as a student may want to perform well, but still enjoy working together with his or her peers. Indeed, the results for several countries suggest that these learning preferences may be complementary rather than conflicting (OECD average latent correlation is 0.35; see Table B.1).

The items comprising the *index of competitive learning* are:

- STQ37a I would like to be the best in my class in mathematics (*best*).
- STQ37c I try very hard in mathematics because I want to do better in the exams than others (*exams*).
- STQ37e I make a real effort in mathematics because I want to be one of the best (*effort*).
- STQ37g In mathematics I always try to do better than the other students in my class (*do better*).
- STQ37j I do my best work in mathematics when I try to do better than others (*best work*).

Figure 2.7 shows the percentage of students agreeing or strongly agreeing to each of these items and gives the distributions across schools on the index. Here there is a wide range across countries in levels of agreement to the individual items, although, as discussed above, this could reflect cultural bias in response. As for earlier items, students in Mexico, Turkey and the partner country Tunisia show high percentages of agreement. The United States is relatively high on this index, as are the partner countries Brazil and Indonesia. Among the countries whose students performed the best in mathematics in PISA 2003, students in Hungary, the Netherlands, Japan, Switzerland, Austria, Belgium and Finland tend to report being less competitive on average compared to other countries.

Within countries, students who compete with their peers tend to do better in PISA, as is shown in Chapter 3. However, in some countries, there is considerably less of an ethos of competition in some schools than in others. Students' reports of preference for competitive learning situations vary most among schools in Austria, Korea and Italy and the partner country Liechtenstein. In fact, all students in the middle 50% of schools in Austria report a preference below the OECD average for competitive learning situations (Figure 2.7).

### Preference for co-operative learning situations

The items comprising the PISA *index of co-operative learning* are:

- STQ37b In mathematics I enjoy working with other students in groups (*group*).
- STQ37d When we work on a project in mathematics, I think that it is a good idea to combine the ideas of all the students in a group (*project*).
- STQ37f I do my best work in mathematics when I work with other students (*other students*).
- STQ37h In mathematics I enjoy helping others to work well in a group (*helping*).
- STQ37i In mathematics I learn most when I work with other students in my class (*learn most*).

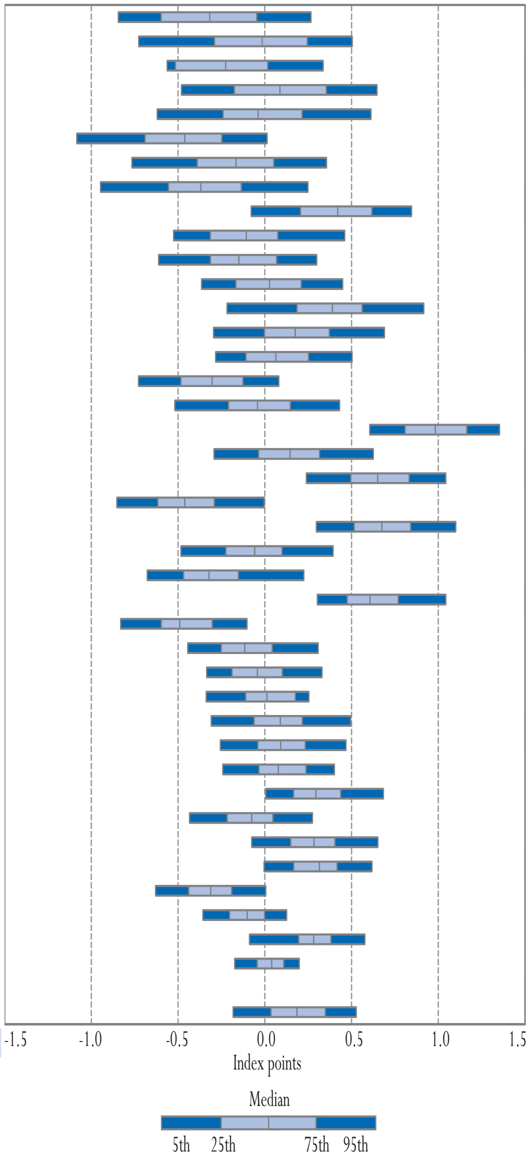


## Figure 2.7 ■ Students' preference for competitive learning situations

- **A** I would like to be the best in my class in mathematics.
- **B** I try very hard in mathematics because I want to do better in the exams than others.
- **C** I make a real effort in mathematics because I want to be one of the best.
- **D** In mathematics I always try to do better than the other students in my class.
- **E** I do my best work in mathematics when I try to do better than others.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Austria | 59 | 36 | 46 | 32 | 32 |
| Korea | 78 | 44 | 29 | 48 | 39 |
| Liechtenstein | 68 | 34 | 46 | 33 | 32 |
| Italy | 65 | 54 | 54 | 48 | 47 |
| Germany | 64 | 51 | 53 | 35 | 35 |
| Japan | 31 | 41 | 21 | 32 | 51 |
| Serbia | 53 | 40 | 38 | 35 | 38 |
| Switzerland | 55 | 32 | 40 | 32 | 33 |
| United States | 78 | 71 | 68 | 58 | 53 |
| Uruguay | 56 | 54 | 47 | 35 | 29 |
| France | m | m | m | m | m |
| Spain | 65 | 47 | 49 | 42 | 50 |
| Brazil | 83 | 60 | 70 | 46 | 47 |
| Canada | 71 | 61 | 58 | 46 | 45 |
| Ireland | 74 | 52 | 56 | 38 | 38 |
| Norway | 53 | 38 | 37 | 32 | 33 |
| Denmark | 45 | 60 | 49 | 32 | 50 |
| Tunisia | 90 | 87 | 79 | 79 | 74 |
| New Zealand | 67 | 62 | 54 | 46 | 47 |
| Turkey | 88 | 69 | 75 | 69 | 69 |
| Netherlands | 45 | 29 | 20 | 25 | 29 |
| Mexico | 87 | 71 | 81 | 72 | 76 |
| Sweden | 70 | 45 | 43 | 33 | 34 |
| Belgium | 48 | 36 | 36 | 31 | 36 |
| Indonesia | m | m | m | m | m |
| Hungary | 36 | 28 | 23 | 26 | 36 |
| Czech Republic | 51 | 55 | 41 | 40 | 33 |
| Russian Fed. | 57 | 60 | 43 | 35 | 38 |
| Luxembourg | 61 | 53 | 52 | 40 | 39 |
| Slovak Republic | 57 | 71 | 48 | 49 | 42 |
| Hong Kong-China | 71 | 73 | 53 | 33 | 45 |
| Poland | 72 | 60 | 53 | 40 | 40 |
| Australia | 74 | 83 | 59 | 52 | 47 |
| Portugal | 66 | 38 | 47 | 31 | 47 |
| Iceland | 82 | 61 | 60 | 52 | 37 |
| Thailand | 69 | 75 | 72 | 59 | 62 |
| Finland | 45 | 33 | 49 | 31 | 29 |
| Latvia | 66 | 42 | 36 | 33 | 42 |
| Greece | 74 | 62 | 60 | 43 | 61 |
| Macao-China | 67 | 65 | 44 | 26 | 42 |
| United Kingdom[2] | 70 | 64 | 58 | 45 | 47 |
| **OECD average** | **63** | **52** | **49** | **41** | **43** |

Variation in students' preference for competitive learning situations among schools within each country[1]




*Note:* Countries are ranked in descending order of variation among the middle 50% of schools in students' preference for competitive learning situations.

1. At the 5th percentile students at only 5% of schools have less of a preference for the use of competitive learning situations. Students at a school at the 95th percentile have a stronger preference for the use of competitive learning situations than students in 95% of the other schools.
2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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Results for these items and for the *index of co-operative learning* appear in Figure 2.8. Again, there is a wide response range across countries and across schools within countries and, in this case, the previous analysis of PISA 2000 shows that these questions are interpreted similarly across different cultures.

In terms of percentage agreement, support for co-operative learning is generally higher than that for competitive learning. Students in some countries – such as the United States, as well as in the partner countries Brazil and Tunisia – score relatively highly on both indices, while students in Japan, for example, report comparatively low preference for both learning situations. In other countries, there are clear indications of differences in preference for these two learning situations. For example, students in Korea, Iceland, Mexico and Turkey report stronger preference for competitive than co-operative learning situations, while students in Switzerland and Portugal report stronger preference for co-operative learning situations. However, only in Switzerland do there seem to be two distinct groups of students reporting preference for either one or the other of the learning situations (there is very weak correlation between the two indices, 0.09). In general, the results indicate that some students report preferences for both learning situations with positive latent correlations of at least 0.20 between the two indices in 21 of the OECD countries (Table B.1).

These results, combined with those for memorisation, elaboration and control, suggest that learning strategies may be relatively undifferentiated. This issue requires further investigation to determine if the results obtained are a function of response bias or whether these various strategies are, indeed, complementary. For the purpose of further analysis, both because of the theoretical and policy interest of these indices and because the models used allow the effects of each index to be examined while accounting for other factors, the report retains the indices as defined.

## TEACHING STRATEGIES AND CLIMATE

Central to the effectiveness of teaching and learning is the actual manner in which teaching takes place: both the teaching methods employed and the atmosphere in the classroom. Since these two aspects interact, the report considers teaching strategies and climate together.

As noted earlier, there are limits to the amount of detail on teaching strategies that can be gathered in a broad survey, especially in the absence of a teacher questionnaire. Nevertheless, a number of items connected with teaching strategies appear on the PISA 2003 school and student questionnaires. The school questionnaire contains items on staff consensus about mathematics teaching, staff preference for traditional versus new teaching methods, consensus on goals, teacher morale, pride and enthusiasm, teacher expectations of students, assessment practices, student grouping and enrichment, and remedial mathematics activities. The student questionnaire contains a set of items on the frequency of occurrence of specific behaviours and events in their mathematics lessons. Students' answers form the basis of two indices: the *index of teacher support* and the *index of disciplinary climate.* A further set of items gathers students' views on how well students and teachers get along in their school in general. The answers combine to form the *index of student-teacher relations*.

Note that although strategies and climate are closely related, they have a different significance in the analysis in this report. The teaching strategies described here do not appear in the model presented in Chapter 3. They were omitted because these strategies have either low correlations with achievement or only small effects, which may be a result of the indirect way they are reported, that is, via

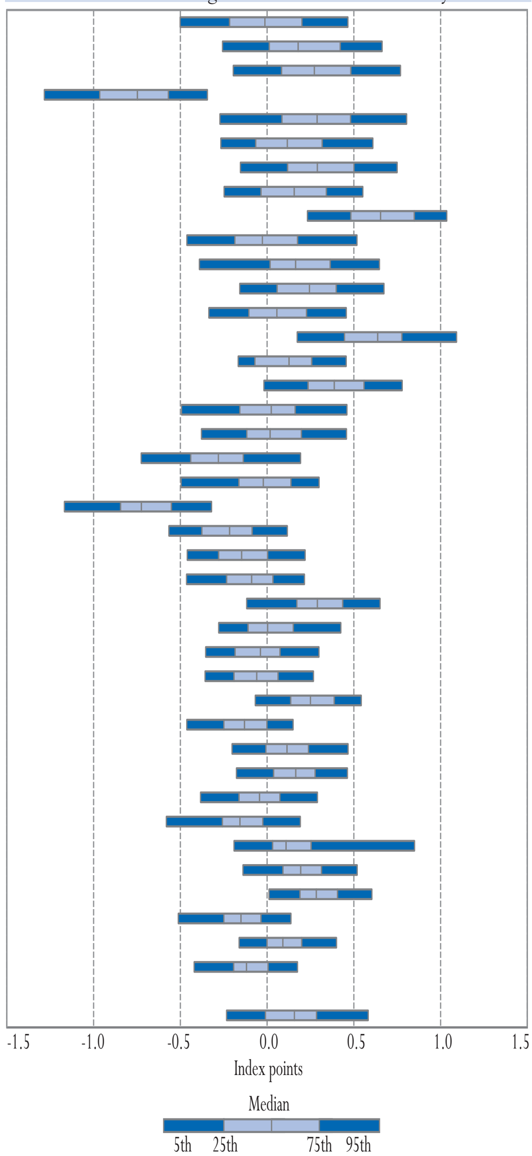


## Figure 2.8 ■ Students' preference for co-operative learning situations

- **A** In mathematics I enjoy working with other students in groups.
- **B** When we work on a project in mathematics, I think that it is a good idea to combine the ideas of all the students in a group.
- **C** I do my best work in mathematics when I work with other students.
- **D** In mathematics I enjoy helping others to work well in a group.
- **E** In mathematics I learn most when I work with other students in my class.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Austria | 63 | 73 | 46 | 69 | 53 |
| Mexico | 68 | 78 | 66 | 61 | 74 |
| Serbia | 77 | 82 | 59 | 83 | 64 |
| Korea | 29 | 50 | 17 | 44 | 31 |
| United States | 77 | 80 | 66 | 73 | 64 |
| Italy | 72 | 79 | 69 | 67 | 58 |
| Turkey | 73 | 73 | 66 | 76 | 70 |
| Canada | 77 | 79 | 57 | 67 | 59 |
| Brazil | 82 | 90 | 86 | 83 | 75 |
| Germany | 69 | 64 | 46 | 69 | 55 |
| Switzerland | 76 | 76 | 49 | 73 | 60 |
| Denmark | 79 | 80 | 81 | 76 | 55 |
| Spain | 72 | 72 | 58 | 71 | 66 |
| Tunisia | 79 | 81 | 65 | 82 | 75 |
| Macao-China | 71 | 72 | 65 | 61 | 73 |
| Uruguay | 83 | 85 | 63 | 81 | 69 |
| Norway | 70 | 77 | 57 | 64 | 60 |
| France | m | m | m | m | m |
| Iceland | 57 | 72 | 37 | 66 | 37 |
| Hong Kong-China | 71 | 67 | 65 | 55 | 71 |
| Japan | 32 | 39 | 39 | 46 | 38 |
| Sweden | 64 | 84 | 36 | 56 | 46 |
| Netherlands | 73 | 74 | 50 | 63 | 54 |
| Ireland | 68 | 72 | 51 | 65 | 52 |
| Portugal | 76 | 86 | 78 | 83 | 62 |
| Indonesia | m | m | m | m | m |
| Czech Republic | 69 | 86 | 48 | 72 | 53 |
| Russian Fed. | 73 | 63 | 53 | 60 | 69 |
| Slovak Republic | 79 | 89 | 68 | 80 | 69 |
| Latvia | 71 | 73 | 50 | 60 | 57 |
| Poland | 78 | 88 | 64 | 63 | 61 |
| New Zealand | 82 | 78 | 61 | 71 | 63 |
| Belgium | 73 | 78 | 50 | 68 | 53 |
| Luxembourg | 66 | 68 | 44 | 56 | 49 |
| Liechtenstein | 76 | 78 | 46 | 78 | 61 |
| Greece | 67 | 78 | 67 | 76 | 71 |
| Thailand | 84 | 88 | 77 | 81 | 68 |
| Finland | 71 | 67 | 51 | 68 | 52 |
| Australia | 64 | 78 | 61 | 72 | 63 |
| Hungary | 65 | 82 | 48 | 64 | 52 |
| United Kingdom[2] | 83 | 79 | 64 | 70 | 63 |
| **OECD average** | **69** | **75** | **55** | **67** | **57** |

Variation in students' preference for co-operative learning situations among schools within each country[1]




*Note:* Countries are ranked in descending order of variation in students' preference for co-operative learning situations between schools at the 25th and 75th percentiles.

1. At the 5th percentile students at only 5% of schools have less of a preference for the use of co-operative learning situations. Students at a school at the 95th percentile have a stronger preference for the use of co-operative learning situations than students in 95% of the other schools.
2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.



school principals rather than by individual teachers. Thus, the responses do not provide data about individual students' experience of instruction, but only about the perceptions of school principals. However, student descriptions of classroom climate and of student-teacher relations give information about individual students' experiences of the context in which teaching takes place. This information can be compared to each student's performance in mathematics; thus, these climate factors do appear in the model presented in Chapter 3.

## Teacher consensus on key school policies

### Traditional versus new ways of mathematics teaching

PISA 2003 asks school principals a set of questions to gauge the extent to which there are consistent and shared (academic) goals in the teaching of mathematics within their schools. One possible factor associated with effective departments or schools is a high degree of consensus about key school policies. In the first of three item sets, school principals report on teacher support for innovative versus traditional teaching practices in their school. On average in the OECD countries:

| School principals report: | Percentage of students in such schools |
|---|---|
| Mathematics teachers are interested in trying new methods and teaching practices. | 83% |
| There is a preference among mathematics teachers to stay with well-known methods and practices. | 60% |
| There are frequent disagreements between "innovative" and "traditional" mathematics teachers. | 22% |

The percentages of students in each country whose school principals agree with these statements appear in Table A.7.[6] There is strong agreement in most countries that teachers are interested in trying new methods and practices: 80% or more students in 19 of the OECD countries and in all of the partner countries are in schools where the principal agrees with this proposition. School principals in the Netherlands and Japan are least likely to report this: only 59% (the Netherlands) and 63% (Japan) of students are in schools whose principal reports teachers' interest in new methods and practices. There is considerably more variation across countries on the question of teacher preference for traditional methods and practices. For example, among OECD countries, only in Hungary, the Slovak Republic, Turkey, Luxembourg and Italy are 80% or more of students in schools where the principal agrees this is the case. Fewer than 50% of students are in such schools in nine OECD countries and two partner countries. While school principals in several countries – notably Hungary and the Slovak Republic, as well as the partner economies Hong Kong-China, the Russian Federation, Thailand and Tunisia – report high agreement on both propositions, the country-level correlation between the two statements is close to zero. Nevertheless, the within-country correlations are generally negative, indicating that school principals tend to attribute only one of these methods to their teachers. In general, principals report that within their schools, mathematics teachers with different approaches work well together. In 19 OECD countries and in six partner countries, fewer than 25% of students are in schools where principals report frequent disagreements between innovative and traditional mathematics teachers. However, around 50% of students in Mexico and the partner country Indonesia are in schools where the principal reports frequent disagreements between innovative and traditional teachers, and this is also the case for at least one-third of students in Turkey, Portugal and Belgium and the partner countries Uruguay and Brazil.



### Teacher expectations

In the second item set that collects information on consistent and shared (academic) goals, PISA 2003 also asks school principals their opinions on teacher expectations within their school. On average in the OECD countries:

| School principals report: | Percentage of students in such schools |
|---|---|
| There is consensus among mathematics teachers that academic achievement must be kept as high as possible. | 89% |
| There is consensus among mathematics teachers that it is best to adapt academic standards to the students' level and needs. | 71% |
| There are frequent disagreements between mathematics teachers who consider each other to be "too demanding" or "too lax". | 19% |

The percentages of students in each country in schools where the principal agrees with these statements appear in Table A.8. Again, the majority of students in almost all countries are in schools whose principals report that there is consensus among mathematics teachers that academic standards should be kept as high as possible. This finding concerns at least 90% of students in 16 OECD countries and five partner countries, and it falls to fewer than 80% of students only in Sweden, Portugal, Japan, Turkey and the partner country Brazil. The range of agreement to the statement on adapting academic standards to the students' level and needs is extremely wide. While in 11 of the OECD countries and nine of the partner countries, more than 80% of students are in schools whose principals agree that academic standards should be adapted to meet students' levels and needs, this is the case for only 16% of students in Luxembourg and 23% in Germany. Again, the country-level correlation between these variables is close to zero. However, within most countries there is a small positive correlation, suggesting that school principals do not perceive these two kinds of expectations as conflicting. Regarding the statement about disagreements among mathematics teachers concerning whether or not they perceive their counterparts to be too demanding or too lax, school principals in most countries believe the level of disagreement to be low – such disagreement affects fewer than 15% of students in 14 OECD countries. Again, more than 50% of students in Mexico and in the partner country Tunisia are in schools whose principals report that there are frequent disagreements among mathematics teachers concerning their expectations of students, and this also concerns at least one-third of students in Turkey, Luxembourg, Portugal and Italy and in Uruguay, Serbia, Brazil and Thailand.

### Goals of mathematics teaching

The third item set asks principals to report specifically on the mathematics teaching goals in their schools. On average in the OECD countries:

| School principals report: | Percentage of students in such schools |
|---|---|
| There is consensus among mathematics teachers that the social and emotional development of the student is as important as their acquisition of mathematical skills and knowledge in mathematics classes. | 72% |
| There is consensus among mathematics teachers that the development of students' mathematical skills and knowledge is the most important objective in mathematics classes. | 81% |
| There are frequent disagreements between mathematics teachers who consider each other as "too focused on skill acquisition" or "too focused on the affective development" of the student. | 13% |

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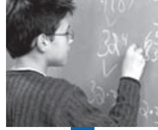



The results for each country are presented in Table A.9. Here, the first statement gives equal preference to both kinds of goals but the second gives preference to the mathematical skills and knowledge goal. The degree of agreement among school principals is relatively strong for both statements, although the mathematical skills and knowledge goal generally receives stronger support than the idea of equal value for both kinds of goals. In the Netherlands, Luxembourg, the United Kingdom and New Zealand there is stronger support for the development of mathematical skills and knowledge as the most important teaching objective (a difference of at least 25 percentage points of students) while the reverse is true in Poland. Again, most school principals in most countries do not encounter frequent disagreements over these priorities among teachers, although Mexico is a notable exception. In particular, such disagreements only affect a small minority of students (5% or fewer) in Japan, New Zealand and the United Kingdom and the partner country Liechtenstein.

### Streaming and grouping

Streaming refers to the assignment of students to classes based on ability. Grouping refers to within-class arrangements that differentiate students by ability. Streaming may thus be thought of as a matter of school policy or perhaps of policy at higher levels of authority. Grouping, however, is something that can be introduced by individual teachers, within or outside any broader policy framework. School principals answer questions about both these practices. In the case of streaming, the questions attempt to differentiate between streaming by difficulty with the same content or with different content. On average in the OECD countries:

| School principals report for some or all classes: | Percentage of students in such schools |
|---|---|
| Mathematics classes study similar content, but at different levels of difficulty. | 30% all classes; 37% some classes |
| Different classes study different content or sets of mathematics topics that have different levels of difficulty. | 15% all classes; 37% some classes |

The percentages of principals in each country who report that their schools practice streaming by difficulty, and by content and difficulty, in some or all classes appear in Table A.10. While a majority of schools in most countries practice streaming by difficulty, the actual proportions differ widely by country. In the United Kingdom, New Zealand, Ireland, Norway, Spain, the United States and Sweden, at least 90% of students encounter streaming into different classes by difficulty for some or all classes, although they study similar content. School principals in Australia, Canada, Poland and the partner economies Hong Kong-China, Latvia and the Russian Federation also report a high degree of streaming by difficulty in at least some classes. Conversely, 30% or fewer students in Greece, the Czech Republic and Austria are in schools whose principals report that there is streaming by difficulty in at least some classes. The pattern for streaming by content and difficulty is different to that for streaming by difficulty only. While there is a relatively high correlation across countries between streaming for content and difficulty and streaming by content only for streaming in some classes, the correlation between these two variables is low for streaming in all classes. There are a few clear examples: school principals in Norway, Poland and Portugal report high levels of streaming by difficulty only (for more than 70% of students) and low levels by content combined with difficulty (for fewer than 25% of students).



With regard to within-class grouping, on average in the OECD countries:

| School principals report for some or all classes: | Percentage of students in such schools |
|---|---|
| Students are grouped by ability within their mathematics classes. | 14% all classes; 30% some classes |
| In mathematics classes, teachers use a pedagogy suitable for students with heterogeneous abilities (*i.e.* students are not grouped by ability). | 40% all classes; 34% some classes |

The results for all countries appear in Table A.11. Because there is considerable overlap in the results when the analysis includes the "some classes" category, the report presents results both with "some classes" and "all classes" combined and for "all classes" only. For the combined categories, the extent of ability grouping in at least some classes varies across countries from 70% or more of schools in New Zealand, Australia, the United Kingdom, Ireland and Korea, and the partner countries, the Russian Federation and Latvia, to fewer than 10% in Greece and Luxembourg. There is much less variation in the use of homogeneous grouping under this measure. With the exception of Germany, Japan, Turkey and the United Kingdom and the partner country Brazil, at least 60% of students are not grouped by ability within mathematics classes.

At first glance, one might expect responses to these questions to show negative correlations to one another. However, the wording of the second question makes it possible to respond positively or negatively to both. Although the countries reporting the lowest levels of ability grouping report high levels of teaching to heterogeneous groups, the opposite is not usually the case. The between-country correlation of these two variables is close to zero, as are most of the within-country correlations, a finding explained by the results in the second two columns of Table A.11. Although many countries practice ability grouping in at least some classes, relatively few do so in all classes. The United Kingdom, Australia and Ireland are exceptions, where close to 50% of schools report ability grouping for all classes. However, the majority of students in many more countries are in classes suitable for students with heterogeneous abilities. In Norway, Denmark and Poland, as well as the partner country Indonesia, at least 70% of students are in mathematics classes with pedagogy suitable for students of all abilities. This figure is at least 60% for students in Portugal, Greece and the partner economies Macao-China and Tunisia.

### Assessment

For this item, principals estimate the frequency of the use of various types of assessment in their schools, on a scale ranging from "never" to "more than once a month". Table A.12 shows the percentages of schools reporting the use of the different assessment types more than three times a year. The table also includes data on use of assessment only once or twice a year. This enables information to be included on the use of standardised tests, because it is rare to employ this form of assessment often, even where the application of standardised tests is a prominent feature of education systems.

It is clear from Table A.12 that teacher tests and student assignments comprise the most frequent types of assessments, with each of these occurring three to five times a year or more in over 80% of schools in almost all countries. Teacher ratings also show a high level of use in most countries (75% of students on average in the OECD countries attend schools where the principal reports teacher ratings are used at least three times a year). Use of student portfolios occurs less often than the other internal forms of assessment, but with wide variation across countries.

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Standardised tests are the least frequently used on average and show the most variation in use across countries. However, frequency of use is not the best indicator of the influence of standardised tests, which may be used to make high-stakes decisions involving students' future education or careers. Table A.12 shows that far more countries use standardised tests one to two times a year than three to five times or more. Although the issue of high-stakes use is a source of considerable controversy, there is no measure in PISA of high-stakes use of standardised tests. In some countries, such as Austria and Belgium, and the partner country Uruguay, standardised tests seem relatively rare. It is not possible to determine from these data if standardised tests are centrally mandated. However, in a few countries, notably Finland, Iceland, the United States, Sweden, Korea and Norway, as well as partner country Latvia, there is almost universal use of standardised tests at least once a year (95% of students or more).

A few countries stand out as using most forms of assessment relatively more frequently or infrequently than others. For example, Turkey emerges as a country where none of the forms is frequently in use in a majority of schools. Teacher ratings, teacher tests and student assignments are frequently used for the majority of students in many countries, but notably in Austria, Belgium, Germany, Iceland, Portugal, Spain, Sweden, the United States and the partner countries Brazil and Latvia, with frequent use by around 90% or more of students. Further, in Spain and the partner country Brazil there is above-average use of both student portfolios and standardised tests. Use of student assignments is extensive as a form of assessment in all countries: the OECD average is 86% of students being subject to this form of assessment more than three times a year, but in Greece, only 15% of students are similarly assessed.

The second aspect of assessment measured by the school questionnaire is the use of assessment results. The various purposes of assessment, and the percentages of schools using it for those purposes, appear in Table A.13.

By far the most common use of student assessment is for reporting to parents. More than 90% of schools in almost all countries use assessment for this purpose. Its use for student retention and promotion is also common, except in Denmark, Iceland and Korea. In countries where social promotion is a matter of national policy, no schools should report using assessment for this purpose. Nevertheless, there is no way to determine, in cases where a few schools report use for this purpose, if the data are unreliable or if a few schools are not following national policies. While the issue of social promotion deserves further attention from a policy perspective, the PISA questionnaires do not address it in more detail.

The remaining uses of assessment are highly variable across countries. For example, use for comparison with national standards occurs in more than 80% of schools in the United States, the United Kingdom, New Zealand, Hungary and Iceland, but in fewer than 10% of schools in Denmark and Belgium, and in the partner economy Macao-China. A similar pattern exists for comparison with other schools. Denmark stands out in this overall picture, with only a very small number of schools using assessment for any purposes other than reporting to parents and curriculum improvement.



## STUDENT PERCEPTIONS OF THE LEARNING ENVIRONMENT: OVERVIEW

The remaining factors to consider in this section concern the degree to which students report that their classroom climate and their relations with teachers have characteristics likely to be conducive to learning. A summary of the distribution of these factors and the extent to which they appear to be related to performance appears in Table 2.3.

As will be shown further in Chapter 3, these factors are particularly important because students who learn in a positive climate where they interact well with their teachers tend to perform better in mathematics. This relationship is clearest for disciplinary climate. Factors related to teacher support and relations have an association with performance that is perhaps complicated by extra support being given to weaker students. Nevertheless, the importance of these factors for teaching and learning is obvious.

It is notable here that (as shown in Table 2.3) the magnitude of the variability between schools is greater than for the learning strategies and preference factors considered earlier. The middle half of schools within each country vary on average by at least 0.40 of a standard deviation for climate-related factors, compared to around 0.30 of a standard deviation for learning strategies. This result indicates that for climate factors, more of the variation in the experiences of individuals can be attributed to variations among schools. Even in a country like Finland, where there are below-average levels of variation in climate factors among schools, there is actually about the average variation level for learning strategies.

### Classroom climate

The measurement of classroom climate uses a series of items on the student questionnaire related to degree of teacher interest and support for students, and elements of time use and disruption.

Table 2.3
**Distribution of students' experience of classroom climate and teacher-student relations, and the relationship of these factors with performance**

| Variable | Variability within countries:<br>Variability within middle half of schools (interquartile range)<br>Measured on index scale standardised relative to international standard deviation of individual learner characteristics | Relationship with performance<br>(Bivariate effect on mathemetics score, significant effects only) |
|---|---|---|
| Classroom climate<br>(a) Teacher support | OECD average range: 0.42 standard deviations<br>Highest variability: 0.61 in Austria, 0.55 in the Slovak Republic, 0.54 in Italy and 0.60 in the partner country Serbia<br>Lowest variability: 0.22 in Korea, 0.25 in the Netherlands and 0.19 in Macao-China and Liechtenstein | Small positive association in 13 countries, negative in 7. (When accounting for other factors, mainly negative: see Chapter 3.) |
| Classroom climate<br>(b) Disciplinary climate | OECD average range: 0.50 standard deviations<br>Highest variability: 0.79 in Japan, 0.76 in Austria, 0.68 in the Czech Republic and Hungary and 0.79 in Liechtenstein<br>Lowest variability: 0.29 in Luxembourg, 0.36 to 0.38 in New Zealand, Greece, the Netherlands, Korea and in the partner countries Indonesia, Brazil, Thailand and Macao-China | Significant positive association in almost all countries. (Remains when accounting for other factors: see Chapter 3.) |
| Teacher-student relations | OECD average range: 0.41 standard deviations<br>Highest variability: 0.61 in Tunisia, 0.60 in Liechtenstein, 0.55-0.58 in Austria, Switzerland and in the partner countries Serbia and Brazil<br>Lowest variability: 0.32 in New Zealand, 0.33 in Portugal and 0.31 in the partner country Thailand | Positive association in 12 countries, in some cases relatively strong; negative association in 11 countries, in all cases weak. (Positive associations weaker when accounting for other factors: see Chapter 3.) |

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These questions require response on a frequency-of-occurrence scale ranging from "every lesson" to "never or hardly ever". The 11 items on this scale combine to form two indices: the *index of teacher support* and the *index of disciplinary climate*. As with some other aspects of teaching strategies, these indices may be considered as characteristic of a classroom rather than of a student. In the absence of a classroom identifier, the most appropriate level at which to examine these variables is the school level. The extent to which these indices vary across schools within a country is an indicator of school-system differentiation. However, it must be recognised that assessment of variations among teachers within a school is lost when the aggregation is to the school level.

### Teacher support

The five items making up the *index of teacher support* are:

STQ38a The teacher shows an interest in every student's learning (*interested*).

STQ38c The teacher gives extra help when students need it (*extra help*).

STQ38e The teacher helps students with their learning (*helps learning*).

STQ38g The teacher continues teaching until students understand (*understand*).

STQ38j The teacher gives students an opportunity to express opinions (*opinions*).

Figure 2.9 shows the percentages of students reporting that these factors occur in every lesson or most lessons. The box plots give the range of variation across schools in each country.

A majority of students in almost all countries report that teacher support activities occur in all or most lessons. This result indicates, in absolute terms, perception of a high level of teacher support. There is a particularly strong perception of teacher support in Mexico and Turkey, and in the partner countries Brazil and Thailand; there is a comparatively weak perception of teacher support in Austria, Germany, Japan and Luxembourg. Students in Australia, Canada, Denmark, Finland, Iceland, New Zealand, Portugal, Sweden and the United States all perceive a higher level of teacher support than the average in OECD countries.

Within countries, differences in support across the middle 90% of schools range from just over half a standard deviation in Korea and the partner economy Macao-China to about one-and-a-half standard deviations in the Slovak Republic and the partner country Serbia.

### Disciplinary climate

The *index of disciplinary climate in mathematics lessons* consists of the following five items:

STQ38b Students don't listen to what the teacher says (*don't listen*).

STQ38f There is noise and disorder (*noise*).

STQ38h The teacher has to wait a long time for students to "quieten down" (*quiet down*).

STQ38i Students cannot work well (*can't work well*).

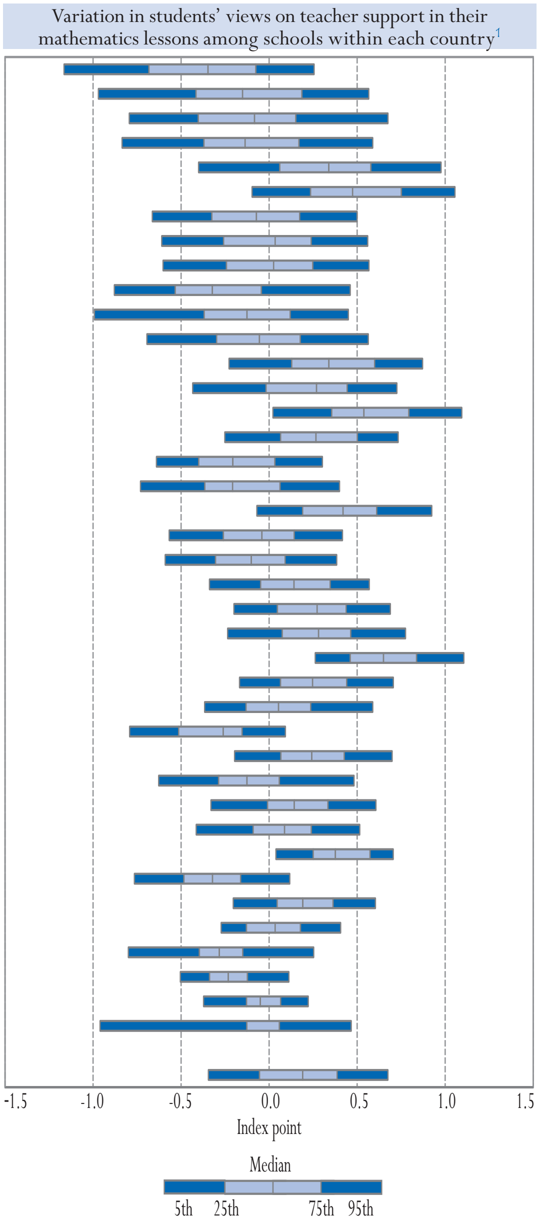
STQ38k Students don't start working for a long time after the lesson begins (*late start*).



## Figure 2.9 ■ Students' views on teacher support in their mathematics lessons

A The teacher shows an interest in every student's learning.
B The teacher gives extra help when students need it.
C The teacher helps students with their learning.
D The teacher continues teaching until the students understand.
E The teacher gives students an opportunity to express opinions.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Austria | 49 | 59 | 45 | 51 | 52 |
| Serbia | 53 | 49 | 54 | 51 | 55 |
| Slovak Republic | 57 | 58 | 65 | 52 | 60 |
| Italy | 57 | 49 | 70 | 61 | 61 |
| Uruguay | 77 | 51 | 81 | 75 | 73 |
| Mexico | 81 | 68 | 78 | 70 | 73 |
| Hungary | 54 | 64 | 72 | 55 | 62 |
| Ireland | 62 | 62 | 75 | 68 | 50 |
| Switzerland | 55 | 73 | 67 | 61 | 69 |
| Germany | 43 | 59 | 59 | 54 | 53 |
| Czech Republic | 47 | 75 | 59 | 51 | 57 |
| Spain | 65 | 48 | 72 | 65 | 60 |
| United States | 69 | 78 | 84 | 71 | 63 |
| Iceland | 66 | 69 | 89 | 78 | 59 |
| Brazil | 81 | 71 | 86 | 81 | 76 |
| Portugal | 67 | 73 | 82 | 71 | 67 |
| Poland | 51 | 61 | 62 | 55 | 55 |
| France | 48 | 63 | 66 | 62 | 50 |
| Turkey | 77 | 74 | 82 | 68 | 70 |
| Greece | 43 | 62 | 74 | 59 | 71 |
| Belgium | 49 | 65 | 66 | 64 | 53 |
| Denmark | 57 | 68 | 85 | 73 | 69 |
| Tunisia | 71 | 62 | 77 | 70 | 62 |
| Canada | 63 | 80 | 86 | 71 | 62 |
| Thailand | 85 | 77 | 88 | 83 | 79 |
| Russian Fed. | 67 | 74 | 80 | 67 | 71 |
| Latvia | 51 | 72 | 82 | 63 | 64 |
| Luxembourg | 53 | 61 | 49 | 57 | 59 |
| Australia | 64 | 78 | 85 | 72 | 63 |
| Norway | 55 | 60 | 81 | 60 | 58 |
| New Zealand | 63 | 77 | 84 | 68 | 59 |
| Finland | 54 | 77 | 86 | 61 | 62 |
| Indonesia | 64 | 66 | 81 | 78 | 81 |
| Japan | 50 | 62 | 73 | 50 | 47 |
| Sweden | 69 | 70 | 87 | 71 | 62 |
| Hong Kong-China | 62 | 67 | 74 | 68 | 60 |
| Netherlands | 49 | 66 | 49 | 60 | 54 |
| Korea | 58 | 56 | 79 | 40 | 49 |
| Macao-China | 60 | 57 | 68 | 64 | 57 |
| Liechtenstein | 55 | 72 | 63 | 60 | 66 |
| United Kingdom[2] | 63 | 75 | 83 | 73 | 57 |
| **OECD average** | **58** | **66** | **73** | **62** | **60** |




*Note:* Countries are ranked in descending order of variation of students' views of teacher support in mathematics between schools at the 25th and 75th percentiles.

1. At the 5th percentile students at only 5% of schools have a more negative view of teacher support in their mathematics lessons. Students at a school at the 95th percentile have a more positive view of teacher support in their mathematics lessons than students in 95% of the other schools.

2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.



Percentage responses to the “all lessons” and “most lessons” categories on the index variable appear in Figure 2.10. Please note that this scale is “reverse scored” so that low levels of agreement with the five statements can be interpreted as representing a positive disciplinary climate.

The frequency data show that students in most countries perceive their mathematics classes as having mainly positive disciplinary climates. The majority view of students that the behaviours presented in the statements occur relatively infrequently, compared to the frequencies reported for teacher support, indicates that students are making distinctions between positive and negative statements about classroom climate. That is, there is less indication of response bias here than for the statements based on the agree/disagree scales.

In absolute terms, the differences between countries are not particularly large on this scale. Even for countries at the negative end of the index, the frequencies of occurrence of the negative behaviours tend to be in the 30% to 40% range while those for countries at the positive end, the frequencies are in the range of 20%.

The variation among schools within countries is higher here than for the teacher support variable. The narrowest distributions among schools occur in Luxembourg, New Zealand, Greece, the Netherlands and Korea, as well as in the partner economies Indonesia, Brazil, Thailand and Macao-China, while the widest occur in Japan, Austria, the Czech Republic and Hungary and in the partner country Liechtenstein.

### Student-teacher relations

A third index, the *index of student-teacher relations*, is an indicator of students’ views on their school climate. The items included in this index are the following, with responses on a four-point agree-disagree scale:

STQ26a Students get along well with most teachers.

STQ26b Most teachers are interested in students’ well-being.

STQ26c Most of my teachers really listen to what I have to say.

STQ26d If I need extra help, I will receive it from my teachers.

STQ26e Most of my teachers treat me fairly.

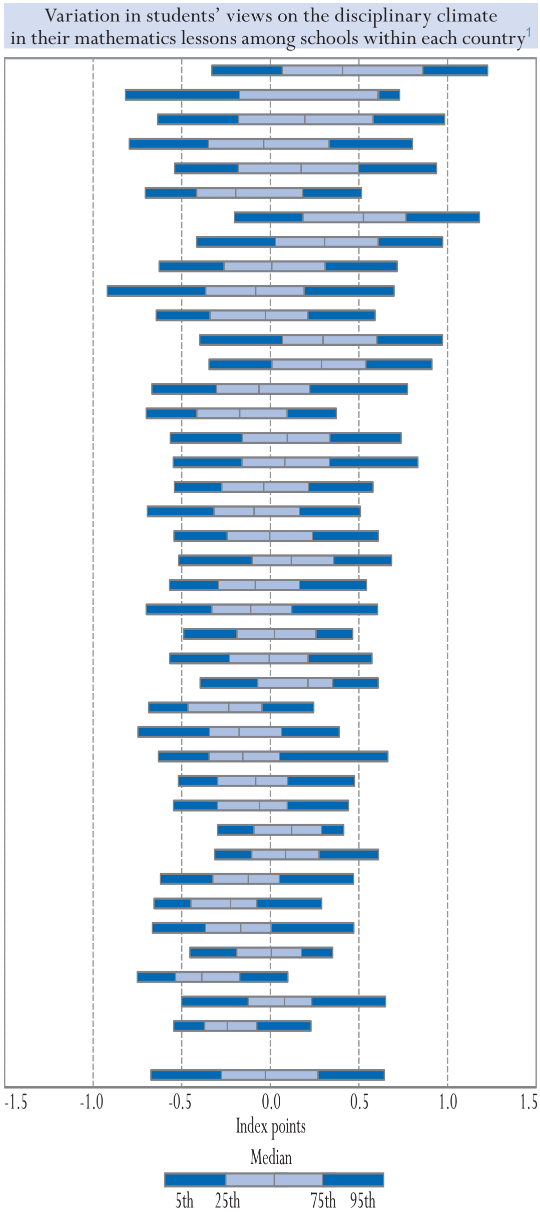
Figure 2.11 shows the patterns of agreement with these items and the range of variation across schools. The level of agreement with these statements is moderate to high, with percentages in the 50 to 80% range in most cases. The pattern across countries is quite similar to that for teacher support, and shows a comparable range, with more than one-and-a-quarter standard deviations between the 5th and 95th percentiles in Austria, Norway, Mexico and Germany and the partner countries Tunisia, Serbia and Brazil, and more than one-and-a-half standard deviations in Switzerland.



## Figure 2.10 ■ Students' views on the disciplinary climate in their mathematics lessons

- **A** Students don't listen to what the teacher says.
- **B** There is noise and disorder.
- **C** The teacher has to wait for a long time for students to "quieten down".
- **D** Students cannot work well.
- **E** Students don't start working for a long time after the lesson begins.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Japan | 19 | 17 | 14 | 25 | 15 |
| Liechtenstein | 26 | 28 | 33 | 28 | 25 |
| Austria | 31 | 27 | 33 | 27 | 30 |
| Czech Republic | 36 | 34 | 34 | 25 | 25 |
| Hungary | 28 | 28 | 30 | 22 | 19 |
| France | 33 | 46 | 38 | 25 | 42 |
| Russian Fed. | 22 | 16 | 18 | 19 | 15 |
| Germany | 22 | 25 | 32 | 26 | 26 |
| Belgium | 28 | 37 | 34 | 19 | 33 |
| Italy | 37 | 42 | 39 | 25 | 33 |
| Uruguay | 32 | 37 | 32 | 24 | 31 |
| Latvia | 27 | 20 | 20 | 18 | 21 |
| Ireland | 32 | 32 | 25 | 19 | 21 |
| Spain | 30 | 35 | 36 | 24 | 35 |
| Iceland | 31 | 41 | 36 | 25 | 26 |
| Poland | 33 | 27 | 30 | 21 | 22 |
| Switzerland | 28 | 33 | 32 | 26 | 31 |
| Australia | 34 | 42 | 32 | 20 | 27 |
| Denmark | 32 | 43 | 28 | 20 | 27 |
| Canada | 29 | 39 | 28 | 18 | 31 |
| United States | 32 | 34 | 26 | 19 | 27 |
| Sweden | 26 | 36 | 33 | 20 | 28 |
| Slovak Republic | 39 | 34 | 34 | 25 | 28 |
| Portugal | 28 | 35 | 30 | 22 | 27 |
| Mexico | 29 | 27 | 26 | 24 | 34 |
| Hong Kong-China | 21 | 17 | 19 | 19 | 20 |
| Norway | 34 | 41 | 36 | 28 | 36 |
| Finland | 36 | 48 | 35 | 19 | 32 |
| Turkey | 24 | 33 | 35 | 31 | 31 |
| Serbia | 33 | 32 | 28 | 27 | 28 |
| Tunisia | 26 | 37 | 36 | 33 | 52 |
| Macao-China | 18 | 15 | 17 | 21 | 20 |
| Korea | 27 | 72 | 19 | 18 | 21 |
| Netherlands | 27 | 42 | 36 | 19 | 39 |
| Greece | 35 | 43 | 35 | 29 | 39 |
| New Zealand | 38 | 47 | 37 | 23 | 31 |
| Thailand | 22 | 27 | 32 | 23 | 28 |
| Brazil | 35 | 38 | 38 | 30 | 63 |
| Indonesia | 25 | 32 | 37 | 22 | 30 |
| Luxembourg | 35 | 48 | 43 | 39 | 35 |
| United Kingdom[2] | 33 | 42 | 36 | 22 | 29 |




*Note:* Countries are ranked in descending order of variation of student views on the disciplinary climate in their mathematics lessons between schools at the 25th and 75th percentiles.

1. At the 5th percentile students at only 5% of schools have a more negative view of disciplinary climate in their mathematics lessons. Students at a school at the 95th percentile have a more positive view of disciplinary climate in their mathematics lessons than students in 95% of the other schools.
2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

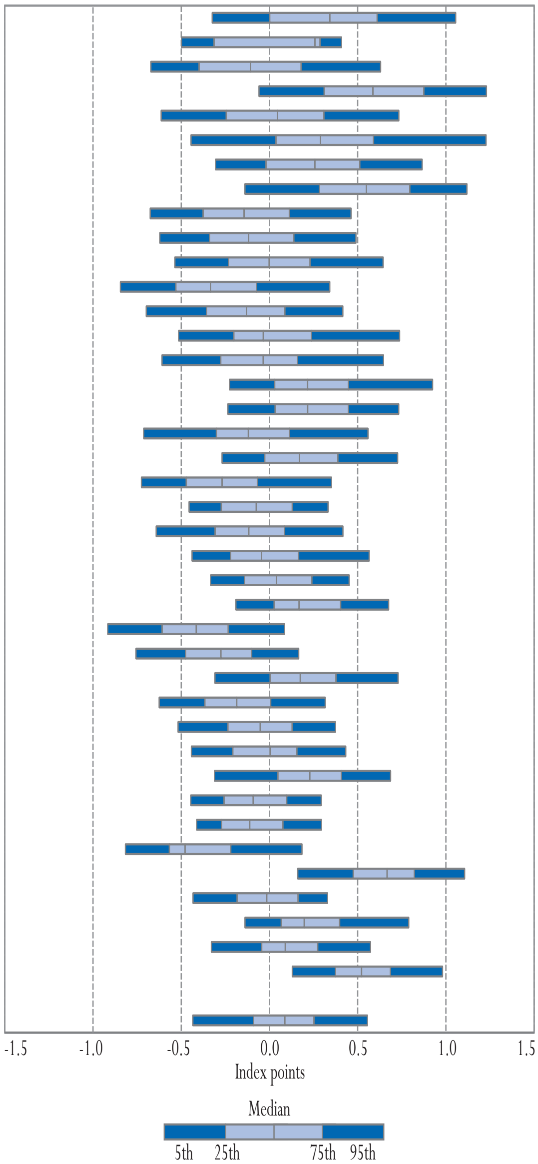


## Figure 2.11 ■ Students' views on student-teacher relations

- **A** Students get along well with most teachers.
- **B** Most teachers are interested in students' well-being.
- **C** Most of my teachers really listen to what I have to say.
- **D** If I need extra help, I will receive it from my teachers.
- **E** Most of my teachers treat me fairly.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| Tunisia | 64 | 60 | 78 | 78 | 75 |
| Liechtenstein | 66 | 66 | 60 | 72 | 79 |
| Serbia | 56 | 62 | 59 | 73 | 70 |
| Brazil | 80 | 82 | 79 | 88 | 85 |
| Austria | 73 | 64 | 58 | 67 | 78 |
| Switzerland | 70 | 74 | 70 | 82 | 82 |
| Denmark | 78 | 80 | 71 | 82 | 90 |
| Mexico | 85 | 85 | 77 | 80 | 84 |
| Spain | 62 | 70 | 66 | 65 | 75 |
| Greece | 68 | 60 | 66 | 68 | 71 |
| Iceland | 70 | 70 | 65 | 77 | 76 |
| Italy | 59 | 65 | 59 | 58 | 65 |
| Hungary | 63 | 59 | 74 | 72 | 68 |
| Latvia | 74 | 76 | 70 | 71 | 79 |
| Germany | 66 | 60 | 58 | 67 | 75 |
| Uruguay | 81 | 77 | 78 | 77 | 77 |
| Canada | 73 | 78 | 72 | 90 | 84 |
| Norway | 74 | 66 | 55 | 75 | 74 |
| Turkey | 80 | 60 | 74 | 75 | 66 |
| Slovak Republic | 65 | 47 | 62 | 67 | 76 |
| Netherlands | 70 | 68 | 64 | 84 | 84 |
| France | m | m | m | m | m |
| Russian Fed. | 76 | 59 | 74 | 61 | 77 |
| Hong Kong-China | 84 | 65 | 66 | 83 | 75 |
| Australia | 78 | 82 | 72 | 87 | 86 |
| Japan | 64 | 45 | 54 | 58 | 67 |
| Poland | 67 | 47 | 62 | 68 | 69 |
| United States | 71 | 75 | 70 | 88 | 87 |
| Czech Republic | 64 | 66 | 56 | 78 | 74 |
| Belgium | 69 | 69 | 66 | 81 | 76 |
| Ireland | 72 | 78 | 60 | 77 | 82 |
| Sweden | 81 | 78 | 72 | 81 | 83 |
| Macao-China | 81 | 58 | 58 | 75 | 73 |
| Korea | 84 | 65 | 55 | 85 | 70 |
| Luxembourg | 56 | 53 | 50 | 53 | 67 |
| Indonesia | m | m | m | m | m |
| Finland | 73 | 64 | 64 | 86 | 81 |
| Portugal | 83 | 80 | 76 | 84 | 84 |
| New Zealand | 72 | 79 | 68 | 85 | 84 |
| Thailand | 93 | 91 | 84 | 86 | 91 |
| United Kingdom[2] | 71 | 79 | 62 | 87 | 81 |
| **OECD average** | **71** | **68** | **65** | **76** | **77** |

Variation in students' views on student-teacher relations among schools within each country[1]




*Note:* Countries are ranked in descending order of variation of student views on student-teacher relations between schools at the 25th and 75th percentiles.

1. At the 5th percentile students at only 5% of schools have a more negative view of student-teacher relations. Students at a school at the 95th percentile have a more positive view of student-teacher relations than students in 95% of the other schools.

2. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.



## SUMMARY: A PROFILE OF MATHEMATICS TEACHING AND LEARNING

Overall, the results of this analysis show a complex and widely varying picture of mathematics instruction both within and across participating countries. While it is almost impossible to present a simple summary, a qualitative profile can be developed by looking at mid-ranked countries and at those at the extremes of the various distributions.

Students in participating countries spend an average of 37 weeks per year in school. Most countries show only small differences between schools in the number of weeks in the school year. This evidence undoubtedly reflects either national consensus or national regulation of the school year. However, in several countries the between-school differences are striking. On average, the school week is 24.4 hours long, again with only small differences between schools in most countries. Multiplying number of weeks in the school year by hours per week gives a measure of total instructional time per year. This measure averages close to 1 000 hours in most countries, but ranges from a high of over 1300 hours in the partner country Thailand to fewer than 800 hours in Mexico. According to this measure, the school year is more variable within countries than the number of school weeks would suggest.

On average in the OECD countries, 15-year-olds report that they spend approximately 200 minutes per week, or 14% of total instructional time, on mathematics. This figure compares to averages of 17% of total compulsory instructional time spent on mathematics by 9-to-11-year-olds and 13% spent by 12-to-14-year-olds, as reported in the 2004 OECD-INES Survey on Teachers and the Curriculum.

In most countries, the profile shows that fewer than 20% of students have a tutor or participate in school-related classes outside school hours, and the amount of time spent on such activities is relatively small even for those who do participate. However, a few countries show very high proportions of students taking part in such activities. This finding is essentially unrelated to the amount of time spent in school. It is difficult to identify the factors that contribute to students' and parents' decisions to pursue such activities, and in particular whether such decisions relate to competitive environments, attempts to mitigate poor school performance or concern with the quality of schooling. It is also unclear if having a tutor or participating in out-of-class lessons relates to socio-economic status. However, the highest participation rates in these activities occur in a few countries with relatively low socio-economic levels. This evidence suggests several possibilities, including a strong emphasis on education as a way to improve individual economic prospects or, conceivably, the availability of inexpensive education services outside regular schools. Alternatively, of course, it is possible that the results represent anomalies due to misunderstanding of the question or another form of response bias.

According to the profile, almost all students do some homework outside school, both in mathematics and in other subjects. On average, students spend close to six hours per week on homework, of which about 2.5 hours is on mathematics. Proportionally, mathematics occupies more of students' homework time than of their school time, suggesting that there is greater emphasis on homework in mathematics than in other subject areas. There is substantial homework variation across schools in most countries. In some cases, the within-country variation is as great as the average variation across countries. This evidence suggests that the amount of homework completed is largely a function of school policies.



Of the three meta-cognitive learning strategies, it is clear that students use elaboration and control strategies more than memorisation/rehearsal strategies. However, the results indicate that, among the memorisation/rehearsal strategies, students favour using examples and trying to learn procedures over simple "learn by heart" memorisation. Within the elaboration cluster, learning to relate concepts to what is already known is more common and less variable than other strategies. Most of the specific strategies within the control cluster receive high support from students, with relatively little variation across countries. There is also relatively little variation across schools for these strategies, especially elaboration and control, suggesting that these are stable student attributes rather than highly influenced by the school. Memorisation and elaboration show higher than usual variation across schools in only a small number of countries.

In general, the profile shows students reporting stronger preferences for co-operative than for competitive learning situations in mathematics. In a few countries, students express strong preferences for both learning situations, while in others there is a clear division. While these constructs may intuitively appear mutually exclusive, or at least negatively related, the data do not support this argument.

Most school principals agree that their teachers are open to innovative teaching practices. There is more variation across countries in teacher support for traditional ways of teaching. The correlations between these two factors within countries are negative, indicating that school staff tend to support either traditional or innovative methods. In most countries, there is relatively little indication of disagreement among staff about these approaches.

A large majority of school principals in all countries believe that their teachers expect high academic standards of their students and that the development of mathematical skills and knowledge is the most important objective of mathematics teaching. However, there is wide variation across countries in the degree of support for adapting standards to student abilities. Most school principals also report that their teachers support the proposition that social and emotional goals are as important as acquiring mathematics skills and knowledge.

The profile shows that there are wide variations among countries in the degree of streaming of students into different mathematics classes based on ability. Streaming is particularly prevalent in the United Kingdom, New Zealand, Ireland, the United States, Australia and Canada. Variations occur among countries that otherwise have regional or cultural similarities. For example, streaming is prevalent in Norway and Sweden, but not in Denmark or Finland. Similarly, there is a high level of streaming in the partner economy Hong Kong-China but a relatively low level in Japan and in the partner economy Macao-China. The use of within-class grouping is much more widely variable than streaming. Surprisingly, many countries that practice high degrees of streaming also have high levels of within-class grouping. This combination is frequent in New Zealand, Australia, the United Kingdom, Ireland, the United States, Sweden, the Netherlands, Canada and the partner countries, the Russian Federation and Latvia.

The most frequently used methods of assessment in almost all countries are teacher tests and student assignments. Teacher ratings are also often used in most countries. However, there is considerable variation among countries in the use of standardised tests and student portfolios. School principals in most countries report that 20 to 39 student assessments take place each year. Since the assessment questions were not specific to mathematics, it is not clear if this is within subjects



or over all subjects. The most common use of assessments is for reporting to parents. Use of assessment for student retention is also common. However, in a few countries, notably Denmark, Iceland and Korea, this is only rarely the case. Use of assessments for comparison with national standards varies widely: this is the case in more than 80% of schools in some countries and in fewer than 10% of schools in others. Denmark stands out as rarely using assessment for any purpose other than reporting to parents.

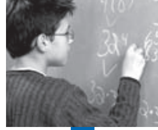
The profile indicates a majority of students in most countries agreeing that activities associated with teacher support are frequently used in their classrooms and that student-teacher relations are generally positive. Most students feel that teachers take an interest in their learning, that teachers give them help when needed, that they have an opportunity to express opinions and that teachers treat them fairly. There are few extremes here, suggesting that most students in most countries have a positive view of their teachers. The smaller-than-average proportions of students who report noise and disruption and other disciplinary problems reinforce this finding. However, there appears to be more variation across schools in the *index of disciplinary climate in mathematics lessons* than in the *index of teacher support*, and more between-school differences on this set of variables than for learning strategies.

### Differences that matter

The above description seems to show, in particular, that students' relations with their teachers and the disciplinary climate are two factors associated with better performance in which variation across schools can be considerable. The implication of this is that a more consistently positive teaching environment can contribute to reductions in between-school differences in performance, and this is more obviously so than might be the case for other factors examined here. The problem, as noted earlier, is that there is a likely interaction between disciplinary climate and student-teacher relations on the one hand and socio-economic and other student background factors on the other, possibly leading to a mutually reinforcing or mutually detrimental effect on achievement. This issue needs to be investigated more thoroughly than is possible in this overview study and can be revisited in PISA 2012.

However, the limited association with performance and degree of difference across schools for any one element studied suggests that a combination of teaching and learning factors may give students in one school an advantage over those in another. One noticeable trend in the summary tables in this chapter is that some countries show high levels of between-school differences across many factors, while others show consistently low levels of difference. In particular, Austria, Hungary, Italy and Mexico are among those countries with the widest variations in a range of factors, while Finland has relatively low variations on many factors. The combined impact of differences is likely to have a cumulative effect on student performance.

In interpreting the patterns presented in this profile, a central issue is the extent to which variations in teaching and learning practices affect students' chances of success, and where such differences are most significant. In some cases variations across countries are considerable, but they need to be interpreted with caution. Of greater interest is the large variation in teaching and learning factors between schools in some countries, giving unequal chances to different students. Also, the relationships noted in this chapter between teaching and learning strategies and student performance in mathematics represent simple correlations. The analysis of these relationships is refined in Chapter 3, using models in which the effect of a particular teaching or learning strategy is examined while adjusting for other variables.





## Notes

1 There are a few exceptions to this among OECD countries. In particular, in Mexico, Portugal and Turkey, fewer than 90% of students aged 15 are enrolled in school (OECD, 2005).

2 Strictly speaking, teaching strategies should be thought of as characteristic of a teacher. However, in the absence of a teacher questionnaire, student perceptions of teaching strategies have been aggregated to the school level and considered representative of the school. In addition, some of the time variables, such as instructional weeks per year and instructional hours per week, are better conceptualised as school-level than as student-level factors. Nevertheless, in some countries, the existence of streaming and the fact that PISA students may be found in more than one grade implies that within-school differences in time allocation and use may also be important. Such differences are neither characteristic of schools nor of individual students but of sub-units within schools, and hence are not examined here.

3 The graphs in this chapter have been arranged in descending order of the range from the 25th to the 75th percentile. This order is designed to allow easy inspection of differences between schools within countries.

4 *Education at a Glance: OECD Indicators 2005* (OECD, 2005) shows Mexico's average total instructional hours as slightly longer than the OECD average.

5 Caution is required here as it is possible that students in some countries are giving what they perceive to be socially desirable responses.

6 Results based on the school questionnaire are presented as tables rather than graphs because multiple series bar graphs for a large number of countries are difficult to read and interpret. In this situation the tables are more compact than comparable graphs.

# References

**Artelt, C.** *et al.* (2003), *Learners for Life: Student Approaches to Learning,* OECD, Paris.

**Carroll, J.B.** (1963), "A Model for School Learning", *Teachers College Record, Vol.* 64, No. 8, pp. 723-733.

**Carroll, J.B.** (1989), "The Carroll Model: A 25-Year Retrospective and Prospective View", *Educational Researcher*, Vol. 18, No. 1, 26-31.

**Marzano, R.** (2003), *What Works in Schools: Translating Research into Action,* Association for Supervision and Curriculum Development, Washington.

**OECD** (2004), *Learning for Tomorrow's World: First Results from PISA 2003*, OECD, Paris.

**OECD** (2005), *Education at a Glance: OECD Indicators 2005,* OECD, Paris.

**Zimmerman, B.J.** and **D.H. Schunk** (2001), *Self-Regulated Learning and Academic Achievement: Theoretical Perspectives,* Second edition, Erlbaum, Mahway, NJ.

3

# Are Students' Perceptions of their Mathematics Teaching and Learning Related to Mathematics Performance?

*This chapter first outlines the approach taken to develop an analytical framework of teaching and learning strategies, and then considers the actual effects of background factors and teaching and learning factors in PISA 2003, with separate findings for each country. Teaching and learning strategies do not take place in a vacuum. Rather, various background characteristics of students and schools create a context that can profoundly influence teaching and learning processes and outcomes. These background factors require examination alongside the teaching and learning factors, whose predictive power is the main subject of investigation in this chapter.*



## INTRODUCTION

The extent to which teaching and learning enable students to acquire knowledge and skills is central to the success of school systems. But can measurable features of teaching and learning activity be linked with testable student outcomes? In principle, PISA provides the tools to make such connections, both by measuring a range of characteristics of teaching and learning as reported by students and school principals and by testing student performance. However, drawing out links between the two is an imprecise science, not least because the knowledge and skills a student may have at age 15 are the product of learning over many years, both inside and outside school, whereas PISA is only able to look at conditions that 15-year-olds are experiencing in their schools at the time of the survey.

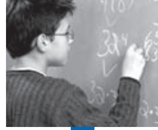
Recognising these limitations, this report uses a model designed to consider the extent to which certain features of teaching and learning can help predict performance in mathematics in the PISA assessment. This model acknowledges that teaching and learning do not take place in a vacuum. Various background characteristics of students and schools create a context that can profoundly influence the teaching and learning process and its outcomes. These characteristics include socio-economic background, student attitudes to school and mathematics, student levels of motivation, their perceptions of their own capability, and structural characteristics of schools such as school size. Such factors can be regarded as the antecedents of teaching and learning because they are not, for the most part, under the control of those who manage schools. These background factors bear examination alongside the teaching and learning factors whose predictive power is the main subject of investigation in this chapter.

The chapter outlines the approach taken in developing an analytical model of teaching and learning, and then considers the actual effects of background factors and of teaching and learning factors in PISA 2003.[1]

### An analytical model of the effect of teaching and learning strategies on mathematics achievement

The discussion that follows uses an analytical model designed to determine to what extent learning strategies and teaching strategies are associated with stronger mathematics performance, after accounting for other characteristics of students and schools. Thus, mathematics achievement is the educational outcome, student learning strategies and teaching strategies are its main predictors and a wide variety of other characteristics are treated as antecedents to learning. These last characteristics are controlled for in the analytical models, so that the teaching and learning effects can be more clearly seen.

The measures of teaching and learning that are considered here can be thought of as those that contribute to the efficiency or effectiveness with which learning takes place. The measures of antecedents to learning mainly cover factors that appear in other PISA reports, and in the literature, as being significantly related to achievement. Although it is impossible to establish the causal direction of effects in analytical models built on correlational data, measures other than teaching and learning strategies are modelled here as having influences on achievement that are independent of the antecedent variables.





The analytical model is a multi-level one which looks at the performance and characteristics both of individual students and of groups of students within schools. The grouping of students within schools in the survey makes it possible to examine variations across schools as well as among students. The analytical model first provides an estimate of the proportions of variability in achievement as accounted for by school differences on the one hand and by student differences within schools on the other. Once these proportions have been established, each measure of teaching and learning can be added in turn to the analytical model and its contribution to achievement estimated when account is made for all the other variables. The report expresses this contribution as an effect (regression coefficient), which may be interpreted as the change in mathematics achievement attributable to a one-unit change in the chosen measure or predictor in the analytical model. The theoretical approach outlined in Chapter 1 and the general logic of education production functions, which treats context measures essentially as antecedents to teaching and learning and hence as factors to be accounted for in studies of teaching and learning strategies, determine the overall structure of the analytical model. Measures of context in this analysis include students' socio-economic background, students' self-beliefs as mathematics learners and students' general attitudes towards school.

In this type of analytical model, a third level of analysis could potentially be added: that at country level, in addition to student and school levels. However, the analysis of three-level models is complex, and the relatively small number of countries surveyed precludes the use of many country-level variables. In addition, there are indications that students in different countries may interpret questionnaire items differently, making it difficult to treat some of the measures as a single scale across countries. For these reasons, the report presents results for each country separately. While the report does not build cross-country comparisons into the modelling, it is useful nevertheless to examine whether the effects of particular teaching and learning strategies are universal or country-specific. This question is analysed by examining differences in the size of the model coefficients across countries.

The PISA database contains many measures that can be analysed to investigate the effects of teaching and learning strategies (see Chapter 2) The choice of variables included in the model and the choice of results presented in this chapter was guided by an in-depth exploratory analysis of a wide range of variables in the PISA 2003 database.[2] The final set of measures included in the analytical model are those judged to give the best overall predictive power of student achievement with minimal redundancy among the predictors. This exercise has led to the exclusion of several measures related to time and to school principals' perceptions of teaching strategies, as these have shown essentially no separate effects when modelled as predictors of achievement.

## REPORTING THE RESULTS

To avoid undue complexity the reported results concentrate on two types of effects relating the measures of teaching and learning strategies to PISA mathematics performance. The first type is a bivariate regression coefficient representing the direct or absolute association of a particular teaching or learning strategy variable with performance, as already presented in Chapter 2. This coefficient shows how strongly each measure is associated with performance, before accounting for other factors. The second type is a multi-level, multivariate regression coefficient and shows the unique effect of a single variable, after accounting for other factors in the teaching and learning analytical model (see Box 3.1). This chapter reports on the unique effects for each factor and reminds readers



of the observed associations with performance already found for each factor. Comparing the two sets of coefficients for all countries presents a picture of the extent to which other factors included in the analytical model have mediated the effect of the factor under examination.[3]

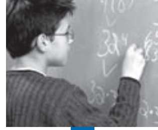
A complete breakdown of the effects for each measure included in the analytical model for each country appears in Annex C, Multilevel Model, Table C.1, Multivariate regression coefficients and standard errors. Table C.2 presents the bivariate regression coefficients and standard errors. For those interested in a complete profile for a specific country or group of countries, the tables can be used to construct within-country figures across all of the factors analysed, similar to the across-country figures presented in this chapter.

### Box 3.1 ■ **Interpreting the effects of regression coefficients**

The figures and tables in this chapter are based on regression coefficients designed to show the effect on mathematics achievement of a one-unit change in each of the independent measures or predictors included in the analytical model.

A one-unit change indicates a difference of one standard deviation in each measure. In some cases, the measure of interest is an index and a difference of one standard deviation equals an increase of one unit on the index. For each index, values are standardised so that the mean value is zero and one unit is equal to one standard deviation. For example, on an index showing the strength of the disciplinary climate as reported by students in answering a range of questions, an average-strength disciplinary climate is represented as zero. The index is constructed so that about two-thirds of students internationally report a disciplinary climate in the range +1 to -1, *i.e.* within one standard deviation of the mean. A regression coefficient of, say, 10 indicates that a one-point difference on this scale is associated with a difference of 10 score points on the PISA mathematics scale. Looked at in another way this would mean that, taking the middle two-thirds of students ranked by how strongly they rate the disciplinary climate of their schools, those with the strongest disciplinary climate would have predicted mathematics scores 20 points ahead of those with the weakest disciplinary climate (because they would be separated by two standard deviations on the disciplinary climate scale).

In most figures and tables, both a bivariate coefficient (absolute or observed effect) and a full-model coefficient (relative or unique effect) are shown for each country. The bivariate effect represents the effect on mathematics achievement of one unit change in the variable of interest when this variable is considered alone. This effect is often referred to as the observed association with performance. The full-model effect is the coefficient obtained when all measures are included in the model. Therefore, it represents the effect on mathematics achievement of a one-unit change in the measure of interest, accounting for all of the other measures included in the model. This relative or unique effect is shown for each country in graphical format, with countries ordered by the size of the effect. Statistically significant effects are shown as blue bars and non-significant effects as white outline bars. In each case, the accompanying table gives some further information to aid in interpreting the effects. A comparison of the bivariate coefficient with the full model coefficient gives a sense of the degree to which other measures included in the model exert mediating effects on the measure of interest's association with performance. In almost all cases, the full-model effect is smaller than the bivariate effect because of these mediating influences.





**Box 3.1 ■ Interpreting the effects of regression coefficients** *(continued)*

It is important to note that, although the figures have been ordered by size of effects, these figures should not be interpreted as a comparative ranking of countries, as is the case for the achievement results. Statistical significance of the effects shown refers to whether the coefficient is significantly different from zero, not whether effects in different countries are statistically significant when compared with each other. Where the strength of an effect is shown as greater in one country than another, this difference is not always statistically significant. In some cases, comments are made in the text about comparative effects: these apply mainly to countries at the extremes of the distribution or to patterns across countries with similar characteristics. All differences large enough to warrant comment are statistically significant.

Including a large number of measures in regression models makes calculations technically difficult. One problem is that the effects of occasional missing data are more significant overall than when fewer factors are considered. In the analysis conducted in this report, multiple imputation techniques were used to deal with missing data.

## HOW MUCH PERFORMANCE VARIATION IS DUE TO SCHOOL DIFFERENCES AND HOW DO A RANGE OF FACTORS CONTRIBUTE TO THIS VARIATION?

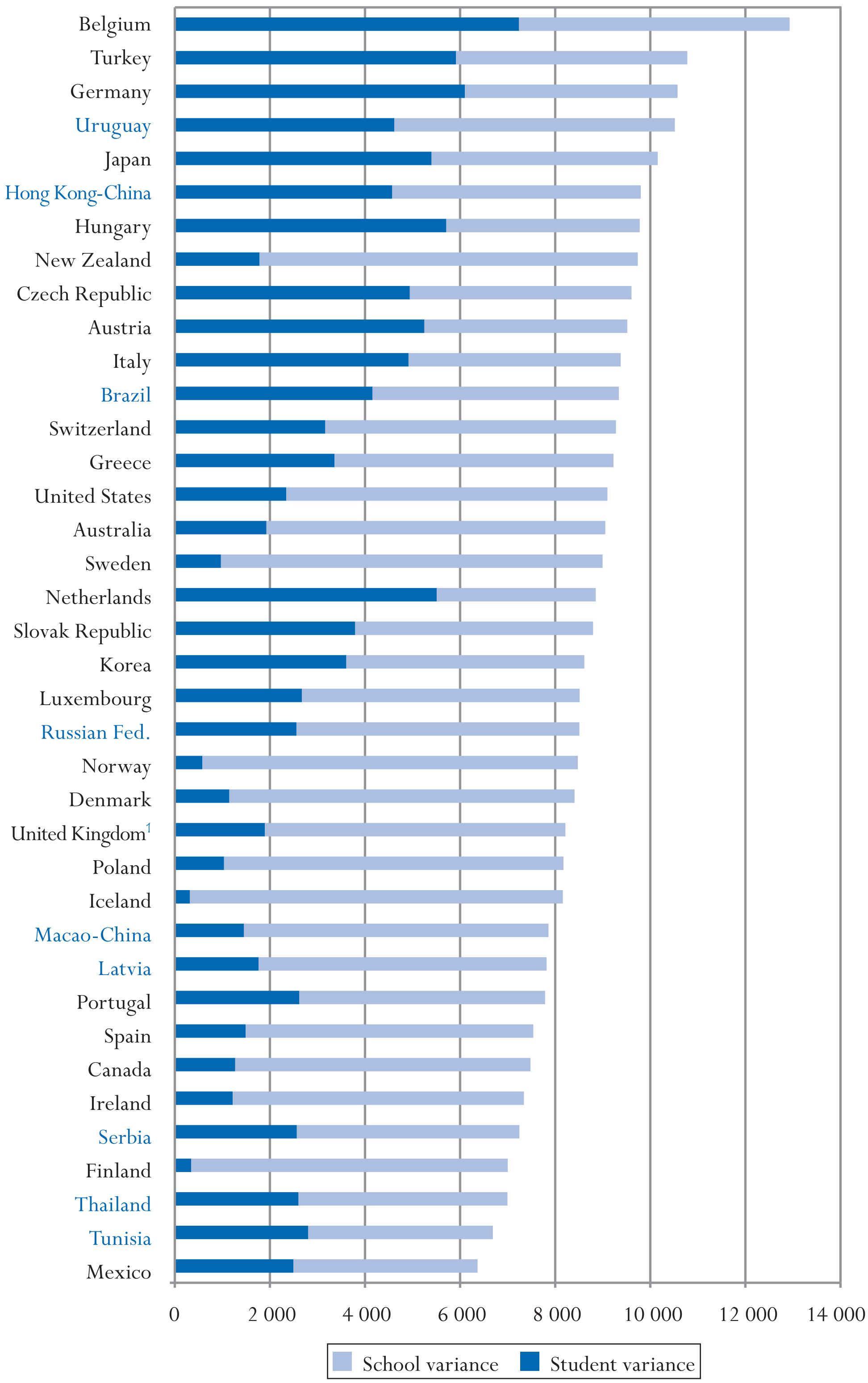
From the results presented in Chapter 2, it is clear that the amount of variation among schools in some of the factors analysed here differs widely from one country to another. Some countries seem to have relatively homogeneous school systems, while in others schools have wide variations in a number of factors. PISA results have shown strong differences with regard to the socio-economic composition of schools: some countries have schools that are highly differentiated in terms of students' backgrounds and other countries have relatively small differences in socio-economic composition between different schools (OECD, 2004). To what extent do schools differ in teaching and learning strategies?

The analysis in this report partitions the total variation in students' performance in mathematics into between-student and between-school components. It is instructive to examine these components in terms of the impact on overall performance of differences between schools and as a precursor to the more detailed analysis of the effects of selected student and school factors on achievement.

Figure 3.1 shows the total variance in mathematics performance accounted for by the teaching and learning analytical model for each country, and the amount of this variance attributable to differences between students and schools. In this graph, the total length of the bars gives the total variance, with the two segments showing how much of this variance is attributable to differences between schools (left segment) and variation within schools (right segment). Generally speaking, countries that have high total variation in achievement also tend to have high between-school variation, and vice versa. That is, highly differentiated school systems tend to be associated with high variations in achievement while relatively homogeneous school systems tend to be associated with smaller overall variations in achievement. There are notable exceptions to this, however. For example, Sweden has moderate total variation in performance but low variation between schools, while the Netherlands has similar total variation in performance to Sweden but much greater variation between schools.

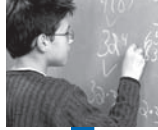


Figure 3.1 ■ **Total student and school variance accounted for by the model**




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.





Finland, Ireland, Canada and Spain have among the smallest total variation in performance and the smallest variation between schools. In the cases of Canada and Finland, this finding also combines with high average performance in mathematics, showing that uniformity does not necessarily come at the expense of overall performance. Conversely, some high-achieving countries, notably Japan and the partner economy Hong Kong-China, have both high variation overall and between schools.

The results from the analytical model are not dependent on the order of entry of the different factors analysed; nevertheless, an important indicator of the predictive power of the model is the proportion of school and student variance accounted for as one adds additional measures or factors. When built in stages, the analytical model unfolds with one or more factors added at each stage and with the order of addition chosen on *a priori* grounds. Stable student factors or measures considered as precursors of learning strategies enter before the measures of more specific learning strategies. For example, the three measures of students' socio-economic background enter at the first stage in order to account for the effects of socio-economic background when examining learning strategies. Student attitudes towards school, students' motivation to learn mathematics and their levels of anxiety in learning mathematics, as well as students' self-beliefs as mathematics learners enter next, in that order, because these factors were judged to be predictors of students' use of learning strategies. Student learning strategies enter next, on the assumption that student factors are more stable and hence require treatment as antecedent to teaching strategies. Finally, teaching strategies enter, along with two school-level factors, school size and school level socioeconomic status, considered as related to teaching strategies.

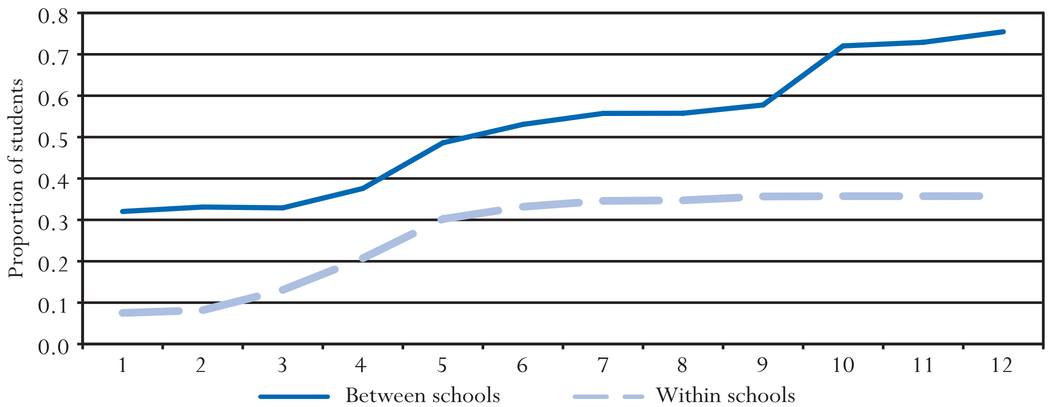
The analytical model examines many different student and school factors. As such, the predictive power of an individual measure is likely to be reduced due to the impact of mediating effects, as already described. While this might suggest that the effects of teaching and learning strategies are underestimated or are artefacts of the analytical model chosen, it is important to recognise that this model was established on *a priori* grounds, based on a hypothesised causal sequence. The effects of teaching and learning strategies thus appear as unique effects, accounting for all factors considered to be antecedents.[4] In any event, comparison of the bivariate and analytical model coefficients provides a sense of the impact of other factors in the model on the variables of interest.

Figure 3.2 shows the average proportions of school and student variance accounted for by the model. (A complete breakdown of these proportions by country appears in Table C.3, Variance explained by the multivariate multilevel model on teaching and learning.) As can be seen, the model is more effective in accounting for school variance than for student variance. The greatest incremental contributions to the variance accounted for occur when the measures of motivation to learn mathematics and self-belief as mathematics learners are included, and also with the inclusion of the socio-economic composition of the school. Nevertheless, there are significant contributions, especially to school variance, on entering some of the measures of student learning strategies and teaching strategies.

While the report presents this partitioning of variance in terms of gradually adding more factors to the model, in reporting the final model results each factor is considered in relation to all other factors in the model, demonstrating both the observed (bivariate) association with performance and the unique effects after taking account of other factors. The analysis looks in turn at the antecedents to learning and at the predictors. The methodology for calculating the effect of these two groups of factors is the same, but the second set are of greatest interest in this report; the first set are reported for context.



Figure 3.2 ■ **Average proportions of student and school variance accounted for by the model**




Model Stage

1 Parents' highest occupational status, parents' highest level of education, number of books in the home
2 Students' attitudes towards school and students' sense of belonging at school
3 Students' interest in and enjoyment of mathematics and students' instrumental motivation in learning mathematics
4 Students' anxiety in mathematics
5 Students' self-efficacy in mathematics and students' self-concept in mathematics
6 Hours per week of total homework, hours per week of mathematics homework, tutoring in mathematics, out-of-school classes
7 Memorisation/rehearsal strategies, elaboration strategies, control strategies
8 Preference for competitive learning situtations, preference for co-operative learning situtations
9 Teacher support, student-teacher relations
10 School average of the highest international socio-economic index of occupational status (HISEI) of both parents
11 School size
12 School average disciplinary climate

*Source:* OECD PISA 2003 Database.

## THE MEASURED EFFECTS OF ANTECEDENTS TO LEARNING INCLUDED IN THE ANALYTICAL MODEL

### Students' socio-economic background

The report uses three measures of students' socio-economic background. These measures are the highest occupational status of parents (HISEI), the highest educational level of parents (HISCED) and the number of books in the home. The report uses these measures in preference to the composite index of socio-economic background (a variable called ESCS) found in the PISA data file because they are straightforward and easily understandable variables, and because exploratory analysis reveals them to be better predictors of achievement than most other variables that make up the composite index.

Figure 3.3 shows the effects of the highest occupational status of parents. This socio-economic measure is positively associated with mathematics performance in all countries. In Japan and in the partner economy Macao-China the relationship is non-significant. Even after accounting for other teaching and learning factors, there remains a positive association in 31 countries, although the other factors greatly reduce the effect. For example, the effect decreases by at least two-thirds in the Slovak Republic,

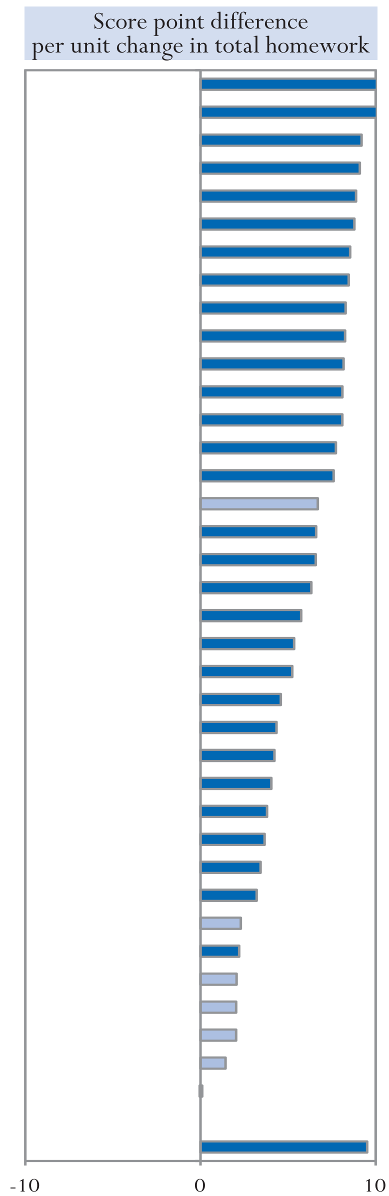


Spain, the Russian Federation, Norway, Poland and Sweden. In most countries, this index and the other two measures of students' socio-economic background account for substantially more of the variation between schools than between students. This finding indicates that there is a considerable school-level effect independent of variations in students' socio-economic backgrounds within schools.

The second measure of students' socio-economic background is the level of education of the parents (Figure 3.4). PISA asked students to indicate the educational level of both parents; the index used here is the highest level of either parent. This measure, like the highest occupational status of parents, shows a positive association with mathematics performance for almost all countries. The exceptions

Figure 3.3 ■ **Parents' highest occupational status (HISEI) and mathematics performance**

| | | Bivariate | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Belgium | 50.59 | 17.9 | (1.13) | 10.5 | (1.26) |
| Poland | 44.96 | 32.2 | (1.74) | 10.3 | (1.77) |
| Australia | 52.59 | 19.8 | (1.30) | 9.2 | (1.19) |
| Norway | 54.63 | 28.4 | (1.75) | 9.1 | (1.51) |
| Denmark | 49.26 | 25.4 | (1.75) | 8.9 | (1.60) |
| Sweden | 50.64 | 27.3 | (1.79) | 8.8 | (1.47) |
| United States | 54.55 | 22.2 | (1.26) | 8.5 | (1.15) |
| Portugal | 43.10 | 22.6 | (1.40) | 8.5 | (1.57) |
| Switzerland | 49.30 | 18.6 | (1.54) | 8.3 | (1.38) |
| Brazil | 40.12 | 13.1 | (2.26) | 8.3 | (2.07) |
| Ireland | 48.34 | 22.2 | (1.73) | 8.2 | (1.42) |
| Finland | 50.23 | 21.7 | (1.28) | 8.1 | (1.07) |
| Canada | 52.58 | 18.1 | (1.06) | 8.1 | (0.96) |
| New Zealand | 51.46 | 23.1 | (1.44) | 7.7 | (1.27) |
| Latvia | 50.28 | 15.6 | (1.82) | 7.6 | (1.45) |
| Macao-China | 39.42 | 6.1 | (4.10) | 6.7 | (3.91) |
| Luxembourg | 48.17 | 15.3 | (1.42) | 6.6 | (1.69) |
| Tunisia | 37.50 | 10.5 | (1.39) | 6.6 | (1.52) |
| Uruguay | 46.15 | 13.0 | (1.36) | 6.3 | (1.59) |
| Thailand | 36.01 | 9.7 | (1.39) | 5.7 | (1.67) |
| Netherlands | 51.26 | 9.5 | (1.35) | 5.3 | (1.24) |
| Czech Republic | 50.05 | 15.3 | (1.59) | 5.2 | (1.63) |
| Italy | 46.83 | 7.3 | (1.11) | 4.6 | (1.02) |
| Germany | 49.33 | 13.0 | (1.52) | 4.3 | (1.39) |
| Hong Kong-China | 41.13 | 5.7 | (1.76) | 4.2 | (1.69) |
| Hungary | 48.58 | 10.1 | (1.62) | 4.0 | (1.57) |
| Russian Fed. | 49.86 | 12.8 | (1.51) | 3.8 | (1.49) |
| Serbia | 48.07 | 11.1 | (1.43) | 3.7 | (1.14) |
| Spain | 44.29 | 15.8 | (1.25) | 3.4 | (1.14) |
| Slovak Republic | 48.79 | 14.5 | (1.25) | 3.2 | (1.24) |
| Greece | 46.94 | 12.2 | (1.66) | 2.3 | (1.73) |
| Mexico | 40.12 | 4.8 | (0.96) | 2.2 | (0.88) |
| Turkey | 41.57 | 6.4 | (1.60) | 2.1 | (1.52) |
| Austria | 47.06 | 7.0 | (1.21) | 2.0 | (1.35) |
| Iceland | 53.72 | 12.9 | (1.50) | 2.0 | (1.46) |
| Korea | 46.32 | 7.5 | (1.52) | 1.4 | (1.25) |
| Japan | 49.98 | 2.0 | (1.47) | 0.0 | (1.28) |
| United Kingdom[1] | 49.65 | 21.8 | (1.38) | 9.5 | (1.27) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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

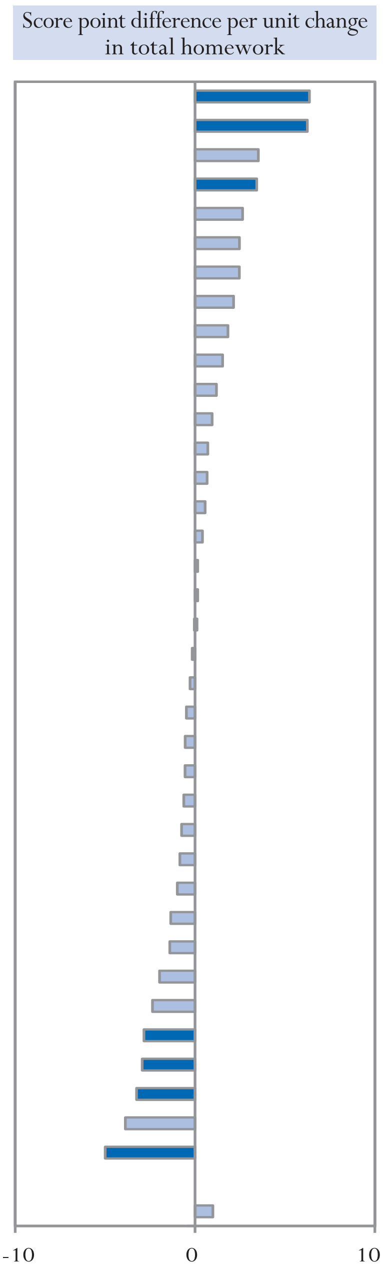


are Austria and the partner economies Brazil, Hong Kong-China, Indonesia and Macao-China. (In these countries, the relationship is non-significant). However, when included in the analytical model with all other factors, this positive association with performance remains in only Denmark, Iceland and Ireland and becomes negative in Austria, Italy and the partner countries Tunisia and Brazil.

The third measure of students' home background is the students' estimate of the number of books in the home.[5] Figure 3.5 gives the results for books in the home and – unlike for parents' education – there is

Figure 3.4 ■ **Parents' highest educational level (HISCED) and mathematics performance**

| | Bivariate | | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Denmark | 4.47 | 25.8 | (2.02) | 6.4 | (1.76) |
| Iceland | 4.28 | 20.1 | (1.79) | 6.2 | (1.86) |
| Poland | 4.09 | 35.9 | (2.36) | 3.5 | (1.96) |
| Ireland | 4.23 | 18.9 | (1.59) | 3.4 | (1.43) |
| Czech Republic | 4.36 | 17.8 | (2.09) | 2.6 | (2.16) |
| Slovak Republic | 4.32 | 18.2 | (2.16) | 2.5 | (1.50) |
| New Zealand | 4.25 | 20.9 | (1.93) | 2.5 | (1.71) |
| Germany | 4.05 | 11.4 | (1.34) | 2.1 | (1.36) |
| Finland | 4.80 | 19.4 | (1.52) | 1.8 | (1.30) |
| Russian Fed. | 4.86 | 15.8 | (1.92) | 1.5 | (2.20) |
| Switzerland | 3.88 | 13.6 | (1.34) | 1.2 | (1.10) |
| Canada | 4.84 | 18.5 | (1.49) | 1.0 | (1.48) |
| Hungary | 4.22 | 13.1 | (1.66) | 0.7 | (1.35) |
| Spain | 3.87 | 10.2 | (0.86) | 0.7 | (0.98) |
| Turkey | 2.84 | 6.1 | (1.39) | 0.6 | (1.23) |
| Greece | 4.12 | 10.8 | (1.45) | 0.4 | (1.34) |
| Latvia | 4.90 | 18.9 | (3.95) | 0.1 | (2.25) |
| Mexico | 3.15 | 2.0 | (0.99) | 0.0 | (0.97) |
| United States | 4.67 | 20.0 | (1.90) | 0.0 | (1.60) |
| Korea | 4.04 | 6.3 | (1.20) | -0.2 | (1.06) |
| Thailand | 2.55 | 5.4 | (1.21) | -0.3 | (1.36) |
| Luxembourg | 4.09 | 8.5 | (1.08) | -0.5 | (1.34) |
| Uruguay | 3.83 | 7.3 | (1.47) | -0.5 | (1.54) |
| Japan | 4.77 | 3.5 | (1.64) | -0.6 | (1.38) |
| Macao-China | 2.63 | 2.4 | (3.23) | -0.6 | (2.85) |
| Belgium | 4.64 | 11.0 | (1.25) | -0.7 | (1.15) |
| Australia | 4.62 | 12.4 | (1.49) | -0.8 | (1.25) |
| Sweden | 4.67 | 15.9 | (1.75) | -1.0 | (1.54) |
| Netherlands | 4.56 | 4.3 | (1.21) | -1.4 | (1.13) |
| Portugal | 2.70 | 10.4 | (1.10) | -1.4 | (0.95) |
| Serbia | 4.21 | 7.4 | (1.50) | -2.0 | (1.47) |
| Norway | 4.75 | 23.8 | (2.30) | -2.4 | (2.36) |
| Brazil | 3.72 | 0.1 | (1.20) | -2.8 | (1.11) |
| Italy | 3.95 | 3.1 | (1.11) | -2.9 | (1.10) |
| Tunisia | 2.46 | 4.2 | (1.06) | -3.3 | (1.26) |
| Hong Kong-China | 2.58 | -0.7 | (2.01) | -3.9 | (2.01) |
| Austria | 4.09 | 1.9 | (1.68) | -5.0 | (1.50) |
| United Kingdom[1] | 4.22 | 18.5 | (1.77) | 1.0 | (1.57) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

*Note:* Statistically significant score point differences are marked in a darker tone.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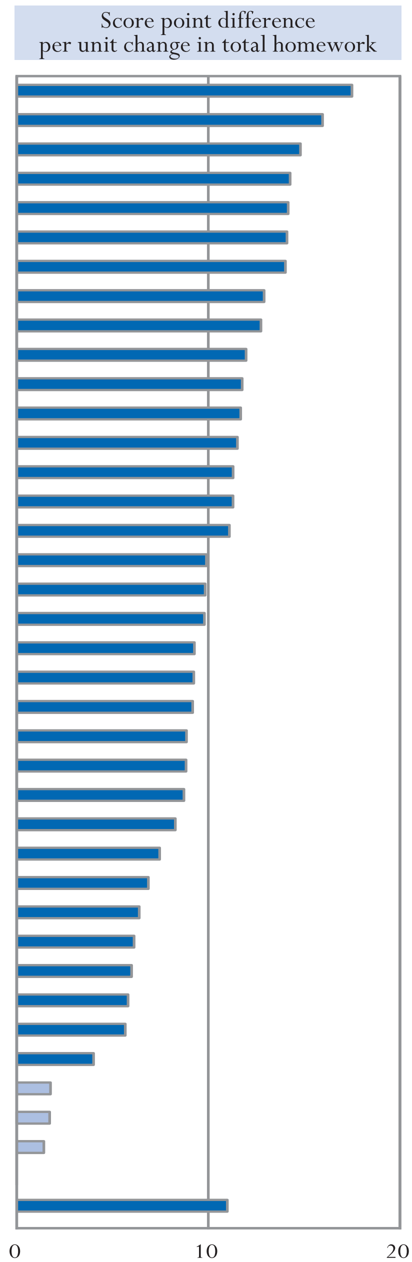
a positive association with mathematics performance, even when considered in the wider context of teaching and learning, in all countries except Mexico and the partner economies Macao-China and Thailand where there is no significant relationship. In 19 of the OECD countries the effect of the number of books in the home is of 10 score points or more. Clearly, this factor plays a significant role in achievement independently of the other measures of socio-economic background and of other school and student effects.

Figure 3.5 ■ **Number of books in the home and mathematics performance**

| | Bivariate | | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Sweden | 3.92 | 34.4 | (1.51) | 17.5 | (1.18) |
| Spain | 3.76 | 28.8 | (1.36) | 16.0 | (1.26) |
| Slovak Republic | 3.53 | 26.4 | (1.89) | 14.8 | (1.54) |
| Switzerland | 3.37 | 25.3 | (1.21) | 14.3 | (1.08) |
| Korea | 3.57 | 24.0 | (1.55) | 14.2 | (1.65) |
| Norway | 4.00 | 29.7 | (1.66) | 14.1 | (1.45) |
| United States | 3.30 | 28.4 | (1.18) | 14.0 | (1.16) |
| Finland | 3.59 | 28.6 | (1.47) | 12.9 | (1.22) |
| New Zealand | 3.70 | 29.0 | (1.59) | 12.7 | (1.32) |
| Austria | 3.43 | 17.1 | (1.28) | 12.0 | (1.20) |
| Poland | 3.39 | 31.2 | (1.49) | 11.8 | (1.18) |
| Czech Republic | 4.11 | 19.8 | (1.63) | 11.7 | (1.63) |
| Iceland | 4.05 | 24.9 | (1.73) | 11.5 | (1.47) |
| Ireland | 3.34 | 24.1 | (1.48) | 11.3 | (1.14) |
| Denmark | 3.54 | 27.6 | (1.77) | 11.3 | (1.46) |
| Canada | 3.72 | 20.6 | (0.98) | 11.1 | (0.70) |
| Portugal | 3.04 | 24.9 | (1.53) | 9.9 | (1.80) |
| Australia | 3.87 | 21.4 | (0.95) | 9.8 | (0.86) |
| Luxembourg | 3.53 | 16.5 | (1.30) | 9.8 | (1.21) |
| Turkey | 2.55 | 15.3 | (1.70) | 9.3 | (1.48) |
| Germany | 3.67 | 17.8 | (1.17) | 9.2 | (1.15) |
| Latvia | 3.94 | 21.3 | (2.16) | 9.2 | (1.51) |
| Netherlands | 3.39 | 12.9 | (1.34) | 8.9 | (1.28) |
| Belgium | 3.36 | 16.8 | (1.12) | 8.8 | (1.04) |
| Hungary | 3.92 | 15.2 | (1.24) | 8.7 | (1.18) |
| Hong Kong-China | 2.54 | 12.9 | (1.42) | 8.3 | (1.36) |
| Greece | 3.20 | 17.0 | (1.31) | 7.5 | (1.47) |
| Russian Fed. | 3.81 | 18.6 | (1.40) | 6.9 | (1.35) |
| Japan | 3.50 | 10.8 | (1.26) | 6.4 | (1.33) |
| Brazil | 2.01 | 12.0 | (2.27) | 6.1 | (2.20) |
| Serbia | 2.65 | 15.3 | (1.76) | 6.0 | (1.51) |
| Tunisia | 2.31 | 11.7 | (1.44) | 5.8 | (1.21) |
| Uruguay | 2.71 | 12.9 | (1.86) | 5.7 | (1.46) |
| Italy | 3.51 | 10.7 | (1.18) | 4.0 | (1.07) |
| Thailand | 2.45 | 8.3 | (1.66) | 1.8 | (1.43) |
| Macao-China | 2.27 | 7.0 | (3.70) | 1.7 | (3.16) |
| Mexico | 2.12 | 5.2 | (1.57) | 1.4 | (1.49) |
| United Kingdom[1] | 3.41 | 26.0 | (1.37) | 11.0 | (1.19) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

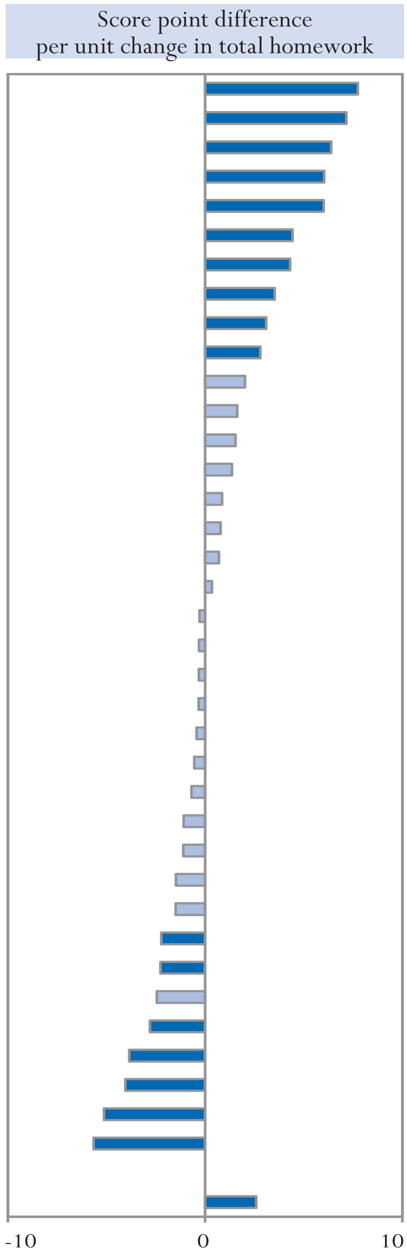
*Note:* Statistically significant score point differences are marked in a darker tone.



In summary, two of the three measures of students' socio-economic background, the highest occupational status of parents and students' estimates of the number of books in the home, remain almost universally significant contributors to achievement, even after accounting for a large number of other student and school characteristics. The size of these effects is generally diminished in the full analytical model relative to their observed association with performance, indicating that other factors can help overcome disadvantages in students' socio-economic background. While universally positively correlated with achievement, parents' educational levels do not generally exert independent effects after other factors are accounted for.

Figure 3.6 ■ **Students' attitudes towards school and mathematics performance**

| | Bivariate | | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Mexico | 0.42 | 10.5 | (1.11) | 7.7 | (1.02) |
| Iceland | 0.00 | 15.0 | (1.46) | 7.2 | (1.51) |
| Latvia | 0.22 | 8.7 | (1.94) | 6.4 | (1.31) |
| Finland | 0.11 | 12.1 | (1.46) | 6.0 | (1.27) |
| New Zealand | 0.10 | 13.4 | (1.53) | 6.0 | (1.48) |
| Norway | -0.21 | 15.8 | (1.86) | 4.4 | (1.76) |
| Sweden | 0.02 | 13.0 | (1.46) | 4.3 | (1.44) |
| Tunisia | 0.72 | 4.8 | (0.87) | 3.5 | (0.85) |
| Thailand | 0.28 | 7.6 | (1.31) | 3.1 | (1.26) |
| Australia | 0.25 | 10.2 | (1.10) | 2.8 | (0.96) |
| Brazil | 0.53 | 1.7 | (1.40) | 2.0 | (1.41) |
| Switzerland | 0.03 | 1.4 | (1.90) | 1.6 | (1.29) |
| Denmark | -0.03 | 5.2 | (1.64) | 1.5 | (1.66) |
| Portugal | 0.27 | 6.6 | (1.31) | 1.4 | (1.13) |
| Ireland | 0.13 | 6.1 | (1.46) | 0.9 | (1.26) |
| Uruguay | 0.11 | 2.1 | (1.61) | 0.8 | (1.61) |
| Serbia | 0.17 | -0.8 | (1.32) | 0.7 | (1.16) |
| Italy | -0.06 | 0.6 | (1.08) | 0.3 | (1.36) |
| Macao-China | -0.37 | 1.2 | (5.68) | -0.3 | (4.13) |
| Russian Fed. | 0.19 | 3.6 | (1.38) | -0.3 | (1.60) |
| Spain | 0.14 | 5.1 | (1.28) | -0.3 | (1.22) |
| Canada | 0.06 | 6.6 | (0.87) | -0.3 | (0.70) |
| Czech Republic | -0.01 | 1.3 | (1.33) | -0.4 | (1.18) |
| Austria | 0.12 | -2.2 | (1.00) | -0.6 | (1.02) |
| United States | 0.09 | 6.6 | (1.23) | -0.7 | (1.26) |
| Luxembourg | -0.23 | -2.5 | (1.33) | -1.1 | (1.23) |
| Poland | -0.12 | -0.8 | (1.72) | -1.1 | (1.42) |
| Hong Kong-China | -0.52 | 6.3 | (1.90) | -1.5 | (1.74) |
| Korea | -0.37 | 1.2 | (1.16) | -1.5 | (1.10) |
| Germany | -0.08 | -3.8 | (1.25) | -2.2 | (1.08) |
| Turkey | 0.13 | -1.0 | (1.32) | -2.3 | (1.13) |
| Japan | -0.50 | -0.8 | (1.43) | -2.4 | (1.38) |
| Netherlands | -0.19 | -1.1 | (1.43) | -2.8 | (1.34) |
| Slovak Republic | 0.03 | -6.4 | (1.35) | -3.8 | (1.20) |
| Greece | 0.08 | -5.6 | (1.53) | -4.0 | (1.62) |
| Belgium | -0.19 | -3.4 | (1.10) | -5.1 | (1.10) |
| Hungary | -0.22 | -7.3 | (1.36) | -5.7 | (1.35) |
| United Kingdom[1] | 0.12 | 9.8 | (1.23) | 2.6 | (1.24) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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



### Students' general perceptions of school

Two indices in PISA 2003 represent student perceptions of school in general. These are: attitudes towards school and sense of belonging at school. Although it can be argued that attitudes should relate to achievement, an interesting question of causality arises here because it is not obvious if success in learning engenders better attitudes or if a positive attitude to school is effectively a factor in motivating students to learn.

The effects on achievement of students' attitudes towards school and sense of belonging at school appear in Figures 3.6 and 3.7. Students' attitudes towards school are only weakly correlated with achievement. The report finds statistically significant effects for about half the countries studied, but these are not in a consistent direction. Countries where positive student attitudes towards school are positively associated with mathematics performance include Norway, Iceland, New Zealand, Sweden, Finland, Mexico, as well as Australia and the partner countries Latvia, Tunisia and Thailand. Countries where a more positive attitude towards school shows a negative association with mathematics performance include Hungary, the Slovak Republic, Greece, Germany and Belgium. Therefore, there appears to be a tendency for the effect to be positive in countries with relatively homogeneous school systems and negative in a few highly differentiated school systems. For students' sense of belonging at school, other teaching and learning factors offset any positive (albeit weak) associations with student performance. In fact, in 20 of the OECD countries, a sense of belonging at school is negatively associated with performance once other teaching and learning factors are accounted for – Turkey is the only OECD country where this effect is positive.

### Student motivation to learn mathematics

The literature on students' motivation to learn often makes a distinction between intrinsic and extrinsic motivation, commonly holding that intrinsic motivators are more effective than extrinsic ones in engendering engagement and performance.

PISA views interest in the subject matter as an intrinsic motivational preference which affects intensity of engagement with the subject. The report uses the index variable *interest in and enjoyment of mathematics* to represent this construct. This variable derives from a series of questionnaire items on how much students enjoy and look forward to doing mathematics. The report considers subject-matter interest to be an aspect of student learning strategies, especially if interest in the subject flows in some way out of or from the teaching. This type of positive motivation might be expected to result in increased achievement.

In contrast to the intrinsic nature of interest and enjoyment, students may be motivated to study mathematics by its perceived importance to future education or to careers. To analyse this possibility, the report uses the PISA *index of instrumental motivation in mathematics*, measured by a series of questionnaire items on the perceived value of studying mathematics for these external reasons.

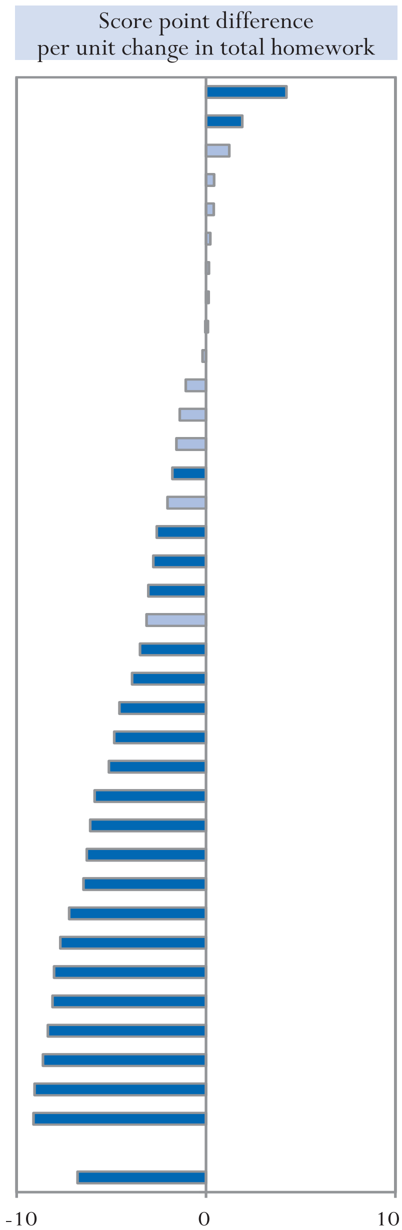
Figures 3.8 and 3.9 give the effects of each of these measures of motivation on mathematics performance. Together, on average, the two measures of motivation to learn mathematics account for an additional 5% of performance variation among students but no additional performance variation among schools (see Table C.4, Variance explained by model changes). Students' motivation accounts for 11% of the variation in student performance in Norway, 9% in Denmark and Finland and 8% in Korea. Students' reported levels of interest in and enjoyment of mathematics show relatively strong positive association with mathematics performance. However, this changes mainly to moderate



negative effects in the full analytical model. In contrast, students' instrumental motivation to learn mathematics, which also has a strong positive observed association with performance, continues to show significant positive effects in 13 of the OECD countries in the full model. Poland displays the strongest positive effects (11 score points), followed by Norway and Spain (6 score points) and the United States, Canada and the Russian Federation (5 score points). It is interesting to note that in Poland, the United States, Canada and the Russian Federation, the effect of students' interest in and enjoyment of mathematics is negative while the effect of students' instrumental motivation to learn mathematics is positive.

Figure 3.7 ■ **Students' sense of belonging at school and mathematics performance**

| | Bivariate | | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Turkey | -0.44 | 9.6 | (1.69) | 4.2 | (1.46) |
| Tunisia | -0.09 | 3.6 | (0.93) | 1.9 | (0.96) |
| Portugal | 0.09 | 10.1 | (1.50) | 1.2 | (1.50) |
| Mexico | 0.08 | 3.7 | (0.94) | 0.4 | (0.97) |
| Brazil | 0.13 | 3.1 | (1.12) | 0.4 | (1.31) |
| Czech Republic | -0.27 | 7.8 | (1.72) | 0.2 | (1.46) |
| Uruguay | 0.24 | 2.3 | (1.26) | 0.2 | (1.32) |
| Russian Fed. | -0.29 | 7.7 | (1.00) | 0.1 | (0.96) |
| Thailand | -0.29 | 6.9 | (1.42) | 0.0 | (1.56) |
| Luxembourg | 0.23 | 4.4 | (1.33) | -0.2 | (1.15) |
| Macao-China | -0.61 | 4.3 | (5.21) | -1.1 | (4.27) |
| Hungary | 0.08 | 2.0 | (1.19) | -1.4 | (1.21) |
| Greece | 0.04 | 2.2 | (1.44) | -1.6 | (1.41) |
| Serbia | 0.03 | 0.2 | (1.02) | -1.8 | (0.90) |
| Poland | -0.17 | 7.5 | (1.35) | -2.0 | (1.11) |
| Switzerland | 0.19 | 3.0 | (1.29) | -2.6 | (0.92) |
| Slovak Republic | -0.16 | 0.2 | (1.30) | -2.8 | (1.15) |
| Austria | 0.44 | 0.1 | (0.95) | -3.0 | (0.89) |
| Latvia | -0.21 | 9.4 | (2.10) | -3.1 | (1.75) |
| Belgium | -0.28 | -0.8 | (1.31) | -3.5 | (1.31) |
| Italy | 0.05 | -0.5 | (1.15) | -3.9 | (1.15) |
| Spain | 0.20 | 0.4 | (1.37) | -4.6 | (1.13) |
| Japan | -0.53 | -1.0 | (1.50) | -4.8 | (1.50) |
| Netherlands | -0.06 | -2.8 | (1.47) | -5.1 | (1.53) |
| Germany | 0.24 | -3.4 | (1.36) | -5.9 | (1.39) |
| Korea | -0.39 | 1.0 | (1.31) | -6.1 | (1.25) |
| Hong Kong-China | -0.61 | 5.5 | (1.62) | -6.3 | (1.71) |
| Denmark | 0.01 | 1.7 | (1.69) | -6.5 | (1.50) |
| Canada | 0.02 | -1.4 | (0.89) | -7.2 | (0.81) |
| Iceland | 0.16 | 0.1 | (1.45) | -7.7 | (1.20) |
| Ireland | 0.08 | -4.7 | (1.42) | -8.0 | (1.13) |
| Norway | 0.24 | -0.2 | (1.53) | -8.1 | (1.21) |
| New Zealand | -0.01 | 2.5 | (1.38) | -8.4 | (1.32) |
| Australia | 0.04 | 0.9 | (1.19) | -8.6 | (0.97) |
| Sweden | 0.25 | -0.4 | (1.53) | -9.1 | (1.26) |
| Finland | -0.02 | -1.9 | (1.23) | -9.1 | (1.09) |
| United Kingdom[1] | 0.08 | 0.2 | (1.21) | -6.8 | (1.30) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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

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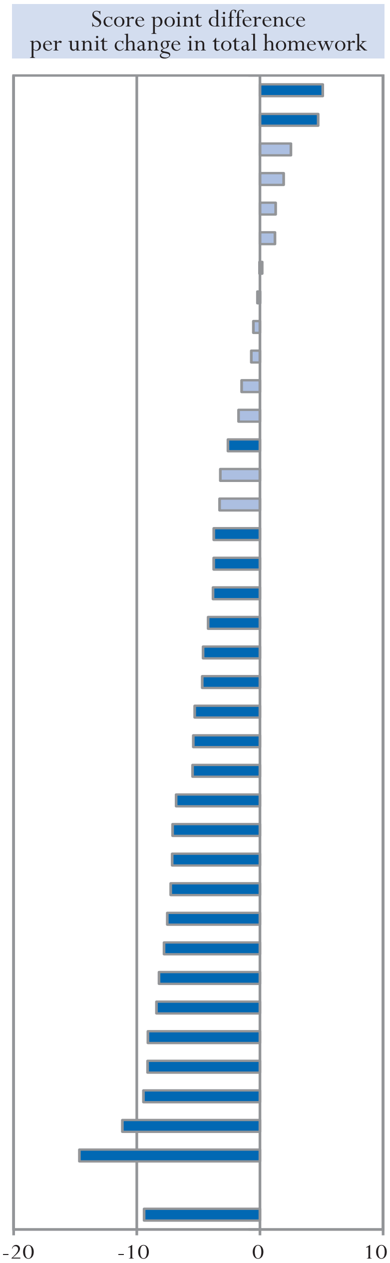
Positive attitudes towards school and motivation to learn may be, independently of their impact on achievement, important outcomes in their own right. The four measures of students' perceptions of school in general and their motivation to learn mathematics show positive correlations among themselves. This lack of independence among these measures no doubt accounts for the change in patterns of relationship when all of the measures enter into the same analytical model.

### Figure 3.8 ■ Students' interest in and enjoyment of mathematics and mathematics performance

| | | Bivariate | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Hong Kong-China | 0.22 | 22.0 | (1.25) | 5.1 | (1.83) |
| Japan | -0.39 | 15.9 | (1.11) | 4.7 | (1.70) |
| Korea | -0.12 | 23.3 | (1.03) | 2.5 | (1.71) |
| Luxembourg | -0.26 | 9.8 | (1.18) | 1.9 | (1.77) |
| Norway | -0.17 | 34.0 | (1.36) | 1.3 | (2.01) |
| Macao-China | 0.13 | 19.2 | (4.18) | 1.2 | (4.53) |
| Switzerland | 0.12 | 14.5 | (1.36) | 0.0 | (1.87) |
| Netherlands | -0.20 | 15.1 | (1.47) | -0.2 | (1.71) |
| Belgium | -0.17 | 15.1 | (1.18) | -0.5 | (1.46) |
| Uruguay | 0.36 | 15.9 | (1.62) | -0.7 | (2.42) |
| Hungary | -0.21 | 10.8 | (1.52) | -1.5 | (1.80) |
| Greece | 0.10 | 19.8 | (1.30) | -1.7 | (2.14) |
| Germany | 0.04 | 14.3 | (1.09) | -2.6 | (1.31) |
| Turkey | 0.55 | 12.9 | (1.64) | -3.2 | (2.10) |
| Spain | -0.07 | 20.6 | (1.24) | -3.3 | (1.93) |
| Ireland | -0.05 | 17.1 | (1.52) | -3.8 | (1.72) |
| Czech Republic | -0.19 | 18.4 | (1.52) | -3.8 | (1.81) |
| Italy | 0.07 | 14.1 | (1.15) | -3.8 | (1.74) |
| Iceland | -0.11 | 24.7 | (1.45) | -4.2 | (1.68) |
| Finland | -0.24 | 30.2 | (1.61) | -4.6 | (1.79) |
| Sweden | 0.09 | 27.2 | (1.63) | -4.7 | (1.76) |
| Austria | -0.28 | 10.2 | (1.22) | -5.3 | (1.48) |
| Slovak Republic | 0.03 | 15.4 | (1.67) | -5.4 | (1.90) |
| Tunisia | 0.94 | 8.4 | (1.17) | -5.5 | (1.76) |
| Russian Fed. | 0.25 | 11.5 | (1.70) | -6.8 | (2.36) |
| Canada | -0.01 | 19.9 | (0.94) | -7.1 | (1.29) |
| Denmark | 0.41 | 28.1 | (1.56) | -7.1 | (2.23) |
| Thailand | 0.71 | 6.4 | (1.79) | -7.2 | (2.52) |
| United States | 0.04 | 12.9 | (1.18) | -7.5 | (1.33) |
| Australia | 0.01 | 17.2 | (1.07) | -7.8 | (1.57) |
| Mexico | 0.58 | 7.9 | (1.52) | -8.2 | (2.03) |
| Portugal | 0.16 | 15.6 | (1.75) | -8.4 | (2.35) |
| Brazil | 0.54 | 5.3 | (2.07) | -9.1 | (2.54) |
| New Zealand | 0.12 | 15.9 | (1.62) | -9.1 | (2.07) |
| Serbia | -0.06 | 1.7 | (1.57) | -9.5 | (1.86) |
| Poland | 0.11 | 17.7 | (1.37) | -11.2 | (1.85) |
| Latvia | 0.05 | 16.5 | (2.43) | -14.7 | (2.52) |
| United Kingdom[1] | 0.00 | 13.8 | (1.30) | -9.4 | (1.73) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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

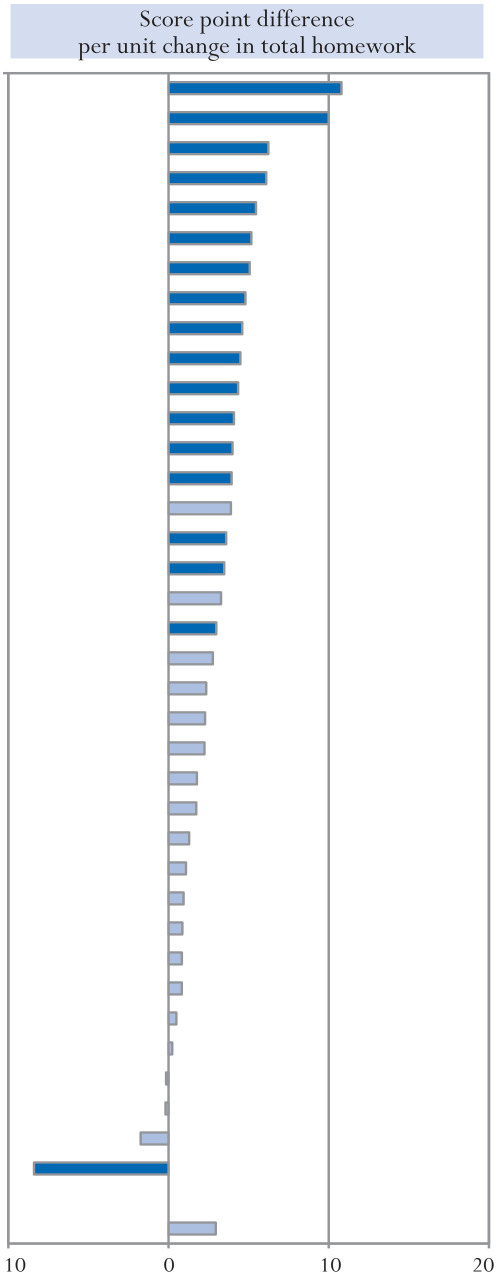


### Student perceptions of their mathematics capability

PISA assesses student perceptions of their capabilities in mathematics using three indices. One of these, the *index of anxiety in mathematics*, effectively represents an emotional reaction to mathematics. High anxiety is measured by agreement with items having to do with worrying about obtaining good marks or feeling helpless or nervous when doing mathematics problems. A second measure, the *index of self-efficacy in mathematics*, is more cognitive than affective in nature and derives from

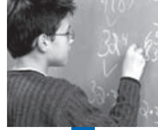
Figure 3.9 ■ **Students' instrumental motivation in mathematics and mathematics performance**

| | | Bivariate | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Poland | 0.04 | 18.8 | (1.63) | 10.8 | (1.65) |
| Latvia | 0.07 | 19.2 | (1.61) | 10.0 | (1.58) |
| Norway | 0.15 | 27.9 | (1.55) | 6.2 | (1.55) |
| Spain | -0.05 | 19.2 | (1.04) | 6.1 | (1.60) |
| United States | 0.17 | 16.8 | (1.23) | 5.5 | (1.28) |
| Canada | 0.23 | 19.0 | (0.86) | 5.2 | (0.94) |
| Russian Fed. | 0.00 | 10.1 | (1.54) | 5.1 | (1.54) |
| Portugal | 0.27 | 15.0 | (1.59) | 4.8 | (1.74) |
| Belgium | -0.32 | 11.6 | (1.20) | 4.6 | (1.26) |
| Slovak Republic | -0.05 | 11.8 | (1.36) | 4.5 | (1.66) |
| Sweden | 0.02 | 22.9 | (1.83) | 4.3 | (1.51) |
| Serbia | -0.20 | 2.1 | (1.32) | 4.1 | (1.58) |
| New Zealand | 0.29 | 16.3 | (1.72) | 4.0 | (1.44) |
| Italy | -0.15 | 9.9 | (1.29) | 3.9 | (1.67) |
| Thailand | 0.49 | 9.0 | (1.69) | 3.9 | (2.19) |
| Finland | 0.06 | 26.6 | (1.71) | 3.6 | (1.46) |
| Tunisia | 0.52 | 9.9 | (1.18) | 3.5 | (1.48) |
| Greece | -0.05 | 13.2 | (1.33) | 3.3 | (1.86) |
| Czech Republic | 0.01 | 14.1 | (1.38) | 3.0 | (1.20) |
| Korea | -0.44 | 19.0 | (1.15) | 2.8 | (1.43) |
| Iceland | 0.31 | 18.0 | (1.68) | 2.4 | (1.68) |
| Hungary | -0.11 | 8.1 | (1.34) | 2.3 | (1.30) |
| Uruguay | 0.27 | 10.0 | (1.31) | 2.2 | (1.41) |
| Germany | -0.04 | 9.7 | (1.29) | 1.8 | (1.23) |
| Australia | 0.23 | 15.6 | (0.94) | 1.7 | (1.41) |
| Hong Kong-China | -0.12 | 15.7 | (1.50) | 1.3 | (1.67) |
| Turkey | 0.23 | 9.3 | (1.47) | 1.1 | (1.75) |
| Mexico | 0.58 | 5.7 | (1.32) | 0.9 | (1.82) |
| Ireland | 0.10 | 8.3 | (1.40) | 0.9 | (1.32) |
| Netherlands | -0.26 | 10.5 | (1.29) | 0.8 | (1.20) |
| Japan | -0.66 | 11.5 | (1.15) | 0.8 | (1.57) |
| Brazil | 0.40 | 0.5 | (1.72) | 0.5 | (1.95) |
| Luxembourg | -0.41 | 4.7 | (1.19) | 0.2 | (1.56) |
| Denmark | 0.37 | 21.0 | (1.48) | -0.2 | (1.87) |
| Switzerland | -0.04 | 8.4 | (1.54) | -0.2 | (1.28) |
| Austria | -0.49 | 3.1 | (1.15) | -1.7 | (1.37) |
| Macao-China | -0.03 | 4.5 | (3.79) | -8.4 | (4.25) |
| United Kingdom[1] | 0.12 | 11.6 | (1.45) | 2.9 | (1.54) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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





responses to questions about student confidence in their ability to solve specific kinds of mathematics problems. The third measure, the *index of self-concept in mathematics*, represents responses to items on student perceptions of how good they are at mathematics in general. These three measures are not mutually independent. There is a strong positive correlation between self-concept in mathematics and self-efficacy in mathematics and strong negative correlations between both of these and anxiety in mathematics; the correlation between anxiety in mathematics and self-concept in mathematics is particularly pronounced (-0.80 on average in OECD countries; see Table B.1.).

As Figure 3.10 shows, anxiety in mathematics has a significant negative association with performance for most countries and, furthermore, the pattern remains the same even when taking other contextual and teaching and learning factors into consideration, with only Korea showing a significant positive effect. Among the OECD countries where anxiety in mathematics shows the largest negative effects Mexico (-13 score points) has above-average reported levels of anxiety, Denmark (-12 score points) and New Zealand (-11 score points) have below-average reported levels of anxiety and Poland (-15 score points) has average reported levels of anxiety. As noted earlier, these patterns may relate to country or cultural differences in the interpretation by students of the questions making up the anxiety scale. This potential source of bias needs to be investigated further.

The association between students' self-efficacy in mathematics and mathematics performance is positive and strong in all countries (Figure 3.11). Indeed, self-efficacy in mathematics shows the strongest overall effects of any factor in the teaching and learning analytical model in 12 OECD countries and 3 partner countries. The strength of this relationship is perhaps not surprising, as the items used to measure self-efficacy in mathematics to some extent resemble the actual test items, although the assessment items are more generic. The important difference between them is that the self-efficacy items indicate students' perceptions of their ability to perform the task rather than their actual performance. Nevertheless, it can be argued that self-efficacy in mathematics, if not a proxy for achievement, is closer to achievement as a construct than any other factor analysed in the model.

Figure 3.12 demonstrates that self-concept in mathematics has a similar relationship with performance both before and after other contextual and teaching and learning factors are considered: there is a strong and positive association with mathematics performance, although the strength of the association varies more among countries. These results are consistent with the high observed correlations of self-concept in mathematics with achievement. Self-concept in mathematics shows a positive effect of 30 score points in Finland, and between 20 and 25 score points in Denmark, Iceland, Australia, the Slovak Republic, New Zealand, Norway, Poland and the partner country Latvia. In Denmark, Finland and Iceland self-concept in mathematics shows the strongest overall positive effects of any of the factors analysed in the teaching and learning model. Students in Denmark report above-average levels of self-concept in mathematics.

It is interesting to note that, although these three measures of student perceptions of capability are intercorrelated, all three exert independent effects on achievement when included together in the model.[6] This indicates that the analysis has measured relatively independent constructs. It also indicates that all of these factors are powerful predictors of achievement. However, PISA data do not show the direction of causation. The argument that students have a positive self-concept or self-efficacy in mathematics because they are good at mathematics is just as plausible as the argument that being more confident in learning mathematics will lead to better performance. In fact, these



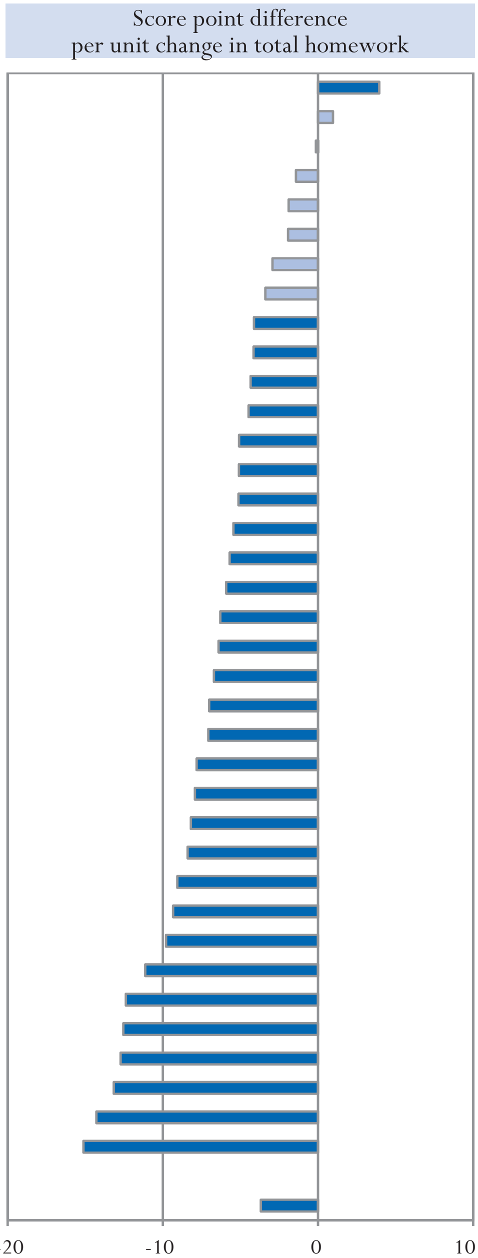
results indicate that high levels of confidence and high performance are mutually reinforcing. The same is true for high levels of anxiety in learning mathematics and low performance. The report addresses the policy implications of this finding in Chapter 4.

## School size

Two school-level measures, school size and socio-economic composition of the school, are used in the teaching and learning analytical model. School size was chosen because of its observed high

Figure 3.10 ■ **Anxiety in mathematics and mathematics performance**

| | Bivariate | | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Korea | 0.41 | -18.3 | (1.38) | 3.9 | (1.87) |
| Iceland | -0.20 | -33.1 | (1.34) | 1.0 | (1.54) |
| Hong Kong-China | 0.23 | -20.3 | (1.72) | -0.1 | (2.24) |
| Japan | 0.44 | -14.4 | (1.18) | -1.4 | (1.83) |
| Tunisia | 0.62 | -10.0 | (1.33) | -1.9 | (1.34) |
| Netherlands | -0.38 | -20.4 | (1.43) | -1.9 | (1.65) |
| Macao-China | 0.24 | -26.4 | (3.71) | -2.9 | (4.23) |
| Spain | 0.28 | -22.6 | (1.74) | -3.4 | (1.73) |
| Thailand | 0.49 | -14.9 | (1.58) | -4.1 | (1.75) |
| Portugal | 0.15 | -27.7 | (1.40) | -4.2 | (1.82) |
| Australia | -0.05 | -34.2 | (1.25) | -4.3 | (1.40) |
| Austria | -0.27 | -20.9 | (1.03) | -4.5 | (1.49) |
| Belgium | 0.09 | -23.0 | (1.09) | -5.1 | (1.34) |
| United States | -0.10 | -30.1 | (1.17) | -5.1 | (1.46) |
| Germany | -0.25 | -22.2 | (0.87) | -5.1 | (1.37) |
| Switzerland | -0.29 | -26.1 | (1.04) | -5.5 | (1.36) |
| Canada | -0.04 | -30.6 | (0.79) | -5.7 | (1.11) |
| Czech Republic | -0.05 | -32.0 | (1.35) | -5.9 | (1.65) |
| Finland | -0.31 | -41.7 | (1.51) | -6.3 | (1.88) |
| Luxembourg | -0.01 | -20.8 | (1.17) | -6.4 | (1.65) |
| Uruguay | 0.30 | -28.2 | (1.71) | -6.7 | (1.99) |
| Ireland | 0.07 | -30.0 | (1.53) | -7.0 | (2.24) |
| Turkey | 0.34 | -19.3 | (1.52) | -7.1 | (1.63) |
| Norway | -0.05 | -41.3 | (1.33) | -7.8 | (1.65) |
| Sweden | -0.49 | -41.2 | (1.56) | -7.9 | (1.61) |
| Italy | 0.29 | -25.5 | (1.29) | -8.2 | (1.45) |
| Hungary | -0.01 | -23.6 | (1.23) | -8.4 | (1.72) |
| Serbia | 0.28 | -23.6 | (1.23) | -9.1 | (1.74) |
| Greece | 0.16 | -28.6 | (1.42) | -9.3 | (1.60) |
| Slovak Republic | 0.04 | -37.0 | (1.03) | -9.8 | (1.37) |
| New Zealand | -0.10 | -44.4 | (1.35) | -11.1 | (1.92) |
| Denmark | -0.45 | -42.8 | (1.40) | -12.4 | (1.81) |
| Latvia | 0.12 | -42.1 | (1.99) | -12.5 | (1.95) |
| Mexico | 0.47 | -26.0 | (1.19) | -12.7 | (1.15) |
| Brazil | 0.57 | -27.4 | (2.24) | -13.2 | (2.72) |
| Russian Fed. | 0.14 | -37.3 | (1.68) | -14.3 | (2.25) |
| Poland | 0.04 | -44.8 | (1.34) | -15.1 | (1.65) |
| United Kingdom[1] | -0.08 | -29.9 | (1.20) | -3.7 | (1.84) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

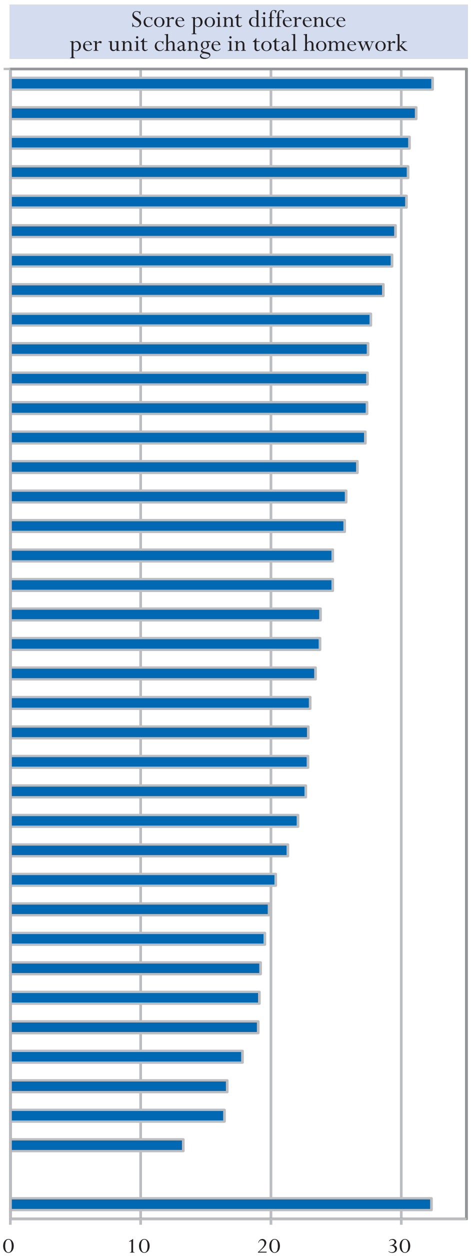
*Note:* Statistically significant score point differences are marked in a darker tone.



correlation with achievement in many countries, and because teaching strategies are treated here as characteristics of schools and hence might be expected to be related to school size. School size is most notable for its variability both within and between countries (see Figure 3.13). A mean school size of more than 1 000 students is found in Luxembourg and the partner economy Macao-China. Both of these countries also show large variations in school size. However, Korea and the United Kingdom, and the partner economy Hong Kong-China, have mean school sizes in the range of 900 to 1 000 students, but with a much more homogeneous distribution. Countries with the smallest average school sizes also tend to show the smallest variation in school sizes. With some exceptions,

Figure 3.11 ■ **Self-efficacy in mathematics and mathematics performance**

| | | Bivariate | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Ireland | -0.03 | 44.0 | (1.35) | 32.4 | (1.82) |
| New Zealand | 0.01 | 48.8 | (1.36) | 31.1 | (1.71) |
| Sweden | 0.03 | 51.8 | (1.61) | 30.6 | (1.66) |
| Australia | 0.10 | 43.4 | (0.88) | 30.5 | (1.35) |
| Switzerland | 0.32 | 40.0 | (1.47) | 30.4 | (2.41) |
| United States | 0.27 | 41.4 | (1.17) | 29.6 | (1.37) |
| Latvia | -0.11 | 47.0 | (2.61) | 29.3 | (2.21) |
| Poland | 0.05 | 50.7 | (1.93) | 28.6 | (2.03) |
| Macao-China | 0.08 | 38.2 | (3.90) | 27.7 | (4.04) |
| Hong Kong-China | 0.11 | 34.8 | (1.61) | 27.5 | (1.82) |
| Canada | 0.25 | 39.7 | (0.83) | 27.4 | (0.93) |
| Russian Fed. | -0.08 | 38.0 | (1.97) | 27.4 | (2.25) |
| Portugal | -0.06 | 43.2 | (1.88) | 27.2 | (1.97) |
| Luxembourg | 0.10 | 31.8 | (1.18) | 26.6 | (1.31) |
| Japan | -0.53 | 30.4 | (1.34) | 25.8 | (1.76) |
| Italy | -0.11 | 34.4 | (1.38) | 25.7 | (1.33) |
| Slovak Republic | 0.39 | 39.4 | (1.49) | 24.7 | (1.71) |
| Belgium | -0.04 | 33.0 | (1.50) | 24.7 | (1.29) |
| Czech Republic | 0.16 | 38.3 | (1.19) | 23.8 | (1.27) |
| Iceland | 0.04 | 40.1 | (1.27) | 23.8 | (1.63) |
| Denmark | -0.07 | 48.7 | (1.78) | 23.4 | (1.93) |
| Germany | 0.15 | 32.6 | (1.23) | 23.0 | (1.62) |
| Norway | -0.04 | 46.4 | (1.52) | 22.9 | (1.74) |
| Hungary | 0.36 | 29.9 | (1.21) | 22.8 | (1.25) |
| Korea | -0.42 | 35.6 | (1.36) | 22.7 | (1.56) |
| Spain | -0.04 | 36.5 | (1.38) | 22.1 | (1.26) |
| Finland | -0.15 | 45.5 | (1.40) | 21.3 | (1.69) |
| Austria | 0.16 | 27.8 | (1.18) | 20.4 | (1.22) |
| Greece | -0.26 | 33.1 | (1.93) | 19.9 | (2.07) |
| Thailand | -0.52 | 23.6 | (1.73) | 19.5 | (1.69) |
| Uruguay | 0.02 | 28.5 | (1.60) | 19.2 | (1.51) |
| Netherlands | -0.09 | 27.3 | (1.25) | 19.1 | (1.56) |
| Turkey | -0.18 | 24.8 | (1.59) | 19.0 | (1.45) |
| Serbia | -0.02 | 22.0 | (1.83) | 17.8 | (1.75) |
| Mexico | -0.22 | 20.1 | (1.27) | 16.6 | (1.46) |
| Brazil | -0.38 | 19.8 | (1.84) | 16.4 | (2.00) |
| Tunisia | -0.29 | 18.2 | (1.32) | 13.3 | (1.36) |
| United Kingdom[1] | -0.11 | 44.4 | (1.29) | 32.3 | (1.49) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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

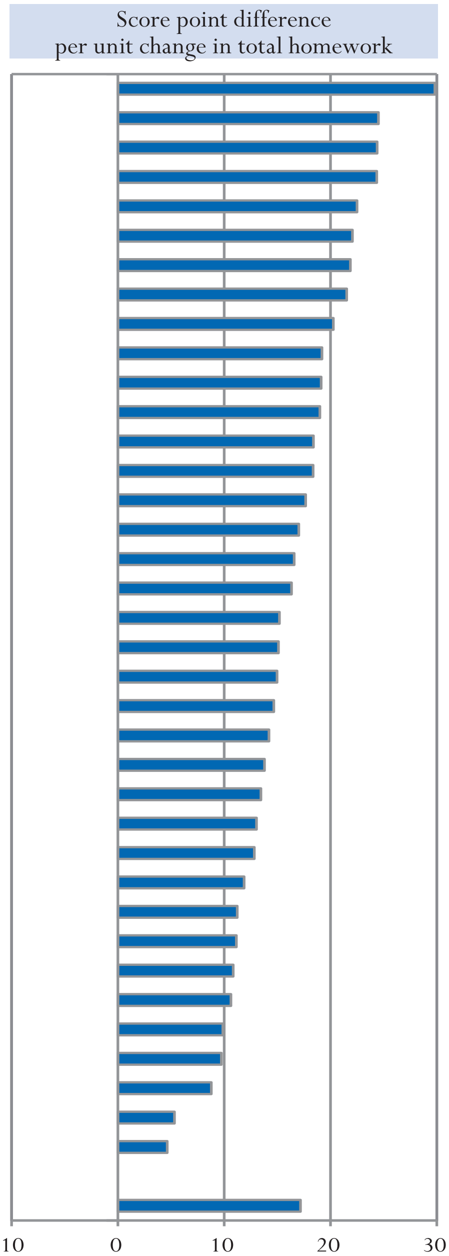


such as Greece, New Zealand and Poland, most countries with small mean school sizes are more sparsely populated. Whether the school is located in an urban of rural setting may therefore be an important variable. This issue could not be examined here but may be of interest for secondary analysis within some countries.

In general, Figure 3.14 shows that the simple observed relationship between school size and mathematics performance is: the bigger the school, the better the performance. However, the strength of this association varies considerably and it is not significant in Greece, Iceland, Norway, Poland, the

Figure 3.12 ■ **Self-concept in mathematics and mathematics performance**

| | Bivariate | | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Finland | 0.01 | 44.9 | (1.19) | 29.8 | (1.94) |
| Denmark | 0.24 | 45.4 | (1.28) | 24.5 | (2.56) |
| Iceland | 0.03 | 39.6 | (1.14) | 24.4 | (1.88) |
| Australia | 0.13 | 39.4 | (1.10) | 24.4 | (1.31) |
| Slovak Republic | -0.05 | 39.9 | (1.44) | 22.5 | (2.22) |
| New Zealand | 0.15 | 44.2 | (1.32) | 22.1 | (2.41) |
| Norway | -0.18 | 45.7 | (1.23) | 21.9 | (2.13) |
| Latvia | -0.11 | 41.8 | (1.93) | 21.5 | (2.12) |
| Poland | 0.03 | 44.8 | (1.39) | 20.3 | (2.17) |
| Greece | 0.11 | 34.1 | (1.56) | 19.2 | (2.41) |
| Serbia | 0.02 | 23.3 | (1.48) | 19.1 | (1.90) |
| Sweden | 0.13 | 46.2 | (1.56) | 19.0 | (1.81) |
| Canada | 0.19 | 34.1 | (0.66) | 18.4 | (1.56) |
| Portugal | -0.18 | 30.9 | (1.18) | 18.4 | (1.72) |
| Korea | -0.35 | 32.1 | (1.26) | 17.7 | (2.55) |
| Czech Republic | -0.09 | 32.8 | (1.27) | 17.0 | (1.75) |
| Spain | -0.19 | 30.5 | (1.13) | 16.6 | (1.95) |
| Mexico | 0.17 | 22.9 | (0.99) | 16.3 | (1.21) |
| Macao-China | -0.20 | 30.6 | (3.69) | 15.2 | (4.07) |
| United States | 0.25 | 32.2 | (1.19) | 15.1 | (1.92) |
| Austria | 0.07 | 23.5 | (1.12) | 15.0 | (1.68) |
| Uruguay | 0.02 | 27.5 | (1.40) | 14.7 | (2.35) |
| Russian Fed. | 0.13 | 34.1 | (1.63) | 14.2 | (2.40) |
| Brazil | 0.04 | 22.3 | (1.57) | 13.8 | (2.22) |
| Italy | 0.00 | 23.6 | (1.06) | 13.5 | (1.77) |
| Belgium | -0.03 | 24.7 | (1.19) | 13.0 | (1.35) |
| Hong Kong-China | -0.26 | 27.1 | (1.56) | 12.8 | (2.58) |
| Thailand | -0.09 | 16.9 | (1.71) | 11.9 | (2.09) |
| Ireland | -0.03 | 32.4 | (1.55) | 11.2 | (2.64) |
| Turkey | 0.02 | 22.2 | (1.56) | 11.1 | (1.83) |
| Tunisia | 0.15 | 13.9 | (0.96) | 10.8 | (1.41) |
| Netherlands | 0.00 | 22.4 | (1.44) | 10.6 | (1.72) |
| Switzerland | 0.13 | 25.3 | (1.15) | 9.9 | (1.77) |
| Hungary | -0.15 | 23.7 | (1.25) | 9.7 | (1.66) |
| Germany | 0.15 | 23.1 | (0.97) | 8.8 | (1.50) |
| Japan | -0.53 | 18.2 | (1.10) | 5.3 | (2.17) |
| Luxembourg | 0.07 | 19.1 | (1.14) | 4.6 | (1.66) |
| United Kingdom[1] | 0.11 | 34.5 | (1.43) | 17.2 | (2.26) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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

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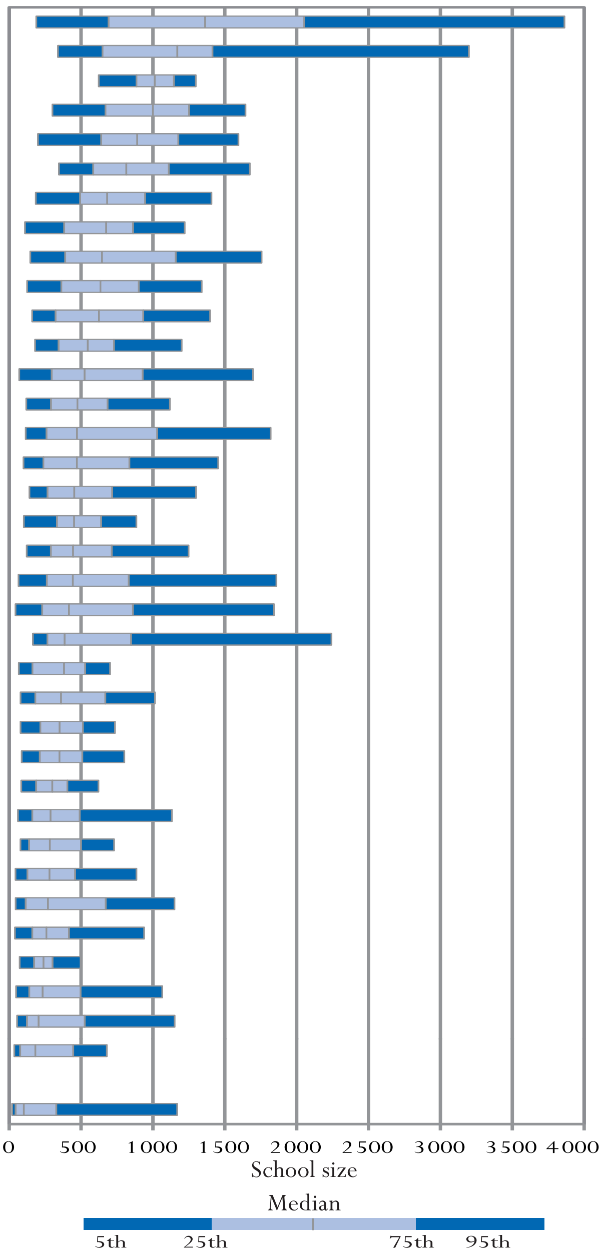
United States, the Slovak Republic, Germany, Luxembourg, the Czech Republic, Turkey, Spain, Italy, Switzerland, and the partner economies Brazil, Macao-China and the Russian Federation. This effect remains significant for most countries when considering other contextual and teaching and learning factors in the analytical model, but is much reduced (only 10 score points or more in 11 countries). These results do not indicate that the high correlations commonly observed between school size and achievement are likely to be products of what takes place in schools, or of student ability or other characteristics of schools or their students. Although it is interesting that the partner economy Hong Kong-China has the largest school effects in Figure 3.14, caution is required in interpreting the results as the number of schools in the sample is relatively small compared to other countries.

Figure 3.13 ■ **School size**

| | Mean | Standard deviation |
|---|---|---|
| Macao-China | 1591 | 1151 |
| Luxembourg | 1210 | 703 |
| Hong Kong-China | 986 | 228 |
| Korea | 993 | 397 |
| United Kingdom | 901 | 411 |
| Tunisia | 877 | 424 |
| Portugal | 732 | 397 |
| Japan | 670 | 396 |
| Netherlands | 800 | 524 |
| Australia | 653 | 385 |
| Serbia | 684 | 411 |
| Spain | 600 | 355 |
| New Zealand | 671 | 510 |
| Belgium | 520 | 310 |
| Brazil | 704 | 593 |
| Canada | 591 | 446 |
| Germany | 559 | 461 |
| Ireland | 484 | 241 |
| Sweden | 534 | 355 |
| Turkey | 670 | 631 |
| United States | 610 | 614 |
| Thailand | 702 | 742 |
| Denmark | 374 | 228 |
| Italy | 448 | 323 |
| Czech Republic | 380 | 215 |
| Slovak Republic | 385 | 221 |
| Finland | 313 | 167 |
| Austria | 385 | 340 |
| Hungary | 343 | 231 |
| Uruguay | 361 | 391 |
| Russian Fed. | 427 | 377 |
| Poland | 335 | 256 |
| Greece | 254 | 125 |
| Switzerland | 384 | 455 |
| Latvia | 369 | 338 |
| Norway | 218 | 139 |
| Iceland | 261 | 214 |
| Mexico | 279 | 409 |




*Source:* OECD PISA 2003 Database.



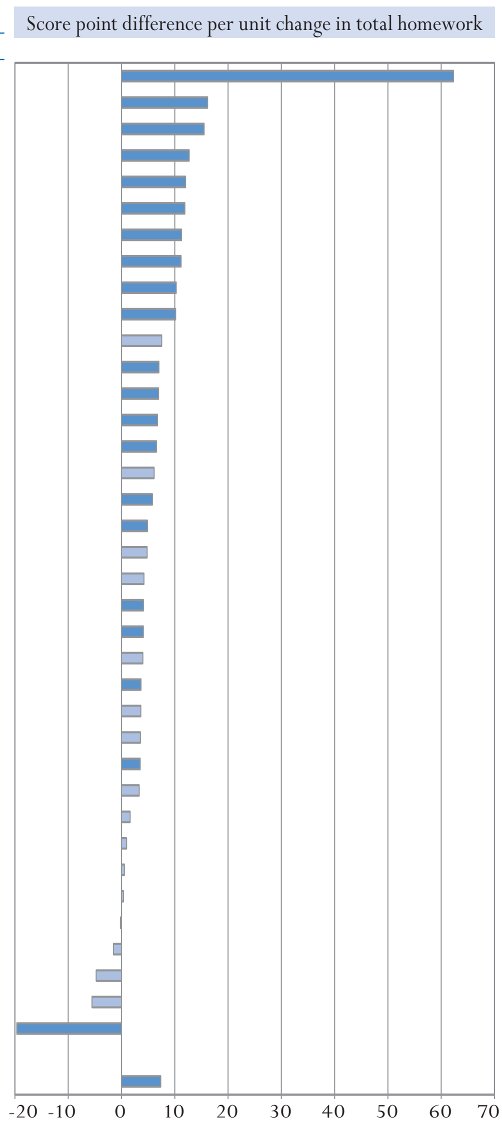
### Socio-economic composition of the school

Because of the way many schools cluster within communities, parent choice of school, the existence of public and private schools, and other factors, schools within a country may differ substantially in the socio-economic background of their student bodies. Figure 3.15 shows that in most countries there is considerable variation among schools in the average socioeconomic backgrounds of their students. It is therefore appropriate to include in the model a measure of the socio-economic composition of the school. The index chosen for this purpose was the average of the highest parental occupation for students in the school, entered as a school-level predictor in the analytical model.

There is a strong positive association between the school average of students' socio-economic background and mathematics performance. Figure 3.16 shows this in a standardised form that allows

**Figure 3.14 ■ School size and mathematics performance**

| | | Bivariate | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Hong Kong-China | 986 | 116.4 | (7.65) | 62.3 | (4.50) |
| Uruguay | 361 | 40.0 | (1.61) | 16.2 | (1.26) |
| Latvia | 369 | 30.3 | (2.65) | 15.5 | (2.12) |
| Belgium | 520 | 29.3 | (6.08) | 12.7 | (2.39) |
| Denmark | 374 | 33.0 | (6.47) | 12.0 | (4.09) |
| Finland | 313 | 22.4 | (2.84) | 11.9 | (3.22) |
| Netherlands | 800 | 18.5 | (2.84) | 11.3 | (3.08) |
| Austria | 385 | 15.7 | (5.19) | 11.2 | (2.88) |
| Korea | 993 | 28.0 | (4.64) | 10.3 | (1.40) |
| Portugal | 732 | 28.2 | (3.85) | 10.2 | (0.81) |
| Hungary | 343 | 22.4 | (11.44) | 7.5 | (4.66) |
| Sweden | 534 | 16.6 | (3.30) | 7.0 | (2.89) |
| Canada | 591 | 11.4 | (1.43) | 7.0 | (0.94) |
| Tunisia | 877 | 12.6 | (4.48) | 6.8 | (2.06) |
| Ireland | 484 | 17.3 | (5.15) | 6.6 | (3.15) |
| Switzerland | 384 | 10.1 | (5.15) | 6.1 | (4.51) |
| Japan | 670 | 25.3 | (1.03) | 5.8 | (1.06) |
| Australia | 653 | 24.9 | (1.34) | 4.9 | (1.17) |
| Russian Fed. | 427 | 14.8 | (4.91) | 4.8 | (3.25) |
| Italy | 448 | 11.5 | (5.59) | 4.2 | (3.52) |
| Serbia | 684 | 8.8 | (1.52) | 4.1 | (0.97) |
| Thailand | 702 | 13.9 | (0.29) | 4.1 | (0.43) |
| Spain | 600 | 9.6 | (4.11) | 4.0 | (2.29) |
| Mexico | 279 | 5.3 | (1.87) | 3.7 | (1.33) |
| Turkey | 670 | 3.1 | (3.16) | 3.6 | (2.93) |
| Macao-China | 1591 | 4.5 | (2.82) | 3.6 | (1.87) |
| New Zealand | 671 | 15.2 | (0.94) | 3.5 | (1.01) |
| Czech Republic | 380 | 8.6 | (9.01) | 3.3 | (3.97) |
| Brazil | 704 | 2.7 | (2.19) | 1.6 | (0.98) |
| Luxembourg | 1210 | 4.5 | (1.12) | 1.0 | (0.78) |
| Germany | 559 | 8.2 | (4.25) | 0.6 | (2.46) |
| Slovak Republic | 385 | 14.1 | (7.64) | 0.4 | (2.67) |
| United States | 610 | 1.1 | (2.27) | -0.2 | (1.26) |
| Poland | 335 | 18.3 | (2.70) | -1.5 | (2.65) |
| Norway | 218 | 8.8 | (7.99) | -4.8 | (7.55) |
| Iceland | 261 | 5.1 | (4.93) | -5.5 | (4.36) |
| Greece | 254 | -2.3 | (16.24) | -19.6 | (7.27) |
| United Kingdom[1] | 901 | 11.0 | (4.71) | 7.4 | (1.87) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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

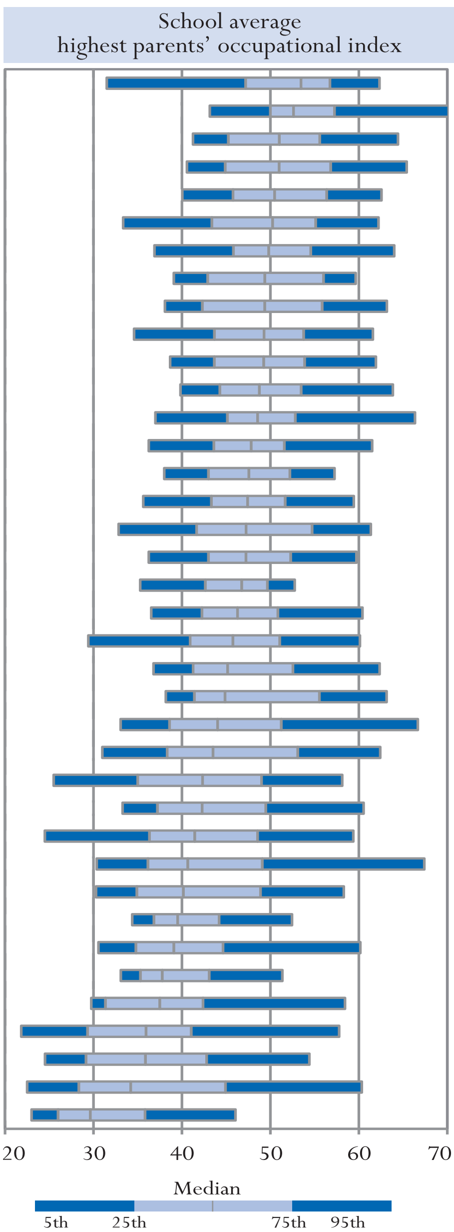


comparison with the school-level effects of other measures included in the analytical model. Even when considering other factors, one standard deviation increase in the school average of parents' occupational status is associated with a positive effect of at least 20 score points in 20 countries. It is associated with a positive effect of at least 30 score points in Japan, the Netherlands, Italy, Hungary, Germany and the Czech Republic. Conversely, in Finland, Norway, Sweden, Denmark and Iceland this association is relatively weak or even negative (8 score points or less).

It is interesting to note that although associations at the school level are comparatively weak in Denmark, Finland, Norway and Sweden, there are comparatively strong associations at the student level (8 or 9 score points; the maximum effect among countries is 10 score points). In other

Figure 3.15 ■ **School average highest parents' occupational status**

| | Mean | Standard deviation |
|---|---|---|
| United States | 51.72 | 8.14 |
| Norway | 54.53 | 8.26 |
| Sweden | 51.35 | 7.40 |
| Australia | 51.23 | 7.53 |
| Netherlands | 51.13 | 6.96 |
| Iceland | 49.28 | 8.56 |
| Canada | 50.24 | 7.70 |
| United Kingdom | 50.65 | 8.34 |
| Serbia | 49.15 | 8.14 |
| Finland | 48.81 | 7.44 |
| New Zealand | 49.47 | 7.54 |
| Czech Republic | 49.55 | 7.27 |
| Denmark | 49.60 | 8.16 |
| Latvia | 48.06 | 7.53 |
| Japan | 47.65 | 6.08 |
| Russian Fed. | 47.46 | 7.02 |
| Belgium | 47.86 | 9.02 |
| Switzerland | 47.67 | 7.18 |
| Korea | 45.84 | 5.70 |
| Ireland | 46.66 | 7.25 |
| Slovak Republic | 45.86 | 8.41 |
| Germany | 47.33 | 8.21 |
| Luxembourg | 48.12 | 8.12 |
| Poland | 45.63 | 9.94 |
| Austria | 45.79 | 10.21 |
| Hungary | 41.96 | 9.75 |
| Spain | 44.11 | 8.83 |
| Italy | 42.20 | 9.97 |
| Uruguay | 43.25 | 10.38 |
| Greece | 41.99 | 9.00 |
| Hong Kong-China | 41.13 | 5.94 |
| Portugal | 40.53 | 8.16 |
| Macao-China | 40.10 | 6.29 |
| Turkey | 38.54 | 9.07 |
| Brazil | 36.61 | 10.20 |
| Tunisia | 37.12 | 9.72 |
| Mexico | 37.17 | 12.16 |
| Thailand | 31.65 | 7.56 |



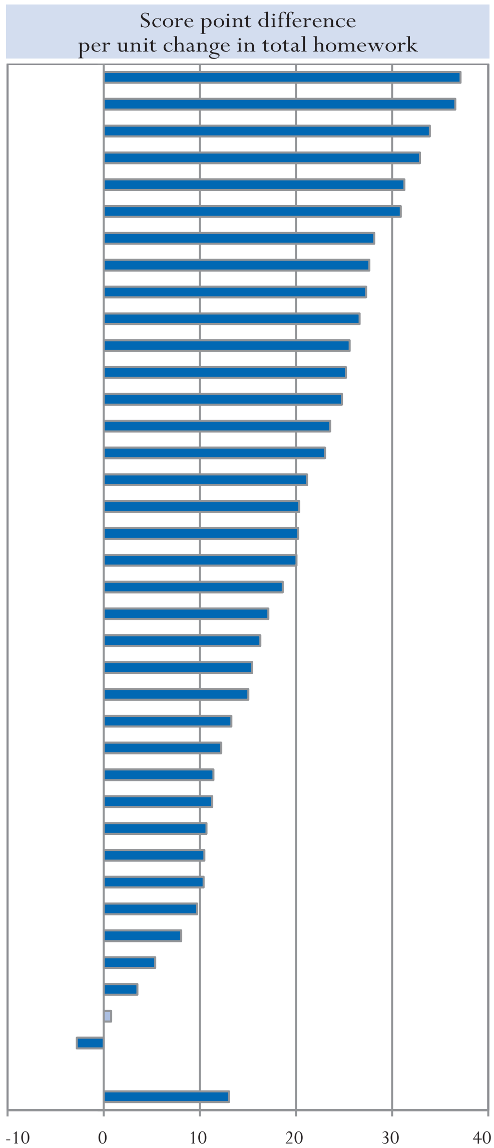

*Source:* OECD PISA 2003 Database.



countries, the school average effects of parents' occupational status are independent of and substantially larger than student-level effects, indicating that in most countries students attending a school in which most students are from relatively advantaged socio-economic backgrounds are at an academic advantage. This result is most striking in Japan and Korea, where at the student level there is no association, but one standard deviation improvement in the school average of parents' occupational status shows a positive effect of 37 score points (Japan) and 26 score points (Korea). Finland and Japan demonstrate two different situations where both countries achieve high mean performance, but Finland has a relatively homogenous distribution of school-level parents' occupational status, while this is not the case in Japan.

**Figure 3.16 ■ School average of the highest international socio-economic index of occupational status (HISEI) of both parents and mathematics performance**

| | | Bivariate | | Multivariate | |
|---|---|---|---|---|---|
| | Mean | Effect | S.E. | Effect | S.E. |
| Japan | 47.65 | 77.8 | (0.83) | 37.1 | (1.63) |
| Netherlands | 51.13 | 52.1 | (3.46) | 36.6 | (2.53) |
| Italy | 42.20 | 49.1 | (0.68) | 33.9 | (1.11) |
| Hungary | 41.96 | 56.2 | (1.28) | 32.9 | (1.69) |
| Germany | 47.33 | 50.6 | (3.37) | 31.3 | (2.05) |
| Czech Republic | 49.55 | 53.9 | (4.60) | 30.9 | (3.07) |
| Luxembourg | 48.12 | 53.5 | (1.16) | 28.1 | (1.82) |
| Turkey | 38.54 | 50.0 | (0.94) | 27.6 | (1.63) |
| Belgium | 47.86 | 53.0 | (2.46) | 27.3 | (1.83) |
| Austria | 45.79 | 47.1 | (1.28) | 26.6 | (1.79) |
| Korea | 45.84 | 58.3 | (1.08) | 25.6 | (1.35) |
| Slovak Republic | 45.86 | 46.7 | (0.63) | 25.2 | (0.93) |
| Greece | 41.99 | 40.2 | (1.07) | 24.8 | (1.56) |
| Brazil | 36.61 | 40.2 | (1.74) | 23.6 | (1.34) |
| Uruguay | 43.25 | 44.4 | (0.76) | 23.0 | (1.14) |
| Serbia | 49.15 | 41.2 | (0.66) | 21.2 | (1.02) |
| Tunisia | 37.12 | 31.9 | (0.32) | 20.3 | (0.91) |
| Hong Kong-China | 41.13 | 48.7 | (1.24) | 20.2 | (1.79) |
| Thailand | 31.65 | 36.4 | (0.82) | 20.1 | (1.25) |
| Switzerland | 47.67 | 39.5 | (0.90) | 18.6 | (1.49) |
| Mexico | 37.17 | 25.9 | (0.32) | 17.1 | (0.76) |
| Australia | 51.23 | 39.8 | (3.37) | 16.3 | (2.24) |
| Macao-China | 40.10 | 23.8 | (3.52) | 15.4 | (3.95) |
| United States | 51.72 | 41.1 | (0.91) | 15.0 | (1.37) |
| New Zealand | 49.47 | 36.0 | (1.76) | 13.3 | (1.64) |
| Ireland | 46.66 | 34.6 | (1.69) | 12.2 | (1.90) |
| Russian Fed. | 47.46 | 30.4 | (1.18) | 11.4 | (1.63) |
| Latvia | 48.06 | 26.6 | (1.37) | 11.3 | (1.57) |
| Portugal | 40.53 | 35.5 | (0.98) | 10.7 | (1.27) |
| Canada | 50.24 | 25.8 | (0.78) | 10.5 | (0.73) |
| Spain | 44.11 | 26.4 | (0.59) | 10.4 | (1.09) |
| Poland | 45.63 | 29.7 | (1.36) | 9.7 | (1.63) |
| Denmark | 49.60 | 29.5 | (1.85) | 8.1 | (1.93) |
| Sweden | 51.35 | 25.0 | (1.62) | 5.4 | (1.66) |
| Norway | 54.53 | 19.2 | (1.71) | 3.5 | (1.55) |
| Iceland | 49.28 | 8.0 | (1.87) | 0.8 | (1.66) |
| Finland | 48.81 | 9.7 | (0.99) | -2.8 | (1.10) |
| United Kingdom[1] | 50.65 | 37.3 | (2.87) | 13.0 | (1.22) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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

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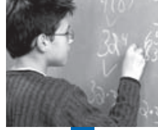




## THE MEASURED EFFECTS OF TEACHING AND LEARNING IN THE ANALYTICAL MODEL

### Homework time

The time students spend on homework is widely considered an important element of both teaching and learning strategies. Teachers vary in the amount and type of homework they assign and students obviously differ in the amount of time spent on homework. This last point is of direct interest here as time spent on homework may be an important element of student learning strategies. It is also possible that school policy, or policies developed by local or state authorities, influences homework assignment. From the perspective of the Carroll model discussed in Chapter 2, homework is one of the few ways of increasing the time spent learning in school systems where the total learning time in school is fixed.

A full analysis of homework should examine both the amount of homework assigned and the amount of time actually spent on homework, as well as the nature of the homework, its supervision and monitoring. Unfortunately, PISA does not provide measures of all of these elements. However, PISA 2003 does collect two measures of students' reports on how much time they spend on homework: hours per week of total homework and hours per week of mathematics homework. Figures 3.17 and 3.18 give the effects for these two measures of homework. Note that, again, the effect is shown in standardised form, as the performance change associated with a rise of one standard deviation in homework time, which averages more than 300 minutes per week for total homework and 160 minutes for mathematics homework across the OECD countries. There is a high degree of variability in the amount of homework reported by students, suggesting that this measure may not reflect very accurately the prescribed amount of homework, but that different students report spending more or less time doing homework.

For most countries, the number of hours students spend each week on homework in total is positively associated with mathematics performance, while the number of hours spent each week solely on mathematics homework is negatively associated with mathematics performance. Of course these two measures are not independent: mathematics homework forms a significant component of the total amount of homework reported by students in OECD countries, averaging 53% across all OECD countries and ranging from 33% in Hungary, Italy, the Netherlands and Sweden to 55% in Mexico. When looking at both these measures in the context of other factors, one might therefore expect that the effects of total homework would suppress the effects of mathematics homework. However, this is not the case, as shown by the observed negative association between mathematics homework and mathematics performance in 19 of the countries studied (Figure 3.18).

While a negative relationship between homework and achievement may seem counter-intuitive, it is conceivable that assigning extra homework to weaker students along with the likelihood that stronger students finish standard homework in less time could produce this relationship. However, such a relationship is also inconsistent with the literature on homework. As in earlier work, a new synthesis of homework research across studies employing a variety of correlational and quasi-experimental methods (Cooper *et al.*, 2006) reports positive homework effects in languages, arts and mathematics. Unfortunately, this synthesis covers only studies conducted in the United States, but the observed association between mathematics homework and mathematics performance in the United States is consistent with Cooper's work, although the relationship is weak (5 score points).

To what extent are homework effects characteristic of particular countries? In particular, to what extent are they characteristic of the way in which various countries treat homework? It is notable



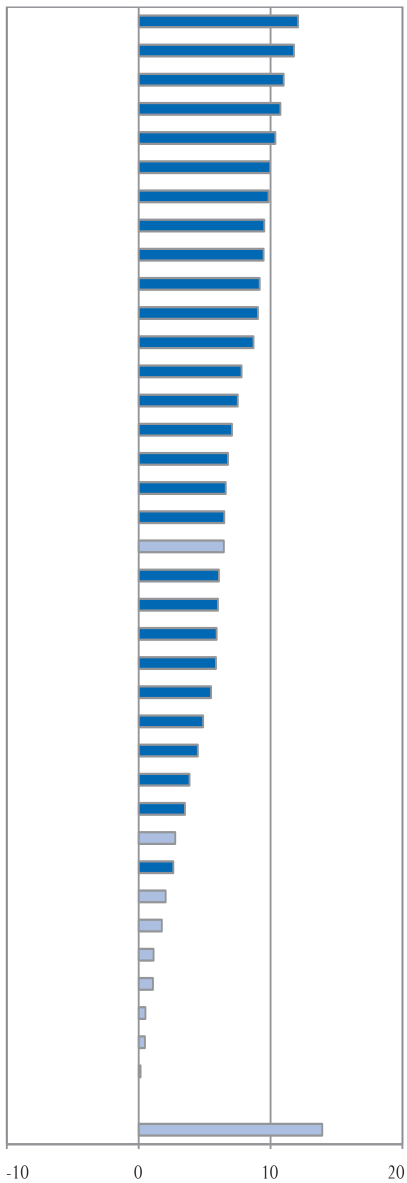
that the strongest negative effects for mathematics homework in the teaching and learning analytical model are seen in Finland, Sweden, Norway, Switzerland and Iceland, which is also the case for the observed associations with performance.

Another noteworthy finding concerns the performance within each country of students reporting no mathematics homework compared to that for students reporting some homework. In most

## Figure 3.17 ■ Hours per week of total homework and mathematics performance

| | Mean number of hours per week | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| New Zealand | 4.5 | 18.5 | (2.65) | 12.1 | (2.19) |
| Korea | 3.5 | 15.4 | (2.38) | 11.8 | (2.74) |
| Thailand | 6.9 | 16.9 | (1.31) | 11.0 | (1.61) |
| Spain | 7.4 | 15.0 | (1.87) | 10.7 | (1.92) |
| Poland | 8.1 | 8.4 | (1.18) | 10.4 | (1.32) |
| Iceland | 4.6 | 8.5 | (2.81) | 10.0 | (2.98) |
| Hong Kong-China | 6.8 | 11.7 | (1.17) | 9.8 | (1.92) |
| Ireland | 7.7 | 14.9 | (1.38) | 9.5 | (1.32) |
| Norway | 4.8 | 8.0 | (2.26) | 9.5 | (2.43) |
| United States | 5.7 | 18.1 | (1.89) | 9.2 | (2.04) |
| Brazil | 4.9 | 7.8 | (1.58) | 9.0 | (2.08) |
| Japan | 3.8 | 10.0 | (2.06) | 8.7 | (2.70) |
| Mexico | 5.8 | 13.0 | (1.07) | 7.8 | (1.57) |
| Belgium | 6.2 | 5.5 | (1.48) | 7.5 | (1.61) |
| Netherlands | 5.7 | 2.4 | (1.43) | 7.1 | (1.49) |
| Luxembourg | 6.1 | -1.0 | (2.03) | 6.8 | (2.19) |
| Canada | 5.6 | 9.4 | (1.20) | 6.6 | (1.06) |
| Australia | 5.7 | 14.7 | (1.38) | 6.5 | (1.53) |
| Macao-China | 7.8 | 13.0 | (3.27) | 6.5 | (4.26) |
| Switzerland | 4.6 | -6.3 | (2.49) | 6.1 | (2.97) |
| Portugal | 4.9 | 7.7 | (2.02) | 6.0 | (2.15) |
| Finland | 3.7 | -4.2 | (2.44) | 5.9 | (2.91) |
| Greece | 8.3 | 9.0 | (1.29) | 5.9 | (1.04) |
| Turkey | 5.9 | 5.1 | (1.46) | 5.5 | (2.07) |
| Sweden | 3.9 | 4.6 | (2.71) | 4.9 | (2.44) |
| Hungary | 10.0 | 0.4 | (0.94) | 4.5 | (1.12) |
| Czech Republic | 3.8 | -2.3 | (1.80) | 3.9 | (1.84) |
| Latvia | 9.4 | 1.4 | (1.30) | 3.5 | (1.35) |
| Uruguay | 6.8 | 5.4 | (1.50) | 2.8 | (1.87) |
| Russian Fed. | 12.7 | 3.5 | (1.00) | 2.6 | (0.88) |
| Germany | 6.3 | -4.5 | (1.76) | 2.0 | (2.02) |
| Austria | 4.0 | -6.9 | (2.23) | 1.8 | (3.02) |
| Tunisia | 4.9 | 6.8 | (1.68) | 1.1 | (2.05) |
| Serbia | 5.3 | 3.1 | (1.49) | 1.1 | (1.64) |
| Italy | 10.5 | 0.5 | (0.77) | 0.5 | (0.92) |
| Slovak Republic | 8.4 | -1.9 | (1.52) | 0.5 | (1.35) |
| Denmark | 5.4 | -2.9 | (2.83) | 0.0 | (2.91) |
| United Kingdom[1] | 6.0 | 19.6 | (1.72) | 13.9 | (1.70) |

Score point difference per unit change in total homework




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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

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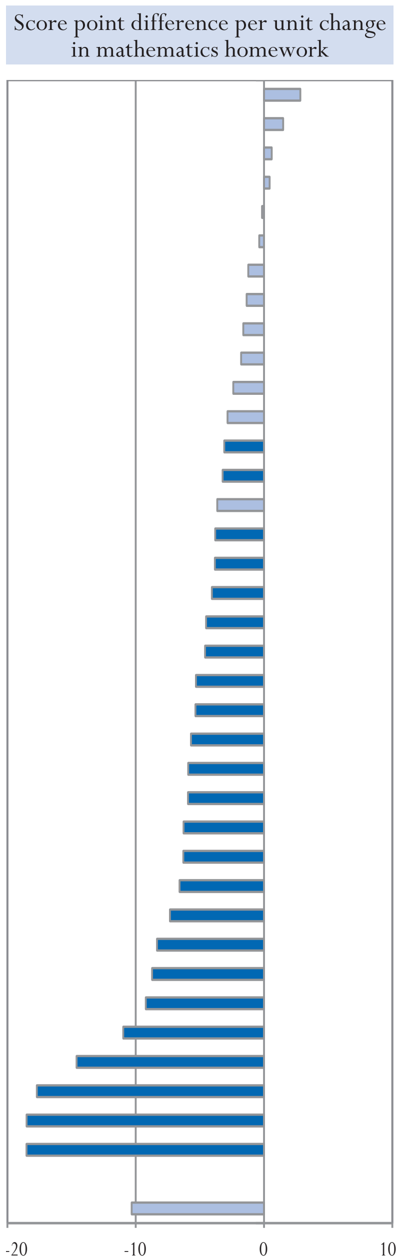
cases, the proportions of students reporting no mathematics homework were small. In virtually all countries, however, those reporting no homework performed at significantly higher levels than those reporting some homework. This result indicates that a small number of students can maintain high achievement in mathematics with no homework in that subject. Whether this is a matter of underlying ability or the influence of favourable school characteristics or instructional organisation is not clear.

Figure 3.18 ■ **Hours per week of mathematics homework and mathematics performance**

| | Mean number of hours per week | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Macao-China | 4.34 | 5.3 | (2.07) | 2.8 | (3.27) |
| Tunisia | 2.76 | 5.2 | (1.33) | 1.5 | (1.59) |
| Serbia | 2.43 | 0.5 | (1.23) | 0.6 | (1.55) |
| Thailand | 4.02 | 10.0 | (0.93) | 0.4 | (1.17) |
| Mexico | 3.20 | 7.3 | (0.74) | -0.2 | (1.26) |
| Greece | 3.31 | 5.3 | (1.24) | -0.4 | (1.19) |
| Uruguay | 2.83 | 0.7 | (1.42) | -1.2 | (1.57) |
| Russian Fed. | 5.03 | -1.8 | (0.86) | -1.4 | (0.73) |
| Slovak Republic | 3.16 | -5.5 | (1.15) | -1.6 | (1.06) |
| Australia | 2.34 | 8.3 | (1.42) | -1.8 | (1.26) |
| Japan | 1.98 | 4.9 | (1.45) | -2.4 | (1.80) |
| Hong Kong-China | 3.08 | 7.2 | (1.19) | -2.8 | (1.70) |
| Italy | 3.49 | -2.7 | (1.22) | -3.1 | (1.13) |
| United States | 2.77 | 4.6 | (1.19) | -3.2 | (1.20) |
| Korea | 1.76 | 8.0 | (2.05) | -3.6 | (2.81) |
| Turkey | 2.85 | 2.1 | (1.35) | -3.8 | (1.85) |
| Canada | 2.81 | 1.2 | (1.00) | -3.8 | (0.92) |
| Latvia | 3.68 | -6.0 | (1.58) | -4.1 | (1.67) |
| Belgium | 2.23 | -2.3 | (1.42) | -4.5 | (1.52) |
| Hungary | 3.29 | -6.1 | (1.15) | -4.6 | (1.21) |
| Austria | 1.75 | -15.8 | (2.35) | -5.3 | (2.60) |
| Ireland | 2.84 | 3.0 | (1.64) | -5.3 | (1.61) |
| Brazil | 2.37 | 0.2 | (1.52) | -5.7 | (1.87) |
| Portugal | 2.03 | 1.3 | (1.77) | -5.9 | (2.09) |
| Spain | 2.94 | 3.0 | (1.65) | -5.9 | (1.84) |
| Denmark | 2.59 | -10.3 | (1.89) | -6.3 | (2.10) |
| Germany | 2.59 | -12.1 | (1.49) | -6.3 | (1.78) |
| Netherlands | 1.87 | -8.4 | (1.62) | -6.6 | (1.78) |
| Czech Republic | 1.67 | -11.9 | (1.72) | -7.3 | (1.76) |
| Poland | 4.10 | -6.4 | (0.92) | -8.3 | (0.97) |
| New Zealand | 1.73 | 1.2 | (2.32) | -8.7 | (1.97) |
| Luxembourg | 2.34 | -12.5 | (1.71) | -9.2 | (1.74) |
| Iceland | 2.27 | -8.4 | (2.28) | -11.0 | (2.31) |
| Switzerland | 1.85 | -19.9 | (2.38) | -14.6 | (2.49) |
| Norway | 1.83 | -9.8 | (1.91) | -17.7 | (2.69) |
| Finland | 1.46 | -18.5 | (2.37) | -18.5 | (2.42) |
| Sweden | 1.28 | -25.8 | (2.94) | -18.5 | (2.46) |
| United Kingdom[1] | 2.04 | -3.1 | (1.54) | -10.3 | (1.55) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

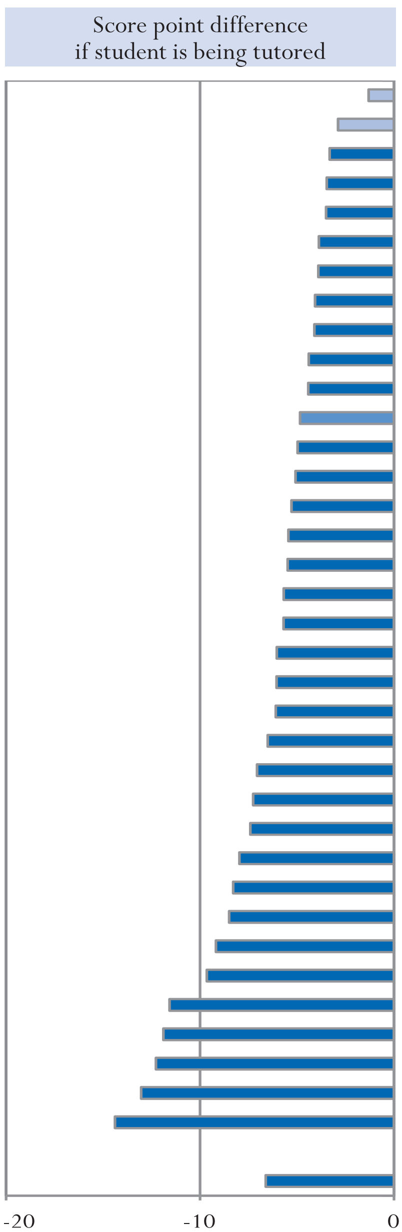
*Note:* Statistically significant score point differences are marked in a darker tone.



This finding, of course, does not account for the generally positive effects for total homework. Very few students reported doing no weekly homework and for those that did the achievement results were the opposite of those of students doing no mathematics homework. To the extent that these results replicate across virtually all countries, it indicates a fundamental but complex pattern in which higher-performing students do more homework generally but do less mathematics homework. This result may relate to the earlier point about mathematics being fundamentally a school subject. It is possible that the most able students learn their mathematics mainly in school and hence

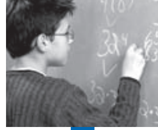
Figure 3.19 ■ **Students being tutored in mathematics and mathematics performance**

| | Percentage of students being tutored | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Slovak Republic | 7 | -2.0 | (1.26) | -1.3 | (1.09) |
| Mexico | 90 | -4.2 | (2.47) | -2.9 | (2.35) |
| Serbia | 21 | -6.3 | (1.04) | -3.3 | (0.98) |
| Luxembourg | 16 | -9.4 | (1.15) | -3.5 | (1.15) |
| Korea | 21 | -2.8 | (0.88) | -3.5 | (0.87) |
| Thailand | 14 | -4.9 | (1.01) | -3.9 | (0.94) |
| Australia | 13 | -6.5 | (1.03) | -3.9 | (0.92) |
| Portugal | 26 | -3.6 | (0.85) | -4.1 | (0.81) |
| Poland | 11 | -10.0 | (1.22) | -4.1 | (0.92) |
| Latvia | 12 | -9.9 | (1.19) | -4.4 | (0.94) |
| Hong Kong-China | 16 | -6.4 | (1.04) | -4.4 | (0.88) |
| Hungary | 14 | -9.2 | (0.97) | -4.8 | (1.08) |
| Germany | 15 | -12.2 | (0.85) | -5.0 | (0.86) |
| Spain | 23 | -7.2 | (0.88) | -5.1 | (0.81) |
| Canada | 9 | -11.5 | (0.87) | -5.3 | (0.76) |
| Netherlands | 5 | -10.0 | (1.55) | -5.4 | (1.23) |
| Czech Republic | 6 | -9.3 | (1.22) | -5.5 | (1.21) |
| Austria | 7 | -13.8 | (1.28) | -5.7 | (1.11) |
| Belgium | 4 | -11.0 | (1.63) | -5.7 | (1.51) |
| Italy | 13 | -10.5 | (1.02) | -6.0 | (0.87) |
| Switzerland | 8 | -12.9 | (1.71) | -6.1 | (1.40) |
| Russian Fed. | 15 | -9.2 | (1.23) | -6.1 | (1.04) |
| Greece | 29 | -6.0 | (1.04) | -6.5 | (0.92) |
| Turkey | 43 | -6.4 | (1.68) | -7.1 | (1.60) |
| United States | 9 | -14.6 | (1.16) | -7.3 | (1.10) |
| Iceland | 11 | -16.4 | (1.55) | -7.4 | (1.31) |
| Ireland | 16 | -10.4 | (1.42) | -8.0 | (1.17) |
| Uruguay | 20 | -14.2 | (1.57) | -8.3 | (1.43) |
| New Zealand | 10 | -14.5 | (1.76) | -8.5 | (1.65) |
| Denmark | 2 | -18.7 | (3.62) | -9.2 | (3.26) |
| Japan | 4 | -9.4 | (1.53) | -9.7 | (1.40) |
| Macao-China | 10 | -15.3 | (2.83) | -11.6 | (2.59) |
| Finland | 1 | -22.0 | (3.84) | -11.9 | (3.29) |
| Brazil | 21 | -15.7 | (1.25) | -12.3 | (1.35) |
| Sweden | 4 | -22.2 | (2.56) | -13.0 | (1.73) |
| Norway | 3 | -25.8 | (2.49) | -14.4 | (2.38) |
| United Kingdom[1] | 8 | -8.3 | (1.43) | -6.6 | (1.15) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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



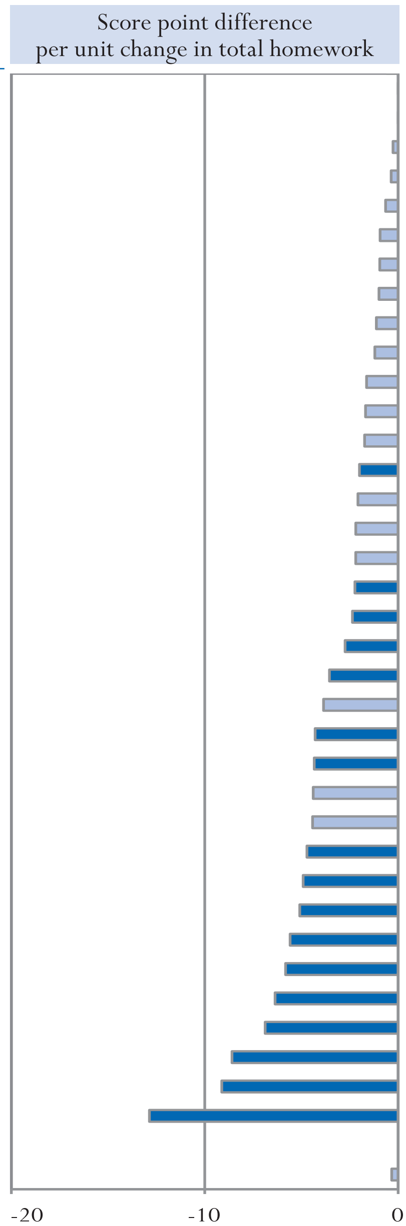


have no need for homework, while less-well-performing students struggle more with mathematics, generating a need for mathematics homework. This and other aspects of the cumulative nature of mathematics learning would best be investigated using longitudinal studies, which follow student learning behaviours and performance over several years.

It is interesting to note that in the majority of OECD countries there is very little correlation between mathematics homework and self-efficacy in mathematics, although there are moderate

Figure 3.20 ■ **Out-of-school classes and mathematics performance**

| | Percentage of students taking out-of-school classes | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Turkey | 59 | 3.0 | (0.98) | 0.6 | (0.90) |
| Korea | 37 | 3.7 | (0.66) | 0.3 | (0.61) |
| Thailand | 20 | -0.6 | (0.96) | -0.3 | (0.82) |
| Tunisia | 35 | 0.7 | (0.58) | -0.4 | (0.47) |
| Russian Fed. | 15 | -0.6 | (1.07) | -0.6 | (0.99) |
| Spain | 20 | -3.9 | (0.95) | -0.9 | (0.85) |
| Greece | 42 | -0.3 | (0.71) | -1.0 | (0.57) |
| Hong Kong-China | 13 | -0.6 | (0.88) | -1.0 | (0.84) |
| Brazil | 26 | -3.9 | (0.98) | -1.1 | (0.95) |
| Czech Republic | 4 | -5.5 | (1.97) | -1.2 | (1.59) |
| Ireland | 8 | -1.0 | (1.92) | -1.6 | (1.43) |
| Mexico | 89 | -5.1 | (0.97) | -1.7 | (0.95) |
| Latvia | 9 | -2.9 | (1.84) | -1.7 | (1.35) |
| Portugal | 9 | -3.4 | (1.27) | -2.0 | (1.01) |
| Canada | 3 | -7.3 | (1.68) | -2.1 | (1.24) |
| Macao-China | 9 | -7.8 | (2.23) | -2.2 | (1.99) |
| Uruguay | 12 | -7.4 | (1.50) | -2.2 | (1.33) |
| Japan | 13 | -2.2 | (1.17) | -2.2 | (1.02) |
| Hungary | 16 | -6.7 | (0.73) | -2.4 | (0.87) |
| Slovak Republic | 6 | -3.7 | (1.58) | -2.7 | (1.10) |
| Belgium | 3 | -10.6 | (1.63) | -3.6 | (1.59) |
| Denmark | 4 | -12.7 | (2.45) | -3.9 | (2.16) |
| Iceland | 6 | -10.1 | (2.26) | -4.3 | (1.62) |
| Poland | 9 | -5.9 | (1.32) | -4.3 | (1.09) |
| Norway | 2 | -10.4 | (2.81) | -4.4 | (2.29) |
| Sweden | 1 | -12.4 | (4.22) | -4.4 | (3.08) |
| Luxembourg | 6 | -9.0 | (1.88) | -4.7 | (1.78) |
| Serbia | 4 | -9.3 | (2.02) | -4.9 | (1.77) |
| Switzerland | 3 | -8.3 | (3.37) | -5.1 | (2.19) |
| Italy | 2 | -9.3 | (1.90) | -5.6 | (1.61) |
| Australia | 3 | -9.2 | (1.89) | -5.8 | (1.49) |
| United States | 4 | -13.3 | (2.49) | -6.4 | (2.07) |
| Germany | 2 | -13.5 | (2.67) | -6.9 | (1.99) |
| New Zealand | 5 | -17.3 | (1.66) | -8.6 | (1.56) |
| Austria | 1 | -13.4 | (3.24) | -9.1 | (3.09) |
| Finland | 1 | -13.8 | (5.35) | -12.9 | (4.05) |
| United Kingdom[1] | 9 | 0.7 | (1.44) | -0.3 | (1.23) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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



positive correlations in Japan (0.25), Korea (0.20) and Australia (0.18). Similarly, there is no correlation between mathematics homework and the number of books students have at home (which is used as a proxy for students' socio-economic background): on average across OECD countries the correlation is 0.02. The presence or absence of these control variables in the model does not change the overall pattern of mathematics homework effects.

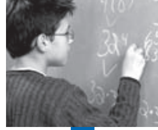
### Tutoring and out-of-school lessons

Students reported the number of hours they spend per week taking mathematics lessons outside school and having tutoring in mathematics. In most countries, only a relatively small proportion of students spend any time at all at either of these activities, so these variables are dichotomised to distinguish between those exposed to these activities and those not exposed. The dichotomised variables are summarised as the percentage of students in each country taking part in these activities. Results for the two variables appear in Figures 3.19 and 3.20. In almost all cases, the effects are negative. In some countries, the effects of having tutoring or taking part in out-of-class lessons are strongly negative.

Tutoring and other forms of out-of-school learning are similar to homework in that they are ways to increase time spent in learning. All things being equal, the Carroll model would predict that these activities should contribute to increased learning. While the results presented here seem to run counter to the theoretical prediction, there are nevertheless two competing interpretations of these results.

First, it is possible that those taking part in tutoring or out-of-school lessons tend to be low-achieving students and that this characteristic outweighs the extent to which extra learning converts low achievement into high achievement for participating individuals. However, this is not to say that the activities do not convey individual benefit – PISA simply did not measure this. Another possibility is that the students taking part in these activities tend to be students whose parents have the means to pay for extra tuition. More specifically, it might be argued that participants in tutoring and out-of-school lessons are more likely to be low-achieving students of such parents. This finding raises the issue of the mediating effects of students' socio-economic background. However, on average across the OECD countries there is no correlation between the measures of students' socio-economic background and students' participation in tutoring and out-of-school lessons.[7] Having said this, in Greece, Korea and Portugal there are weak positive correlations between the student socio-economic background measures and students' participation in tutoring (between 0.11 and 0.21) and this is also the case for out-of-school lessons in Japan, Korea, Mexico and Turkey (between 0.11 and 0.21). These findings indicate that in these countries students coming from more advantaged socio-economic backgrounds are more likely to take part in these activities.

In general, the OECD countries with lower average achievement tend to have greater proportions of students participating in tutoring or out-of-school lessons: there is a strong negative cross-country correlation between these measures and overall performance. (The one clear exception to this finding is Korea, where performance is well above the OECD average and where 21% of students participate in tutoring and 37% of students participate in out-of-school lessons). Combined with the negative within-country correlations between these two measures and student performance, this suggests that additional learning beyond regular school instruction is a way to compensate for the limited quantity of schooling in some countries. The strong negative correlation across countries between number of instructional hours per year and use of extra tuition supports this suggestion.





There is no way to tell from these results if these activities have a marginal effect, which cannot be detected from the overall picture presented here, or if the effects of tutoring and out-of-school lessons are more positive for outcomes directly related to the curriculum than for more general outcomes such as those measured by PISA. Indeed, it can plausibly be argued that these activities are likely to specifically target narrower outcomes, such as school grades, than broader ones, such as building students' competencies and self-confidence. More comprehensive studies of these phenomena are clearly needed. However, some caution is required in interpreting these results, as it is not possible to dismiss the possibility of students in some countries giving socially desirable responses or interpreting the questions differently from the intended meaning.

### Learning strategies

Learning strategies (sometimes referred to as meta-cognitive strategies) are generic approaches that students use to address a learning task. In the Carroll model, such strategies are at least loosely identified with ability to learn in the sense that it might be expected that students with effective learning strategies would learn more quickly than other students. The Wang *et al.* (1993) synthesis identifies learning strategies as among the proximate factors that contribute to higher achievement. However, this research is silent on whether some of these strategies are more effective than other types of strategies. The three indices used in PISA to measure students' use of learning strategies are memorisation/rehearsal strategies, elaboration strategies and control strategies (see Chapter 2).

The effects for students' use of memorisation/rehearsal strategies appear in Figure 3.21. These effects are almost universally negative, suggesting that memorisation is an ineffective strategy for learning mathematics and/or that weaker students have a greater tendency to use this strategy. It is interesting to note, however, that the observed effects are only slightly more negative across countries and have a wider overall range than the teaching and learning model effects. In general across the OECD, countries with the largest positive observed effects have close to zero effects in the analytical model and those with the largest negative observed effects tend to have the most negative effects in the analytical model.[8] Nevertheless, some countries, notably Norway, Sweden, Denmark, Australia, Japan, Korea, Spain, Finland, Canada and the partner economy Tunisia show a substantial shift in the size of the effect. This result implies that other measures analysed in the model mediate the effects that the use of memorisation/rehearsal strategies has on performance in these countries. Interestingly, however, there is no relationship between the size of the effect and achievement at the country level.

One might argue that the negative effects for the use of memorisation/rehearsal strategies are intuitively plausible and consistent with other research. However, much of the available research speaks not to the negative effects of memorisation/rehearsal strategies but to the greater positive effects of such techniques as developing and using problem-solving skills. Elaboration relates to problem solving and to the more general idea of attempting to establish meaning in the material one is attempting to learn. While it is common to interpret these strategies as more effective than memorisation for learning mathematics (Grouws and Cebulla, 2000), the research covered in this review refers to the teaching of meaning as a teaching strategy rather than as a student learning strategy.

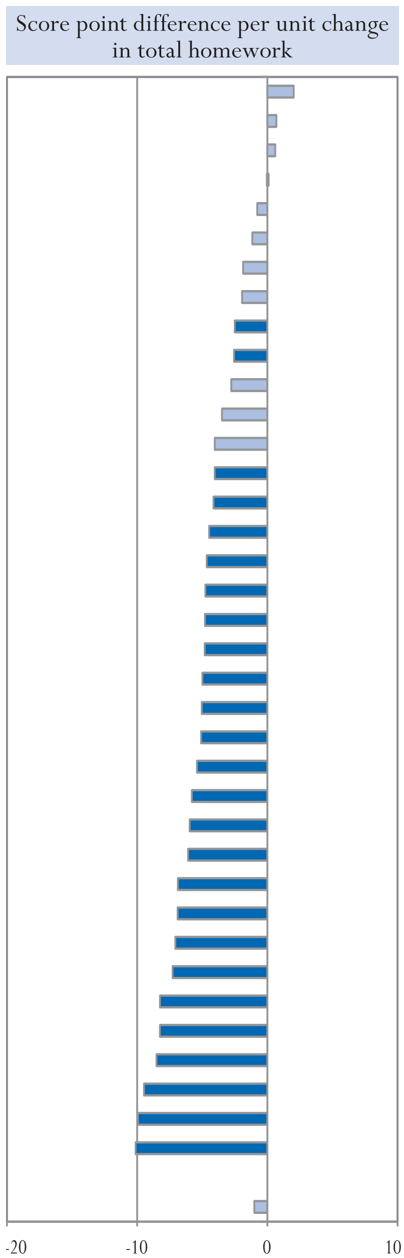
The effects for students' use of elaboration strategies appear in Figure 3.22. In the teaching and learning analytical model the effects for elaboration strategies are mainly negative or near zero. The strongest negative effects appear in New Zealand, Australia and Norway, where there are no observed associations between the use of elaboration strategies and mathematics performance. The



positive observed association between students' use of elaboration strategies and mathematics performance in 26 countries, combined with the absence of countries where this strategy has a positive effect in the teaching and learning analytical model, raises the question of whether other research, particularly that based on less comprehensive models, is incorrect, or if other factors in the current analytical model account for the shift.

Figure 3.21 ■ **Memorisation/rehearsal strategies and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Netherlands | -0.16 | 5.2 | (1.61) | 2.0 | (1.25) |
| Sweden | -0.08 | 14.4 | (1.82) | 0.7 | (1.48) |
| Norway | -0.12 | 21.8 | (1.55) | 0.6 | (1.75) |
| Tunisia | 0.43 | 5.9 | (0.92) | 0.0 | (1.21) |
| Uruguay | 0.16 | -1.6 | (1.49) | -0.8 | (1.57) |
| Turkey | 0.10 | 3.2 | (1.47) | -1.2 | (1.76) |
| Japan | -0.56 | 7.2 | (1.29) | -1.9 | (1.37) |
| Belgium | -0.09 | -6.7 | (1.35) | -1.9 | (1.17) |
| Luxembourg | -0.05 | -7.6 | (1.24) | -2.5 | (1.26) |
| Spain | 0.07 | 6.8 | (1.23) | -2.6 | (1.28) |
| Ireland | 0.11 | 4.7 | (1.65) | -2.8 | (1.75) |
| Latvia | -0.14 | -1.3 | (3.09) | -3.5 | (2.30) |
| Brazil | 0.48 | -7.3 | (1.91) | -4.0 | (2.28) |
| Canada | 0.16 | 6.5 | (0.97) | -4.0 | (1.07) |
| New Zealand | 0.13 | 5.7 | (1.48) | -4.1 | (1.56) |
| Russian Fed. | -0.04 | -0.6 | (1.27) | -4.5 | (1.62) |
| Denmark | -0.27 | 9.5 | (1.80) | -4.7 | (1.63) |
| Mexico | 0.56 | 1.4 | (0.96) | -4.8 | (1.06) |
| Poland | 0.15 | -3.7 | (1.87) | -4.8 | (1.58) |
| Finland | -0.19 | 6.6 | (1.48) | -4.8 | (1.27) |
| United States | 0.31 | 3.1 | (1.31) | -5.0 | (1.47) |
| Australia | 0.17 | 7.9 | (1.17) | -5.0 | (1.32) |
| Iceland | -0.03 | -0.5 | (1.47) | -5.1 | (1.64) |
| Hungary | 0.16 | -6.2 | (0.94) | -5.4 | (1.19) |
| Slovak Republic | 0.13 | -6.7 | (1.47) | -5.8 | (1.33) |
| Portugal | -0.11 | -2.3 | (1.71) | -6.0 | (1.72) |
| Italy | 0.03 | -5.5 | (1.23) | -6.1 | (1.34) |
| Germany | -0.06 | -9.1 | (1.16) | -6.9 | (1.12) |
| Czech Republic | -0.05 | -5.7 | (1.52) | -6.9 | (1.27) |
| Switzerland | -0.19 | -11.1 | (1.38) | -7.1 | (1.02) |
| Greece | 0.20 | -1.7 | (1.91) | -7.3 | (1.91) |
| Austria | 0.06 | -11.3 | (0.97) | -8.2 | (1.07) |
| Serbia | -0.05 | -12.4 | (1.53) | -8.3 | (1.62) |
| Hong Kong-China | -0.15 | 3.7 | (1.51) | -8.5 | (1.58) |
| Korea | -0.35 | 7.1 | (1.24) | -9.5 | (1.64) |
| Thailand | 0.47 | -0.3 | (1.66) | -9.9 | (2.57) |
| Macao-China | -0.03 | -12.1 | (4.12) | -10.1 | (3.76) |
| United Kingdom[1] | 0.11 | 10.3 | (1.64) | -1.0 | (1.56) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

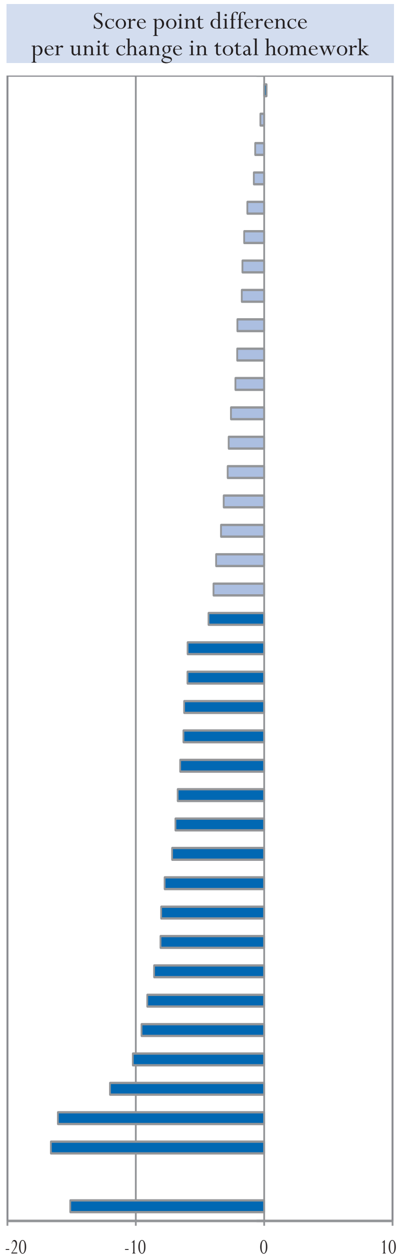
*Note:* Statistically significant score point differences are marked in a darker tone.



Before examining this point further, it is necessary to look at the results for students' use of control strategies to learn mathematics. While the use of elaboration strategies may be identified with effectiveness in learning, the use of control strategies may be thought of as indicators of efficiency, in the sense that the items used to measure this factor are linked to finding ways to focus on what it is important to learn.

Figure 3.22 ■ **Elaboration strategies and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Tunisia | 0.94 | 7.8 | (0.91) | 0.2 | (1.48) |
| Germany | -0.31 | 4.6 | (1.26) | -0.3 | (1.03) |
| Austria | -0.27 | 3.1 | (1.08) | -0.7 | (1.05) |
| Czech Republic | 0.13 | 12.6 | (1.37) | -0.8 | (1.41) |
| Thailand | 0.62 | 5.1 | (1.55) | -1.3 | (2.00) |
| Latvia | 0.13 | 6.3 | (3.34) | -1.6 | (2.86) |
| Mexico | 0.85 | 2.4 | (1.02) | -1.7 | (1.42) |
| Uruguay | 0.36 | 3.7 | (1.45) | -1.7 | (2.34) |
| Serbia | 0.41 | -2.5 | (1.49) | -2.1 | (1.72) |
| Hungary | -0.10 | 3.1 | (1.16) | -2.1 | (1.14) |
| Macao-China | 0.04 | 14.6 | (3.92) | -2.2 | (3.74) |
| Japan | -0.75 | 9.1 | (1.07) | -2.6 | (1.35) |
| Netherlands | -0.25 | 5.9 | (1.43) | -2.8 | (1.46) |
| Hong Kong-China | 0.00 | 14.8 | (1.45) | -2.8 | (1.96) |
| Brazil | 0.76 | -1.0 | (1.38) | -3.2 | (1.95) |
| Slovak Republic | 0.38 | 4.5 | (1.58) | -3.4 | (1.81) |
| Italy | 0.04 | 5.7 | (1.21) | -3.7 | (1.29) |
| Korea | -0.39 | 17.7 | (1.12) | -3.9 | (1.46) |
| Spain | 0.09 | 11.4 | (1.06) | -4.3 | (1.26) |
| Greece | 0.33 | 8.4 | (1.32) | -6.0 | (1.65) |
| Sweden | -0.02 | 9.9 | (2.03) | -6.0 | (1.67) |
| Finland | -0.14 | 16.8 | (1.34) | -6.2 | (1.39) |
| Portugal | 0.16 | 10.6 | (1.61) | -6.3 | (1.86) |
| Poland | 0.25 | 7.4 | (1.84) | -6.5 | (1.75) |
| Russian Fed. | 0.14 | 4.1 | (1.65) | -6.7 | (2.03) |
| Switzerland | -0.06 | -0.1 | (1.44) | -6.9 | (1.53) |
| Denmark | 0.07 | 10.7 | (2.00) | -7.2 | (2.22) |
| Belgium | -0.17 | 1.2 | (1.36) | -7.8 | (1.36) |
| Turkey | 0.44 | 4.3 | (1.17) | -8.0 | (1.50) |
| Canada | 0.08 | 7.5 | (1.01) | -8.1 | (1.00) |
| Luxembourg | -0.25 | -2.5 | (1.14) | -8.6 | (1.35) |
| United States | 0.18 | -1.0 | (1.25) | -9.1 | (1.57) |
| Ireland | -0.14 | -0.5 | (1.73) | -9.6 | (1.47) |
| Iceland | -0.06 | 0.4 | (1.58) | -10.2 | (1.83) |
| Norway | -0.16 | 8.0 | (1.47) | -12.0 | (1.70) |
| Australia | 0.06 | 0.0 | (0.99) | -16.1 | (1.20) |
| New Zealand | 0.13 | -2.9 | (1.88) | -16.6 | (1.90) |
| United Kingdom[1] | 0.04 | -1.7 | (1.75) | -15.1 | (1.62) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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



The results for students' use of control strategies appear in Figure 3.23. Here the picture is much more mixed that for elaboration strategies. There is an observed positive association between students' use of control strategies and mathematics performance in 20 countries, but in the teaching and learning analytical model, there are only small positive effects found in New Zealand, Portugal, Australia, Canada, Korea, Turkey, Spain and in the partner economy Hong Kong-China. Further, there are negative effects in Sweden, the Netherlands, Denmark, the Slovak Republic, the Czech Republic and Belgium, as well as in the partner countries Latvia, the Russian Federation and Uruguay. The positive and negative effects are quite consistent across countries (country level correlation 0.67).

These three indices strongly intercorrelate: correlations as high as 0.60 or more are common within countries. In particular there are strong correlations between students' use of control strategies and students' use of memorisation/rehearsal strategies, with correlations of at least 0.90 in 16 of the OECD countries (Table B.1). Further factor analysis of the items making up these indices shows that, while each of the three learning strategies can be clearly identified, students' use of memorisation/rehearsal strategies accounts for much more of the mathematics performance variance than the other two learning strategies. However, the three measures of learning strategies are distinct and it is not the case that all students respond to each of the items included in the measures in a similar way.[9]

One possible explanation for these results is that students' use of learning strategies relates to their sense of self-efficacy in mathematics. Both areas involve perceptions of mathematics learning. In particular, if attempting to find meaning in mathematics is an effective learning strategy, students who employ elaboration strategies "to a greater extent" might be expected to have a higher sense of their self-efficacy in learning mathematics. In fact, all three learning strategies correlate positively with self-efficacy in mathematics. The most consistent correlations are found between students' use of control strategies and student self-efficacy in mathematics, with correlations of at least 0.20 in 29 of the OECD countries, including correlations of 0.50 in Korea, 0.43 in Finland and Mexico and 0.40 in Turkey (see Annex B, Table B.1, Correlations among Selected Index Variables). There are correlations of at least 0.20 in 22 of the OECD countries for students' use of elaboration strategies and in 18 of the OECD countries for students' use of memorisation/rehearsal strategies. However, in Austria, the Czech Republic, Germany and Switzerland there is no correlation between students' use of memorisation/rehearsal strategies and students' self-efficacy in mathematics. Accounting for students' self-efficacy in mathematics reduces the observed positive effects of using learning strategies on mathematics performance, altering most of the positive values to negative ones (see Annex C, Multilevel Model, Table C.5, Effect of Mathematics Achievement of Learning Strategies Controlling for Self-Efficacy), a result which is consistent with the correlations in Table B.1. Nevertheless, removing self-efficacy in mathematics from the teaching and learning analytical model yielded almost no changes in the results.

Of course, this raises further questions concerning the links between the underlying constructs of self-efficacy in mathematics and student learning strategies. Does greater use of learning strategies contribute to the development of a sense of self-efficacy? To what extent do the joint effects of learning strategies and self-efficacy in mathematics contribute to achievement? More importantly, can teaching strategies influence students' sense of self-efficacy in mathematics and use of learning strategies in ways that can enhance achievement? Or are these attributes, especially self-efficacy in mathematics, simply consequences of achievement or proxies for achievement? Models based on survey data break down at this point because the direction of causality cannot clearly be delineated.

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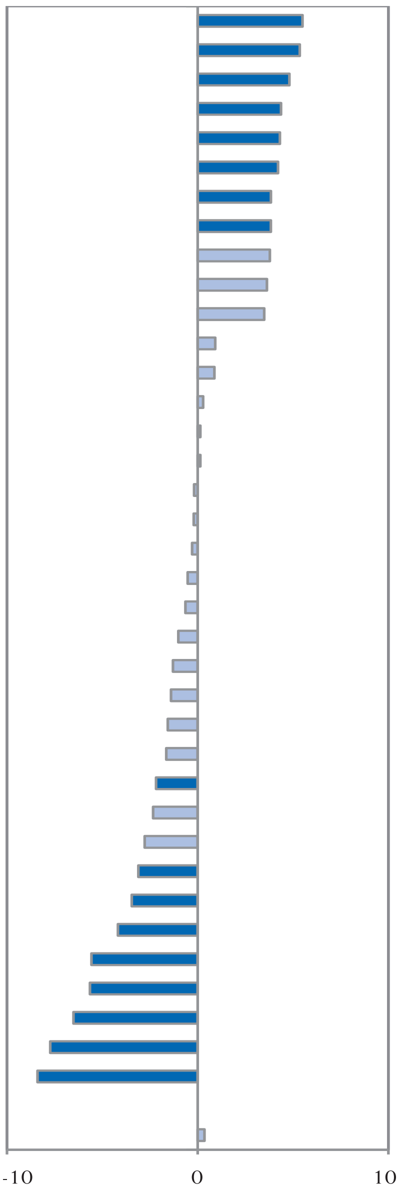
## Co-operative and competitive learning situations

The indices measuring students' reported preference for co-operative and competitive learning situations in mathematics were derived from student responses to items on whether they prefer working with others or helping others, or whether they want to be the best or do better than others. It is important to note that the co-operative learning construct used here as a student

Figure 3.23 ■ **Control strategies and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Hong Kong-China | -0.07 | 14.9 | (1.45) | 5.5 | (1.31) |
| New Zealand | -0.03 | 11.0 | (1.46) | 5.4 | (1.61) |
| Portugal | 0.14 | 12.3 | (1.53) | 4.8 | (1.65) |
| Australia | 0.01 | 12.4 | (1.27) | 4.4 | (1.18) |
| Canada | 0.06 | 11.5 | (1.05) | 4.3 | (1.13) |
| Korea | -0.49 | 20.0 | (1.16) | 4.2 | (1.85) |
| Turkey | 0.26 | 8.9 | (1.43) | 3.8 | (1.93) |
| Spain | -0.02 | 11.5 | (1.13) | 3.8 | (1.47) |
| Macao-China | 0.07 | 4.5 | (4.07) | 3.8 | (3.82) |
| Thailand | -0.03 | 6.1 | (1.34) | 3.6 | (2.03) |
| Brazil | 0.57 | 0.6 | (1.59) | 3.5 | (1.94) |
| Tunisia | 0.68 | 7.0 | (1.02) | 0.9 | (1.34) |
| Italy | 0.21 | 2.0 | (1.30) | 0.9 | (1.33) |
| Norway | -0.26 | 14.5 | (1.58) | 0.3 | (1.71) |
| Switzerland | 0.19 | -3.0 | (1.50) | 0.1 | (1.18) |
| Greece | 0.27 | 3.0 | (1.41) | 0.1 | (1.71) |
| Mexico | 0.45 | 2.7 | (0.99) | -0.2 | (1.16) |
| Austria | 0.52 | -3.6 | (1.06) | -0.2 | (1.17) |
| Serbia | 0.50 | -4.1 | (1.02) | -0.3 | (1.31) |
| Finland | -0.48 | 11.4 | (1.36) | -0.5 | (1.50) |
| United States | 0.01 | 5.5 | (1.32) | -0.6 | (1.52) |
| Germany | 0.38 | -5.9 | (1.23) | -1.0 | (1.39) |
| Luxembourg | 0.08 | -4.6 | (1.30) | -1.3 | (1.40) |
| Iceland | 0.00 | 4.4 | (1.62) | -1.4 | (1.50) |
| Poland | -0.03 | 4.3 | (1.88) | -1.6 | (1.58) |
| Ireland | -0.01 | 3.7 | (1.48) | -1.6 | (1.49) |
| Belgium | -0.05 | -2.4 | (1.19) | -2.2 | (1.05) |
| Japan | -0.54 | 7.4 | (1.13) | -2.3 | (1.27) |
| Czech Republic | 0.06 | -0.9 | (1.67) | -2.8 | (1.42) |
| Hungary | 0.06 | -4.7 | (1.33) | -3.1 | (1.57) |
| Slovak Republic | 0.07 | -5.2 | (1.49) | -3.5 | (1.40) |
| Uruguay | 0.20 | -0.7 | (1.50) | -4.2 | (1.85) |
| Denmark | -0.19 | 4.4 | (2.17) | -5.6 | (1.84) |
| Netherlands | -0.27 | -3.6 | (1.95) | -5.7 | (1.29) |
| Russian Fed. | -0.09 | -2.0 | (1.37) | -6.5 | (1.72) |
| Latvia | -0.26 | -6.1 | (2.74) | -7.7 | (2.33) |
| Sweden | -0.40 | 0.2 | (1.86) | -8.4 | (1.41) |
| United Kingdom[1] | -0.11 | 9.2 | (1.74) | 0.4 | (1.97) |

Score point difference per unit change in total homework




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

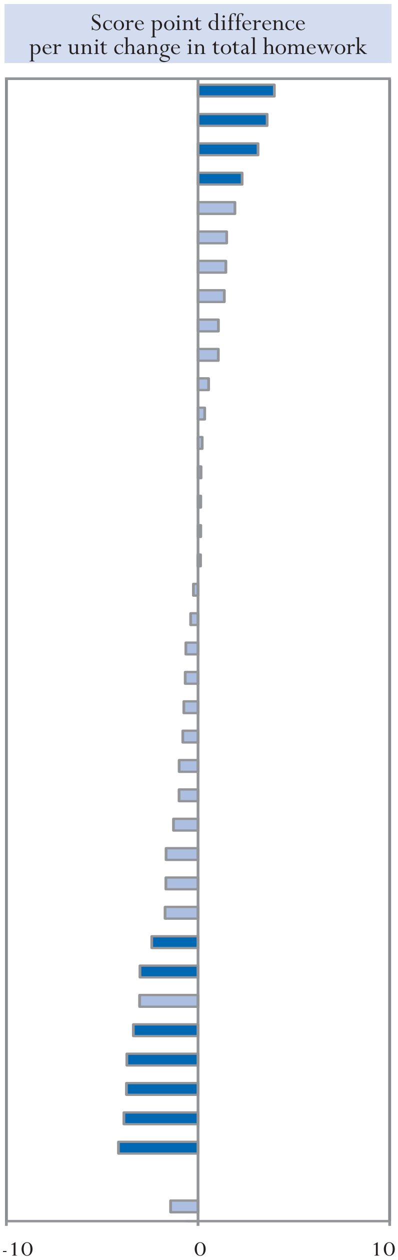
*Note:* Statistically significant score point differences are marked in a darker tone.



preference is different from the construct of co-operative learning as a teaching strategy as used in the literature. In the literature it refers to specific ways of organising groups to facilitate learning (Slavin, 1994). PISA does measure this construct as well, but it would be inappropriate to infer that student preference for co-operative learning is a proxy for use of co-operative teaching strategies or a consequence of teaching through co-operative grouping. Nevertheless, this is not to imply that

Figure 3.24 ■ **Preference for co-operative learning situations and mathematics performance**

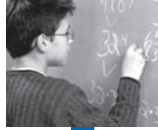
| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Japan | -0.72 | 7.8 | (1.19) | 4.0 | (1.11) |
| Hungary | -0.11 | 0.6 | (1.43) | 3.6 | (1.53) |
| Finland | -0.15 | 3.0 | (1.66) | 3.1 | (1.36) |
| Switzerland | 0.17 | -4.0 | (1.16) | 2.3 | (1.09) |
| Netherlands | -0.13 | 1.1 | (1.82) | 1.9 | (1.25) |
| Norway | 0.01 | 1.0 | (1.56) | 1.5 | (1.20) |
| Sweden | -0.22 | 4.3 | (2.00) | 1.5 | (1.28) |
| Hong Kong-China | -0.04 | 12.9 | (1.55) | 1.4 | (1.60) |
| Belgium | -0.05 | -4.3 | (1.27) | 1.1 | (1.12) |
| Germany | -0.01 | 0.7 | (1.09) | 1.1 | (1.10) |
| Brazil | 0.65 | -3.3 | (1.65) | 0.6 | (2.15) |
| Korea | -0.77 | 21.3 | (1.28) | 0.3 | (1.54) |
| Portugal | 0.29 | 2.3 | (1.87) | 0.2 | (1.60) |
| Spain | 0.05 | 6.9 | (1.18) | 0.2 | (1.33) |
| Austria | -0.01 | -2.2 | (1.09) | 0.1 | (0.84) |
| Ireland | -0.10 | -2.9 | (1.73) | 0.0 | (1.54) |
| Russian Fed. | -0.07 | 4.7 | (1.46) | 0.0 | (1.53) |
| Serbia | 0.27 | -5.1 | (1.28) | -0.2 | (1.28) |
| Czech Republic | -0.04 | -5.6 | (1.23) | -0.4 | (1.06) |
| Italy | 0.14 | -3.7 | (1.01) | -0.6 | (1.01) |
| Turkey | 0.30 | 2.4 | (1.04) | -0.7 | (1.50) |
| Greece | 0.20 | 0.5 | (1.23) | -0.7 | (1.30) |
| Uruguay | 0.39 | -7.9 | (1.34) | -0.8 | (1.32) |
| Luxembourg | -0.17 | -5.2 | (1.08) | -1.0 | (0.96) |
| Canada | 0.14 | -5.0 | (1.01) | -1.0 | (0.89) |
| Slovak Republic | 0.25 | -11.3 | (1.49) | -1.3 | (1.24) |
| Thailand | 0.31 | 4.8 | (1.69) | -1.7 | (2.12) |
| Poland | 0.11 | -5.0 | (1.65) | -1.7 | (1.31) |
| Latvia | -0.13 | -5.3 | (2.44) | -1.7 | (2.03) |
| United States | 0.27 | -3.8 | (1.17) | -2.4 | (1.10) |
| Mexico | 0.21 | -1.1 | (1.03) | -3.0 | (1.04) |
| Macao-China | 0.11 | 5.3 | (3.93) | -3.0 | (3.58) |
| Denmark | 0.23 | -4.0 | (1.72) | -3.4 | (1.54) |
| New Zealand | 0.16 | -5.4 | (1.62) | -3.7 | (1.45) |
| Iceland | -0.30 | -1.4 | (1.43) | -3.7 | (1.34) |
| Australia | 0.10 | -2.5 | (1.30) | -3.9 | (1.13) |
| Tunisia | 0.61 | 3.6 | (1.00) | -4.2 | (1.14) |
| United Kingdom[1] | 0.16 | -1.4 | (1.50) | -1.4 | (1.15) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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





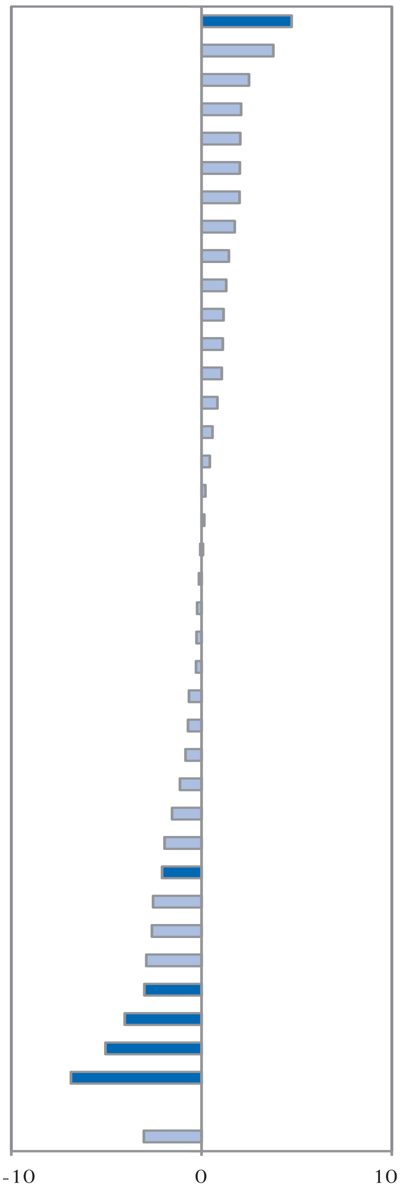
schools or teachers cannot encourage either a co-operative or a competitive learning environment in their classrooms.

The PISA results show that in several countries these two learning situations are not mutually exclusive, that is, students preferring competitive learning situations often tend also to enjoy co-operating with

**Figure 3.25 ■ Preference for competitive learning situations and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Denmark | -0.04 | 22.3 | (1.65) | 4.7 | (1.92) |
| Russian Fed. | -0.03 | 13.3 | (1.45) | 3.8 | (1.97) |
| Greece | 0.28 | 11.8 | (1.41) | 2.5 | (1.78) |
| Korea | -0.05 | 22.1 | (1.10) | 2.1 | (1.55) |
| Mexico | 0.68 | 6.0 | (1.28) | 2.0 | (1.68) |
| Slovak Republic | 0.08 | 9.1 | (1.36) | 2.0 | (1.22) |
| Tunisia | 0.99 | 8.9 | (1.18) | 2.0 | (1.62) |
| Turkey | 0.65 | 10.9 | (1.27) | 1.7 | (1.73) |
| Czech Republic | -0.10 | 12.5 | (1.34) | 1.4 | (1.24) |
| Austria | -0.31 | 0.5 | (1.03) | 1.3 | (1.05) |
| Sweden | -0.06 | 16.5 | (1.89) | 1.2 | (1.55) |
| Australia | 0.31 | 12.5 | (1.26) | 1.1 | (1.61) |
| Poland | 0.09 | 12.3 | (1.91) | 1.1 | (1.50) |
| United States | 0.41 | 8.4 | (1.33) | 0.8 | (1.43) |
| Macao-China | 0.02 | 9.0 | (4.32) | 0.6 | (4.43) |
| Spain | 0.03 | 11.5 | (1.08) | 0.4 | (1.21) |
| Latvia | -0.10 | 13.2 | (2.23) | 0.2 | (2.48) |
| Luxembourg | -0.01 | 1.0 | (1.24) | 0.0 | (1.29) |
| Germany | -0.03 | 5.9 | (1.22) | -0.1 | (1.12) |
| Finland | -0.32 | 19.7 | (1.34) | -0.1 | (1.32) |
| Iceland | 0.26 | 14.0 | (1.69) | -0.2 | (1.59) |
| Ireland | 0.08 | 5.6 | (1.79) | -0.3 | (1.40) |
| Thailand | 0.31 | 2.7 | (1.79) | -0.3 | (2.18) |
| Japan | -0.47 | 9.7 | (0.94) | -0.7 | (1.17) |
| Serbia | -0.18 | -2.4 | (1.38) | -0.7 | (1.65) |
| Hungary | -0.45 | 6.7 | (1.30) | -0.8 | (1.29) |
| Italy | 0.09 | 5.7 | (1.39) | -1.1 | (1.26) |
| Brazil | 0.38 | -3.5 | (1.87) | -1.6 | (1.77) |
| Portugal | -0.08 | 5.4 | (1.29) | -1.9 | (1.44) |
| Canada | 0.19 | 12.1 | (0.93) | -2.1 | (0.86) |
| Norway | -0.31 | 18.5 | (1.44) | -2.5 | (1.47) |
| Netherlands | -0.45 | 2.8 | (1.75) | -2.6 | (1.62) |
| Uruguay | -0.10 | -1.0 | (1.73) | -2.9 | (1.61) |
| Belgium | -0.29 | -0.3 | (1.18) | -3.0 | (1.15) |
| Switzerland | -0.35 | -3.1 | (1.84) | -4.0 | (1.89) |
| New Zealand | 0.15 | 6.9 | (1.82) | -5.1 | (1.60) |
| Hong Kong-China | 0.10 | 13.1 | (1.47) | -6.9 | (1.59) |
| United Kingdom[1] | 0.18 | 5.7 | (1.90) | -3.0 | (1.58) |

Score point difference per unit change in total homework




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

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



other students in their learning. Students reported agreement or disagreement with a set of 10 different statements about situations in which to learn mathematics, so that students could report, for example, that they like to work with others while also reporting that they want to be the best in the class. Indeed, the almost universally positive correlations between these two indices show that students often report a preference for both learning situations (Table B.1). There are strong positive latent correlations between student preferences for competitive and co-operative learning situations in the OECD countries Korea (0.84), Mexico (0.70) and Turkey (0.62). However, in several countries there is weak or no correlation between the two learning situations: in Finland (-0.01) and in the partner countries the Slovak Republic (-0.02) and the Czech Republic (0.08). It cannot be determined from the results if this is a function of response bias or of some characteristics of students or schools in these countries.

Student preferences for learning situations are not strongly associated with mathematics performance when considered in the wider context of teaching and learning (Figures 3.24 and 3.25). The effects are non-significant in most countries and inconsistent in direction even in those countries where they are significant. The observed effects for co-operative learning follow a similar pattern to the analytical model effects. Even in the minority of countries where there are strong observed effects, these become insignificant once other contextual and teaching and learning factors are accounted for (for example, there are positive observed effects in Korea and the partner economy Hong Kong-China, and a negative observed effect in the Slovak Republic). The situation for competitive learning is somewhat different: fairly large positive observed effects are attenuated in the teaching and learning analytical model. Similarly as for student learning strategies, removing the measure of self-efficacy in mathematics from the teaching and learning analytical model does not change the results in any significant way. Again, note that these are measured as student factors. It is plausible to argue that dispositions towards either competitive or co-operative learning may themselves be learned or may be characteristics of schools; however, the inclusion of these factors in the teaching and learning analytical model at the school level yields no effect.

## TEACHING STRATEGIES

Although PISA did not directly survey teachers, a limited number of measures of teaching strategies were collected via the student and school questionnaires. This report presents information provided by school principals on innovation, teacher expectations, streaming and assessment in Chapter 2. However, these measures are not included in the teaching and learning analytical model, since they either have low correlations with achievement or only show small effects in early versions of the multi-level model.

The main teaching strategy measures from the student questionnaire are the indices of *student-teacher relations*, *disciplinary climate* and *teacher support*. All of these derive from a series of items in which students were asked to indicate how frequently specified behaviours occur in their mathematics classes (see Chapter 2).

Two additional school-level measures are included in the analytical model as controls. These are school size (total students enrolled) and the socio-economic composition of the school (parents' highest occupational level aggregated to the school). School size shows a moderate correlation with achievement in many countries. The socio-economic composition of the school is highly correlated with achievement in almost all countries.

It is important to point out that, although students may influence the climate of a classroom, teaching strategies are fundamentally characteristic of teachers or classrooms and not of individual students.

Students' perceptions of the classroom climate are the basis of the indices analysed. It would therefore be appropriate to examine these indices at both the student and classroom levels. However, because classrooms within a school are not identifiable in the PISA data, the classroom cannot function as a level of analysis in the model. Therefore the analysis aggregated the indices to the school level for modelling purposes. This procedure is defensible as long as differences between classrooms within a school are small. Unfortunately, the PISA analysis has no measure of the extent of such differences and no indication of the number of different teachers who are represented in the student responses. This lack of refinement is likely to be one of the reasons why many of the reported effects are small.

### Disciplinary climate

As indicated in Chapter 2, *disciplinary climate* is an index derived from student responses to items about noise and disruption in the classroom, lost time and student behaviour towards the teacher.

Figure 3.26 shows the effects of disciplinary climate at the student level. There is substantial variation in average disciplinary climate across countries, amounting to close to one standard deviation unit between the highest-rated countries, Japan and the partner country the Russian Federation, to the lowest, the partner country Brazil. A stronger disciplinary climate is positively associated with mathematics performance in all countries. The observed effects and the analytical model effects are of similar magnitudes and are highly correlated, indicating that the impact that disciplinary climate has on performance is largely independent of other contextual and teaching and learning factors analysed in the model.

As already noted, disciplinary climate is more appropriately measured at the classroom level than at the student level. In the absence of a classroom-level identifier, aggregation to the school level has been carried out. Indeed, an argument can be made that classroom disciplinary climate is a component of the broader school climate, although more directly under teacher control than other school climate factors, hence its identification as a teaching strategy.[10]

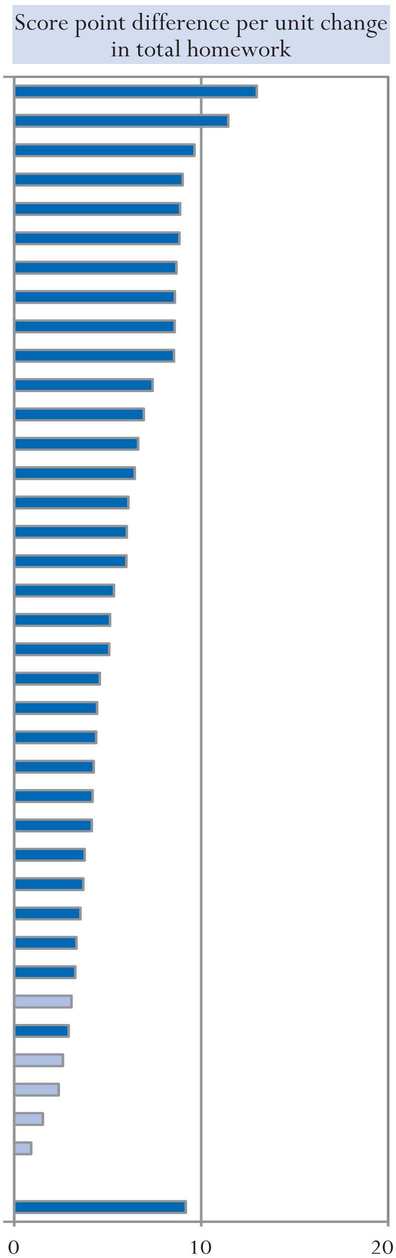
The effects of school average disciplinary climate appear in Figure 3.27. The pattern of school-level means for each country is essentially the same as that at the student level. There is a positive observed association between disciplinary climate and mathematics performance in all countries, but this ranges from effects of 40 score points or more in Luxembourg, Turkey, Japan and the partner economies Hong Kong-China and Macao-China to less than 10 score points in Poland, Finland, Ireland, Iceland and the partner country Latvia. The effects from the teaching and learning analytical model follow a similar pattern, remaining significantly positive in all countries except Finland, Ireland, Iceland, Poland and the partner country Thailand. Turkey, Belgium, Japan, Korea and Portugal and the partner economy Hong Kong-China have the strongest positive association between school average disciplinary climate and mathematics performance.

These results indicate that disciplinary climate is one of the most robust predictors of achievement studied in the PISA 2003 survey. The existence of much larger school-level effects than student-level effects in many countries shows the importance of examining the effects of disciplinary climate at the school level, and that averaging student responses over schools yields a separate strong predictor of achievement. In Korea, the Netherlands, Greece, Denmark and Norway the school average disciplinary climate has positive effects, but disciplinary climate at the student level shows no association with performance in the analytical model. Overall, the effects of school average disciplinary climate

are twice as strong as those effects at the student level in 19 countries. The country-level correlation of the mean value for school average disciplinary climate and the size of the effect in the teaching and learning analytical model is close to zero. This finding suggests that the observed effect within a country is a function of the relative values of disciplinary climate within the country rather than of the average position of the country on the international scale.

Figure 3.26 ■ **Disciplinary climate and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Thailand | 0.00 | 19.2 | (1.50) | 13.0 | (1.52) |
| Macao-China | 0.09 | 15.4 | (4.12) | 11.4 | (3.38) |
| United States | 0.12 | 20.6 | (1.23) | 9.6 | (1.28) |
| Latvia | 0.30 | 15.2 | (2.48) | 9.0 | (1.75) |
| Portugal | 0.01 | 15.2 | (1.64) | 8.9 | (1.43) |
| Switzerland | 0.10 | 11.0 | (2.13) | 8.8 | (2.10) |
| Russian Fed. | 0.49 | 14.7 | (1.56) | 8.7 | (1.48) |
| Ireland | 0.27 | 15.8 | (1.52) | 8.6 | (1.35) |
| Spain | -0.04 | 13.1 | (1.34) | 8.6 | (1.08) |
| Turkey | -0.12 | 13.5 | (1.71) | 8.5 | (1.55) |
| Belgium | 0.04 | 10.8 | (0.90) | 7.4 | (0.91) |
| Canada | 0.02 | 14.3 | (0.93) | 6.9 | (0.83) |
| New Zealand | -0.17 | 14.7 | (1.61) | 6.6 | (1.23) |
| Australia | -0.01 | 16.0 | (0.89) | 6.4 | (0.85) |
| Poland | 0.10 | 15.0 | (1.38) | 6.1 | (1.23) |
| Tunisia | -0.08 | 7.1 | (1.23) | 6.0 | (1.29) |
| Serbia | -0.09 | 10.3 | (1.52) | 6.0 | (1.62) |
| Luxembourg | -0.21 | 7.4 | (1.23) | 5.3 | (1.07) |
| Mexico | 0.00 | 10.5 | (1.32) | 5.1 | (1.27) |
| Austria | 0.21 | 6.9 | (1.31) | 5.1 | (1.17) |
| Czech Republic | -0.01 | 6.2 | (1.05) | 4.6 | (1.01) |
| Brazil | -0.35 | 10.4 | (1.90) | 4.4 | (1.78) |
| Iceland | -0.15 | 13.1 | (1.76) | 4.4 | (1.75) |
| Japan | 0.44 | 5.3 | (1.84) | 4.3 | (1.45) |
| Germany | 0.30 | 7.5 | (1.16) | 4.2 | (1.04) |
| Hong Kong-China | 0.15 | 10.7 | (1.33) | 4.1 | (1.34) |
| Finland | -0.15 | 10.3 | (1.42) | 3.8 | (1.30) |
| Uruguay | -0.03 | 7.4 | (1.82) | 3.7 | (1.59) |
| Sweden | -0.05 | 13.2 | (1.81) | 3.5 | (1.18) |
| Slovak Republic | -0.10 | 5.1 | (1.34) | 3.3 | (1.09) |
| Italy | -0.10 | 4.6 | (1.12) | 3.3 | (1.06) |
| Norway | -0.24 | 11.4 | (1.84) | 3.1 | (1.71) |
| Hungary | 0.17 | 3.1 | (1.11) | 2.9 | (1.16) |
| Netherlands | -0.13 | 4.3 | (1.68) | 2.6 | (1.47) |
| Denmark | -0.08 | 6.8 | (1.97) | 2.4 | (1.49) |
| Greece | -0.22 | 5.3 | (1.56) | 1.5 | (1.32) |
| Korea | 0.12 | 1.7 | (1.38) | 0.9 | (1.11) |
| United Kingdom[1] | -0.01 | 20.0 | (1.10) | 9.2 | (1.03) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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

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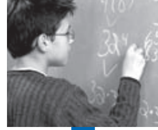


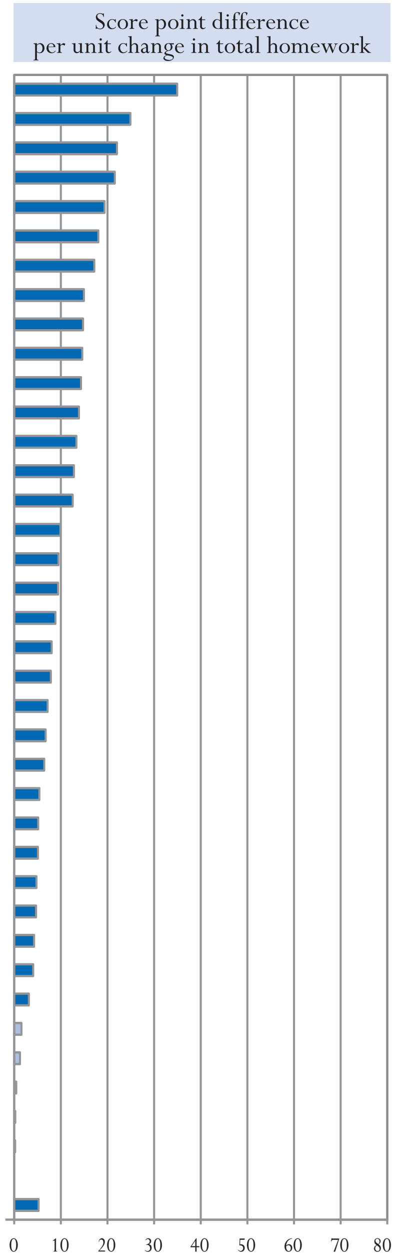


### Student-teacher relations

The PISA *index of student-teacher relations* is derived from student responses to items on how well students get along with teachers, how interested teachers are in students' work and whether teachers treat students fairly. The results for this index appear in Figure 3.28. Like *disciplinary climate*, the means for *student-teacher relations* vary by close to one standard deviation unit between countries, with

**Figure 3.27 ■ School average disciplinary climate and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Hong Kong-China | 0.16 | 77.2 | (1.28) | 35.0 | (1.62) |
| Turkey | -0.10 | 45.3 | (1.50) | 24.9 | (2.14) |
| Belgium | 0.02 | 38.9 | (3.48) | 22.0 | (1.25) |
| Japan | 0.43 | 42.1 | (0.89) | 21.6 | (0.98) |
| Korea | 0.11 | 37.1 | (3.69) | 19.4 | (3.60) |
| Portugal | -0.01 | 36.5 | (1.03) | 18.0 | (1.41) |
| Serbia | -0.09 | 33.7 | (0.68) | 17.2 | (1.06) |
| Brazil | -0.36 | 35.1 | (3.97) | 14.9 | (2.65) |
| Netherlands | -0.13 | 19.3 | (7.38) | 14.8 | (4.21) |
| Macao-China | 0.07 | 45.0 | (3.93) | 14.6 | (5.46) |
| Uruguay | -0.05 | 33.9 | (1.07) | 14.3 | (1.23) |
| Luxembourg | -0.20 | 60.3 | (2.32) | 13.9 | (2.98) |
| Tunisia | -0.08 | 20.3 | (0.66) | 13.3 | (0.81) |
| Germany | 0.30 | 25.7 | (2.40) | 12.8 | (1.55) |
| Mexico | 0.04 | 23.8 | (0.98) | 12.5 | (0.78) |
| Switzerland | 0.11 | 19.8 | (1.00) | 9.9 | (1.17) |
| Austria | 0.21 | 24.2 | (1.97) | 9.5 | (1.47) |
| Russian Fed. | 0.53 | 17.5 | (1.12) | 9.4 | (1.57) |
| Czech Republic | 0.00 | 18.6 | (2.26) | 8.8 | (1.74) |
| Hungary | 0.13 | 18.0 | (1.60) | 8.0 | (1.25) |
| Slovak Republic | -0.11 | 19.5 | (0.75) | 7.9 | (0.85) |
| Italy | -0.12 | 22.3 | (0.49) | 7.2 | (0.63) |
| United States | 0.12 | 27.9 | (0.95) | 6.7 | (0.98) |
| Greece | -0.27 | 24.6 | (2.60) | 6.4 | (2.46) |
| Australia | -0.05 | 29.5 | (0.59) | 5.4 | (0.97) |
| Denmark | -0.07 | 15.9 | (1.60) | 5.1 | (1.41) |
| Spain | -0.02 | 15.0 | (0.80) | 5.1 | (0.84) |
| Canada | 0.03 | 14.8 | (0.97) | 4.8 | (0.83) |
| Norway | -0.22 | 13.1 | (1.62) | 4.7 | (1.38) |
| Sweden | -0.04 | 15.3 | (2.00) | 4.3 | (1.60) |
| Latvia | 0.32 | 7.0 | (0.92) | 4.1 | (1.22) |
| New Zealand | -0.15 | 20.7 | (1.38) | 3.1 | (1.50) |
| Poland | 0.14 | 3.1 | (1.55) | 1.6 | (1.36) |
| Iceland | -0.06 | 6.7 | (1.80) | 1.2 | (1.83) |
| Thailand | 0.00 | 16.1 | (1.06) | 0.4 | (1.20) |
| Ireland | 0.26 | 5.7 | (0.92) | -0.2 | (1.16) |
| Finland | -0.11 | 3.4 | (1.29) | -0.2 | (1.02) |
| United Kingdom[1] | 0.10 | 22.6 | (1.76) | 5.2 | (1.15) |




1. Response rate too low to ensure comparability.

*Source:* OECD PISA 2003 Database.

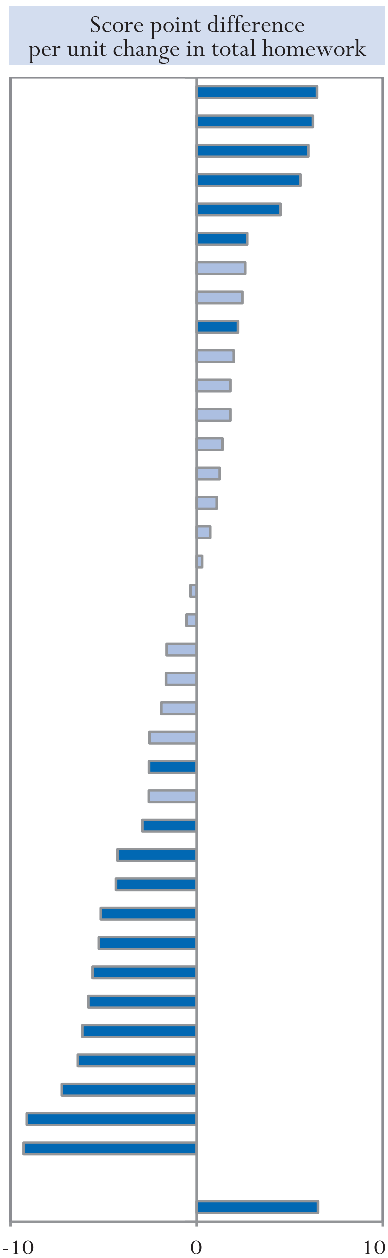
*Note:* Statistically significant score point differences are marked in a darker tone.



students in Mexico and the partner countries Brazil, Thailand and Tunisia reporting the most positive perceptions of student-teacher relations and students in Japan and Luxembourg the most negative. Within each OECD country there are weak positive correlations between students' reports on disciplinary climate and student-teacher relations, thus indicating that many students who see their teachers as helpful and fair also tend to report a more positive classroom disciplinary climate.

Figure 3.28 ■ **Student-teacher relations and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| New Zealand | 0.11 | 15.4 | (1.72) | 6.5 | (1.57) |
| Australia | 0.21 | 13.4 | (1.02) | 6.2 | (0.89) |
| Norway | -0.09 | 16.1 | (1.61) | 6.0 | (1.50) |
| Sweden | 0.21 | 14.8 | (1.37) | 5.6 | (1.37) |
| Denmark | 0.27 | 8.0 | (1.65) | 4.5 | (1.63) |
| Ireland | -0.01 | 4.5 | (1.70) | 2.7 | (1.31) |
| Hong Kong-China | 0.06 | 6.7 | (1.41) | 2.6 | (1.34) |
| Macao-China | -0.09 | 4.0 | (3.81) | 2.5 | (3.51) |
| Canada | 0.22 | 9.3 | (1.05) | 2.2 | (0.86) |
| Iceland | 0.02 | 11.7 | (1.43) | 2.0 | (1.44) |
| Japan | -0.41 | 3.0 | (1.52) | 1.8 | (1.61) |
| Luxembourg | -0.39 | 0.3 | (1.33) | 1.8 | (1.33) |
| United States | 0.20 | 10.0 | (1.41) | 1.4 | (1.27) |
| Korea | -0.08 | 6.2 | (1.22) | 1.2 | (1.36) |
| Netherlands | -0.07 | 3.0 | (1.83) | 1.1 | (1.53) |
| Germany | -0.03 | 0.4 | (1.06) | 0.7 | (1.10) |
| Finland | -0.03 | 8.9 | (1.37) | 0.3 | (1.37) |
| Belgium | -0.05 | -1.1 | (1.11) | -0.3 | (0.98) |
| Austria | 0.04 | 0.3 | (1.29) | -0.5 | (1.22) |
| Czech Republic | -0.18 | -1.4 | (1.27) | -1.6 | (1.24) |
| Switzerland | 0.32 | 0.0 | (1.81) | -1.6 | (1.31) |
| Hungary | -0.12 | -3.8 | (1.19) | -1.9 | (1.42) |
| Portugal | 0.24 | -0.5 | (1.42) | -2.5 | (1.43) |
| Spain | -0.13 | 1.1 | (1.30) | -2.6 | (1.23) |
| Brazil | 0.59 | -4.6 | (1.34) | -2.6 | (1.49) |
| Italy | -0.29 | -5.1 | (1.06) | -2.9 | (1.28) |
| Greece | -0.10 | -2.7 | (1.69) | -4.3 | (1.79) |
| Latvia | 0.02 | 0.8 | (2.05) | -4.3 | (1.75) |
| Russian Fed. | -0.01 | -4.7 | (1.35) | -5.2 | (1.41) |
| Poland | -0.29 | -7.4 | (1.80) | -5.3 | (1.70) |
| Mexico | 0.54 | -3.1 | (1.29) | -5.6 | (1.33) |
| Slovak Republic | -0.25 | -9.6 | (1.42) | -5.8 | (1.31) |
| Uruguay | 0.27 | -6.7 | (1.27) | -6.1 | (1.48) |
| Turkey | 0.18 | -2.3 | (1.46) | -6.4 | (1.43) |
| Tunisia | 0.35 | -4.3 | (0.85) | -7.2 | (0.96) |
| Thailand | 0.55 | -4.8 | (1.34) | -9.1 | (1.35) |
| Serbia | -0.09 | -11.8 | (1.35) | -9.3 | (1.44) |
| United Kingdom[1] | 0.08 | 14.2 | (1.46) | 6.5 | (1.42) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

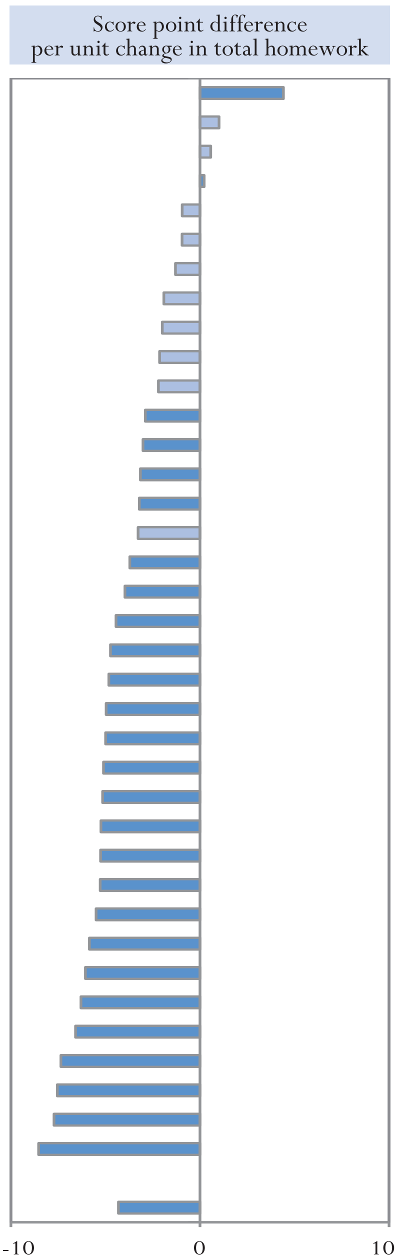
*Note:* Statistically significant score point differences are marked in a darker tone.



Despite this, the effects of student-teacher relations on achievement are quite different from those of disciplinary climate in the majority of countries, although they are similar in Australia, New Zealand, Sweden, the United Kingdom and the partner economy Hong Kong-China. In 12 of the 25 countries where the observed association between student-teacher relations and mathematics performance is positive, it becomes negative when other contextual and teaching and learning factors

Figure 3.29 ■ **Teacher support and mathematics performance**

| | Mean index | Change in mathematics score | | Change in mathematics score when accounting for other background, teaching and learning characteristics | |
|---|---|---|---|---|---|
| Thailand | 0.67 | 5.3 | (1.28) | 4.4 | (1.31) |
| Greece | -0.06 | 0.5 | (1.70) | 1.0 | (1.79) |
| Turkey | 0.41 | 2.0 | (1.40) | 0.6 | (1.17) |
| Korea | -0.22 | 3.8 | (1.42) | 0.2 | (1.52) |
| Hong Kong-China | 0.03 | 8.1 | (1.63) | -0.9 | (1.40) |
| Iceland | 0.20 | 9.7 | (1.87) | -0.9 | (1.83) |
| Netherlands | -0.27 | 1.0 | (1.33) | -1.3 | (1.35) |
| Russian Fed. | 0.26 | 3.5 | (1.46) | -1.9 | (1.32) |
| Mexico | 0.48 | 0.1 | (1.02) | -2.0 | (1.11) |
| Tunisia | 0.24 | -0.1 | (1.17) | -2.1 | (1.51) |
| Hungary | -0.08 | 0.0 | (1.21) | -2.2 | (1.16) |
| Australia | 0.25 | 7.4 | (1.24) | -2.9 | (1.02) |
| Austria | -0.39 | -0.9 | (1.46) | -3.0 | (1.25) |
| United States | 0.34 | 6.7 | (1.31) | -3.2 | (1.14) |
| Denmark | 0.14 | 6.6 | (2.00) | -3.2 | (1.54) |
| Japan | -0.34 | 1.7 | (1.77) | -3.3 | (1.76) |
| Germany | -0.29 | 0.5 | (1.13) | -3.7 | (0.92) |
| Serbia | -0.17 | -8.2 | (1.22) | -4.0 | (1.46) |
| Switzerland | 0.01 | -1.6 | (1.88) | -4.4 | (1.49) |
| Brazil | 0.56 | -5.8 | (1.42) | -4.7 | (1.63) |
| Luxembourg | -0.30 | -2.8 | (1.13) | -4.8 | (1.03) |
| Belgium | -0.11 | -2.2 | (0.92) | -5.0 | (1.07) |
| Portugal | 0.27 | -0.9 | (1.75) | -5.0 | (1.31) |
| Poland | -0.18 | -0.8 | (1.58) | -5.1 | (1.32) |
| Canada | 0.27 | 6.3 | (1.02) | -5.2 | (0.86) |
| Czech Republic | -0.16 | -1.6 | (1.44) | -5.2 | (1.24) |
| Uruguay | 0.32 | -4.8 | (1.55) | -5.3 | (1.40) |
| Spain | -0.07 | -0.8 | (1.46) | -5.3 | (1.32) |
| Italy | -0.12 | -2.6 | (1.07) | -5.5 | (1.12) |
| New Zealand | 0.16 | 4.4 | (1.40) | -5.8 | (1.30) |
| Norway | -0.11 | 13.7 | (1.90) | -6.1 | (1.80) |
| Slovak Republic | -0.10 | -6.8 | (1.13) | -6.3 | (1.17) |
| Latvia | 0.05 | 0.3 | (2.11) | -6.6 | (1.80) |
| Finland | 0.08 | 4.9 | (1.78) | -7.4 | (1.44) |
| Sweden | 0.20 | 3.1 | (1.84) | -7.5 | (1.67) |
| Ireland | 0.00 | -1.7 | (1.67) | -7.7 | (1.47) |
| Macao-China | -0.05 | -3.6 | (4.41) | -8.5 | (4.03) |
| United Kingdom[1] | 0.18 | 7.4 | (1.31) | -4.3 | (1.36) |




1. Response rate too low to ensure comparability.
*Source:* OECD PISA 2003 Database.

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



are taken into account. However, once other contextual and teaching and learning factors have been accounted for there is a positive association between student-teacher relations and mathematics performance in the United Kingdom, New Zealand, Australia, Norway, Sweden, Denmark, Ireland, Canada and the partner economy Hong Kong-China (Figure 3.28).

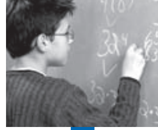
It is worth noting that student-teacher relations were analysed at the school level in earlier models. Student reports on student-teacher relations generally showed no effect when aggregated to the school level, indicating that such perceptions are more student-specific than school-specific, unlike student reports on disciplinary climate.

### Teacher support

Teacher support covers areas similar to student-teacher relations. The basis of the teacher support index are questions on: students' perceptions of their teachers, including items on teacher interest in students, whether the teacher helps students with learning and allows students to express opinions. Indeed, this variable has a correlation of 0.78 with student-teacher relations across OECD countries and there are correlations of at least 0.40 at the student level in 26 of the OECD countries. It would therefore be expected that this measure would not yield significant effects in the teaching and learning analytical model, which controls for teacher-student relations among other factors. Nevertheless, as Figure 3.29 indicates, there are negative effects for teacher support in 27 countries, including in the OECD countries where there are positive effects for student-teacher relations in the teaching and learning analytical model. This result is in stark contrast to the observed associations between teacher support and mathematics performance: they are negative in only the Slovak Republic, Luxembourg, Italy and Belgium as well as in the partner countries Serbia, Brazil and Uruguay. In fact, observed positive associations between teacher support and mathematics performance occur in 13 countries.

Aggregating the measure of teacher support to the school level in earlier versions of the teaching and learning analytical model yielded few significant effects.

The results for teacher support suggest the possibility that in some countries teachers give higher levels of support to the lowest-achieving students, a finding that makes sense if teachers are concerned to address the problems of such students. The shift from positive observed effects to negative effects in the analytical model in Norway, Australia, the United States, Denmark, Canada, Finland and New Zealand indicates that teacher support is mediated by some of the other factors included in the analytical model. As in other cases, the key mediator seems to be self-efficacy in mathematics. The correlations between self-efficacy in mathematics and teacher support are generally small but positive (correlations are at least 0.20 only in Canada, Iceland, Mexico, Norway, the United Kingdom and the United States). Adding a control for self-efficacy in mathematics to the student-level bivariate model effectively changes most positive effects into negative ones. However, removing self-efficacy in mathematics from the teaching and learning analytical model results in almost no change in the effects. The implication of this is that much of the positive value of teacher support is a function of its joint effects with other factors, especially those that relate to self-efficacy in mathematics.





### Other variables

A variety of other school-level factors and student factors aggregated to the school level enter into the analytical model throughout its preliminary stages of development. In particular, the analysis incorporated several time-related variables, including *total instructional time* and *mathematics instructional time*, and measures of teacher innovation, expectations, streaming and assessment. In no cases did these contribute significantly to the predictive power of the analytical model.[11] From an analytical standpoint, therefore, it seems clear that maximum predictive power has been drawn from the teaching and learning analytical model. Nevertheless, even though the overall predictive power of the model is strong, especially in accounting for school-level variance, only a few of the factors analysed are major contributors to the prediction.

This chapter has examined the contributions of student learning strategies and teaching strategies to mathematics achievement, especially those factors connected with the way in which students approach the learning of mathematics. Rather than emphasising variations among countries, the focus has been on factors that are of universal value. Many such factors appear in the literature. These include use of time, attitudes and dispositions and student use of learning strategies or generic approaches to learning.

This report uses an analytical model which treats factors such as students' socio-economic background and perceptions of school as antecedents to teaching and learning. The results reported for the teaching and learning factors analysed are therefore their unique effects after removing any joint effects of the other contextual and teaching and learning factors included in the analytical model. This type of analytical model has the advantage of being more closely representative of the real world of schools and classrooms, in which all of the antecedent factors may be considered as preconditions on learning. The disadvantage of this analytical model is that, in some cases, there is ambiguity as to what constitutes an antecedent, or indeed an outcome, and that some factors analysed in the model may mediate the effects of the main teaching and learning strategies.

In addition to looking at the observed association between various factors and performance, and at the unique effects of each factor when other factors have been accounted for, it is important to consider the interaction between the different factors discussed in this chapter. A good example here is the relationship between self-efficacy in mathematics (students' rating of their own effectiveness as learners), learning strategies and mathematics performance. In the analytical model, adjusting for self-efficacy in mathematics in many cases turned the positive observed effect of adopting a learning strategy into a negative effect. What can be inferred from this change depends on the nature of the causality in the interaction between these three factors.

## HIGHLIGHTS OF THE ANALYTICAL RESULTS

*There are links between a sense of self-efficacy and use of learning strategies*. If students' views of their mathematics abilities are simply based on how well they do in mathematics (high performance causes self-efficacy), the main effect of adjusting for self-efficacy as a variable may be to mask some of the benefits (in terms of improved performance) of adopting effective learning strategies. In this case, an emphasis on the development of learning strategies such as elaborating and controlling one's learning should contribute to achievement more than is implied by their unique effects alone. If, on the other hand, self-efficacy is a factor that helps contribute to performance and effective learning strategies tend to follow from a belief in one's efficacy in tackling mathematics problems, then the



emphasis in schools should be on building students' belief in their own effectiveness. While evidence from PISA cannot distinguish between these two interpretations of the analytical results, the strength of the relationship between self-efficacy and learning strategies suggests that both are valid, and that building up student confidence needs to go hand in hand with enabling them to develop strategies for effective learning.

*A strong sense of one's own ability to learn mathematics is of key importance.* Students' self-concept in mathematics and self-efficacy in mathematics yield strong positive effects in all OECD countries where these factors are not overridden by students' socio-economic background, perceptions of school, motivation to learn or other factors. A strong sense of confidence in one's own abilities in mathematics as well as a strong sense of efficacy in overcoming difficulties in learning tasks are both strongly associated with mathematical competencies. Pronounced effects occur particularly in Australia, New Zealand, Sweden and the United States. It is important to reiterate here that no causal effect can be inferred from the relationship between self-concept and self-efficacy on the one hand and mathematics performance on the other. It is just as plausible to infer that high performance yields high self-concept or self-efficacy as to infer the reverse relationship.

*The time students invest in study in addition to their lessons is important, but mathematics learning is mainly school-based.* In 25 of the OECD countries, the effect of hours per week of total homework on mathematics performance remains positive and these effects are relatively stable compared to the observed associations with performance; conversely, hours per week of mathematics homework showed negative effects in 21 of the OECD countries. (There is, however, evidence that doing some mathematics homework is better than doing none at all for the majority of OECD countries: the small proportion of students who reported doing no mathematics homework at all had lower mathematics performance in 23 of the OECD countries compared to students who reported doing some mathematics homework.) The finding that hours per week of mathematics homework showed negative effects in many countries may be attributed to the inclusion of mathematics homework in total homework. Indeed, mathematics homework makes up a substantial proportion of total homework for most students. However, when these results are interpreted from the perspective of the Carroll model, too much homework may have the effect of adding unnecessarily to time spent, so that it exceeds time needed. Taking this argument a step further, one might hypothesise that students with higher aptitudes do not need to spend so much time on homework. Unfortunately, the data available do not allow the testing of this hypothesis. Longitudinal studies, which follow student behaviours and performance over several years, would be the optimal way to study this issue and the cumulative nature of mathematics learning in general.

Participating in tutoring and taking out-of-school classes in mathematics are negatively associated with mathematics performance, both before and after accounting for other contextual and teaching and learning factors. A common-sense interpretation of this finding is that students who engage in these activities tend to be performing less well in school compared to other students and do not improve sufficiently thanks to these activities to be among the better performers in the PISA mathematics assessment. This interpretation does not imply that these students do not benefit from participating in study organised outside school. The analysis supports this view by the generally small negative correlations between these activities and PISA performance. A second interpretation could be that these activities are narrow in scope, and although they may have positive effects on the students' school performance, these students are nevertheless more challenged by the general mathematical literacy that PISA measures.

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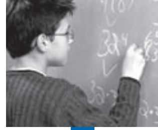



*Students' use of learning strategies show different associations with mathematics performance across countries, but when other contextual and teaching and learning factors are accounted for, the use of memorisation/rehearsal and elaboration strategies are negatively associated with performance in the majority of countries*. The measures of learning strategies generally behave differently in the teaching and learning analytical model compared with their observed effects. In all OECD countries with significant effects, the use of elaboration strategies and memorisation/rehearsal strategies is negatively associated with mathematics performance. However, the use of control strategies is not associated with mathematics performance in the majority of countries, although there are weak positive effects in New Zealand, Portugal, Australia, Canada, Korea, Turkey, Spain, and in the partner economy Hong Kong-China, and weak negative effects in nine countries.

Preferences for either co-operative or competitive learning situations are not strongly associated with mathematics performance once other contextual and teaching and learning factors are accounted for. However, there is an observed positive association between a preference for competitive learning situations and mathematics performance in 29 countries, but in the teaching and learning model the only country where the positive association remains is Denmark. In Japan, Hungary, Finland and Switzerland, a preference for co-operative learning situations shows small positive effects in the teaching and learning model; interestingly, among these countries, the observed association with performance is only positive in Japan. Although it is possible to advance arguments about school or societal influences on student dispositions in these areas, the effects are not clear enough to draw any conclusions about whether either of these approaches should be encouraged by schools and teachers.

*A strong disciplinary climate is strongly and positively associated with mathematics performance*. The notable exception to the pattern of small and inconsistent effects for teaching and learning strategies is the result for disciplinary climate. Positive disciplinary climate shows positive effects on achievement for all countries at either the student or school level, and at both levels for the majority of countries, no matter how the analytical model is structured. Indeed, the average school-level disciplinary climate exerts independent positive effects from those found for student-level disciplinary climate. This finding has important implications because school-level disciplinary climate is something that can potentially be addressed by school-level policies. While school-level disciplinary climate may relate to such factors as the socio-economic composition of the school, PISA results indicate that improving disciplinary climate seems to be a universally valid way to improve achievement. Looked at another way, lost learning time in school mathematics classes is strongly associated with lower mathematics performance.

*The socio-economic composition of the school and students' sense of self-efficacy in mathematics generally show the strongest associations with mathematics performance*. In 18 of the countries studied, the socio-economic composition of the school has stronger associations with mathematics performance than any of the teaching and learning factors analysed. In 15 of the countries, self-efficacy in mathematics has the strongest association with mathematics performance. In Finland, Denmark, Iceland and Australia, students' self-concept in mathematics shows the strongest association with mathematics performance. Among the teaching and learning factors analysed, disciplinary climate at the student and school levels and hours per week of homework in total stand out as having the strongest unique effects across the majority of countries, with student use of control strategies and student-teacher relations having positive associations with mathematics performance in some countries but not in others.



Chapter 3 has presented the results of multi-level modelling that measures selected features of teaching and learning effects on performance in mathematics after adjusting for other characteristics of students and schools. The next chapter examines some of the policy implications of the results and provides observations for the design of future PISA surveys.

## Notes

1 Three of the PISA 2003 participating countries are excluded from parts of this analysis. School-level analysis for France is not presented in this report; Indonesia has too much missing data on the measures included in the analytical model; and results for Liechtenstein are not reliable in two-level models, as there are too few participating schools.

2 Initially, correlations among measures were examined and several versions of the analytical model drawn up and examined, using different combinations of measures. Because some of the measures (predictors) were highly intercorrelated or were found to have only small correlations with achievement, not all of the measures of potential analytical interest were included in the final model.

3 A significant concern in building multiple regression models such as those used here is that the measures or predictors are often correlated with each other, and in complex patterns. This means that the impact of a particular variable on the outcome (in this case on mathematics achievement) depends not only on the correlation of that variable with achievement but also on which other variables are included in the model and on how these are correlated with the particular variable of interest. Under certain circumstances, the effects found in a multiple regression model may be quite different from those found in a simple correlational model. The effects reported here are the unique effects of each variable of interest, adjusting for all other variables in the model. Using different combinations of variables in different versions of the model can help determine if the effects of a particular variable are being mediated, or even suppressed, by particular other variables. Mediation or suppression refers to a situation in which two or more variables are associated with the outcome and also with each other. Taken one at a time in a model, such variables may appear to be good predictors of the outcome. However, when taken in combination in a more comprehensive model, the effects of one variable may override the effects of others.

For example, the two socio-economic background variables – parent occupation and parent education – tend to be highly correlated with each other. Taken separately, each is also typically a good predictor of achievement. However, when taken together, the first of these to be entered into the model is likely to account for most of the variability in achievement, and hence mediates or suppresses the effect of the second variable. The effect of the second variable is essentially subsumed by that of the first. One hypothesis tested in developing the model was that students' own confidence in their mathematical ability (self-efficacy in mathematics) was such a strong influence on achievement, and so closely correlated with teaching and learning variables, that it would suppress other observed effects. In fact, very little difference was found in the magnitude of the effects according to whether or not students' self-efficacy in mathematics was included as a background variable. The effects of this variable could therefore be treated as independent of the effects of other variables. While it would have been desirable to examine many other model combinations as a way of probing these effects further, this complicates the presentation significantly when the model contains many variables.

An argument can be made that the unique effects of teaching and learning, rather than those mediated by factors such as student background, are of most interest from the perspective of policy and practice, because teaching and learning takes place in an overall context that cannot easily be controlled by teachers or students. However, it can also be argued that broader policies could be influenced by knowledge of mediating effects, because these may be a consequence of particular ways of organising schools or classrooms. It is also possible that one aspect of teaching and learning can mediate another, and thus there is scope for looking at two or more aspects together as part of an overall teaching and learning strategy.

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A simple example of possible mediating effects in this study arises from the composition of the variables "total homework" and "mathematics homework". Because the former includes the latter, these two variables are obviously correlated. The size of the correlation will depend partly on the proportion of total homework that is mathematics homework. On the one hand, the actual correlation between these variables is in the 0.60 range in most countries, which is very high compared to most other correlations of interest here. Intuitively, one might expect mathematics homework to be more highly correlated with mathematics achievement than total homework. On the other hand, total homework may be an indicator of a more general propensity to attend to school work, and thus might be independently correlated with mathematics achievement. Once the two variables are included in the model, the effect of one may be mediated or suppressed by the other. As it happens, this is not what occurs in this case. Nevertheless, this example illustrates in a straightforward way the difficulties in interpreting model effects.

4 The order of entry of the measures analysed is more of an issue when a stepwise analysis is undertaken, that is, when measures are entered in order of relative predictive power.

5 The estimate of the number of books in the home was used directly as it proved to be a better predictor of achievement than the *index of cultural possessions*.

6 Across OECD countries on average the latent correlations among the three measures are: -0.80 for self-concept in mathematics and anxiety in mathematics; -0.52 for self-efficacy in mathematics and anxiety in mathematics; and 0.62 for self-concept in mathematics and self-efficacy in mathematics (Table A.2).

7 On average across the OECD countries, the correlation between participation in tutoring and both the highest parental occupation and educational level is 0.04, and the correlation between participation in out-of-school lessons and both the highest parental occupation and educational level is 0.02.

8 The correlation between the observed effects and the analytical effects for students' use of memorisation/rehearsal strategies is 0.58.

9 This was tested by constructing one composite index that simply combines responses to all of the items making up the three indices for student learning strategies. This composite yielded close to a normal distribution, indicating that the problem is not that of a halo effect or the tendency of students to respond in a similar way to all items in a set. The country-level correlations for the composite were mixed – positive and negative – indicating that the effect of the composite is no more universal than that of the individual components.

10 The PISA school questionnaire contains a number of indices of school climate. However, examination of these indices was considered beyond the scope of this study because they could not be clearly identified with teaching strategies.

11 Exploratory analysis was undertaken using observed variables within selected PISA indices instead of the PISA indices themselves. Other than the variable *number of books in the home*, none of these variables contributed more to the predictive power of the analytical model than the composite PISA indices.



# References

**Cooper, H., J.C. Robinson** and **E.A. Patall** (2006), "Does Homework Improve Academic Achievement? A Synthesis of Research, 1987-2003", *Review of Educational Research, Vol.* 76, No. 1, pp. 1-62.

**Grouws, D.A** and **K.J. Cebulla** 2000, *Improving Student Achievement in Mathematics, Part 1: Research Findings. ERIC Digest*. (ED463952)

**OECD** (2004), *Learning for Tomorrow's World: First Results from PISA 2003*, OECD, Paris.

**Slavin, R.** (1994), *Cooperative learning: Theory, research and practice*, Allyn and Bacon, Boston.

**Wang, M.C., G.D. Haertel** and **H.J. Walberg** (1993), "Toward a Knowledge Base for School Learning", *Review of Educational Research*. Vol. 63, No. 3, pp. 249-294.

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4

# Summary and Implications for Further Research

*This chapter summarises the main results of the report, identifies relevant issues for further research and development of PISA, and examines the extent to which the available results speak to the relevant issues. For many of the variables explored, country differences stand out so much that their effects may be best interpreted within countries or clusters of countries with similar cultural backgrounds or school systems.*



## INTRODUCTION

This chapter offers a stand-alone overview of the report. It summarises the main results, identifies relevant issues of policy and practice and examines the extent to which the results available address these issues. It also considers the design of PISA in the light of interpretation issues encountered in this study.

The analysis in this report contributes to understanding:

- *The differences between teaching and learning practices in different countries, thus allowing countries to benchmark practices.* Some of the descriptive data are therefore of interest, for example in comparing homework practices across education systems. Such comparisons need, however, to be made with caution, especially when comparing statements made by principals and students that require a degree of interpretation (*e.g.* how much certain learning strategies are employed) and where response bias can arise because of different cultural contexts.

- *The extent to which teaching and learning practices vary across schools within each country.* This area is the principal focus of Chapter 2 and is an important concern in education systems that aim to provide equality of opportunity to all students.

- *The extent to which individual aspects of teaching and learning are associated with better or worse performance.* These associations are difficult to identify because of the complexity of interactions between various factors, as well as the interaction of different factors with student characteristics such as socio-economic background or students' belief in their own efficacy. Nevertheless, taken together, it is clear that teaching and learning factors have a significant association with student performance in mathematics.

It is important to recognise that teaching is a complex activity and that an enormous number of variables, many of which are outside the control of schools or teachers, influence learning. Even the most carefully designed studies, such as PISA, cannot be expected to identify a few simple school or classroom practices that, if implemented, would make a major difference to student learning. This argument is especially true here since even the best cross-sectional survey cannot yield a cumulative picture of the school and classroom experience of students near the end of their compulsory school careers. Estimates of school and teaching effects in a cross-sectional study are, at best, a one-year snapshot, while the effects of home background and attitudes are likely to be more stable. Surveys can indicate particular areas of interest and may in a few instances, such as for disciplinary climate in this report, identify a factor which appears to have universal positive or negative effects on performance. However, many teaching and learning factors are likely to interact with each other and with the cultural climate in particular countries to yield different impacts in different countries. It is clear that the teaching and learning factors measured in PISA show more than random effects on mathematics achievement. However, it is equally clear that these effects are not universally in the same direction or of similar magnitude across countries. Country differences stand out for many of these variables, to the extent that analysis within countries or clusters of countries with similar cultural backgrounds or school systems may provide the best interpretation of their effects.

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## BACKGROUND FACTORS THAT PROVIDE THE CONTEXT FOR TEACHING AND LEARNING

### The place of socio-economic status

This report does not directly focus on socio-economic background. Nevertheless, the PISA results clearly show that socio-economic background plays a major role in determining the achievement levels of students. Much of the analytical work using the PISA data has addressed the impact of socio-economic background on achievement. While socio-economic background is a more-or-less fixed background factor which education systems can do little to influence directly, the biggest long-term social change that schools can accomplish is to help children overcome the disadvantages of their backgrounds and hence facilitate social mobility.

The immediate implication of this finding for the analysis in this report is that the impact of teaching and learning strategies needs examination independently of students' backgrounds. Thus the design of the models developed here aims to adjust for socio-economic background when examining the effects of teaching and learning strategies. Ideally, the use of appropriate teaching and learning strategies moderates the impact of socio-economic background on achievement, and many educational policy initiatives are intended to compensate for adverse socio-economic effects. Nevertheless, the models used here make clear that socio-economic background remains one of the strongest predictors of achievement, even in the presence of a large variety of teaching and learning strategy variables. That is, the teaching and learning variables examined here do not seem in practice to mitigate very much the disadvantaged social backgrounds of some students.

### Student attitudes, motivations and self-concept

Like socio-economic status, students' self-confidence and motivation as learners show consistent correlations with achievement. These factors could also be related to teaching and learning strategies, and therefore they are included as control variables in the models. Nevertheless, unlike socio-economic background, the direction of causation is not at all clear for these variables. That is, it is possible that attitudes can be influenced by teaching strategies, that attitudes influence learning strategies or that attitudes are affected by achievement. For example, the question remains unresolved of whether a high level of perceived competence in mathematics precedes or follows a high level of achievement, or whether low achievement engenders high mathematics anxiety or vice versa. As noted earlier, cultural differences are likely to affect students' interpretation of self-confidence and motivation questions. Results in these areas should be interpreted with country differences in their mean index values in mind. Readers familiar with particular countries or cultures are better placed than the authors to make judgments about such differences. These variables show some unexpected patterns when taken in the context of other factors in the full model and hence warrant further discussion.

Self-efficacy is often seen as a major determinant of behaviour (Bandura, 1993). However, there is some debate as to whether self-efficacy is best thought of as a generic or a subject-specific trait. The extent of its correlation with achievement seems to depend on the type of self-efficacy measure used (Moulton, Brown and Lent, 1991). PISA 2003 measures self-efficacy, specifically as a mathematics trait, using items in which students evaluate their competence at solving a variety of mathematics problems, yielding the index of self-efficacy in mathematics. Countries in which students have a greater sense of self-efficacy tend to have higher performance, while within most countries there

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is a correlation with performance that remains even when adjusting for other factors.The average sense of self-efficacy (set as zero internationally) varies considerably across countries. In the Slovak Republic students overall have self-efficacy half a standard deviation above average, while those in Japan and Korea, and the partner country Thailand, are the same amount below average. In countries where students have least confidence in their own efficacy, this variable also makes least difference to their predicted achievement; it is most closely correlated in some countries that have about average self-efficacy overall.

The question arises of whether there would be any benefit in attempting to enhance self-efficacy in mathematics as a means of improving achievement. PISA cannot show whether this would be effective, but the question does highlight a pertinent cultural issue. Students in Japan and Korea have among the lowest average sense of self-efficacy in mathematics, though both countries have among the highest average achievement levels. This finding raises the further question of whether the culture or the school systems of these countries are in some way engendering more negative student opinions of their mathematics competence than the reality of their achievement warrants.

Another affective variable showing wide differences across countries is anxiety in mathematics. Students in Mexico, Japan and Korea, and the partner countries Tunisia, Brazil and Thailand (a contrasting mix of high- and low-achieving countries), express particularly high levels of anxiety about mathematics. However, in Denmark, Finland, the Netherlands and Sweden (all relatively high-achieving countries) students show particularly low anxiety. Both within and across countries, students who are anxious about learning mathematics tend to perform worse in the subject. Again, there may be lessons for teachers here, especially in countries where anxiety is highest, to make more efforts to reduce it. Particularly in Mexico and the partner country Brazil, high anxiety tends to go with low mathematics performance.

PISA also gives some indication to teachers that students' motivation is an important aspect of their learning. When asked about their motivation to learn mathematics – out of interest or for more instrumental reasons – students once again responded differently across countries. Although cultural differences may influence the way students respond to this question across countries, within countries those with the highest motivation perform best on average (there is a moderate correlation between motivation and performance).

Much of the research on efficacy, attitudes and motivation hinges on the working hypothesis that high values of such variables are associated with high achievement (*e.g.* Baumert and Koeller, 1998; Aitken, 1974; Lepper, 1988; Wigfield, Eccles and Rodriguez, 1998; Moulton, Brown and Lent, 1991; Branden, 1994). However, some sources suggest that the relationship between these factors and achievement is subtler and more indirect than the simple hypothesis would indicate. This study strongly reinforces that view. While most of the bivariate relationships operate in the predicted direction when examined within countries, there is an obvious country-specific component in the patterns. For example, students in several high-achieving countries, particularly Asian ones, show a generally negative sense of self-efficacy and have relatively negative attitudes and motivations. The existence of negative between-country effects suggests that country-specific features strongly influence the measurement of these factors. Even within countries, however, positive associations between certain attitudes and performance sometimes become negative when adjusting for other factors.

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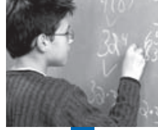



Common-sense logic dictates that teaching can and should influence such attitudes and motivations. If, in their turn, these factors influence achievement, it might be desirable to direct teaching strategies towards improving attitudes and motivations in the hope that this would have indirect positive effects on achievement. While there is no way of measuring the extent to which teachers deliberately aim to improve attitudes in order to improve achievement, in practice there is a consistent bivariate association between good student attitudes and the adoption of helpful teaching strategies, for example by creating a positive classroom climate. This finding needs to be interpreted with caution, however, since teaching strategies in PISA are rated by students, and it is possible that those who have positive views of what their teachers are doing also tend to have positive attitudes in general. Nevertheless, it seems that there is little to be lost in having teachers act in ways that help reduce mathematics anxiety and increase students' sense of self-efficacy in mathematics and their self-concept. However, teachers should also note that students who enjoy mathematics or feel a sense of belonging at school actually tend to perform worse in mathematics when adjusting for all other factors. This evidence does not mean that enjoying mathematics causes students to perform worse, but that a student who enjoys mathematics more than another will not necessarily perform better if she does not also have other characteristics that tend to go with enjoyment, such as greater confidence in her mathematics ability.

### Time allocations

Since Carroll's groundbreaking 1963 paper, time allocation has become one of the most significant variables in studies of achievement. Although Carroll suggested in his 1989 retrospective that he had not done much more than state the obvious, his model took the analysis of time well beyond the common-sense notions that no learning can take place without spending time and that more time should lead to greater learning. In particular, the distinction between time allocated and time needed, and the relationship of these variables to student aptitude, quality of instruction, opportunity to learn and perseverance have become established elements in the analysis of time and its impact on learning. One can think of this model, therefore, as capturing teaching and learning strategies within a framework in which more effective strategies either decrease time needed or increase time spent (through longer periods of instruction or more out-of-class learning).

For school authorities, the length of the school year and school day are the most salient time variables. States can also regulate other aspects of time, such as time allocations to particular subjects or the length of class periods, although the school often decides these matters. Depending on the degree of centralisation of the system, schools can treat state-level time policies as guidelines or as definitive allocations. Since PISA 2003 did not measure jurisdictional-level variables directly, the information on global time allocations available comes from the school questionnaire and hence reflects variations among schools.

The number of weeks in the school year varies considerably in countries taking part in PISA, with a norm of 36-40 weeks, but only 33 weeks in Ireland, 32 in the partner country Tunisia and 24 in Mexico. These country differences do have a positive correlation with performance, but within countries, the correlation is mostly negative, although weak – probably because of limited within-country variation and the influence of a few outlier schools. A second time measure, the length of the school week, shows greater variation than the school year within some countries, especially in the United States, although in Finland and the partner country Latvia, for example, neither the school week nor the school year vary much. In these countries, therefore, the main correlation with



performance is within countries, although when adjusting for other factors the correlation tends not to be significant. Similar results apply for the quantity of mathematics teaching, even though here country differences are striking: the partner economies Hong Kong-China and Macao-China provide over 4.5 hours of mathematics instruction each week to 15-year-olds, whereas Finland provides only 2.5 hours.

These results suggest that giving more overall time to mathematics instruction does not greatly contribute to better achievement. While this does not negate the value of time spent on mathematics learning, it does suggest that other intervening variables can offset any advantages of longer overall time allocations. This area requires further investigation within some countries, particularly those with very low time allocations and very low achievement.

## STUDENT LEARNING STRATEGIES

### Student use of time

The Carroll model addresses time use at the level of the individual. Total allocated learning time in the school is only one aspect of this model. While this aspect might be a limiting factor on learning, the reality is that students may fail either to use all of the instructional time available or may find ways to extend this time. PISA does not investigate lost time in any comprehensive way (although the issue is touched on when looking at classroom climate, where students are asked, for example, whether at least five minutes at the start of lessons are spent doing nothing). However, PISA does measure additional time spent on learning using questions on exposure to tutoring and other out-of-class instruction and on time spent on homework.

The proportion of students tutored in mathematics is in the 10% to 20% range for most countries. It is less than 10% in several high-achieving countries such as Belgium, Finland and Japan, but exceeds 30% in some low-achieving countries, particularly Greece, Mexico and Turkey. Patterns of out-of-class lessons are similar. However, in both cases it is difficult to find positive effects on learning – although the literature suggests these positive effects do exist (Cohen, Kulik and Kulik, 1982; Hattie, 1992) – because those who receive such extra support may be more likely to be less able students. Indeed, there is generally a strong negative correlation between participation in such activities and achievement in mathematics. The prevalence of tutoring and extra lessons in some low-achieving countries suggests that extra efforts are being made by many students and by their parents (who must pay for such services) to overcome low achievement. However, these efforts are clearly not yielding sufficient payoff to raise achievement levels significantly for the country as a whole. The obvious policy implication is that countries cannot rely on services provided outside the school setting to overcome those characteristics of their school systems or of their societies that are contributing to low achievement. Taking this argument a step further, it is possible that the value of extra-school instruction is being oversold by a large and growing industry.

Several other related issues follow from these results. It is particularly important to investigate whether students from more affluent families are taking tutoring and out-of-class lessons. The results indicate that there is a small positive relationship between socio-economic background and these activities. It is not clear if the high prevalence of these activities in some countries is related to the cost of such services, to such factors as the availability of qualified but unemployed personnel and to whether regular teachers engage in such activities after school hours, perhaps to supplement

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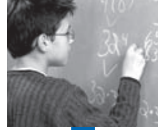




low salaries. It is also unclear whether the high proportions recorded in some countries simply represent over-reporting. These points warrant detailed investigation in the light of the mixed results on whether the impact of extra learning on individual students is positive, especially in countries with low average achievement and where these activities are prevalent.

The second major area of student use of time measured in PISA is homework. There is substantial support in the literature for the value of homework as a contributor to achievement (Paschal, Weinstein and Walberg, 1984; Hattie, 1992; Cooper, Robinson and Patall, 2006) when the homework assignment reinforces the material that has been learnt, rather than being given in place of instruction. However, a report by Mullis *et al.* (2000), based on the IEA Third International Mathematics and Science Study (TIMSS), found that homework time was a negative predictor of mathematics and science achievement.

The PISA student questionnaire contains items on hours per week spent on all homework and on mathematics homework. As with tutoring and extra classes, the assignment of homework occurs more in countries with lower overall achievement. However, in the case of homework, unlike with tutoring, the evidence suggests an overall beneficial effect within countries. Even adjusting for other variables, total homework time shows significant positive effects on achievement for almost all countries, although the effects for mathematics homework are mainly significantly negative. A key finding that helps explain the latter result is that the small proportion of students reporting no mathematics homework tend to have higher achievement than those reporting some mathematics homework. This evidence indicates that some students can learn mathematics effectively through their within-school work and thus have no need for homework.

All of this presents a complex picture for the effect of homework. Negative country-level correlations and the inordinate amount of time spent by students in some low-achieving countries on homework suggest that homework is being used to compensate, but not very effectively, for the limitations of schooling or to substitute for instruction by teachers. It also seems likely that in many high-achieving countries, and for high-achieving students in all countries, the current approach to teaching mathematics in school is sufficient to allow students to function well without much homework. However, it is clear that within each country, higher-achieving students do more total homework than other students.

The policy implications of these results are not straightforward. A general argument can be made, based on these results and on the literature, that schools and school systems should encourage homework. However, further investigation is required to determine if homework is being used to offset problems occurring within schools and on the effectiveness of homework for low-achieving students. More specifically, it would be useful to know what particular forms of homework students are doing and whether teachers primarily assign homework as specific tasks or as a general requirement to practise certain topics.

### Meta-cognitive strategies

Meta-cognitive strategies are generic approaches that students use in addressing a learning task. There is support in the literature for the hypothesis that student use of meta-cognitive strategies contributes to achievement. Indeed, this is one of the proximal areas considered by Wang, Haertel and Walberg (1994) as having the greatest influence on achievement.



The three index variables used in PISA are memorisation/rehearsal, elaboration strategies and control strategies. Memorisation involves activities such as going through examples repeatedly and trying to remember all of the steps in a procedure. Elaboration is associated with activities such as thinking of new ways to solve a problem and relating the problem to existing knowledge. Control strategies involve trying to discern what are the important parts of a problem and working out what needs to be learnt. Although memorisation has been widely investigated by psychologists, today they generally regard it as a low-level strategy, associated with a behaviourist approach to learning, and hence it is often discouraged as a general strategy for school learning. Elaboration is a more comprehensive strategy, consistent with the more constructivist view of learning now prevalent, especially in teacher education programmes. Control strategies seem to relate to efficiency in learning, though it is more difficult to situate such strategies within any particular psychological framework.

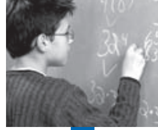
Consistent with expectations, memorisation strategies tend to be less frequently used than either elaboration or control strategies. They tend to be used more by students in relatively low-performing countries: students in Mexico, Brazil, Thailand and Tunisia say that they use memorisation the most, which produces a very high negative correlation between countries' use of memorisation and their performance in PISA. The within-country correlations with achievement are mostly close to zero, but with a few significant positive and negative values.

It must therefore be concluded that memorisation is an ineffective strategy. This finding has important implications for policy and practice in some of the lowest-achieving countries, where students rely extensively on memorisation. It is clear that teachers need to find ways to enable students to reduce their reliance on memory. One possible approach is to teach generic strategies for attacking mathematics problems: to teach methods, not a memorisable body of information.

The report suggests that the *index of elaboration strategies* can be an indicator of whether students use such generic strategies, though not of whether students have learned these methods from teachers directly. While students use elaboration strategies more often than memorisation strategies in most countries, the patterns of relationship with achievement are similar. On the standard scale, students in Mexico and Turkey, and the partner countries Brazil, Serbia, Thailand and Tunisia, show the highest positive levels of use of elaboration strategies, while those in Japan and Korea show the highest negative levels. Within-country correlations are mostly small but the between-country correlation is strongly negative. This evidence suggests that those countries using memorisation are not doing so at the cost of elaboration, but it is also possible that cultural bias affects responses to these questions, and in particular that students in some countries are generally more inclined to agree with statements of this type, whatever their actual learning habits.

This tendency would seem to be confirmed by students' self-reports on use of control strategies: students in Mexico and the partner countries Tunisia and Brazil, along with those in Austria and the partner country Serbia, were the most likely to say they controlled their learning. Control strategies differ from the other two meta-cognitive strategies in that, in some countries, there is a correlation between adopting such strategies and performance even after adjusting for other factors. However, this applies to only one-half of these countries, and the correlation is negative as often as positive.

One possible explanation for the limited degree to which control strategies have unique effects on performance after accounting for other factors is that one of the variables controlled for is self-efficacy in mathematics. The hypothesis here is that students with higher levels of self-efficacy are





more likely to use elaboration and control strategies and that these act jointly to influence achievement. In fact, all three meta-cognitive strategies are found to correlate positively with self-efficacy, and the impact of adjusting for self-efficacy is to change bivariate positive effects for all three meta-cognitive strategies into negative effects in the joint model. If, as seems plausible, adopting an effective learning strategy results in both greater confidence in mathematical efficacy and higher mathematical achievement, by adjusting for self-efficacy the possible benefits of such strategies may be masked. This issue could be investigated by treating self-efficacy as the outcome variable, adjusting for achievement, and comparing the modelled effects of the meta-cognitive variables on that outcome with those for achievement.

It is difficult to know how to interpret these results. They are clearly inconsistent with the literature as they show only small and inconsistent bivariate effects and mainly negative effects on achievement when other variables are controlled. In fact, these three variables are highly intercorrelated, suggesting that the concept of meta-cognitive strategies has only one dimension. However, if this is so, it could be argued that a specific strategy adopted on its own will not make a significant difference to achievement.

These variables are clearly more complex than expected, both from an international perspective and when examined in the presence of other factors. In particular, the between-country correlations again suggest a generalised response bias under which students in high-achieving countries report low level of use of such strategies and those in many low-achieving countries hold what may be an overly optimistic view of how much they elaborate and control their learning.

Educators who intuitively perceive the usefulness of these learning strategies would like a clear statement for policy makers and practitioners which says that encouraging, or perhaps even explicitly teaching, the use of meta-cognitive strategies will enhance student achievement. However, the results of this study do not unequivocally support such a statement, particularly as student perceptions of use of these strategies are measured here, rather than actual approaches to teaching.

### Co-operative and competitive learning situations

A substantial literature exists on co-operative learning in classrooms (see, for example, Slavin, 1994; Johnson and Johnson, 1989). Entire programmes operate that are built around the notion that working in co-operative groups can enhance student achievement and social skills. On the one hand, there has been little in-depth investigation into the alternative approach of engendering competitive learning environments and, indeed, this type of investigation seems inconsistent with the ethos of many school systems. On the other hand, at levels beyond those in which universal participation is expected (the tertiary level in some countries but the secondary level in others), competition for places can be extreme.

The PISA *index of co-operative learning strategies* and the PISA *index of competitive learning strategies* derive from student responses to items on whether they prefer working with others or helping others or whether they want to be the best or do better than others. Overall, a majority of students in most countries tend to agree with statements reflecting both of these strategies, suggesting that they may not be opposites on a single continuum. Indeed, these indices correlate positively with each other in most countries. Students in Japan show much less enthusiasm for either strategy than elsewhere

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in the OECD, while students in Turkey and in the partner countries Brazil and Tunisia are strongly positive on both.

Students who engage in competitive learning tend in many countries to be among the higher achievers, but this effect mainly disappears once one accounts for other characteristics of these students. Co-operative learning does not correlate with achievement at either level. This finding suggests that while achievement can predict student learning styles to some extent (high achievers may compete more, because they also have other characteristics such as confidence in their abilities), there is no evidence to indicate that a particular learning style is more effective. In interpreting these limited findings about competition and co-operation, it is important to note that what are being measured are student preferences for these strategies and not classroom organisation or instruction in reference to them. Moreover, the tendency for students to express enthusiasm for these strategies in some countries with low average achievement, where students also tend to be enthusiastic about other learning strategies, suggests a cultural bias that makes it hard to draw firm conclusions.

## TEACHING STRATEGIES

### Disciplinary climate

Across countries, disciplinary climate is the teaching and learning factor with the strongest correlation with performance and this correlation remains positive and significant in most countries even after adjusting for other factors.

Disciplinary climate refers to the creation of a classroom atmosphere that is conducive to learning. More specifically, it refers to a classroom that is efficient, free of disruptions and in which on-task behaviour is maximised. Despite the common-sense significance of disciplinary climate and its public visibility as an issue in schooling, it has not been widely investigated in studies of teaching. However, studies of time on task (Denham and Lieberman, 1980), classroom distractions (Behnke *et. al.,* 1981) and teacher control (Crocker and Brooker, 1986) do address elements of disciplinary climate. Effective classroom management is one of the factors identified in a recent review of Marzano's (2003) review "What Works in Schools."

The PISA *index of disciplinary climate* consists of items in which students are asked to report the frequency with which negative behaviours occur in their mathematics classrooms. Examples include: students not listening to the teacher, noise and disorder in the classroom, waiting for a long time for lessons to start or for students to quieten down, and student inability to work well in the classroom.

The proportion of students indicating that these things occur in most or all lessons tend to be in the 20% to 40% range. The most positive disciplinary climates are in Japan and the partner country the Russian Federation, and the most negative in the partner country Brazil, but overall the average scores on this variable do not differ greatly across countries.

By contrast, within-country differences in disciplinary climate are a key issue. One of the most important findings in this study is that not only is disciplinary climate the teaching and learning factor with the closest link to performance, but it is also one in which differences across schools are particularly high. (Although reported by students, this factor is aggregated to the school level). Moreover, the correlation between disciplinary climate and achievement is much higher at the

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school than at the student level. These results show that if school systems are to provide equal learning opportunities to all of their students, it is very important to improve the disciplinary climate in those schools where it is poor.

### Teacher support and student-teacher relations

The *index of teacher support* derives from items concerning whether the teacher shows an interest in student work, helps students with their learning and allows students to express opinions. A majority of students in most countries are of the view that their teachers act in these ways. However, there is more variation across countries in this factor than in disciplinary climate. The highest average levels of teacher support occur in Mexico and Turkey and in the partner countries Thailand and Brazil, while the lowest levels occur in Austria, Japan, Luxembourg and Germany. Teacher support mainly correlates negatively with achievement within countries and most of the model effects are negative, suggesting that support is intentionally targeted towards weaker students.

Although considered in PISA to be an aspect of school climate rather than of teaching strategies, the *index of student-teacher relations* consists of items that closely resemble those for teacher support, concerning how well students get along with teachers, whether teachers listen to students and whether teachers treat students fairly.

The response patterns are similar for these two variables. Most of the within-country correlations are either significantly negative or close to zero. However, the model effects are more mixed. Several western European countries show positive effects for student-teacher relations while several eastern European countries, along with Mexico and the partner countries Thailand and Tunisia, show negative effects.

Teacher support and student-teacher relations may be thought of as affective counterparts to the management emphasis reflected in disciplinary climate. Soar and Soar (1979) are among the few researchers to have examined emotional climate in the classroom in relation to achievement. Their research reports a non-linear relationship, with negative emotional climate (*e.g.* criticism, student resistance) yielding negative results but positive emotional climate not yielding the expected positive effect on student achievement. It is possible to infer from the Soar and Soar studies that an emotional climate that is free of the most negative features, combined with strong teacher management behaviours (*e.g.* setting limits on student movement and disruption), yields the highest achievement levels.

The results for these teaching strategy variables are consistent with the literature and have direct implications for teaching practice. Teachers who create classroom conditions that are free of disruptions and lost time can expect better student performance than those who do not. Teachers who exhibit high levels of warmth or positive affect towards students are not likely to have higher-achieving students than those teachers showing less positive feelings towards their students. School administrators need to identify classrooms with frequent negative behaviours and take steps to improve the management skills of teachers in these classrooms. Identifying whole schools with such problems and helping them to address them are tasks for higher-level education authorities.

All of this analysis provides specific directions for change in what might be an important component of a school improvement plan. However, the results need to be differentiated further to determine



if the observed effects are universal or are applicable to schools that are not average in terms of student ability, socio-economic background or other characteristics. It is also important to note that most of the studies of discipline and affect occur at lower grade-levels than those in PISA. The consistency in general pattern suggests common aspects of good teaching and not grade-specific effects.

## WHAT DOES THE EVIDENCE SAY?

Table 4.1 gives a summary of the range and variation of values of the main teaching and learning variables studied here, their univariate and multivariate effects and the interpretations and policy implications that one can drawn from the results.

The results clearly show wide variations among countries in the average values of the variables of interest and in the diversity among schools of values of these variables. There seems to be some evidence of clustering of countries with similar cultural features or with similar school systems. For example, a few countries show consistent patterns of high diversity across schools, suggesting a highly decentralised school system. However, the degree of diversity across schools does not seem to be clearly linked to mathematics achievement. In some cases, the results indicate interesting teaching and learning patterns, such as the relatively high homework levels in some low-achieving countries, which appear to conflict with the overall average effects for these variables across all the countries studied. In other cases, such as the high level of memorisation found in some low-achieving countries, the between-country differences are consistent with the overall achievement effects for these variables. In general, the absolute values of the variables across countries appear to be of less importance than their relative values within countries.

The analysis does not provide a clearly defined picture of a set of teaching and learning conditions associated with strong student performance. In many cases, the model shows weak, non-significant or negative associations between individual factors and performance in mathematics, once all other factors are controlled for. This finding does not mean that teaching and learning factors are irrelevant, or that success is entirely determined by other factors such as a student's background or self-confidence: it may simply be that the separate effects of teaching and learning factors are difficult to measure. Nevertheless, the results do seem to indicate that a combination of conditions is associated with effective teaching and learning, not a single factor alone.

There is one factor that seems to have a universally strong association with performance when adjusting for other factors: disciplinary climate, especially at the school level. Students who experience disorderly classrooms are less likely to perform well, whatever their other characteristics. This finding seems to indicate that having an orderly place to learn is an important prerequisite without which teaching and learning cannot thrive. Beyond this condition, factors such as good relations with teachers, the adoption of effective learning strategies and homework assignments contribute collectively to a student's chances of success, but no individual practice can be said to make a decisive difference.

Figure 3.2 illustrates vividly that these and other factors play a part in explaining differences between the performance of different students and schools. At the school level, three-quarters of school variance can be attributed to the particular combination of the background factors and teaching and learning factors presented in this report. In this context, the analysis of school differences discussed in Chapter 2 is useful. In particular, some countries tend to show relatively wide

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differences among schools on a range of variables, and this will have a cumulative effect on students' chances. These differences seem to be particularly large with respect to school climate and student-teacher relations, indicating that it is not just instructional strategies but the learning environment that countries need to look at when pursuing equal educational opportunities.

Moreover, even though there are a few teaching and learning variables with a consistent effect across countries, some of those noted above may be context-specific. For example, while positive disciplinary climate seems to be related to higher achievement in all countries, positive student-teacher relations have a positive effect on achievement in some countries and a negative effect in others. It is not possible, in a broad study such as this, to investigate the specific cultural characteristics of countries, features of national education systems or the extent to which interpretations of items vary in different languages or cultural contexts. Individual countries may wish to pursue longitudinal studies to delve into issues such as homework time, or observation studies to deepen understanding of issues such as classroom climate.

### Final thoughts

The recent publication of first results from the Teaching and Learning International Survey (TALIS) (OECD, 2009) sheds new light on many of the teaching and learning strategies reported here. Using many of the same constructs as found in PISA, the TALIS study addresses a major gap in the PISA studies by using a teacher questionnaire to record teaching strategies as well as teacher beliefs and attitudes. TALIS categorises teacher beliefs under two main theoretical viewpoints, referred to as direct transmission and constructivist. The contrast between these viewpoints is the basis for much of the literature on teaching and teacher education. Many of the teaching strategy indices used in both PISA and TALIS may be associated, to a greater or lesser degree, with one or other of these positions.

While TALIS investigates the links between specific teaching strategies and these broader constructs, it does not include measures of student achievement, so cannot address the key question of which of these constructs is most conducive to learning or the circumstances under which one or the other may be more effective. This exercise could be done in future PISA studies, either by including a TALIS-like teacher questionnaire or by linking existing PISA variables to transmissive or constructivist orientations at the school level. The examination of these orientations would be a particularly interesting approach to adopt for PISA 2012, when mathematics will again be the main focus of research. Most contemporary approaches to mathematics curriculum and instruction emphasise the importance of problem-solving, which is widely believed to be better taught from a constructivist than from a transmissive perspective.

Table 4.1
**Summary of teaching and learning effects and policy implications**

| Variable | Range across countries | Variation across schools within countries | Relationship with mathematics outcome[5] | Interpretation | Implications for further research |
|---|---|---|---|---|---|
| **Total homework time**[1] | Highest in Italy, Hungary and the Slovak Republic, and in the partner countries the Russian Federation and Latvia<br><br>Lowest in Korea, Finland, the Czech Republic, Japan and Sweden | Widest variation in Italy, Hungary, Greece and the partner countries the Russian Federation and Thailand<br><br>Least variation in Finland, Sweden, Denmark and Luxembourg | Univariate: positive for 25 countries, negative for 4, non-significant for 10<br><br>Multivariate: positive for 29 countries, non-significant for 10 | Consistent with literature on overall positive effects of homework.<br><br>Wide variations in means across countries. Low-performing countries have some of the largest homework times and some of the highest-performing countries have little homework. This suggests that effect is relative rather than absolute and that homework interacts with other aspects of school work. | Large absolute homework hours in some countries may not yield large absolute effects on achievement.<br><br>The exceptionally large amounts of homework combined with low achievement suggests that the measurement of total homework may need to be revised to ensure cultural and response biases are avoided. . |
| **Mathematics homework time**[1] | Highest in Poland, Italy and in the partner economies the Russian Federation, Macao-China, Thailand and Latvia<br><br>Lowest in Sweden, Finland, the Czech Republic, Liechtenstein and New Zealand | Widest variation in Italy, Japan and in the partner countries Thailand, Macao-China and Hong Kong-China<br><br>Least variation in Luxembourg, Liechtenstein, Finland, Sweden, Norway and Portugal | Univariate: positive for 10 countries, negative for 19, non-significant for 10<br><br>Multivariate: negative for 25 countries, non-significant for 14 | These results probably reflect the non-independence of total and mathematics homework. Once total homework is controlled for there is little additional contribution made by mathematics homework.<br>It is also possible that extra mathematics homework is assigned more often for those students that need it most, as a remedial strategy. | Since mathematics homework is included in the total, mathematics homework is desirable as part of a total homework assignment. |
| **Tutoring**[2] | Relatively few students: <10% in most countries, but 90% in Mexico, 43% in Turkey, 29 % in Greece and 26% in Portugal. Fewer students tutored in mathematics than overall, except in Mexico where the percentage remains at 90%. | Not reported because of small numbers being tutored | Univariate: negative for 34 countries, non-significant for 3<br><br>Multivariate: negative for 35 countries, non-significant for 3 | The effect of tutoring on individuals could not be measured in PISA. The overall negative effect may be due to the fact that students being tutored are likely to be the lowest-achieving students and that tutoring is insufficient to change this. Results for some countries are probably a function of positive response bias. | Studies specific to tutoring are required to separate individual from overall population effects. If possible, identifying issues related to who selects to undertake tutoring and the reasons for doing this may help in disentangling the relationship between tutoring and performance. |

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Table 4.1

**Summary of teaching and learning effects and policy implications** *(continued)*

| Variable | Range across countries | Variation across schools within countries | Relationship with mathematics outcome[5] | Interpretation | Implications for further research |
|---|---|---|---|---|---|
| **Out-of-school classes**[2] | All results and interpretations are similar to those for tutoring. There is a high correlation between these two variables, suggesting either that both phenomena are closely related, students are giving socially acceptable responses or that the two variables are viewed as having the same meaning. | | | | |
| **Memorisation/ rehearsal strategies** | Highest use (>0.40)[3] in Mexico and in the partner countries Brazil, Thailand and Tunisia<br><br>Lowest use (<-20) in Japan, Korea and Denmark | Widest variation (>0.40)[4] in Liechtenstein, Germany, Austria, Switzerland, Mexico and Indonesia<br><br>Least variation (<0.25) in Luxembourg, Japan, and the partner economies Thailand, Latvia, Greece and Macao-China | Univariate: positive for 17 countries, negative for 13, non-significant for 8<br><br>Multivariate: negative for 26 countries, non-significant for 12 | Taking account of other factors, use of memorisation generally shows a negative effect on achievement. This is consistent with literature indicating that memorisation is not an effective strategy for learning mathematics. The change in the direction of the relationship when accounting for other factors suggests this strategy is mostly utilised by certain groups of students who share an observable characteristic. | The use of memorisation may be discuraged, especially in countries showing extensive use of this strategy. Further research could focus on who uses this strategy and why. |
| **Elaboration strategies** | Highest use (>0.50)[3] in Mexico and in the partner countries Tunisia, Brazil, Thailand and Indonesia<br><br>Lowest use (<-0.25) in Japan, Korea, Germany, the Netherlands and Austria | Widest variation (>0.45)[4] in Austria, Germany, Italy and in the partner country Liechtenstein<br><br>Least variation (<0.25) in Portugal, Finland and the partner economies Latvia, Macao-China, Indonesia and Thailand | Univariate: positive for 26 countries, negative for one<br><br>Multivariate: negative for 22 countries, non– significant for 13 | The reversal of effects from univariate to multivariate suggests strong mediation of this effect by other variables. Here again, given that observed student characteristics contribute significantly to this change, it is possible to try to understand better who these students are. | Understanding who relies on elaboration strategies may help identify ways of making these strategies more effective. It is also possible that this analysis reveals ways of measuring and approaching metacognitive strategies in a a more policy relevant manner. |

Table 4.1
**Summary of teaching and learning effects and policy implications** *(continued)*

| Variable | Range across countries | Variation across schools within countries | Relationship with mathematics outcome[5] | Interpretation | Implications for further research |
|---|---|---|---|---|---|
| **Control strategies** | Highest use (>0.40)[3] in Austria, Mexico and in the partner countries Tunisia, Brazil and Serbia<br><br>Lowest use (<-0.40) in Japan, Finland, Korea and Sweden | Widest variation (>0.40)[4] in Korea, Belgium, Canada, Germany, Mexico and Turkey<br><br>Least variation (<0.25) in Latvia, Finland, Hungary, Luxembourg and Thailand | Univariate: positive for 21 countries, negative for 9, non-significant for 8<br><br>Multivariate: non-significant for 21 countries, positive for 8 and negative for 9 | Substantial decrease in effect sizes in the multivariate analysis suggests mediation by other variables.<br><br>All three student learning strategies are highly correlated, indicating that they may have more of a unitary effect than theoretically indicated or that a response bias may exist. | Measuring metacognitive strategies has proven to be quite a challenging task for a project like PISA. A cross sectional international perspective add value as a description of practices most commonly used but it is more limited in identifying the effectiveness of these strategies for enhancing student performance. |
| **Preference for competitive learning** | Highest use (>0.40)[3] in Mexico, Turkey, the United States and in the partner countries Tunisia and Indonesia<br><br>Lowest use (< -0.35) in Hungary, the Netherlands, Japan and Switzerland | Widest variation (>0.50)[4] in Austria, Korea, Liechtenstein and Italy<br><br>Least variation (<0.25) in the partner ecomomies Macao-China, Greece and Latvia | Univariate: positive for 29 countries, non-significant for all others.<br><br>Multivariate: mostly non-significant | Suppressive effects are evident in the shift from mostly positive univariate to multivariate non-significance. Self-efficacy in mathematics appears to be the main suppressor variable. | The evidence is quite mixed and more research is required to determine the interaction between competitive preference, self-efficacy and achievement. |
| **Preference for co-operative learning** | Highest use (>0.30)[3] in the partner countries Brazil, Tunisia and Uruguay<br><br>Lowest use (<-0.20) in Korea, Japan, Iceland and Sweden | Widest variation (>0.40)[4] in Austria, Mexico, Korea, the United States and the partner country Serbia<br><br>Least variation (<0.25) in Hungary, Australia, Finland, Greece, Liechtenstein and in the partner country Thailand | Univariate: positive for 9 countries, negative for 16, non-significant for 13<br><br>Multivariate: mostly non-significant; positive for 4 countries and negative for 7 | Mixed univariate results suggest that effect may be related to characteristics of school systems in different countries. Other factors appear to mediate the relationship of this variable on performance. | Results do not suggest that encouraging a co-operative learning environment will positively influence achievement. The definition of co-operative learning in PISA differs from that used in much of the literature on forming co-operative groups in the classroom. Improvements in the analysis and the measurement of these concepts are needed to produce further solid policy advice. |


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Table 4.1
**Summary of teaching and learning effects and policy implications** *(continued)*

| Variable | Range across countries | Variation across schools within countries | Relationship with mathematics outcome[5] | Interpretation | Implications for further research |
|---|---|---|---|---|---|
| **Disciplinary climate** | Highest (>0.30)[3] in Japan, Germany and in the partner countries Latvia and the Russian Federation<br><br>Lowest (<-0.20) in Norway, Greece, Luxembourg and the partner country Brazil | Widest variation (>0.60)[4] in Japan, Liechtenstein, Austria, the Czech Republic and Hungary<br><br>Least variation (<0.40) in Luxembourg, New Zealand and the partner countries Indonesia, Brazil and Thailand | Univariate: positive for all but two countries<br><br>Multivariate: positive for all but six countries. Effect sizes are widely variable. | Disciplinary climate is defined mainly in terms of absence of disruptions and lost time. This variable shows one of the most consistently positive effects across countries. While the univariate effects are attenuated somewhat in the presence of other variables, they remain positive throughout. | Improving the disciplinary climate is within the control of schools and teachers and policies should be directed towards reducing disruption and lost time in classrooms. Case studies may provide insights as to what policies and practices are most likely to improve disciplinary climate within specific contexts. |
| **School average disciplinary climate** | Highest (>0.30)[3] in Japan, Germany and the partner countries the Russian Federation and Latvia<br><br>Lowest (<-0.20) in Greece, Norway, Luxembourg and the partner country Brazil | Variation across schools is not meaningful for data that are based on school averages within countries. | Univariate: universally positive and generally much larger than for the individual-level variable<br><br>Multivariate: attenuated but remain positive for all but five countries | School average disciplinary climate is obviously a composite of the individually reported values. Nevertheless, it exerts a strong positive effect in addition to the individual effects. | The existence of an independent school-level effect indicates that policies to improve disciplinary climate can be implemented at the school level as well as directed towards individual students. |





Table 4.1

**Summary of teaching and learning effects and policy implications** *(continued)*

| Variable | Range across countries | Variation across schools within countries | Relationship with mathematics outcome[5] | Interpretation | Implications for further research |
|---|---|---|---|---|---|
| **Student-teacher relations** | Highest (>0.50)[3] in Indonesia, Brazil, Thailand and Mexico<br><br>Lowest (<-0.25) in Japan, Luxembourg, Italy, Poland and the Slovak Republic | Widest variation (>0.50)[4] in Austria, Switzerland and in the partner countries Tunisia, Liechtenstein, Serbia and Brazil<br><br>Least variation (<0.35) in New Zealand, Portugal and in the partner country Thailand | Univariate: positive for 13 countries, negative for 12 and non-significant for 16<br><br>Multivariate: positive for 8 countries, negative for 14 and non-significant for 18 | This variable is represented by items such as teachers getting along with students, showing interest in them and treating them fairly. These behaviours seem to have little effect on mathematics achievement. | Student-teacher relations refer to complex processes that are hard to capture in a consistent manner through an international survey such as PISA. Problems of cultural and response bias need to be taken into account when building instruments to measure these constructs. |
| **Teacher support** | Highest (>0.40)[3] in Mexico, Turkey and the partner countries Thailand and Brazil<br><br>Lowest (<-0.25) in Austria, Japan, Luxembourg, Germany and the Netherlands | Widest variation (>0.50)[4] in Austria, Italy, the Slovak Republic and Serbia<br><br>Least variation (<0.20) in Korea and the Netherlands | Univariate: positive for 13 countries, negative for 7 and non-significant for 17<br><br>Multivariate: negative for 26 countries, positive for only one. Mostly small effects. | This variable is similar to teacher-student relations, with a little more emphasis on teachers helping their students, and shows similar effects. A possible interpretation for the negative effects in the multivariate is those teachers focus their support on those students who need it most. | Given the cross-sectional nature of PISA, these measures are most useful as descriptions of the perceptions of students with respect to their teachers. The caveats mentioned above also apply here. |

*Notes:* 1. Unit: hours per week
2. Unit: percentage of students reporting non-zero time per week
3. Unit: standard deviations from the mean
4. Unit: interquartile range (25th-75th percentile)
5. Unit: number of points change in mathematics score for one standard deviation change in teaching/learning strategy variable



# References

**Aitken, L.R.** (1974), "Two Scales of Attitude Toward Mathematics", *Journal for Research in Mathematics Education, Vol.* 5, pp. 67-71.

**Bandura, A.** (1993), "Perceived Self-Efficacy in Cognitive Development and Functioning", *Educational Psychologist,* Vol. 28, No. 2, pp. 117-148.

**Baumert, J.** and **O. Koeller** (1998), "Interest Research in Secondary Level I: An Overview", in L. Hoffmann, A. Krapp, K.A. Renninger and J. Baumert (eds.), *Interest and Learning,* IPN, Kiel.

**Behnke, G. *et al*.** (1981), "Coping with Classroom Distractions", *The Elementary School Journal*, Vol. 81, No. 3, pp. 135-155.

**Bloom. B. S.** (1976), *Human Characteristics and School Learning*, McGraw-Hill, New York.

**Branden, N.** (1994), *Six Pillars of Self-Esteem,* Bantam Books, New York.

**Cohen, P.A., J.A. Kulik** and **C.C. Kulik** (1982), "Educational Outcomes of Tutoring: A Meta-Analysis of Findings", *American Educational Research Journal*, Vol. 19, No. 2, pp. 237-248.

**Cooper, H., J.C. Robinson** and **E.A. Patall** (2006), "Does Homework Improve Academic Achievement? A Synthesis of Research, 1987-2003", *Review of Educational Research, Vol.* 76, No. 1, pp. 1-62.

**Crocker, R.K.** and **G.M. Brooker** (1986), "Classroom Control and Student Outcomes in Grades 2 and 5", *American Educational Research Journal, Vol.* 23, No. 1, pp. 1-11.

**Denham, C.** and **A. Lieberman** (eds.) (1980), *Time to Learn,* California Commission for Teacher Preparation and Licensing, Sacramento.

**Hattie, J.** (1992), "Measuring the Effects of Schooling", *Australian Journal of Education,* Vol. 36, No. 1, pp. 5-13.

**Johnson, D.** and **R. Johnson** (1989), *Cooperation and Competition: Theory and Research,* Interaction Book Company, Edina, MN.

**Lepper, M.R.** (1988), "Motivational Considerations in the Study of Instruction", *Cognition and Instruction, Vol.* 5, No. 4, pp. 289-309.

**Marzano, R.** (2003), *What Works in Schools: Translating Research into Action,* Association for Supervision and Curriculum Development, Washington.

**Moulton, K.D., S.D. Brown** and **R.W. Lent** (1991), "Relation of Self-Efficacy Beliefs to Academic Outcomes: A Meta-Analytic Investigation", *Journal of Counselling Psychology*, Vol. 38, pp. 30-38.

**Mullis, I.V.S., M.O. Martin, E.J. Gonzalez, K.D. Gregory, R.A. Garden, K.M. O'Connor, T.A. Chrostowski** and **T.A. Smith** (2000), *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade,* International Study Center, Boston, MA.

**OECD** (2009), *Creating Effective Teaching and Learning Environments: First Results from TALIS*, OECD, Paris.

**Paschal, R.A., T. Weinstein** and **H.J. Walberg** (1984), "The Effects of Homework on Learning: A Quantitative Synthesis", *Journal of Educational Research*, Vol. 78, pp. 97-104.

**Slavin, R.** (1994), *Cooperative Learning: Theory, Research and Practice,* Allyn and Bacon, Boston.



**Soar, R.S.** and **R.M. Soar** (1979), "Emotional Climate and Management", in P. Peterson and H Walberg (eds.), *Research on Teaching: Concepts, Findings and Implications,* McCutchan, Berkeley, CA.

**Wang, M.C., G.D. Haertel** and **H.J. Walberg** (1994), "What Helps Students Learn?", *Educational Leadership,* December 1993-January 1994, pp. 74-79.

**Wigfield, A., J.S. Eccles** and **D. Rodriguez** (1998), "The Development of Children's Motivation in School Contexts", *Review of Research in Education,* Vol. 23, pp. 73-118.

**Wiley, D.** and **A. Harneschfeger** (1974), Explosion of a Myth: Quantity of Schooling and Exposure to Instruction. *Educational Researcher*, Vol. 3, No. 4, pp.7-12.

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# Conclusions and Implications for Policy and Practice



## OVERVIEW

Teaching and learning strategies are broad concepts. Teaching strategies refer to a wide range of processes, from the way in which classrooms are organised and resources used to the daily activities engaged in by teachers and students to facilitate learning. Student learning strategies refer to cognitive and meta-cognitive processes employed by students as they attempt to learn something new.

PISA 2003 used a variety of questionnaire items to measure teaching and learning strategies in mathematics. These items were combined and scaled to yield a number of composite or index variables representing broad constructs. Examples of these constructs are disciplinary climate, teacher-student relations, memorisation strategies and time spent on various learning activities. In PISA 2003 these measures were specifically geared towards the learning of mathematics.

Analysing the data collected in PISA 2003 can inform policy makers in individual countries as to how their situation might differ from that of other countries in terms of consistency or variety among schools. It can also provide a broad profile of commonalities and differences in mathematics teaching and learning within an educational system. Merging these variables with the PISA assessment of individual competencies, it is also possible to analyse the relationship between student performance and teaching and learning strategies. While limited by the scope of PISA, its cross-sectional nature and the sheer complexity of the processes involved in teaching and learning strategies, these relationships yield important insights for education policy makers and stakeholders.

The evidence emerging from PISA 2003 shows that systems differ substantially in the kinds of teaching and learning practices most commonly used across schools. Even within the same educational system, there is a large variation in the teaching and learning practices most commonly employed across schools. While PISA shows teaching and learning factors are related to mathematics achievement, the relationships are not consistent and robust across all PISA countries and economies. Significant country differences stand out for many of the variables measuring teaching and learning strategies. Socio-economic background factors are among the most significant factors affecting performance, even after accounting for different teaching and learning strategies.

Two general messages merge from this evidence. First, the effects of teaching and learning strategies are best interpreted within countries or clusters of countries with similar cultural backgrounds or school systems. Second, across all countries the use of teaching and learning strategies does not seem to significantly mitigate the disadvantaged social backgrounds of some students.

With respect to findings on specific teaching and learning strategies, the evidence presented in this report highlights a number of interesting results. In terms of teaching strategies this study shows the importance of disciplinary climate and instruction time. The analysis however does not reveal how to achieve a more effective use of either of these strategies, only that they are associated with higher performance.

In terms of student learning strategies, this study stresses the importance of antecedents over different meta-cognitive strategies. For example, student attitudes such as motivation and confidence are strongly associated with higher performance, while anxiety is associated with lower performance, even after accounting for learning strategies and other factors. It is unclear, however, if these student attitudes lead to higher performance or if it is this high performance that leads to, for example,

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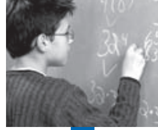



more confidence. For meta-cognitive strategies, while an association between higher performance and student use of control and elaboration strategies is observed, it disappears or turns negative when other factors are taken into account. The analysis does not reveal however how student learning strategies interact with other student factors.

An important conclusion for education policy makers and analysts emerges from this report. For policy makers and stake holders, the value added of the PISA data in this area is highest as a descriptive tool. The data can best be used to better understand which teaching and learning strategies are most common and how much variation exists across schools within a particular system. Moreover, the complexity and the cross country variance apparent in the results suggest that while teaching and learning strategies are an important area of educational policy and research, a cross-sectional international perspective such as offered by PISA is of limited use when trying to understand which teaching and learning strategies lead to higher student performance and which ones do not, particularly for complex processes such as individual student meta-cognitive strategies or student-teacher relations.

## OVERARCHING ISSUES

### The place of socio-economic status

Socio-economic background remains one of the strongest predictors of achievement, even in the presence of widely varying teaching and learning strategies. Ideally, the impact of socio-economic background on achievement would be moderated by the use of appropriate teaching and learning strategies, and many educational policy initiatives are intended to compensate for adverse socio-economic effects. The models used in this study adjust for socio-economic background when examining the effects of teaching and learning strategies. Yet, the results show that the teaching and learning variables examined here do not seem, in practice, to mitigate very much the disadvantaged social backgrounds of some students.

### Student attitudes, motivations and self-concept

As with socio-economic status, students' self-confidence and motivation as learners show consistent correlations with achievement. Since these variables can be considered to be related to teaching and learning strategies as well as to achievement, they are therefore included as antecedents in the models. Nevertheless, unlike socio-economic background, the direction of causation is for these constructs varies. It is possible that attitudes can be influenced by teaching strategies and that attitudes, themselves, influence learning strategies or are affected by achievement. Furthermore, cultural differences are likely to affect students' interpretation of self-confidence and motivation questions. Therefore, results in these areas should be interpreted taking into account the context and culture of each specific country.

PISA 2003 measured self-efficacy, specifically in relation to mathematics, using questionnaire items in which students were asked to judge their competence at solving a variety of mathematics problems, yielding the index of self-efficacy in mathematics. Countries in which students have a greater sense of self-efficacy tend to have better overall performance in mathematics, while within most countries there is a correlation with performance that remains even when adjusting for other factors. The average sense of self-efficacy (set as zero internationally) varies considerably across



countries. In the Slovak Republic students on average have self-efficacy half a standard deviation above average, while those in Japan and Korea, and the partner country Thailand, are the same amount below average. In countries where students have the least confidence in their own efficacy, this variable also makes the least difference to their predicted achievement; the variable is most closely correlated in some countries with above-average self-efficacy overall.

Another variable showing wide differences across countries was anxiety in mathematics. Students in Japan, Korea and Mexico, and their partner countries Brazil, Thailand and Tunisia (a contrasting mix of high- and low-achieving countries), express particularly high levels of anxiety about mathematics. However, in Denmark, Finland, the Netherlands and Sweden (all relatively high-achieving countries), students show particularly low anxiety. Both within and across countries, students who are anxious about learning mathematics tend to perform worse in the subject. Again, there may be lessons here for teachers, especially in countries where anxiety is highest, to make more effort to reduce it. Particularly in Mexico and the partner country Brazil, high anxiety tends to go with low mathematics performance.

### Instructional time

For school authorities, the length of the school year and school day are among the most salient time variables. States can also regulate other aspects of time allocation, such as allocations to particular subjects or the length of class periods, although these matters are often left to the school. Since PISA 2003 did not measure jurisdictional-level variables directly, the available information on global time allocations comes from the school questionnaire and hence reflects variations among schools.

The number of weeks in the school year varies considerably in countries taking part in PISA, with a norm of 36-40 weeks, but only 33 weeks in Ireland, 32 in the partner country Tunisia and 24 in Mexico. These country differences do have a positive correlation with performance, but within countries, the correlation is weak and mostly negative. A second time measure, the length of the school week, shows greater variation within some countries than that of the school year, especially in the United States, although in Finland and the partner country Latvia, for example, neither the school week nor the school year vary much. In these countries, the main correlation with performance is within countries, although when adjusting for other factors the association tends to disappear. Similar results apply to the quantity of mathematics teaching, even though here country differences are striking: the partner countries Hong Kong-China and Macao-China give over 4.5 hours of mathematics instruction each week to 15-year-olds, whereas Finland gives only 2.6 hours.

Yet, across systems there is a strong correlation among total instruction time and mean performance in mathematics. Combining the information from the number of hours per week and the length of the school year in weeks per year, an index of total instruction time is constructed. The total instruction time in the year varies considerably across and within countries. Some of the countries with the highest average performance, such as Korea, have also one of the highest yearly instruction times with an estimate of over 1000 hours per year. Mexico is at the other extreme, with an estimate of less than 600 hours of instruction per year on average. Interestingly Korea achieves a high total instruction time with over 30 hours per week, the most among OECD countries, and less than 36 weeks per year, the OECD average. Mexico has an estimated mean of 24 hours per week, the OECD average, but at below 24 weeks of instruction per year, it also has one of the lowest estimates for the OECD in this measure.

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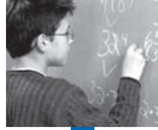




## STUDENT LEARNING STRATEGIES

### Alternative uses of student learning time outside schools

PISA measures student use of time by questions on exposure to tutoring and other out-of-class instruction and by time spent on homework. The proportion of students being tutored in mathematics is in the 10% to 20% range for most countries. It is less than 10% in several high-achieving countries such as Belgium, Finland and Japan, but exceeds 30% in some low-achieving countries, particularly Greece, Mexico and Turkey. Patterns of out-of-class lessons are similar. The prevalence of tutoring and extra lessons in some low-achieving countries suggests that extra efforts are being made by many students and by their parents to overcome low achievement. However, these efforts may not be yielding the expected payoff for individuals or helping to raise the level of achievement significantly for the country as a whole.

The second major area of student use of time measured in PISA is homework. The PISA student questionnaire contains items on hours per week spent on all homework and on mathematics homework. Similar to tutoring and extra classes, homework tends to be used more in countries with lower achievement overall. In the case of homework, the evidence suggests an overall beneficial effect within countries. Even adjusting for other variables, total homework time shows significant positive effects on achievement for almost all countries. Extra mathematics homework appears to be targeted to those that need it most as the within country relationship between extra mathematics homework and performance tends to be negative across systems. The small proportion of students reporting no mathematics homework tends to have higher achievement than those reporting some mathematics homework.

All of this presents a complex picture for the homework effect. Negative country-level correlations and the inordinate amount of time spent by students in some low-achieving countries on homework suggest that extra efforts in terms of mathematics homework used to compensate for limitations of schooling or to substitute for instruction by teachers can only have a limited positive effect. It also seems likely that in many high-achieving countries, and for high-achieving students in all countries, the mathematics teaching provided in school is sufficient to allow students to function well without extra homework. It is clear however that within each country, higher-achieving students are doing more homework overall.

### Meta-cognitive strategies

Meta-cognitive strategies are generic approaches that students use in addressing a learning task. The three index variables that PISA uses for these strategies are memorisation/rehearsal, elaboration strategies and control strategies. Consistent with expectations, memorisation strategies tend to be less frequently used than either elaboration or control strategies. They tend to be used more by students in relatively low-performing countries, with students in Mexico, Brazil, Thailand and Tunisia saying that they use memorisation the most, producing a very high negative correlation between countries' use of memorisation and their performance in PISA. The within-country correlations with achievement are mostly close to zero, but with a few significant positive and negative values.

Students report using elaboration strategies more often than memorisation strategies. In most countries, the patterns of relationship are similar. On the standard scale, students in Mexico and Turkey, and the partner countries Brazil, Serbia, Thailand and Tunisia, show the highest positive levels



of use of this strategy, while those in Japan and Korea show the highest negative levels. Within-country correlations are mostly small but the between-country correlation is strongly negative. This tendency would seem to be confirmed by students' self-reports on control strategies, where again students in Mexico and the partner countries Brazil and Tunisia, along with those in Austria and the partner country Serbia, are the most likely to say they controlled their learning. Control strategies differ from the other two meta-cognitive strategies in that in some countries there is a correlation between the adoption of such strategies and performance, even after adjusting for other factors. However, this result applies to only one-half of these countries, and the correlation is negative as often as positive.

### Co-operative and competitive learning situations

In this report indices of co-operative learning and of competitive learning strategies derive from student responses to PISA items asking whether students prefer working with others or helping others or whether they want to be the best or do better than others. Overall, a majority of students in most countries tend to agree with statements reflecting both of these strategies, suggesting that these strategies may not be opposites on a single continuum. Indeed, these indices correlate positively with each other in most countries. Students in Japan showed much less enthusiasm for either strategy than elsewhere in the OECD, while students in the partner countries Brazil and Tunisia were strongly positive on both. Students who engage in competitive learning tend to be among the higher achievers in many countries, but this effect disappears once other characteristics of these students have been taken into account. Co-operative learning does not correlate with achievement at either level.

## TEACHING STRATEGIES

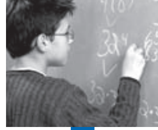
### Disciplinary climate

Across the group of countries studied, disciplinary climate is the teaching and learning factor that has the strongest correlation with performance. This correlation remains positive and significant in most countries even after adjusting for other factors. Japan and the Russian Federation have the most positive disciplinary climate, and Brazil the most negative. Overall the average scores on this variable do not differ greatly across countries.

In contrast, within-country differences in disciplinary climate are a key issue. One of the most important findings of this study is that disciplinary climate is not only the teaching and learning factor with the closest link to performance, but also the one in which differences across schools are particularly high. (Although reported by students individually, this factor was aggregated to the school level.) Moreover, the correlation between disciplinary climate and achievement is much higher at the school than at the student level. These results show that if school systems are to provide equal learning opportunities to all of their students, it is very important to improve the disciplinary climate in those schools where it is poor.

### Teacher support and student-teacher relations

The index of student-teacher relations comprises items that closely resemble those for teacher support, dealing with the extent to which students get along with teachers, whether teachers listen to students and whether teachers treat students fairly. A majority of students in most countries are





of the view that their teachers support them. However, there is more variation across countries in this factor than in disciplinary climate. The highest average levels of teacher support arise in Mexico and Turkey, and the partner countries Brazil and Thailand, while the lowest levels occur in Austria, Germany, Japan and Luxembourg. Teacher support correlates mainly negatively with achievement within countries and most of the model effects are negative, suggesting that support intentionally concentrates on weaker students. Several western European countries show positive effects for student-teacher relations while several eastern European countries, along with Mexico and the partner countries Thailand and Tunisia, show negative effects. One possible explanation for these findings is that in some countries teachers focus on those students who need it most, providing more support to low performing students.

## CONCLUSION

This study shows that there are wide variations across countries in the average values of the PISA variables measuring teaching and learning strategies and in the level of diversity among schools in values of these variables within countries. There is some evidence of clustering of countries with similar cultural features or with similar school systems. For example, a few countries show consistent patterns of high diversity across schools, suggesting a highly decentralised school system. However, these clusters do not seem to be clearly linked to mathematics achievement. In some cases, the patterns indicate unusual teaching and learning patterns, such as the relatively high homework levels in some low-achieving countries, which appear to conflict with the overall results for these variables. In other cases, such as the high level of memorisation in some low-achieving countries, the between-country differences are consistent with the overall achievement effects for these variables. In general, the absolute values of the variables across countries appear to be of less importance than their relative values within countries.

# Annex A

## DESCRIPTIVE STATISTICS

Table A.1
**Instructional weeks per year: mean, standard deviation and percentile distribution among schools**

| | | | | | Schools at the … | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | | Standard deviation | | 5th percentile | | 25th percentile | | 75th percentile | | 95th percentile | |
| | Mean | S.E. | S.D. | S.E. | p5 | S.E. | p25 | S.E. | p75 | S.E. | p95 | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 39.4 | (0.1) | 1.8 | (0.1) | 36.0 | (0.0) | 39.0 | (0.5) | 40.0 | (0.0) | 41.0 | (0.3) |
| Austria | 36.7 | (0.8) | 9.2 | (1.0) | 10.0 | (0.0) | 38.0 | (0.5) | 40.0 | (0.4) | 43.0 | (0.0) |
| Belgium | 36.2 | (0.2) | 3.2 | (0.2) | 30.0 | (0.3) | 36.0 | (0.4) | 38.0 | (0.9) | 40.0 | (0.0) |
| Canada | 38.6 | (0.2) | 3.0 | (0.3) | 35.0 | (1.3) | 38.0 | (1.0) | 40.0 | (0.0) | 41.0 | (0.7) |
| Czech Republic | 41.0 | (0.2) | 2.2 | (0.2) | 37.0 | (0.9) | 40.0 | (0.0) | 43.0 | (0.0) | 44.0 | (0.0) |
| Denmark | 39.6 | (0.1) | 1.5 | (0.3) | 36.0 | (1.3) | 40.0 | (0.0) | 40.0 | (0.0) | 40.0 | (0.0) |
| Finland | 38.1 | (0.0) | 0.5 | (0.1) | 38.0 | (0.0) | 38.0 | (0.0) | 38.0 | (0.0) | 39.0 | (0.9) |
| France | m | m | m | m | m | m | m | m | m | m | m | m |
| Germany | 39.7 | (0.2) | 2.4 | (0.2) | 36.0 | (0.5) | 38.0 | (0.0) | 42.0 | (1.3) | 43.0 | (1.5) |
| Greece | 34.3 | (0.2) | 1.9 | (0.3) | 30.0 | (0.8) | 35.0 | (0.0) | 35.0 | (0.0) | 35.0 | (0.0) |
| Hungary | 36.6 | (0.1) | 1.1 | (0.2) | 35.0 | (1.3) | 36.0 | (0.0) | 37.0 | (0.0) | 37.0 | (0.7) |
| Iceland | 36.7 | (0.0) | 1.0 | (0.0) | 35.0 | (0.0) | 36.0 | (0.0) | 37.0 | (0.0) | 38.0 | (0.0) |
| Ireland | 33.1 | (0.2) | 1.9 | (0.3) | 30.0 | (0.8) | 33.0 | (0.0) | 34.0 | (0.0) | 36.0 | (1.1) |
| Italy | 33.5 | (0.2) | 1.8 | (0.2) | 30.0 | (2.7) | 33.0 | (0.0) | 34.0 | (0.0) | 37.0 | (1.6) |
| Japan | 38.9 | (0.3) | 4.4 | (0.2) | 32.0 | (2.8) | 35.0 | (0.0) | 43.0 | (1.0) | 45.0 | (0.0) |
| Korea | 35.6 | (0.3) | 3.1 | (0.5) | 32.0 | (1.8) | 34.0 | (0.0) | 37.0 | (0.0) | 41.0 | (0.9) |
| Luxembourg | 36.0 | (0.0) | 0.0 | (0.0) | 36.0 | (0.0) | 36.0 | (0.0) | 36.0 | (0.0) | 36.0 | (0.0) |
| Mexico | 23.9 | (0.7) | 8.0 | (0.6) | 17.0 | (1.1) | 20.0 | (1.3) | 23.0 | (1.6) | 42.0 | (1.8) |
| Netherlands | 38.1 | (0.2) | 2.1 | (0.1) | 34.0 | (1.5) | 36.0 | (0.0) | 40.0 | (0.0) | 40.0 | (0.0) |
| New Zealand | 36.0 | (0.1) | 2.0 | (0.1) | 33.0 | (0.5) | 35.0 | (0.2) | 38.0 | (1.4) | 40.0 | (0.0) |
| Norway | 38.0 | (0.0) | 0.0 | (0.0) | 38.0 | (0.0) | 38.0 | (0.0) | 38.0 | (0.0) | 38.0 | (0.0) |
| Poland | 38.3 | (0.2) | 2.2 | (0.2) | 36.0 | (0.7) | 37.0 | (0.0) | 40.0 | (0.5) | 42.0 | (0.0) |
| Portugal | 35.4 | (0.2) | 2.5 | (0.4) | 32.0 | (0.6) | 35.0 | (0.8) | 36.0 | (0.0) | 40.0 | (2.3) |
| Slovak Republic | 39.2 | (0.3) | 4.0 | (0.2) | 33.0 | (0.0) | 36.0 | (1.8) | 43.0 | (0.0) | 44.0 | (0.0) |
| Spain | 35.4 | (0.2) | 2.2 | (0.2) | 32.0 | (0.0) | 35.0 | (1.0) | 36.0 | (1.7) | 39.0 | (1.4) |
| Sweden | 36.6 | (0.1) | 1.7 | (0.2) | 34.0 | (0.9) | 36.0 | (0.0) | 37.0 | (1.0) | 40.0 | (0.0) |
| Switzerland | 39.2 | (0.1) | 1.3 | (0.2) | 37.0 | (0.0) | 39.0 | (0.0) | 40.0 | (0.0) | 40.0 | (0.0) |
| Turkey | 35.7 | (0.3) | 3.5 | (0.6) | 28.0 | (5.8) | 36.0 | (0.4) | 37.0 | (0.0) | 39.0 | (1.3) |
| United States | 36.0 | (0.0) | 0.7 | (0.1) | 35.0 | (0.0) | 36.0 | (0.0) | 36.0 | (0.0) | 37.0 | (0.0) |
| ***OECD average*** | *36.7* | *(0.0)* | *2.4* | *(0.1)* | *32.5* | *(0.3)* | *35.9* | *(0.1)* | *37.8* | *(0.1)* | *39.9* | *(0.2)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 40.6 | (0.2) | 2.1 | (0.3) | 39.0 | (1.4) | 40.0 | (0.0) | 41.0 | (0.8) | 45.0 | (0.4) |
| Hong Kong-China | 35.4 | (0.4) | 4.9 | (0.2) | 28.0 | (1.0) | 31.0 | (1.3) | 40.0 | (0.0) | 42.0 | (0.2) |
| Indonesia | 40.0 | (0.4) | 5.0 | (0.4) | 33.0 | (1.4) | 37.0 | (1.0) | 43.0 | (0.9) | 48.0 | (0.8) |
| Latvia | 34.9 | (0.1) | 0.8 | (0.1) | 34.0 | (0.9) | 35.0 | (0.0) | 35.0 | (0.0) | 36.0 | (0.2) |
| Liechtenstein | 39.0 | (0.0) | 0.8 | (0.0) | 38.0 | (0.0) | 38.0 | (0.0) | 40.0 | (0.0) | 40.0 | (0.0) |
| Macao-China | 39.2 | (0.0) | 2.8 | (0.0) | 36.0 | (2.0) | 38.0 | (0.0) | 41.0 | (0.0) | 42.0 | (0.0) |
| Russian Fed. | 35.0 | (0.2) | 2.2 | (0.2) | 33.0 | (1.3) | 34.0 | (0.0) | 35.0 | (1.3) | 40.0 | (0.0) |
| Serbia | 37.1 | (0.1) | 1.3 | (0.3) | 35.0 | (0.0) | 37.0 | (0.0) | 37.0 | (0.0) | 39.0 | (0.0) |
| Thailand | 39.7 | (0.1) | 1.1 | (0.1) | 36.0 | (0.0) | 40.0 | (0.0) | 40.0 | (0.0) | 40.0 | (0.0) |
| Tunisia | 31.9 | (0.3) | 3.6 | (0.3) | 26.0 | (1.1) | 30.0 | (0.0) | 33.0 | (1.2) | 38.0 | (1.0) |
| Uruguay | 33.9 | (0.2) | 2.5 | (0.1) | 30.0 | (0.0) | 32.0 | (0.0) | 36.0 | (0.0) | 37.0 | (0.0) |
| United Kingdom[1] | 37.8 | (0.1) | 1.4 | (0.2) | 35.0 | (0.4) | 38.0 | (0.0) | 38.0 | (0.0) | 39.0 | (0.0) |

1. Response rate too low to ensure comparability.

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Table A.2
**Instructional hours in school week: mean, standard deviation and percentile distribution among schools**

| | Mean | | Standard deviation | | Schools at the … 5th percentile | | 25th percentile | | 75th percentile | | 95th percentile | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.E. | S.D. | S.E. | p5 | S.E. | p25 | S.E. | p75 | S.E. | p95 | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 24.1 | (0.1) | 5.6 | (0.1) | 14.0 | (0.4) | 23.0 | (0.3) | 26.3 | (0.3) | 31.0 | (1.0) |
| Austria | 27.2 | (0.3) | 7.6 | (0.3) | 7.5 | (1.1) | 25.0 | (0.8) | 31.7 | (0.2) | 37.5 | (1.3) |
| Belgium | 26.9 | (0.1) | 4.4 | (0.1) | 18.5 | (1.4) | 26.7 | (0.0) | 29.2 | (1.0) | 30.0 | (0.0) |
| Canada | 23.6 | (0.1) | 7.4 | (0.1) | 5.4 | (0.3) | 23.3 | (0.3) | 25.7 | (0.1) | 32.1 | (0.7) |
| Czech Republic | 23.6 | (0.1) | 1.8 | (0.1) | 20.8 | (0.7) | 22.5 | (0.0) | 24.8 | (0.0) | 27.0 | (0.5) |
| Denmark | 22.1 | (0.2) | 5.1 | (0.4) | 15.0 | (0.0) | 21.0 | (0.0) | 23.3 | (0.0) | 29.3 | (1.0) |
| Finland | 22.6 | (0.1) | 2.0 | (0.1) | 20.3 | (0.2) | 22.5 | (0.0) | 23.3 | (0.0) | 25.5 | (0.2) |
| France | 24.8 | (0.2) | 7.0 | (0.1) | 9.2 | (0.8) | 22.9 | (0.8) | 29.0 | (0.7) | 33.0 | (0.4) |
| Germany | 22.6 | (0.1) | 3.7 | (0.2) | 17.3 | (1.0) | 21.8 | (0.0) | 24.0 | (0.0) | 27.0 | (0.0) |
| Greece | 23.5 | (0.1) | 1.4 | (0.0) | 22.5 | (0.0) | 22.5 | (0.0) | 25.5 | (0.0) | 26.3 | (0.0) |
| Hungary | 23.9 | (0.1) | 2.9 | (0.1) | 20.8 | (0.6) | 22.5 | (0.0) | 24.9 | (0.8) | 27.8 | (0.8) |
| Iceland | 26.1 | (0.1) | 6.9 | (0.1) | 20.0 | (0.7) | 24.0 | (0.0) | 26.0 | (0.2) | 48.0 | (1.1) |
| Ireland | 27.4 | (0.1) | 4.8 | (0.2) | 18.7 | (1.4) | 26.7 | (0.1) | 30.0 | (0.0) | 30.0 | (0.6) |
| Italy | 26.4 | (0.3) | 7.6 | (0.2) | 9.0 | (1.0) | 24.8 | (0.4) | 30.0 | (0.7) | 35.0 | (0.4) |
| Japan | 23.8 | (0.2) | 6.7 | (0.2) | 7.5 | (0.6) | 24.0 | (0.7) | 27.1 | (0.5) | 31.7 | (0.8) |
| Korea | 30.2 | (0.3) | 8.3 | (0.3) | 7.5 | (1.2) | 29.2 | (0.0) | 34.2 | (1.1) | 40.8 | (1.2) |
| Luxembourg | 24.1 | (0.1) | 4.8 | (0.1) | 10.8 | (1.6) | 25.0 | (0.0) | 25.8 | (0.2) | 26.7 | (0.3) |
| Mexico | 24.0 | (0.3) | 9.8 | (0.1) | 6.0 | (0.2) | 17.5 | (1.2) | 30.0 | (0.0) | 37.5 | (0.3) |
| Netherlands | 23.9 | (0.2) | 4.9 | (0.2) | 13.3 | (1.2) | 22.5 | (0.0) | 26.7 | (0.0) | 29.2 | (0.0) |
| New Zealand | 23.5 | (0.1) | 5.5 | (0.2) | 9.0 | (1.3) | 22.9 | (0.0) | 25.0 | (0.0) | 30.0 | (0.8) |
| Norway | 22.1 | (0.1) | 4.0 | (0.1) | 15.0 | (0.8) | 22.5 | (0.1) | 22.5 | (0.0) | 27.0 | (0.1) |
| Poland | 22.9 | (0.1) | 3.4 | (0.1) | 18.8 | (0.0) | 22.5 | (0.3) | 24.0 | (0.0) | 27.0 | (0.2) |
| Portugal | 25.1 | (0.3) | 8.0 | (0.4) | 12.8 | (0.7) | 22.5 | (0.2) | 26.7 | (0.6) | 45.0 | (1.4) |
| Slovak Republic | 23.5 | (0.1) | 3.7 | (0.2) | 18.0 | (0.7) | 22.5 | (0.3) | 24.9 | (0.8) | 27.8 | (0.6) |
| Spain | 26.4 | (0.1) | 4.9 | (0.2) | 15.0 | (1.6) | 25.0 | (0.0) | 29.3 | (0.2) | 31.5 | (0.8) |
| Sweden | 22.5 | (0.2) | 5.4 | (0.2) | 13.3 | (0.3) | 20.0 | (0.0) | 25.0 | (0.0) | 30.0 | (1.4) |
| Switzerland | 24.1 | (0.3) | 4.9 | (0.5) | 13.3 | (3.5) | 23.5 | (0.7) | 26.7 | (0.5) | 29.3 | (0.1) |
| Turkey | 23.1 | (0.3) | 6.2 | (0.5) | 8.7 | (0.7) | 21.3 | (0.0) | 26.7 | (1.0) | 30.0 | (0.0) |
| United States | 22.1 | (0.3) | 11.3 | (0.2) | 5.3 | (0.2) | 9.6 | (1.4) | 30.0 | (0.0) | 35.8 | (1.6) |
| ***OECD average*** | *24.4* | *(0.0)* | *5.5* | *(0.0)* | *13.7* | *(0.2)* | *22.8* | *(0.1)* | *26.8* | *(0.1)* | *31.6* | *(0.1)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 19.0 | (0.2) | 6.1 | (0.2) | 6.7 | (0.1) | 16.7 | (0.0) | 20.9 | (0.6) | 26.5 | (0.8) |
| Hong Kong-China | 26.5 | (0.2) | 6.8 | (0.2) | 7.5 | (0.7) | 23.3 | (0.3) | 31.5 | (0.7) | 35.0 | (0.8) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | 23.9 | (0.2) | 4.1 | (0.6) | 20.0 | (0.0) | 23.3 | (0.3) | 24.7 | (0.0) | 28.0 | (0.4) |
| Liechtenstein | 27.1 | (0.2) | 3.2 | (0.4) | 24.0 | (0.6) | 26.3 | (0.0) | 28.5 | (0.0) | 30.8 | (0.2) |
| Macao-China | 26.9 | (0.1) | 4.9 | (0.3) | 20.7 | (2.0) | 26.0 | (0.2) | 29.3 | (0.0) | 32.0 | (1.1) |
| Russian Fed. | 23.8 | (0.2) | 5.2 | (0.4) | 17.3 | (1.1) | 21.3 | (0.0) | 26.2 | (0.8) | 30.0 | (0.4) |
| Serbia | 23.7 | (0.1) | 4.6 | (0.2) | 16.5 | (1.9) | 22.5 | (0.0) | 25.5 | (0.0) | 28.5 | (0.5) |
| Thailand | 30.5 | (0.2) | 3.7 | (0.2) | 25.0 | (1.2) | 29.2 | (0.0) | 33.3 | (0.6) | 36.7 | (0.5) |
| Tunisia | 27.6 | (0.2) | 6.5 | (0.2) | 13.0 | (2.7) | 26.0 | (0.0) | 30.0 | (0.5) | 36.0 | (1.4) |
| Uruguay | 21.6 | (0.3) | 6.5 | (0.2) | 9.0 | (0.7) | 18.7 | (0.7) | 26.0 | (0.9) | 30.8 | (1.4) |
| United Kingdom[1] | 24.6 | (0.1) | 5.1 | (0.2) | 17.0 | (1.8) | 25.0 | (0.3) | 25.0 | (0.0) | 30.0 | (0.0) |

1. Response rate too low to ensure comparability.

Table A.3

**Index of total instructional hours per year: mean, standard deviation and percentile distribution among schools**

| | Mean | | Standard deviation | | Schools at the … 5th percentile | | 25th percentile | | 75th percentile | | 95th percentile | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.E. | S.D. | S.E. | p5 | S.E. | p25 | S.E. | p75 | S.E. | p95 | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 952.5 | (5.4) | 226.2 | (6.0) | 546.0 | (24.2) | 900.0 | (0.0) | 1025.0 | (15.6) | 1240.0 | (34.1) |
| Austria | 991.4 | (18.7) | 353.6 | (14.9) | 285.0 | (23.2) | 900.0 | (35.2) | 1233.3 | (16.3) | 1397.5 | (32.5) |
| Belgium | 968.6 | (6.4) | 179.8 | (5.6) | 671.7 | (15.5) | 925.0 | (26.0) | 1066.7 | (6.5) | 1171.7 | (25.7) |
| Canada | 909.7 | (5.3) | 295.9 | (4.7) | 215.0 | (8.4) | 871.2 | (7.9) | 1023.8 | (9.9) | 1260.0 | (21.7) |
| Czech Republic | 930.1 | (5.5) | 77.0 | (3.9) | 780.0 | (21.6) | 900.0 | (3.3) | 967.5 | (8.6) | 1050.0 | (7.5) |
| Denmark | 857.6 | (6.1) | 163.7 | (13.0) | 600.0 | (4.3) | 840.0 | (14.1) | 900.0 | (18.9) | 1050.0 | (32.5) |
| Finland | 860.5 | (2.5) | 77.9 | (3.9) | 769.5 | (6.3) | 855.0 | (0.0) | 883.5 | (0.0) | 969.0 | (13.1) |
| France | m | m | m | m | m | m | m | m | m | m | m | m |
| Germany | 901.5 | (5.6) | 144.6 | (7.2) | 684.0 | (25.3) | 848.3 | (12.4) | 966.6 | (10.4) | 1102.5 | (19.8) |
| Greece | 805.6 | (5.1) | 64.0 | (5.0) | 697.5 | (33.5) | 787.5 | (0.0) | 813.8 | (46.2) | 918.8 | (0.0) |
| Hungary | 876.8 | (3.9) | 106.5 | (5.0) | 749.3 | (8.2) | 832.5 | (0.0) | 915.8 | (6.2) | 1026.0 | (27.4) |
| Iceland | 953.4 | (3.0) | 249.8 | (3.3) | 760.0 | (17.6) | 864.0 | (0.8) | 937.3 | (0.0) | 1728.0 | (39.2) |
| Ireland | 903.3 | (6.7) | 166.6 | (5.7) | 612.0 | (30.3) | 866.3 | (12.3) | 990.0 | (2.1) | 1050.0 | (20.6) |
| Italy | 884.0 | (9.8) | 256.9 | (7.7) | 300.0 | (26.3) | 820.4 | (9.8) | 1023.0 | (9.3) | 1188.0 | (5.4) |
| Japan | 931.1 | (12.5) | 285.7 | (8.5) | 273.3 | (23.2) | 845.8 | (17.9) | 1105.7 | (12.3) | 1300.0 | (36.3) |
| Korea | 1073.9 | (15.1) | 312.3 | (12.7) | 255.0 | (13.2) | 991.7 | (21.8) | 1225.0 | (17.7) | 1541.7 | (46.4) |
| Luxembourg | 865.9 | (2.9) | 176.4 | (4.9) | 390.0 | (49.2) | 900.0 | (0.0) | 930.0 | (20.6) | 972.0 | (25.0) |
| Mexico | 564.3 | (17.1) | 305.9 | (18.2) | 128.3 | (6.5) | 375.0 | (18.8) | 666.7 | (28.6) | 1200.0 | (33.9) |
| Netherlands | 911.4 | (7.8) | 194.5 | (7.9) | 506.7 | (39.9) | 840.0 | (11.5) | 1020.0 | (11.4) | 1133.3 | (4.2) |
| New Zealand | 845.4 | (4.8) | 197.5 | (6.1) | 348.3 | (48.8) | 816.7 | (3.9) | 924.0 | (15.9) | 1023.2 | (23.6) |
| Norway | 840.3 | (4.4) | 151.7 | (5.1) | 570.0 | (31.1) | 855.0 | (2.5) | 855.0 | (0.0) | 1026.0 | (2.8) |
| Poland | 876.9 | (5.3) | 140.8 | (4.9) | 702.0 | (10.8) | 832.5 | (7.2) | 936.0 | (10.1) | 1054.5 | (19.5) |
| Portugal | 881.9 | (12.9) | 287.7 | (14.0) | 437.5 | (11.7) | 765.0 | (13.8) | 935.0 | (15.5) | 1522.5 | (93.5) |
| Slovak Republic | 917.0 | (7.3) | 165.5 | (7.9) | 693.0 | (12.2) | 826.5 | (18.2) | 999.8 | (20.5) | 1161.0 | (15.8) |
| Spain | 937.4 | (7.6) | 182.9 | (6.9) | 551.3 | (34.5) | 886.5 | (15.8) | 1045.0 | (7.3) | 1140.0 | (7.7) |
| Sweden | 822.5 | (8.9) | 200.4 | (7.6) | 490.0 | (21.6) | 720.0 | (3.9) | 910.0 | (12.2) | 1166.7 | (68.8) |
| Switzerland | 951.9 | (7.0) | 176.3 | (7.9) | 540.0 | (19.1) | 912.0 | (2.7) | 1050.0 | (3.1) | 1140.8 | (28.8) |
| Turkey | 812.5 | (15.7) | 238.9 | (19.7) | 317.3 | (6.6) | 746.7 | (22.6) | 933.3 | (25.1) | 1080.0 | (35.2) |
| United States | 803.9 | (11.4) | 403.4 | (6.1) | 194.0 | (4.2) | 378.0 | (59.8) | 1080.0 | (19.4) | 1282.5 | (49.0) |
| ***OECD average*** | *888.3* | *(1.7)* | *206.0* | *(1.7)* | *507.3* | *(4.7)* | *821.4* | *(3.3)* | *976.3* | *(3.0)* | *1172.5* | *(6.2)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 769.1 | (9.1) | 251.6 | (7.5) | 260.0 | (13.2) | 666.7 | (4.3) | 891.8 | (19.9) | 1102.5 | (37.7) |
| Hong Kong-China | 936.2 | (13.4) | 277.8 | (8.1) | 266.7 | (21.7) | 798.0 | (19.3) | 1114.8 | (14.0) | 1306.7 | (10.6) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | 824.9 | (4.4) | 114.8 | (4.8) | 700.0 | (0.0) | 793.3 | (14.0) | 863.3 | (2.6) | 956.7 | (27.8) |
| Liechtenstein | 1059.5 | (6.2) | 118.4 | (16.1) | 940.5 | (26.1) | 997.5 | (0.0) | 1140.0 | (9.8) | 1230.0 | (11.2) |
| Macao-China | 1055.4 | (5.8) | 204.4 | (9.7) | 738.0 | (34.2) | 1014.0 | (14.5) | 1148.0 | (6.2) | 1260.0 | (19.8) |
| Russian Fed. | 835.0 | (12.5) | 208.4 | (26.4) | 612.0 | (26.4) | 725.3 | (18.9) | 899.9 | (23.9) | 1080.0 | (29.4) |
| Serbia | 883.9 | (5.5) | 162.0 | (7.2) | 682.5 | (29.8) | 832.5 | (0.0) | 943.5 | (11.2) | 1069.5 | (19.7) |
| Thailand | 1210.1 | (7.4) | 152.3 | (7.5) | 936.0 | (53.5) | 1166.7 | (0.0) | 1300.6 | (32.5) | 1466.7 | (27.6) |
| Tunisia | 835.4 | (12.0) | 225.4 | (11.5) | 304.0 | (71.1) | 756.0 | (16.6) | 928.0 | (16.9) | 1120.0 | (32.3) |
| Uruguay | 727.8 | (12.9) | 232.6 | (8.1) | 288.8 | (22.4) | 600.0 | (11.2) | 864.0 | (16.5) | 1071.0 | (28.2) |
| United Kingdom[1] | 930.6 | (4.3) | 190.3 | (7.0) | 646.0 | (51.6) | 918.3 | (15.1) | 950.0 | (0.0) | 1108.3 | (20.8) |

1. Response rate too low to ensure comparability.

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Table A.4
**Hours per week of mathematics instruction: mean, standard deviation and percentile distribution among schools**

| | Mean | | Standard deviation | | Schools at the … 5th percentile | | 25th percentile | | 75th percentile | | 95th percentile | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.E. | S.D. | S.E. | p5 | S.E. | p25 | S.E. | p75 | S.E. | p95 | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 3.8 | (0.0) | 1.4 | (0.1) | 2.3 | (0.0) | 3.3 | (0.0) | 4.2 | (0.1) | 6.0 | (0.2) |
| Austria | 2.8 | (0.1) | 1.6 | (0.1) | 0.8 | (0.0) | 1.7 | (0.1) | 3.3 | (0.0) | 5.0 | (0.4) |
| Belgium | 3.3 | (0.0) | 1.4 | (0.1) | 0.8 | (0.0) | 2.5 | (0.0) | 4.2 | (0.0) | 5.0 | (0.1) |
| Canada | 3.7 | (0.0) | 2.7 | (0.0) | 0.0 | (0.0) | 1.3 | (0.1) | 5.8 | (0.2) | 6.7 | (0.1) |
| Czech Republic | 2.8 | (0.0) | 0.8 | (0.0) | 1.5 | (0.0) | 2.3 | (0.0) | 3.0 | (0.0) | 3.8 | (0.4) |
| Denmark | 3.4 | (0.0) | 1.3 | (0.1) | 2.3 | (0.0) | 3.0 | (0.0) | 3.8 | (0.0) | 5.3 | (0.1) |
| Finland | 2.6 | (0.0) | 1.2 | (0.1) | 0.0 | (0.0) | 2.3 | (0.0) | 3.0 | (0.4) | 4.5 | (0.0) |
| France | 3.5 | (0.0) | 1.3 | (0.1) | 1.5 | (0.7) | 2.8 | (0.0) | 3.7 | (0.0) | 4.6 | (0.0) |
| Germany | 3.0 | (0.0) | 1.4 | (0.1) | 1.5 | (0.4) | 2.3 | (0.0) | 3.0 | (0.0) | 4.5 | (0.0) |
| Greece | 3.1 | (0.0) | 0.7 | (0.0) | 2.3 | (0.0) | 3.0 | (0.0) | 3.8 | (0.0) | 3.8 | (0.0) |
| Hungary | 2.7 | (0.0) | 0.8 | (0.1) | 2.3 | (0.0) | 2.3 | (0.0) | 3.0 | (0.0) | 3.8 | (0.0) |
| Iceland | 4.2 | (0.0) | 1.4 | (0.1) | 3.3 | (0.0) | 3.3 | (0.0) | 4.2 | (0.2) | 7.7 | (0.6) |
| Ireland | 3.2 | (0.0) | 1.2 | (0.1) | 2.0 | (0.0) | 2.9 | (0.2) | 3.3 | (0.0) | 4.0 | (0.0) |
| Italy | 3.5 | (0.1) | 1.6 | (0.1) | 0.9 | (0.1) | 2.8 | (0.1) | 4.2 | (0.0) | 5.3 | (0.3) |
| Japan | 3.6 | (0.1) | 1.7 | (0.1) | 0.9 | (0.8) | 2.5 | (0.0) | 4.3 | (0.3) | 5.8 | (0.0) |
| Korea | 4.1 | (0.1) | 1.8 | (0.1) | 2.5 | (0.0) | 3.3 | (0.0) | 4.2 | (0.1) | 6.7 | (0.6) |
| Luxembourg | 3.3 | (0.0) | 1.5 | (0.1) | 1.7 | (0.0) | 3.3 | (0.0) | 3.3 | (0.0) | 5.0 | (0.0) |
| Mexico | 4.0 | (0.1) | 2.6 | (0.2) | 1.1 | (0.3) | 3.0 | (0.3) | 4.2 | (0.0) | 7.5 | (0.5) |
| Netherlands | 2.5 | (0.0) | 1.5 | (0.1) | 0.0 | (0.0) | 2.3 | (0.2) | 3.0 | (0.3) | 3.8 | (0.2) |
| New Zealand | 4.0 | (0.0) | 1.1 | (0.1) | 2.8 | (0.2) | 3.7 | (0.0) | 4.2 | (0.0) | 5.0 | (0.0) |
| Norway | 2.8 | (0.1) | 1.5 | (0.2) | 0.7 | (0.8) | 2.3 | (0.0) | 3.0 | (0.0) | 4.5 | (0.0) |
| Poland | 3.4 | (0.0) | 0.6 | (0.0) | 3.0 | (0.0) | 3.0 | (0.0) | 3.8 | (0.0) | 4.5 | (0.0) |
| Portugal | 3.3 | (0.1) | 1.5 | (0.1) | 1.5 | (0.0) | 2.9 | (0.3) | 3.3 | (0.0) | 6.0 | (0.0) |
| Slovak Republic | 3.3 | (0.1) | 1.7 | (0.1) | 1.5 | (0.0) | 2.3 | (0.6) | 3.8 | (0.0) | 4.5 | (0.4) |
| Spain | 2.9 | (0.0) | 0.7 | (0.0) | 2.0 | (0.2) | 2.5 | (0.0) | 3.3 | (0.0) | 4.0 | (0.4) |
| Sweden | 2.7 | (0.0) | 1.3 | (0.2) | 1.7 | (0.2) | 2.5 | (0.0) | 3.0 | (0.0) | 4.0 | (0.0) |
| Switzerland | 3.3 | (0.1) | 1.4 | (0.1) | 0.8 | (0.9) | 3.0 | (0.0) | 3.8 | (0.0) | 5.0 | (0.5) |
| Turkey | 3.3 | (0.1) | 1.1 | (0.1) | 2.0 | (0.7) | 2.7 | (0.1) | 3.8 | (0.0) | 5.3 | (0.8) |
| United States | 3.7 | (0.1) | 2.3 | (0.1) | 0.7 | (0.6) | 2.7 | (0.3) | 4.5 | (0.0) | 7.5 | (0.0) |
| ***OECD average*** | *3.3* | *(0.0)* | *1.4* | *(0.0)* | *1.6* | *(0.1)* | *2.7* | *(0.0)* | *3.7* | *(0.0)* | *5.1* | *(0.1)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 3.5 | (0.1) | 1.8 | (0.2) | 1.7 | (0.1) | 3.0 | (0.2) | 4.2 | (0.0) | 5.0 | (0.0) |
| Hong Kong-China | 4.5 | (0.1) | 1.9 | (0.1) | 2.0 | (0.4) | 3.5 | (0.0) | 5.3 | (0.0) | 7.0 | (0.0) |
| Indonesia | 3.9 | (0.1) | 2.4 | (0.1) | 1.3 | (0.3) | 2.3 | (0.1) | 4.5 | (0.0) | 6.0 | (0.0) |
| Latvia | 3.6 | (0.1) | 1.3 | (0.2) | 2.0 | (0.0) | 3.3 | (0.0) | 4.0 | (0.0) | 4.7 | (0.0) |
| Liechtenstein | 3.6 | (0.0) | 0.8 | (0.0) | 2.3 | (0.0) | 3.0 | (0.0) | 3.8 | (0.0) | 5.3 | (0.0) |
| Macao-China | 4.5 | (0.0) | 1.4 | (0.1) | 2.7 | (0.0) | 4.0 | (0.0) | 5.3 | (0.0) | 6.7 | (0.5) |
| Russian Fed. | 3.4 | (0.1) | 1.3 | (0.1) | 1.5 | (0.5) | 2.7 | (0.4) | 4.0 | (0.0) | 5.3 | (0.2) |
| Serbia | 2.7 | (0.0) | 1.7 | (0.2) | 1.5 | (0.7) | 2.3 | (0.0) | 3.0 | (0.0) | 3.8 | (0.0) |
| Thailand | 3.7 | (0.0) | 1.1 | (0.0) | 1.7 | (0.0) | 3.0 | (0.4) | 4.2 | (0.2) | 5.0 | (0.1) |
| Tunisia | 4.2 | (0.0) | 1.4 | (0.2) | 3.7 | (0.2) | 4.0 | (0.0) | 4.0 | (0.0) | 5.0 | (0.0) |
| Uruguay | 3.1 | (0.1) | 2.2 | (0.2) | 1.3 | (0.0) | 2.3 | (0.0) | 3.5 | (0.2) | 4.5 | (0.0) |
| United Kingdom[1] | 3.4 | (0.0) | 1.4 | (0.1) | 2.3 | (0.1) | 3.0 | (0.0) | 3.5 | (0.1) | 5.0 | (0.3) |

1. Response rate too low to ensure comparability.

Table A.5

**Hours per week of homework or other study set by teachers in total: mean, standard deviation and percentile distribution among schools**

| | Mean | | Standard deviation | | Schools at the … 5th percentile | | 25th percentile | | 75th percentile | | 95th percentile | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.E. | S.D. | S.E. | p5 | S.E. | p25 | S.E. | p75 | S.E. | p95 | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 5.7 | (0.1) | 2.1 | (0.1) | 2.9 | (0.1) | 4.0 | (0.1) | 7.1 | (0.2) | 9.6 | (0.2) |
| Austria | 3.9 | (0.1) | 1.6 | (0.1) | 1.5 | (0.2) | 2.8 | (0.1) | 4.9 | (0.2) | 6.4 | (0.7) |
| Belgium | 6.1 | (0.1) | 2.4 | (0.1) | 2.4 | (0.2) | 4.1 | (0.2) | 7.6 | (0.1) | 10.4 | (0.5) |
| Canada | 5.7 | (0.1) | 2.3 | (0.1) | 2.6 | (0.1) | 4.0 | (0.1) | 7.1 | (0.3) | 10.1 | (0.2) |
| Czech Republic | 3.8 | (0.1) | 1.7 | (0.2) | 1.8 | (0.1) | 2.6 | (0.2) | 4.6 | (0.2) | 6.5 | (0.3) |
| Denmark | 5.4 | (0.1) | 1.4 | (0.1) | 3.5 | (0.1) | 4.5 | (0.1) | 6.0 | (0.2) | 7.4 | (0.3) |
| Finland | 3.7 | (0.1) | 0.9 | (0.0) | 2.3 | (0.1) | 3.0 | (0.1) | 4.2 | (0.1) | 5.3 | (0.2) |
| France | 6.7 | (0.1) | 1.9 | (0.1) | 3.8 | (0.4) | 5.3 | (0.1) | 8.1 | (0.2) | 9.8 | (0.1) |
| Germany | 6.2 | (0.1) | 1.7 | (0.1) | 3.2 | (0.2) | 4.9 | (0.2) | 7.4 | (0.1) | 8.9 | (0.3) |
| Greece | 8.3 | (0.2) | 2.7 | (0.1) | 3.4 | (0.4) | 5.9 | (0.8) | 10.2 | (0.3) | 12.3 | (0.5) |
| Hungary | 9.9 | (0.2) | 3.4 | (0.2) | 4.1 | (0.3) | 7.7 | (0.4) | 12.4 | (0.2) | 15.3 | (0.1) |
| Iceland | 4.6 | (0.0) | 1.5 | (0.0) | 2.4 | (0.0) | 3.4 | (0.0) | 5.7 | (0.0) | 7.2 | (0.0) |
| Ireland | 7.7 | (0.2) | 2.0 | (0.1) | 4.7 | (0.3) | 6.3 | (0.1) | 9.1 | (0.2) | 10.6 | (0.5) |
| Italy | 10.5 | (0.2) | 4.3 | (0.2) | 3.6 | (0.8) | 7.5 | (0.3) | 13.4 | (0.3) | 18.7 | (1.1) |
| Japan | 3.8 | (0.2) | 3.3 | (0.4) | 1.0 | (0.1) | 1.8 | (0.1) | 4.6 | (0.6) | 9.5 | (1.3) |
| Korea | 3.5 | (0.1) | 1.7 | (0.4) | 1.5 | (0.0) | 2.5 | (0.2) | 4.3 | (0.1) | 5.7 | (0.6) |
| Luxembourg | 6.0 | (0.0) | 1.0 | (0.0) | 4.8 | (0.0) | 5.4 | (0.0) | 6.9 | (0.0) | 7.5 | (0.0) |
| Mexico | 5.7 | (0.1) | 2.5 | (0.1) | 2.1 | (0.2) | 4.0 | (0.2) | 7.3 | (0.4) | 10.0 | (0.5) |
| Netherlands | 5.7 | (0.1) | 2.3 | (0.1) | 2.5 | (0.1) | 3.6 | (0.2) | 7.4 | (0.2) | 9.5 | (0.3) |
| New Zealand | 4.5 | (0.1) | 1.6 | (0.1) | 2.4 | (0.2) | 3.4 | (0.1) | 5.3 | (0.2) | 7.3 | (0.2) |
| Norway | 4.8 | (0.1) | 1.3 | (0.1) | 3.0 | (0.2) | 3.9 | (0.2) | 5.6 | (0.1) | 7.1 | (0.3) |
| Poland | 8.1 | (0.2) | 2.1 | (0.1) | 5.2 | (0.1) | 6.3 | (0.2) | 9.3 | (0.2) | 11.8 | (0.2) |
| Portugal | 4.9 | (0.1) | 1.3 | (0.1) | 2.8 | (0.2) | 3.9 | (0.1) | 5.9 | (0.1) | 7.1 | (0.3) |
| Slovak Republic | 8.3 | (0.2) | 2.6 | (0.1) | 5.0 | (0.4) | 6.6 | (0.1) | 9.7 | (0.6) | 12.9 | (0.3) |
| Spain | 7.3 | (0.1) | 2.1 | (0.1) | 4.5 | (0.3) | 5.9 | (0.1) | 8.4 | (0.2) | 11.6 | (0.6) |
| Sweden | 3.9 | (0.1) | 1.2 | (0.1) | 2.4 | (0.1) | 3.1 | (0.1) | 4.4 | (0.1) | 6.5 | (0.6) |
| Switzerland | 4.5 | (0.1) | 1.5 | (0.1) | 2.6 | (0.1) | 3.5 | (0.1) | 5.4 | (0.2) | 7.0 | (0.1) |
| Turkey | 5.8 | (0.2) | 1.7 | (0.2) | 3.6 | (0.3) | 4.7 | (0.2) | 6.8 | (0.4) | 9.1 | (0.9) |
| United States | 5.6 | (0.1) | 2.2 | (0.1) | 2.6 | (0.2) | 4.0 | (0.1) | 6.9 | (0.3) | 9.4 | (0.3) |
| ***OECD average*** | *5.9* | *(0.0)* | *2.0* | *(0.0)* | *3.1* | *(0.0)* | *4.4* | *(0.0)* | *7.1* | *(0.0)* | *9.3* | *(0.1)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 4.8 | (0.1) | 1.8 | (0.1) | 2.3 | (0.3) | 3.5 | (0.1) | 5.8 | (0.2) | 8.2 | (1.0) |
| Hong Kong-China | 6.7 | (0.2) | 2.8 | (0.1) | 2.2 | (0.3) | 4.5 | (0.4) | 8.3 | (0.4) | 11.9 | (0.7) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | 9.4 | (0.2) | 2.2 | (0.1) | 5.7 | (0.3) | 8.0 | (0.2) | 11.0 | (0.4) | 12.9 | (0.5) |
| Liechtenstein | 4.4 | (0.0) | 1.1 | (0.0) | 2.7 | (0.0) | 3.6 | (0.0) | 5.4 | (0.0) | 5.4 | (0.0) |
| Macao-China | 7.8 | (0.0) | 3.1 | (0.0) | 3.7 | (0.0) | 5.7 | (0.0) | 9.4 | (0.0) | 13.0 | (0.0) |
| Russian Fed. | 12.7 | (0.3) | 3.1 | (0.2) | 6.9 | (0.6) | 10.6 | (0.6) | 14.8 | (0.3) | 17.6 | (0.8) |
| Serbia | 5.2 | (0.2) | 2.2 | (0.3) | 2.5 | (0.2) | 3.7 | (0.3) | 6.0 | (0.6) | 9.3 | (1.0) |
| Thailand | 6.9 | (0.2) | 2.6 | (0.1) | 3.5 | (0.3) | 4.8 | (0.3) | 8.7 | (0.4) | 11.5 | (0.5) |
| Tunisia | 4.7 | (0.1) | 1.9 | (0.1) | 2.4 | (0.2) | 3.3 | (0.1) | 5.7 | (0.3) | 8.5 | (0.4) |
| Uruguay | 6.7 | (0.1) | 2.0 | (0.1) | 3.6 | (0.3) | 5.5 | (0.2) | 7.7 | (0.3) | 10.3 | (0.3) |
| United Kingdom[1] | 6.0 | (0.1) | 2.0 | (0.1) | 3.4 | (0.1) | 4.3 | (0.2) | 7.3 | (0.2) | 9.5 | (0.3) |

1. Response rate too low to ensure comparability.

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Table A.6
**Hours per week of homework or other study set by mathematics teachers: mean, standard deviation and percentile distribution among schools**

| | Mean | | Standard deviation | | Schools at the … 5th percentile | | 25th percentile | | 75th percentile | | 95th percentile | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.E. | S.D. | S.E. | p5 | S.E. | p25 | S.E. | p75 | S.E. | p95 | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 2.3 | (0.0) | 0.8 | (0.0) | 1.1 | (0.1) | 1.7 | (0.0) | 2.9 | (0.0) | 3.8 | (0.1) |
| Austria | 1.7 | (0.0) | 0.6 | (0.0) | 0.7 | (0.1) | 1.3 | (0.1) | 2.1 | (0.1) | 2.9 | (0.2) |
| Belgium | 2.2 | (0.0) | 0.8 | (0.0) | 1.0 | (0.1) | 1.7 | (0.0) | 2.6 | (0.1) | 3.7 | (0.2) |
| Canada | 2.8 | (0.1) | 1.1 | (0.0) | 1.4 | (0.1) | 2.1 | (0.1) | 3.5 | (0.1) | 4.8 | (0.1) |
| Czech Republic | 1.7 | (0.0) | 0.6 | (0.1) | 0.9 | (0.1) | 1.2 | (0.1) | 2.0 | (0.0) | 2.8 | (0.2) |
| Denmark | 2.6 | (0.0) | 0.7 | (0.1) | 1.5 | (0.2) | 2.2 | (0.1) | 2.9 | (0.1) | 3.7 | (0.1) |
| Finland | 1.5 | (0.0) | 0.4 | (0.0) | 0.9 | (0.0) | 1.2 | (0.0) | 1.7 | (0.0) | 2.1 | (0.1) |
| France | 2.5 | (0.0) | 0.7 | (0.0) | 1.5 | (0.1) | 2.1 | (0.1) | 2.9 | (0.1) | 3.8 | (0.2) |
| Germany | 2.6 | (0.1) | 0.7 | (0.1) | 1.5 | (0.1) | 2.1 | (0.0) | 3.1 | (0.1) | 3.7 | (0.3) |
| Greece | 3.3 | (0.1) | 1.0 | (0.0) | 1.6 | (0.1) | 2.7 | (0.1) | 4.0 | (0.1) | 4.9 | (0.2) |
| Hungary | 3.3 | (0.1) | 0.8 | (0.0) | 2.0 | (0.2) | 2.8 | (0.1) | 3.8 | (0.0) | 4.3 | (0.1) |
| Iceland | 2.3 | (0.0) | 0.7 | (0.0) | 1.1 | (0.0) | 1.8 | (0.0) | 2.7 | (0.0) | 3.6 | (0.0) |
| Ireland | 2.8 | (0.1) | 0.6 | (0.0) | 1.9 | (0.1) | 2.4 | (0.1) | 3.2 | (0.1) | 4.0 | (0.1) |
| Italy | 3.5 | (0.1) | 1.2 | (0.1) | 1.7 | (0.1) | 2.7 | (0.1) | 4.3 | (0.2) | 5.3 | (0.3) |
| Japan | 1.9 | (0.1) | 1.5 | (0.2) | 0.6 | (0.2) | 1.0 | (0.0) | 2.5 | (0.3) | 5.3 | (0.7) |
| Korea | 1.7 | (0.1) | 0.8 | (0.1) | 0.7 | (0.0) | 1.1 | (0.0) | 2.1 | (0.1) | 3.1 | (0.2) |
| Luxembourg | 2.3 | (0.0) | 0.3 | (0.0) | 1.9 | (0.0) | 2.2 | (0.0) | 2.5 | (0.0) | 2.7 | (0.0) |
| Mexico | 3.2 | (0.1) | 1.2 | (0.1) | 1.5 | (0.1) | 2.4 | (0.1) | 3.8 | (0.1) | 5.2 | (0.2) |
| Netherlands | 1.9 | (0.0) | 0.5 | (0.0) | 1.0 | (0.1) | 1.5 | (0.1) | 2.3 | (0.1) | 2.7 | (0.1) |
| New Zealand | 1.7 | (0.0) | 0.6 | (0.0) | 0.9 | (0.1) | 1.3 | (0.1) | 2.1 | (0.0) | 2.9 | (0.1) |
| Norway | 1.8 | (0.0) | 0.5 | (0.0) | 1.1 | (0.1) | 1.5 | (0.0) | 2.1 | (0.1) | 3.0 | (0.4) |
| Poland | 4.1 | (0.1) | 1.1 | (0.1) | 2.7 | (0.2) | 3.4 | (0.2) | 4.8 | (0.1) | 6.0 | (0.2) |
| Portugal | 2.0 | (0.0) | 0.5 | (0.0) | 1.4 | (0.1) | 1.7 | (0.1) | 2.4 | (0.1) | 2.8 | (0.2) |
| Slovak Republic | 3.1 | (0.1) | 0.9 | (0.0) | 1.8 | (0.1) | 2.6 | (0.1) | 3.8 | (0.1) | 4.5 | (0.1) |
| Spain | 2.9 | (0.1) | 0.8 | (0.0) | 1.8 | (0.0) | 2.4 | (0.1) | 3.5 | (0.1) | 4.1 | (0.2) |
| Sweden | 1.3 | (0.0) | 0.5 | (0.0) | 0.7 | (0.0) | 0.9 | (0.0) | 1.5 | (0.1) | 2.3 | (0.2) |
| Switzerland | 1.9 | (0.0) | 0.7 | (0.0) | 0.9 | (0.1) | 1.4 | (0.1) | 2.3 | (0.1) | 3.1 | (0.2) |
| Turkey | 2.8 | (0.1) | 0.7 | (0.0) | 1.7 | (0.1) | 2.3 | (0.1) | 3.3 | (0.2) | 3.9 | (0.1) |
| United States | 2.7 | (0.1) | 0.9 | (0.0) | 1.4 | (0.1) | 2.1 | (0.1) | 3.4 | (0.1) | 4.3 | (0.2) |
| ***OECD average*** | *2.4* | *(0.0)* | *0.8* | *(0.0)* | *1.3* | *(0.0)* | *1.9* | *(0.0)* | *2.9* | *(0.0)* | *3.8* | *(0.0)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 2.4 | (0.1) | 0.9 | (0.0) | 1.3 | (0.0) | 1.8 | (0.0) | 2.9 | (0.1) | 3.9 | (0.2) |
| Hong Kong-China | 3.1 | (0.1) | 1.2 | (0.1) | 1.2 | (0.1) | 2.2 | (0.1) | 3.7 | (0.2) | 5.4 | (0.4) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | 3.7 | (0.1) | 0.8 | (0.0) | 2.5 | (0.1) | 3.1 | (0.1) | 4.3 | (0.1) | 5.0 | (0.1) |
| Liechtenstein | 1.7 | (0.0) | 0.5 | (0.0) | 1.2 | (0.2) | 1.4 | (0.0) | 1.8 | (0.1) | 2.2 | (0.0) |
| Macao-China | 4.3 | (0.0) | 1.6 | (0.0) | 2.0 | (0.0) | 3.1 | (0.0) | 5.3 | (0.0) | 7.3 | (0.0) |
| Russian Fed. | 5.0 | (0.1) | 1.2 | (0.1) | 3.1 | (0.3) | 4.2 | (0.2) | 5.7 | (0.1) | 7.2 | (0.3) |
| Serbia | 2.4 | (0.1) | 0.8 | (0.1) | 1.2 | (0.1) | 1.9 | (0.1) | 2.8 | (0.1) | 3.8 | (0.2) |
| Thailand | 4.0 | (0.1) | 1.4 | (0.1) | 2.2 | (0.0) | 2.9 | (0.2) | 5.0 | (0.2) | 6.8 | (0.4) |
| Tunisia | 2.7 | (0.1) | 0.9 | (0.1) | 1.6 | (0.1) | 2.2 | (0.1) | 3.2 | (0.1) | 4.4 | (0.2) |
| Uruguay | 2.8 | (0.1) | 0.8 | (0.1) | 1.7 | (0.1) | 2.3 | (0.1) | 3.4 | (0.1) | 3.9 | (0.1) |
| United Kingdom[1] | 2.0 | (0.0) | 0.6 | (0.0) | 1.2 | (0.1) | 1.6 | (0.1) | 2.3 | (0.0) | 3.3 | (0.1) |

1. Response rate too low to ensure comparability.

Table A.7

**School principals' views on mathematics teachers' support for innovative teaching practices**

| | Percentage of school principals agreeing or strongly agreeing with the following statements: | | | | | |
|---|---|---|---|---|---|---|
| | Mathematics teachers are interested in trying new methods and teaching practices. | | There is a preference among mathematics teachers to stay with well-known methods and practices. | | There are frequent disagreements between "innovative" and "traditional" mathematics teachers. | |
| | % | S.E. | % | S.E. | % | S.E. |
| **OECD** | | | | | | |
| Australia | 75.2 | (2.8) | 70.3 | (2.8) | 26.6 | (2.8) |
| Austria | 83.2 | (3.0) | 36.2 | (3.8) | 12.1 | (2.5) |
| Belgium | 74.5 | (2.7) | 66.4 | (2.6) | 34.0 | (3.2) |
| Canada | 85.2 | (1.7) | 74.7 | (2.1) | 24.3 | (2.1) |
| Czech Republic | 92.8 | (1.8) | 59.9 | (3.1) | 11.6 | (2.2) |
| Denmark | 93.5 | (1.6) | 42.6 | (3.6) | 18.7 | (3.2) |
| Finland | 74.4 | (3.4) | 42.7 | (3.7) | 16.8 | (3.0) |
| France | w | w | w | w | w | w |
| Germany | 77.7 | (2.6) | 35.7 | (3.0) | 23.7 | (3.0) |
| Greece | 84.6 | (3.2) | 67.5 | (4.2) | 20.5 | (4.6) |
| Hungary | 94.1 | (1.6) | 89.2 | (2.5) | 6.2 | (1.7) |
| Iceland | 86.1 | (0.1) | 48.7 | (0.2) | 13.8 | (0.1) |
| Ireland | 72.5 | (3.6) | 76.4 | (4.1) | 11.9 | (2.6) |
| Italy | 87.9 | (2.4) | 79.6 | (3.0) | 24.8 | (3.5) |
| Japan | 63.2 | (4.0) | 35.2 | (3.9) | 8.4 | (2.5) |
| Korea | 87.0 | (2.8) | 71.2 | (3.7) | 20.2 | (3.3) |
| Luxembourg | 68.7 | (0.1) | 81.9 | (0.0) | 29.0 | (0.1) |
| Mexico | 87.0 | (1.6) | 74.8 | (3.0) | 53.3 | (3.1) |
| Netherlands | 58.8 | (4.4) | 56.2 | (4.2) | 26.1 | (4.0) |
| New Zealand | 83.7 | (2.8) | 53.8 | (3.6) | 14.7 | (2.2) |
| Norway | 84.0 | (2.7) | 54.0 | (3.7) | 28.8 | (3.9) |
| Poland | 92.5 | (2.2) | 20.5 | (3.4) | 11.9 | (2.5) |
| Portugal | 90.4 | (3.4) | 36.9 | (4.4) | 34.6 | (4.6) |
| Slovak Republic | 97.1 | (1.0) | 86.0 | (2.2) | 12.3 | (2.7) |
| Spain | 88.1 | (2.4) | 59.9 | (3.3) | 20.6 | (3.5) |
| Sweden | 83.2 | (2.8) | 54.3 | (3.5) | 29.9 | (3.6) |
| Switzerland | 78.3 | (3.5) | 52.9 | (4.3) | 18.3 | (2.4) |
| Turkey | 79.9 | (4.1) | 85.8 | (3.0) | 36.8 | (4.4) |
| United States | 86.7 | (2.4) | 75.3 | (2.9) | 25.8 | (2.8) |
| ***OECD average*** | *82.9* | *(0.5)* | *59.8* | *(0.6)* | *21.6* | *(0.6)* |
| **Partners** | | | | | | |
| Brazil | 90.3 | (2.3) | 58.3 | (3.6) | 34.6 | (3.5) |
| Hong Kong-China | 94.7 | (1.9) | 85.8 | (2.7) | 17.0 | (3.2) |
| Indonesia | 98.1 | (1.2) | 53.6 | (3.6) | 50.7 | (3.9) |
| Latvia | 97.6 | (1.2) | 78.1 | (3.8) | 14.4 | (2.8) |
| Liechtenstein | 97.9 | (0.0) | 47.9 | (0.4) | 0.0 | (0.0) |
| Macao-China | 99.4 | (0.0) | 79.2 | (0.2) | 3.9 | (0.1) |
| Russian Fed. | 96.5 | (1.3) | 92.8 | (2.4) | 12.2 | (2.0) |
| Serbia | 88.1 | (2.6) | 68.7 | (4.0) | 19.5 | (3.6) |
| Thailand | 95.2 | (1.7) | 90.8 | (2.5) | 28.2 | (3.4) |
| Tunisia | 92.1 | (2.3) | 97.9 | (1.2) | 32.7 | (4.0) |
| Uruguay | 84.0 | (3.6) | 42.2 | (4.7) | 36.1 | (4.3) |
| United Kingdom[1] | 92.2 | (1.7) | 46.2 | (3.3) | 11.8 | (2.1) |

1. Response rate too low to ensure comparability.

Table A.8
**School principals' perceptions of mathematics teachers' expectations**

| | Percentage of school principals agreeing or strongly agreeing with the following statements: | | | | | |
|---|---|---|---|---|---|---|
| | There is consensus among mathematics teachers that academic achievement must be kept as high as possible. | | There is consensus among mathematics teachers that it is best to adapt academic standards to the students' level and needs. | | There are frequent disagreements between mathematics teachers who consider each other to be "too demanding" or "too lax". | |
| | % | S.E. | % | S.E. | % | S.E. |
| **OECD** | | | | | | |
| Australia | 96.8 | (1.1) | 73.4 | (2.3) | 12.2 | (2.2) |
| Austria | 87.0 | (2.7) | 44.7 | (3.9) | 14.3 | (2.8) |
| Belgium | 84.2 | (2.5) | 58.6 | (3.6) | 27.9 | (2.9) |
| Canada | 95.2 | (1.3) | 59.1 | (2.2) | 21.3 | (2.0) |
| Czech Republic | 91.9 | (1.7) | 61.0 | (3.2) | 11.1 | (2.0) |
| Denmark | 99.3 | (0.5) | 92.4 | (2.1) | 3.3 | (1.3) |
| Finland | 92.9 | (2.0) | 76.2 | (3.2) | 10.6 | (2.6) |
| France | w | w | w | w | w | w |
| Germany | 89.1 | (1.8) | 22.7 | (2.6) | 16.3 | (3.0) |
| Greece | 85.1 | (3.7) | 79.1 | (4.0) | 24.7 | (4.9) |
| Hungary | 84.1 | (3.0) | 73.8 | (3.4) | 16.1 | (3.0) |
| Iceland | 99.0 | (0.0) | 67.8 | (0.2) | 13.7 | (0.1) |
| Ireland | 93.9 | (2.1) | 83.6 | (2.9) | 11.3 | (2.9) |
| Italy | 87.4 | (2.3) | 73.0 | (3.3) | 34.1 | (3.6) |
| Japan | 72.3 | (3.8) | 68.8 | (4.0) | 3.0 | (1.5) |
| Korea | 85.8 | (2.9) | 97.2 | (1.4) | 13.8 | (2.9) |
| Luxembourg | 100.0 | (0.0) | 16.3 | (0.0) | 40.6 | (0.1) |
| Mexico | 86.7 | (2.6) | 69.4 | (3.7) | 54.1 | (3.0) |
| Netherlands | 96.2 | (1.5) | 73.4 | (3.8) | 23.7 | (4.2) |
| New Zealand | 95.4 | (1.7) | 83.2 | (2.6) | 8.3 | (2.2) |
| Norway | 98.2 | (1.0) | 87.7 | (2.4) | 9.5 | (2.4) |
| Poland | 94.6 | (1.8) | 96.2 | (1.6) | 14.5 | (2.6) |
| Portugal | 61.2 | (4.3) | 81.4 | (3.7) | 39.9 | (4.1) |
| Slovak Republic | 91.9 | (1.8) | 64.5 | (3.7) | 19.8 | (3.1) |
| Spain | 87.5 | (2.7) | 81.5 | (3.4) | 16.9 | (3.3) |
| Sweden | 56.5 | (3.6) | 90.9 | (2.0) | 21.7 | (3.1) |
| Switzerland | 91.2 | (3.2) | 41.5 | (4.0) | 10.3 | (1.9) |
| Turkey | 77.8 | (4.1) | 84.1 | (3.7) | 43.6 | (3.9) |
| United States | 98.4 | (0.9) | 66.2 | (3.0) | 20.0 | (3.1) |
| ***OECD average*** | *88.9* | *(0.4)* | *70.6* | *(0.6)* | *19.4* | *(0.5)* |
| **Partners** | | | | | | |
| Brazil | 78.3 | (3.4) | 80.1 | (2.7) | 38.4 | (3.3) |
| Hong Kong-China | 93.8 | (2.0) | 95.4 | (1.7) | 11.8 | (2.8) |
| Indonesia | 99.8 | (0.1) | 99.1 | (0.4) | 30.9 | (3.5) |
| Latvia | 92.3 | (2.3) | 84.2 | (3.1) | 11.7 | (2.9) |
| Liechtenstein | 89.3 | (0.4) | 30.8 | (0.5) | 9.5 | (0.1) |
| Macao-China | 85.1 | (0.2) | 85.4 | (0.2) | 9.8 | (0.1) |
| Russian Fed. | 92.9 | (2.1) | 96.1 | (2.1) | 25.0 | (3.8) |
| Serbia | 89.6 | (2.9) | 88.0 | (2.8) | 38.7 | (3.3) |
| Thailand | 88.3 | (2.8) | 94.7 | (2.1) | 38.3 | (3.5) |
| Tunisia | 98.0 | (1.1) | 88.7 | (2.6) | 51.2 | (4.2) |
| Uruguay | 88.9 | (2.3) | 58.6 | (4.2) | 40.3 | (4.2) |
| United Kingdom[1] | 97.8 | (1.1) | 80.7 | (2.4) | 6.0 | (1.7) |

1. Response rate too low to ensure comparability.

Table A.9
**School principals' perceptions of mathematics teachers' support of teaching goals**

| | Percentage of school principals agreeing or strongly agreeing with the following statements: | | | | | |
|---|---|---|---|---|---|---|
| | There is consensus among mathematics teachers that the social and emotional development of the student is as important as their acquisition of mathematical skills and knowledge in mathematics classes. | | There is consensus among mathematics teachers that the development of students' mathematical skills and knowledge is the most important objective in mathematics classes. | | There are frequent disagreements between mathematics teachers who consider each other as "too focused on skill acquisition" or "too focused on the affective development" of the student. | |
| | % | S.E. | % | S.E. | % | S.E. |
| **OECD** | | | | | | |
| Australia | 74.8 | (2.7) | 83.0 | (2.2) | 13.0 | (2.3) |
| Austria | 62.7 | (3.7) | 71.9 | (3.5) | 9.4 | (2.4) |
| Belgium | 62.5 | (2.8) | 76.7 | (2.9) | 16.2 | (2.6) |
| Canada | 66.5 | (2.3) | 87.2 | (1.5) | 12.3 | (1.5) |
| Czech Republic | 76.3 | (2.7) | 76.3 | (3.0) | 9.4 | (2.0) |
| Denmark | 60.9 | (3.4) | 77.5 | (2.7) | 7.0 | (1.8) |
| Finland | 65.3 | (3.6) | 75.9 | (3.4) | 9.5 | (2.2) |
| France | w | w | w | w | w | w |
| Germany | 73.2 | (3.2) | 79.7 | (2.9) | 7.1 | (1.4) |
| Greece | 78.7 | (4.7) | 76.5 | (4.3) | 15.7 | (3.9) |
| Hungary | 75.4 | (3.7) | 84.6 | (2.6) | 8.3 | (2.2) |
| Iceland | 80.8 | (0.2) | 93.3 | (0.1) | 13.8 | (0.1) |
| Ireland | 71.6 | (4.0) | 76.3 | (4.0) | 11.7 | (2.5) |
| Italy | 73.3 | (3.0) | 78.6 | (3.1) | 23.0 | (3.1) |
| Japan | 66.8 | (4.6) | 57.8 | (4.1) | 0.0 | (0.0) |
| Korea | 93.1 | (2.0) | 82.7 | (3.2) | 10.2 | (2.4) |
| Luxembourg | 50.7 | (0.1) | 89.5 | (0.1) | 18.5 | (0.1) |
| Mexico | 86.5 | (2.3) | 79.4 | (3.4) | 46.7 | (2.9) |
| Netherlands | 44.2 | (4.6) | 87.0 | (3.3) | 13.2 | (3.2) |
| New Zealand | 61.9 | (3.2) | 88.8 | (2.0) | 5.1 | (1.4) |
| Norway | 70.0 | (3.4) | 89.2 | (2.8) | 12.7 | (2.6) |
| Poland | 95.5 | (1.7) | 66.8 | (3.4) | 9.4 | (2.3) |
| Portugal | 63.0 | (4.5) | 80.1 | (3.7) | 18.7 | (3.7) |
| Slovak Republic | 88.8 | (2.1) | 75.0 | (2.5) | 15.6 | (3.1) |
| Spain | 78.4 | (3.3) | 81.9 | (2.9) | 11.3 | (2.8) |
| Sweden | 70.1 | (3.5) | 92.1 | (2.1) | 14.2 | (2.6) |
| Switzerland | 74.5 | (3.9) | 76.9 | (3.3) | 8.1 | (1.5) |
| Turkey | 84.2 | (3.9) | 81.4 | (3.8) | 32.6 | (4.3) |
| United States | 70.2 | (3.1) | 91.5 | (1.9) | 10.2 | (2.2) |
| ***OECD average*** | *71.7* | *(0.6)* | *80.8* | *(0.5)* | *13.3* | *(0.5)* |
| **Partners** | | | | | | |
| Brazil | 84.5 | (2.9) | 67.7 | (3.3) | 24.2 | (3.3) |
| Hong Kong-China | 77.7 | (3.4) | 90.8 | (2.4) | 6.5 | (2.1) |
| Indonesia | 94.0 | (1.7) | 96.0 | (1.3) | 35.2 | (3.6) |
| Latvia | 86.2 | (2.9) | 78.7 | (3.8) | 8.2 | (2.4) |
| Liechtenstein | 64.2 | (0.4) | 83.1 | (0.4) | 0.0 | (0.0) |
| Macao-China | 85.7 | (0.2) | 78.8 | (0.1) | 5.6 | (0.1) |
| Russian Fed. | 91.4 | (2.3) | 85.2 | (2.2) | 19.1 | (2.9) |
| Serbia | 62.9 | (4.4) | 85.2 | (3.5) | 17.0 | (2.9) |
| Thailand | 99.3 | (0.6) | 95.9 | (1.6) | 27.5 | (3.6) |
| Tunisia | 70.3 | (3.8) | 91.8 | (2.3) | 32.2 | (3.8) |
| Uruguay | 76.6 | (3.3) | 69.0 | (2.6) | 24.5 | (4.0) |
| United Kingdom[1] | 58.5 | (4.0) | 86.3 | (2.3) | 2.3 | (0.9) |

1. Response rate too low to ensure comparability.

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Table A.10
**Streaming of students in some or all mathematics classes**

| | Mathematics classes study similar content. but at different levels of difficulty | | | | | | Different classes study different content or sets of mathematics topics that have different levels of difficulty | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | For all classes | | For some classes | | Not for any classes | | For all classes | | For some classes | | Not for any classes | |
| | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 32.2 | (3.1) | 56.8 | (2.9) | 11.0 | (2.0) | 22.9 | (2.8) | 60.4 | (3.2) | 16.7 | (2.6) |
| Austria | 16.3 | (1.9) | 13.7 | (2.7) | 70.1 | (2.1) | m | m | m | m | m | m |
| Belgium | 4.4 | (1.3) | 46.8 | (3.1) | 48.8 | (3.0) | 16.8 | (1.8) | 44.1 | (2.9) | 39.1 | (3.1) |
| Canada | 26.6 | (2.2) | 54.4 | (2.2) | 19.1 | (2.0) | 33.4 | (1.9) | 52.5 | (2.1) | 14.0 | (1.6) |
| Czech Republic | 7.6 | (1.7) | 17.6 | (2.5) | 74.7 | (2.8) | 8.7 | (2.3) | 23.7 | (3.1) | 67.6 | (3.5) |
| Denmark | 23.0 | (3.4) | 23.3 | (3.7) | 53.7 | (4.1) | 14.7 | (2.8) | 23.6 | (3.5) | 61.8 | (3.3) |
| Finland | 10.9 | (2.2) | 27.6 | (3.7) | 61.5 | (3.8) | 1.4 | (0.9) | 32.7 | (3.5) | 66.0 | (3.5) |
| France | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | 24.2 | (2.9) | 18.2 | (2.8) | 57.5 | (3.2) | 12.2 | (2.5) | 16.6 | (2.6) | 71.2 | (2.9) |
| Greece | 6.2 | (3.0) | 12.8 | (3.6) | 80.9 | (3.5) | 0.0 | (0.0) | 4.7 | (2.2) | 95.3 | (2.2) |
| Hungary | 19.3 | (3.5) | 37.3 | (4.0) | 43.4 | (4.0) | 5.7 | (2.0) | 24.1 | (3.4) | 70.1 | (3.7) |
| Iceland | 52.7 | (0.2) | 19.2 | (0.1) | 28.2 | (0.2) | 22.9 | (0.1) | 34.7 | (0.2) | 42.4 | (0.2) |
| Ireland | 60.9 | (4.4) | 34.4 | (4.4) | 4.7 | (1.9) | 27.0 | (4.0) | 45.8 | (4.3) | 27.1 | (4.0) |
| Italy | 21.5 | (2.7) | 34.0 | (3.5) | 44.5 | (3.1) | 9.8 | (2.2) | 45.6 | (3.4) | 44.6 | (3.6) |
| Japan | 13.7 | (2.6) | 29.8 | (3.8) | 56.6 | (4.4) | 3.4 | (1.5) | 23.9 | (3.3) | 72.7 | (3.5) |
| Korea | 10.9 | (2.8) | 60.2 | (4.5) | 28.9 | (3.8) | 2.3 | (1.3) | 55.0 | (4.1) | 42.7 | (4.0) |
| Luxembourg | 4.3 | (0.0) | 41.8 | (0.1) | 54.0 | (0.1) | 19.0 | (0.0) | 41.3 | (0.1) | 39.7 | (0.1) |
| Mexico | 15.6 | (2.4) | 56.3 | (3.7) | 28.0 | (3.3) | 13.5 | (1.8) | 57.2 | (3.3) | 29.3 | (3.0) |
| Netherlands | 34.8 | (4.4) | 42.4 | (4.2) | 22.7 | (3.6) | 39.7 | (4.2) | 38.7 | (4.1) | 21.6 | (3.8) |
| New Zealand | 37.0 | (3.5) | 59.8 | (3.4) | 3.2 | (1.2) | 14.6 | (2.4) | 76.8 | (3.0) | 8.7 | (2.1) |
| Norway | 78.1 | (3.5) | 14.2 | (2.9) | 7.6 | (2.0) | 8.0 | (2.2) | 17.3 | (3.3) | 74.7 | (3.7) |
| Poland | 41.9 | (3.8) | 38.2 | (3.9) | 20.0 | (3.2) | 1.0 | (0.7) | 21.1 | (3.1) | 78.0 | (3.2) |
| Portugal | 32.3 | (4.1) | 39.5 | (4.3) | 28.2 | (4.3) | 0.7 | (0.5) | 9.8 | (2.2) | 89.5 | (2.2) |
| Slovak Republic | 44.2 | (3.7) | 25.8 | (3.1) | 30.0 | (3.4) | 11.8 | (2.9) | 21.7 | (2.6) | 66.5 | (3.5) |
| Spain | 33.3 | (3.6) | 58.3 | (3.5) | 8.4 | (2.4) | 6.9 | (1.8) | 50.5 | (3.9) | 42.5 | (3.9) |
| Sweden | 50.7 | (3.9) | 39.6 | (3.9) | 9.7 | (2.2) | 12.4 | (2.6) | 45.2 | (4.0) | 42.4 | (3.7) |
| Switzerland | 19.9 | (2.3) | 46.6 | (4.1) | 33.5 | (3.9) | 20.7 | (3.3) | 34.9 | (3.9) | 44.4 | (3.6) |
| Turkey | 33.2 | (4.4) | 41.9 | (4.7) | 24.9 | (3.6) | 23.5 | (4.0) | 39.9 | (4.1) | 36.6 | (4.2) |
| United States | 25.4 | (3.0) | 65.5 | (3.3) | 9.1 | (2.0) | 31.4 | (3.2) | 56.2 | (3.3) | 12.4 | (2.3) |
| ***OECD average*** | *29.8* | *(0.6)* | *37.0* | *(0.6)* | *33.3* | *(0.6)* | *14.8* | *(0.5)* | *37.1* | *(0.6)* | *48.1* | *(0.6)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 44.3 | (3.5) | 28.7 | (3.3) | 27.0 | (3.4) | 29.8 | (3.3) | 27.4 | (3.7) | 42.8 | (3.7) |
| Hong Kong-China | 15.9 | (3.2) | 70.3 | (4.0) | 13.8 | (3.2) | 14.1 | (2.9) | 54.7 | (4.3) | 31.2 | (4.1) |
| Indonesia | 46.9 | (3.1) | 24.4 | (3.5) | 28.7 | (3.3) | 31.0 | (3.3) | 17.8 | (2.8) | 51.2 | (3.7) |
| Latvia | 34.3 | (4.9) | 52.4 | (5.1) | 13.3 | (3.3) | 13.1 | (3.2) | 47.0 | (4.8) | 39.8 | (4.7) |
| Liechtenstein | 21.6 | (0.5) | 37.0 | (0.4) | 41.4 | (0.4) | 11.2 | (0.5) | 70.4 | (0.5) | 18.3 | (0.2) |
| Macao-China | 7.2 | (0.0) | 40.6 | (0.2) | 52.2 | (0.2) | 17.9 | (0.2) | 32.2 | (0.2) | 49.9 | (0.2) |
| Russian Fed. | 33.4 | (3.4) | 56.1 | (3.9) | 10.6 | (2.6) | 24.7 | (3.4) | 40.5 | (3.8) | 34.8 | (4.1) |
| Serbia | 15.7 | (3.2) | 61.0 | (4.3) | 23.3 | (3.8) | 15.7 | (3.2) | 55.9 | (4.5) | 28.4 | (3.9) |
| Thailand | 27.6 | (3.8) | 41.9 | (4.0) | 30.5 | (4.2) | 36.6 | (4.6) | 34.1 | (4.1) | 29.3 | (4.0) |
| Tunisia | 36.1 | (3.9) | 11.4 | (2.3) | 52.5 | (3.9) | 17.7 | (3.6) | 12.7 | (2.7) | 69.6 | (4.1) |
| Uruguay | 13.3 | (2.5) | 56.9 | (4.1) | 29.8 | (4.3) | 7.6 | (1.8) | 35.6 | (4.6) | 56.9 | (4.5) |
| United Kingdom[1] | 82.3 | (2.2) | 16.1 | (2.2) | 1.6 | (0.3) | 29.0 | (3.6) | 40.5 | (3.9) | 30.5 | (3.7) |

1. Response rate too low to ensure comparability.

Table A.11
**Ability grouping within mathematics classes**

| | Students are grouped by ability within their mathematics classes | | | | | | In mathematics classes, teachers use a pedagogy suitable for students with heterogeneous abilities (*i.e.* students are not grouped by ability) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | For all classes | | For some classes | | Not for any classes | | For all classes | | For some classes | | Not for any classes | |
| | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. |
| **OECD** | | | | | | | | | | | | |
| Australia | 49.6 | (3.1) | 34.4 | (2.9) | 16.1 | (2.3) | 18.1 | (2.5) | 44.5 | (3.0) | 37.4 | (3.0) |
| Austria | 7.7 | (2.0) | 19.7 | (3.0) | 72.5 | (2.7) | 23.7 | (3.2) | 40.0 | (3.2) | 36.3 | (3.8) |
| Belgium | 2.1 | (0.7) | 16.7 | (2.5) | 81.1 | (2.5) | 50.2 | (3.2) | 31.3 | (3.1) | 18.5 | (2.1) |
| Canada | 18.4 | (2.0) | 34.6 | (2.4) | 47.0 | (2.5) | 37.0 | (2.2) | 38.8 | (2.1) | 24.2 | (2.1) |
| Czech Republic | 13.1 | (2.2) | 28.8 | (3.2) | 58.2 | (3.1) | 53.4 | (3.5) | 30.7 | (3.0) | 15.8 | (2.4) |
| Denmark | 5.4 | (1.8) | 15.2 | (2.8) | 79.3 | (2.9) | 73.8 | (3.1) | 18.2 | (3.1) | 8.0 | (1.6) |
| Finland | 7.0 | (2.0) | 36.2 | (3.9) | 56.8 | (4.3) | 39.9 | (3.9) | 45.7 | (4.3) | 14.4 | (2.9) |
| France | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | 11.2 | (2.3) | 34.6 | (3.6) | 54.2 | (3.5) | 35.2 | (3.6) | 17.0 | (2.4) | 47.8 | (3.6) |
| Greece | 0.6 | (0.5) | 1.3 | (1.1) | 98.1 | (1.3) | 62.0 | (4.7) | 12.6 | (3.9) | 25.4 | (4.1) |
| Hungary | 15.2 | (2.9) | 38.9 | (4.2) | 45.9 | (4.3) | 49.2 | (4.4) | 38.6 | (4.0) | 12.1 | (2.5) |
| Iceland | 23.3 | (0.1) | 46.4 | (0.2) | 30.4 | (0.2) | 47.9 | (0.2) | 39.2 | (0.2) | 12.9 | (0.1) |
| Ireland | 49.3 | (4.2) | 28.1 | (4.2) | 22.6 | (3.7) | 27.1 | (4.2) | 42.7 | (4.6) | 30.3 | (4.1) |
| Italy | 2.7 | (1.4) | 21.4 | (3.2) | 75.8 | (3.5) | 39.1 | (3.3) | 37.3 | (3.6) | 23.7 | (2.8) |
| Japan | 13.8 | (2.7) | 22.4 | (3.5) | 63.7 | (4.2) | 19.6 | (3.5) | 18.7 | (3.3) | 61.7 | (3.9) |
| Korea | 5.9 | (1.9) | 64.6 | (3.9) | 29.5 | (3.8) | 14.9 | (2.7) | 69.4 | (4.0) | 15.7 | (3.1) |
| Luxembourg | 0.0 | (0.0) | 6.9 | (0.0) | 93.1 | (0.0) | 46.2 | (0.1) | 34.0 | (0.1) | 19.7 | (0.0) |
| Mexico | 8.1 | (1.7) | 40.5 | (3.5) | 51.4 | (3.3) | 32.1 | (3.4) | 41.5 | (3.3) | 26.4 | (3.2) |
| Netherlands | 11.5 | (2.5) | 44.8 | (4.4) | 43.8 | (4.7) | 29.7 | (4.1) | 39.1 | (4.4) | 31.2 | (4.0) |
| New Zealand | 19.3 | (2.9) | 66.1 | (3.4) | 14.6 | (2.5) | 23.5 | (2.9) | 57.5 | (3.5) | 19.0 | (2.9) |
| Norway | 4.7 | (1.7) | 22.1 | (3.2) | 73.2 | (3.6) | 78.0 | (3.4) | 16.1 | (3.0) | 5.9 | (1.9) |
| Poland | 3.5 | (1.5) | 17.7 | (3.1) | 78.9 | (3.4) | 73.3 | (3.3) | 18.9 | (3.0) | 7.8 | (2.2) |
| Portugal | 0.5 | (0.5) | 13.8 | (2.8) | 85.8 | (2.9) | 67.5 | (4.2) | 16.9 | (3.0) | 15.6 | (3.1) |
| Slovak Republic | 8.0 | (1.6) | 26.8 | (3.5) | 65.2 | (3.4) | 53.3 | (3.5) | 22.5 | (3.2) | 24.3 | (2.8) |
| Spain | 8.3 | (1.4) | 33.7 | (3.2) | 58.1 | (3.1) | 51.0 | (3.6) | 32.7 | (3.1) | 16.3 | (2.9) |
| Sweden | 22.3 | (3.4) | 44.8 | (3.5) | 33.0 | (3.6) | 34.0 | (4.0) | 45.2 | (3.7) | 20.8 | (3.1) |
| Switzerland | 13.9 | (2.6) | 27.5 | (3.6) | 58.6 | (3.3) | 42.2 | (3.8) | 28.9 | (3.8) | 28.9 | (3.5) |
| Turkey | 8.0 | (2.7) | 16.9 | (3.6) | 75.1 | (4.3) | 12.4 | (3.0) | 27.5 | (4.2) | 60.1 | (5.1) |
| United States | 21.9 | (3.3) | 45.7 | (3.6) | 32.4 | (3.1) | 14.2 | (2.3) | 46.6 | (3.8) | 39.2 | (3.8) |
| ***OECD average*** | *14.0* | *(0.4)* | *30.3* | *(0.6)* | *55.7* | *(0.6)* | *39.9* | *(0.6)* | *33.6* | *(0.6)* | *26.5* | *(0.6)* |
| **Partners** | | | | | | | | | | | | |
| Brazil | 5.8 | (1.7) | 8.9 | (2.4) | 85.3 | (2.6) | 30.4 | (3.2) | 16.5 | (3.0) | 53.1 | (3.7) |
| Hong Kong-China | 3.7 | (1.6) | 32.0 | (3.9) | 64.4 | (3.9) | 34.5 | (3.9) | 47.1 | (4.5) | 18.4 | (3.1) |
| Indonesia | 9.3 | (2.3) | 12.3 | (2.1) | 78.4 | (3.1) | 76.3 | (3.3) | 10.0 | (2.3) | 13.8 | (2.7) |
| Latvia | 5.1 | (1.8) | 71.2 | (3.3) | 23.7 | (3.1) | 43.7 | (4.4) | 52.1 | (4.3) | 4.2 | (1.7) |
| Liechtenstein | 25.4 | (0.5) | 35.8 | (0.4) | 38.8 | (0.4) | 33.1 | (0.4) | 33.7 | (0.4) | 33.1 | (0.5) |
| Macao-China | 0.0 | (0.0) | 12.7 | (0.2) | 87.3 | (0.2) | 63.4 | (0.2) | 17.2 | (0.2) | 19.4 | (0.2) |
| Russian Fed. | 8.3 | (2.1) | 71.4 | (4.1) | 20.3 | (4.0) | 43.1 | (4.3) | 53.6 | (4.6) | 3.3 | (1.6) |
| Serbia | 0.0 | (0.0) | 56.0 | (4.9) | 44.0 | (4.9) | 14.6 | (3.3) | 64.2 | (4.3) | 21.2 | (3.8) |
| Thailand | 13.2 | (2.6) | 43.5 | (3.6) | 43.3 | (3.6) | 35.5 | (3.6) | 48.6 | (3.8) | 16.0 | (2.7) |
| Tunisia | 6.3 | (2.0) | 11.1 | (2.8) | 82.6 | (3.1) | 63.6 | (4.3) | 7.9 | (2.4) | 28.5 | (3.8) |
| Uruguay | 0.0 | (0.0) | 11.9 | (2.5) | 88.1 | (2.5) | 44.3 | (3.6) | 44.2 | (3.6) | 11.5 | (2.4) |
| United Kingdom[1] | 50.6 | (3.1) | 27.3 | (3.1) | 22.1 | (2.9) | 9.2 | (2.0) | 22.0 | (3.2) | 68.8 | (3.7) |

1. Response rate too low to ensure comparability.

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Table A.12
**Methods of assessment**

| | Standardised tests | | | | Teacher tests | | | | Teacher ratings | | | | Student portfolios | | | | Student assignments | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1-2 times a year | | More than 3 times a year | | 1-2 times a year | | More than 3 times a year | | 1-2 times a year | | More than 3 times a year | | 1-2 times a year | | More than 3 times a year | | 1-2 times a year | | More than 3 times a year | |
| | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. |
| **OECD** | | | | | | | | | | | | | | | | | | | | |
| Australia | 49.8 | (3.3) | 11.3 | (2.0) | 3.3 | (1.2) | 96.2 | (1.3) | 16.5 | (2.2) | 76.2 | (2.5) | 36.4 | (3.0) | 40.4 | (2.7) | 1.3 | (0.7) | 98.2 | (0.8) |
| Austria | 19.8 | (3.2) | 11.9 | (2.6) | 7.7 | (2.2) | 92.3 | (2.2) | 4.6 | (2.1) | 95.4 | (2.1) | 42.5 | (4.1) | 43.5 | (4.0) | 9.6 | (2.3) | 89.0 | (2.4) |
| Belgium | 20.5 | (2.8) | 9.5 | (1.9) | 8.2 | (1.5) | 90.9 | (1.6) | 4.2 | (1.1) | 90.5 | (1.8) | 34.9 | (3.0) | 42.5 | (3.0) | 3.8 | (1.2) | 95.0 | (1.4) |
| Canada | 70.6 | (1.8) | 12.6 | (1.5) | 1.0 | (0.5) | 99.0 | (0.5) | 8.7 | (1.3) | 73.8 | (2.1) | 41.8 | (2.2) | 38.6 | (2.3) | 2.1 | (0.7) | 97.9 | (0.7) |
| Czech Republic | 69.1 | (3.2) | 9.3 | (1.7) | 6.3 | (1.6) | 93.3 | (1.6) | 15.0 | (2.2) | 81.7 | (2.6) | 30.3 | (2.9) | 65.4 | (3.0) | 8.0 | (2.1) | 91.9 | (2.1) |
| Denmark | 70.8 | (3.0) | 16.4 | (3.0) | 31.3 | (3.4) | 65.3 | (3.3) | 44.2 | (3.8) | 55.0 | (3.7) | 11.8 | (2.4) | 81.9 | (2.9) | 11.1 | (2.2) | 88.0 | (2.1) |
| Finland | 83.2 | (2.9) | 16.5 | (2.9) | 0.0 | (0.0) | 100.0 | (0.0) | 39.5 | (3.6) | 55.9 | (3.8) | 57.2 | (3.8) | 16.3 | (3.1) | 11.6 | (2.5) | 88.4 | (2.5) |
| France | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | 37.1 | (3.2) | 6.3 | (1.5) | 4.0 | (1.5) | 96.0 | (1.5) | 9.0 | (1.9) | 89.5 | (2.2) | 45.1 | (3.6) | 52.9 | (3.7) | 9.0 | (2.0) | 90.4 | (2.1) |
| Greece | 32.4 | (5.4) | 32.0 | (5.8) | 8.0 | (2.5) | 92.0 | (2.5) | 43.8 | (5.1) | 56.2 | (5.1) | 37.7 | (4.8) | 17.0 | (4.1) | 54.1 | (5.4) | 14.7 | (4.3) |
| Hungary | 71.7 | (4.0) | 18.9 | (3.4) | 1.3 | (0.8) | 98.5 | (0.9) | 14.2 | (2.6) | 82.5 | (3.0) | 51.0 | (4.1) | 47.4 | (4.2) | 1.2 | (0.8) | 98.8 | (0.8) |
| Iceland | 84.8 | (0.2) | 14.6 | (0.1) | 5.0 | (0.1) | 95.0 | (0.1) | 8.5 | (0.1) | 91.5 | (0.1) | 19.0 | (0.2) | 80.3 | (0.2) | 4.0 | (0.1) | 96.0 | (0.1) |
| Ireland | 44.8 | (4.5) | 10.5 | (2.8) | 25.6 | (4.2) | 74.4 | (4.2) | 22.9 | (3.7) | 72.7 | (4.0) | 48.2 | (4.3) | 13.3 | (3.0) | 2.7 | (1.4) | 94.5 | (1.8) |
| Italy | 38.2 | (3.4) | 38.2 | (3.4) | 5.6 | (1.7) | 93.4 | (1.8) | 7.8 | (1.8) | 85.0 | (2.7) | 20.3 | (2.5) | 76.0 | (2.8) | 8.7 | (1.8) | 90.0 | (1.9) |
| Japan | 32.7 | (4.2) | 24.1 | (3.4) | 0.7 | (0.7) | 99.3 | (0.7) | 15.5 | (3.3) | 79.8 | (3.6) | 15.4 | (3.3) | 84.6 | (3.3) | 18.0 | (3.4) | 82.0 | (3.4) |
| Korea | 36.1 | (4.0) | 58.7 | (3.8) | 2.4 | (1.4) | 97.6 | (1.4) | 32.7 | (3.9) | 66.6 | (4.0) | 46.7 | (4.5) | 44.4 | (4.7) | 34.2 | (4.2) | 65.4 | (4.2) |
| Luxembourg | 82.4 | (0.1) | 10.7 | (0.0) | 7.6 | (0.0) | 84.3 | (0.1) | 5.3 | (0.0) | 84.4 | (0.0) | 33.5 | (0.1) | 41.0 | (0.1) | 10.0 | (0.0) | 87.6 | (0.0) |
| Mexico | 34.5 | (3.4) | 40.6 | (3.4) | 8.1 | (1.5) | 88.2 | (2.0) | 24.7 | (2.5) | 55.4 | (3.1) | 18.1 | (2.2) | 75.2 | (2.7) | 19.1 | (2.5) | 75.0 | (3.0) |
| Netherlands | 30.9 | (4.5) | 44.2 | (4.4) | 0.0 | (0.0) | 99.5 | (0.5) | 20.2 | (3.3) | 52.1 | (4.3) | 28.2 | (3.9) | 16.4 | (3.3) | 8.7 | (2.2) | 89.9 | (2.4) |
| New Zealand | 29.4 | (3.1) | 51.6 | (3.3) | 4.6 | (1.4) | 95.4 | (1.4) | 22.7 | (2.8) | 66.3 | (2.9) | 50.8 | (3.5) | 39.7 | (3.5) | 5.9 | (1.5) | 91.6 | (2.0) |
| Norway | 64.9 | (4.1) | 29.7 | (3.5) | 0.0 | (0.0) | 100.0 | (0.0) | 21.1 | (3.3) | 78.9 | (3.3) | 30.6 | (3.9) | 23.4 | (3.7) | 4.4 | (1.6) | 95.0 | (1.5) |
| Poland | 73.5 | (3.6) | 20.1 | (3.0) | 6.6 | (1.8) | 93.4 | (1.8) | 21.2 | (3.2) | 13.2 | (2.9) | 37.3 | (3.7) | 26.7 | (3.4) | 4.2 | (1.6) | 95.8 | (1.6) |
| Portugal | 82.6 | (3.5) | 0.0 | (0.0) | 0.0 | (0.0) | 100.0 | (0.0) | 0.6 | (0.6) | 99.4 | (0.6) | 38.4 | (4.8) | 20.6 | (3.6) | 7.7 | (2.4) | 92.3 | (2.4) |
| Slovak Republic | 59.2 | (3.1) | 16.5 | (3.2) | 6.9 | (1.4) | 93.1 | (1.4) | 5.1 | (1.6) | 94.9 | (1.6) | 46.5 | (3.6) | 43.7 | (3.6) | 14.6 | (2.3) | 84.8 | (2.3) |
| Spain | 30.5 | (3.3) | 36.4 | (3.3) | 0.0 | (0.0) | 100.0 | (0.0) | 4.0 | (1.2) | 88.3 | (2.2) | 3.0 | (0.9) | 96.0 | (1.0) | 2.9 | (1.1) | 97.1 | (1.1) |
| Sweden | 55.9 | (4.1) | 41.0 | (4.1) | 2.1 | (1.0) | 96.2 | (1.5) | 9.8 | (2.4) | 89.0 | (2.6) | 26.0 | (3.6) | 13.1 | (2.8) | 3.4 | (1.4) | 94.6 | (1.8) |
| Switzerland | 38.7 | (4.2) | 11.1 | (2.4) | 2.0 | (0.7) | 97.8 | (0.7) | 13.6 | (2.2) | 84.5 | (2.3) | 32.3 | (3.8) | 17.7 | (2.4) | 14.0 | (2.3) | 85.3 | (2.3) |
| Turkey | 44.9 | (5.3) | 42.6 | (5.0) | 42.6 | (4.1) | 40.0 | (4.5) | 51.8 | (4.9) | 42.1 | (4.8) | 54.8 | (4.9) | 32.0 | (4.2) | 62.9 | (4.5) | 35.5 | (4.6) |
| United States | 77.1 | (3.0) | 21.3 | (2.8) | 0.5 | (0.5) | 99.5 | (0.5) | 4.2 | (1.4) | 95.1 | (1.5) | 47.2 | (3.7) | 32.3 | (3.3) | 0.5 | (0.5) | 99.5 | (0.5) |
| ***OECD average*** | *52.6* | *(0.7)* | *23.0* | *(0.6)* | *7.2* | *(0.3)* | *91.4* | *(0.3)* | *17.8* | *(0.5)* | *74.8* | *(0.6)* | *36.0* | *(0.6)* | *43.3* | *(0.6)* | *11.9* | *(0.4)* | *86.1* | *(0.4)* |
| **Partners** | | | | | | | | | | | | | | | | | | | | |
| Brazil | 27.2 | (3.0) | 33.1 | (3.4) | 1.3 | (0.8) | 96.6 | (1.2) | 5.2 | (1.9) | 90.3 | (2.2) | 3.1 | (1.3) | 94.4 | (1.8) | 1.7 | (1.0) | 96.6 | (1.4) |
| Hong Kong-China | m | m | m | m | 5.9 | (2.0) | 94.1 | (2.0) | 48.7 | (4.8) | 35.3 | (4.2) | 44.5 | (4.2) | 16.5 | (3.4) | 25.1 | (3.8) | 74.9 | (3.8) |
| Indonesia | 50.0 | (3.8) | 16.1 | (2.9) | 6.4 | (1.4) | 77.5 | (3.3) | 40.9 | (3.4) | 53.4 | (3.4) | 24.5 | (4.1) | 27.8 | (3.4) | 2.4 | (1.3) | 91.8 | (2.0) |
| Latvia | 50.2 | (4.0) | 49.4 | (4.0) | 3.3 | (1.3) | 96.7 | (1.3) | 5.9 | (2.1) | 92.5 | (2.4) | 28.3 | (3.7) | 71.3 | (3.7) | 11.3 | (2.7) | 88.1 | (2.8) |
| Liechtenstein | 74.0 | (0.5) | 9.5 | (0.1) | 0.0 | (0.0) | 100.0 | (0.0) | 17.7 | (0.4) | 82.3 | (0.4) | 73.7 | (0.3) | 21.0 | (0.3) | 13.0 | (0.5) | 87.0 | (0.5) |
| Macao-China | m | m | m | m | 2.4 | (0.0) | 97.6 | (0.0) | 26.9 | (0.2) | 62.6 | (0.2) | 28.4 | (0.3) | 42.5 | (0.3) | 16.0 | (0.1) | 84.0 | (0.1) |
| Russian Fed. | 54.8 | (4.3) | 26.8 | (3.9) | 5.2 | (1.8) | 94.6 | (1.8) | 19.7 | (3.0) | 68.3 | (2.9) | 32.3 | (4.1) | 42.3 | (4.5) | 21.6 | (3.2) | 78.2 | (3.2) |
| Serbia | 35.6 | (4.1) | 6.8 | (2.4) | 32.3 | (3.9) | 67.1 | (4.0) | 2.7 | (1.4) | 95.6 | (1.7) | 13.9 | (3.1) | 5.9 | (1.5) | 50.5 | (4.3) | 40.0 | (4.2) |
| Thailand | 80.6 | (3.5) | 3.6 | (1.4) | 15.4 | (2.9) | 78.3 | (3.4) | 58.3 | (4.1) | 29.9 | (3.4) | 47.4 | (4.5) | 37.4 | (4.0) | 13.2 | (2.8) | 83.7 | (3.0) |
| Tunisia | 16.7 | (3.3) | 56.8 | (4.1) | 5.3 | (1.6) | 87.4 | (2.4) | 8.1 | (2.5) | 70.4 | (3.9) | 33.4 | (4.0) | 40.9 | (4.1) | 23.7 | (3.8) | 63.5 | (4.1) |
| Uruguay | 25.3 | (3.4) | 6.4 | (2.1) | 0.8 | (0.5) | 99.2 | (0.5) | 4.6 | (1.6) | 94.2 | (1.8) | 13.5 | (2.5) | 24.8 | (2.4) | 15.2 | (3.4) | 84.8 | (3.4) |
| United Kingdom[1] | 60.2 | (3.5) | 10.9 | (2.2) | 18.3 | (2.7) | 81.6 | (2.7) | 23.5 | (3.5) | 74.3 | (3.6) | 58.1 | (3.5) | 31.8 | (3.4) | 6.1 | (1.7) | 93.8 | (1.7) |

1. Response rate too low to ensure comparability.

Table A.13
**Use of assessment results**

| | Inform parents about their child's progress | | Student retention/ promotion | | Group students | | Compare to national standards | | School's progress | | Teachers' effectiveness | | Improve curriculum | | Compare to other schools | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. | % | S.E. |
| **OECD** | | | | | | | | | | | | | | | | |
| Australia | 100.0 | (0.0) | 61.5 | (2.9) | 77.8 | (2.6) | 54.9 | (2.4) | 76.5 | (2.7) | 34.0 | (2.9) | 81.5 | (2.5) | 38.7 | (2.7) |
| Austria | 92.2 | (2.2) | 93.2 | (2.3) | 31.8 | (2.3) | 12.4 | (2.8) | 59.2 | (3.9) | 35.6 | (3.5) | 65.6 | (3.7) | 38.0 | (3.9) |
| Belgium | 99.6 | (0.4) | 99.1 | (0.6) | 19.9 | (2.4) | 9.6 | (2.2) | 37.6 | (2.8) | 19.4 | (2.4) | 66.1 | (3.0) | 6.9 | (1.7) |
| Canada | 99.4 | (0.3) | 95.5 | (1.0) | 72.0 | (2.1) | 70.1 | (2.2) | 79.5 | (1.8) | 31.4 | (2.4) | 84.1 | (1.8) | 53.0 | (2.4) |
| Czech Republic | 98.3 | (0.9) | 91.8 | (1.9) | 35.2 | (3.3) | 50.0 | (3.3) | 85.6 | (2.4) | 61.7 | (3.4) | 88.7 | (2.1) | 55.3 | (3.7) |
| Denmark | 67.6 | (3.5) | 3.8 | (0.9) | 14.1 | (2.6) | 5.9 | (1.7) | 8.4 | (2.0) | 3.7 | (1.4) | 46.7 | (3.9) | 2.9 | (1.3) |
| Finland | 100.0 | (0.0) | 95.2 | (0.9) | 17.1 | (3.0) | 56.3 | (4.0) | 65.0 | (4.1) | 32.1 | (3.5) | 65.6 | (3.6) | 34.9 | (3.5) |
| Germany | 96.1 | (1.4) | 96.3 | (1.2) | 35.8 | (3.0) | 21.2 | (3.2) | 44.0 | (3.2) | 11.8 | (2.3) | 44.8 | (3.9) | 17.1 | (2.7) |
| Greece | 96.6 | (2.0) | 99.4 | (0.5) | 11.1 | (2.1) | 12.2 | (2.8) | 35.6 | (5.7) | 15.2 | (4.4) | 40.5 | (5.3) | 15.8 | (3.0) |
| Hungary | 99.1 | (0.9) | 94.7 | (1.9) | 34.8 | (3.5) | 86.4 | (2.6) | 95.8 | (1.4) | 77.0 | (3.5) | 93.7 | (2.1) | 77.5 | (3.2) |
| Iceland | 99.7 | (0.0) | 14.8 | (0.1) | 56.1 | (0.2) | 84.1 | (0.1) | 88.1 | (0.1) | 30.9 | (0.2) | 96.6 | (0.0) | 65.6 | (0.2) |
| Ireland | 99.3 | (0.7) | 43.7 | (4.2) | 78.1 | (3.3) | 17.2 | (3.2) | 49.5 | (4.0) | 16.9 | (3.2) | 42.2 | (4.3) | 8.8 | (2.6) |
| Italy | 96.0 | (1.3) | 83.7 | (2.8) | 51.5 | (3.9) | 32.8 | (3.4) | 69.3 | (3.0) | 23.3 | (3.2) | 83.8 | (2.9) | 29.1 | (3.2) |
| Japan | 98.3 | (1.0) | 89.5 | (2.6) | 44.7 | (4.5) | 17.8 | (3.4) | 47.7 | (4.4) | 81.5 | (3.3) | 78.9 | (3.4) | 11.8 | (2.8) |
| Korea | 95.5 | (1.8) | 24.8 | (3.8) | 62.6 | (4.0) | 62.0 | (3.7) | 58.6 | (4.0) | 54.5 | (4.3) | 90.2 | (2.7) | 54.9 | (3.9) |
| Luxembourg | 100.0 | (0.0) | 100.0 | (0.0) | 29.7 | (0.1) | 21.8 | (0.0) | 26.1 | (0.1) | 21.0 | (0.0) | 62.9 | (0.1) | 10.3 | (0.0) |
| Mexico | 96.7 | (0.9) | 92.9 | (1.8) | 59.4 | (3.2) | 55.5 | (3.1) | 91.2 | (1.6) | 77.3 | (3.1) | 89.2 | (2.2) | 50.5 | (3.5) |
| Netherlands | 99.5 | (0.5) | 96.8 | (1.6) | 88.7 | (2.7) | 63.5 | (4.1) | 63.3 | (4.2) | 42.2 | (4.4) | 71.8 | (3.9) | 47.0 | (4.4) |
| New Zealand | 98.4 | (1.0) | 77.9 | (2.8) | 73.7 | (3.0) | 86.7 | (2.3) | 95.6 | (1.6) | 53.0 | (3.4) | 95.8 | (1.2) | 73.5 | (3.2) |
| Norway | 100.0 | (0.0) | m | m | 37.8 | (4.0) | 63.8 | (3.6) | 67.7 | (3.3) | 19.5 | (3.0) | 70.1 | (3.5) | 47.1 | (3.8) |
| Poland | 98.0 | (1.1) | 84.2 | (2.8) | 33.0 | (4.1) | 71.1 | (3.7) | 96.6 | (1.5) | 73.2 | (3.2) | 87.8 | (2.8) | 62.3 | (3.6) |
| Portugal | 98.8 | (0.7) | 96.6 | (1.6) | 26.1 | (3.8) | 32.9 | (4.2) | 78.5 | (3.1) | 34.7 | (4.4) | 84.3 | (3.2) | 22.3 | (3.4) |
| Slovak Republic | 98.7 | (0.7) | 96.7 | (1.0) | 54.9 | (3.8) | 45.9 | (3.7) | 95.0 | (1.5) | 75.0 | (2.7) | 89.0 | (2.2) | 47.7 | (3.1) |
| Spain | 99.7 | (0.3) | 99.5 | (0.3) | 47.6 | (3.5) | 18.2 | (2.1) | 68.6 | (3.2) | 35.9 | (3.5) | 88.5 | (2.3) | 17.2 | (2.1) |
| Sweden | 94.1 | (1.6) | 95.2 | (1.5) | 28.1 | (3.2) | 18.5 | (2.0) | 24.9 | (4.5) | 36.8 | (3.5) | 51.9 | (3.6) | 15.9 | (3.7) |
| Switzerland | 96.4 | (1.5) | 38.9 | (4.1) | 45.2 | (4.0) | 73.0 | (3.1) | 85.4 | (2.7) | 21.2 | (3.1) | 80.7 | (3.0) | 64.8 | (3.5) |
| Turkey | 84.8 | (3.0) | 71.1 | (4.2) | 50.8 | (4.3) | 58.7 | (4.4) | 76.3 | (3.3) | 33.8 | (4.4) | 34.0 | (3.7) | 58.9 | (4.4) |
| United States | 98.4 | (0.8) | 76.3 | (2.8) | 65.9 | (3.3) | 90.7 | (1.9) | 93.5 | (1.6) | 54.7 | (3.1) | 92.0 | (1.9) | 80.3 | (2.8) |
| ***OECD average*** | *96.6* | *(0.2)* | *77.9* | *(0.4)* | *47.5* | *(0.6)* | *47.7* | *(0.6)* | *67.6* | *(0.6)* | *41.1* | *(0.6)* | *74.4* | *(0.6)* | *41.1* | *(0.6)* |
| **Partners** | | | | | | | | | | | | | | | | |
| Brazil | 87.9 | (2.6) | 83.4 | (2.5) | 44.7 | (4.1) | 37.5 | (3.5) | 75.7 | (3.5) | 55.5 | (3.5) | 92.1 | (2.1) | 23.3 | (2.9) |
| Hong Kong-China | 98.7 | (0.9) | 96.3 | (1.5) | 63.3 | (4.2) | 22.7 | (4.0) | 90.5 | (2.5) | 63.9 | (4.0) | 96.9 | (1.2) | 18.9 | (3.1) |
| Indonesia | 89.2 | (2.4) | 84.3 | (2.6) | 46.4 | (3.8) | 50.6 | (3.8) | 86.0 | (2.7) | 87.3 | (2.5) | 78.8 | (3.2) | 77.2 | (2.9) |
| Latvia | 100.0 | (0.0) | 94.1 | (2.7) | 40.1 | (4.3) | 79.7 | (4.1) | 99.2 | (0.6) | 86.5 | (2.8) | 96.7 | (1.4) | 65.1 | (4.2) |
| Liechtenstein | 100.0 | (0.0) | 96.7 | (0.0) | 57.7 | (0.4) | 28.7 | (0.3) | 17.5 | (0.3) | 39.1 | (0.5) | 21.3 | (0.5) | 39.3 | (0.4) |
| Macao-China | 96.5 | (0.1) | 96.5 | (0.1) | 43.4 | (0.2) | 3.1 | (0.1) | 81.4 | (0.2) | 81.5 | (0.3) | 97.5 | (0.1) | 14.5 | (0.1) |
| Russian Fed. | 100.0 | (0.0) | 96.7 | (1.3) | 55.7 | (4.0) | 69.9 | (4.1) | 96.9 | (1.3) | 98.7 | (0.8) | 98.8 | (0.7) | 81.3 | (3.2) |
| Serbia | 92.8 | (2.3) | 88.7 | (2.4) | 19.4 | (3.5) | 42.7 | (4.2) | 76.7 | (3.5) | 51.0 | (4.5) | 64.4 | (4.0) | 50.1 | (4.2) |
| Thailand | 89.6 | (2.6) | 71.9 | (4.0) | 77.2 | (3.5) | 59.3 | (3.6) | 88.0 | (3.0) | 70.6 | (3.6) | 76.9 | (3.8) | 56.8 | (4.0) |
| Tunisia | 74.8 | (3.4) | 84.3 | (2.9) | 43.6 | (4.3) | 73.1 | (3.6) | 81.8 | (3.4) | 62.7 | (3.7) | 71.9 | (3.2) | 71.7 | (3.4) |
| Uruguay | 94.2 | (1.7) | 90.6 | (2.4) | 29.0 | (3.1) | 18.1 | (3.2) | 76.5 | (4.0) | 40.7 | (4.5) | 68.8 | (3.7) | 10.5 | (2.4) |
| United Kingdom[1] | 100.0 | (0.0) | 68.3 | (3.4) | 93.7 | (1.6) | 88.9 | (1.8) | 97.3 | (1.1) | 85.9 | (2.3) | 91.4 | (2.1) | 84.4 | (2.1) |

1. Response rate too low to ensure comparability.

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# Annex B

## CORRELATIONS

Table B.1
**Latent correlations among selected measures used in the teaching and learning analytical model**

| | Learning strategies and student confidence | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Latent correlations between:** | | | | | | | | |
| | Control strategies | Control strategies | Elaboration strategies | Self-efficacy in mathematics | Self-efficacy in mathematics | Anxiety in mathematics | Self-efficacy in mathematics | Self-efficacy in mathematics | Self-efficacy in mathematics |
| | Elaboration strategies | Memo-risation/ rehearsal strategies | Memo-risation/ rehearsal strategies | Anxiety in mathematics | Self-concept in mathematics | Self-concept in mathematics | Memo-risation/ rehearsal strategies | Elaboration strategies | Control strategies |
| Australia | 0.75 | 0.96 | 0.78 | -0.55 | 0.72 | -0.78 | 0.32 | 0.36 | 0.30 |
| Austria | 0.45 | 0.84 | 0.35 | -0.42 | 0.48 | -0.87 | 0.00 | 0.13 | 0.26 |
| Belgium | 0.62 | 0.88 | 0.60 | -0.36 | 0.43 | -0.82 | 0.09 | 0.22 | 0.23 |
| Canada | 0.60 | 0.89 | 0.63 | -0.55 | 0.64 | -0.91 | 0.25 | 0.32 | 0.33 |
| Czech Republic | 0.81 | 0.94 | 0.83 | -0.57 | 0.61 | -0.81 | 0.02 | 0.16 | 0.24 |
| Denmark | 0.60 | 0.95 | 0.60 | -0.75 | 0.83 | -0.91 | 0.05 | 0.16 | 0.31 |
| Finland | 0.71 | 0.90 | 0.68 | -0.64 | 0.77 | -0.82 | 0.03 | 0.12 | 0.24 |
| France | 0.50 | 0.81 | 0.39 | -0.43 | 0.60 | -0.75 | 0.38 | 0.33 | 0.39 |
| Germany | 0.84 | 0.89 | 0.73 | -0.49 | 0.54 | -0.89 | 0.28 | 0.34 | 0.37 |
| Greece | 0.65 | 0.95 | 0.57 | -0.58 | 0.73 | -0.87 | 0.27 | 0.33 | 0.43 |
| Hungary | 0.62 | 0.85 | 0.60 | -0.43 | 0.40 | -0.86 | 0.20 | 0.29 | 0.28 |
| Iceland | 0.78 | 1.03 | 0.86 | -0.61 | 0.76 | -0.70 | 0.35 | 0.33 | 0.28 |
| Ireland | 0.81 | 1.00 | 0.76 | -0.59 | 0.67 | -0.84 | 0.20 | 0.25 | 0.36 |
| Italy | 0.49 | 0.94 | 0.50 | -0.41 | 0.56 | -0.68 | 0.10 | 0.15 | 0.18 |
| Japan | 0.89 | 0.91 | 0.86 | -0.45 | 0.47 | -0.86 | 0.28 | 0.27 | 0.25 |
| Korea | 0.56 | 0.96 | 0.74 | -0.49 | 0.69 | -0.83 | 0.27 | 0.34 | 0.33 |
| Luxembourg | 0.61 | 0.87 | 0.68 | -0.37 | 0.45 | -0.78 | 0.12 | 0.28 | 0.32 |
| Mexico | 0.80 | 0.97 | 0.86 | -0.43 | 0.52 | -0.77 | 0.33 | 0.36 | 0.37 |
| Netherlands | 0.75 | 0.93 | 0.73 | -0.54 | 0.61 | -0.85 | 0.35 | 0.56 | 0.50 |
| New Zealand | 0.62 | 0.94 | 0.48 | -0.64 | 0.72 | -0.83 | 0.08 | 0.16 | 0.24 |
| Norway | 0.74 | 0.78 | 0.62 | -0.62 | 0.77 | -0.81 | 0.41 | 0.43 | 0.43 |
| Poland | 0.71 | 1.03 | 0.75 | -0.57 | 0.66 | -0.82 | 0.27 | 0.17 | 0.28 |
| Portugal | 0.82 | 0.80 | 0.79 | -0.40 | 0.65 | -0.72 | 0.45 | 0.37 | 0.34 |
| Slovak Republic | 0.43 | 0.73 | 0.51 | -0.56 | 0.60 | -0.87 | 0.28 | 0.31 | 0.28 |
| Spain | 0.43 | 0.76 | 0.48 | -0.25 | 0.53 | -0.63 | 0.14 | 0.23 | 0.29 |
| Sweden | 0.92 | 0.99 | 0.86 | -0.59 | 0.77 | -0.78 | 0.14 | 0.39 | 0.38 |
| Switzerland | 0.63 | 0.64 | 0.18 | -0.56 | 0.61 | -0.85 | 0.10 | 0.18 | 0.24 |
| Turkey | 0.65 | 0.89 | 0.62 | -0.47 | 0.62 | -0.80 | 0.37 | 0.25 | 0.34 |
| United Kingdom | 0.75 | 0.89 | 0.82 | -0.60 | 0.73 | -0.80 | 0.26 | 0.44 | 0.40 |
| United States | 0.79 | 0.98 | 0.87 | -0.54 | 0.55 | -0.86 | 0.29 | 0.31 | 0.27 |
| OECD | 0.66 | 0.90 | 0.67 | -0.52 | 0.62 | -0.80 | 0.23 | 0.29 | 0.33 |

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Table B.1
**Latent correlations among selected measures used in the teaching and learning analytical model** *(continued)*

| | Approaches to learning and learning environment | | | | | |
|---|---|---|---|---|---|---|
| | **Latent correlations between:** | | | | | |
| | Competitive learning | Interest in and enjoyment of mathematics | Teacher support | Attitudes towards school | Attitudes towards school | Student-teacher relations |
| | Co-operative learning | Instrumental motivation to learn mathematics | Disciplinary climate | Student-teacher relations | Sense of belonging at school | Sense of belonging at school |
| Australia | 0.20 | 0.61 | 0.32 | 0.63 | 0.30 | 0.34 |
| Austria | 0.27 | 0.60 | 0.18 | 0.57 | 0.19 | 0.16 |
| Belgium | 0.26 | 0.73 | 0.12 | 0.67 | 0.43 | 0.37 |
| Canada | 0.12 | 0.67 | 0.30 | 0.48 | 0.39 | 0.16 |
| Czech Republic | 0.08 | 0.59 | 0.24 | 0.59 | 0.42 | 0.28 |
| Denmark | 0.31 | 0.67 | 0.35 | 0.73 | 0.41 | 0.26 |
| Finland | -0.01 | 0.64 | 0.31 | 0.55 | 0.32 | 0.29 |
| France | 0.23 | 0.70 | 0.20 | 0.58 | 0.25 | 0.19 |
| Germany | 0.29 | 0.56 | 0.23 | 0.58 | 0.29 | 0.26 |
| Greece | 0.45 | 0.66 | 0.23 | 0.58 | 0.38 | 0.24 |
| Hungary | 0.17 | 0.67 | 0.23 | 0.50 | 0.26 | 0.18 |
| Iceland | 0.25 | 0.68 | 0.18 | 0.65 | 0.32 | 0.20 |
| Ireland | 0.18 | 0.60 | 0.35 | 0.64 | 0.37 | 0.15 |
| Italy | 0.24 | 0.68 | 0.26 | 0.60 | 0.43 | 0.22 |
| Japan | 0.44 | 0.68 | 0.23 | 0.44 | 0.45 | 0.42 |
| Korea | 0.84 | 0.72 | a | 0.48 | 0.34 | 0.21 |
| Luxembourg | 0.29 | 0.65 | 0.10 | 0.68 | 0.21 | 0.21 |
| Mexico | 0.70 | 0.67 | 0.22 | 0.36 | 0.43 | 0.42 |
| Netherlands | 0.24 | 0.59 | 0.33 | 0.65 | 0.43 | 0.13 |
| New Zealand | 0.18 | 0.50 | 0.35 | 0.58 | 0.35 | 0.25 |
| Norway | 0.15 | 0.68 | 0.24 | 0.81 | 0.35 | 0.25 |
| Poland | 0.35 | 0.70 | 0.18 | 0.53 | 0.18 | 0.19 |
| Portugal | 0.57 | 0.65 | 0.15 | 0.38 | 0.40 | 0.14 |
| Slovak Republic | -0.02 | 0.69 | 0.07 | 0.53 | 0.45 | 0.28 |
| Spain | 0.50 | 0.72 | 0.09 | 0.53 | 0.33 | 0.17 |
| Sweden | 0.26 | 0.59 | 0.29 | 0.59 | 0.39 | 0.22 |
| Switzerland | 0.09 | 0.71 | 0.08 | 0.63 | 0.53 | 0.40 |
| Turkey | 0.62 | 0.68 | 0.05 | 0.55 | 0.25 | 0.25 |
| United Kingdom | 0.33 | 0.62 | 0.42 | 0.65 | 0.33 | 0.27 |
| United States | 0.48 | 0.66 | 0.25 | a | a | a |
| OECD | 0.35 | 0.61 | 0.20 | 0.61 | 0.37 | 0.26 |

# Annex C

## BIVARIATE AND MULTILEVEL MODELS

Table C.1
**Multivariate regression coefficients and standard errors**

| | Score point difference associated with the various factors shown below, before accounting for the other factors | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | School characteristics | | | | | | | | | | | | | | | |
| | | | | | | | School climate | | | | | | Classroom climate | | | | | |
| | Intercept | | School average of the highest international socio-economic index of occupational status (HISEI) between both parents | | School size | | Attitudes towards school | | Sense of belonging at school | | Student-teacher relations | | Discipli-nary climate | | School average disciplinary climate | | Teacher support | |
| | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. |
| **OECD** | | | | | | | | | | | | | | | | | | |
| Australia | 509.3 | (1.02) | **16.3** | (2.24) | **4.9** | (1.17) | 2.8 | (0.96) | **-8.6** | (0.97) | **6.3** | (0.89) | **6.4** | (0.86) | **5.4** | (1.01) | **-2.8** | (1.01) |
| Austria | 497.3 | (1.84) | **26.6** | (1.79) | **11.2** | (2.88) | -0.6 | (1.02) | **-3.0** | (0.89) | -0.4 | (1.22) | **5.0** | (1.17) | **9.4** | (1.46) | **-3.1** | (1.25) |
| Belgium | 528.2 | (1.06) | **27.3** | (1.83) | **12.7** | (2.39) | **-5.1** | (1.10) | **-3.5** | (1.31) | -0.3 | (0.99) | **7.4** | (0.91) | **22.0** | (1.25) | **-4.9** | (1.08) |
| Canada | 515.5 | (1.09) | **10.5** | (0.73) | **7.0** | (0.94) | -0.3 | (0.70) | **-7.2** | (0.81) | **2.2** | (0.85) | **6.9** | (0.84) | **4.7** | (0.83) | **-5.1** | (0.85) |
| Czech Republic | 510.4 | (2.47) | **30.9** | (3.07) | 3.3 | (3.97) | -0.4 | (1.18) | 0.2 | (1.46) | -1.5 | (1.25) | **4.5** | (1.00) | **8.9** | (1.72) | **-5.2** | (1.26) |
| Denmark | 513.3 | (2.84) | **8.1** | (1.93) | **12.0** | (4.09) | 1.5 | (1.66) | **-6.5** | (1.50) | **4.5** | (1.60) | 2.3 | (1.49) | **5.3** | (1.41) | **-3.3** | (1.54) |
| Finland | 537.7 | (2.82) | **-2.8** | (1.10) | **11.9** | (3.22) | **6.0** | (1.27) | **-9.1** | (1.09) | 0.3 | (1.37) | **3.8** | (1.30) | -0.2 | (1.02) | **-7.4** | (1.44) |
| France | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | 495.2 | (1.94) | **31.3** | (2.05) | 0.6 | (2.46) | **-2.2** | (1.08) | **-5.9** | (1.39) | 0.7 | (1.10) | **4.2** | (1.00) | **12.6** | (1.53) | **-3.6** | (0.93) |
| Greece | 453.6 | (6.89) | **24.8** | (1.56) | **-19.6** | (7.27) | **-4.0** | (1.62) | -1.6 | (1.41) | **-4.4** | (1.77) | 1.4 | (1.30) | **6.6** | (2.46) | 1.0 | (1.77) |
| Hungary | 477.7 | (3.07) | **32.9** | (1.69) | 7.5 | (4.66) | **-5.7** | (1.35) | -1.4 | (1.21) | -1.9 | (1.42) | **2.9** | (1.16) | **8.0** | (1.25) | -2.2 | (1.17) |
| Iceland | 510.1 | (3.77) | 0.8 | (1.66) | -5.5 | (4.36) | **7.2** | (1.51) | **-7.7** | (1.20) | 1.9 | (1.45) | **4.4** | (1.74) | 1.2 | (1.83) | -0.9 | (1.84) |
| Ireland | 512.2 | (1.74) | **12.2** | (1.90) | **6.6** | (3.15) | 0.9 | (1.26) | **-8.0** | (1.13) | **2.7** | (1.31) | **8.6** | (1.35) | -0.2 | (1.15) | **-7.7** | (1.47) |
| Italy | 499.0 | (2.00) | **33.9** | (1.11) | 4.2 | (3.52) | 0.3 | (1.36) | **-3.9** | (1.15) | **-2.9** | (1.27) | **3.3** | (1.06) | 7.1 | (0.63) | **-5.5** | (1.13) |
| Japan | 531.2 | (2.45) | **37.1** | (1.63) | **5.8** | (1.06) | -2.4 | (1.38) | **-4.8** | (1.50) | 1.9 | (1.59) | **4.2** | (1.43) | **21.6** | (0.97) | -3.4 | (1.75) |
| Korea | 556.8 | (2.76) | **25.6** | (1.35) | **10.3** | (1.40) | -1.5 | (1.10) | **-6.1** | (1.25) | 1.2 | (1.35) | 0.9 | (1.10) | **19.3** | (3.57) | 0.2 | (1.50) |
| Luxembourg | 500.7 | (2.73) | **28.1** | (1.82) | 1.0 | (0.78) | -1.1 | (1.23) | -0.2 | (1.15) | 1.8 | (1.33) | **5.4** | (1.07) | **13.7** | (2.98) | **-4.8** | (1.03) |
| Mexico | 429.4 | (7.45) | **17.1** | (0.76) | **3.7** | (1.33) | **7.7** | (1.02) | 0.4 | (0.97) | **-5.6** | (1.33) | **5.1** | (1.27) | **12.5** | (0.78) | -2.0 | (1.11) |
| Netherlands | 526.5 | (2.06) | **36.6** | (2.53) | **11.3** | (3.08) | **-2.8** | (1.34) | **-5.1** | (1.53) | 1.1 | (1.53) | 2.6 | (1.47) | **14.8** | (4.21) | -1.3 | (1.35) |
| New Zealand | 519.7 | (1.75) | **13.3** | (1.64) | **3.5** | (1.01) | **6.0** | (1.48) | **-8.4** | (1.32) | **6.5** | (1.57) | **6.6** | (1.24) | **3.2** | (1.48) | **-5.8** | (1.30) |
| Norway | 487.6 | (6.54) | **3.5** | (1.55) | -4.8 | (7.55) | **4.4** | (1.76) | **-8.1** | (1.21) | **6.0** | (1.50) | 3.0 | (1.71) | **4.7** | (1.38) | **-6.0** | (1.80) |
| Poland | 497.5 | (1.39) | **9.7** | (1.63) | -1.5 | (2.65) | -1.1 | (1.42) | -2.0 | (1.11) | **-5.3** | (1.70) | **6.1** | (1.24) | 1.6 | (1.36) | **-5.1** | (1.33) |
| Portugal | 488.0 | (1.53) | **10.7** | (1.27) | **10.2** | (0.81) | 1.4 | (1.13) | 1.2 | (1.50) | -2.5 | (1.43) | **8.8** | (1.43) | **18.0** | (1.39) | **-4.9** | (1.29) |
| Slovak Republic | 493.5 | (1.99) | **25.2** | (0.93) | 0.4 | (2.67) | **-3.8** | (1.20) | **-2.8** | (1.15) | **-5.9** | (1.31) | **3.4** | (1.09) | **7.9** | (0.86) | **-6.3** | (1.18) |
| Spain | 507.2 | (1.09) | **10.4** | (1.09) | 4.0 | (2.29) | -0.3 | (1.22) | **-4.6** | (1.13) | **-2.5** | (1.24) | **8.7** | (1.06) | **5.0** | (0.83) | **-5.3** | (1.32) |
| Sweden | 493.7 | (2.36) | **5.4** | (1.66) | **7.0** | (2.89) | **4.3** | (1.44) | **-9.1** | (1.26) | **5.6** | (1.38) | **3.5** | (1.18) | **4.3** | (1.59) | **-7.5** | (1.67) |
| Switzerland | 509.5 | (3.17) | **18.6** | (1.49) | 6.1 | (4.51) | 1.6 | (1.29) | **-2.6** | (0.92) | -1.6 | (1.31) | **8.9** | (2.10) | **9.9** | (1.17) | **-4.4** | (1.50) |
| Turkey | 481.5 | (3.80) | **27.6** | (1.63) | 3.6 | (2.93) | **-2.3** | (1.13) | **4.2** | (1.46) | **-6.4** | (1.43) | **8.4** | (1.55) | **24.9** | (2.14) | 0.6 | (1.17) |
| United States | 464.5 | (2.13) | **15.0** | (1.37) | -0.2 | (1.26) | -0.7 | (1.26) | m | m | 1.3 | (1.27) | **9.6** | (1.28) | **6.7** | (0.98) | **-3.1** | (1.13) |
| **Partners** | | | | | | | | | | | | | | | | | | |
| Brazil | 451.5 | (3.88) | **23.6** | (1.34) | 1.6 | (0.98) | 2.0 | (1.41) | 0.4 | (1.31) | -2.6 | (1.49) | **4.5** | (1.76) | **14.8** | (2.63) | **-4.6** | (1.63) |
| Hong Kong-China | 526.2 | (3.80) | **20.2** | (1.79) | **62.3** | (4.50) | -1.5 | (1.74) | **-6.3** | (1.71) | **2.7** | (1.32) | **4.1** | (1.33) | **34.9** | (1.62) | -1.0 | (1.41) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | 480.2 | (1.72) | **11.3** | (1.57) | **15.5** | (2.12) | **6.4** | (1.31) | -3.1 | (1.75) | **-4.4** | (1.75) | **8.8** | (1.74) | **3.9** | (1.24) | **-6.4** | (1.80) |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c |
| Macao-China | 532.8 | (6.35) | **15.4** | (3.95) | 3.6 | (1.87) | -0.3 | (4.13) | -1.1 | (4.27) | 2.5 | (3.51) | **11.4** | (3.44) | **14.5** | (5.45) | **-8.5** | (4.06) |
| Russian Fed. | 465.4 | (2.09) | **11.4** | (1.63) | 4.8 | (3.25) | -0.3 | (1.60) | 0.1 | (0.96) | **-5.1** | (1.39) | **8.6** | (1.48) | **9.4** | (1.57) | -1.9 | (1.31) |
| Serbia | 450.6 | (1.99) | **21.2** | (1.02) | **4.1** | (0.97) | 0.7 | (1.16) | **-1.8** | (0.90) | **-9.2** | (1.44) | **6.0** | (1.61) | **17.3** | (1.05) | **-3.9** | (1.44) |
| Thailand | 469.8 | (3.58) | **20.1** | (1.25) | **4.1** | (0.43) | **3.1** | (1.26) | 0.0 | (1.56) | **-9.1** | (1.35) | **13.0** | (1.54) | 0.3 | (1.21) | **4.4** | (1.32) |
| Tunisia | 409.6 | (3.07) | **20.3** | (0.91) | **6.8** | (2.06) | **3.5** | (0.85) | **1.9** | (0.96) | **-6.9** | (0.94) | **5.6** | (1.27) | **12.7** | (0.81) | -1.9 | (1.52) |
| Uruguay | 458.5 | (1.80) | **23.0** | (1.14) | **16.2** | (1.26) | 0.8 | (1.61) | 0.2 | (1.32) | **-6.0** | (1.48) | **3.7** | (1.60) | **14.3** | (1.23) | **-5.2** | (1.42) |
| United Kingdom[1] | 508.8 | (1.30) | **13.0** | (1.22) | **7.4** | (1.87) | **2.6** | (1.24) | **-6.8** | (1.30) | **6.5** | (1.41) | **9.2** | (1.03) | **5.2** | (1.15) | **-4.2** | (1.36) |

1. Response rate too low to ensure comparability.


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Table C.1
**Multivariate regression coefficients and standard errors** *(continued)*

| | Score point difference associated with the various factors shown below, before accounting for the other factors | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Student characteristics | | | | | | | | | | | | | | | |
| | Home background | | | | | | Self-related cognitions in mathematics | | | | | | | | | |
| | The highest international socio-economic index of occupational status (HISEI) between both parents | | The highest level of education between both parents (HISCED) | | Number of books in the home | | Anxiety in mathematics | | Instrumental motivation in mathematics | | Interest in and enjoyment of mathematics | | Self-concept in mathematics | | Self-efficacy in mathematics | |
| | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. |
| **OECD** | | | | | | | | | | | | | | | | |
| Australia | **9.2** | (1.19) | -0.8 | (1.25) | **9.8** | (0.86) | **-4.3** | (1.40) | 1.7 | (1.41) | **-7.8** | (1.57) | **24.4** | (1.31) | 30.5 | (1.35) |
| Austria | 2.0 | (1.35) | **-5.0** | (1.50) | **12.0** | (1.20) | **-4.5** | (1.49) | -1.7 | (1.37) | **-5.3** | (1.48) | **15.0** | (1.68) | 20.4 | (1.22) |
| Belgium | **10.5** | (1.26) | -0.7 | (1.15) | **8.8** | (1.04) | **-5.1** | (1.34) | **4.6** | (1.26) | -0.5 | (1.46) | **13.0** | (1.35) | 24.7 | (1.29) |
| Canada | **8.1** | (0.96) | 1.0 | (1.48) | **11.1** | (0.70) | **-5.7** | (1.11) | **5.2** | (0.94) | **-7.1** | (1.29) | **18.4** | (1.56) | 27.4 | (0.93) |
| Czech Republic | **5.2** | (1.63) | 2.6 | (2.16) | **11.7** | (1.63) | **-5.9** | (1.65) | **3.0** | (1.20) | **-3.8** | (1.81) | **17.0** | (1.75) | 23.8 | (1.27) |
| Denmark | **8.9** | (1.60) | **6.4** | (1.76) | **11.3** | (1.46) | **-12.4** | (1.81) | -0.2 | (1.87) | **-7.1** | (2.23) | **24.5** | (2.56) | 23.4 | (1.93) |
| Finland | **8.1** | (1.07) | 1.8 | (1.30) | **12.9** | (1.22) | **-6.3** | (1.88) | **3.6** | (1.46) | **-4.6** | (1.79) | **29.8** | (1.94) | 21.3 | (1.69) |
| France | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | **4.3** | (1.39) | 2.1 | (1.36) | **9.2** | (1.15) | **-5.1** | (1.37) | 1.8 | (1.23) | **-2.6** | (1.31) | **8.8** | (1.50) | **23.0** | (1.62) |
| Greece | 2.3 | (1.73) | 0.4 | (1.34) | **7.5** | (1.47) | **-9.3** | (1.60) | 3.3 | (1.86) | -1.7 | (2.14) | **19.2** | (2.41) | **19.9** | (2.07) |
| Hungary | **4.0** | (1.57) | 0.7 | (1.35) | **8.7** | (1.18) | **-8.4** | (1.72) | 2.3 | (1.30) | -1.5 | (1.80) | **9.7** | (1.66) | **22.8** | (1.25) |
| Iceland | 2.0 | (1.46) | **6.2** | (1.86) | **11.5** | (1.47) | 1.0 | (1.54) | 2.4 | (1.68) | **-4.2** | (1.68) | **24.4** | (1.88) | **23.8** | (1.63) |
| Ireland | **8.2** | (1.42) | **3.4** | (1.43) | **11.3** | (1.14) | **-7.0** | (2.24) | 0.9 | (1.32) | **-3.8** | (1.72) | **11.2** | (2.64) | **32.4** | (1.82) |
| Italy | **4.6** | (1.02) | **-2.9** | (1.10) | **4.0** | (1.07) | **-8.2** | (1.45) | **3.9** | (1.67) | **-3.8** | (1.74) | **13.5** | (1.77) | **25.7** | (1.33) |
| Japan | 0.0 | (1.28) | -0.6 | (1.38) | **6.4** | (1.33) | -1.4 | (1.83) | 0.8 | (1.57) | **4.7** | (1.70) | **5.3** | (2.17) | **25.8** | (1.76) |
| Korea | 1.4 | (1.25) | -0.2 | (1.06) | **14.2** | (1.65) | **3.9** | (1.87) | 2.8 | (1.43) | 2.5 | (1.71) | **17.7** | (2.55) | **22.7** | (1.56) |
| Luxembourg | **6.6** | (1.69) | -0.5 | (1.34) | **9.8** | (1.21) | **-6.4** | (1.65) | 0.2 | (1.56) | 1.9 | (1.77) | **4.6** | (1.66) | **26.6** | (1.31) |
| Mexico | **2.2** | (0.88) | 0.0 | (0.97) | **1.4** | (1.49) | **-12.7** | (1.15) | 0.9 | (1.82) | **-8.2** | (2.03) | **16.3** | (1.21) | **16.6** | (1.46) |
| Netherlands | **5.3** | (1.24) | -1.4 | (1.13) | **8.9** | (1.28) | -1.9 | (1.65) | 0.8 | (1.20) | -0.2 | (1.71) | **10.6** | (1.72) | **19.1** | (1.56) |
| New Zealand | **7.7** | (1.27) | 2.5 | (1.71) | **12.7** | (1.32) | **-11.1** | (1.92) | **4.0** | (1.44) | **-9.1** | (2.07) | **22.1** | (2.41) | **31.1** | (1.71) |
| Norway | **9.1** | (1.51) | -2.4 | (2.36) | **14.1** | (1.45) | **-7.8** | (1.65) | **6.2** | (1.55) | 1.3 | (2.01) | **21.9** | (2.13) | **22.9** | (1.74) |
| Poland | **10.3** | (1.77) | 3.5 | (1.96) | **11.8** | (1.18) | **-15.1** | (1.65) | **10.8** | (1.65) | **-11.2** | (1.85) | **20.3** | (2.17) | **28.6** | (2.03) |
| Portugal | **8.5** | (1.57) | -1.4 | (0.95) | **9.9** | (1.80) | **-4.2** | (1.82) | **4.8** | (1.74) | **-8.4** | (2.35) | **18.4** | (1.72) | **27.2** | (1.97) |
| Slovak Republic | **3.2** | (1.24) | 2.5 | (1.50) | **14.8** | (1.54) | **-9.8** | (1.37) | **4.5** | (1.66) | **-5.4** | (1.90) | **22.5** | (2.22) | **24.7** | (1.71) |
| Spain | **3.4** | (1.14) | 0.7 | (0.98) | **16.0** | (1.26) | -3.4 | (1.73) | **6.1** | (1.60) | -3.3 | (1.93) | **16.6** | (1.95) | **22.1** | (1.26) |
| Sweden | **8.8** | (1.47) | -1.0 | (1.54) | **17.5** | (1.18) | **-7.9** | (1.61) | **4.3** | (1.51) | **-4.7** | (1.76) | **19.0** | (1.81) | **30.6** | (1.66) |
| Switzerland | **8.3** | (1.38) | 1.2 | (1.10) | **14.3** | (1.08) | **-5.5** | (1.36) | -0.2 | (1.28) | 0.0 | (1.87) | **9.9** | (1.77) | **30.4** | (2.41) |
| Turkey | 2.1 | (1.52) | 0.6 | (1.23) | **9.3** | (1.48) | **-7.1** | (1.63) | 1.1 | (1.75) | -3.2 | (2.10) | **11.1** | (1.83) | **19.0** | (1.45) |
| United States | **8.5** | (1.15) | 0.0 | (1.60) | **14.0** | (1.16) | **-5.1** | (1.46) | **5.5** | (1.28) | **-7.5** | (1.33) | **15.1** | (1.92) | **29.6** | (1.37) |
| **Partners** | | | | | | | | | | | | | | | | |
| Brazil | **8.3** | (2.07) | **-2.8** | (1.11) | **6.1** | (2.20) | **-13.2** | (2.72) | 0.5 | (1.95) | **-9.1** | (2.54) | **13.8** | (2.22) | **16.4** | (2.00) |
| Hong Kong-China | **4.2** | (1.69) | -3.9 | (2.01) | **8.3** | (1.36) | -0.1 | (2.24) | 1.3 | (1.67) | **5.1** | (1.83) | **12.8** | (2.58) | **27.5** | (1.82) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | **7.6** | (1.45) | 0.1 | (2.25) | **9.2** | (1.51) | **-12.5** | (1.95) | **10.0** | (1.58) | **-14.7** | (2.52) | **21.5** | (2.12) | **29.3** | (2.21) |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c |
| Macao-China | 6.7 | (3.91) | -0.6 | (2.85) | 1.7 | (3.16) | -2.9 | (4.23) | **-8.4** | (4.25) | 1.2 | (4.53) | **15.2** | (4.07) | **27.7** | (4.04) |
| Russian Fed. | **3.8** | (1.49) | 1.5 | (2.20) | **6.9** | (1.35) | **-14.3** | (2.25) | **5.1** | (1.54) | **-6.8** | (2.36) | **14.2** | (2.40) | **27.4** | (2.25) |
| Serbia | **3.7** | (1.14) | -2.0 | (1.47) | **6.0** | (1.51) | **-9.1** | (1.74) | **4.1** | (1.58) | **-9.5** | (1.86) | **19.1** | (1.90) | **17.8** | (1.75) |
| Thailand | **5.7** | (1.67) | -0.3 | (1.36) | 1.8 | (1.43) | **-4.1** | (1.75) | 3.9 | (2.19) | **-7.2** | (2.52) | **11.9** | (2.09) | **19.5** | (1.69) |
| Tunisia | **6.6** | (1.52) | **-3.3** | (1.26) | **5.8** | (1.21) | -1.9 | (1.34) | **3.5** | (1.48) | **-5.5** | (1.76) | **10.8** | (1.41) | **13.3** | (1.36) |
| Uruguay | **6.3** | (1.59) | -0.5 | (1.54) | **5.7** | (1.46) | **-6.7** | (1.99) | 2.2 | (1.41) | -0.7 | (2.42) | **14.7** | (2.35) | **19.2** | (1.51) |
| United Kingdom[1] | **9.5** | (1.27) | 1.0 | (1.57) | **11.0** | (1.19) | **-3.7** | (1.84) | 2.9 | (1.54) | **-9.4** | (1.73) | **17.2** | (2.26) | **32.3** | (1.49) |

1. Response rate too low to ensure comparability.

Table C.1
**Multivariate regression coefficients and standard errors** *(continued)*

| | Score point difference associated with the various factors shown below, before accounting for the other factors | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time students invest in learning | | | | | | | | Learning strategies and preferences in mathematics | | | | | | | | | |
| | Out-of-school learning time | | | | | | | | Learning strategies | | | | | | Students' preference for learning situations | | | |
| | Attending out-of-school classes | | Hours per week of homework in total | | Hours per week of mathematics homework | | Working with a tutor | | Control strategies | | Elaboration strategies | | Memo-risation/ rehearsal strategies | | Competitive learning situations | | Co-operative learning situations | |
| | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. |
| **OECD** | | | | | | | | | | | | | | | | | | |
| Australia | **-7.4** | (1.57) | **6.5** | (1.53) | -1.9 | (1.28) | **-2.5** | (0.91) | **4.3** | (1.17) | **-15.9** | (1.20) | **-5.1** | (1.32) | 1.1 | (1.60) | **-3.9** | (1.13) |
| Austria | **-10.2** | (3.13) | 1.7 | (3.01) | **-5.3** | (2.57) | **-4.5** | (1.12) | -0.2 | (1.16) | -0.6 | (1.06) | **-8.3** | (1.05) | 1.2 | (1.05) | 0.2 | (0.84) |
| Belgium | **-4.8** | (1.57) | **7.4** | (1.59) | **-4.4** | (1.50) | **-4.6** | (1.53) | **-2.2** | (1.05) | **-7.7** | (1.37) | -1.9 | (1.17) | **-3.0** | (1.15) | 1.0 | (1.11) |
| Canada | **-3.2** | (1.26) | **6.6** | (1.04) | **-3.9** | (0.90) | **-4.2** | (0.81) | **4.3** | (1.14) | **-8.1** | (1.00) | **-4.1** | (1.08) | **-2.0** | (0.86) | -1.0 | (0.89) |
| Czech Republic | -2.0 | (1.62) | **3.8** | (1.83) | **-7.3** | (1.74) | **-5.0** | (1.23) | **-2.8** | (1.41) | -0.7 | (1.40) | **-6.7** | (1.27) | 1.4 | (1.24) | -0.4 | (1.05) |
| Denmark | **-5.8** | (2.09) | 0.3 | (2.89) | **-6.4** | (2.08) | **-7.5** | (3.23) | **-5.5** | (1.83) | **-7.1** | (2.19) | **-4.7** | (1.63) | **4.8** | (1.92) | **-3.3** | (1.56) |
| Finland | **-12.8** | (4.09) | **5.9** | (2.91) | **-18.5** | (2.43) | **-12.0** | (3.33) | -0.5 | (1.50) | **-6.2** | (1.39) | **-4.8** | (1.27) | -0.1 | (1.32) | **3.1** | (1.36) |
| France | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | **-9.4** | (1.88) | 2.0 | (2.01) | **-6.3** | (1.77) | **-3.5** | (0.91) | -1.1 | (1.40) | -0.3 | (1.02) | **-6.9** | (1.12) | -0.3 | (1.13) | 1.1 | (1.09) |
| Greece | **-2.4** | (0.63) | **5.8** | (1.08) | -0.3 | (1.21) | **-5.6** | (0.94) | 0.0 | (1.67) | **-5.8** | (1.67) | **-7.3** | (1.93) | 2.4 | (1.78) | -0.6 | (1.31) |
| Hungary | **-3.1** | (1.00) | **4.5** | (1.11) | **-4.5** | (1.20) | **-4.1** | (1.26) | -3.1 | (1.57) | -2.1 | (1.14) | **-5.3** | (1.20) | -0.9 | (1.28) | **3.6** | (1.54) |
| Iceland | **-4.9** | (1.62) | **9.9** | (2.98) | **-10.8** | (2.32) | **-6.8** | (1.29) | -1.4 | (1.50) | **-10.3** | (1.83) | **-5.0** | (1.64) | -0.3 | (1.57) | **-3.6** | (1.34) |
| Ireland | -2.1 | (1.50) | **9.5** | (1.32) | **-5.3** | (1.61) | **-7.5** | (1.27) | -1.6 | (1.49) | **-9.6** | (1.46) | -2.8 | (1.74) | -0.3 | (1.40) | 0.0 | (1.54) |
| Italy | **-5.9** | (1.61) | 0.5 | (0.92) | **-3.1** | (1.13) | **-5.8** | (0.82) | 0.9 | (1.33) | **-3.7** | (1.29) | **-6.1** | (1.35) | -1.1 | (1.26) | -0.6 | (1.02) |
| Japan | **-3.0** | (1.07) | **8.5** | (2.68) | -2.1 | (1.79) | **-8.8** | (1.44) | -2.3 | (1.28) | -2.6 | (1.34) | -1.8 | (1.38) | -0.6 | (1.17) | **4.0** | (1.11) |
| Korea | -0.5 | (0.66) | **11.8** | (2.75) | -3.7 | (2.79) | **-3.1** | (0.89) | **4.4** | (1.84) | **-3.9** | (1.47) | **-9.5** | (1.63) | 2.0 | (1.57) | 0.3 | (1.52) |
| Luxembourg | **-6.1** | (1.94) | **6.7** | (2.18) | **-9.1** | (1.75) | -2.2 | (1.24) | -1.3 | (1.40) | **-8.6** | (1.34) | -2.5 | (1.27) | 0.0 | (1.29) | -0.9 | (0.97) |
| Mexico | -1.5 | (3.85) | **7.8** | (1.57) | -0.2 | (1.26) | -3.1 | (4.59) | -0.2 | (1.16) | -1.7 | (1.43) | **-4.8** | (1.06) | 2.0 | (1.68) | **-3.0** | (1.04) |
| Netherlands | m | m | **7.1** | (1.49) | **-6.6** | (1.78) | **-5.4** | (1.23) | **-5.7** | (1.29) | -2.8 | (1.46) | 2.0 | (1.25) | -2.6 | (1.62) | 1.9 | (1.25) |
| New Zealand | **-10.6** | (1.65) | **12.1** | (2.16) | **-8.6** | (1.97) | **-6.5** | (1.79) | **5.3** | (1.60) | **-16.6** | (1.89) | **-4.0** | (1.56) | **-5.1** | (1.60) | **-3.6** | (1.42) |
| Norway | **-5.0** | (2.36) | **9.4** | (2.43) | **-17.6** | (2.70) | **-13.7** | (2.43) | 0.3 | (1.71) | **-12.0** | (1.70) | 0.5 | (1.75) | -2.5 | (1.47) | 1.5 | (1.20) |
| Poland | **-4.3** | (1.09) | **10.4** | (1.33) | **-8.3** | (0.96) | **-4.1** | (0.90) | -1.6 | (1.58) | **-6.5** | (1.75) | **-4.8** | (1.58) | 1.1 | (1.50) | -1.7 | (1.31) |
| Portugal | **-3.0** | (1.11) | **5.8** | (2.18) | **-5.8** | (2.09) | **-3.3** | (0.84) | **4.8** | (1.65) | **-6.4** | (1.85) | **-6.0** | (1.69) | -2.0 | (1.41) | 0.3 | (1.60) |
| Slovak Republic | **-3.0** | (1.10) | 0.5 | (1.34) | -1.6 | (1.05) | -1.1 | (1.12) | **-3.4** | (1.39) | -3.4 | (1.80) | **-5.8** | (1.33) | 2.1 | (1.22) | -1.3 | (1.24) |
| Spain | **-2.5** | (0.86) | **10.7** | (1.92) | **-5.9** | (1.83) | **-3.5** | (0.86) | **3.7** | (1.49) | **-4.3** | (1.28) | -2.4 | (1.27) | 0.5 | (1.18) | 0.2 | (1.35) |
| Sweden | -5.3 | (3.16) | **4.9** | (2.45) | **-18.4** | (2.44) | **-12.5** | (1.84) | **-8.4** | (1.41) | **-6.0** | (1.67) | 0.7 | (1.47) | 1.2 | (1.55) | 1.4 | (1.29) |
| Switzerland | **-6.2** | (2.27) | **6.1** | (2.97) | **-14.6** | (2.48) | **-5.0** | (1.62) | 0.1 | (1.18) | **-6.9** | (1.53) | **-7.0** | (1.02) | **-4.0** | (1.89) | **2.2** | (1.09) |
| Turkey | **-2.5** | (1.23) | **5.4** | (2.05) | -3.7 | (1.87) | **-4.5** | (1.78) | **3.9** | (1.91) | **-8.0** | (1.52) | -1.2 | (1.75) | 1.9 | (1.72) | -0.7 | (1.52) |
| United States | **-7.9** | (2.10) | **9.2** | (2.03) | **-3.3** | (1.21) | **-6.1** | (1.20) | -0.7 | (1.52) | **-9.0** | (1.60) | **-5.1** | (1.46) | 0.9 | (1.44) | **-2.4** | (1.11) |
| **Partners** | | | | | | | | | | | | | | | | | | |
| Brazil | **-4.2** | (1.34) | **8.8** | (2.09) | **-5.5** | (1.89) | **-9.5** | (1.49) | 3.4 | (1.97) | -3.1 | (2.00) | -4.2 | (2.29) | -1.5 | (1.74) | 0.5 | (2.15) |
| Hong Kong-China | -1.6 | (0.90) | **9.9** | (1.91) | -2.8 | (1.69) | **-4.0** | (0.89) | **5.6** | (1.29) | -2.9 | (1.97) | **-8.6** | (1.56) | **-6.9** | (1.62) | 1.4 | (1.60) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | -2.5 | (1.41) | **3.6** | (1.34) | **-4.0** | (1.67) | **-3.8** | (0.95) | **-7.8** | (2.32) | -1.5 | (2.85) | -3.6 | (2.28) | 0.4 | (2.46) | -1.5 | (1.99) |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c |
| Macao-China | -3.0 | (2.10) | 6.1 | (4.29) | 3.1 | (3.28) | **-11.0** | (2.47) | 4.1 | (3.80) | -2.1 | (3.75) | **-10.4** | (3.81) | 0.4 | (4.41) | -2.9 | (3.56) |
| Russian Fed. | -1.6 | (0.97) | **2.7** | (0.87) | -1.3 | (0.72) | **-5.2** | (1.05) | **-6.4** | (1.74) | **-6.7** | (2.05) | **-4.5** | (1.64) | 3.8 | (1.97) | 0.0 | (1.53) |
| Serbia | **-6.2** | (1.78) | 1.0 | (1.65) | 0.7 | (1.56) | **-2.5** | (0.97) | -0.5 | (1.28) | -2.1 | (1.72) | **-8.1** | (1.62) | -0.7 | (1.64) | -0.1 | (1.27) |
| Thailand | -0.3 | (0.82) | **11.0** | (1.62) | 0.5 | (1.18) | **-3.9** | (0.94) | 3.6 | (2.03) | -1.3 | (1.99) | **-9.9** | (2.57) | -0.3 | (2.18) | -1.6 | (2.13) |
| Tunisia | **-2.8** | (0.52) | 0.6 | (1.99) | 1.5 | (1.59) | m | m | 1.2 | (1.32) | 0.1 | (1.46) | 0.2 | (1.18) | 1.7 | (1.63) | **-3.7** | (1.11) |
| Uruguay | **-5.3** | (1.51) | 2.6 | (1.88) | -1.1 | (1.59) | **-5.6** | (1.48) | **-4.2** | (1.85) | -1.7 | (2.31) | -0.6 | (1.55) | -2.9 | (1.62) | -0.7 | (1.34) |
| United Kingdom[1] | -1.0 | (1.30) | **14.0** | (1.70) | **-10.3** | (1.54) | **-5.9** | (1.23) | 0.3 | (1.96) | **-15.1** | (1.62) | -1.0 | (1.56) | -3.0 | (1.57) | -1.4 | (1.14) |

1. Response rate too low to ensure comparability.

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Table C.2
**Bivariate regression coefficients and standard errors**

| | Score point difference associated with the various factors shown below, before accounting for the other factors | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | School characteristics | | | | | | | | | | | | | | | |
| | | | | | School climate | | | | | | Classroom climate | | | | | |
| | School average of the highest international socio-economic index of occupational status (HISEI) between both parents | | School size | | Attitudes towards school | | Sense of belonging at school | | Student-teacher relations | | Disciplinary climate | | School average disciplinary climate | | Teacher support | |
| | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. |
| **OECD** | | | | | | | | | | | | | | | | |
| Australia | **39.8** | (3.37) | **24.9** | (1.34) | **10.2** | (1.10) | 0.9 | (1.19) | **13.4** | (1.02) | **16.0** | (0.89) | **29.5** | (0.59) | **7.4** | (1.24) |
| Austria | **47.1** | (1.28) | **15.7** | (5.19) | **-2.2** | (1.00) | 0.1 | (0.95) | 0.3 | (1.29) | **6.9** | (1.31) | **24.2** | (1.97) | -0.9 | (1.46) |
| Belgium | **53.0** | (2.46) | **29.3** | (6.08) | **-3.4** | (1.10) | -0.8 | (1.31) | -1.1 | (1.11) | **10.8** | (0.90) | **38.9** | (3.48) | **-2.2** | (0.92) |
| Canada | **25.8** | (0.78) | **11.4** | (1.43) | **6.6** | (0.87) | -1.4 | (0.89) | **9.3** | (1.05) | **14.3** | (0.93) | **14.8** | (0.97) | **6.3** | (1.02) |
| Czech Republic | **53.9** | (4.60) | 8.6 | (9.01) | **1.3** | (1.33) | **7.8** | (1.72) | -1.4 | (1.27) | **6.2** | (1.05) | **18.6** | (2.26) | -1.6 | (1.44) |
| Denmark | **29.5** | (1.85) | **33.0** | (6.47) | **5.2** | (1.64) | 1.7 | (1.69) | **8.0** | (1.65) | 6.8 | (1.97) | **15.9** | (1.60) | **6.6** | (2.00) |
| Finland | **9.7** | (0.99) | **22.4** | (2.84) | **12.1** | (1.46) | -1.9 | (1.23) | 8.9 | (1.37) | **10.3** | (1.42) | **3.4** | (1.29) | **4.9** | (1.78) |
| France | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | **50.6** | (3.37) | 8.2 | (4.25) | **-3.8** | (1.25) | **-3.4** | (1.36) | 0.4 | (1.06) | **7.5** | (1.16) | **25.7** | (2.40) | 0.5 | (1.13) |
| Greece | **40.2** | (1.07) | -2.3 | (16.24) | **-5.6** | (1.53) | 2.2 | (1.44) | -2.7 | (1.69) | 5.3 | (1.56) | **24.6** | (2.60) | 0.5 | (1.70) |
| Hungary | **56.2** | (1.28) | **22.4** | (11.44) | **-7.3** | (1.36) | 2.0 | (1.19) | **-3.8** | (1.19) | **3.1** | (1.11) | **18.0** | (1.60) | 0.0 | (1.21) |
| Iceland | **8.0** | (1.87) | 5.1 | (4.93) | **15.0** | (1.46) | 0.1 | (1.45) | **11.7** | (1.43) | **13.1** | (1.76) | **6.7** | (1.80) | **9.7** | (1.87) |
| Ireland | **34.6** | (1.69) | **17.3** | (5.15) | **6.1** | (1.46) | **-4.7** | (1.42) | **4.5** | (1.70) | **15.8** | (1.52) | **5.7** | (0.92) | -1.7 | (1.67) |
| Italy | **49.1** | (0.68) | **11.5** | (5.59) | **0.6** | (1.08) | -0.5 | (1.15) | **-5.1** | (1.06) | **4.6** | (1.12) | **22.3** | (0.49) | **-2.6** | (1.07) |
| Japan | **77.8** | (0.83) | **25.3** | (1.03) | **-0.8** | (1.43) | -1.0 | (1.50) | 3.0 | (1.52) | **5.3** | (1.84) | **42.1** | (0.89) | 1.7 | (1.77) |
| Korea | **58.3** | (1.08) | **28.0** | (4.64) | **1.2** | (1.16) | 1.0 | (1.31) | **6.2** | (1.22) | 1.7 | (1.38) | **37.1** | (3.69) | **3.8** | (1.42) |
| Luxembourg | **53.5** | (1.16) | **4.5** | (1.12) | **-2.5** | (1.33) | **4.4** | (1.33) | 0.3 | (1.33) | **7.4** | (1.23) | **60.3** | (2.32) | **-2.8** | (1.13) |
| Mexico | **25.9** | (0.32) | **5.3** | (1.87) | **10.5** | (1.11) | **3.7** | (0.94) | **-3.1** | (1.29) | **10.5** | (1.32) | **23.8** | (0.98) | 0.1 | (1.02) |
| Netherlands | **52.1** | (3.46) | **18.5** | (2.84) | **-1.1** | (1.43) | -2.8 | (1.47) | 3.0 | (1.83) | 4.3 | (1.68) | **19.3** | (7.38) | 1.0 | (1.33) |
| New Zealand | **36.0** | (1.76) | **15.2** | (0.94) | **13.4** | (1.53) | 2.5 | (1.38) | **15.4** | (1.72) | **14.7** | (1.61) | **20.7** | (1.38) | **4.4** | (1.40) |
| Norway | **19.2** | (1.71) | 8.8 | (7.99) | **15.8** | (1.86) | -0.2 | (1.53) | **16.1** | (1.61) | 11.4 | (1.84) | **13.1** | (1.62) | **13.7** | (1.90) |
| Poland | **29.7** | (1.36) | **18.3** | (2.70) | **-0.8** | (1.72) | **7.5** | (1.35) | **-7.4** | (1.80) | **15.0** | (1.38) | **3.1** | (1.55) | -0.8 | (1.58) |
| Portugal | **35.5** | (0.98) | **28.2** | (3.85) | **6.6** | (1.31) | **10.1** | (1.50) | -0.5 | (1.42) | **15.2** | (1.64) | **36.5** | (1.03) | -0.9 | (1.75) |
| Slovak Republic | **46.7** | (0.63) | 14.1 | (7.64) | **-6.4** | (1.35) | 0.2 | (1.30) | **-9.6** | (1.42) | **5.1** | (1.34) | **19.5** | (0.75) | **-6.8** | (1.13) |
| Spain | **26.4** | (0.59) | **9.6** | (4.11) | **5.1** | (1.28) | 0.4 | (1.37) | **1.1** | (1.30) | **13.1** | (1.34) | **15.0** | (0.80) | -0.8 | (1.46) |
| Sweden | **25.0** | (1.62) | **16.6** | (3.30) | **13.0** | (1.46) | -0.4 | (1.53) | **14.8** | (1.37) | **13.2** | (1.81) | **15.3** | (2.00) | 3.1 | (1.84) |
| Switzerland | **39.5** | (0.90) | 10.1 | (5.15) | **1.4** | (1.90) | **3.0** | (1.29) | 0.0 | (1.81) | **11.0** | (2.13) | **19.8** | (1.00) | -1.6 | (1.88) |
| Turkey | **50.0** | (0.94) | 3.1 | (3.16) | **-1.0** | (1.32) | **9.6** | (1.69) | -2.3 | (1.46) | **13.5** | (1.71) | **45.3** | (1.50) | 2.0 | (1.40) |
| United States | **41.1** | (0.91) | 1.1 | (2.27) | **6.6** | (1.23) | m | m | **10.0** | (1.41) | **20.6** | (1.23) | **27.9** | (0.95) | **6.7** | (1.31) |
| **Partners** | | | | | | | | | | | | | | | | |
| Brazil | **40.2** | (1.74) | 2.7 | (2.19) | **1.7** | (1.40) | **3.1** | (1.12) | -4.6 | (1.34) | **10.4** | (1.90) | **35.1** | (3.97) | **-5.8** | (1.42) |
| Hong Kong-China | **48.7** | (1.24) | **116.4** | (7.65) | **6.3** | (1.90) | **5.5** | (1.62) | **6.7** | (1.41) | **10.7** | (1.33) | **77.2** | (1.28) | **8.1** | (1.63) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | **26.6** | (1.37) | **30.3** | (2.65) | **8.7** | (1.94) | **9.4** | (2.10) | **0.8** | (2.05) | **15.2** | (2.48) | **7.0** | (0.92) | 0.3 | (2.11) |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c |
| Macao-China | **23.8** | (3.52) | **4.5** | (2.82) | **1.2** | (5.68) | 4.3 | (5.21) | 4.0 | (3.81) | **15.4** | (4.12) | **45.0** | (3.93) | -3.6 | (4.41) |
| Russian Fed. | **30.4** | (1.18) | **14.8** | (4.91) | **3.6** | (1.38) | **7.7** | (1.00) | **-4.7** | (1.35) | **14.7** | (1.56) | **17.5** | (1.12) | **3.5** | (1.46) |
| Serbia | **41.2** | (0.66) | **8.8** | (1.52) | **-0.8** | (1.32) | **0.2** | (1.02) | **-11.8** | (1.35) | **10.3** | (1.52) | **33.7** | (0.68) | **-8.2** | (1.22) |
| Thailand | **36.4** | (0.82) | **13.9** | (0.29) | **7.6** | (1.31) | 6.9 | (1.42) | **-4.8** | (1.34) | **19.2** | (1.50) | 16.1 | (1.06) | **5.3** | (1.28) |
| Tunisia | **31.9** | (0.32) | **12.6** | (4.48) | **4.8** | (0.87) | **3.6** | (0.93) | **-4.3** | (0.85) | **7.1** | (1.23) | **20.3** | (0.66) | -0.1 | (1.17) |
| Uruguay | **44.4** | (0.76) | 40.0 | (1.61) | 2.1 | (1.61) | 2.3 | (1.26) | **-6.7** | (1.27) | **7.4** | (1.82) | **33.9** | (1.07) | **-4.8** | (1.55) |
| United Kingdom[1] | **37.3** | (2.87) | **11.0** | (4.71) | **9.8** | (1.23) | 0.2 | (1.21) | **14.2** | (1.46) | **20.0** | (1.10) | **22.6** | (1.76) | **7.4** | (1.31) |

1. Response rate too low to ensure comparability.

**Table C.2**
**Bivariate regression coefficients and standard errors** *(continued)*

| | Score point difference associated with the various factors shown below, before accounting for the other factors | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Student characteristics | | | | | | | | | | | | | | | |
| | Home background | | | | | | Self-related cognitions in mathematics | | | | | | | | | |
| | The highest international socio-economic index of occupational status (HISEI) between both parents | | The highest level of education between both parents (HISCED) | | Number of books in the home | | Anxiety in mathematics | | Instrumental motivation in mathematics | | Interest in and enjoyment of mathematics | | Self-concept in mathematics | | Self-efficacy in mathematics | |
| | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. |
| **OECD** | | | | | | | | | | | | | | | | |
| Australia | 19.8 | (1.30) | 12.4 | (1.49) | 21.4 | (0.95) | -34.2 | (1.25) | 15.6 | (0.94) | 17.2 | (1.07) | 39.4 | (1.10) | 43.4 | (0.88) |
| Austria | 7.0 | (1.21) | 1.9 | (1.68) | 17.1 | (1.28) | -20.9 | (1.03) | 3.1 | (1.15) | 10.2 | (1.22) | 23.5 | (1.12) | 27.8 | (1.18) |
| Belgium | 17.9 | (1.13) | 11.0 | (1.25) | 16.8 | (1.12) | -23.0 | (1.09) | 11.6 | (1.20) | 15.1 | (1.18) | 24.7 | (1.19) | 33.0 | (1.50) |
| Canada | 18.1 | (1.06) | 18.5 | (1.49) | 20.6 | (0.98) | -30.6 | (0.79) | 19.0 | (0.86) | 19.9 | (0.94) | 34.1 | (0.66) | 39.7 | (0.83) |
| Czech Republic | 15.3 | (1.59) | 17.8 | (2.09) | 19.8 | (1.63) | -32.0 | (1.35) | 14.1 | (1.38) | 18.4 | (1.52) | 32.8 | (1.27) | 38.3 | (1.19) |
| Denmark | 25.4 | (1.75) | 25.8 | (2.02) | 27.6 | (1.77) | -42.8 | (1.40) | 21.0 | (1.48) | 28.1 | (1.56) | 45.4 | (1.28) | 48.7 | (1.78) |
| Finland | 21.7 | (1.28) | 19.4 | (1.52) | 28.6 | (1.47) | -41.7 | (1.51) | 26.6 | (1.71) | 30.2 | (1.61) | 44.9 | (1.19) | 45.5 | (1.40) |
| France | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | 13.0 | (1.52) | 11.4 | (1.34) | 17.8 | (1.17) | -22.2 | (0.87) | 9.7 | (1.29) | 14.3 | (1.09) | 23.1 | (0.97) | 32.6 | (1.23) |
| Greece | 12.2 | (1.66) | 10.8 | (1.45) | 17.0 | (1.31) | -28.6 | (1.42) | 13.2 | (1.33) | 19.8 | (1.30) | 34.1 | (1.56) | 33.1 | (1.93) |
| Hungary | 10.1 | (1.62) | 13.1 | (1.66) | 15.2 | (1.24) | -23.6 | (1.23) | 8.1 | (1.34) | 10.8 | (1.52) | 23.7 | (1.25) | 29.9 | (1.21) |
| Iceland | 12.9 | (1.50) | 20.1 | (1.79) | 24.9 | (1.73) | -33.1 | (1.34) | 18.0 | (1.68) | 24.7 | (1.45) | 39.6 | (1.14) | 40.1 | (1.27) |
| Ireland | 22.2 | (1.73) | 18.9 | (1.59) | 24.1 | (1.48) | -30.0 | (1.53) | 8.3 | (1.40) | 17.1 | (1.52) | 32.4 | (1.55) | 44.0 | (1.35) |
| Italy | 7.3 | (1.11) | 3.1 | (1.11) | 10.7 | (1.18) | -25.5 | (1.29) | 9.9 | (1.29) | 14.1 | (1.15) | 23.6 | (1.06) | 34.4 | (1.38) |
| Japan | 2.0 | (1.47) | 3.5 | (1.64) | 10.8 | (1.26) | -14.4 | (1.18) | 11.5 | (1.15) | 15.9 | (1.11) | 18.2 | (1.10) | 30.4 | (1.34) |
| Korea | 7.5 | (1.52) | 6.3 | (1.20) | 24.0 | (1.55) | -18.3 | (1.38) | 19.0 | (1.15) | 23.3 | (1.03) | 32.1 | (1.26) | 35.6 | (1.36) |
| Luxembourg | 15.3 | (1.42) | 8.5 | (1.08) | 16.5 | (1.30) | -20.8 | (1.17) | 4.7 | (1.19) | 9.8 | (1.18) | 19.1 | (1.14) | 31.8 | (1.18) |
| Mexico | 4.8 | (0.96) | 2.0 | (0.99) | 5.2 | (1.57) | -26.0 | (1.19) | 5.7 | (1.32) | 7.9 | (1.52) | 22.9 | (0.99) | 20.1 | (1.27) |
| Netherlands | 9.5 | (1.35) | 4.3 | (1.21) | 12.9 | (1.34) | -20.4 | (1.43) | 10.5 | (1.29) | 15.1 | (1.47) | 22.4 | (1.44) | 27.3 | (1.25) |
| New Zealand | 23.1 | (1.44) | 20.9 | (1.93) | 29.0 | (1.59) | -44.4 | (1.35) | 16.3 | (1.72) | 15.9 | (1.62) | 44.2 | (1.32) | 48.8 | (1.36) |
| Norway | 28.4 | (1.75) | 23.8 | (2.30) | 29.7 | (1.66) | -41.3 | (1.33) | 27.9 | (1.55) | 34.0 | (1.36) | 45.7 | (1.23) | 46.4 | (1.52) |
| Poland | 32.2 | (1.74) | 35.9 | (2.36) | 31.2 | (1.49) | -44.8 | (1.34) | 18.8 | (1.63) | 17.7 | (1.37) | 44.8 | (1.39) | 50.7 | (1.93) |
| Portugal | 22.6 | (1.40) | 10.4 | (1.10) | 24.9 | (1.53) | -27.7 | (1.40) | 15.0 | (1.59) | 15.6 | (1.75) | 30.9 | (1.18) | 43.2 | (1.88) |
| Slovak Republic | 14.5 | (1.25) | 18.2 | (2.16) | 26.4 | (1.89) | -37.0 | (1.03) | 11.8 | (1.36) | 15.4 | (1.67) | 39.9 | (1.44) | 39.4 | (1.49) |
| Spain | 15.8 | (1.25) | 10.2 | (0.86) | 28.8 | (1.36) | -22.6 | (1.74) | 19.2 | (1.04) | 20.6 | (1.24) | 30.5 | (1.13) | 36.5 | (1.38) |
| Sweden | 27.3 | (1.79) | 15.9 | (1.75) | 34.4 | (1.51) | -41.2 | (1.56) | 22.9 | (1.83) | 27.2 | (1.63) | 46.2 | (1.56) | 51.8 | (1.61) |
| Switzerland | 18.6 | (1.54) | 13.6 | (1.34) | 25.3 | (1.21) | -26.1 | (1.04) | 8.4 | (1.54) | 14.5 | (1.36) | 25.3 | (1.15) | 40.0 | (1.47) |
| Turkey | 6.4 | (1.60) | 6.1 | (1.39) | 15.3 | (1.70) | -19.3 | (1.52) | 9.3 | (1.47) | 12.9 | (1.64) | 22.2 | (1.56) | 24.8 | (1.59) |
| United States | 22.2 | (1.26) | 20.0 | (1.90) | 28.4 | (1.18) | -30.1 | (1.17) | 16.8 | (1.23) | 12.9 | (1.18) | 32.2 | (1.19) | 41.4 | (1.17) |
| **Partners** | | | | | | | | | | | | | | | | |
| Brazil | 13.1 | (2.26) | 0.1 | (1.20) | 12.0 | (2.27) | -27.4 | (2.24) | 0.5 | (1.72) | 5.3 | (2.07) | 22.3 | (1.57) | 19.8 | (1.84) |
| Hong Kong-China | 5.7 | (1.76) | -0.7 | (2.01) | 12.9 | (1.42) | -20.3 | (1.72) | 15.7 | (1.50) | 22.0 | (1.25) | 27.1 | (1.56) | 34.8 | (1.61) |
| Indonesia | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | 15.6 | (1.82) | 18.9 | (3.95) | 21.3 | (2.16) | -42.1 | (1.99) | 19.2 | (1.61) | 16.5 | (2.43) | 41.8 | (1.93) | 47.0 | (2.61) |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c |
| Macao-China | 6.1 | (4.10) | 2.4 | (3.23) | 7.0 | (3.70) | -26.4 | (3.71) | 4.5 | (3.79) | 19.2 | (4.18) | 30.6 | (3.69) | 38.2 | (3.90) |
| Russian Fed. | 12.8 | (1.51) | 15.8 | (1.92) | 18.6 | (1.40) | -37.3 | (1.68) | 10.1 | (1.54) | 11.5 | (1.70) | 34.1 | (1.63) | 38.0 | (1.97) |
| Serbia | 11.1 | (1.43) | 7.4 | (1.50) | 15.3 | (1.76) | -23.6 | (1.23) | 2.1 | (1.32) | 1.7 | (1.57) | 23.3 | (1.48) | 22.0 | (1.83) |
| Thailand | 9.7 | (1.39) | 5.4 | (1.21) | 8.3 | (1.66) | -14.9 | (1.58) | 9.0 | (1.69) | 6.4 | (1.79) | 16.9 | (1.71) | 23.6 | (1.73) |
| Tunisia | 10.5 | (1.39) | 4.2 | (1.06) | 11.7 | (1.44) | -10.0 | (1.33) | 9.9 | (1.18) | 8.4 | (1.17) | 13.9 | (0.96) | 18.2 | (1.32) |
| Uruguay | 13.0 | (1.36) | 7.3 | (1.47) | 12.9 | (1.86) | -28.2 | (1.71) | 10.0 | (1.31) | 15.9 | (1.62) | 27.5 | (1.40) | 28.5 | (1.60) |
| United Kingdom[1] | 21.8 | (1.38) | 18.5 | (1.77) | 26.0 | (1.37) | -29.9 | (1.20) | 11.6 | (1.45) | 13.8 | (1.30) | 34.5 | (1.43) | 44.4 | (1.29) |

1. Response rate too low to ensure comparability.

**Table C.2**
**Bivariate regression coefficients and standard errors** *(continued)*

| | Score point difference associated with the various factors shown below, before accounting for the other factors | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time students invest in learning | | | | | | | | Learning strategies and preferences in mathematics | | | | | | | | | |
| | Out-of-school learning time | | | | | | | | Learning strategies | | | | | | Students' preference for learning situations | | | |
| | Attending out-of-school classes | | Hours per week of homework in total | | Hours per week of mathematics homework | | Working with a tutor | | Control strategies | | Elaboration strategies | | Memo-risation/ rehearsal strategies | | Competitive learning situations | | Co-operative learning situations | |
| | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. | Coeff. | S.E. |
| **OECD** | | | | | | | | | | | | | | | | | | |
| Australia | **-9.2** | (1.89) | **14.7** | (1.38) | **8.3** | (1.42) | **-6.5** | (1.03) | **12.4** | (1.27) | 0.0 | (0.99) | **7.9** | (1.17) | **12.5** | (1.26) | -2.5 | (1.30) |
| Austria | **-13.4** | (3.24) | **-6.9** | (2.23) | **-15.8** | (2.35) | **-13.8** | (1.28) | **-3.6** | (1.06) | **3.1** | (1.08) | **-11.3** | (0.97) | 0.5 | (1.03) | **-2.2** | (1.09) |
| Belgium | **-10.6** | (1.63) | **5.5** | (1.48) | -2.3 | (1.42) | **-11.0** | (1.63) | **-2.4** | (1.19) | 1.2 | (1.36) | **-6.7** | (1.35) | -0.3 | (1.18) | **-4.3** | (1.27) |
| Canada | **-7.3** | (1.68) | **9.4** | (1.20) | 1.2 | (1.00) | **-11.5** | (0.87) | **11.5** | (1.05) | **7.5** | (1.01) | **6.5** | (0.97) | **12.1** | (0.93) | **-5.0** | (1.01) |
| Czech Republic | **-5.5** | (1.97) | -2.3 | (1.80) | **-11.9** | (1.72) | **-9.3** | (1.22) | -0.9 | (1.67) | **12.6** | (1.37) | **-5.7** | (1.52) | **12.5** | (1.34) | **-5.6** | (1.23) |
| Denmark | **-12.7** | (2.45) | -2.9 | (2.83) | **-10.3** | (1.89) | **-18.7** | (3.62) | **4.4** | (2.17) | **10.7** | (2.00) | **9.5** | (1.80) | **22.3** | (1.65) | **-4.0** | (1.72) |
| Finland | **-13.8** | (5.35) | -4.2 | (2.44) | **-18.5** | (2.37) | **-22.0** | (3.84) | **11.4** | (1.36) | **16.8** | (1.34) | **6.6** | (1.48) | **19.7** | (1.34) | 3.0 | (1.66) |
| France | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w | w |
| Germany | **-13.5** | (2.67) | **-4.5** | (1.76) | **-12.1** | (1.49) | **-12.2** | (0.85) | **-5.9** | (1.23) | **4.6** | (1.26) | **-9.1** | (1.16) | **5.9** | (1.22) | 0.7 | (1.09) |
| Greece | -0.3 | (0.71) | **9.0** | (1.29) | **5.3** | (1.24) | **-6.0** | (1.04) | **3.0** | (1.41) | **8.4** | (1.32) | -1.7 | (1.91) | **11.8** | (1.41) | 0.5 | (1.23) |
| Hungary | **-6.7** | (0.73) | 0.4 | (0.94) | **-6.1** | (1.15) | **-9.2** | (0.97) | **-4.7** | (1.33) | **3.1** | (1.16) | **-6.2** | (0.94) | **6.7** | (1.30) | 0.6 | (1.43) |
| Iceland | **-10.1** | (2.26) | **8.5** | (2.81) | **-8.4** | (2.28) | **-16.4** | (1.55) | **4.4** | (1.62) | 0.4 | (1.58) | -0.5 | (1.47) | **14.0** | (1.69) | -1.4 | (1.43) |
| Ireland | -1.0 | (1.92) | **14.9** | (1.38) | 3.0 | (1.64) | **-10.4** | (1.42) | **3.7** | (1.48) | -0.5 | (1.73) | **4.7** | (1.65) | **5.6** | (1.79) | -2.9 | (1.73) |
| Italy | **-9.3** | (1.90) | 0.5 | (0.77) | **-2.7** | (1.22) | **-10.5** | (1.02) | 2.0 | (1.30) | **5.7** | (1.21) | **-5.5** | (1.23) | **5.7** | (1.39) | **-3.7** | (1.01) |
| Japan | -2.2 | (1.17) | **10.0** | (2.06) | **4.9** | (1.45) | **-9.4** | (1.53) | **7.4** | (1.13) | **9.1** | (1.07) | **7.2** | (1.29) | **9.7** | (0.94) | **7.8** | (1.19) |
| Korea | **3.7** | (0.66) | **15.4** | (2.38) | **8.0** | (2.05) | **-2.8** | (0.88) | **20.0** | (1.16) | **17.7** | (1.12) | **7.1** | (1.24) | **22.1** | (1.10) | **21.3** | (1.28) |
| Luxembourg | **-9.0** | (1.88) | -1.0 | (2.03) | **-12.5** | (1.71) | **-9.4** | (1.15) | **-4.6** | (1.30) | **-2.5** | (1.14) | **-7.6** | (1.24) | 1.0 | (1.24) | **-5.2** | (1.08) |
| Mexico | **-5.1** | (0.97) | **13.0** | (1.07) | **7.3** | (0.74) | -4.2 | (2.47) | **2.7** | (0.99) | **2.4** | (1.02) | 1.4 | (0.96) | **6.0** | (1.28) | -1.1 | (1.03) |
| Netherlands | m | m | 2.4 | (1.43) | **-8.4** | (1.62) | **-10.0** | (1.55) | -3.6 | (1.95) | **5.9** | (1.43) | **5.2** | (1.61) | 2.8 | (1.75) | 1.1 | (1.82) |
| New Zealand | **-17.3** | (1.66) | **18.5** | (2.65) | 1.2 | (2.32) | **-14.5** | (1.76) | **11.0** | (1.46) | -2.9 | (1.88) | **5.7** | (1.48) | **6.9** | (1.82) | **-5.4** | (1.62) |
| Norway | **-10.4** | (2.81) | **8.0** | (2.26) | **-9.8** | (1.91) | **-25.8** | (2.49) | **14.5** | (1.58) | **8.0** | (1.47) | **21.8** | (1.55) | **18.5** | (1.44) | 1.0 | (1.56) |
| Poland | **-5.9** | (1.32) | **8.4** | (1.18) | **-6.4** | (0.92) | **-10.0** | (1.22) | **4.3** | (1.88) | **7.4** | (1.84) | **-3.7** | (1.87) | **12.3** | (1.91) | **-5.0** | (1.65) |
| Portugal | **-3.4** | (1.27) | **7.7** | (2.02) | 1.3 | (1.77) | **-3.6** | (0.85) | **12.3** | (1.53) | **10.6** | (1.61) | -2.3 | (1.71) | **5.4** | (1.29) | 2.3 | (1.87) |
| Slovak Republic | **-3.7** | (1.58) | -1.9 | (1.52) | **-5.5** | (1.15) | -2.0 | (1.26) | **-5.2** | (1.49) | **4.5** | (1.58) | **-6.7** | (1.47) | **9.1** | (1.36) | **-11.3** | (1.49) |
| Spain | **-3.9** | (0.95) | **15.0** | (1.87) | 3.0 | (1.65) | **-7.2** | (0.88) | **11.5** | (1.13) | **11.4** | (1.06) | **6.8** | (1.23) | **11.5** | (1.08) | 6.9 | (1.18) |
| Sweden | **-12.4** | (4.22) | 4.6 | (2.71) | **-25.8** | (2.94) | **-22.2** | (2.56) | 0.2 | (1.86) | **9.9** | (2.03) | **14.4** | (1.82) | **16.5** | (1.89) | **4.3** | (2.00) |
| Switzerland | **-8.3** | (3.37) | **-6.3** | (2.49) | **-19.9** | (2.38) | **-12.9** | (1.71) | **-3.0** | (1.50) | -0.1 | (1.44) | **-11.1** | (1.38) | -3.1 | (1.84) | **-4.0** | (1.16) |
| Turkey | **3.0** | (0.98) | **5.1** | (1.46) | 2.1 | (1.35) | **-6.4** | (1.68) | **8.9** | (1.43) | **4.3** | (1.17) | **3.2** | (1.47) | **10.9** | (1.27) | **2.4** | (1.04) |
| United States | **-13.3** | (2.49) | **18.1** | (1.89) | **4.6** | (1.19) | **-14.6** | (1.16) | **5.5** | (1.32) | -1.0 | (1.25) | **3.1** | (1.31) | **8.4** | (1.33) | **-3.8** | (1.17) |
| **Partners** | | | | | | | | | | | | | | | | | | |
| Brazil | **-3.9** | (0.98) | **7.8** | (1.58) | 0.2 | (1.52) | **-15.7** | (1.25) | 0.6 | (1.59) | -1.0 | (1.38) | **-7.3** | (1.91) | -3.5 | (1.87) | **-3.3** | (1.65) |
| Hong Kong-China | -0.6 | (0.88) | **11.7** | (1.17) | **7.2** | (1.19) | **-6.4** | (1.04) | **14.9** | (1.45) | **14.8** | (1.45) | **3.7** | (1.51) | **13.1** | (1.47) | **12.9** | (1.55) |
| Indonesia | m | m | m | m | m | m | N/A | m | m | m | m | m | m | m | m | m | m | m |
| Latvia | -2.9 | (1.84) | 1.4 | (1.30) | **-6.0** | (1.58) | **-9.9** | (1.19) | **-6.1** | (2.74) | 6.3 | (3.34) | -1.3 | (3.09) | **13.2** | (2.23) | **-5.3** | (2.44) |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c | c |
| Macao-China | **-7.8** | (2.23) | 13.0 | (3.27) | **5.3** | (2.07) | **-15.3** | (2.83) | 4.5 | (4.07) | **14.6** | (3.92) | **-12.1** | (4.12) | **9.0** | (4.32) | 5.3 | (3.93) |
| Russian Fed. | -0.6 | (1.07) | **3.5** | (1.00) | **-1.8** | (0.86) | **-9.2** | (1.23) | -2.0 | (1.37) | **4.1** | (1.65) | -0.6 | (1.27) | **13.3** | (1.45) | **4.7** | (1.46) |
| Serbia | **-9.3** | (2.02) | 3.1 | (1.49) | 0.5 | (1.23) | **-6.3** | (1.04) | **-4.1** | (1.02) | -2.5 | (1.49) | **-12.4** | (1.53) | -2.4 | (1.38) | **-5.1** | (1.28) |
| Thailand | -0.6 | (0.96) | **16.9** | (1.31) | **10.0** | (0.93) | **-4.9** | (1.01) | **6.1** | (1.34) | **5.1** | (1.55) | -0.3 | (1.66) | 2.7 | (1.79) | **4.8** | (1.69) |
| Tunisia | 0.7 | (0.58) | 6.8 | (1.68) | **5.2** | (1.33) | N/A | m | **7.0** | (1.02) | **7.8** | (0.91) | **5.9** | (0.92) | **8.9** | (1.18) | **3.6** | (1.00) |
| Uruguay | **-7.4** | (1.50) | 5.4 | (1.50) | 0.7 | (1.42) | **-14.2** | (1.57) | -0.7 | (1.50) | **3.7** | (1.45) | -1.6 | (1.49) | -1.0 | (1.73) | **-7.9** | (1.34) |
| United Kingdom[1] | **0.7** | (1.44) | **19.6** | (1.72) | **-3.1** | (1.54) | **-8.3** | (1.43) | **9.2** | (1.74) | -1.7 | (1.75) | **10.3** | (1.64) | 5.7 | (1.90) | -1.4 | (1.50) |

1. Response rate too low to ensure comparability.

Table C.3
**Variance explained by the multivariate multilevel model on teaching and learning strategies**

| | Variance explained | |
|---|---|---|
| | Between schools | Within schools |
| OECD | | |
| Australia | 0.81 | 0.38 |
| Austria | 0.78 | 0.31 |
| Belgium | 0.77 | 0.29 |
| Canada | 0.70 | 0.41 |
| Czech Republic | 0.79 | 0.34 |
| Denmark | 0.75 | 0.44 |
| Finland | 0.50 | 0.47 |
| France | w | w |
| Germany | 0.84 | 0.35 |
| Greece | 0.73 | 0.27 |
| Hungary | 0.82 | 0.27 |
| Iceland | 0.56 | 0.42 |
| Ireland | 0.87 | 0.40 |
| Italy | 0.64 | 0.26 |
| Japan | 0.83 | 0.22 |
| Korea | 0.80 | 0.29 |
| Luxembourg | 0.92 | 0.30 |
| Mexico | 0.64 | 0.22 |
| Netherlands | 0.80 | 0.27 |
| New Zealand | 0.85 | 0.44 |
| Norway | 0.64 | 0.48 |
| Poland | 0.83 | 0.47 |
| Portugal | 0.85 | 0.36 |
| Slovak Republic | 0.80 | 0.39 |
| Spain | 0.66 | 0.32 |
| Sweden | 0.72 | 0.49 |
| Switzerland | 0.75 | 0.37 |
| Turkey | 0.68 | 0.22 |
| United States | 0.84 | 0.42 |
| **Partners** | | |
| Brazil | 0.77 | 0.24 |
| Hong Kong-China | 0.77 | 0.27 |
| Indonesia | m | m |
| Latvia | 0.68 | 0.37 |
| Liechtenstein | c | c |
| Macao-China | 0.71 | 0.31 |
| Russian Federation | 0.56 | 0.30 |
| Serbia | 0.81 | 0.26 |
| Thailand | 0.64 | 0.19 |
| Tunisia | 0.74 | 0.17 |
| Uruguay | 0.83 | 0.25 |
| United Kingdom[1] | 0.82 | 0.44 |

1. Response rate too low to ensure comparability.

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Table C.4
**Variance explained by model changes**

| | Variance in mathematics performance | | Model 1: Parents' highest occupational status, parents' highest level of education, number of books in the home | | Model 2: Students' attitudes towards school and students' sense of belonging at school | | Model 3: Students' interest in and enjoyment of mathematics and students' instrumental motivation in learning mathematics | | Model 4: Students' anxiety in mathematics | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Between schools | Within schools | Between schools | Within schools | Between schools | Within schools | Between schools | Within schools | Between schools | Within schools |
| **OECD** | | | | | | | | | | |
| Australia | 1927 | 7127 | 0.39 | 0.07 | 0.41 | 0.08 | 0.41 | 0.11 | 0.46 | 0.19 |
| Austria | 5250 | 4265 | 0.22 | 0.04 | 0.22 | 0.05 | 0.22 | 0.07 | 0.26 | 0.17 |
| Belgium | 7240 | 5691 | 0.22 | 0.06 | 0.22 | 0.07 | 0.22 | 0.11 | 0.23 | 0.15 |
| Canada | 1270 | 6210 | 0.30 | 0.08 | 0.31 | 0.08 | 0.30 | 0.15 | 0.35 | 0.24 |
| Czech Republic | 4942 | 4662 | 0.27 | 0.06 | 0.27 | 0.06 | 0.28 | 0.11 | 0.35 | 0.20 |
| Denmark | 1147 | 7260 | 0.52 | 0.11 | 0.53 | 0.11 | 0.51 | 0.20 | 0.57 | 0.33 |
| Finland | 343 | 6659 | 0.19 | 0.13 | 0.23 | 0.14 | 0.25 | 0.23 | 0.29 | 0.33 |
| France | w | w | w | w | w | w | w | w | w | w |
| Germany | 6101 | 4473 | 0.27 | 0.06 | 0.27 | 0.06 | 0.25 | 0.12 | 0.31 | 0.20 |
| Greece | 3357 | 5869 | 0.25 | 0.04 | 0.26 | 0.04 | 0.25 | 0.10 | 0.28 | 0.15 |
| Hungary | 5710 | 4068 | 0.28 | 0.03 | 0.28 | 0.04 | 0.25 | 0.08 | 0.30 | 0.14 |
| Iceland | 319 | 7842 | 0.36 | 0.08 | 0.40 | 0.11 | 0.36 | 0.16 | 0.40 | 0.24 |
| Ireland | 1218 | 6124 | 0.56 | 0.09 | 0.57 | 0.10 | 0.56 | 0.14 | 0.62 | 0.21 |
| Italy | 4915 | 4463 | 0.13 | 0.02 | 0.13 | 0.02 | 0.12 | 0.06 | 0.17 | 0.12 |
| Japan | 5400 | 4757 | 0.07 | 0.02 | 0.07 | 0.02 | 0.13 | 0.07 | 0.10 | 0.08 |
| Korea | 3607 | 5006 | 0.27 | 0.07 | 0.27 | 0.07 | 0.41 | 0.15 | 0.40 | 0.16 |
| Luxembourg | 2673 | 5841 | 0.35 | 0.06 | 0.36 | 0.06 | 0.34 | 0.08 | 0.40 | 0.14 |
| Mexico | 2496 | 3872 | 0.09 | 0.00 | 0.16 | 0.03 | 0.12 | 0.04 | 0.20 | 0.11 |
| Netherlands | 5508 | 3345 | 0.18 | 0.05 | 0.18 | 0.05 | 0.16 | 0.11 | 0.18 | 0.16 |
| New Zealand | 1781 | 7956 | 0.46 | 0.11 | 0.47 | 0.13 | 0.41 | 0.15 | 0.58 | 0.27 |
| Norway | 578 | 7898 | 0.39 | 0.13 | 0.43 | 0.15 | 0.52 | 0.26 | 0.57 | 0.35 |
| Poland | 1035 | 7139 | 0.62 | 0.13 | 0.62 | 0.14 | 0.61 | 0.18 | 0.66 | 0.33 |
| Portugal | 2620 | 5167 | 0.36 | 0.11 | 0.39 | 0.12 | 0.38 | 0.15 | 0.41 | 0.20 |
| Slovak Republic | 3794 | 5003 | 0.36 | 0.08 | 0.37 | 0.09 | 0.34 | 0.13 | 0.38 | 0.25 |
| Spain | 1489 | 6050 | 0.41 | 0.10 | 0.41 | 0.10 | 0.41 | 0.16 | 0.44 | 0.19 |
| Sweden | 970 | 8026 | 0.48 | 0.14 | 0.50 | 0.16 | 0.47 | 0.22 | 0.57 | 0.32 |
| Switzerland | 3165 | 6114 | 0.28 | 0.10 | 0.29 | 0.10 | 0.27 | 0.14 | 0.32 | 0.21 |
| Turkey | 5915 | 4864 | 0.18 | 0.03 | 0.19 | 0.04 | 0.19 | 0.07 | 0.24 | 0.11 |
| United States | 2345 | 6754 | 0.46 | 0.12 | 0.46 | 0.12 | 0.40 | 0.16 | 0.52 | 0.25 |
| *OECD average* | *3069* | *5822* | *0.32* | *0.08* | *0.34* | *0.08* | *0.33* | *0.13* | *0.38* | *0.21* |
| **Partners** | | | | | | | | | | |
| Brazil | 4159 | 5180 | 0.18 | 0.02 | 0.18 | 0.02 | 0.16 | 0.03 | 0.28 | 0.10 |
| Hong Kong-China | 4573 | 5226 | 0.09 | 0.02 | 0.10 | 0.03 | 0.17 | 0.10 | 0.20 | 0.12 |
| Indonesia | m | m | m | m | m | m | m | m | m | m |
| Latvia | 1761 | 6059 | 0.29 | 0.07 | 0.30 | 0.08 | 0.30 | 0.11 | 0.41 | 0.23 |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c |
| Macao-China | 1455 | 6404 | 0.08 | 0.00 | 0.10 | 0.01 | 0.14 | 0.06 | 0.16 | 0.12 |
| Russian Fed. | 2558 | 5951 | 0.22 | 0.05 | 0.22 | 0.06 | 0.22 | 0.07 | 0.29 | 0.17 |
| Serbia | 2566 | 4681 | 0.25 | 0.03 | 0.25 | 0.03 | 0.23 | 0.04 | 0.37 | 0.13 |
| Thailand | 2602 | 4394 | 0.21 | 0.01 | 0.22 | 0.02 | 0.22 | 0.03 | 0.22 | 0.04 |
| Tunisia | 2807 | 3882 | 0.21 | 0.03 | 0.23 | 0.04 | 0.23 | 0.06 | 0.24 | 0.07 |
| Uruguay | 4618 | 5899 | 0.25 | 0.03 | 0.25 | 0.03 | 0.23 | 0.07 | 0.31 | 0.12 |
| United Kingdom[1] | 1892 | 6322 | 0.47 | 0.11 | 0.47 | 0.12 | 0.46 | 0.14 | 0.51 | 0.22 |

1. Response rate too low to ensure comparability.

Table C.4
**Variance explained by model changes** *(continued)*

| | Model 5 | | Model 6 | | Model 7 | | Model 8 | | Model 9 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Students' self-efficacy in mathematics and students' self-concept in mathematics | | Hours per week of total homework, hours per week of mathematics homework, tutoring in mathematics, out-of-school classes | | Memorisation/ rehearsal strategies, elaboration strategies, control strategies | | Preference for competitive learning situtations, preference for co-operative learning situtations | | Teacher support, student-teacher relations | |
| | Between schools | Within schools | Between schools | Within schools | Between schools | Within schools | Between schools | Within schools | Between schools | Within schools |
| **OECD** | | | | | | | | | | |
| Australia | 0.57 | 0.32 | 0.61 | 0.34 | 0.65 | 0.37 | 0.65 | 0.37 | 0.67 | 0.38 |
| Austria | 0.40 | 0.26 | 0.44 | 0.29 | 0.47 | 0.31 | 0.47 | 0.31 | 0.49 | 0.31 |
| Belgium | 0.31 | 0.24 | 0.39 | 0.26 | 0.43 | 0.28 | 0.43 | 0.28 | 0.46 | 0.29 |
| Canada | 0.50 | 0.37 | 0.52 | 0.39 | 0.56 | 0.40 | 0.56 | 0.40 | 0.57 | 0.41 |
| Czech Republic | 0.49 | 0.30 | 0.53 | 0.32 | 0.55 | 0.33 | 0.55 | 0.33 | 0.57 | 0.34 |
| Denmark | 0.62 | 0.40 | 0.65 | 0.42 | 0.67 | 0.44 | 0.66 | 0.44 | 0.68 | 0.44 |
| Finland | 0.43 | 0.43 | 0.44 | 0.45 | 0.46 | 0.46 | 0.46 | 0.46 | 0.48 | 0.47 |
| France | w | w | w | w | w | w | w | w | w | w |
| Germany | 0.42 | 0.29 | 0.48 | 0.33 | 0.51 | 0.34 | 0.51 | 0.34 | 0.53 | 0.35 |
| Greece | 0.40 | 0.21 | 0.46 | 0.25 | 0.48 | 0.27 | 0.48 | 0.27 | 0.49 | 0.27 |
| Hungary | 0.45 | 0.23 | 0.50 | 0.26 | 0.51 | 0.27 | 0.52 | 0.27 | 0.53 | 0.27 |
| Iceland | 0.35 | 0.35 | 0.45 | 0.39 | 0.52 | 0.42 | 0.53 | 0.42 | 0.54 | 0.42 |
| Ireland | 0.76 | 0.33 | 0.77 | 0.36 | 0.79 | 0.38 | 0.79 | 0.38 | 0.79 | 0.40 |
| Italy | 0.30 | 0.22 | 0.32 | 0.25 | 0.35 | 0.26 | 0.35 | 0.26 | 0.39 | 0.26 |
| Japan | 0.37 | 0.17 | 0.45 | 0.21 | 0.46 | 0.22 | 0.46 | 0.22 | 0.50 | 0.22 |
| Korea | 0.56 | 0.24 | 0.59 | 0.28 | 0.60 | 0.29 | 0.60 | 0.29 | 0.61 | 0.29 |
| Luxembourg | 0.51 | 0.24 | 0.54 | 0.27 | 0.57 | 0.29 | 0.57 | 0.29 | 0.60 | 0.30 |
| Mexico | 0.29 | 0.17 | 0.36 | 0.19 | 0.36 | 0.20 | 0.36 | 0.20 | 0.39 | 0.22 |
| Netherlands | 0.27 | 0.24 | 0.36 | 0.26 | 0.37 | 0.26 | 0.37 | 0.26 | 0.38 | 0.27 |
| New Zealand | 0.61 | 0.37 | 0.68 | 0.41 | 0.73 | 0.43 | 0.73 | 0.44 | 0.75 | 0.44 |
| Norway | 0.59 | 0.43 | 0.61 | 0.46 | 0.61 | 0.47 | 0.61 | 0.47 | 0.62 | 0.48 |
| Poland | 0.74 | 0.42 | 0.75 | 0.44 | 0.76 | 0.46 | 0.76 | 0.46 | 0.78 | 0.46 |
| Portugal | 0.55 | 0.30 | 0.59 | 0.33 | 0.61 | 0.35 | 0.62 | 0.35 | 0.66 | 0.36 |
| Slovak Republic | 0.55 | 0.36 | 0.57 | 0.37 | 0.59 | 0.38 | 0.58 | 0.38 | 0.61 | 0.39 |
| Spain | 0.49 | 0.27 | 0.52 | 0.31 | 0.54 | 0.31 | 0.54 | 0.31 | 0.57 | 0.32 |
| Sweden | 0.60 | 0.43 | 0.66 | 0.47 | 0.67 | 0.48 | 0.67 | 0.48 | 0.66 | 0.49 |
| Switzerland | 0.52 | 0.30 | 0.55 | 0.33 | 0.59 | 0.35 | 0.60 | 0.35 | 0.63 | 0.36 |
| Turkey | 0.37 | 0.17 | 0.40 | 0.19 | 0.41 | 0.20 | 0.41 | 0.20 | 0.44 | 0.22 |
| United States | 0.60 | 0.35 | 0.71 | 0.39 | 0.74 | 0.41 | 0.74 | 0.41 | 0.76 | 0.42 |
| ***OECD average*** | ***0.49*** | ***0.30*** | ***0.54*** | ***0.33*** | ***0.56*** | ***0.35*** | ***0.56*** | ***0.35*** | ***0.58*** | ***0.35*** |
| **Partners** | | | | | | | | | | |
| Brazil | 0.39 | 0.15 | 0.55 | 0.23 | 0.57 | 0.23 | 0.57 | 0.24 | 0.58 | 0.24 |
| Hong Kong-China | 0.39 | 0.22 | 0.46 | 0.26 | 0.48 | 0.27 | 0.48 | 0.27 | 0.49 | 0.27 |
| Indonesia | m | m | m | m | m | m | m | m | m | m |
| Latvia | 0.49 | 0.33 | 0.51 | 0.35 | 0.52 | 0.36 | 0.52 | 0.36 | 0.55 | 0.37 |
| Liechtenstein | c | c | c | c | c | c | c | c | c | c |
| Macao-China | 0.39 | 0.21 | 0.54 | 0.27 | 0.55 | 0.29 | 0.55 | 0.29 | 0.57 | 0.30 |
| Russian Fed. | 0.35 | 0.24 | 0.37 | 0.27 | 0.39 | 0.28 | 0.39 | 0.28 | 0.43 | 0.30 |
| Serbia | 0.47 | 0.20 | 0.48 | 0.22 | 0.51 | 0.24 | 0.51 | 0.24 | 0.58 | 0.26 |
| Thailand | 0.28 | 0.09 | 0.33 | 0.14 | 0.34 | 0.15 | 0.35 | 0.15 | 0.37 | 0.19 |
| Tunisia | 0.35 | 0.12 | 0.41 | 0.15 | 0.41 | 0.15 | 0.42 | 0.15 | 0.47 | 0.17 |
| Uruguay | 0.40 | 0.18 | 0.48 | 0.23 | 0.50 | 0.24 | 0.51 | 0.24 | 0.55 | 0.25 |
| United Kingdom[1] | 0.64 | 0.35 | 0.68 | 0.40 | 0.71 | 0.42 | 0.71 | 0.42 | 0.73 | 0.44 |

1. Response rate too low to ensure comparability.

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Table C.4
**Variance explained by model changes** *(continued)*

| | Model 10 | | Model 11 | | Model 12 | |
|---|---|---|---|---|---|---|
| | School average of the highest international socio-economic index of occupational status (HISEI) between both parents | | School size | | Disciplinary climate and school average disciplinary climate | |
| | Between schools | Within schools | Between schools | Within schools | Between schools | Within schools |
| **OECD** | | | | | | |
| Australia | 0.81 | 0.38 | 0.81 | 0.38 | 0.81 | 0.38 |
| Austria | 0.72 | 0.31 | 0.75 | 0.31 | 0.78 | 0.31 |
| Belgium | 0.70 | 0.29 | 0.70 | 0.29 | 0.77 | 0.29 |
| Canada | 0.67 | 0.41 | 0.69 | 0.41 | 0.70 | 0.41 |
| Czech Republic | 0.77 | 0.33 | 0.77 | 0.33 | 0.79 | 0.34 |
| Denmark | 0.72 | 0.44 | 0.73 | 0.44 | 0.75 | 0.44 |
| Finland | 0.48 | 0.47 | 0.50 | 0.47 | 0.50 | 0.47 |
| France | w | w | w | w | w | w |
| Germany | 0.80 | 0.35 | 0.80 | 0.35 | 0.84 | 0.35 |
| Greece | 0.71 | 0.27 | 0.72 | 0.27 | 0.73 | 0.27 |
| Hungary | 0.79 | 0.27 | 0.80 | 0.27 | 0.82 | 0.27 |
| Iceland | 0.54 | 0.42 | 0.56 | 0.42 | 0.56 | 0.42 |
| Ireland | 0.86 | 0.40 | 0.87 | 0.40 | 0.87 | 0.40 |
| Italy | 0.63 | 0.26 | 0.63 | 0.26 | 0.64 | 0.26 |
| Japan | 0.73 | 0.22 | 0.73 | 0.22 | 0.83 | 0.22 |
| Korea | 0.75 | 0.29 | 0.76 | 0.29 | 0.80 | 0.29 |
| Luxembourg | 0.91 | 0.30 | 0.91 | 0.30 | 0.92 | 0.30 |
| Mexico | 0.59 | 0.22 | 0.61 | 0.22 | 0.64 | 0.22 |
| Netherlands | 0.75 | 0.26 | 0.78 | 0.27 | 0.80 | 0.27 |
| New Zealand | 0.84 | 0.44 | 0.85 | 0.44 | 0.85 | 0.44 |
| Norway | 0.63 | 0.48 | 0.63 | 0.48 | 0.64 | 0.48 |
| Poland | 0.82 | 0.47 | 0.82 | 0.47 | 0.83 | 0.47 |
| Portugal | 0.75 | 0.36 | 0.78 | 0.36 | 0.85 | 0.36 |
| Slovak Republic | 0.78 | 0.39 | 0.78 | 0.39 | 0.80 | 0.39 |
| Spain | 0.65 | 0.32 | 0.65 | 0.32 | 0.66 | 0.32 |
| Sweden | 0.69 | 0.49 | 0.71 | 0.49 | 0.72 | 0.49 |
| Switzerland | 0.72 | 0.37 | 0.72 | 0.37 | 0.75 | 0.37 |
| Turkey | 0.61 | 0.22 | 0.61 | 0.22 | 0.68 | 0.22 |
| United States | 0.82 | 0.42 | 0.82 | 0.42 | 0.84 | 0.42 |
| ***OECD average*** | *0.73* | *0.35* | *0.73* | *0.35* | *0.76* | *0.36* |
| **Partners** | | | | | | |
| Brazil | 0.75 | 0.24 | 0.75 | 0.24 | 0.77 | 0.24 |
| Hong Kong-China | 0.60 | 0.27 | 0.72 | 0.27 | 0.77 | 0.27 |
| Indonesia | m | m | m | m | m | m |
| Latvia | 0.62 | 0.37 | 0.67 | 0.37 | 0.68 | 0.37 |
| Liechtenstein | c | c | c | c | c | c |
| Macao-China | 0.63 | 0.30 | 0.69 | 0.30 | 0.71 | 0.31 |
| Russian Fed. | 0.52 | 0.30 | 0.52 | 0.30 | 0.56 | 0.30 |
| Serbia | 0.76 | 0.26 | 0.76 | 0.26 | 0.81 | 0.26 |
| Thailand | 0.62 | 0.19 | 0.64 | 0.19 | 0.64 | 0.19 |
| Tunisia | 0.70 | 0.17 | 0.71 | 0.17 | 0.74 | 0.17 |
| Uruguay | 0.78 | 0.25 | 0.79 | 0.25 | 0.83 | 0.25 |
| United Kingdom[1] | 0.80 | 0.44 | 0.81 | 0.44 | 0.82 | 0.44 |

1. Response rate too low to ensure comparability.

Table C.5
**Effect of mathematics achievement of learning strategies controlling for self-efficacy**

| | Dependent Variable: Student mathematics achievement | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (Constant) | | Memorisation strategies (WLE) | | Elaboration strategies (WLE) | | Control strategies (WLE) | | Mathematics self-efficacy (WLE) | |
| | B | S.E. | B | S.E. | B | S.E. | B | S.E. | S.E. | B |
| **OECD** | | | | | | | | | | |
| Australia | **519.61** | 0.18 | **-0.82** | 0.26 | **-19.92** | 0.24 | **5.47** | 0.26 | **48.41** | 0.19 |
| Austria | **498.06** | 0.33 | **-14.68** | 0.30 | **-9.17** | 0.27 | **1.95** | 0.29 | **43.17** | 0.29 |
| Belgium | **532.99** | 0.29 | **-4.07** | 0.38 | **-16.08** | 0.34 | **-2.93** | 0.38 | **44.10** | 0.31 |
| Canada | **523.79** | 0.15 | **-3.72** | 0.19 | **-9.11** | 0.18 | **4.05** | 0.19 | **41.76** | 0.15 |
| Czech Republic | **511.60** | 0.24 | **-14.83** | 0.32 | **-2.00** | 0.36 | -0.57 | 0.35 | **50.96** | 0.27 |
| Denmark | **515.31** | 0.40 | **-3.78** | 0.52 | **-6.42** | 0.56 | **-8.72** | 0.57 | **53.28** | 0.43 |
| Finland | **545.53** | 0.39 | **-2.90** | 0.44 | **-2.16** | 0.49 | **-2.99** | 0.55 | **44.19** | 0.38 |
| France | **510.29** | 0.10 | **-6.40** | 0.12 | **-12.62** | 0.11 | **3.23** | 0.12 | **46.30** | 0.11 |
| Germany | **501.39** | 0.11 | **-14.89** | 0.09 | **-8.09** | 0.09 | **0.22** | 0.10 | **47.27** | 0.09 |
| Greece | **465.65** | 0.32 | **-12.05** | 0.37 | **-2.34** | 0.37 | **2.89** | 0.37 | **41.90** | 0.34 |
| Hungary | **472.99** | 0.28 | **-6.34** | 0.35 | **-11.50** | 0.34 | **-5.08** | 0.37 | **50.03** | 0.27 |
| Iceland | **511.59** | 1.31 | **-4.39** | 1.66 | **-11.20** | 1.68 | -2.70 | 1.77 | **42.23** | 1.25 |
| Ireland | **503.07** | 0.34 | **-2.65** | 0.45 | **-12.58** | 0.43 | **-3.36** | 0.46 | **47.31** | 0.37 |
| Italy | **475.50** | 0.13 | **-11.59** | 0.17 | **-14.79** | 0.16 | **2.33** | 0.17 | **51.93** | 0.16 |
| Japan | **553.74** | 0.10 | **-2.74** | 0.10 | **-5.51** | 0.09 | **1.92** | 0.10 | **51.60** | 0.08 |
| Korea | **560.34** | 0.12 | **-7.11** | 0.15 | **-3.00** | 0.16 | **14.82** | 0.17 | **44.63** | 0.14 |
| Luxembourg | **488.02** | 1.35 | **-3.47** | 1.45 | **-13.33** | 1.29 | **-3.75** | 1.49 | **41.58** | 1.27 |
| Mexico | **423.19** | 0.13 | **-2.25** | 0.12 | **-16.27** | 0.13 | **7.05** | 0.12 | **32.25** | 0.11 |
| Netherlands | **538.96** | 0.20 | **12.24** | 0.29 | **-18.82** | 0.27 | **-7.71** | 0.28 | **43.57** | 0.22 |
| New Zealand | **526.38** | 0.39 | **-4.15** | 0.55 | **-25.87** | 0.53 | **6.79** | 0.54 | **52.03** | 0.42 |
| Norway | **497.53** | 0.37 | **9.15** | 0.49 | **-12.43** | 0.48 | **-3.02** | 0.52 | **42.94** | 0.38 |
| Poland | **492.28** | 0.12 | **-7.77** | 0.16 | **-5.44** | 0.17 | **-2.30** | 0.17 | **49.56** | 0.12 |
| Portugal | **471.55** | 0.27 | **-11.78** | 0.33 | **-10.39** | 0.36 | **10.75** | 0.37 | **49.55** | 0.34 |
| Slovak Republic | **483.53** | 0.33 | **-7.65** | 0.40 | **-7.09** | 0.43 | **-7.27** | 0.43 | **52.88** | 0.29 |
| Spain | **490.53** | 0.14 | **-3.15** | 0.20 | **-3.67** | 0.19 | **3.00** | 0.20 | **40.06** | 0.17 |
| Sweden | **501.07** | 0.29 | **2.38** | 0.34 | **-3.22** | 0.37 | **-16.39** | 0.38 | **50.86** | 0.27 |
| Switzerland | **507.04** | 0.31 | **-13.25** | 0.31 | **-10.55** | 0.32 | 0.21 | 0.33 | **50.35** | 0.29 |
| Turkey | **451.73** | 0.15 | **-9.71** | 0.17 | **-12.96** | 0.17 | **8.43** | 0.17 | **47.06** | 0.14 |
| United States | **478.85** | 0.05 | **-4.16** | 0.07 | **-17.85** | 0.06 | **1.23** | 0.07 | **48.16** | 0.05 |
| ***OECD average*** | *501.80* | *0.31* | *-5.40* | *0.37* | *-10.50* | *0.37* | *0.26* | *0.39* | *46.55* | *0.31* |
| **Partners** | | | | | | | | | | |
| Brazil | **411.48** | 0.10 | **-18.84** | 0.09 | **-13.57** | 0.09 | **6.62** | 0.09 | **38.06** | 0.08 |
| Hong Kong-China | **538.72** | 0.33 | **-12.83** | 0.43 | **-3.96** | 0.44 | **12.54** | 0.47 | **49.81** | 0.35 |
| Indonesia | **391.51** | 0.09 | **-24.45** | 0.08 | **5.02** | 0.11 | **9.01** | 0.09 | **18.51** | 0.11 |
| Latvia | **486.71** | 0.51 | **-4.74** | 0.73 | **-3.28** | 0.74 | **-12.25** | 0.72 | **51.02** | 0.58 |
| Liechtenstein | **499.15** | 4.91 | **-23.04** | 4.37 | -8.59 | 4.76 | -3.63 | 4.49 | **46.62** | 4.39 |
| Macao-China | **520.95** | 1.07 | **-14.45** | 1.28 | -0.29 | 1.43 | **5.00** | 1.49 | **34.94** | 1.35 |
| Russian Fed. | **476.41** | 0.06 | **-5.53** | 0.10 | **-7.69** | 0.10 | **-6.97** | 0.09 | **48.55** | 0.08 |
| Serbia | **451.32** | 0.39 | **-14.29** | 0.41 | **-3.41** | 0.41 | -0.36 | 0.36 | **31.97** | 0.37 |
| Thailand | **450.02** | 0.19 | **-16.02** | 0.20 | **0.76** | 0.22 | **6.22** | 0.20 | **32.16** | 0.14 |
| Tunisia | **385.99** | 0.33 | **-2.33** | 0.24 | -0.32 | 0.29 | **1.33** | 0.26 | **25.90** | 0.25 |
| Uruguay | **441.48** | 0.54 | **-6.00** | 0.60 | **-9.64** | 0.65 | **-3.97** | 0.67 | **41.73** | 0.58 |
| United Kingdom[1] | 514.63 | 0.10 | 2.93 | 0.14 | -23.29 | 0.14 | **-1.30** | 0.15 | **51.87** | 0.11 |

1. Response rate too low to ensure comparability.

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