Department for Education

Achievement of 15-Year-Olds in England: PISA 2012 National Report (OECD Programme for International Student Assessment)

December 2013 – revised April 2014

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Acknowledgements

This survey could not have taken place without the co-operation of the pupils, teachers and headteachers in the participating schools. We are very grateful for their help.

The authors would like to thank all the colleagues in various departments at NFER who contributed to the success of the survey and the publication of this report. In particular, we would like to thank:

- The Project Coordinator, Pat Bhullar, for all her work throughout the project, especially in production of tests and questionnaires and organisation of marking.
- Nick Ward and the Print Shop team for printing all the publicity and survey materials.
- Mark Bailey and his colleagues in Research Operations for their invaluable work in supporting and communicating with the PISA schools.
- Colleagues in the Centre for Statistics, NFER, for their analysis of the PISA national data. In particular, we are grateful to Jack Worth for his assistance in interpretation of the data and for his technical contributions to the report.

PISA is a collaborative project with a number of international partners. We are grateful to all the members of the PISA International Consortium whose hard work and support contributed towards successful implementation of PISA 2012. We would also like to thank Andreas Schleicher and colleagues at OECD for their support and flexibility which were much appreciated.

We are also grateful for the support and guidance we have received at all stages of the survey from Adrian Higginbotham, the DfE project manager; Lorna Bertrand, Chair of PISA Governing Board; the members of the steering group; and colleagues at DfE.

This revised edition of the England national report includes an additional chapter on Problem Solving and its accompanying appendix. It was released at the same time as Volume V of the PISA 2012 international report (OECD, 2014).

Executive summary

Background

The Programme for International Student Assessment (PISA) is a survey of the educational achievement of 15-year-olds organised by the Organisation for Economic Co-operation and Development (OECD). In the UK, PISA 2012 was carried out on behalf of the respective governments by the National Foundation for Educational Research.

PISA assesses students' mathematics, science and reading skills. Mathematics was the main subject in PISA 2012 and so was assessed in greater depth compared with the other two areas. In addition pupils and schools complete questionnaires to provide information about pupil background and attitudes, and aspects of school management and school climate respectively. Pupils in England were also assessed in their problem solving skills and this updated report (published in April 2014) includes England's results compared with other countries that took part in the assessment of problem solving.

Results for the United Kingdom as a whole are included in the international PISA report published by OECD with the results of the other 64 participating countries. With the UK, this included 34 OECD member countries and 27 members of the European Union. The results from PISA provide the Government with complementary information to that provided by other international surveys, such as the Trends in International Maths and Science Survey (TIMSS) and Progress in International Reading Literacy Study (PIRLS). In addition, England's performance in mathematics will also feed into the debate following England's numeracy results in the OECD Survey of Adult Skills (PIAAC), which found that England's performance in numeracy was below the OECD average with particularly poor performance in young adults.

Strict international quality standards are applied at all stages of the PISA survey to ensure equivalence in the translation and adaptation of instruments, sampling procedures and survey administration in all participating countries. In England, a total of 170 schools took part in PISA 2012. The response rate for the UK was 89 per cent of sampled schools and 86 per cent of sampled pupils. This is a good response rate and fully met the PISA 2012 participation requirements.

Overview of mathematics, science and reading performance

England's performance in mathematics, science and reading has remained stable since PISA 2006. In each survey, pupils in England have performed similarly to the OECD average in mathematics and reading and significantly better than the OECD average in science. This is in contrast to a number of other countries which have seen gains and losses. For example, Singapore, Macao-China, Estonia, Poland, the Republic of Ireland and Romania have shown significant improvements in mathematics, science and reading since 2009, whereas Finland, New Zealand, Iceland, the Slovak Republic and Sweden have shown significant declines in all three subjects during the same period. However, average scores give only part of the picture. In all three subjects, England has a relatively large difference in the performance of lowest and highest achievers; this is greater than the OECD average.

The key findings from pupils' performance in mathematics, science, reading and problem solving and from the Student and School Questionnaires are outlined below.

Mathematics in England

England's performance in mathematics has remained stable since PISA 2006. In PISA 2012, there were 19 countries that significantly outperformed England in mathematics and 11 countries with a score that was not significantly different from that of England. Of the 19 countries with mean scores in mathematics that were significantly higher, the seven highest achieving countries were in East and South East Asia. There were seven EU countries that significantly outperformed England and eight EU countries that performed similarly. Thirty-four countries had mean scores which were significantly lower than England. This group contained 11 EU countries.

England's performance was not significantly different from the OECD average, but causes for concern are a relatively low percentage of pupils in the highest achieving levels and a relatively wide difference in performance between the highest and lowest attainers. Only ten countries had a greater difference between the mean scores of the highest and lowest attainers. Boys performed significantly better than girls, as was the case in nearly two-thirds of participating countries.

As mathematics was the main subject in PISA 2012, it was assessed in greater depth than science and reading and, therefore, performance of pupils in different areas of mathematics can be compared. In England, pupils are relatively strong on questions that focus on probability and statistics (*uncertainty and data*) or require them to *interpret, apply and evaluate* mathematical outcomes in order to solve problems, and they are less strong on questions that focus on aspects of *space and shape* and those requiring them to *formulate* situations mathematically in order to solve a problem. This is a different pattern of performance compared with the seven top performing countries. In these high achieving East and South East Asian countries pupils are relatively strong on questions that focus on *space and shape* or require than to *formulate* situations mathematically in order to solve a problem. However, they are less strong on questions that focus on probability and statistics (*uncertainty and data*) and those that require them to *interpret, apply and evaluate* mathematical outcomes in order to solve problems.

Science in England

England's performance in science has remained stable since PISA 2006 and while not among the highest achieving group of countries internationally, it compares well with other EU and OECD countries in terms of science achievement. England performed significantly above the OECD average.

There were ten countries which performed at a level significantly higher than England, including only three EU countries (Finland, Estonia and Poland). In 11 countries, science attainment was not significantly different from that of England, while the remaining 43 countries performed significantly less well. Five EU countries did not perform significantly differently from England and 18 performed less well.

There was a relatively large difference between the score points of the lowest scoring pupils and the highest scoring pupils in England compared with other countries. Only eight countries had a wider distribution. However, the proportion of pupils at each level of achievement shows that England tends to have a greater proportion of high achievers and a lower proportion of low achievers than the OECD average. That said, compared with other high achieving countries, England tends to have a greater proportion of lower achievers and, consequently, raising the attainment of lower achievers would be an important step towards improving England's performance.

There was no clear pattern of performance by gender across participating countries. In England, there was a significant gender difference of 14 points in favour of boys.

Reading in England

England's performance in reading in PISA 2012, as in 2009 and 2006, was not significantly different from the OECD average. The proportion of pupils at each level of achievement in England was broadly similar to the OECD average. However, England had a relatively large difference between the lowest and the highest scoring pupils in reading compared with many other countries – only 13 countries had a wider distribution than England.

Seventeen countries had a mean score for reading significantly higher than that of England. In eight countries the difference in mean scores from that in England was not statistically significant. Thirty-nine countries had mean scores which were significantly lower than England.

Of the 17 countries with higher mean scores (where the difference was statistically significant), six are EU members (Finland, Republic of Ireland, Poland, Estonia, Netherlands and Belgium). Four EU countries did not perform significantly differently from England and 16 performed less well.

Girls scored significantly higher than boys in all countries, although in England the gender difference, while statistically significant, was not as large as in the majority of other countries. In England, this difference was 24 score points between girls and boys compared with an OECD average of 38 score points.

Problem solving in England

PISA 2012 was the first round of PISA to include a computer based assessment of problem solving competency and it was administered in 44 countries. Pupils in England performed well, with a score significantly higher than the OECD average. Pupils in seven East Asian countries scored significantly higher than pupils in England (and these countries also outperformed England on mathematics and reading). Twelve countries performed at the same level as England and the pupils in the remaining 24 countries which participated in the problem solving assessment performed significantly less well than pupils in England.

The difference in scores between the top and bottom five per cent of attainment in England is in line with the OECD average, which is in contrast to the performance between top and bottom performers in mathematics, science and reading. In all seven countries in which pupils outperformed pupils in England the gap is smaller.

There was no significant difference in the performance of boys and girls in England, though boys significantly outperformed girls across the OECD on average.

Pupils in England showed a stronger performance on tasks involving the utilisation of knowledge. Pupils in the countries which outperformed England were found to be strong at knowledge-acquisition tasks.

Performance in problem solving was strongly related to performance in mathematics, science and reading. However the strength of the association of problem solving and the three other subjects was weaker than the association between the three subjects themselves.

Pupils and mathematics in England

Pupils in England reported moderate interest in learning mathematics, but recognised that it is useful. A very high proportion of pupils reported that their parents believe in the importance of mathematics. Pupils in England show greater motivation to learn mathematics than the OECD average and report a high sense of belonging and satisfaction with school, similar to the OECD average.

Pupils reported a high amount of control over their ability to succeed in mathematics and a high level of conscientiousness towards learning mathematics. Pupils in England generally reported a greater level of conscientiousness and perseverance for mathematics tasks than the OECD average. Related to this, pupils in England reported that they were confident in their ability to perform mathematics tasks and had low anxiety about mathematics. Levels of anxiety were lower than the OECD average.

Pupils in England reported a higher level of support from their mathematics teachers than that found for the OECD on average and reported that a wide variety of tasks and strategies are used by their teachers in the mathematics lessons.

Pupils in England are better able to overcome disadvantage and achieve scores higher than predicted by their background when compared with some other OECD countries.

Schools in England

Headteachers in England reported that they have a high level of responsibility for most aspects of school management. This was also the case in 2009. However, compared with 2009, headteachers reported a reduced role for themselves, school governing bodies and local or national education authorities in the management of schools, with the role of school governing bodies having reduced the most. Compared with the OECD average, headteachers in England play a greater role in most aspects of school management, particularly in relation to teachers' pay.

Headteachers in England also reported a higher frequency for most school leadership activities than their OECD counterparts, with over 70 per cent of headteachers in England saying they praised teachers and ensured teachers worked according to the school's goals once a week or more, compared with less than 40 per cent of headteachers saying so across the OECD on average.

Headteachers in England reported the biggest staffing issue was a shortage of mathematics teachers. This had also been reported as the biggest hindrance to providing instruction in 2009, but the proportion of headteachers reporting this issue as hindering instruction to some extent or a lot has reduced from 30 per cent in 2009 to 17 per cent in this survey. The greatest resource issue for headteachers is inadequacy of school buildings and grounds.

Schools in England reported a more positive climate for learning and noted that learning was less hindered by problems, particularly disciplinary problems compared to their OECD counterparts. Pupils were on the whole very positive about the climate of their school, but did report a greater level of disruption than headteachers. Pupils were generally very positive about their relationships with their teachers, and more positive than the OECD average.

In schools in England assessments serve various purposes, with the most frequent use being to monitor year-on-year progress, inform parents, identify areas to be improved, group pupils and compare the school's performance with local or national performance. Headteachers in England report a much greater use of pupil assessments for a variety of reasons than the OECD average.

PISA in the United Kingdom

In mathematics, the mean scores for England and Scotland and England and Northern Ireland were similar. Scotland significantly outperformed Northern Ireland. The mean score of pupils in Wales was significantly lower than that in the other parts of the UK. In England, Scotland and Wales, boys significantly outperformed girls. In Northern Ireland, the difference between the performance of boys and girls was not significant. The spread of attainment was greatest in England and Northern Ireland and this was above the OECD average for both countries. Wales and Scotland had a similar narrower spread of attainment. Across the OECD on average, 15 per cent of the variance in mathematics scores can be explained by socio-economic background. Of the UK countries, only Northern Ireland had a variance greater than the OECD average (at 17 per cent), while Wales had the lowest percentage (10 per cent). This suggests that socio-economic background has the least impact on performance in mathematics in Wales, whereas it has the biggest impact in Northern Ireland.

In science, there were no significant differences between England, Scotland and Northern Ireland but the mean score in Wales was significantly lower. Boys significantly outperformed girls in England, Scotland and Wales. The spread of attainment was greatest in England and Northern Ireland. Wales and Scotland had a narrower spread of attainment. Scotland had the narrowest spread of attainment of UK countries.

In reading, the mean scores in England, Scotland and Northern Ireland were similar. The mean score of pupils in Wales was significantly lower than that of pupils in the other parts of the UK. The spread of attainment was greatest in England and Northern Ireland and this was above the OECD average for both countries. Wales and Scotland had a narrower spread of attainment compared with the OECD average, and Scotland had the narrowest spread of attainment of UK countries. Girls outperformed boys in all parts of the UK, as they did in every other country in the PISA survey, although the difference in performance of boys and girls was less in all parts of the UK than the OECD average.

Pupils in all parts of the UK showed moderate interest in mathematics. Pupils in England tended to look forward to their mathematics lessons most and pupils in Northern Ireland were most likely to worry that mathematics classes would be difficult.

There were some differences in staffing and resource shortages with headteachers in Northern Ireland reporting a greater shortage of resources than headteachers in other parts of the UK. Headteachers in Scotland reported the highest shortage of teachers of subjects other than mathematics, science or reading.

Scotland, Wales and Northern Ireland did not participate in the problem solving element of PISA 2012.

1 Introduction

1.1 What is PISA?

The Programme for International Student Assessment (PISA) is a survey of educational achievement organised by the Organisation for Economic Co-operation and Development (OECD). In England, Wales, Northern Ireland and Scotland, the PISA 2012 survey was carried out on behalf of the respective governments by the National Foundation for Educational Research (NFER). The PISA surveys provide Government with detailed comparative evidence on which to base educational policy.

The OECD has 34 member countries, of which the United Kingdom is one, and is an organisation dedicated to global development. As a measure of educational outcomes PISA complements the other educational indicators gathered by OECD members to make international comparisons. It assesses the knowledge, skills and readiness for adult life of pupils aged 15. Pupils are assessed on their competence to address real life challenges involving reading, mathematics and science. This aim differentiates PISA from other pupil assessments which measure their mastery of the school curriculum, as instead it measures their 'literacy' in these areas. In 2012, there was also an assessment of problem solving, in which England was the only part of the UK to participate. This updated national report for England contains the results for England in problem solving compared with other countries with participated in the assessment.

PISA is carried out on a three-year cycle. The first PISA study was in 2000 (supplemented in 2002) and was undertaken in 43 countries (32 in 2000 and another 11 in 2002). Since then, the number of participating countries has increased. In PISA 2012, 65 countries took part. Of these, 34 were members of OECD. Each round of PISA focuses on one of the three areas of literacy in which knowledge and skills are assessed: mathematics, science and reading. The main focus for PISA 2012 was mathematics, with science and reading as minor domains. A computer based assessment of problem solving was also included in PISA 2012.

In addition to the PISA assessment, pupils completed a questionnaire. The Student Questionnaire provided information on pupils' economic and social backgrounds, study habits, and attitudes to mathematics and to mathematics activities in school. A School Questionnaire was also completed by headteachers in participating schools. This provided information on the school's size, intake, resources and organisation, as well as mathematics activities available in the school. The questionnaires provided contextual information to support a more detailed analysis of the findings.

Age, rather than year group, is used to define pupils eligible to participate in the survey. This has an advantage over year group definitions as the age at which pupils start school can make it difficult to determine comparable year groups and because countries have different policies about holding pupils back a year or pushing them forward depending on their performance at school. The pupils who took part were mainly in Year 11 in England and Wales, Year 12 in Northern Ireland and S3 or S4 in Scotland.

All pupils sat some mathematics questions and approximately 70 per cent of the pupils who took part were assessed in science and reading. Mathematics is therefore covered more fully than

science and reading. The results reported for each domain are estimates for the whole population of 15-year-olds in England, based on the performance of pupils who were presented with test items in each domain. These estimates take into account information about how pupils with specific characteristics performed. The characteristics cover a wide range of variables from the Student Questionnaires (see OECD (forthcoming)). Further details on the development of the survey, what PISA measures, PISA scales and proficiency levels, how the survey was administered and the PISA sample are included in Appendix A. This appendix details some of the guidelines for survey procedures to ensure the quality of the data collected in every country.

1.2 Organisation of this report

There are 65 countries in PISA 2012, including the UK. The OECD international report includes outcomes for all 65 participating countries. In this national report, the scores for England are compared with the 64 other countries, excluding the UK.

Chapters 2, 4 and 5 describe PISA results for mathematics, science and reading. Chapter 3 discusses pupils' responses to the Student Questionnaire, in particular, responses on attitudes towards mathematics. Chapter 6 presents responses by headteachers to the School Questionnaire and also responses by pupils to questions in the Student Questionnaire where questions are related. Chapter 7 describes and discusses the PISA results in the four constituent parts of the United Kingdom. Chapter 8 reports the finding of the computer based assessment of problem solving. In each chapter, comparisons are made with the OECD average. This is the average of the 34 members of the OECD. This is more useful than a comparison with all participating countries as it enables comparison with similarly developed countries or emerging countries. Information about how to interpret differences in performance between participating countries is included in each chapter which discusses attainment data. Further details on the background to PISA 2012 are included in Appendix A.

The international tables and figures presented in the appendices of this report include the results for the United Kingdom since these are reported in all international tables. In most cases, tables and figures include results for England, Wales, Northern Ireland and Scotland since these figures are referred to in Chapter 7. Where comparisons with performance of the constituent parts of the UK are made with PISA 2009 and 2006, figures come from analysis carried out for the national reports for these surveys (Bradshaw *et. al.*, 2009; Bradshaw *et. al.*, 2006).

More detailed analyses of international results can be found in the OECD report on PISA 2012, which also includes results for the United Kingdom (OECD, 2013; OECD, 2014). The results from the separate parts of the UK are reported in an Annex to the international report.

2 Mathematics

Chapter outline

This chapter reports the attainment of pupils in England in mathematics and how performance varies on different aspects of mathematical literacy. It draws on findings outlined in the international report (OECD, 2013) and places outcomes for England in the context of those findings. Throughout the chapter, comparisons are made between the findings for PISA 2012 and those from PISA 2006 and 2009. It is important to note that, for PISA 2006 and 2009, mathematics was a minor domain and as such it is not possible to compare the subscale data obtained in the PISA 2012 cycle where mathematics was the main focus. It is also not possible to compare the findings from PISA 2012 with those from PISA 2003 (the last time that mathematics was the main focus) because in 2003 the UK did not meet the data requirements and therefore the OECD does not make comparisons before 2006.

Key findings

- England has maintained the same level of performance in mathematics seen in the last two cycles of PISA. As was the case in 2006 and 2009, England's performance in 2012 is not significantly different from the OECD average.
- Nineteen countries had mean scores in mathematics that were significantly higher than England's. Of these countries, three significantly outperformed England for the first time in PISA 2012. These countries are: Poland and Austria who have overtaken England since PISA 2009; and Vietnam, a new participant in PISA.
- In England, pupils are relatively strong on questions that focus on probability and statistics (*uncertainty and data*) or require them *to interpret, apply and evaluate* mathematical outcomes in order to solve problems, and they are less strong on questions that focus on aspects of *space and shape* and those requiring them to *formulate* situations mathematically in order to solve a problem.
- England has a relatively wide spread of attainment compared with other countries. Only ten comparison countries had a greater difference between the mean scores of their highest and lowest attainers.
- In England, the gap between high and low achievers appears to be widening. The difference between the highest and lowest achievers has increased in England since 2009.
- In terms of the PISA proficiency levels, the percentage of pupils in England at Level 1 or below does not compare well with the highest achieving countries. This percentage has increased slightly since 2006. In addition, England had a relatively low percentage of pupils, 12.4 per cent, in the top two levels (Levels 5 and 6).
- In England, boys performed significantly better than girls. This was the case in nearly two thirds of the participating countries.

2.1 Comparison countries

The international report includes outcomes for all 65 participating countries, including the UK as a whole (outcomes for the four nations of the UK are not reported separately in the international report). In this chapter, scores for England are compared with 64 other countries excluding the UK. Comparisons between England and the other three constituent parts of the UK are reported in Chapter 7. While findings for all countries are reported in this chapter where relevant, most findings relate to a sub-group of countries. The countries forming the comparison group include OECD countries, EU countries and other countries with relatively high scores. Since countries with very low scores are not so relevant for comparison purposes, those with a mean score for mathematics of less than 430 have been omitted from tables unless they are in the OECD or the EU. Hence, the comparison group for mathematics in this chapter comprises 50 countries (of which 26 are EU members and 33 OECD members).

Table 2.1 Countries compared with England

Australia	France*	*Lithuania**	*Shanghai-China*
Austria*	Germany*	Luxembourg*	*Singapore*
Belgium*	Greece*	*Macao-China*	Slovak Republic*
*Bulgaria**	*Hong Kong-China*	Mexico	Slovenia*
Canada	Hungary*	Netherlands*	Spain*
Chile	Iceland	New Zealand	Sweden*
Chinese Taipei	Israel	Norway	Switzerland
*Croatia**	Italy*	Poland*	Turkey
Cyprus	Japan	Portugal*	*United Arab Emirates*
Czech Republic*	*Kazakhstan*	Republic of Ireland*	United States
Denmark*	Korea	*Romania**	*Vietnam*
Estonia*	*Latvia**	*Russian Federation*	
Finland*	*Liechtenstein*	*Serbia*	

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

In addition to the countries listed above, tables and figures in Appendix B include the data for all four constituent parts of the United Kingdom.

Outcomes for the United Kingdom as a whole are presented in the international report (OECD, 2013) and in the appendices that accompany this chapter (Appendix B). Outcomes for England (and the other three constituent parts of the UK) are derived from the 'sub-national' level analysis carried out by the international consortium, as well as from additional analysis carried out by NFER using the international dataset. Comparisons between the four constituent parts of the UK are provided in Chapter 7.

Interpreting differences between countries

It is important to know what can reasonably be concluded from the PISA data and which interpretations would be going beyond what can be reliably supported by the results. This section outlines some points that need to be kept in mind while reading this chapter.

Sources of uncertainty

There are two sources of uncertainty which have to be taken into account in the statistical analysis and interpretation of any test results. These are described as *sampling error* and *measurement error*. The use of the term 'error' does not imply that a mistake has been made; it simply highlights the necessary uncertainty.

Sampling error stems from the inherent variation of human populations which can never be summarised with absolute accuracy. It affects virtually all research and data collection that makes use of sampling. Only if every 15-year-old in each participating country had taken part in PISA could it be stated with certainty that the results are totally representative of the attainment of the entire population of pupils in those countries. In reality the data was collected from a sample of 15-year-olds. Therefore, the results are a best estimation of how the total population of 15-year-olds could be expected to perform in these tests. There are statistical methods to measure how good the estimation is. It is important to recognise that all data on human performance or attitudes which is based on a sample carries a margin of error.

Measurement error relates to the results obtained by each individual pupil, and takes account of variations in their score which are not directly due to underlying ability in the subject but which are influenced by other factors related to individuals or to the nature of the tests or testing conditions, such as sickness on the day of testing.

Interpreting rank order

Because of the areas of uncertainty described above, interpretations of very small differences between two sets of results are often meaningless. Were they to be measured again it could well be that the results would turn out the other way round. For this reason, this chapter focuses mainly on *statistically significant* differences between mean scores rather than the simple rank order of countries. Statistically significant differences are unlikely to have been caused by random fluctuations due to sampling or measurement error.

Where statistically significant differences between countries are found, these may be the result of a great number of factors. The data for some of these factors were not collected in the PISA survey. Therefore, the PISA survey is only able to explain the reasons for differences between countries to a limited extent. For example, differences in school systems and educational experiences in different countries could play a part, but so could a wide range of different out-of-school experiences. It is important to bear this in mind while reading this report.

2.2 Scores in England

Mathematical literacy

> *'…an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals in recognising the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens*.' (OECD, 2013)

England's pupils achieved a **mean score of 495 in mathematics in PISA 2012**, which was slightly above but not significantly different statistically from the OECD mean of 494. (See section 2.1 on interpreting differences between countries for an explanation of how statistical significance should be interpreted in this report.) England's performance in mathematics has remained relatively stable since 2006, when the mean score was 495. In contrast, the OECD average has decreased slightly since 2006, from 498 to 494 score points. England's mean score has not been significantly different from the OECD average for the last three cycles of PISA.

Internationally, the performance in mathematics in 19 of the other 64 participating countries was significantly higher than that in England (see Table 2.2). Since 2006, there has been fluctuation in the number of countries with mean scores significantly higher than England (from 18 in 2006 to 20 in 2009). The increase between 2006 and 2009 was mainly a result of the high performance of Shanghai-China and Singapore who participated for the first time in 2009. Table 2.2 also shows whether countries' mean scores have changed significantly since PISA 2009 (further data including mean scores for mathematics for the previous PISA cycles can be found in Appendix B21).

Of the 19 countries with mean scores in mathematics that were significantly higher than England's, the seven highest achieving countries are in East and South East Asia. Two of these countries (Hong Kong-China and Singapore) have strong historical links with the education system of the UK, and English is the medium of instruction in Singapore. Four of the highest performing countries (Shanghai-China, Singapore, Chinese Taipei and Macao-China) continue to improve, with significantly higher mean scores for mathematics compared with PISA 2009. There was some movement amongst the group of countries outperforming England, with the major change in 2012 being the movement of New Zealand, Iceland, Denmark and Slovenia out of the group and of Poland, Vietnam (a new participant in PISA) and Austria into it. Poland had one of the biggest increases in mean score between PISA 2009 and 2012; a significant increase of 23 score points.

Seven of the countries that significantly outperformed England are EU members (Netherlands, Estonia, Finland, Poland, Belgium, Germany and Austria). A further eight EU countries did not perform significantly differently from England and 11 performed less well. Among OECD countries, 12 outperformed England, 10 performed similarly, and 11 performed less well. This indicates that England, while not among the highest achieving group of countries internationally, compares well with other EU and OECD countries in terms of mathematics achievement.

Table 2.2 Countries outperforming England in mathematics in 2012 (significant differences)

Country	Mean score		Country	Mean score	
Shanghai-China	613	∧	Estonia*	521	∧
Singapore	573	∧	Finland*	519	∨
Hong Kong-China	561		Canada	518	∨
Chinese Taipei	560	∧	Poland*	518	∧
Korea	554		Belgium*	515	
Macao-China	538	∧	Germany*	514	
Japan	536		*Vietnam*	511	
Liechtenstein	535		Austria*	506	
Switzerland	531		Australia	504	∨
Netherlands*	523				

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

∧ ∨ Indicates a significant change since PISA 2009

Eleven countries performed at a level that was not significantly different from that of England, while the remaining 34 countries performed significantly less well. Tables 2.3 and 2.4 show the comparison group countries that performed similarly to England, and those whose performance was lower than England's. Further data can be found in Appendix B1 (mean scores and standard errors for England and the comparison group countries and significant differences between England and the comparison group countries). Tables 2.3 and 2.4 also show whether countries' scores have changed significantly since PISA 2009 (further data including mean scores for mathematics for the previous PISA cycles can be found in Appendix B21).

There was some movement amongst the group of countries performing at a level not significantly different from that of England and the group that performed significantly less well. A significant decrease since 2009 in the mean scores of New Zealand and Iceland has resulted in a performance in PISA 2012 that was not significantly different from England's. In contrast, the Republic of Ireland showed significant improvement in PISA 2012 (an increase of 14 score points), although their performance is still not significantly different from England's. There were a few countries whose lower level of performance in PISA 2012, compared with 2009, resulted in mean scores that were significantly lower than England's in this cycle of PISA. For example, Sweden's mean score decreased significantly from 494 in 2009 to 478 in 2012.

In terms of English speaking countries, only one (Australia) has a mean score in mathematics that is significantly higher than that of England, although Canada (a predominantly English speaking country) also outperforms England. The Republic of Ireland and New Zealand had scores that were not significantly different to England's, while the performance of the United States was significantly below that of England. In PISA 2009 the United States did not perform significantly differently to England and therefore the mean scores for mathematics in 2012 indicate a relative drop in performance compared with England. The data for all four constituent parts of the UK are included in Appendix B1 and comparisons between them can be found in Chapter 7.

Table 2.3 Countries not significantly different from England in mathematics

Country	Mean score		Country	Mean score	
Republic of Ireland*	501	∧	France*	495	
Slovenia *	501		Iceland	493	∨
Denmark*	500		*Latvia**	491	∧
New Zealand	500	∨	Luxembourg*	490	
Czech Republic*	499		Norway	489	∨
England	**495**		Portugal*	487	

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
∧ ∨ Indicates a significant change since PISA 2009

Table 2.4 Countries significantly below England in mathematics

Country	Mean score		Country	Mean score	
Italy*	485		*Serbia*	449	
Spain*	484		Turkey	448	
Russian Federation	482	∧	*Romania**	445	∧
Slovak Republic*	482	∨	*Cyprus**	440	
United States	481		*Bulgaria**	439	
*Lithuania**	479		*United Arab Emirates*	434	∧
Sweden*	478	∨	*Kazakhstan*	432	∧
Hungary*	477	∨	Chile	423	
*Croatia**	471	∧	Mexico	413	
Israel	466	∧			
Greece*	453	∨	*plus 14 other countries*		

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
∧ ∨ Indicates a significant change since PISA 2009

2.2.1 Mathematics content and process category scale scores

2.2.1.1 Mathematics content category scale scores

Mathematical literacy in PISA is assessed in relation to four content categories (*quantity*, *uncertainty and data*, *change and relationships*, and *space and shape*). Brief descriptions of each of these content categories are provided below (OECD 2013). Figures 2.1 to 2.4 provide examples of released PISA 2012 mathematics items covering the four content categories (and the three mathematical process subscales; see section 2.2.2) (the mark schemes for these items can be found in Appendix B22). In addition to their overall performance, pupils' performance in mathematics was analysed separately by content category and by mathematical process (section 2.2.2). In some countries, pupils showed notably stronger or weaker performance in some of these areas, relative to their mean performance. If mean scores on some subscales are lower than on others, this could have implications for teaching and learning or might suggest that the balance of

these areas in the curriculum should be evaluated. Appendices B5 to B11 show the mean scores for each comparison group country on each of the seven subscales, while Appendices B12 to B18 summarise the statistically significant differences for these scales.

Table 2.5 shows the difference between the overall mean mathematics scores and the mean scores for each of the content categories and mathematical processes for each of the countries that outperformed England. The size of the difference has been colour coded and the key for the table should be interpreted in the following way:

	The score is more than 20 score points lower than the overall country mean
	The score is between 11 and 20 score points lower than the overall country mean
	The score is between 5 and 10 score points lower than the overall country mean
	The score is between 5 and 10 score points higher than the overall country mean
	The score is between 11 and 20 score points higher than the overall country mean
	The score is more than 20 score points higher than the overall country mean

Table 2.5 Differences between scale scores in countries outperforming England in 2012

	Overall mathematics mean	Difference from overall mathematics mean						
		Mathematics content categories				Mathematical processes		
		quantity	*uncertainty and data*	*change and relationships*	*space and shape*	*formulate*	*employ*	*interpret*
Shanghai-China	613	-22	-21	11	36	12	0	-34
Singapore	573	-5	-14	7	6	8	1	-18
Hong Kong-China	561	4	-8	3	6	7	-3	-10
Chinese Taipei	560	-16	-11	1	32	19	-11	-11
Korea	554	-16	-16	5	19	8	-1	-14
Macao-China	538	-8	-13	4	20	7	-2	-9
Japan	536	-18	-8	6	21	18	-6	-5
Liechtenstein	535	3	-9	7	4	0	1	5
Switzerland	531	0	-9	-1	13	7	-2	-2
Netherlands*	523	9	9	-5	-16	4	-4	3
Estonia*	521	4	-10	9	-8	-3	4	-8
Finland*	519	8	0	2	-12	0	-3	9
Canada	518	-3	-2	7	-8	-2	-2	3
Poland*	518	1	-1	-8	7	-2	1	-3
Belgium*	515	4	-7	-1	-6	-2	1	-2
Germany*	514	4	-5	2	-6	-3	2	3
Vietnam	511	-2	8	-2	-4	-14	12	-15
Austria*	506	5	-7	1	-5	-6	4	3
Australia	504	-4	4	5	-8	-6	-4	10
England	**495**	**0**	**8**	**3**	**-18**	**-5**	**-2**	**6**

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

Differences have been calculated using unrounded mean scores.

Quantity

Quantity incorporates the quantification of attributes of objects, relationships, situations, and entities in the world, understanding various representations of those quantifications, and judging interpretations and arguments based on quantity. It involves understanding measurements, counts, magnitudes, units, indicators, relative size, and numerical trends and patterns, and employing number sense, multiple representations of numbers, mental calculation, estimation, and assessment of reasonableness of results (OECD, 2013).

Figure 2.1 below is an example of a question from PISA 2012 that assesses the content area of *quantity*.

England's mean score on the *quantity* subscale was the same as the overall mean for mathematics. A number of the countries that outperformed England also had mean scores for this subscale that were similar to the overall mean (for example: Switzerland, Poland, Vietnam, Canada and Liechtenstein). However, of the seven top performing countries four had mean scores for *quantity* that were more than ten points below the overall mean score for mathematics. For example, the mean score for *quantity* in Shanghai-China was 591, 22 points lower than the overall mean.

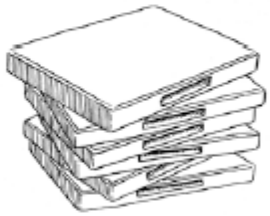
Figure 2.1 DVD Rental: a released quantity question from PISA 2012

DVD RENTAL

Jenn works at a store that rents DVDs and computer games.

At this store the annual membership fee costs 10 zeds.

The DVD rental fee for members is lower than the fee for non-members, as shown in the following table:



Non-member rental fee for one DVD	Member rental fee for one DVD
3.20 zeds	2.50 zeds

What is the minimum number of DVDs a member needs to rent so as to cover the cost of the membership fee? Show your work.

.....

.....

.....

Number of DVDs: .....

Uncertainty and data

Uncertainty and data covers two closely related sets of issues: how to identify and summarise the messages that are embedded in sets of data presented in many ways, and how to appreciate the likely impact of the variability that is inherent in many real processes. Uncertainty is part of scientific predictions, poll results, weather forecasts, and economic models; variation occurs in manufacturing processes, test scores, and survey findings; and chance is part of many recreational activities that individuals enjoy. Probability and statistics, taught as part of mathematics, address these issues (OECD, 2013).

Figure 2.2 below shows an example of a question from PISA 2012 that assesses the content area of *uncertainty and data*.

England's mean score for this content category was eight points above the overall mean. However, the majority of countries that outperformed England had lower scale scores for *uncertainty and data* than the overall mean. The Netherlands, Vietnam and Australia were the only high performing countries to have higher mean scores in this content area compared with the overall mean. This suggests that pupils in England are relatively strong in answering questions related to statistics and probability compared with pupils in a number of the high performing countries.

Change and relationships

Change and relationships focuses on the multitude of temporary and permanent relationships among objects and circumstances, where changes occur within systems of interrelated objects or in circumstances where the elements influence one another. Some of these changes occur over time; some are related to changes in other objects or quantities. Being more literate in this content category involves understanding fundamental types of change and recognising when change occurs so that suitable mathematical models can be employed to describe and predict change (OECD, 2013).

Figure 2.3 shows an example of a question from PISA 2012 that assesses the content area of *change and relationships*.

In England, the mean score for *change and relationships* is similar to the overall mean score for mathematics (a difference of three score points). Amongst the high performing countries the majority have higher mean scores for this content area compared with the overall mean; the difference ranges from 11 points higher in Shanghai-China to only one point in Chinese Taipei. Notable exceptions are the Netherlands and Poland who have a lower mean score in *change and relationships* compared with the overall mean (a difference of five and eight points respectively).

Figure 2.2 Penguins: a released uncertainty and data question from PISA 2012

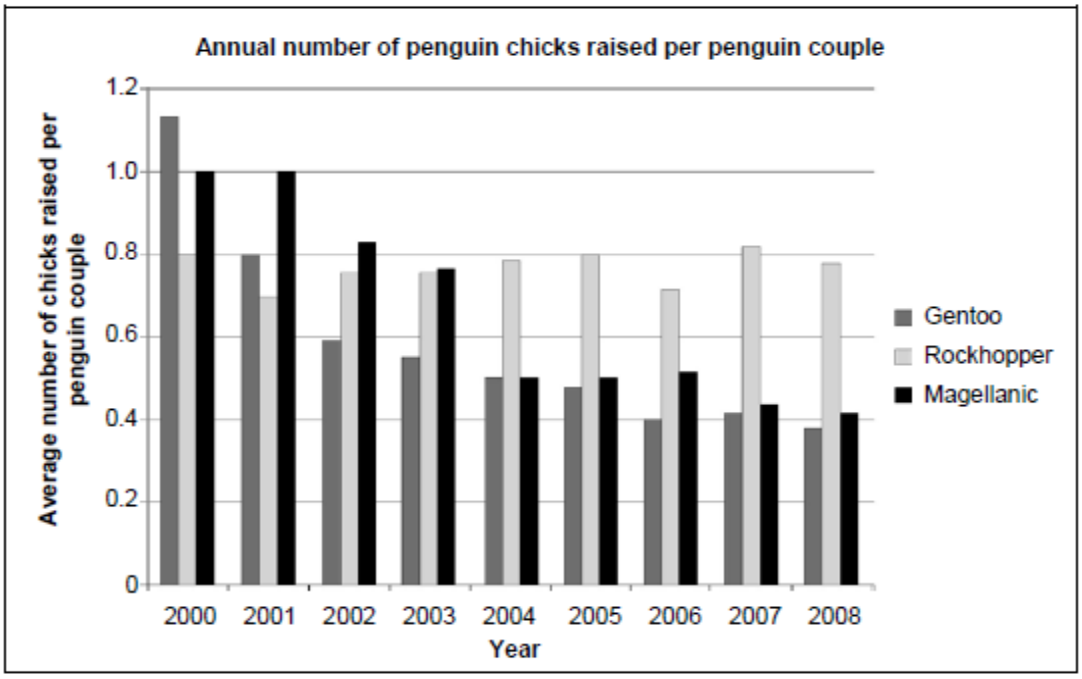
PENGUINS

The animal photographer Jean Baptiste went on a year-long expedition and took numerous photos of penguins and their chicks.

He was particularly interested in the growth in the size of different penguin colonies.

After he gets home from his trip, Jean Baptiste has a look on the Internet to see how many chicks a penguin couple raise on average.

He finds the following bar chart for the three penguin types Gentoo, Rockhopper and Magellanic.



Based on the chart above, are the following statements about these three penguin types true or false?

Circle "True" or "False" for each statement.

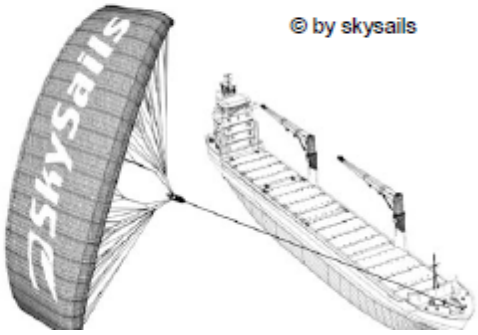
Statement	Is the statement true or false?
In 2000, the average number of chicks raised per penguin couple was larger than 0.6.	True / False
In 2006, on average, less than 80% of penguin couples raised a chick.	True / False
By about 2015 these three penguin types will be extinct.	True / False
The average number of Magellanic penguin chicks raised per penguin couple decreased between 2001 and 2004.	True / False

Figure 2.3 Sailing ships: a released change and relationships question from PISA 2012

SAILING SHIPS

Ninety-five percent of world trade is moved by sea, by roughly 50 000 tankers, bulk carriers and container ships. Most of these ships use diesel fuel.

Engineers are planning to develop wind power support for ships. Their proposal is to attach kite sails to ships and use the wind's power to help reduce diesel consumption and the fuel's impact on the environment.



© by skysails

Due to high diesel fuel costs of 0.42 zeds per litre, the owners of the ship *NewWave* are thinking about equipping their ship with a kite sail.

It is estimated that a kite sail like this has the potential to reduce the diesel consumption by about 20% overall.

Name: *NewWave*

Type: freighter

Length: 117 metres

Breadth: 18 metres

Load capacity: 12 000 tons

Maximum speed: 19 knots

Diesel consumption per year without a kite sail: approximately 3 500 000 litres

The cost of equipping the *NewWave* with a kite sail is 2 500 000 zeds.

After about how many years would the diesel fuel savings cover the cost of the kite sail? Give calculations to support your answer.

.....

.....

.....

.....

.....

.....

.....

Number of years:.....

Space and shape

Space and shape encompasses a wide range of phenomena that are encountered everywhere: patterns, properties of objects, positions and orientations, representations of objects, decoding and encoding of visual information, navigation, and dynamic interaction with real shapes and their representations. Geometry is essential to *space and shape*, but the category extends beyond traditional geometry in content, meaning and method, drawing on elements of other mathematical areas, such as spatial visualisation, measurement and algebra. Mathematical literacy in *space and shape* involves understanding perspective, creating and reading maps, transforming shapes with and without technology, interpreting views of three-dimensional scenes from various perspectives, and constructing representations of shapes (OECD, 2013).

Figure 2.4 below is an example of a question from PISA 2012 that assesses the content area of *space and shape*.

England's mean score for this content category was considerably lower than the overall mean score for mathematics; a difference of 18 score points. A number of the EU countries that outperformed England (for example: the Netherlands, Finland and Estonia) also have a mean score on this scale that is lower than the overall mean. England does not compare well on this content category with the highest performing countries. The nine highest performing countries all had mean scores for *space and shape* that were higher than their overall scores for mathematics (for example Shanghai-China and Chinese Taipei had a difference of over 30 score points).

2.2.1.2 Mathematics process category scale scores

The PISA items are also classified according to the main mathematical process that a pupil uses to solve the problem they are presented with. There are three process categories:

- *formulating* situations mathematically
- *employing* mathematical concepts, facts, procedures and reasoning
- interpreting, applying and evaluating mathematical outcomes.

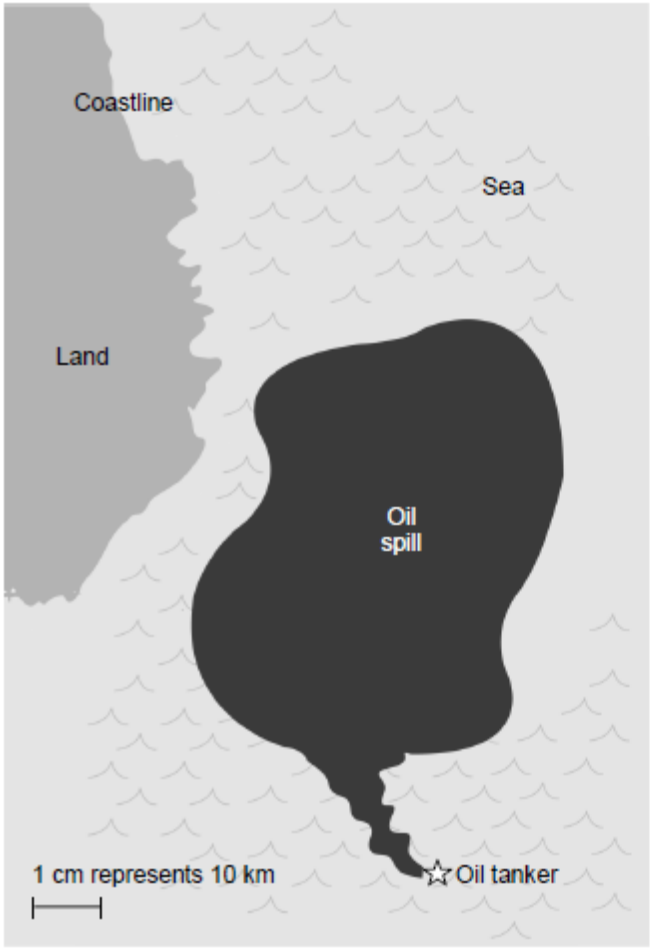
As shown in Table 2.5[1], England's highest mathematical process score was attained on the *interpret* subscale with a mean of 501; six points higher than the overall mean for mathematics. Five of the countries that outperformed England (Liechtenstein, Finland, Canada, Germany and Australia) also achieved the highest process score on the *interpret* subscale. England's mean scale score for the *employ* subscale was closer to the overall mean, only two points lower. A number of the countries that outperformed England also achieved mean scores in this process that were close to the overall mean for mathematics. For example Singapore, Korea, Liechtenstein, Poland and Belgium all had a difference of one point between the mean score in the *employ* subscale and their overall mean. England's lowest mathematical process score was attained on the *formulate* subscale, five points lower than the overall mean. Less than half of the countries that outperformed England had this pattern of performance and the seven top performing countries all had mean scores for the *formulate* subscale that were higher than the overall mean.

[1] Differences have been calculated using unrounded mean scores.

Figure 2.4 Oil spill: a released space and shape question from PISA 2012

OIL SPILL

An oil tanker at sea struck a rock, making a hole in the oil storage tanks. The tanker was about 65 km from land. After a number of days the oil had spread, as shown on the map below.



Using the map scale, estimate the area of the oil spill in square kilometres (km^2).

Answer: ..... km^2

Summary

In England, pupil performance varied across the four mathematical content categories and the three mathematical process categories; variation was also seen in other countries. None of the countries that significantly outperformed England demonstrated consistent performance across the four content categories and the three mathematical processes (see Table 2.5 above). Of the four content categories, England achieved the highest mean score on the *uncertainty and data* scale

(503), eight score points higher than the overall mean. England's lowest score was attained on the *space and shape* scale (477), 18 score points lower than the overall mean. This trend was not observed in several of the highest performing countries, where conversely the mean score for *space and shape* was higher than the overall mean and the mean score for *uncertainty and data* was lower than the overall mean. For example, Shanghai-China scored 36 scale points higher than the overall mean on *space and shape* but over 20 score points lower on the *quantity* and *uncertainty and data* subscales. Chinese Taipei, Japan, Korea and Macao-China showed the same subscale trends as Shanghai-China, although to a less pronounced degree.

Comparing mean scores for the three mathematical processes, 22 of the 50 comparison countries had relatively high scores on the *interpret* subscale. However, a number of the high performing countries (for example: Shanghai China, Singapore and Japan) had lower mean scores for this process compared to their other mathematical process subscale scores and their overall mean. These high performing countries had higher mean scores on the *formulate* subscale, England's weakest process area.

These findings suggest that, in England, pupils are relatively strong on the questions that focus on probability and statistics (*uncertainty and data*) and require them to *interpret, apply and evaluate* mathematical outcomes in order to solve problems. However, they are less strong on those questions focusing on aspects of *space and shape* and those requiring them to *formulate* situations mathematically in order to solve a problem. This is a very different pattern of performance compared with the seven top performing countries. In these high achieving East and South East Asian countries pupils are relatively strong on questions that focus on *space and shape* or require than to *formulate* situations mathematically in order to solve a problem. However, they are less strong on questions that focus on probability and statistics (*uncertainty and data*) and require them to *interpret, apply and evaluate* mathematical outcomes in order to solve problems.

Comparisons between the four constituent parts of the UK are provided in Chapter 7.

2.3 Differences between highest and lowest attainers

In addition to knowing how well pupils in England performed overall and across the different subscales assessed, it is also important for the purposes of teaching and learning to examine the spread in performance between the highest and lowest achievers. Amongst countries with similar mean scores there may be differences in the numbers of high- and low-scoring pupils (the highest and lowest attainers). A country with a wide spread of attainment may have large numbers of pupils who are underachieving as well as pupils performing at the highest levels. A country with a lower spread of attainment may have fewer very high achievers but may also have fewer underachievers.

2.3.1 Distribution of scores

The first way in which the spread of performance in each country can be examined is by looking at the distribution of scores. Appendix B2 shows the scores achieved by pupils at different percentiles. The 5th percentile is the score at which five per cent of pupils score lower, while the 95th percentile is the score at which five per cent score higher. The difference between the highest and lowest attainers at the 5th and 95th percentiles is a better measure of the spread of scores for

comparing countries than using the lowest and highest scoring pupils. Such a comparison may be affected by a small number of pupils in a country with unusually high or low scores. Comparison of the 5th and the 95th percentiles gives a better indication of the typical spread of attainment.

The score of pupils in England at the 5th percentile was 335, while the score of those at the 95th percentile was 652; a difference of 316 score points[2]. By comparison, the average difference across the OECD countries was 301 score points, indicating that England has a slightly wider distribution of scores. Only ten comparison countries had a greater difference between the mean scores of their highest and lowest attainers. Of these 10 countries, five are the countries with the highest overall mean scores for mathematics, they have a difference of between 318 points (Hong Kong-China) and 375 (Chinese Taipei) score points between the lowest and highest scoring pupils. In addition to Korea, a further five OECD countries also demonstrated a larger difference between their highest and lowest attainers compared with England (Israel, Belgium, Slovak Republic, New Zealand and France). Comparisons between the four constituent parts of the UK are provided in Chapter 7.

2.3.2 Performance across PISA proficiency levels

Proficiency levels for mathematics overall

The second way of examining the spread of attainment is by looking at England's performance at each of the PISA proficiency levels. The PISA proficiency levels are devised by the PISA Consortium and are not linked to National Curriculum levels in England. As explained in Appendix A3, mathematics attainment in PISA is described in terms of six levels of achievement. These six performance levels are outlined in Figure 2.5 and Figure 2.6. Figure 2.5 shows the cumulative percentages at each level for the OECD average and for England. In all participating countries there were some pupils at or below the lowest level of achievement (Level 1) and in all countries at least some pupils achieved the highest level (Level 6). Full information on the proportion of pupils at each level in all comparison countries is provided in Appendices B19 and B20.

Figure 2.5 demonstrates that the proportion of pupils in England at each PISA proficiency level was very similar to the OECD average. In England, 8.0 per cent of pupils scored below PISA Level 1. This was the same as the OECD average. England had 21.7 per cent of pupils at Level 1 or below, compared with an OECD average of 23.0 per cent. However, 25 of the comparison countries had fewer pupils at or below Level 1 than England. England's relatively long tail of underachievement does not compare well with the highest scoring countries. In Shanghai-China, Singapore and Hong Kong-China, for example, fewer than ten per cent of pupils were at Level 1 or below.

In contrast to the number of low attaining pupils, however, England also has some high achievers. In England 3.1 per cent of pupils achieved PISA Level 6; a similar percentage to the OECD average (3.3 per cent). Combining the two top levels (Level 5 and 6), England is again just below the OECD average (12.4 per cent compared with an OECD average of 12.6 per cent). However, the numbers of pupils scoring at these high levels do not compare well with the higher performing countries. All of the countries that outperformed England in mathematics had a higher percentage

[2] Differences have been calculated using unrounded mean scores.

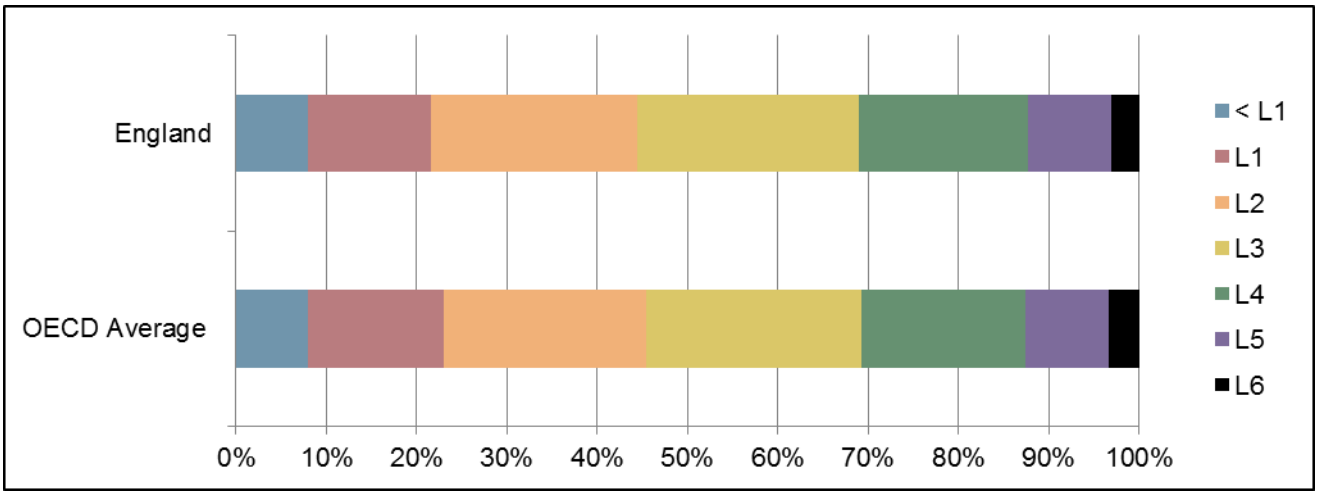
of pupils at Level 5 or above. For example, Shanghai-China had 55.4 per cent of pupils in the top two levels, and Belgium and the Netherlands had over 19 per cent of pupils at Level 5 or above (the proportion of pupils at each level in all comparison countries is provided in Appendices B19 and B20).

Figure 2.5 PISA mathematics proficiency levels

Level	% at this level		What students can typically do at each level
	OECD	**England**	
6	3.3% perform tasks at Level 6	3.1% perform tasks at Level 6	Students at Level 6 of the PISA mathematics assessment are able to successfully complete the most difficult PISA items. At Level 6, students can conceptualise, generalise and use information based on their investigations and modelling of complex problem situations, and can use their knowledge in relatively non-standard contexts. They can link different information sources and representations and move flexibly among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for addressing novel situations. Students at this level can reflect on their actions, and can formulate and precisely communicate their actions and reflections regarding their findings, interpretations and arguments, and can explain why they were applied to the original situation.
5	12.6% perform tasks at least at Level 5	12.4% perform tasks at least at Level 5	At Level 5, students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterisations, and insights pertaining to these situations. They begin to reflect on their work and can formulate and communicate their interpretations and reasoning.
4	30.8% perform tasks at least at Level 4	31.0% perform tasks at least at Level 4	At Level 4, students can work effectively with explicit models on complex, concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic representations, linking them directly to aspects of real-world situations. Students at this level can use their limited range of skills and can reason with some insight, in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, reasoning and actions.

Level	% at this level		What students can typically do at each level
	OECD	England	
3	54.5% perform tasks at least at Level 3	55.6% perform tasks at least at Level 3	At Level 3, students can execute clearly described procedures, including those that require sequential decisions. Their interpretations are sufficiently sound to be the basis for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships. Their solutions reflect that they have engaged in basic interpretation and reasoning.
2	77.0% perform tasks at least at Level 2	78.4% perform tasks at least at Level 2	At Level 2, students can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures or conventions to solve problems involving whole numbers. They are capable of making literal interpretations of the results.
1	92.0% perform tasks at least at Level 1	92.0% perform tasks at least at Level 1	At Level 1, students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are almost always obvious and follow immediately from the given stimuli.

Figure 2.6 Percentage of pupils achieving each PISA level in the 2012 mathematics assessment



Proficiency levels for mathematics content and process categories

Findings presented earlier show that there was some inconsistency in the performance of pupils in England across the mathematical content subscales and the mathematical process subscales. We might expect to see a similar pattern of achievement for each subscale at each proficiency level.

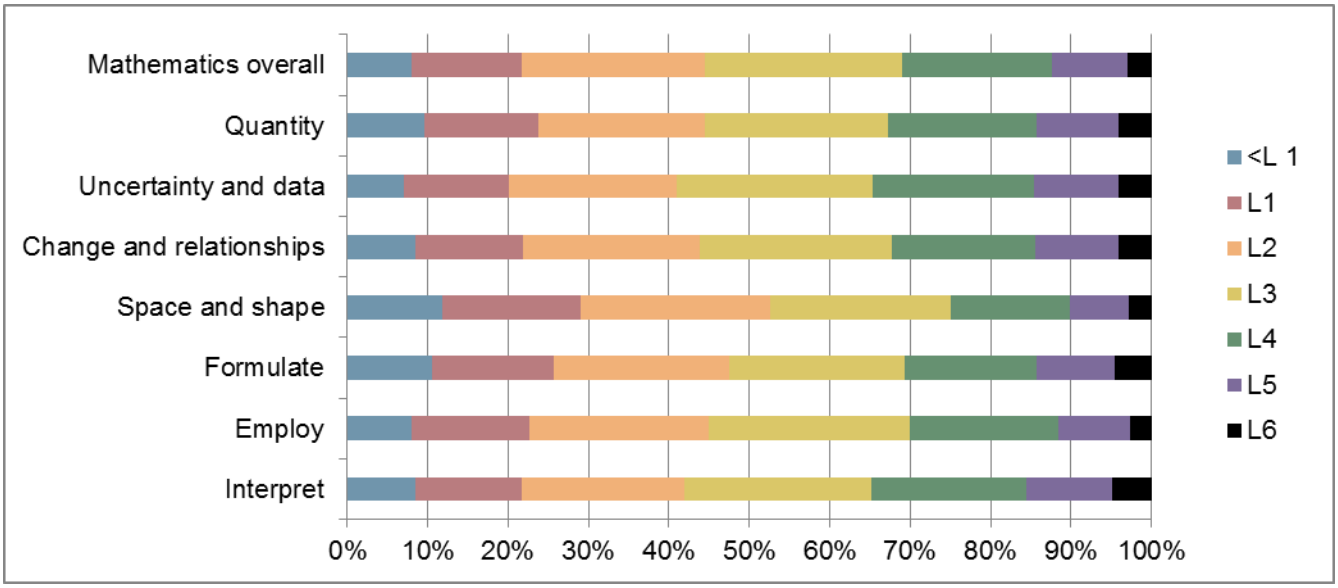
Table 2.6 and Figure 2.7 show the percentage of pupils in England at each level for each mathematics subscale.

The proficiency distribution reflects that seen for mathematics overall in England, that is, that there are slightly higher numbers of pupils at the higher proficiency levels in the *quantity*, *uncertainty and data, change and relationships* and *interpret* subscales. Of these subscales, three are the content areas and process category in which pupils in England demonstrated relatively higher mean scores compared with the overall mathematics mean. In the *uncertainty and data* subscale, 14.6 per cent of pupils were at Levels 5 and 6; in the *change and relationships* subscale this figure was 14.4 per cent; and in the *interpret* subscale this figure was 15.5 per cent, compared with 12.4 per cent for mathematics overall. This pattern of achievement for the *uncertainty and data* and *interpret* subscales is also supported by the findings for the lower proficiency levels, that is, there is a smaller percentage of pupils performing at Level 2 or below compared with mathematics overall (41.0 per cent and 41.9 per cent respectively compared with 44.5 per cent for mathematics overall). Conversely, there is a higher percentage of pupils at the lower proficiency levels for *space and shape* (52.5 per cent compared with 44.5 per cent for mathematics overall) and a lower percentage of pupils at Levels 5 and 6 (10.1 per cent compared with 12.4 per cent for mathematics overall). This is unsurprising as the mean score for *space and shape* was considerably lower than the mean score for mathematics overall.

Table 2.6 Percentage at each level in England for each mathematics subscale

Scale	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1	Below level 1
Mathematics overall	3.1	9.3	18.7	24.5	22.8	13.7	8.0
Quantity	4.1	10.1	18.6	22.7	20.8	14.1	9.6
Uncertainty and data	4.1	10.5	20.1	24.2	20.9	13.1	7.0
Change and relationships	4.1	10.3	17.9	23.8	21.9	13.5	8.4
Space and shape	2.9	7.2	14.8	22.6	23.5	17.1	11.9
Formulate	4.6	9.6	16.4	21.8	21.9	15.1	10.5
Employ	2.7	9.0	18.4	25.0	22.4	14.6	8.0
Interpret	4.9	10.6	19.2	23.3	20.2	13.2	8.5

Figure 2.7 Percentage of pupils at each level in England for each mathematics subscale



2.3.3 Comparison with PISA 2006 and 2009

This section compares the distribution of scores in PISA 2012 with those from PISA 2006 and 2009. It is important to note that, for PISA 2006 and 2009, mathematics was a minor domain and as such it is not possible to compare the subscale data obtained in this PISA cycle where mathematics was the main focus.

In England, there appears to be a widening gap between high and low achievers. The difference in scores between the lowest and highest percentiles for OECD countries has increased slightly in 2012 to 301 points from 300 points in 2006 and 2009. However, the increase in the difference between the highest and lowest attainers has been more dramatic in England, from 285 points in 2009 to 316 points in 2012. The reason for this larger difference is that the score of pupils at the lowest percentile has decreased since 2006 (350 in 2006, 349 in 2009 and 335 in 2012), whilst the score achieved by the highest percentile of pupils has increased (643 in 2006, 634 in 2009 and 652 in 2012).

The proportion of low achieving pupils (pupils achieving Level 1 or below) in England has increased slightly since 2006 (19.9 per cent in 2006, 19.8 per cent in 2009 and 21.7 per cent in 2012). For the top two levels combined (Levels 5 and 6), the proportion of pupils has increased since 2009 from 9.9 per cent to 12.4 per cent in 2012; a difference of 2.5 per cent. In contrast, the OECD average proportion of high achieving pupils has remained virtually unchanged since 2009. In England the percentage of pupils at Levels 2, 3 and 4 has remained relatively stable since 2006.

2.4 Differences between boys and girls

In England, there was a significant difference favouring boys. Of the 64 other participating countries, 41 had a statistically significant difference in performance by gender. In 36 countries this favoured boys and in five (Jordan, Qatar, Thailand, Malaysia and Iceland) it favoured girls (see Appendix B2). The difference in England of 13 score points between girls and boys was

slightly higher than the OECD average of 11 score points. However, England was not one of the countries with the largest difference; 14 comparison countries had larger differences. Among the highest performing countries, six (Liechtenstein, Austria, Japan, Korea, Hong Kong-China and Germany) had scale point differences between girls and boys that were larger than the difference seen in England. Comparisons between the four constituent parts of the UK are provided in Chapter 7.

As noted in section 2.2.1, the performance of pupils in England varied across the seven mathematics subscales: pupils were relatively strong in the *uncertainty and data* and *interpret* subscales and performed less well in the *space and shape* subscale. However, the gender difference in England was fairly evenly distributed across the different (content and process) subscales for mathematics, with boys having higher mean scores than girls on all seven subscales (although on the *formulate* scale this difference was not statistically significant). There was a difference of 14 score points for the *quantity*, *uncertainty and data* and *interpret* subscales. There was a slightly larger difference between boys and girls for *change and relationships* (15 score points) and a slightly smaller different for *space and shape* and *employ* (13 and 12 score points respectively). There was no significant difference between boys and girls on the *formulate* subscale.

It is important to note that the size of the gender differences on each of the subscales is similar. The biggest differences are found between *change and relationships* and *formulate,* and *change and relationships* and *employ* (only three points in each case). In England the gender differences on each subscale are similar regardless of the overall performance on the subscales. For example, the gender difference on the *uncertainty and data* and *space and shape* content areas is similar (14 and 13 score points respectively) although there is a difference of 26 score points between the mean scores for these subscales.

There was considerable variation in the pattern of gender differences across the subscales for mathematics between the comparison countries. In 17 comparison countries there were significant gender differences on all the subscales, whereas in a number of countries there were only significant differences on one or two of the subscales (for example: the United States, Sweden, Singapore and Israel). In 19 of the comparison countries the largest difference between boys and girls was on the *formulate* subscale. This was also observed in the OECD average, although as noted above this difference was not significant in England. This suggests that in some countries boys are relatively stronger at formulating situations mathematically compared with girls, whereas in England boys and girls are able to use this process equally well in order to solve mathematical problems. On the other subscales there were no clear patterns in terms of gender differences.

It is interesting to compare this pattern of gender difference with that found in other assessments used in England, both national and international. At Key Stage 4, attainment in the GCSE mathematics qualification (taken by 695,050 pupils in 2013) shows very little gender difference, with 14.5 per cent of boys and 13.8 per cent of girls achieving an A* or grade A (www.jcq.org.uk). In terms of international assessments, TIMSS 2011 found that for pupils aged 9–10 and aged 13-14 there was no significant difference in the overall mathematics performance of boys and girls. It seems that results from these two measures do not tell the same story about gender differences

as the PISA survey. Further analysis of the PISA and TIMSS data would be needed in order to explain this difference.

2.4.1 Comparison with PISA 2006 and 2009

This section compares the gender differences found in PISA 2012 with those from PISA 2006 and 2009. However, as mathematics was a minor domain in 2006 and 2009 it is not possible to compare the subscale data obtained in this PISA cycle where mathematics was the main focus. In 2012, as in 2009 and 2006, boys scored significantly higher than girls. It appears that the gender gap in England has decreased slightly between the 2009 and 2012 PISA cycles, from a 21 point difference in 2009 to a 13 point difference in 2012. In contrast, the OECD average for gender difference has remained relatively stable over the last three cycles of PISA (11 points in 2006, 12 points in 2009 and 11 points in 2012).This narrowing of the gender gap is starting to bring the results for PISA more in line with those of other assessments, for example GCSE and TIMSS, where there is no significant gender difference.

2.5 Summary

England's performance in 2012 does not differ greatly from its performance in the last two cycles of the survey (2006 and 2009) and is not significantly different from the OECD average. The number of countries outperforming England has decreased slightly; from 20 in 2009 to 19 in 2012. However, the composition of this group has changed with Poland, Vietnam and Austria scoring significantly higher than England for the first time. England had a relatively wide spread of attainment compared with other countries. The difference between the score of pupils at the 5th percentile and the score of pupils at the 95th percentile was 316 score points (OECD average 301 score points). Only ten comparison countries had a greater difference between their highest and lowest attainers.

In 2012, there was a small increase in the proportion of both high and low achieving pupils. In terms of the PISA proficiency levels, nearly 80 per cent of pupils achieved Level 2 or above. This compares favourably with the OECD average, with a similar proportion of pupils at each level of achievement. However, compared with the high achieving countries, England had a relatively low percentage of pupils, 12.4 per cent, in the top two proficiency levels (Levels 5 and 6).

In terms of gender differences, boys performed significantly better than girls (a 13 point difference). This was the case in nearly two thirds of the participating countries. Fourteen comparison countries had larger gender differences. There does not appear to be a clear relationship between a country's mean score and the existence of a high or low gender difference in performance. For example, Liechtenstein (in the group of countries outperforming England) and Chile (in those performing below England) had two of the biggest gender differences (23 and 25 score points respectively). Since 2006 there has been a narrowing of the gender gap in England and this brings the results for PISA more in line with those of other assessments, for example GCSE and TIMSS, where there is no significant gender difference in performance.

3. Pupils and mathematics

Chapter outline

This chapter reports on pupils' attitudes to school and learning, their drive and motivation for mathematics-related tasks, and their self-beliefs and participation in mathematics. In addition, aspects of mathematics lessons are discussed. The chapter begins by looking at the link between mathematics scores and pupils' backgrounds.

Key findings

- On average, pupils in England have a socio-economic status that is higher than the OECD average.
- Socio-economic status is associated with attainment in mathematics in England and across the OECD, with lower status related to lower mean scores.
- For England, 12 per cent of the variance in mathematics scores can be explained by socio-economic background, which is slightly lower than the OECD average of 15 per cent.
- Pupils in England report a high sense of belonging and satisfaction with school, similar to the OECD average.
- Pupils in England, similar to the OECD average, regard school as useful and worthwhile.
- With regard to mathematics in particular, pupils report only moderate interest in learning mathematics, but recognise that it is useful.
- Pupils in England show greater motivation to learn mathematics than the OECD average.
- Pupils report a high amount of control over their ability to succeed in mathematics and a high level of conscientiousness towards learning mathematics. Pupils in England generally report a greater level of conscientiousness and perseverance for mathematics tasks than the OECD average.
- Pupils in England report that they are confident in their ability to perform mathematics tasks and have low anxiety about mathematics. Levels of anxiety are lower than the OECD average.
- Pupils in England report a higher level of support from their mathematics teachers than that found for the OECD on average.
- Pupils in England report that a wide variety of tasks and strategies are used by their teachers in mathematics lessons.

3.1 How do mathematics scores link with pupils' backgrounds?

This section reports on interactions between socio-economic background and mathematics scores. Socio-economic background in PISA is reported as the ESCS Index (economic, social and cultural status). This is based on pupils' responses to questions about their parents' background and education, and possessions in their homes. The index is set to a mean of zero across OECD countries, with a standard deviation of one.

England's mean score on the ESCS Index was 0.29, indicating that on average pupils in the PISA sample in England have a higher socio-economic status than the average across OECD countries.

In general there was a gap in achievement in OECD countries between those who are highest and those who are lowest on the ESCS Index, and this was also the case in England. As shown in Table 3.1, those in the bottom quarter of the ESCS Index have a mathematics score of 460, those in the second quarter 478, in the third quarter 511 and in the top quarter 546. This compares with the overall mean score for England of 495. The difference between the top and bottom quarters is 87 points, which represents approximately two years of schooling. (The difference is calculated on figures not rounded to the nearest whole number). Appendix E shows the Index for comparator countries.

Table 3.1Socio-economic background and mathematics performance in England and the OECD

	PISA index of economic, social and cultural status (ESCS)		Mean scores on the mathematics scale, by national quarters of the ESCS index				Score point difference in mathematics associated with one unit increase in the ESCS	Percentage of explained variance in mathematics performance
	Mean index for all students	Mathematics overall mean score	Bottom quarter	Second quarter	Third quarter	Top quarter		
England	0.29	495	460	478	511	546	41	12.4
OECD average	0	494	452	482	506	542	39	14.6

The change in score for each unit of the index in England is 41 points on the PISA mathematics scale, and this is relatively large. This means that, for a change of one standard deviation on the ESCS Index, there will be a predicted difference in score of 41 points. The OECD average is 39. This suggests that socio-economic background has a slightly larger effect in England than the average in OECD countries. Twelve OECD countries had a larger change in score than England.

However, to gain a true picture of interactions between mathematics score and the ESCS Index, it is also necessary to look at the amount of variance in scores which can be explained by socio-economic background. This shows the extent to which the scores of pupils in each country are predicted by socio-economic background. In the case of England, 12 per cent of the variance in scores can be explained by socio-economic background. The OECD average is 15 per cent.

In Japan, Shanghai-China and Poland the change in score per unit of the ESCS was the same as that in England. In Japan, the amount of variance explained was ten per cent. This means that the more disadvantaged pupils in England have less chance of performing as well as their more advantaged peers than their counterparts in Japan, and suggests that the education system in Japan is more successful at overcoming the effects of socio-economic background. In Shanghai-China and Poland, however, the opposite is the case. The amount of variance explained was 15 and 17 per cent respectively, suggesting that the education systems in these countries are less successful at overcoming the effects of socio-economic background than in England. The country in which the most disadvantaged pupils have the best chance of succeeding in spite of their

background is Macao-China, where the change in the mathematics score per unit is 17 and the amount of variance explained is three per cent.

3.2 Pupils' attitudes to school and learning

Pupils in England, and across the OECD on average, reported a high sense of belonging and satisfaction with school, as shown in Table 3.2. Pupils might be expected to be able to achieve more if they feel comfortable in their learning environment. The proportions of responses were very similar for England and the OECD average, with the exception of the statement "Things are ideal in my school"; 72 per cent of pupils in England agreed or strongly agreed with this compared with 61 per cent for the OECD average.

Table 3.2 Sense of belonging

Thinking about your school, to what extent do you agree with the following statements?		
	England	OECD average
	agree/strongly agree	
I make friends easily at school.	88%	87%
I feel like I belong at school.	80%	81%
Other students seem to like me.	93%	89%
I feel happy at school.	84%	80%
Things are ideal in my school.	72%	61%
I am satisfied with my school.	85%	78%
	disagree/strongly disagree	
I feel like an outsider (or left out of things) at school.	89%	89%
I feel awkward and out of place in my school.	88%	88%
I feel lonely at school.	92%	91%

Pupils were asked two further questions about their attitude towards school: one focused on learning outcomes (reported in Table 3.3), the other on learning activities (reported in Table 3.4). Attitudes are believed to be important because they can predict pupils' intentions, which can then predict behaviours. However, the international PISA report (Volume 3, Chapter 2, OECD, 2013) found that pupils' attitudes towards school were not highly associated with mathematics performance. Pupils in England, and on average across the OECD, reported that they regarded school as useful, with the overwhelming majority of pupils in England agreeing or strongly agreeing that "Trying hard at school is important" (97 per cent; slightly higher than the OECD average of 93 per cent). In addition, 94 per cent of pupils in England disagreed or strongly disagreed with the statement "School has been a waste of time" (higher than the OECD average of 88 per cent).

Table 3.3 Pupils' attitudes towards school: learning outcomes

Thinking about what you have learned at school, to what extent do you agree with the following statements?		
	England	OECD average
	disagree/strongly disagree	
School has done little to prepare me for adult life when I leave school.	74%	71%
School has been a waste of time.	94%	88%
	agree/strongly agree	
School has helped give me confidence to make decisions.	83%	77%
School has taught me things which could be useful in a job.	85%	87%

Table 3.4 Pupils' attitudes towards school: learning activities

Thinking about your school, to what extent do you agree with the following statements?		
	England	OECD average
	agree/strongly agree	
Trying hard at school will help me get a good job.	96%	91%
Trying hard at school will help me get into a good university.	96%	94%
I enjoy receiving good marks.	98%	95%
Trying hard at school is important.	97%	93%

3.3 Pupils' attitudes to learning mathematics

Pupils' attitudes towards mathematics in particular were investigated in a series of questions looking at motivation, beliefs about success and conscientiousness.

Motivation to learn mathematics was measured on two scales in the Student Questionnaire, looking at *intrinsic motivation* to learn mathematics (based on a pupil's interest and enjoyment) and *instrumental motivation* (where learning mathematics is seen as a useful activity).

Table 3.5 shows the percentages of pupils in England, and on average across OECD countries, who agreed or strongly agreed with the statements presented as part of this question. Pupils did not report a particularly high level of intrinsic motivation to learn mathematics, and there is little difference between the proportions of pupils in England and the OECD average, apart from a greater proportion of pupils in England reporting that they look forward to their mathematics lessons (52 per cent compared with the OECD average of 36 per cent).

While pupils are, on average, not particularly interested in learning mathematics, they show a greater level of instrumental motivation to learn mathematics, apparently recognising that it is useful. In addition, larger differences for the statements relating to instrumental motivation were shown than for intrinsic motivation, with pupils in England showing greater motivation to learn

mathematics than pupils across the OECD on average. Nine out of ten pupils in England (91 per cent) said that learning mathematics is worthwhile because it will improve career chances, compared with eight out of ten for the OECD average (78 per cent).

Table 3.5 Pupils' motivation to learn mathematics

Thinking about your views on mathematics, to what extent do you agree with the following statements?		
	agree/strongly agree	
	England	OECD average
Intrinsic motivation to learn mathematics		
I enjoy reading about mathematics.	35%	31%
I look forward to my mathematics lessons.	52%	36%
I do mathematics because I enjoy it.	41%	38%
I am interested in the things I learn in mathematics.	57%	53%
Instrumental motivation to learn mathematics		
Making an effort in mathematics is worth it because it will help me in the work that I want to do later on.	88%	75%
Learning mathematics is worthwhile for me because it will improve my career chances.	91%	78%
Mathematics is an important subject for me because I need it for what I want to study later on.	73%	66%
I will learn many things in mathematics that will help me get a job.	81%	70%

A large proportion of pupils reported that learning mathematics was worthwhile because it was important. They also reported feeling high levels of control over their ability to succeed in mathematics. As shown in Table 3.6, pupils in England reported a high degree of perceived control of success in mathematics, similar to the OECD average. Almost all pupils said that with sufficient effort they could succeed in mathematics (96 per cent for England, slightly higher than the OECD average of 92 per cent). The international PISA report (Volume 3, Chapter 3, OECD, 2013) found that pupils who strongly agreed that they can succeed in mathematics if they put in enough effort performed better (by 32 score points) on the PISA mathematics assessment than those pupils who did not feel such a strong belief in their ability to succeed in mathematics. This link between perceived control of success in mathematics and performance in the PISA mathematics assessment was also found to be the case for the mathematics performance of pupils in England.

Table 3.6 Pupils' perceived control of success in mathematics

Thinking about your mathematics lessons, to what extent do you agree with the following statements?		
	England	OECD average
	agree/strongly agree	
If I put in enough effort I can succeed in mathematics.	96%	92%
Whether or not I do well in mathematics is completely up to me.	82%	83%
If I wanted to, I could do well in mathematics.	87%	83%
	disagree/strongly disagree	
Family demands or other problems prevent me from putting a lot of time into my mathematics work.	71%	73%
If I had different teachers, I would try harder in mathematics.	68%	64%
I do badly in mathematics whether or not I study for my exams.	77%	73%

One question asked pupils to imagine that they had recently been doing badly on mathematics tests, and to say whether they were likely to blame this on any of a series of factors. As reported above, pupils felt a high level of control over their ability to succeed in mathematics and, as shown in Table 3.7, pupils in England were generally less likely to attribute blame for failing to succeed than pupils across the OECD on average. While there was little difference in the proportions agreeing with the statement which placed the blame on themselves, "I'm not very good at solving mathematics problems" (55 per cent in England and 58 per cent for the OECD average), pupils in England were less likely to attribute the failing to external factors such as hard course materials (61 per cent compared with the OECD average of 71 per cent) or bad luck (39 per cent compared with 49 per cent).

Table 3.7 Pupils' self-responsibility for failing in mathematics

Imagine you are a student in the following situation: *Each week, your mathematics teacher gives a short test. Recently you have done badly on these tests. Today you are trying to figure out why.* **How likely are you to have these thoughts or feelings in this situation?**		
	agree/strongly agree	
	England	OECD average
I'm not very good at solving mathematics problems.	55%	58%
My teacher did not explain the concepts well this week.	44%	48%
This week I made bad guesses on the test.	39%	46%
Sometimes the course material is too hard.	61%	71%
The teacher did not get students interested in the material.	44%	53%
Sometimes I am just unlucky.	39%	49%

Pupils reported a high level of conscientiousness towards mathematics-related tasks, with the majority of all pupils saying that they worked hard and sensibly in order to learn mathematics. Pupils in England generally reported a greater level of conscientiousness towards mathematics-related tasks than pupils across the OECD on average. In particular, pupils in England were more likely to report putting effort into their work for mathematics homework and for mathematics tests. As shown in Table 3.8, 72 per cent of pupils in England agreed or strongly agreed that "I work hard on my mathematics homework" compared with 56 per cent for the OECD average, and 71 per cent agreed or strongly agreed that "I study hard for mathematics tests" compared with 52 per cent for the OECD average.

Table 3.8 Pupils' conscientiousness towards mathematics-related tasks

Thinking about the mathematics you do for school, to what extent do you agree with the following statements?		
	agree/strongly agree	
	England	OECD average
I finish my homework in time for mathematics lessons.	78%	68%
I work hard on my mathematics homework.	72%	56%
I am prepared for my mathematics exams.	79%	67%
I study hard for mathematics tests.	71%	52%
I keep studying until I understand mathematics material.	67%	60%
I pay attention in mathematics lessons.	87%	77%
I listen in mathematics lessons.	92%	83%
I avoid distractions when I am studying mathematics.	56%	58%
I keep my mathematics work well organised.	69%	59%

An associated question, relating to perseverance with tasks, showed a slightly less positive picture of pupils' attitudes. As shown in Table 3.9, pupils were asked how well a set of statements (this time not related to mathematics) described themselves. Pupils reported a lower level of commitment to achieving tasks in this question than the previous one (see Table 3.8), though pupils in England reported a greater level of perseverance than the OECD average. The international PISA report (Volume 3, Chapter 3, OECD, 2013) found that in most countries and economies, including England, the association between pupils' perseverance and mathematics performance was relatively strong.

Table 3.9 Pupils' perseverance

How well does each of the following statements describe you?		
	very much or mostly like me	
	England	OECD average
When confronted with a problem, I give up easily.	60%	56%
I put off difficult problems.	44%	37%
I remain interested in the tasks that I start.	52%	49%
I continue working on tasks until everything is perfect.	47%	44%
When confronted with a problem, I do more than what is expected of me.	36%	34%

In addition to investigating pupils' conscientiousness and perseverance, the Student Questionnaire asked pupils about their willingness to tackle problems. This openness to problem solving is considered an important characteristic alongside proficiency in academic subjects. Generally, pupils showed a moderate amount of openness to problem solving, with just over half agreeing or strongly agreeing with four of the five statements, as shown in Table 3.10. The statement, "I like to solve complex problems" was the one with which the lowest proportion of pupils agreed, both in England and on average across the OECD.

The proportions of pupils agreeing or strongly agreeing with statements about their openness to problem solving in England were similar to the OECD averages. The international PISA report (Volume 3, Chapter 3, OECD, 2013) found that, in most countries and economies, there is a strong association between pupils' openness to problem solving (as measured by this group of statements) and mathematics performance and, for England compared with other countries, the association is one of the strongest.

Table 3.10 Pupils' openness to problem solving

How well does each of the following statements describe you?		
	agree/strongly agree	
	England	OECD average
I can handle a lot of information.	52%	53%
I am quick to understand things.	52%	57%
I seek explanations for things.	60%	61%
I can easily link facts together.	57%	57%
I like to solve complex problems.	38%	33%

Pupils' attitudes to mathematics were further explored by questions looking at the influence of friends and parents, self-confidence in tackling mathematics, anxiety about mathematics and mathematics activities done at home and school.

The influence of parents and friends on pupils' attitudes towards mathematics is expected to impact on their behaviour, where positive attitudes and behaviours will be more likely to result from a social environment which promotes mathematics and the study of mathematics. Table 3.11 shows that high proportions of pupils reported that their parents believe in the importance of mathematics and that three out of five pupils believe their parents like mathematics. The proportions of pupils agreeing or strongly agreeing with the statements are generally very similar in England and across the OECD on average.

However, there is an apparent difference between England and the OECD in terms of the proportions of pupils reporting that their friends do well and work hard at mathematics, with 85 per cent of pupils in England saying that most of their friends do well (compared with the OECD average of 60 per cent) and 73 per cent saying that most of their friends work hard at mathematics (the OECD average is 51 per cent). The proportion of pupils reporting that their friends enjoy taking mathematics tests is the same low percentage for England as the OECD average (13 per cent). This may be influenced by the fact that pupils answered this question in the Student Questionnaire just after finishing the PISA assessment.

Table 3.11 Pupils' subjective norms in mathematics

Thinking about how people important to you view mathematics, how strongly do you agree with the following statements?		
	agree/strongly agree	
	England	OECD average
Most of my friends do well in mathematics.	85%	60%
Most of my friends work hard at mathematics.	73%	51%
Most of my friends enjoy taking mathematics tests.	13%	13%
My parents believe it's important for me to study mathematics.	95%	90%
My parents believe that mathematics is important for my career.	85%	80%
My parents like mathematics.	59%	58%

A question asking pupils how confident they felt about having to do specific mathematical tasks was intended to measure pupils' self-efficacy in mathematics. It is believed that pupils who are not confident in their ability are at risk of underperforming if their lack of confidence does not reflect a lack of ability. Generally, pupils showed a high level of confidence in their ability to perform the tasks, as shown in Table 3.12. For five of the tasks, the proportions of pupils in England saying they were confident or very confident were slightly higher than the OECD averages, and for three tasks the proportions were slightly lower.

Table 3.12 Pupils' self-efficacy in mathematics

How confident do you feel about having to do the following mathematics tasks?		
	confident/very confident	
	England	OECD average
Using a train timetable to work out how long it would take to get from one place to another.	88%	81%
Calculating how much cheaper a TV would be after a 30% discount.	85%	80%
Calculating how many square metres of tiles you need to cover a floor.	69%	68%
Understanding graphs presented in newspapers.	84%	80%
Solving an equation like $3x + 5 = 17$.	87%	85%
Finding the actual distance between two places on a map with a 1:10,000 scale.	49%	56%
Solving an equation like $2(x + 3) = (x + 3)(x - 3)$.	70%	73%
Calculating the petrol consumption rate of a car.	51%	56%

In addition to reporting that they were confident in their ability to perform mathematics tasks, pupils also showed generally positive mathematics self-concepts and low anxiety about mathematics. As shown in Table 3.13, pupils in England reported greater belief in their abilities in mathematics than was the case for the OECD on average. In particular, nearly three-quarters (74 per cent) of pupils in England reported that they get good marks in mathematics compared with 59 per cent for the OECD average. A greater proportion also reported that they understand even the most difficult mathematics classwork (49 per cent in England compared with 37 per cent on average in the OECD), and a greater proportion disagreed or strongly disagreed with the statement "I am just not good at mathematics" (68 per cent in England compared with 57 per cent on average for the OECD).

This greater belief in ability is reflected in the level of anxiety reported about mathematics, where pupils in England reported less anxiety about mathematics lessons and tasks than the OECD average. The greatest difference was for the statement "I often worry that it will be difficult for me in mathematics classes", which nearly three-fifths of pupils across the OECD agreed or strongly agreed with, but which fewer than half of pupils in England agreed or strongly agreed with.

Table 3.13 Pupils' self-concept in mathematics alongside pupils' mathematics anxiety

Thinking about studying mathematics, to what extent do you agree with the following statements?		
	agree/strongly agree	
Self-concept in mathematics	England	OECD average
I am just not good at mathematics. *(figures for disagree/strongly disagree)*	68%	57%
I get good marks in mathematics.	74%	59%
I learn mathematics quickly.	59%	52%
I have always believed that mathematics is one of my best subjects.	44%	38%
In my mathematics class, I understand even the most difficult work.	49%	37%
Mathematics anxiety		
I often worry that it will be difficult for me in mathematics classes.	46%	59%
I get very tense when I have to do mathematics homework.	28%	33%
I get very nervous doing mathematics problems.	25%	31%
I feel helpless when doing a mathematics problem.	19%	30%
I worry that I will get poor marks in mathematics.	57%	61%

When asked about mathematics behaviour at school and outside of school, pupils generally reported that they did not perform tasks relating to mathematics very often. The most common behaviour was helping friends with mathematics which a quarter of pupils did often, almost always, or always (26 per cent for England, 25 per cent for the OECD average). As shown in Table 3.14, there was little difference between the proportions of pupils in England and on average across the OECD who reported that they frequently did mathematics-related tasks outside of lessons.

Table 3.14 Pupils' mathematics behaviours

How often do you do the following at school and outside of school?		
	often, almost always or always	
	England	OECD average
I talk about mathematics problems with my friends.	14%	18%
I help my friends with mathematics.	26%	25%
I do mathematics as an extra-curricular activity.	12%	15%
I take part in mathematics competitions.	4%	7%
I do mathematics more than 2 hours a day outside of school.	8%	9%
I play chess.	8%	12%
I program computers.	12%	15%
I participate in a mathematics club.	5%	4%

3.4 Pupils' experience of learning mathematics

In the Student Questionnaire, pupils were asked about how supportive their mathematics teachers were in lessons. Table 3.15 shows that a large proportion of pupils said that teachers were supportive in most or all lessons. For most of the statements the proportions of pupils in England were greater than the OECD average. The largest difference was for the statement "The teacher helps students with their learning", which nine out of ten pupils in England said happened in most or all lessons, compared with around seven out of ten across the OECD on average. The lowest proportion in England was for "The teacher gives students an opportunity to express opinions" which two-thirds of pupils said happened in most or all lessons (matching the OECD average).

Table 3.15 Teacher support in mathematics classes

How often do these things happen in your mathematics lessons?		
	most/all lessons	
	England	OECD average
The teacher shows an interest in every student's learning.	76%	63%
The teacher gives extra help when students need it.	85%	72%
The teacher helps students with their learning.	90%	72%
The teacher continues teaching until the students understand.	79%	66%
The teacher gives students an opportunity to express opinions.	66%	66%

Pupils were also asked how often teachers ask pupils to tackle mathematics problems in their lessons. Responses are reported in Table 3.16. These statements have been described as reflecting different types of 'cognitive activation' which pupils are asked to use. For all of the approaches mentioned in the question, greater proportions of pupils in England, compared with the OECD average, reported that they occurred often, almost always, or always in their mathematics lessons. The largest difference was for the statement, "The teacher gives us problems that require us to think for an extended time", which 72 per cent of pupils in England said happened frequently, compared with 52 per cent of pupils across the OECD on average. A similar difference was seen for the statement, "The teacher helps us to learn from mistakes we have made", reported as a frequent occurrence by 78 per cent of pupils in England (and 59 per cent across the OECD on average). The statement which the lowest proportion of pupils in England said was a common practice was "The teacher asks us to decide on our own procedures for solving complex problems" which less than half of pupils (46 per cent) said happened often, almost always, or always (the OECD average was 41 per cent).

Table 3.16 Cognitive activation in mathematics lessons

Thinking about the mathematics teacher who taught your last mathematics lesson, how often does he or she do each of the following?		
	often, almost always or always	
	England	OECD average
The teacher asks questions that make us reflect on the problem.	69%	59%
The teacher gives us problems that require us to think for an extended time.	72%	52%
The teacher asks us to decide on our own procedures for solving complex problems.	46%	41%
The teacher presents problems which have no immediately obvious method for finding the answer.	59%	46%
The teacher presents problems in different contexts so that students know whether they have understood the concepts.	67%	58%
The teacher helps us to learn from mistakes we have made.	78%	59%
The teacher asks us to explain how we have solved a problem.	83%	69%
The teacher presents problems that require students to apply what they have learned to new contexts.	73%	61%
The teacher gives us problems that can be solved in several different ways.	66%	59%

A similar question asked pupils about the instructional strategies used by their mathematics teachers. These strategies represent the three categories of ‘structuring’, ‘student orientation’ and ‘enhanced activities’. As shown in Table 3.17, there are considerable differences between the proportions of pupils reporting that the various strategies are used in most or all lessons, something which might be expected due to the nature of the work appropriate to each strategy. For instance, 87 per cent of pupils in England reported that “The teacher tells us what we have to learn” in most or all lessons; this is something that would be expected to feature in most lessons, unlike pupils helping to plan classroom activities or topics (reported by eight per cent of pupils), which might be expected to happen infrequently.

Comparing the findings for England with the OECD average, the majority of instructional strategies are reported as more common in England than across the OECD. In particular, three statements relating to feedback on performance in mathematics were reported as more common in England than on average across the OECD. These were (with percentages in England and the OECD average, respectively): “The teacher tells me what I need to do to become better in mathematics” (60 per cent, 46 per cent); “The teacher gives me feedback on my strengths and weaknesses in mathematics” (39 per cent, 26 per cent); and “The teacher tells me about how well I am doing in my mathematics class” (43 per cent, 31 per cent). As noted above, the lowest proportion for England was for the statement “The teacher asks us to help plan classroom activities or topics”, which only eight per cent of pupils said happened in most or all lessons. This statement showed the biggest negative difference with the OECD average, which was eight percentage points higher

at 17 per cent (when the difference is calculated using figures which have not been rounded to the nearest whole percentage point).

Table 3.17 Teaching practices in mathematics: instructional strategies

How often do these things happen in your mathematics lessons?		
	most or all lessons	
	England	OECD average
The teacher sets clear goals for our learning.	77%	68%
The teacher asks me or my classmates to present our thinking or reasoning at some length.	57%	55%
The teacher gives different work to classmates who have difficulties learning and/or to those who can advance faster.	35%	29%
The teacher sets projects that require at least one week to complete.	21%	16%
The teacher tells me about how well I am doing in my mathematics class.	43%	31%
The teacher asks questions to check whether we have understood what was taught.	80%	70%
The teacher puts us in small groups to come up with joint solutions to a problem or task.	21%	22%
At the beginning of a lesson, the teacher presents a short summary of the previous lesson.	38%	40%
The teacher asks us to help plan classroom activities or topics.	8%	17%
The teacher gives me feedback on my strengths and weaknesses in mathematics.	39%	26%
The teacher tells us what is expected of us when we get a test or assignment.	70%	60%
The teacher tells us what we have to learn.	87%	79%
The teacher tells me what I need to do to become better in mathematics.	60%	46%

3.5 Summary

Pupils in England reported a high sense of belonging and satisfaction with school and an understanding that it is useful, showing a similar level of satisfaction as pupils across the OECD on average. Pupils in England showed a slightly higher level of interest and enjoyment in learning mathematics than the OECD average. For both groups, the motivation to learn mathematics was less to do with enjoyment and more to do with regarding mathematics as a useful activity. Pupils in England also reported feeling high levels of control over their ability to succeed in mathematics.

Pupils reported a high level of conscientiousness towards mathematics-related tasks, with a majority of pupils in England saying that they worked hard and sensibly in order to learn mathematics. This was to a greater degree than the OECD average.

Similarly to the OECD average, pupils in England reported that their parents believe in the importance of mathematics, possibly reflecting home environments which encourage the study of mathematics. Generally, pupils in England showed a high level of confidence in their ability to perform mathematical tasks, and low levels of anxiety about learning mathematics.

Compared with the OECD average, more pupils in England reported that their teachers asked them to approach mathematics learning in a wide variety of ways. Pupils in England were also more likely to report that their mathematics teachers were helpful and supportive.

In England, socio-economic background had a relatively high connection with mathematics scores compared with OECD countries. In England the variance in mathematics scores that can be explained by socio-economic background was below the OECD average. This means that, compared with the OECD average, pupils in England are more likely to be able to overcome the predicted effects of socio-economic background.

4 Science

Chapter outline

This chapter explores attainment in science. It draws on findings outlined in the international report (OECD, 2013) and places outcomes for England in the context of those findings.

Key findings

- England, while not among the highest achieving group of countries internationally, compares well with other EU and OECD countries in terms of science achievement. England performed significantly above the OECD average.
- The achievement of pupils in England has remained stable since 2006 and there has been very little movement in the group of countries that outperform England or that are not significantly different. Poland has shown particularly strong improvement and moved to significantly outperform England. Vietnam has also entered PISA in 2012 as a strong performer and outperformed England.
- England had a relatively large difference between the score points of the lowest scoring pupils and the highest scoring pupils compared with other countries – only eight countries had a wider distribution. Compared with other high achieving countries, England tends to have a greater proportion of lower achievers and, consequently, raising the attainment of these lower achievers would be an important step towards improving England's performance.

4.1 Comparison countries

As with mathematics, the comparator countries reported here include OECD countries, EU countries and other countries with relatively high scores. Since countries with very low scores are not so relevant for comparison purposes, those with a mean score for science of less than 430 (14 countries) have been omitted from tables unless they are in the OECD or EU. This results in a comparison group of 50 countries, as shown in Table 4.1.

Table 4.1 Countries compared with England

Australia	France*	Luxembourg*	*Singapore*
Austria*	Germany*	*Macao-China*	Slovak Republic*
Belgium*	Greece*	Mexico	Slovenia*
*Bulgaria**	*Hong Kong-China*	Netherlands*	Spain*
Canada	Hungary*	New Zealand	Sweden*
Chile	Iceland	Norway	Switzerland
Chinese Taipei	Israel	Poland*	*Thailand*
*Croatia**	Italy*	Portugal*	Turkey
*Cyprus**	Japan	Republic of Ireland*	*United Arab Emirates*
Czech Republic*	Korea	*Romania**	United States
Denmark*	*Latvia**	*Russian Federation*	*Vietnam*
Estonia*	*Liechtenstein*	*Serbia*	
Finland*	*Lithuania**	*Shanghai-China*	

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

In addition to the countries listed above, tables and figures in Appendix C include the data for all four constituent parts of the United Kingdom.

Outcomes for the United Kingdom as a whole are presented in the international report (OECD, 2013) and in the appendices that accompany this chapter (Appendix C). Outcomes for England (and the other three constituent parts of the UK) are derived from the 'sub-national' level analysis carried out by the international consortium, as well as from additional analysis carried out by NFER using the international dataset. Comparisons between the four constituent parts of the UK are provided in Chapter 7.

Interpreting differences between countries

As for mathematics, it is important to know what can reasonably be concluded from the PISA data and which interpretations would be going beyond what can be reliably supported by the results. This section outlines some points that need to be kept in mind while reading this chapter.

Sources of uncertainty

There are two sources of uncertainty which have to be taken into account in the statistical analysis and interpretation of any test results. These are described as *sampling error* and *measurement error*. The use of the term 'error' does not imply that a mistake has been made; it simply highlights the necessary uncertainty.

Sampling error stems from the inherent variation of human populations which can never be summarised with absolute accuracy. It affects virtually all research and data collection that makes use of sampling. Only if every 15-year-old in each participating country had taken part in PISA could it be stated with certainty that the results are totally representative of the attainment of the entire population of pupils in those countries. In reality the data was collected from a sample of 15-year-olds. Therefore, the results are a best estimation of how the total population of 15-year-olds could be expected to perform in these tests. There are statistical methods to measure how good the estimation is. It is important to recognise that all data on human performance or attitudes which is based on a sample carries a margin of error.

Measurement error relates to the results obtained by each individual pupil, and takes account of variations in their score which are not directly due to underlying ability in the subject but which are influenced by other factors related to individuals or to the nature of the tests or testing conditions, such as sickness on the day of testing.

Interpreting rank order

Because of the areas of uncertainty described above, interpretations of very small differences between two sets of results are often meaningless. Were they to be measured again it could well be that the results would turn out the other way round. For this reason, this chapter focuses mainly on *statistically significant* differences between mean scores rather than the simple rank order of countries. Statistically significant differences are unlikely to have been caused by random

fluctuations due to sampling or measurement error.

Where statistically significant differences between countries are found, these may be the result of a great number of factors. The data for some of these factors were not collected in the PISA survey. Therefore, the PISA survey is only able to explain the reasons for differences between countries to a limited extent. For example, differences in school systems and educational experiences in different countries could play a part, but so could a wide range of different out-of-school experiences. It is important to bear this in mind while reading this report.

4.2 Scores in England

Pupils in England achieved a mean score of 516 for science, significantly higher than the OECD average of 501.

Internationally, ten countries performed at a level significantly higher than England. In 11 countries, science attainment was not significantly different from that of England, while the remaining 43 out of a total of 64 countries performed significantly less well. Table 4.2 below shows the countries which significantly outperformed England. Table 4.3 shows the countries whose performance was not significantly different from that of England, while Table 4.4 shows the comparison countries which were significantly lower. (See the box above on interpreting differences between countries for an explanation of how statistical significance should be interpreted in this report.)

Of the ten countries with mean scores significantly above England, only three are EU members (Finland, Estonia and Poland). Poland's mean score for science has significantly increased from 508 in PISA 2009 to 526 in PISA 2012, so that it has moved from being not significantly different from England to significantly outperforming England. Five EU countries did not perform significantly differently from England and 18 performed less well. Similarly, among OECD countries, only Japan, Finland, Estonia, Korea, Poland and Canada outperformed England, whilst eight OECD countries performed similarly and 19 performed less well. This indicates that England, while not among the highest achieving group of countries internationally, compares well with other EU and OECD countries in terms of science achievement.

England performs well compared with other English speaking countries. Only Canada (with a significant number of English speakers) performed significantly better, whilst the Republic of Ireland, Australia and New Zealand performed similarly. The United States performed significantly below England. Two other countries (Hong Kong-China and Singapore) have strong historical links with the education system of the UK, and English is the medium of instruction in Singapore. Both performed significantly better than England.

England's mean score in science and the OECD average score have both remained stable since 2006. England's mean score for science has varied by only one score point (between 515 and 516), as has the OECD average (varying between 500 and 501). The number of countries with mean scores significantly above England increased from seven to ten between the 2006 and 2009 cycles, but has remained at ten in PISA 2012. This is partly due to the participation of Shanghai-

China and Singapore, high performing countries that did not participate in PISA 2006, but did in 2009, and the participation of Vietnam in PISA 2012. These countries have all joined PISA with scores significantly higher than England's. In addition, Poland has shown strong improvement and moved to significantly outperform England, as it has also done in mathematics. Tables 4.2 to 4.4 show which countries have shown a significant change in performance since 2009. There has been very little movement in the group of countries that outperform England or that are not significantly different, emphasising the stability of the results in science since 2009.

More information can be found in Appendix C1, which summarises significant differences in attainment between England and the comparison group countries, while Appendix C2 gives mean scores with standard errors for these countries. Appendix C6 shows how the performance of participating countries has changed since 2006.

Table 4.2 Countries outperforming England in science (significant differences)

Country	Mean score	Country	Mean score
Shanghai-China	580	Estonia*	541 ∧
Hong Kong-China	555	Korea	538
Singapore	551 ∧	*Vietnam*	528
Japan	547	Poland*	526 ∧
Finland*	545 ∨	Canada	525

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries ∧∨ Indicates a significant change since PISA 2009

Table 4.3 Countries not significantly different from England in science

Country	Mean score	Country	Mean score
Liechtenstein	525	*Macao-China*	521 ∧
Germany*	524	**England**	**516**
Chinese Taipei	523	New Zealand	516 ∨
Netherlands*	522	Switzerland	515
Republic of Ireland*	522 ∧	Slovenia*	514
Australia	521	Czech Republic*	508

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries ∧∨ Indicates a significant change since PISA 2009

Table 4.4 Countries significantly below England in science

Country	Mean score	Country	Mean score
Austria*	506	Sweden*	485 ∨
Belgium*	505	Iceland	478 ∨
*Latvia**	502	Slovak Republic*	471 ∨
France*	499	Israel	470 ∧
Denmark*	498	Greece*	467
United States	497	Turkey	463
Spain*	496 ∧	*United Arab Emirates*	448
*Lithuania**	496	*Bulgaria**	446
Norway	495	Chile	445
Hungary*	494	*Serbia*	445
Italy*	494	*Thailand*	444 ∧
*Croatia**	491	*Romania**	439 ∧
Luxembourg*	491 ∧	*Cyprus**	438
Portugal*	489	Mexico	415
Russian Federation	486	*plus 14 other countries*	

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries ∧∨ Indicates a significant change since PISA 2009

4.3 Differences between highest and lowest attainers

It is important for teaching and learning purposes to know the spread of attainment between the highest and lowest scoring pupils. Countries with similar mean scores may have differences in the numbers of high or low attainers. A country with a wide spread of attainment may have a long tail of underachievement as well as pupils who are achieving at the highest levels. A country with a lower spread may have fewer very high achievers but may also have fewer underachievers, indicating greater social equality.

The first way in which the spread of performance in each country can be examined is by looking at the distribution of scores. Appendix C2 shows the average science score of pupils at each percentile and the size of the difference between the highest and lowest attainers (at the 5th and 95th percentiles) in each country. The 5th percentile is the score at which five per cent of pupils score lower, while the 95th percentile is the score at which five per cent score higher. This is a better measure for comparing countries than using the lowest and highest attaining pupils, as such a comparison may be affected by a small number of pupils in a country with unusually high or low scores.

The score of pupils in England at the 5th percentile was 343 while the score of those at the 95th percentile was 674, a difference of 331 score points. This range was larger than the OECD average difference of 304 score points and only eight countries had a wider distribution than England. Seven of these countries were comparison group countries; these were the OECD countries Israel, New Zealand, Luxembourg, Slovak Republic and Belgium, and also Singapore and Bulgaria from the non-OECD comparison countries.

The difference between scores in science at the 5th and the 95th percentile has narrowed slightly for the OECD average from 311 score points in 2006 to 304 in 2012. This is due to a slight increase in score at the 5th percentile and a slight decrease in score at the 95th percentile. The difference in scores between the 5th and 95th percentile is fairly similar in England for PISA 2012 and PISA 2009 – 331 score points in 2012 compared with 325 in 2009, and the scores at the 5th and 95th percentiles have also changed very little. These changes have not been tested for significance.

The second way of examining the spread of attainment is by looking at England's performance at each of the PISA proficiency levels. The PISA proficiency levels are devised by the PISA Consortium and are not linked to National Curriculum levels in England. PISA science attainment is described in terms of six levels of achievement. (See Appendix C3 for a full description of typical performance at each of these six levels.) In all participating countries there were some pupils at or below the lowest level of achievement (Level 1), while in most countries at least some pupils achieved the highest level (Level 6). See Appendices C4 and C5 for details.

In England, 4.3 per cent of pupils scored below PISA Level 1 in science. This was similar to the OECD average of 4.8 per cent. At Level 1 or below, the OECD average was 17.8 per cent compared with 14.9 per cent in England. The proportion of pupils at the highest level in England is 1.9 per cent, compared with an OECD average of 1.2 per cent. When the top two levels are combined (Level 5 and Level 6), a percentage of 11.8 for England is above the OECD average of 8.4 per cent. England therefore has a greater number of high achievers and fewer low achievers than the OECD average. There are only six countries with a larger percentage of pupils at Level 6 than England. These are: Singapore, Shanghai-China, Japan, Finland, New Zealand and Australia.

Although the numbers scoring at each level compare well with the OECD average, England's distribution of scores needs to be considered alongside the score distributions for those countries significantly outperforming or not significantly different from England in their science achievement. All countries that significantly outperformed England or were not significantly different from England in their science achievement have a smaller proportion of pupils at Level 1 or below, except for New Zealand. That is, England has a relatively large number of underachievers when compared with the highest scoring countries.

The OECD average proportions of pupils performing at each of the proficiency levels in science are very similar for PISA 2006, 2009 and 2012. In England, the proportion of low achieving pupils (at Level 1 or below) decreased slightly from 16.7 per cent in 2006 to 14.8 in 2009, and has remained stable at 14.9 in 2012. The proportion of pupils at Level 5 or above is virtually unchanged since 2009. In 2012 it was 11.8 compared with 11.6 per cent in 2009.

To summarise, compared with other high achieving countries, England tends to have a greater proportion of lower achievers who perform similarly to the OECD average. England has a greater number of high achievers compared with the OECD average, and the proportion of pupils in England performing at the higher levels in science is similar to many high performing countries. Consequently, raising the attainment of lower achievers would be an important step towards improving England's performance and narrowing the gap between highest and lowest performers.

4.4 Differences between boys and girls

Of the 64 other countries participating in PISA 2012, 27 had a statistically significant difference in gender performance on the science scale; 17 favouring girls and ten favouring boys. The OECD average shows a statistically significant gender difference in performance which favours boys by one score point. In England, boys performed significantly better than girls by an average of 14 score points. Almost all countries that either outperformed England or were not significantly different did not have a significant gender difference. There were four exceptions and these were: Finland (16 point difference in favour of girls), Slovenia (nine point difference in favour of girls), Japan (11 point difference in favour of boys) and Switzerland (six point difference in favour of boys). In England, there have been some differences since PISA 2006 in the statistical significance of gender differences. In PISA 2006 boys scored significantly higher than girls, although the difference was not large – only 11 score points. In PISA 2009 boys scored ten points higher than girls but this difference did not reach statistical significance.

The range of science subjects on offer at GCSE makes a direct comparison of gender differences between the PISA 2012 scores and GCSE performance far from straightforward. Pupils are able to take science, additional science or the separate sciences of biology, chemistry and physics at GCSE. The provisional results for England for GCSE science from June 2013 show that, on the whole, boys and girls perform similarly, with girls tending to slightly outperform boys (www.jcq.org.uk). Additionally, in the 2011 Trends in Maths and Science Survey (TIMSS), no gender difference was found for pupils assessed in science, either in Year 5 or Year 9 (Sturman *et al.*, 2012).

4.5 Summary

This section summarises England's performance in science and compares the science achievement of pupils in England in PISA 2012 with their achievement in science in PISA 2009 and PISA 2006. In 2006, science was the main subject so there were more science questions than in PISA 2009 and 2012. The questions used for PISA 2012 and PISA 2009 are identical and are the 'link items'. They were used in PISA 2006 and some were also used in previous cycles of PISA.

England's performance in science in PISA 2012 was significantly above the OECD average and only ten countries significantly outperformed England. England also performed well compared to other EU and OECD countries. There was a relatively large difference between the score points of the lowest scoring pupils and the highest scoring pupils compared with other countries – only eight countries had a wider distribution. However, the proportion of pupils at each level of achievement shows that England tends to have a greater proportion of high achievers and a lower proportion of

low achievers than the OECD average. That said, compared with other high achieving countries, England tends to have a greater proportion of lower achievers and, consequently, raising the attainment of these lower achievers would be an important step towards improving England's performance.

There was no clear pattern of performance by gender across participating countries. In England, there was a significant gender difference of 14 points in favour of boys.

For science, pupil performance in England has been very stable since PISA 2006, only varying by one score point in the three cycles. The number of countries that significantly outperform England has also remained constant since 2009, although there have been some changes in those countries which make up the highest achieving group. In England, the proportion of pupils at each proficiency level in science is similar in PISA 2012 to 2009, as is the spread of attainment when scores at the 5th and 95th percentile are considered.

5 Reading

Chapter outline

This chapter explores attainment in reading. It draws on findings outlined in the international report (OECD, 2013) and places outcomes for England in the context of those findings.

Key findings

- England's performance in reading in PISA 2012, as in 2009 and 2006, was not significantly different from the OECD average. England's spread of pupils at each reading level was broadly similar to that across the OECD generally.
- The number of countries outperforming England in reading in PISA 2012 increased to 17, compared with 12 in 2009 and seven in 2006.
- England had a relatively large gap between the lowest and the highest scoring pupils in reading compared with many other countries. This difference has increased by 12 score points since 2009 but is still 13 points less than in 2006.
- The proportion of pupils at both the highest and lowest levels has increased slightly, with high achieving pupils scoring higher and low achieving pupils scoring lower than in 2009.
- Six countries that performed similarly to England, or less well, in 2009 are now significantly outperforming England in reading.
- High performing countries have lower proportions of pupils working at the lower levels. They also have higher proportions working at the higher levels of reading than in England.
- Girls scored significantly higher than boys in all countries, although in England the gender difference, while statistically significant, was not as large as in the majority of other countries.
- Overall, attainment in reading shows very slight changes in England between PISA 2009 and PISA 2012. The spread of achievement has widened again slightly and the percentage of low achieving pupils has increased – but neither of these is as high as in 2006. Compared with 2009, in 2012 England had a higher percentage of high achieving pupils and their mean scores were also higher, similar to those in 2006.

5.1 Comparison countries

While findings for all countries are reported in this chapter where relevant, most findings relate to a sub-group of countries. As with mathematics and science, the comparator countries reported here include OECD countries, EU countries and other countries with relatively high scores. Since countries with very low scores are not so relevant for comparison purposes, those with a mean score for reading of less than 430 have been omitted from tables unless they are in the OECD or the EU. As a result, the comparison group in this chapter for reading comprises 51 countries (of which 26 are EU members and 33 OECD members), as shown in Table 5.1.

Table 5.1 Countries compared with England

Australia	Finland*	*Lithuania**	*Shanghai-China*
Austria*	France*	Luxembourg*	*Singapore*
Belgium*	Germany*	*Macao-China*	Slovak Republic*
*Bulgaria**	Greece*	Mexico	Slovenia*
Canada	*Hong Kong-China*	Netherlands*	Spain*
Chile	Hungary*	New Zealand	Sweden*
Chinese Taipei	Iceland	Norway	Switzerland
Costa Rica	Israel	Poland*	*Thailand*
*Croatia**	Italy*	Portugal*	Turkey
*Cyprus**	Japan	Republic of Ireland*	*United Arab Emirates*
Czech Republic*	Korea	*Romania**	United States
Denmark*	*Latvia**	*Russian Federation*	*Vietnam*
Estonia*	*Liechtenstein*	*Serbia*	

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

In addition to the countries listed above, tables and figures in Appendix D include the data for all four constituent parts of the United Kingdom.

Outcomes for the United Kingdom as a whole are presented in the international report (OECD, 2013) and in the appendices that accompany this chapter (Appendix D). Outcomes for England (and the other three constituent parts of the UK) are derived from the 'sub-national' level analysis carried out by the international consortium, as well as from additional analysis carried out by NFER using the international dataset. Comparisons between the four constituent parts of the UK are provided in Chapter 7.

Interpreting differences between countries

As for mathematics and science, it is important to know what can reasonably be concluded from the PISA data and which interpretations would be going beyond what can be reliably supported by the results. This section outlines some points that need to be kept in mind while reading this chapter.

Sources of uncertainty

There are two sources of uncertainty which have to be taken into account in the statistical analysis and interpretation of any test results. These are described as *sampling error* and *measurement error*. The use of the term 'error' does not imply that a mistake has been made; it simply highlights the necessary uncertainty.

Sampling error stems from the inherent variation of human populations which can never be summarised with absolute accuracy. It affects virtually all research and data collection that makes use of sampling. Only if every 15-year-old in each participating country had taken part in PISA could it be stated with certainty that the results are totally representative of the attainment of the entire population of pupils in those countries. In reality the data was collected from a sample of 15-

year-olds. Therefore, the results are a best estimation of how the total population of 15-year-olds could be expected to perform in these tests. There are statistical methods to measure how good the estimation is. It is important to recognise that all data on human performance or attitudes which is based on a sample carries a margin of error.

Measurement error relates to the results obtained by each individual pupil, and takes account of variations in their score which are not directly due to underlying ability in the subject but which are influenced by other factors related to individuals or to the nature of the tests or testing conditions, such as sickness on the day of testing.

Interpreting rank order

Because of the areas of uncertainty described above, interpretations of very small differences between two sets of results are often meaningless. Were they to be measured again it could well be that the results would turn out the other way round. For this reason, this chapter focuses mainly on *statistically significant* differences between mean scores rather than the simple rank order of countries. Statistically significant differences are unlikely to have been caused by random fluctuations due to sampling or measurement error.

Where statistically significant differences between countries are found, these may be the result of a great number of factors. The data for some of these factors were not collected in the PISA survey. Therefore, the PISA survey is only able to explain the reasons for differences between countries to a limited extent. For example, differences in school systems and educational experiences in different countries could play a part, but so could a wide range of different out-of-school experiences. It is important to bear this in mind while reading this report.

5.2 Scores in England

England's pupils achieved a mean score of 500 in reading, which was not significantly different from the OECD average of 496. The results for reading in 2012 were not significantly different from those in PISA 2009, when the mean for England was 495 and was not significantly different from the OECD average of 493.

Internationally, the performance in reading in 17 of the other 64 participating countries was at a significantly higher level than in England (see Table 5.2). Eight countries performed at a level that was not significantly different from that of England, while the remaining 39 countries performed significantly less well. Tables 5.3 and 5.4 show the comparison group countries which performed similarly to England, and those whose performance was lower than England's. (See the box above in section 5.1 on interpreting differences between countries for an explanation of how statistical significance should be interpreted in this report.)

Of the 17 countries with mean scores in reading that are significantly higher than in England, three are English speaking (Republic of Ireland, New Zealand and Australia) and one has a substantial number of English speakers (Canada). Two other countries (Hong Kong-China and Singapore) have strong historical links with the education system of the UK, and English is the medium of

instruction in Singapore. The mean score of the United States, the only remaining English speaking country, was not significantly different from England's.

Six of the countries that significantly outperformed England are EU members (Finland, Republic of Ireland, Poland, Estonia, Netherlands and Belgium). Four EU countries did not perform significantly differently from England and 16 performed less well. Among OECD countries, 11 outperformed England, seven performed similarly and 15 performed less well. This indicates that in terms of reading achievement, England, while not among the highest achieving group of countries internationally, compares well with other EU and OECD countries.

In 2012, five countries that were performing at a similar level to England in 2009 are now significantly outperforming England in reading; these are the Republic of Ireland, Chinese Taipei, Poland, Estonia and Liechtenstein – all five countries have significantly improved their performance since 2009. One country (Macao-China) that scored significantly lower than England in 2009 scored significantly better than England in 2012. All of these countries have shown a greater decrease in the proportion of pupils below Level 2, and a much greater increase in the proportion of pupils at Level 5 or above than in England. These differences were significant for all but Liechtenstein. Accordingly, the mean scores for reading in these countries increased by between 15 (Estonia) and 28 score points (Republic of Ireland and Chinese Taipei), compared with England's increase of five score points.

Only one country which performed better than England in PISA 2009 is now no longer significantly different (Norway).

Appendix D1 (significant differences between England and the comparison group countries) and Appendix D2 (mean scores and standard errors for England and the comparison group countries) provide further data.

Table 5.2 Countries outperforming England in reading (significant differences)

Country	Mean score		Country	Mean score	
Shanghai-China	570	∧	Poland*	518	∧
Hong Kong-China	545	∧	Estonia*	516	∧
Singapore	542	∧	*Liechtenstein*	516	∧
Japan	538	∧	New Zealand	512	∨
Korea	536		Australia	512	
Finland*	524	∨	Netherlands*	511	
Republic of Ireland*	523	∧	Belgium*	509	
Canada	523		*Macao-China*	509	∧
Chinese Taipei	523	∧			

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
∧ ∨ Indicates a significant change since PISA 2009

Table 5.3 Countries not significantly different from England

Country	Mean score		Country	Mean score	
Switzerland	509	∧	**England***	**500**	
Vietnam	508		United States	498	
Germany*	508	∧	Denmark*	496	
France*	505	∧	Czech Republic*	493	∧
Norway	504				

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
∧ ∨ Indicates a significant change since PISA 2009

Table 5.4 Countries significantly below England

Country	Mean score		Country	Mean score	
Italy*	490		Greece*	477	
Austria*	490		Turkey	475	∧
*Latvia**	489		*Russian Federation*	475	∧
Hungary*	488		Slovak Republic*	463	∨
Spain*	488	∧	*Cyprus**	449	
Luxembourg*	488	∧	*Serbia*	446	
Portugal*	488		*United Arab Emirates*	442	
Israel	486		Chile	441	
*Croatia**	485		*Thailand*	441	∧
Sweden*	483	∨	*Costa Rica*	441	
Iceland	483	∨	*Romania**	438	∧
Slovenia*	481		*Bulgaria**	436	
*Lithuania**	477	∧	Mexico	424	
			plus 13 other countries		

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
∧ ∨ Indicates a significant change since PISA 2009

5.3 Differences between highest and lowest attainers

It is important for teaching and learning purposes to know the spread of attainment between the highest and lowest scoring pupils in reading. Countries with similar mean scores may nevertheless have differences in the numbers of high or low attainers. A country with a wide spread of attainment may have large numbers of pupils who are underachieving as well as pupils performing at the highest levels. A country with a lower spread of attainment may have fewer very high achievers but may also have fewer underachievers.

The first way in which the spread of performance in each country can be examined is by looking at the distribution of scores. Appendix D2 shows the average reading score of pupils at different percentiles and the size of the difference between the highest and lowest attainers (at the 5th and 95th percentiles) in each country. The 5th percentile is the score at which five per cent of pupils score lower, while the 95th percentile is the score at which five per cent score higher. This is a better measure for comparing countries than using the lowest and highest scoring pupils, as such

a comparison may be affected by a small number of pupils in a country with unusually high or low scores.

The score of pupils in England at the 5th percentile was 328, while the score of those at the 95th percentile was 652, a difference of 324 score points. This range was larger than the OECD average difference of 310 score points. Over two-thirds of the OECD countries had a smaller difference between the highest and lowest percentiles than England.

There has been some change in the distribution of reading scores between PISA 2006, 2009 and 2012. While higher achievers have improved, the performance of lower achieving pupils has declined slightly and the gap between them has widened (although it is still narrower than in 2006).

In PISA 2012, the score of high achievers (the 95th percentile) increased by six score points to 652. However, the score of low achievers at the 5th percentile has decreased by six score points since 2009, to 328. Since 2009, therefore, the attainment gap between the highest and lowest achievers has increased by 12 score points to 324. This is greater than in 2009 (312) but less than in 2006 (337).

However, as in 2006 and 2009, there are still only a minority of countries (13) with a wider spread of overall attainment than England.

Of those countries that outperformed England, all had a lower spread of scores except Japan and Singapore, who had a similar spread (325 and 329 score points respectively) and Belgium (339) and New Zealand (347), who had a wider spread. All other high performing countries had a narrower spread of scores than England. Shanghai-China had the lowest spread of scores (259), followed by Estonia (263).

The highest scoring countries at the 95th percentile were Singapore (698), Shanghai-China (690) and Japan (689), compared with 652 for England. Of the countries that outperformed England overall, only four (the Netherlands, Liechtenstein, Estonia and Macao-China) had a lower score among their highest achievers. At the 5th percentile, only Belgium had a lower score among the countries that scored significantly better than England overall.

Of the countries that performed similarly to England, France and England had the lowest scores at the 5th percentile (312 and 328), while Vietnam had the highest mean score (379). At the 95th percentile, France had the highest mean score (669), followed by Norway (658) and England (652). Among this group of countries, Vietnam had the lowest score (623) at the 95th percentile.

The second way of examining the spread of attainment is by looking at performance on each of the PISA proficiency levels. For reading there are seven levels, which include the sub-levels 1a and 1b and below 1b. These reading levels are outlined in Appendix D3.

In all participating countries there were some pupils at or below Level 1, while in most countries (including all the comparison countries) at least some pupils achieved the highest level (Level 6). See Appendices D4 and D5 for details of the proportions at each level in all comparison countries.

England had a slightly lower proportion of low achievers (at or below Level 1) and a slightly higher proportion of high achievers compared with scores across the OECD in general.

The proportion of pupils in England performing at Level 1 or below in reading was 16.7 per cent, whereas across the OECD on average it was 18.0 per cent of pupils. This compares with percentages of 18.4 and 18.8 for England and the OECD respectively in 2009. Of the 17 countries that outperformed England in 2012 in reading, 12 had a lower proportion of pupils working at these levels and in Shanghai-China the figure was only 2.9 per cent.

In England, 1.6 per cent of pupils scored at the lowest PISA reading level (below Level 1b), similar to the OECD average of 1.3 per cent. However, of the 17 countries that outperformed England in reading, only Belgium had a similar proportion of pupils below Level 1b. All the other high performing countries had fewer pupils working at this lowest level and thirteen of these had less than 0.5 per cent (see Appendices D4 and D5).

When the top two levels are combined (Levels 5 and 6), 9.1 per cent of pupils in England achieved these levels in reading, compared with an OECD average of 8.4 per cent. At the highest level (Level 6) the OECD average was 1.1 per cent, compared with 1.3 per cent in England.

Eighteen of the comparison countries had a higher proportion of pupils than England at Level 5 or above. These included all of the countries that outperformed England in reading in PISA 2012 (see Table 5.2), except Estonia and Macao-China. France and Norway also had a greater proportion of high achievers, although their overall scores were not significantly different from England's. Two high performing countries (Shanghai-China and Singapore) had the greatest proportions of high achievers with 25.1.and 21.2 per cent (respectively) of pupils at Level 5 and above. All 26 comparison countries with significantly lower scores than England also had a higher proportion of pupils at Level 1 or below.

Compared with 2009, the proportions of pupils at each of the PISA reading levels in 2012 were similar, although there was an increase of 1.5 per cent in the proportion of pupils at the higher levels (Levels 5 and 6), and a slight increase of 0.5 per cent at the very lowest level (below Level 1b). The attainment gap in reading has widened, having closed between 2006 and 2009, and the scores of the highest achieving pupils have increased while the scores of the lowest achieving pupils have decreased.

5.4 Differences between boys and girls

Of the 64 other countries participating in PISA 2012, all had a statistically significant difference in gender performance on the reading scale, favouring girls (see Appendix D2).

In England, the mean score for boys was 487 and for girls was 512. This difference of 24 score points between girls and boys compares to an OECD average of 38 score points. England's was one of the lowest score point differences among the comparison countries, with only Korea and Chile having a smaller difference than England. Among OECD countries, Finland had the largest difference (with girls outperforming boys by 62 score points), and among the non-OECD comparison countries the largest difference was a 70 point difference in Bulgaria.

A higher proportion of boys scored at the lower levels and a higher proportion of girls at the higher levels, reflecting the overall mean scores. The higher attainment of girls in reading is a common pattern seen in National Curriculum tests in England, and is also found in other international surveys such as the Progress in International Reading and Literacy Study (PIRLS). In recent years, there have been a number of measures taken within schools in England to improve the reading attainment of boys. It is therefore encouraging that the difference between boys and girls in reading, although significant, is less than that in many other countries.

In 2009 and 2006, as in 2012, all participating countries had a statistically significant gender difference in favour of girls for reading. The gender gap in England has remained stable between 2009 and 2012 with a difference of 25 and 24 score points respectively, whereas in 2006 the difference was 29 score points. The OECD average for gender difference has remained around 38 score points throughout the last 3 cycles.

5.5 Summary

England's performance in reading in PISA 2012 was not significantly different from the OECD average, although England had a relatively large difference between the score points of the lowest scoring pupils and the highest scoring pupils compared with many other countries. That said, the proportion of pupils at each level of achievement was broadly similar to the OECD average.

Girls scored significantly higher than boys, which was the case in every country which participated in the PISA 2012 study. However this gender difference, while statistically significant, was not as large in England as that in the majority of other countries.

In general, England's overall performance in reading in 2012 does not differ greatly from that in the last PISA surveys in 2009 or 2006. There was, however, a small increase in the proportion of both the lowest and highest achievers. The range of attainment in reading has widened, having closed between 2006 and 2009, and the scores of the highest achieving pupils have increased while the scores of the lowest achieving pupils have decreased.

In 2012 the number of countries outperforming England increased to 17, compared with 12 in 2009 and seven in 2006. While in 2009 a number of high performing countries had joined the survey, this was not the case in 2012, where only one of the comparison countries was new (Vietnam). Five countries that were not significantly different from England in 2009 performed significantly better in 2012 (Republic of Ireland, Chinese Taipei, Poland, Estonia and Liechtenstein), and Macao-China performed significantly better in 2012 despite having been significantly below England in 2009. These countries have achieved substantial improvements in their reading standards at both the highest and lowest levels and their average point scores have increased significantly by between 15 and 28 points. In contrast, in England, the average increase of five score points was not significant, and although the proportion of high attaining pupils grew and their scores increased, so too did the proportion of low attaining pupils, whose scores decreased since 2009.

6 Schools

Chapter outline

This chapter draws on responses to the School and Student Questionnaires to describe aspects of school management, school climate, assessment practices and school resources.

Key findings

- Headteachers in England report that they have a high level of responsibility for most aspects of school management.
- Compared with the OECD average, headteachers in England play a greater role in most aspects of school management, particularly in relation to teachers' pay.
- Compared with 2009, headteachers of schools participating in PISA 2012 report a lower degree of involvement from other bodies in the management of schools.
- Headteachers in England report a much greater involvement in activities in their schools than the OECD average, such as informally observing lessons and supporting teachers.
- A smaller proportion of headteachers report that pupil-related problems hinder learning than the OECD average. Truancy, for example, was reported as a serious problem by 32 per cent of headteachers across the OECD, compared with only four per cent in England.
- Teacher-related problems that hinder learning are also reported at a lower level by headteachers in England than the OECD average.
- Teacher morale is reported to be very high across the OECD, with headteachers in England reporting it to be even higher than the average.
- Compared with headteachers, pupils in England report a greater degree of disruption to their lessons. The level of disruption reported by pupils is generally similar to the OECD average.
- Pupils in England are generally very positive about their relationships with their teachers, and more positive than the OECD average.
- A lack of qualified mathematics teachers is reported as the greatest staffing problem hindering schools' capacity to provide instruction. This was reported by 17 per cent of headteachers in England.
- In 2009 the same factor was reported as the greatest staffing problem, by 30 per cent of headteachers in England.
- The greatest resource issue for headteachers in England is shortage or inadequacy of school buildings and grounds.
- Headteachers in England report much greater use of pupil assessments for a variety of purposes than the OECD average.

6.1 School management

The School Questionnaire asked about responsibility for aspects of school management. Table 6.1 summarises the responses of headteachers in England and shows a high degree of school autonomy, whereby headteachers reported that a high level of responsibility for most aspects of management lay within the school. The aspects on which headteachers reported the most involvement of bodies external to the school – i.e. local or national government – were in establishing starting salaries, formulating the school budget and deciding on pupil admissions. However, even for these aspects the headteacher was still considered to have more responsibility.

Teachers were reported as having a large amount of responsibility for more instructional or classroom-related issues such as discipline policies, choosing textbooks and courses and establishing assessment policies. Responses also show considerable involvement of school governing bodies in all aspects of the school, with the exception of choosing textbooks and deciding course content.

This question appeared in PISA 2009, and the results from the two surveys can be compared. However, as the level of responsibility of headteachers, governing bodies and local authorities varies between types of school in England, differences found between the two surveys may be due to differences in the types of schools taking part, rather than changes that have occurred over time. Comparing responses to this question with responses to the same question from PISA 2009, headteachers in England reported an overall reduction in the involvement of all parties in school management. The greatest decrease was for school governing bodies, which were reported to have a particularly reduced role in “Selecting teachers to recruit” (from 61 per cent in 2009 to 38 per cent in 2012); “Establishing teachers’ starting salaries” (58 per cent to 47 per cent); “Deciding on budget allocations within the school” (61 per cent to 49 per cent); and “Establishing student disciplinary policies” (66 per cent to 50 per cent). The role of national education authorities in school management in England varied the least, with all changes between the two surveys lower than nine percentage points. Two particular differences for headteachers were a greater role in “Approving students for admission to the school” (from 65 per cent in 2009 to 77 per cent in 2012) and a reduced role in “Determining course content” (from 31 per cent in 2009 to 20 per cent in 2012). Local authorities’ role in school management was reported to have reduced most in “Formulating the school budget” (32 per cent to 15 per cent) and “Dismissing teachers” (21 per cent to 10 per cent). Teachers’ roles were reduced most in “Establishing student disciplinary policies” (72 per cent to 56 per cent) and “Establishing student assessment policies” (81 per cent to 67 per cent).

Table 6.1 School autonomy

Regarding your school, who has a considerable responsibility for the following tasks? *(Please tick as many boxes as appropriate in each row)*					
	Head	*Teachers*	*School governing body*	*Local or Regional Authority*	*National education authority*
Selecting teachers to recruit	99%	28%	38%	3%	-
Dismissing teachers	88%	-	70%	10%	-
Establishing teachers' starting salaries	77%	1%	47%	7%	18%
Determining teachers' salary increases	80%	3%	73%	4%	13%
Formulating the school budget	86%	2%	83%	15%	10%
Deciding on budget allocations within the school	99%	5%	49%	1%	-
Establishing student disciplinary policies	100%	56%	50%	1%	3%
Establishing student assessment policies	96%	67%	31%	0%	5%
Approving students for admission to the school	77%	11%	25%	36%	3%
Choosing which textbooks are used	4%	99%	-	-	-
Determining course content	20%	91%	-	1%	11%
Deciding which courses are offered	81%	83%	23%	-	5%

- indicates no responses while 0% indicates a response from less than 0.5% of headteachers

Looking specifically at the role of headteachers, a comparison with the OECD average shows that headteachers in England play a greater role in school management than is the case across the OECD for all aspects except choosing textbooks and determining course content. For other aspects of school management, as shown in Table 6.2, headteachers in England have greater responsibility than those across the OECD on average. In particular, their role in establishing teachers' starting salaries and salary increases is greater than the OECD average.

Table 6.2 Headteachers' role in school management: comparing England and the OECD average

	England	OECD average
Selecting teachers to recruit	99%	71%
Dismissing teachers	88%	57%
Establishing teachers' starting salaries	77%	18%
Determining teachers' salary increases	80%	23%
Formulating the school budget	86%	56%
Deciding on budget allocations within the school	99%	75%
Establishing student disciplinary policies	100%	71%
Establishing student assessment policies	96%	57%
Approving students for admission to the school	77%	72%
Choosing which textbooks are used	4%	28%
Determining course content	20%	25%
Deciding which courses are offered	81%	60%

A second aspect of school management which was explored in the School Questionnaire is school leadership, specifically the amount of involvement which headteachers have in various activities in their school. Table 6.3 reports these responses in England ordered by the proportions of headteachers reporting that they did each activity on a weekly, or more frequent, basis.

It is interesting to contrast some of these responses with those reported across the OECD on average (also shown in Table 6.3). There are eight statements where the response of headteachers in England was at least 25 percentage points higher, and these are shaded in the table. These figures suggest that headteachers in England take a more direct role in the day-to-day teaching and learning in their schools than do their counterparts in many other OECD countries.

Table 6.3 School leadership

Below are statements about your management of this school. Please indicate the frequency of the following activities and behaviours in your school during the last academic year.		
	Once a week or more	
	England	OECD average
I praise teachers whose students are actively participating in learning.	74%	38%
I pay attention to disruptive behaviour in classrooms.	72%	56%
I ensure that teachers work according to the school's educational goals.	71%	34%
I work to enhance the school's reputation in the community.	64%	46%
I engage teachers to help build a school culture of continuous improvement.	60%	42%
I conduct informal observations in classrooms on a regular basis (informal observations are unscheduled, last at least 5 minutes, and may or may not involve written feedback or a formal meeting).	60%	22%
When a teacher has problems in his/her classroom, I take the initiative to discuss matters.	59%	37%
I draw teachers' attention to the importance of pupils' development of critical and social capacities.	53%	28%
I use student performance results to develop the school's educational goals.	51%	16%
When a teacher brings up a classroom problem, we solve the problem together.	49%	45%
I make sure that the professional development activities of teachers are in accordance with the teaching goals of the school.	45%	19%
I provide staff with opportunities to participate in school decision-making.	45%	37%
I evaluate the performance of staff.	44%	13%
I review work produced by students when evaluating classroom instruction.	44%	13%
I promote teaching practices based on recent educational research.	37%	21%
I refer to the school's academic goals when making curricular decisions with teachers.	33%	14%
I discuss academic performance results with staff to identify curricular strengths and weaknesses.	30%	9%
I discuss the school's academic goals with teachers at staff meetings.	27%	15%
I set aside time at staff meetings for teachers to share ideas or information from in-service activities.	18%	10%
I ask teachers to participate in reviewing management practices.	17%	12%
I lead or attend in-service activities concerned with instruction.	13%	8%

6.2 School climate

Information on school climate is available from questions in both the Student and School Questionnaires. Headteachers were asked the extent to which learning in their school is hindered by a variety of problems. These were divided into teacher-related and pupil-related issues. Table 6.4 shows responses, from the most frequently reported to the least.

In comparison with the OECD average, headteachers in England were much less likely to report pupil-related factors that hindered learning. The problem reported most frequently was pupils arriving late for school, which was said to hinder learning by 13 per cent of headteachers in England. This compares with the OECD average of 31 per cent.

Teacher-related problems that hindered learning were also reported less frequently in England compared with the OECD average (for ten out of the 11 problems). For both England and the OECD average the most commonly reported problem was “Teachers having to teach students of mixed ability within the same class”. While the OECD average was over half (53 per cent), only a fifth of headteachers in England said that this was a problem.

Of the options presented in this question, 12 had also appeared in a similar question in PISA 2009. The answers from headteachers in the two surveys were largely similar. The only notable difference was in the proportion of headteachers saying that “Teachers’ low expectations of students” hindered pupils’ learning a lot or to some extent. The proportion decreased from 22 per cent in 2009 to four per cent in 2012.

Table 6.4 Issues that hinder learning in school

In your school, to what extent is the learning of students hindered by the following?		
	to some extent/a lot	
	England	OECD average
Student-related		
Students arriving late for school	13%	31%
Disruption of classes by students	7%	32%
Students lacking respect for teachers	6%	19%
Student truancy	4%	32%
Students not attending compulsory school events (e.g. sports day) or excursions	3%	13%
Students skipping classes	3%	30%
Students intimidating or bullying other students	1%	10%
Student use of alcohol or illegal drugs	1%	6%
Teacher-related		
Teachers having to teach students of mixed ability within the same class	20%	53%
Teachers not meeting individual students' needs	20%	23%
Staff resisting change	18%	25%
Teacher absenteeism	14%	13%
Students not being encouraged to achieve their full potential	6%	21%
Teachers being too strict with students	5%	10%
Teachers' low expectations of students	4%	14%
Teachers having to teach students of diverse ethnic backgrounds (i.e. language, culture) within the same class	4%	18%
Teachers not being well prepared for classes	3%	8%
Teachers being late for classes	1%	7%
Poor student-teacher relations	0%	7%

Headteachers were also asked about the morale of the teachers at their school. As shown in Table 6.5, headteachers in England reported a very high level of pride and enthusiasm amongst their staff. The lowest proportion of positive responses, at 93 per cent, was for the statement which asked directly about the morale of teachers. For all statements, the proportion agreeing or strongly agreeing was higher in England than the average across the OECD.

Table 6.5 Teacher morale

Thinking about the teachers in your school, how much do you agree with the following statements?		
	agree/strongly agree	
	England	OECD average
The morale of teachers in this school is high.	93%	91%
Teachers work with enthusiasm.	99%	93%
Teachers take pride in this school.	99%	94%
Teachers value academic achievement.	100%	96%

It is possible to compare the headteachers' views with pupils' reports about the climate of their schools. Pupils were asked about discipline, specifically in their mathematics lessons. Table 6.6 summarises their responses. While only seven per cent of headteachers in England reported that disruption of classes by pupils hindered learning, larger proportions of pupils said that disruption occurred in most or all lessons. Around three in ten pupils said that there was often noise and disorder or that pupils did not listen to the teacher in their mathematics lessons. These proportions were similar to the average across the OECD. Despite this reported disruption, only 16 per cent of pupils in England said that pupils cannot work well. Pupils' responses were similar to those of their counterparts in other OECD countries for all but the last two categories which were both related to actually getting on with work in class, where pupils in England gave a slightly more positive picture.

A similar question to this was asked in PISA 2009, but related to English lessons rather than mathematics lessons. There is very little difference in the percentages of pupils reporting disruption to lessons between the two surveys.

Table 6.6 Discipline in mathematics classes

How often do these things happen in your mathematics lessons?		
	in most or all lessons	
	England	OECD average
There is noise and disorder.	31%	32%
Students don't listen to what the teacher says.	30%	32%
The teacher has to wait a long time for students to settle down.	25%	27%
Students don't start working for a long time after the lesson begins.	19%	27%
Students cannot work well.	16%	22%

As seen in Table 6.4 (above), none of the headteachers in England said that poor pupil-teacher relations hindered pupils' learning. Table 6.7 shows pupils' responses to questions on relationships with teachers. This also shows a largely positive feeling among pupils in England about the relationships they have with their teachers. However, nearly a quarter of pupils did not agree or strongly agree that most of their teachers really listen to them. For all the statements, pupils in England were more positive about relationships with teachers than pupils across the OECD on average.

Table 6.7 Teacher-pupil relationships

Thinking about the teachers at your school, to what extent do you agree with the following statements?		
	agree/strongly agree	
	England	OECD average
If I need extra help, I will receive it from my teachers.	91%	80%
Most teachers are interested in students' well-being.	87%	76%
Most of my teachers treat me fairly.	86%	79%
Students get along well with most teachers.	85%	81%
Most of my teachers really listen to what I have to say.	76%	73%

See Chapter 3, section 3.4 for further discussion of the findings from the Student Questionnaire concerning other aspects of teaching practice.

6.3 Resources

The School Questionnaire asked about the extent to which schools had problems with a lack of resources or a lack of qualified staff. Table 6.8 summarises responses sorted by frequency for England, plus OECD averages.

The most frequent staffing problem in England was a lack of qualified mathematics teachers, reported by 17 per cent of headteachers. Generally, shortages of resources or of qualified staff were reported at a slightly lower level in England than across the OECD. The biggest difference was seen for a lack of qualified teachers of subjects other than science, mathematics and English, which was reported as hindering instruction by a fifth of headteachers on average across the OECD, compared with only seven per cent of headteachers in England. The resources most reported as inadequate in England were school buildings and grounds, which two-fifths of headteachers said hindered the school's capacity to provide instruction to some extent or a lot. This was greater than the OECD average of 34 per cent.

Ten of the options presented to headteachers also appeared in PISA 2009. The four options referring to staffing were reported at a lower level in PISA 2012 than in the earlier survey, with the largest difference being for the lack of qualified mathematics teachers. This was the greatest hindrance in both the 2009 and 2012 surveys, but at a reduced level (from 30 per cent in 2009 to 17 per cent in 2012). Hindrances due to shortage of resources were reported at a slightly higher level in 2012 than 2009 for five of the six options that appeared in both PISA 2009 and PISA 2012.

Table 6.8 Staffing and resources

Is your school's capacity to provide instruction hindered by any of the following issues?		
	to some extent/a lot	
	England	OECD average
Staffing		
A lack of qualified mathematics teachers	17%	17%
A lack of qualified science teachers	12%	17%
A lack of qualified teachers of other subjects	7%	20%
A lack of qualified English teachers	5%	9%
Resources		
Shortage or inadequacy of school buildings and grounds	41%	34%
Shortage or inadequacy of instructional space (e.g. classrooms)	26%	32%
Shortage or inadequacy of computers for instruction	25%	33%
Shortage or inadequacy of science laboratory equipment	24%	30%
Lack or inadequacy of internet connectivity	22%	21%
Shortage or inadequacy of computer software for instruction	22%	31%
Shortage or inadequacy of library materials	20%	25%
Shortage or inadequacy of heating/cooling and lighting systems	16%	23%
Shortage or inadequacy of instructional materials (e.g. textbooks)	14%	19%

6.4 Assessment

The School Questionnaire asked about the purposes of assessment within the school. As shown in Table 6.9, schools in England use assessments for a variety of purposes in the vast majority of cases. More than 95 per cent of headteachers in England reported that assessments were used to monitor the school's progress, inform parents, identify areas to be improved, group pupils and compare the school's performance with local or national performance. Across the OECD, the only similarly high response was given for using assessment to inform parents about their child's progress. The only purpose which was reported as being used more in other OECD countries than in England was related to pupils' retention or promotion. On average, three-quarters of headteachers across the OECD reported this was a purpose for which assessment was used, compared with just under two-thirds in England. This is likely to be related to the use of year-repetition in some education systems for underperforming pupils, which is not a typical feature of the English education system.

The percentages for England are similar to those reported in 2009 by headteachers in England. The largest difference is a nine percentage point increase in the proportion of headteachers saying that they use assessments to compare the school with other schools (from 81 per cent to 90 per cent).

Table 6.9 Purposes of assessment

In your school, are assessments used for any of the following purposes for students in Years 10 and 11?		
	Yes	
	England	OECD average
To monitor the school's progress from year to year	100%	80%
To inform parents about their child's progress	98%	97%
To identify aspects of instruction or the curriculum that could be improved	97%	79%
To group students for instructional purposes	97%	50%
To compare the school to local or national performance	97%	62%
To compare the school with other schools	90%	51%
To make judgements about teachers' effectiveness	86%	50%
To make decisions about students' retention or promotion	64%	76%

6.5 Summary

Headteachers reported a high degree of responsibility for most aspects of management of their schools. School governing bodies were also reported to have considerable involvement, with local or national education authorities having less responsibility. Compared with the findings from PISA 2009, headteachers reported a reduced role for all parties in the management of schools, with the role of school governing bodies having reduced the most.

Compared with the OECD average, headteachers in England reported greater responsibility for most aspects of school management. Headteachers in England also reported a higher frequency for most school leadership activities than their OECD counterparts, with over 70 per cent of headteachers in England saying they frequently (once a week or more) praised teachers and ensured teachers worked according to the school's goals, compared with less than 40 per cent of headteachers across the OECD on average.

Headteachers in England reported that the greatest staffing issue was a shortage of qualified mathematics teachers. This had also been reported as the biggest hindrance to providing instruction in 2009, to a greater extent (30 per cent in 2009 compared with 17 per cent in this survey).

Responses to the School Questionnaire on issues which hinder learning showed a more positive school climate than the OECD average for most aspects. This was particularly the case for pupil-related problems. Pupils were on the whole very positive about the climate of their school, although they were least positive about the extent to which they felt their teachers listened to them. They were more positive about their relationships with their teachers than the average across OECD countries.

Pupil assessments serve various purposes in England, the most frequent being to monitor the school's year-on-year progress, inform parents, identify areas to be improved, group pupils and

compare the school’s performance with local or national performance. Assessments were used more frequently in England for a wider variety of reasons than across the OECD on average.

7 PISA in the UK

Chapter outline

This chapter describes some of the main outcomes of the PISA survey in England, Wales, Northern Ireland and Scotland. In particular, it outlines some aspects where there were differences in attainment in mathematics, science and reading, in the range of attainment, in the pattern of gender differences or in responses to the School and Student Questionnaires.

Key findings

- Across mathematics, science and reading, there were no significant differences between Scotland, England and Northern Ireland, with the exception of mathematics where Scotland scored significantly higher than Northern Ireland.
- In all subjects, scores for Wales were significantly below those of other UK countries and the OECD average.
- England had the widest spread of attainment in all three subjects.
- Scotland had the smallest percentage of pupils working at the lowest levels in all three subjects and their low achievers scored more highly in all subjects.
- England had the highest proportion of pupils working at Levels 5 and above, and their high achievers scored more highly in all subjects.
- Northern Ireland was the only country where boys did not significantly outperform girls in mathematics and science.
- In all subjects, Scotland had the lowest percentage of pupils at Level 1 or below, while Wales had the lowest percentage at Levels 5 and above. This pattern is consistent with findings from the 2006 and 2009 surveys.

Mathematics

- Scores in Scotland and England were similar to the OECD average. However, scores in Northern Ireland and Wales were significantly lower than the OECD average.
- Scores in Wales were lower and significantly different from those in the rest of the UK.
- Scotland had the lowest percentage of pupils working below Level 1 in mathematics (4.9 per cent).
- In each of the UK countries, gender gaps for mathematics were similar to the OECD average; however they were smaller than in many other countries.

Science

- In science, there were no significant differences between England, Scotland and Northern Ireland, but the mean score in Wales was significantly lower.
- The spread of attainment was less in Scotland than in the other parts of the UK.
- Scotland's lowest attainers in science scored 28 points higher than low attainers across the OECD and at least 22 points higher than low attainers in the rest of the UK.
- The difference between the performance of boys and girls in science was much larger in the UK than across the OECD in general, particularly in England and Wales.

Reading

- In reading, there were no significant differences between England, Scotland and Northern Ireland but the mean score in Wales was significantly lower.
- England had the widest spread of attainment for reading.
- Girls outperformed boys in all parts of the UK, as they did in every other country in the PISA survey.

Schools and pupils

- More headteachers in England reported informal observations in classrooms and weekly evaluations of staff, and fewer reported these in Northern Ireland.
- Headteachers in Scotland reported greater involvement of local authorities in dismissing teachers, formulating budgets and establishing assessment policies, and less involvement of governing bodies compared with other UK countries. They were also most likely to report that truancy hindered learning, or to report problems with pupils skipping classes or disrupting classes.
- Headteachers in Northern Ireland reported greater shortages or inadequacy of computers for instruction, instructional space (e.g. classrooms), and school buildings and grounds than those in England, Scotland and Wales.
- In Scotland, 36 per cent of teachers reported a shortage of qualified subject teachers, other than in mathematics, science or reading; this was at least twice as many as in other UK countries.
- Differences between the responses of pupils in the different UK countries were minimal.
- Pupils in England were more likely to say that they looked forward to mathematics lessons.
- Pupils in Northern Ireland were more likely to report that they often worried about mathematics classes.
- The mean scores for UK countries on the PISA index of economic, social and cultural status (ESCS) all indicate that on average pupils in the PISA samples in the UK have a higher socio-economic status than the average across OECD countries.
- Only in Northern Ireland did the figures indicate that more disadvantaged pupils have significantly less chance of performing well.

7.1 Mathematics

This section compares the findings outlined in Chapter 2 with the comparable findings for the other parts of the UK.

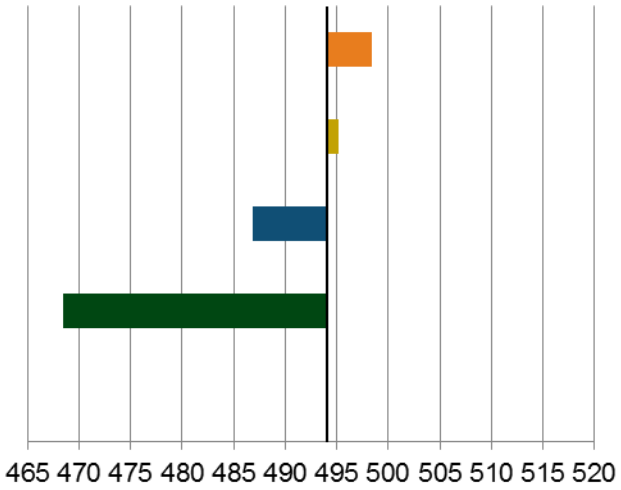
7.1.1 Mean scores in mathematics

Table 7.1 summarises the mean scores for each of England, Wales, Northern Ireland and Scotland on the mathematics achievement scale. The highest attainment for mathematics was in Scotland, followed by England and then Northern Ireland. However, scores between Scotland and England or between Northern Ireland and England were similar and differences were not significant. The lack of a significant difference between the mean scores of England and Northern Ireland does not reflect the finding for TIMSS Grade 4 (9-10-year-olds) where pupils in Northern

Ireland performed at a significantly higher level than pupils in England. However the mean score in Northern Ireland was significantly lower than that in Scotland. The lowest attainment was in Wales, where the mean score was significantly lower than the other constituent parts of the UK.

Table 7.1 Mean scores for mathematics overall

	Mean	**S**	**E**	**NI**	**W**	**OECD**
Scotland	498		*NS*	*S*	*S*	*NS*
England	495	*NS*		*NS*	*S*	*NS*
Northern Ireland	487	*S*	*NS*		*S*	S
Wales	468	*S*	*S*	*S*		*S*
OECD average	494	*NS*	*NS*	*S*	*S*	



S = significantly different *NS* = no significant difference

On the four content subscales, more differences emerged. Scores in these areas are shown in Tables 7.2 to 7.5 All four countries showed some difference between the mean score in each of the content areas and their overall mean score, with the exception of England where there was no difference between the mean score for *quantity* and the overall score for mathematics. However, the biggest difference for all countries was found in the *space and shape* subscale; and for all countries, their lowest mean score was in this content area. All four parts of the UK scored higher on the *uncertainty and data* subscale compared with their overall mathematics score. This suggests that in all four parts of the UK, pupils are relatively strong on the questions that focus on probability and statistics (*uncertainty and data*) and they are less strong on questions that focus on aspects of *space and shape.*

Wales' scores in all four content areas were significantly lower than those for the other three countries. Scotland's scores were significantly higher than Northern Ireland's in all content areas apart from *uncertainty and data*. England's scores on two content areas (*change and relationships* and *space and shape)* were significantly higher than Northern Ireland's.

Table 7.2 Mean scores on the Quantity scale

	Mean	**Scotland**	**England**	**Northern Ireland**	**Wales**
Scotland	501		*NS*	*S*	*S*
England	495	*NS*		*NS*	*S*
Northern Ireland	491	*S*	*NS*		*S*
Wales	465	*S*	*S*	*S*	

S = significantly different *NS* = no significant difference

Table 7.3 Mean scores on the Uncertainty and data scale

	Mean	**Scotland**	**England**	**Northern Ireland**	**Wales**
Scotland	504		*NS*	*NS*	*S*
England	503	*NS*		*NS*	*S*
Northern Ireland	496	*NS*	*NS*		*S*
Wales	483	*S*	*S*	*S*	

S = significantly different *NS* = no significant difference

Table 7.4 Mean scores on the Change and relationships scale

	Mean	**Scotland**	**England**	**Northern Ireland**	**Wales**
Scotland	497		*NS*	*S*	*S*
England	498	*NS*		*S*	*S*
Northern Ireland	486	*S*	*S*		*S*
Wales	470	*S*	*S*	*S*	

S = significantly different *NS* = no significant difference

Table 7.5 Mean scores on the Space and shape scale

	Mean	**Scotland**	**England**	**Northern Ireland**	**Wales**
Scotland	482		*NS*	*S*	*S*
England	477	*NS*		*S*	*S*
Northern Ireland	463	*S*	*S*		*S*
Wales	444	*S*	*S*	*S*	

S = significantly different *NS* = no significant difference

Tables 7.6 to 7.8 show mean scores on the process subscales: *formulate*, *employ* and *interpret*. In all four parts of the UK, pupils were relatively stronger on the *interpret* subscale and relatively weaker on the other two subscales. As was the case for the content areas, Wales' scores in the three process subscales were significantly lower than all other parts of the UK.

Table 7.6 Mean scores on the Formulate scale

	Mean	**Scotland**	**England**	**Northern Ireland**	**Wales**
Scotland	490		*NS*	*S*	*S*
England	491	*NS*		*NS*	*S*
Northern Ireland	479	*S*	*NS*		*S*
Wales	457	*S*	*S*	*S*	

S = significantly different *NS* = no significant difference

Table 7.7 Mean scores on the Employ scale

	Mean	**Scotland**	**England**	**Northern Ireland**	**Wales**
Scotland	496		*NS*	*S*	*S*
England	493	*NS*		*NS*	*S*
Northern Ireland	486	*S*	*NS*		*S*
Wales	466	*S*	*S*	*S*	

S = significantly different *NS* = no significant difference

Table 7.8 Mean scores on the Interpret scale

	Mean	**Scotland**	**England**	**Northern Ireland**	**Wales**
Scotland	510		*NS*	*S*	*S*
England	502	*NS*		*NS*	*S*
Northern Ireland	496	*S*	*NS*		*S*
Wales	483	*S*	*S*	*S*	

S = significantly different *NS* = no significant difference

7.1.2 Distribution of performance in mathematics

Chapter 2 showed that there was some degree of variation around the mean score for mathematics in all countries, as would be expected. The size of this variation indicates the extent of the gap between low and high attaining pupils. This can be seen by comparing the scores of pupils at the 5th percentile (low attainers) and that of pupils at the 95th percentile (high attainers).

The scores at the 5th and the 95th percentile and the differences[3] between them are shown in Table 7.9 The difference between the OECD average score at the 5th percentile and at the 95th percentile was 301 score points. The range was wider than this in England and Northern Ireland and narrower in Scotland and Wales. The highest difference of 316 was found in England.

[3] Differences have been calculated using unrounded mean scores.

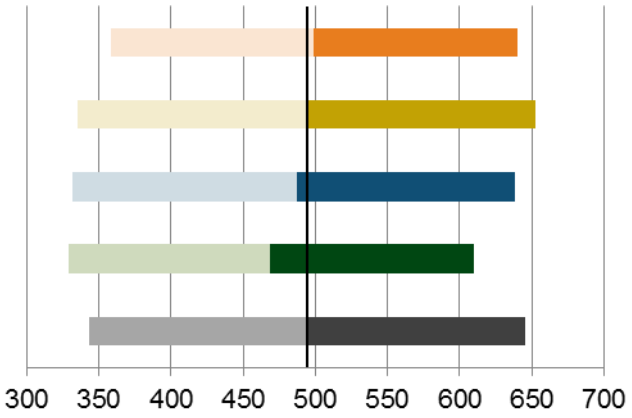
The lowest scoring pupils in England, Northern Ireland and Wales performed slightly less well than the OECD average at the 5th percentile. However, in Scotland, the score of 358 at the 5th percentile was 15 points higher than the OECD average of 343.

At the highest percentile, the OECD average was 645 and the equivalent score in England was seven points above this. The scores at the highest percentile in Wales, Northern Ireland and Scotland were lower than the OECD average; the largest difference was in Wales where the highest performers scored 35 points below the OECD average.

The impact of socio-economic status is discussed in section 7.4.2.1.

Table 7.9 Scores of highest and lowest achieving pupils in mathematics

	Lowest (5th percentile)	Highest (95th percentile)	Difference
Scotland	358	640	282
England	335	652	316
Northern Ireland	332	638	305
Wales	329	610	281
OECD average	343	645	301



Range between lowest (5th percentile) and the mean Range between highest (95th percentile) and the mean

Differences have been calculated using unrounded scores.

Full information on the distribution of performance is in Appendix B2.

7.1.3 Percentages at each level in mathematics

The range of achievement in each country is further emphasised by the percentages of pupils at each of the PISA proficiency levels. These percentages are summarised in Figure 7.1, which shows that all parts of the UK have some pupils at the top and bottom of the achievement range, but that the percentages vary in each case.

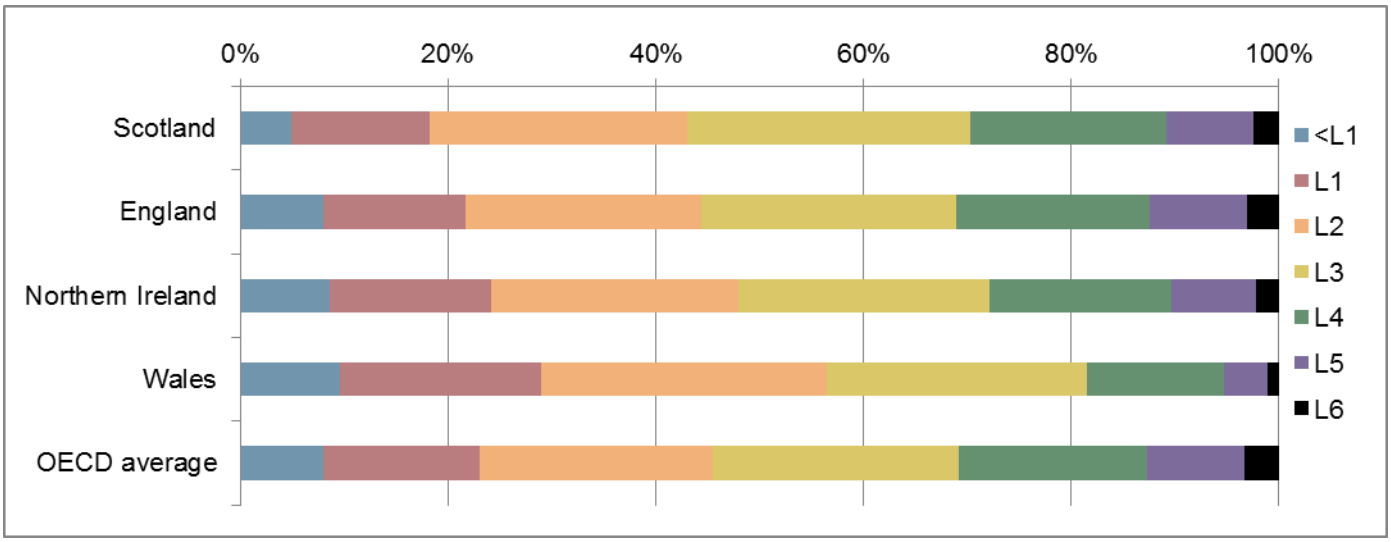
Scotland had the lowest percentage of pupils working below Level 1 in mathematics (4.9 per cent). This compares with the OECD average of 8.0 per cent. In England and Northern Ireland the proportion of pupils working at the lowest level of proficiency in mathematics was close to, or the same as, the OECD average (8 and 8.6 per cent respectively). At 9.6 per cent, Wales had the largest percentage of pupils working below Level 1, which was above the OECD average.

This pattern is highlighted when pupils at Level 1 and below are combined. Scotland had 18.3 per cent working at the lowest proficiency levels in mathematics, England 21.6 per cent, Northern Ireland 24.1 per cent and Wales 29.0 per cent. The OECD average was 23.0 per cent.

At the other end of the scale, all four parts of the UK had a lower percentage of pupils than the OECD average at Level 6 (3.3), although for England this difference from the OECD average is small and unlikely to be statistically significant.

When the top two levels (Levels 5 and 6) are combined, further differences emerge. England's proportion of high achievers (12.4 per cent) was comparable with the OECD average of 12.6 per cent. Northern Ireland and Scotland were slightly below, with 10.3 and 10.8 per cent respectively. Wales had 5.3 per cent of pupils working at the highest levels of proficiency in mathematics, a lower proportion than the other parts of the UK or the OECD average.

Figure 7.1 Percentages at PISA mathematics levels



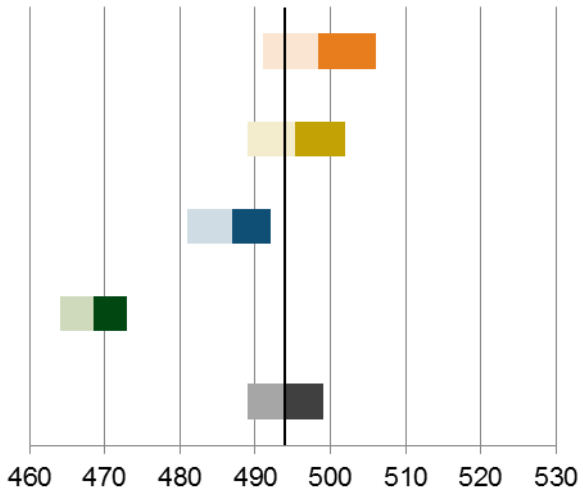
Full information on the percentages at each level is presented in Appendices B19 and B20. Level descriptions showing full details of the expected performance at each of the PISA mathematics levels are provided in Figure 2.5 in Chapter 2. It should be noted that the PISA levels are not the same as levels used in any of the educational systems of the UK.

7.1.4 Gender differences in mathematics

There were differences in the four parts of the UK in terms of the achievement of boys and girls. Table 7.10 shows the mean scores for boys and girls and highlights differences that were statistically significant.

Table 7.10 Mean scores of boys and girls in mathematics

	Overall mean score	Mean score of boys	Mean score of girls	Difference
Scotland	498	506	491	14*
England	495	502	489	13*
Northern Ireland	487	492	481	10
Wales	468	473	464	9*
OECD average	494	499	489	11*



Range between girls' mean score and the mathematics mean Range between boys' mean score and the mathematics mean

* Statistically significant difference
Differences have been calculated using unrounded mean scores

In all cases, boys had a higher mean score than girls and, apart from in Northern Ireland, these differences were statistically significant. The differences in Scotland and England were of a similar size, whereas in Wales the difference was slightly smaller. In all parts of the UK the differences between boys and girls were not as great as those in some other countries and were similar to the OECD average.

Tables 7.11 to 7.13 show the gender differences on each of the mathematics subscales. As was the case for the overall mean score, in Northern Ireland there were no significant gender differences on the mathematics subscales. For the other three countries in the UK there were no clear patterns in terms of gender differences. In England and Wales the largest difference was on the *change and relationships* subscale, whereas for Scotland the largest difference was on the *space and shape* subscale. This is in contrast to the OECD average, where the largest difference was on the *formulate* subscale. The findings for the four constituent parts of the UK reflect what is seen across the comparison countries; that is, considerable variation in the pattern of gender differences across the subscales for mathematics.

Table 7.11 Mean scores of boys and girls in the mathematics content areas of quantity and uncertainty and data

	quantity				*uncertainty and data*			
	all	boys	girls	diff (b-g)	*all*	boys	girls	diff (b-g)
Scotland	*501*	506	495	**11***	*504*	510	498	**12***
England	*495*	502	489	**14***	*503*	511	497	**14***
Northern Ireland	*491*	495	487	**8**	*496*	501	491	**10**
Wales	*465*	470	460	**10***	*483*	487	478	**9***
OECD average	*495*	501	490	**11***	*493*	497	489	**9***

* statistically significant difference Differences have been calculated using unrounded mean scores.

Table 7.12 Mean scores of boys and girls in the mathematics content areas of change and relationships and space and shape

	change and relationships				*space and shape*			
	all	boys	girls	diff (b-g)	*all*	boys	girls	diff (b-g)
Scotland	*497*	506	487	**19***	*482*	492	471	**21***
England	*498*	506	490	**15***	*477*	484	471	**13***
Northern Ireland	*486*	491	479	**12**	*463*	467	460	**7**
Wales	*470*	476	463	**13***	*444*	449	439	**10***
OECD average	*493*	498	487	**11***	*490*	497	482	**15***

* statistically significant difference Differences have been calculated using unrounded mean scores.

Table 7.13 Mean scores of boys and girls in the mathematics process subscales

	formulate				*employ*				*interpret*			
	all	boys	girls	diff (b-g)	*all*	boys	girls	diff (b-g)	*all*	boys	girls	diff (b-g)
Scotland	*490*	499	481	**18***	*496*	504	488	**16***	*510*	516	504	**12***
England	*491*	497	485	**12**	*493*	499	487	**12***	*502*	509	495	**14***
Northern Ireland	*479*	484	474	**10**	*486*	491	481	**10**	*496*	500	491	**8**
Wales	*457*	463	452	**11***	*466*	470	461	**9***	*483*	489	477	**12***
OECD average	*492*	499	484	**16***	*493*	498	489	**9***	*497*	502	492	**9***

* statistically significant difference Differences have been calculated using unrounded mean scores.

7.1.5 Summary

This section has reviewed performance across the UK in mathematics. It shows that there were some significant differences in performance between the four countries of the UK. Scores overall and across the different subscales in Wales were lower than those in the rest of the UK and these differences were significant. The mean score in Northern Ireland was significantly lower than that

in Scotland, but there were no significant differences between Scotland and England, or between Northern Ireland and England.

The difference between the achievement of the highest attaining and the lowest attaining pupils in England and Northern Ireland was above the OECD average; this difference was more pronounced in England. England had a higher proportion of high scoring pupils than the rest of the UK and Scotland had the lowest proportion of low scoring pupils. Wales had a higher proportion of low attaining pupils and fewer high attaining pupils than the other parts of the UK.

In England, Scotland and Wales boys outperformed girls in mathematics. In Northern Ireland boys had a higher overall mean score than girls, but this difference was not statistically significant. The gender gaps in these countries were similar to the OECD average; however they were smaller than in many other countries.

7.2 Science

This section compares the findings outlined in Chapter 4 with the comparable findings for the other parts of the UK.

Science was a minor domain in the PISA 2012 survey.

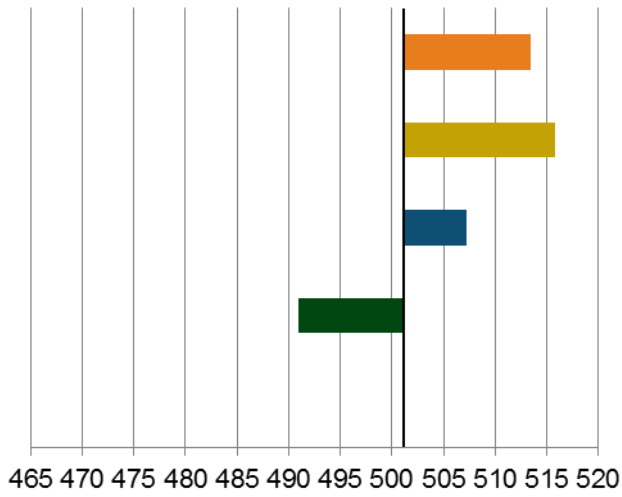
7.2.1 Mean scores in science

Table 7.14 below shows the mean scores in England, Wales, Northern Ireland and Scotland for science and indicates any significant differences between countries. Full data can be found in Appendix C2.

The highest attainment for science was in England, followed by Scotland and then Northern Ireland. However, the scores were very similar and there were no significant differences between these three countries. The lowest attainment was in Wales, where the mean score for science was significantly lower than in the rest of the UK.

Table 7.14 Mean scores for science

	Mean	**S**	**E**	**NI**	**W**	**OECD**
Scotland	513		*NS*	*NS*	*S*	*S*
England	516	*NS*		*NS*	*S*	*S*
Northern Ireland	507	*NS*	*NS*		*S*	*NS*
Wales	491	*S*	*S*	*S*		*S*
OECD average	501	*S*	*S*	*NS*	*S*	



S = significantly different *NS* = no significant difference

7.2.2 Distribution of performance in science

Table 7.15 shows the scores of pupils in each country at the 5th and the 95th percentiles, along with the OECD average score at each of these percentiles. The table indicates the range of scores in each country and also shows the difference in score points at the two percentiles. Full data can be found in Appendix C2.

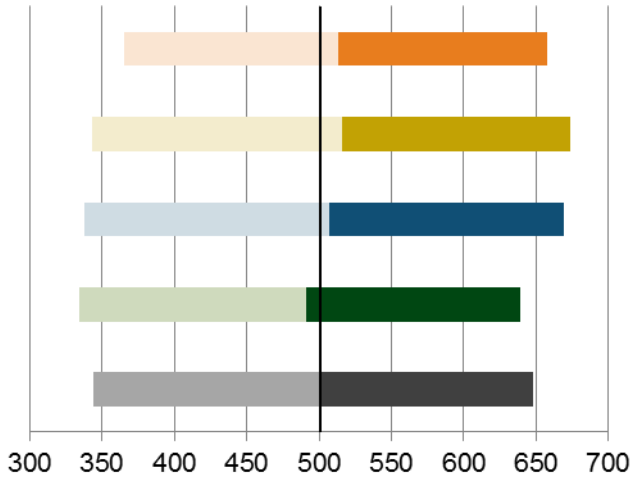
The mean score achieved by Scotland's lowest achieving pupils was 28 points above the OECD average at the 5th percentile. The means in each of the other UK countries were much closer to the OECD average. The lowest achieving pupils were in Wales, where the mean score at the 5th percentile was slightly lower than the OECD average. Northern Ireland was similar to and England slightly higher than the OECD average.

At the 95th percentile, England's highest achieving pupils had the highest mean score, 19 score points above the OECD average, followed by those in Northern Ireland (14 points above the OECD average). In Scotland the score of the highest achievers in science was similar to the OECD average, while the score of the highest achievers in Wales was 16 score points below it.

Looking at the range of performance, as shown by the difference in score points between the highest and lowest achievers, the largest gaps were in England and Northern Ireland and the smallest in Scotland, as low achievers here scored highly compared with those in the other UK countries.

Table 7.15 Scores of highest and lowest achieving pupils in science

	Lowest (5th percentile)	Highest (95th percentile)	Difference
Scotland	365	658	293
England	343	674	331
Northern Ireland	338	669	331
Wales	334	639	305
OECD average	344	648	304



Range between lowest (5th percentile) and the mean

Range between highest (95th percentile) and the mean

Differences have been calculated using unrounded scores.

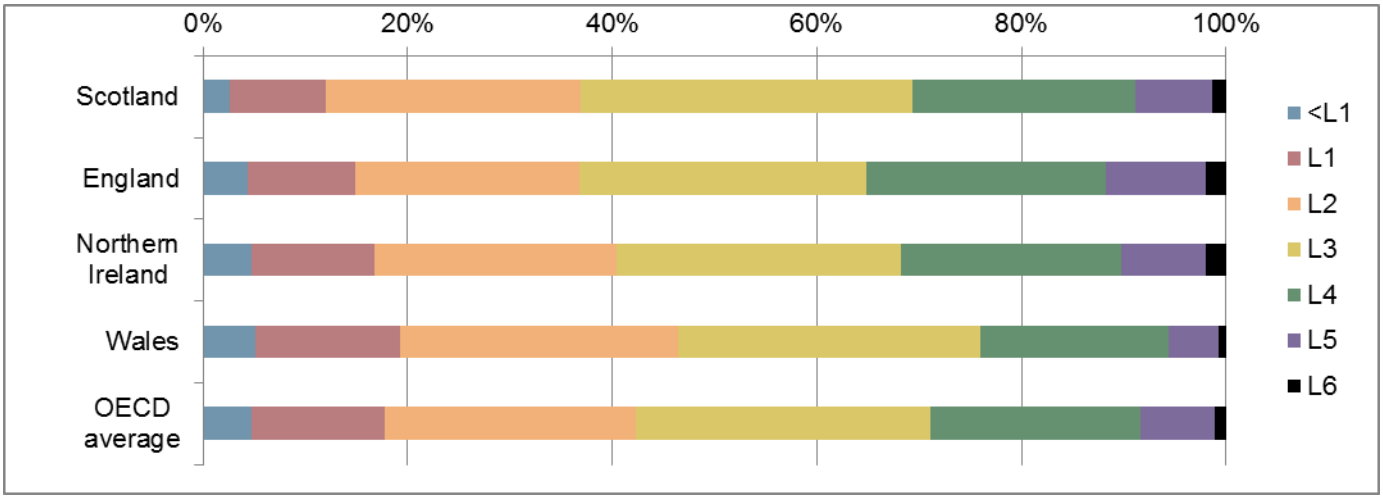
7.2.3 Percentages at each science level

Figure 7.2 shows the percentages of pupils at each of the six levels of science attainment, along with the percentages below Level 1. This indicates that all parts of the UK have some pupils at the top and bottom of the achievement range, but that the percentages vary in each case.

England had the largest percentage of pupils (11.7) at the two highest levels of attainment (Levels 5 and 6), followed by Northern Ireland (10.3); both are higher than the OECD average of 8.4 per cent at these levels. Scotland's proportion at the higher levels (8.8) is similar to the OECD average, but in Wales the proportion of high achievers was lower at 5.7 per cent.

At the other end of the scale, Scotland had the lowest proportion (12.1 per cent) of low attaining pupils at Level 1 and below for science. England had 14.9 per cent of pupils working at the lowest levels of proficiency, Northern Ireland 16.8 per cent and Wales 19.4 per cent. This compares with an OECD average of 17.8 per cent.

Figure 7.2 Percentages at PISA science levels



Full information on the percentages at each level is presented in Appendices C4 and C5.

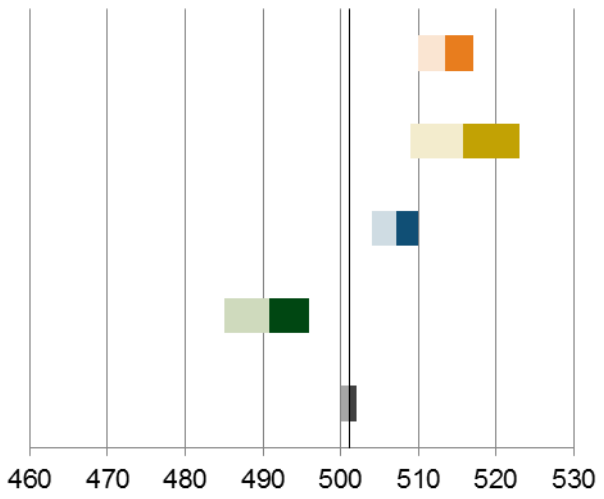
Level descriptions showing full details of the expected performance at each PISA level are in Appendix C3. It should be noted that the PISA levels are not the same as levels used in any of the educational systems of the UK.

7.2.4 Gender differences in science

Table 7.16 shows the mean scores of boys and girls, and the differences in their mean scores. Full data can be found in Appendix C2.

Table 7.16 Mean scores of boys and girls for science

	Overall mean score	Mean score of boys	Mean score of girls	Difference
Scotland	513	517	510	7*
England	516	523	509	14*
Northern Ireland	507	510	504	5
Wales	491	496	485	11*
OECD average	501	502	500	1*



Range between girls' mean score and the science mean

Range between boys' mean score and the science mean

* Statistically significant difference
Differences have been calculated using unrounded mean scores.

Boys' scores were higher than girls' in science in all four of the UK countries. These differences between boys and girls were statistically significant in England, Wales and Scotland, but not significantly different in Northern Ireland. In all cases the differences were larger than the OECD average. The difference between the performance of boys and girls in science was much larger in the UK than across the OECD in general, particularly in England and Wales, where boys scored 14 and 11 points higher respectively, compared with an OECD average of one score point.

7.2.5 Summary

This section has reviewed performance across the UK in science. It shows that there were some significant differences between the four countries of the UK in terms of overall attainment.

Scotland had the lowest range of attainment and the scores of their lowest achieving pupils were much higher than those in the rest of the UK or the OECD on average.

Scores in Wales were lower than those in the rest of the UK and these differences were significant. There were no significant differences between Scotland, England and Northern Ireland.

The difference between the achievement of the highest attaining and the lowest attaining pupils in England and Northern Ireland was above the OECD average. Wales had a higher proportion of low attaining pupils than the other parts of the UK and had fewer high attaining pupils.

In England, Scotland and Wales boys outperformed girls in science. In Northern Ireland boys had a higher overall mean score than girls but this difference was not statistically significant. Among other participating countries there was no clear pattern of gender difference.

The difference between the performance of boys and girls in science was much larger in the UK than across the OECD in general, particularly in England and Wales, where boys scored 14 and 11 points higher, compared with an OECD average of one point.

7.3 Reading

This section compares the findings outlined in Chapter 5 with the comparable findings for the other parts of the UK.

Reading was a minor domain in the PISA 2012 survey.

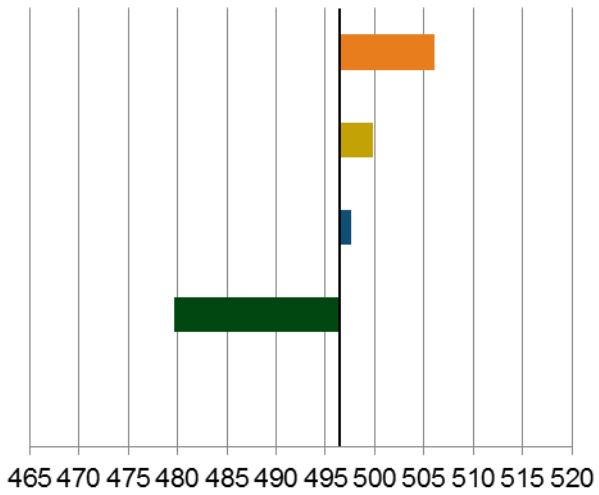
7.3.1 Mean scores for reading

Table 7.17 below shows the mean scores of England, Wales, Northern Ireland and Scotland for reading, and indicates some significant differences between the countries. Full data can be found in Appendix D2.

The mean reading scores achieved in England, Scotland and Northern Ireland were very similar, with no significant differences. The lowest attainment in reading was seen in Wales, where the mean score was significantly lower than the rest of the UK, and the OECD generally.

Table 7.17 Mean scores for reading

	Mean	S	E	NI	W	OECD
Scotland	506		*NS*	*NS*	*S*	*S*
England	500	*NS*		*NS*	*S*	*NS*
Northern Ireland	498	*NS*	*NS*		*S*	NS
Wales	480	*S*	*S*	*S*		*S*
OECD average	496	*S*	*NS*	*NS*	*S*	



S = significantly different *NS* = no significant difference

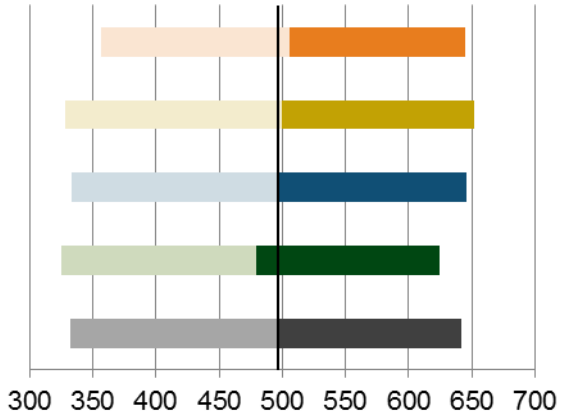
7.3.2 Distribution of performance in reading

Table 7.18 shows the scores of pupils in each country at the 5th and 95th percentiles, along with the OECD average score at each of these percentiles. The table indicates the range of scores in each country and also shows the difference in score points at the two percentiles. Full data can be found in Appendix D2.

Looking at the range of performance as shown by the difference in score points between the highest and lowest achievers, the largest performance range was in England and the smallest in Scotland.

Table 7.18 Scores of highest and lowest achieving pupils in reading

	Lowest (5th percentile)	Highest (95th percentile)	Difference
Scotland	357	645	288
England	328	652	324
Northern Ireland	333	646	313
Wales	325	624	299
OECD average	332	642	310



Range between lowest (5th percentile) and the mean Range between highest (95th percentile) and the mean

Differences have been calculated using unrounded scores.

Table 7.18 shows that the lowest attaining pupils in Scotland achieved higher scores than the lowest attaining pupils in England, Wales and Northern Ireland. At the 95th percentile, the highest scoring pupils were in England, followed by Northern Ireland and Scotland. The lowest scores at both percentiles were in Wales, both of which were lower than the OECD average, as was the score for the lowest achievers in England.

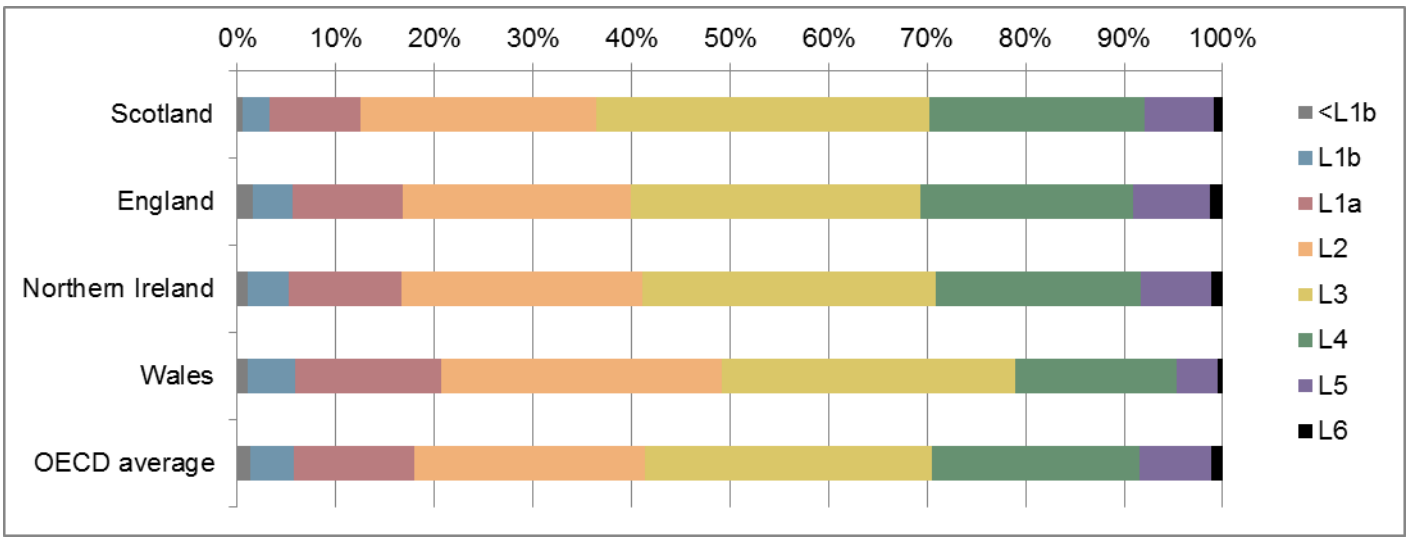
7.3.3 Percentages at each reading level

Figure 7.3 shows the percentages of pupils at each of the seven PISA levels of reading attainment, along with the percentages below Level 1b.

The information in this figure adds to that discussed above and shows that both England and Northern Ireland had a slightly higher proportion of pupils than Scotland at the top two levels (Levels 5 and 6), but also higher proportions below Level 1a. Scotland had the lowest percentage of pupils at Level 1a or below, while Wales had the lowest percentage at Levels 5 and 6. This pattern is consistent with findings from the 2006 and 2009 surveys.

Full data can be found in Appendices D4 and D5. Level descriptions showing full details of the expected performance at each PISA level are in Appendix D3. It should be noted that the PISA levels are not the same as levels used in any of the educational systems of the UK.

Figure 7.3 Percentages at PISA reading levels

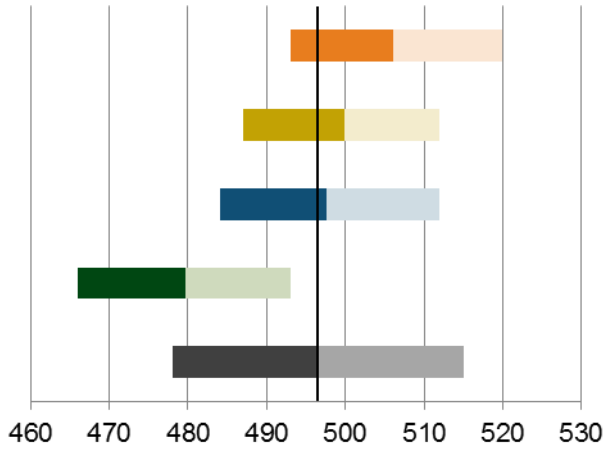


7.3.4 Gender differences in reading

Table 7.19 shows the mean scores of boys and girls, and the difference in their mean scores. Full data can be found in Appendix D2. In all constituent countries of the UK and across the OECD on average, girls had significantly higher mean scores than boys.

Table 7.19 Mean scores of boys and girls for reading

	Overall mean score	Mean score of boys	Mean score of girls	Difference
Scotland	506	493	520	27*
England	500	487	512	24*
Northern Ireland	498	484	512	27*
Wales	480	466	493	27*
OECD average	496	478	515	38*



Range between boys' mean score and the reading mean

Range between girls' mean score and the reading mean

* Statistically significant difference

Differences have been calculated using unrounded mean scores

7.3.5 Summary

This section has reviewed performance across the UK in reading. It shows that there were some significant differences between the four countries of the UK in terms of overall attainment.

Scotland had the narrowest range of attainment and the scores of their lowest achieving pupils were much higher than those in the rest of the UK or the OECD on average.

Scores in Wales were significantly lower than those in the rest of the UK and the OECD average. There were no significant differences between Scotland, England or Northern Ireland. Scotland's overall mean was significantly higher than the OECD average, while England's and Northern Ireland's were not.

The spread of achievement in England and Northern Ireland was wider than the OECD average; for Scotland and Wales the spread was narrower than the OECD average. Wales had a higher proportion of low attaining pupils than the other parts of the UK and a lower proportion of high attaining pupils.

In each of the UK countries, girls outperformed boys in reading, as they did in every participating country.

7.4 Schools and pupils

This section looks at similarities and differences in findings from the School and Student Questionnaires between England, Wales, Northern Ireland and Scotland.

7.4.1 School differences

When headteachers were asked about the management of their schools, the responses of headteachers in Scotland differed from those of headteachers in the rest of the UK. The role of school governing bodies was much smaller in Scotland, while the role of local authorities in dismissing teachers, formulating budgets and establishing assessment policies was greater. Headteachers in Scotland also had less of a role in salary matters and formulating the school budget than their colleagues in the rest of the UK.

There was some variation across UK countries in the leadership behaviours reported by headteachers. Differences greater than 30 per cent were seen for two behaviours that were asked about in the School Questionnaire; 60 per cent of headteachers in England reported that they conduct informal observations in classrooms at least once a week, while in Northern Ireland this was reported by only 13 per cent of headteachers. Weekly evaluations of staff were reported by 12 per cent of headteachers in Northern Ireland, while 44 per cent of headteachers in England said this was the case.

In England only four per cent of headteachers said that truancy hindered learning to some extent or a lot. Headteachers in Wales, Northern Ireland and Scotland reported that it was a greater problem, with the largest proportion (23 per cent) being reported by headteachers in Scotland. Headteachers in Scotland were also more likely to report problems with pupils skipping classes

(than headteachers in England and Northern Ireland) and with pupils lacking respect and disrupting classes (compared with headteachers in England).

For the question asking about issues hindering the school's capacity to provide instruction, there were a number of differences in the proportions of responses between UK countries. In particular, more issues were reported in Northern Ireland than in other parts of the UK. Most notably, headteachers in Northern Ireland reported greater shortages or inadequacy of computers for instruction (58 per cent), instructional space, e.g. classrooms (38 per cent), and school buildings and grounds (62 per cent) than headteachers in England, Scotland and Wales. Another considerable difference was seen between Scotland and the other UK countries concerning a lack of qualified teachers of subjects (other than mathematics, science or reading). In Scotland, 36 per cent of teachers said that this shortage hindered instruction in their schools; in England this was just seven per cent (with figures of 16 and 18 per cent in Wales and Northern Ireland respectively).

There were a number of differences among the UK countries in responses to questions about the purposes for which pupils in Years 10 and 11 (or equivalent) were assessed. The greatest difference was seen for the purpose of making judgements about teachers' effectiveness. While assessments were used by 63 per cent of schools in Northern Ireland for this purpose, this compared with over three quarters of schools in Wales and Scotland, and 86 per cent in England.

There were only small differences between UK countries for questions relating to headteachers' perceptions of teacher morale, discipline issues in mathematics lessons as viewed by pupils, and pupils' opinions of their relationships with their teachers.

7.4.2 Pupil differences

The amount of variation between countries in the UK was low for a number of the issues explored in the Student Questionnaire. These included: pupils' sense of belonging at school; perceived control of success in mathematics (and self-responsibility for failing in mathematics); conscientiousness and perseverance; openness to problem solving; beliefs about friends' and parents' views on mathematics; confidence in tackling mathematics problems; mathematics behaviours at school and outside of school; and views on the supportiveness of teachers.

For the questions looking at attitudes to school, there was little difference between the UK countries. One point of difference was that more pupils in Northern Ireland and Scotland than in Wales were positive about the usefulness of school; pupils in Wales were less likely to disagree with the statement "School has done little to prepare me for adult life when I leave school".

There were few differences between UK countries in the proportions of pupils saying they enjoy mathematics, or understand that it is important. The biggest difference was seen for pupils in England, who were more likely to say that they look forward to their mathematics lessons compared with pupils in Northern Ireland (52 and 42 per cent respectively).

There was little variation between countries in the measure of pupils' anxiety and self-concept in relation to mathematics. However, pupils in Northern Ireland were more likely than those in England to report that they often worry that it will be difficult for them in mathematics classes (57 per cent in Northern Ireland compared with 46 per cent in England).

When asked about instructional strategies used by teachers in their mathematics lessons, pupil responses in the different UK countries did not indicate a high level of variation. However, for the statement “The teacher gives different work to classmates who have difficulties learning and/or to those who can advance faster”, there were differences. The percentages indicate that there is less variation in the work given within classes in Northern Ireland and Wales than in Scotland and England. Pupils in England also agreed more frequently than those in Northern Ireland and in Scotland with the statement “The teacher sets clear goals for our learning”. A similar difference between England and Northern Ireland was found for the statement “The teacher tells me about how well I am doing in my mathematics class”.

7.4.2.1 Differences in pupils’ socio-economic status

The mean scores for UK countries on the PISA index of economic, social and cultural status (ESCS) all indicate that on average pupils in the PISA samples in the UK have a higher socio-economic status than the average across OECD countries (the index is set to a mean of zero across OECD countries). The means for England and Northern Ireland were both 0.29, with 0.19 for Wales and 0.13 for Scotland. Appendix E reports the mathematics scores of pupils in each quarter of the index, and shows that pupils in the top quarter of the index in Wales performed at a similar level to those in the third quarter in England.

The change in score for each unit of the index varies around the OECD average for the UK countries, as shown in Appendix E. Across the OECD, a change of one standard deviation on the ESCS Index is related to a predicted difference in score of 39 points. For England and Northern Ireland (with differences of 41 and 45 points respectively) socio-economic background is seen to have a greater effect than the average in OECD countries. In contrast, Scotland and Wales (with differences of 37 and 35 points respectively) show an effect of socio-economic background which is lower than the OECD average.

Looking at the amount of variance in scores which can be explained by socio-economic background gives a better picture of the interaction between mathematics scores and the ESCS Index. This shows the extent to which pupils in each country are able to overcome the predicted effects of socio-economic background. Across the OECD on average, 15 per cent of the variance in scores can be explained by socio-economic background. Of the UK countries, only Northern Ireland has a variance greater than the OECD average (at 17 per cent), while Wales has the lowest percentage (10 per cent). This suggests that socio-economic background has the least impact on performance in mathematics in Wales, whereas it has the biggest impact in Northern Ireland.

7.5 Summary

Across mathematics, science and reading, there were no significant differences between Scotland, England and Northern Ireland, with the exception of mathematics, where Scotland scored significantly higher than Northern Ireland. In all subjects, scores for Wales were significantly below those of other UK countries and the OECD average.

The widest spread of attainment in all three subjects was found in England. England also had the highest proportion of pupils working at Levels 5 and above, and their high achievers (at the 95th

percentile) scored more highly than those in other UK countries in all subjects. Scotland had the lowest proportion of pupils working at Level 1[4] or below in all three subjects, and their low achievers scored more highly in all subjects.

Scotland had the lowest percentage of pupils at Level 1 or below, while Wales had the lowest percentage at Levels 5 and above. This pattern is consistent with findings from the 2006 and 2009 surveys.

Gender differences followed similar patterns in each of the UK countries, except that in Northern Ireland boys did not significantly outperform girls in mathematics and science.

Mathematics

In mathematics there were some significant differences in performance between the four countries of the UK. Scores in Wales were lower and significantly different from those in the rest of the UK, and the mean score in Northern Ireland was significantly lower than that in Scotland. However, there were no significant differences between Scotland and England or between Northern Ireland and England.

The difference between the achievement of the highest attaining and the lowest attaining pupils in England and Northern Ireland was above the OECD average; this difference was more pronounced in England. Wales had a slightly higher number of low attaining pupils compared with the other parts of the UK, and had fewer high attaining pupils.

In England, Scotland and Wales boys outperformed girls in mathematics. In Northern Ireland boys had a higher overall mean score than girls, but this difference was not statistically significant. The gender gaps in these countries were similar to the OECD average; however they were smaller than in many other countries.

Science

In science there were no significant differences between England, Scotland and Northern Ireland, but the mean score in Wales was significantly lower. The spread of attainment was less in Scotland than in the other parts of the UK. Boys outperformed girls in all parts of the UK and this gender gap was statistically significant in all UK countries except Northern Ireland.

Reading

In reading there were no significant differences between England, Scotland and Northern Ireland, but the mean score in Wales was significantly lower. The spread of attainment between the highest and lowest scoring pupils was widest in England and narrowest in Scotland. Girls outperformed boys in all parts of the UK, as they did in every other country in the PISA survey.

Schools and pupils

Headteachers in England, Wales and Northern Ireland generally reported similar leadership behaviours, although more headteachers in England reported informal observations in classrooms and weekly evaluations of staff, and fewer reported these in Northern Ireland.

[4] Level 1a for reading

In terms of management, headteachers in Scotland reported greater involvement of local authorities in dismissing teachers, formulating budgets and establishing assessment policies, and less involvement of governing bodies compared with other UK countries.

Headteachers in Scotland were most likely to report that truancy hindered learning, or to report problems with pupils skipping classes or disrupting classes. Headteachers in Northern Ireland reported greater shortages or inadequacy of computers for instruction, instructional space (e.g. classrooms), and school buildings and grounds than those in England, Scotland and Wales.

In Scotland, 36 per cent of teachers reported a shortage of qualified subject teachers, other than in mathematics, science or reading; this was at least twice as many as in other UK countries.

Differences between the responses of pupils in the different UK countries were minimal. Slightly more pupils in Wales felt that school had done little to prepare them for adult life. Pupils in England were more likely to say that they looked forward to mathematics lessons. Pupils in Northern Ireland were more likely to report that they often worried about mathematics classes.

Pupil perceptions of instructional strategies indicated that pupils in England and Scotland felt their teachers were more likely to give differentiated work to classmates of different abilities than in other UK countries, and pupils in England were more likely to report that their teacher set clear learning goals.

The mean scores for UK countries on the PISA index of economic, social and cultural status (ESCS) all indicate that on average pupils in the PISA samples in the UK have a higher socio-economic status than the average across OECD countries. However, only in Northern Ireland did the figures indicate that more disadvantaged pupils have significantly less chance of performing as well as their more advantaged peers, compared with their counterparts across the OECD on average.

8 Problem Solving in England

Chapter outline

This chapter reports the attainment of pupils in England in problem solving. It draws on findings outlined in the international report (OECD, 2014) and places outcomes for England in the context of those findings.

Key findings

Relative performance

- England's performance in problem solving was significantly higher than the OECD average.
- Seven of the 43 other countries/economies participating in the problem solving assessment have scores in problem solving that are significantly higher than England's. All seven are East Asian countries/economies and also perform significantly higher than England in mathematics and reading. Only five of the seven countries outperform England in science.
- England is one of seven countries/economies with a specific strength in problem solving; the others being Korea, Japan, United States, Italy, Macao-China and Australia. When comparing the performance of pupils in England with that of pupils in other countries with the same level of achievement in mathematics, science and reading, English pupils perform significantly better at problem solving.
- In England, pupils score significantly better on problem solving tasks measuring *monitoring and reflecting* than their overall scores would have predicted. These tasks involve the utilisation of knowledge. In contrast, pupils in the countries outperforming England are strong at knowledge-acquisition tasks classified as *exploring and understanding* and *representing and formulating*.

Spread of attainment in problem solving

- England has a spread of attainment in line with the OECD average. In just over half (23) of the 43 other participating countries, the gap between the highest and lowest performing pupils was smaller than in England. This was true in all of the countries significantly ahead of England in the assessment.
- In terms of the PISA proficiency levels, the percentage of pupils in England at Level 1 or below is relatively low.
- In England, boys do not score significantly better than girls. However, a significant difference favouring boys is seen across the OECD on average, and in four of the seven high performing countries.

Links with performance in mathematics, reading and science

- Problem solving scores are most strongly correlated with PISA mathematics scores in England and across the OECD on average. However, the correlations between reading and mathematics and between science and mathematics are greater than the correlation between problem solving and mathematics.
- England's strong performance in problem solving can be attributed to those pupils in England who score at or above the mathematics proficiency Level 4.

8.1 Problem solving competency

PISA 2012 defines problem solving competence as:

> *'… an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen*.' (OECD, 2013)

PISA assesses pupils in curriculum subjects in relation to the concepts of mathematical literacy, science literacy and reading literacy. A fundamental part of the definition of these concepts is that they go beyond simple testing of parts of school curricula, and assess pupils in the context of real-life challenges. This inevitably involves finding solutions to problems. The specific assessment of "problem solving" in PISA 2012 contrasts with the assessments of mathematics, science and reading in that the content of the problem solving questions are intended to be unrelated to specific areas of the curriculum. The scenarios continue to reflect real-life contexts, but without the specific subject skills needed to answer the question. By not testing knowledge of a particular subject, the problem solving assessment focuses on pupils' general reasoning ability, their skills in approaching problem solving and their willingness to do so.

Problem solving was previously assessed in PISA 2003 as part of the paper based assessment, but England did not participate in that option. The assessment of problem solving was re-introduced to PISA for 2012 as a computer based assessment. The move from a paper based assessment allowed for more sophisticated questioning and the collection of information based on pupils' use of the computer. A proportion of questions were designed to be interactive, requiring pupils to explore the information presented in order to locate the information needed to resolve the problem. Examples of problem solving items are presented in Appendix G6.

8.2 Comparison countries

Of the 65 countries that took part in PISA 2012, 44 of them participated in the computer based assessment of problem solving. Within the UK, only England took part, and the results are reported as the results for England (United Kingdom) in the international report (Volume V, OECD, 2014).

In this chapter, scores for England are compared with 43 other countries. While findings for all countries are reported in this chapter where relevant, most findings relate to a sub-group of countries. The countries forming the comparison group include OECD countries, EU countries and other countries with relatively high scores. Since countries with very low scores are not so relevant for comparison purposes, those with a mean score for problem solving of less than 430 have been omitted from tables (except for Bulgaria, which is an EU member). Hence, the comparison group for problem solving in this chapter comprises 38 countries (of which 21 are EU members and 27 OECD members), shown in Table 8.1 below. In this chapter, and throughout this report, the results of PISA adjudicated regions are discussed. Information on the performance of sub-regions in some participating countries is available in the international report (OECD, 2014).

Table 8.1 Countries compared with England

Australia	Denmark*	Japan	*Shanghai-China*
Austria*	England	Korea	*Singapore*
Belgium*	Estonia*	*Macao-China*	Slovak Republic*
*Bulgaria**	Finland*	Netherlands*	Slovenia*
Canada	France*	Norway	Spain*
Chile	Germany*	Poland*	Sweden*
Chinese Taipei	*Hong Kong-China*	Portugal*	Turkey
*Croatia**	Hungary*	Republic of Ireland*	United States
*Cyprus**	Israel	*Russian Federation*	
Czech Republic*	Italy*	*Serbia*	

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

Interpreting differences between countries

It is important to know what can reasonably be concluded from the PISA data and which interpretations would be going beyond what can be reliably supported by the results. This section outlines some points that need to be kept in mind while reading this chapter.

Sources of uncertainty

There are two sources of uncertainty which have to be taken into account in the statistical analysis and interpretation of any test results. These are described as *sampling error* and *measurement error*. The use of the term 'error' does not imply that a mistake has been made; it simply highlights the necessary uncertainty.

Sampling error stems from the inherent variation of human populations which can never be summarised with absolute accuracy. It affects virtually all research and data collection that makes use of sampling. Only if every 15-year-old in each participating country had taken part in PISA could it be stated with certainty that the results are totally representative of the attainment of the entire population of pupils in those countries. In reality the data was collected from a sample of 15-year-olds. Therefore, the results are a best estimation of how the total population of 15-year-olds could be expected to perform in these tests. There are statistical methods to measure how good the estimation is. It is important to recognise that all data on human performance or attitudes which is based on a sample carries a margin of error.

Measurement error relates to the results obtained by each individual pupil, and takes account of variations in their score which are not directly due to underlying ability in the subject but which are influenced by other factors related to individuals or to the nature of the tests or testing conditions, such as sickness on the day of testing.

Interpreting rank order

Because of the areas of uncertainty described above, interpretations of very small differences between two sets of results are often meaningless. Were they to be measured again it could well be that the results would turn out the other way round. For this reason, this chapter focuses mainly

on *statistically significant* differences between mean scores rather than the simple rank order of countries. Statistically significant differences are unlikely to have been caused by random fluctuations due to sampling or measurement error.

Where statistically significant differences between countries are found, these may be the result of a great number of factors. The data for some of these factors were not collected in the PISA survey. Therefore, the PISA survey is only able to explain the reasons for differences between countries to a limited extent. For example, differences in school systems and educational experiences in different countries could play a part, but so could a wide range of different out-of-school experiences. It is important to bear this in mind while reading this report.

8.3 Scores in England

England's pupils achieved a mean score of 517 in problem solving in PISA 2012, which was significantly greater than the OECD mean of 500. (See section 8.2 on interpreting differences between countries for an explanation of how statistical significance should be interpreted in this report.)

The performance in problem solving in seven of the other 43 participating countries was significantly higher than that in England (see Table 8.2). These seven countries are all East Asian countries/economies, and were countries which outperformed England in PISA 2012 for mathematics and reading. For science, Chinese Taipei and Macao-China were not significantly different from England, while the remaining five countries had higher scores.

Table 8.2 Countries outperforming England in problem solving (significant differences)

Country	Mean score	Country	Mean score
Singapore	562	*Hong Kong-China*	540
Korea	561	*Shanghai-China*	536
Japan	552	*Chinese Taipei*	534
Macao-China	540		

OECD countries (not italicised) *Countries not in OECD (italicised)*

Twelve countries' performance on problem solving was at a level that was not significantly different from that of England. These countries are all OECD countries, which are either EU members or English speaking countries. The remaining 24 countries performed significantly less well. Tables 8.3 and 8.4 show the comparison group countries that performed similarly to England, and those whose performance was lower than England's. Further data can be found in Appendix G1 (mean scores and standard errors for England and the comparison group countries and significant differences between England and the comparison group countries).

Table 8.3 Countries not significantly different from England in problem solving

Country	Mean score	Country	Mean score
Canada	526	Italy*	510
Australia	523	Czech Republic*	509
Finland*	523	Germany*	509
England	**517**	United States	508
Estonia*	515	Belgium*	508
France*	511	Austria*	506
Netherlands*	511		

OECD countries (not italicised) *EU countries

Table 8.4 Countries significantly below England in problem solving

Country	Mean score	Country	Mean score
Norway	503	*Serbia*	473
Republic of Ireland*	498	*Croatia**	466
Denmark*	497	Hungary*	459
Portugal*	494	Turkey	454
Sweden*	491	Israel	454
Russian Federation	489	Chile	448
Slovak Republic*	483	*Cyprus**	445
Poland*	481	*Bulgaria**	402
Spain*	477		
Slovenia*	476	*plus six other countries*	

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

Analysis of the performance of sub-regions in some participating countries shows variation within countries, with some particularly high-performing regions, such as British Columbia and Alberta in Canada (with means of 535 and 531 respectively), and North West Italy (with a mean score of 533). Further information is available in the international report (OECD, 2014).

8.3.1 Nature of problem solving situations and problem solving processes

The PISA framework for assessing problem solving competence includes two aspects: the nature of the problem situation and the problem solving processes involved in each task. See Appendix G6 for example questions.

The nature of the problem situation is classified as ‘interactive’ or ‘static’. The difference is based on whether the information needed to solve the problem is available at the outset (static) or only

part of the information needed is available, and other crucial elements have to be uncovered by exploring the problem situation (interactive).

Pupils in England did not perform significantly differently on the interactive tasks compared to the static ones, though there was a small tendency for their performance on interactive tasks to be higher. In 20 comparison countries, pupils performed better than expected on interactive items, given their overall performance in the problem solving assessment.

The PISA items are also classified according to the main cognitive process that a pupil uses to solve the problem they are presented with. The four problem solving cognitive processes are:

- *exploring and understanding* the information provided with the problem,
- *representing and formulating*: constructing graphical, tabular, symbolic or verbal representations of the problem situation and formulating hypotheses about the relevant factors and relationships between them,
- *planning and executing*: devising a plan by setting goals and sub-goals, and executing the sequential steps identified in the plan,
- *monitoring and reflecting*: monitoring progress, reacting to feedback, and reflecting on the solution, the information provided with the problem, or the strategy adopted.

Pupils in England did significantly better than their score would have predicted on *monitoring and reflecting* items. This was also found to be the case in nine other comparison countries, while in eight comparison countries the performance *on monitoring and reflecting* items was weaker than expected.

For the other three problem solving processes, pupils in England had a very slightly weaker-than-expected performance, but these differences were not significant. Significant findings were found for a number of other countries. Notably, for countries significantly outperforming England, pupils showed a higher level of proficiency on *exploring and understanding* and *representing and formulating* tasks compared with lower performing countries. The international report classifies these processes as knowledge-acquisition tasks. In contrast, the area which pupils in England performed strongly was *monitoring and reflecting*, which (along with *planning and executing*) can be described as knowledge-utilisation tasks. This may imply that pupils in the high performing East Asian countries are skilled, in particular, at finding the information they need to solve problems.

8.4 Differences between highest and lowest attainers

In addition to knowing how well pupils in England performed overall it is also important to examine the spread in performance between the highest and lowest achievers. Amongst countries with similar mean scores there may be differences in the numbers of high- and low-scoring pupils (the highest and lowest attainers). A country with a wide spread of attainment may have large numbers of pupils who are underachieving as well as pupils performing at the highest levels. A country with a lower spread of attainment may have fewer very high achievers but may also have fewer underachievers.

8.4.1 Distribution of scores

The first way in which the spread of performance in each country can be examined is by looking at the distribution of scores. Appendix G2 shows the scores achieved by pupils at different percentiles. The 5th percentile is the score at which five per cent of pupils score lower, while the 95th percentile is the score at which five per cent score higher. The difference between the highest and lowest attainers at the 5th and 95th percentiles is a better measure of the spread of scores for comparing countries than using the lowest and highest scoring pupils. Such a comparison may be affected by a small number of pupils in a country with unusually high or low scores. Comparison of the 5th and the 95th percentiles gives a better indication of the typical spread of attainment.

The score of pupils in England at the 5th percentile was 352, while the score of those at the 95th percentile was 667; a difference of 315 score points. This is similar to the average difference across the OECD (314 score points). Fourteen comparison countries had a greater difference between the mean scores of their highest and lowest attainers. The largest difference was found for Israel (404 score points). The countries which outperformed England in problem solving were among the 23 countries that had smaller differences between the mean scores of their highest and lowest attainers than England. Macao-China had the smallest difference at 259 score points.

8.4.2 Performance across PISA proficiency levels

The second way of examining the spread of attainment is by looking at England's performance at each of the PISA proficiency levels. As explained in Appendix G3, problem solving attainment in PISA is described in terms of six levels of achievement. These six performance levels are outlined in Table 8.5 and Figure 8.1. Table 8.5 shows the cumulative percentages at each level for the OECD average and for England. In all participating countries there were some pupils at or below the lowest level of achievement (Level 1) and in all countries at least some pupils achieved the highest level (Level 6).

As reported above, pupils in England outperformed the OECD average, and Figure 8.1 demonstrates that, at each proficiency level, the proportion of pupils in England was greater than the OECD average. In England, 5.5 per cent of pupils scored below proficiency Level 1. This was a smaller proportion than the OECD average of 8.2 per cent. While the OECD average for pupils at Level 1 or below was 21.4 per cent, in England this figure was 16.4 per cent. Only 11 of the comparison countries had fewer pupils at or below Level 1 than England. The countries which significantly outperformed England were notable for having less than 12 per cent of their pupils at or below Level 1.

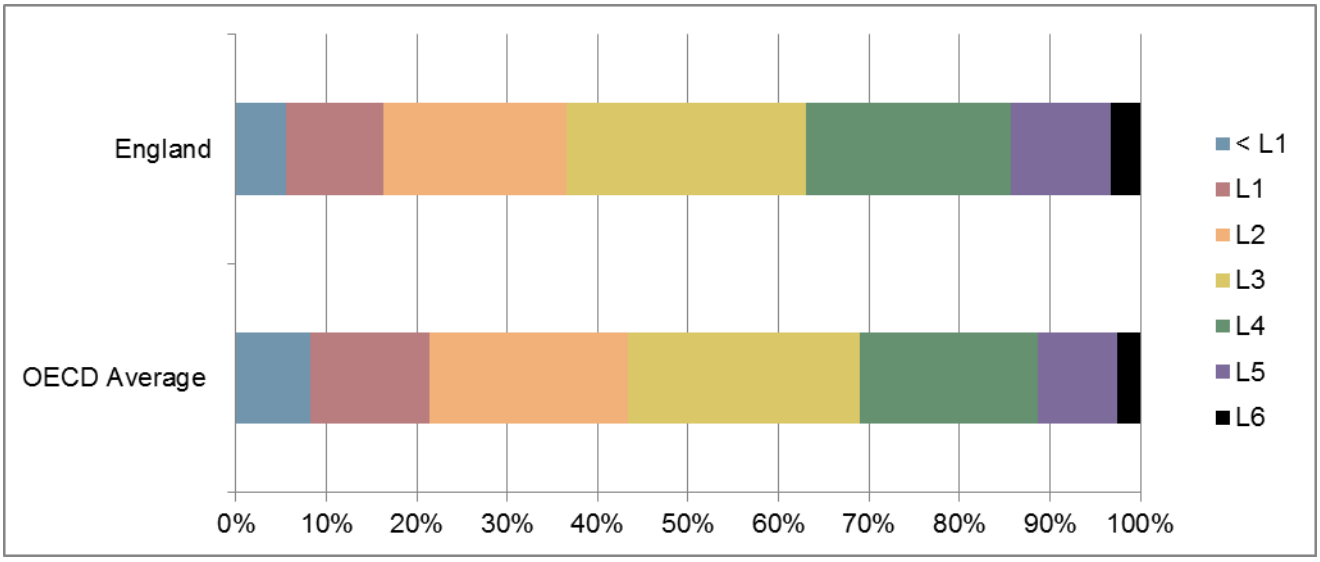
In England 3.3 per cent of pupils achieved PISA Level 6; above the OECD average (2.5 per cent). Combining the two top levels (Level 5 and 6), England is again above the OECD average (14.3 per cent compared with an OECD average of 11.4 per cent). Eleven of the comparison countries had a greater proportion of pupils at these levels, including the seven countries significantly outperforming England in problem solving. Of these, Macao-China was the closest to England, with 16.6 per cent of pupils at these top two levels. Of the other high performers, three had proportions greater than 20 per cent, with Singapore having the greatest percentage of pupils at Levels 5 or 6: 29.3 per cent.

Table 8.5 PISA problem solving proficiency levels

Level	% at this level		What pupils can typically do at each level
	OECD	England	
6	2.5% perform tasks at Level 6	3.3% perform tasks at Level 6	At Level 6, students can develop complete, coherent mental models of diverse problem scenarios, enabling them to solve complex problems efficiently. They can explore a scenario in a highly strategic manner to understand all information pertaining to the problem. The information may be presented in different formats, requiring interpretation and integration of related parts. When confronted with very complex devices, such as home appliances that work in an unusual or unexpected manner, they quickly learn how to control the devices to achieve a goal in an optimal way. Level 6 problem-solvers can set up general hypotheses about a system and thoroughly test them. They can follow a premise through to a logical conclusion or recognise when there is not enough information available to reach one. In order to reach a solution, these highly proficient problem-solvers can create complex, flexible, multi-step plans that they continually monitor during execution. Where necessary, they modify their strategies, taking all constraints into account, both explicit and implicit.
5	11.4% perform tasks at least at Level 5	14.3% perform tasks at least at Level 5	At Level 5, students can systematically explore a complex problem scenario to gain an understanding of how relevant information is structured. When faced with unfamiliar, moderately complex devices, such as vending machines or home appliances, they respond quickly to feedback in order to control the device. In order to reach a solution, Level 5 problem-solvers think ahead to find the best strategy that addresses all the given constraints. They can immediately adjust their plans or backtrack when they detect unexpected difficulties or when they make mistakes that take them off course.
4	31.0% perform tasks at least at Level 4	37.0% perform tasks at least at Level 4	At Level 4, students can explore a moderately complex problem scenario in a focused way. They grasp the links among the components of the scenario that are required to solve the problem. They can control moderately complex digital devices, such as unfamiliar vending machines or home appliances, but they don't always do so efficiently. These students can plan a few steps ahead and monitor the progress of their plans. They are usually able to adjust these plans or reformulate a goal in light of feedback. They can systematically try out different possibilities and check whether multiple conditions have been satisfied. They can form a hypothesis about why a system is malfunctioning, and describe how to test it.

Level	% at this level		What pupils can typically do at each level
	OECD	England	
3	56.6% perform tasks at least at Level 3	63.5% perform tasks at least at Level 3	At Level 3, students can handle information presented in several different formats. They can explore a problem scenario and infer simple relationships among its components. They can control simple digital devices, but have trouble with more complex devices. Problem-solvers at Level 3 can fully deal with one condition, for example, by generating several solutions and checking to see whether these satisfy the condition. When there are multiple conditions or inter-related features, they can hold one variable constant to see the effect of change on the other variables. They can devise and execute tests to confirm or refute a given hypothesis. They understand the need to plan ahead and monitor progress, and are able to try a different option if necessary.
2	78.6% perform tasks at least at Level 2	83.6% perform tasks at least at Level 2	At Level 2, students can explore an unfamiliar problem scenario and understand a small part of it. They try, but only partially succeed, to understand and control digital devices with unfamiliar controls, such as home appliances and vending machines. Level 2 problem-solvers can test a simple hypothesis that is given to them and can solve a problem that has a single, specific constraint. They can plan and carry out one step at a time to achieve a sub-goal, and have some capacity to monitor overall progress towards a solution.
1	91.8% perform tasks at least at Level 1	94.5% perform tasks at least at Level 1	At Level 1, students can explore a problem scenario only in a limited way, but tend to do so only when they have encountered very similar situations before. Based on their observations of familiar scenarios, these students are able only to partially describe the behaviour of a simple, everyday device. In general, students at Level 1 can solve straightforward problems provided there is only a simple condition to be satisfied and there are only one or two steps to be performed to reach the goal. Level 1 students tend not to be able to plan ahead or set sub-goals.

Figure 8.1 Percentage of pupils achieving each PISA level in the 2012 problem solving assessment



8.5 Differences between boys and girls

In England, while boys scored six points higher than girls in problem solving, this difference was not significant. The difference across the OECD, however, was significant, with boys performing better than girls, by seven score points. Among the comparison countries, 14 showed a significant difference favouring boys. Three showed a significant difference favouring girls, and in the remaining 20 there was no significant difference. Among the seven top-performing countries, four showed a significant difference in favour of boys, ranging from nine score points in Singapore to 19 in Japan.

In 30 of the comparison countries, and on average across the OECD, boys were significantly more likely than girls to be performing at or above the problem solving proficiency Level 5. In England there was no such significant difference. In six comparison countries, boys were significantly more likely to be performing below Level 2 than girls, and in three countries, girls were significantly more likely to be performing below Level 2 than boys. Again, there was no significant difference between pupils in England.

With respect to the problem solving processes, across the OECD on average, boys had a significantly greater likelihood of success than girls in three of the four problem solving processes. These were the knowledge-acquisition processes *exploring and understanding* and *representing and formulating* and the knowledge-utilisation process *planning and executing.* For *representing and formulating,* boys in England also had a greater likelihood of success than girls (which was also the case in 19 comparison countries).

The differences in performance between boys and girls can also be examined while accounting for overall differences in performance between boys and girls. This shows that girls in England, and on average across the OECD, perform more strongly on the knowledge utilisation processes (*planning and executing* and *monitoring and reflecting*) than do boys. For *planning and executing*, this was also found to be the case six of the seven countries/economies outperforming England (the difference in Shanghai-China was not significant). For *monitoring and reflecting*, of the seven high performing countries/economies, only Korea and Shanghai-China showed significant differences, which, as found in England, showed girls performing better than boys.

On the knowledge-acquisition process of *representing and formulating* the performance of girls in England was weaker than that of boys. This was also the case across the OECD and for all seven countries/economies which outperformed England. There was no significance in the performance of boys and girls on the other knowledge-acquisition process (*exploring and understanding*) for pupils in England or the OECD on average. For three of the high performing countries/economies, a significant difference was found, showing girls performance to be weaker than boys (in Macao-China, Korea and Hong Kong-China).

8.6 Relationships between Problem Solving and Mathematics, Science and Reading

The problem solving tasks were designed to be answered without relying on curriculum-based knowledge. However, it was expected that high scores on problem solving tasks would be related to high scores on curriculum-based assessments. This is because the skills applied in the problem solving questions would also be required to answer questions which assess curriculum subjects. This is particularly so for PISA where the conceptualisation of mathematical literacy, scientific literacy and reading literacy is assessed by items with real-life contexts. Such questions cannot be answered with subject knowledge alone; a method to solving the question must often be found before the subject knowledge can be applied.

For OECD countries, the correlations between problem solving and the other subjects showed that pupils who do well in problem solving are likely to do well in the other subjects. Table 8.6 shows that the correlations between problem solving, mathematics, science and reading are all stronger in England than the OECD average. The correlations for England and for the OECD show the same pattern of association. For instance, for both England and the OECD, of the three curriculum subjects, mathematics is the one most strongly correlated with problem solving, and reading the least strongly correlated. Table 8.6 also shows that the correlations between problem solving and the three subjects are less strong than the correlations between the three subjects themselves. For example, the correlation between reading and mathematics is stronger than the correlation between problem solving and mathematics.

Table 8.6 Correlations between performance in problem solving, mathematics, science and reading

	Correlation between performance in problem solving and PISA 2012 subjects			**Correlation between performance in PISA 2012 subjects**		
	Mathematics	Reading	Science	Mathematics and reading	Mathematics and science	Reading and science
England	0.86	0.79	0.83	0.90	0.93	0.91
OECD Average	0.81	0.75	0.78	0.85	0.90	0.88

The correlation between mathematics and problem solving is reflected in an analysis of the performance of pupils who score above Level 4 in mathematics. This showed that in England (as well as in Australia and the United States) pupils with strong proficiency in mathematics also perform well in problem solving, and it is because of the strong performers in mathematics that England scored well in problem solving (OECD, 2014, Figure V.2.17 and Table V.2.6).

Nineteen countries had a mean score for problem solving significantly above the OECD average. Of these 19, the international report states that England is one of seven countries/economies with a specific strength in problem solving; the others being Korea, Japan, United States, Italy, Macao-China and Australia. Pupils in England performed better in problem solving than in the other aspects of the PISA 2012 assessment. When comparing the performance of pupils in England

with that of pupils in other countries with the same level of achievement in mathematics, science and reading, English pupils performed significantly better.

In England, 21.1 per cent of pupils were classed as top performers in one of the PISA subjects. This percentage comprised 9.8 per cent of pupils who were top performers in problem solving and at least one other subject, 4.4 per cent who were top performers in problem solving only and 6.8 per cent who were top performers in at least one subject, but not problem solving.

The countries/economies which performed significantly better than England in problem solving also performed better than England in mathematics (Singapore, Korea, Japan, Macao-China, Hong Kong-China, Shanghai-China and Chinese Taipei). As shown in Table 8.7, all but one of the remaining countries which performed better than England in mathematics, performed at the same level as England in problem solving. Italy and the United States also scored at the same level in problem solving, but had achieved a significantly lower score than England in mathematics. Of the countries which scored significantly lower than England in problem solving, Poland is notable as the only country which scored significantly higher in mathematics than England.

When comparing countries' performance on reading with problem solving, the situation is similar to that seen for mathematics. Countries which outperformed England in problem solving also outperformed England in reading. Of the 12 countries which performed at the same level as England, six had outperformed England in reading and two had scored significantly lower in reading than England (Italy and Austria). Again Poland, which had scored significantly higher than England in reading, scored significantly lower than England in problem solving, as did the Republic of Ireland.

England's strong performance in science (compared with mathematics and reading) means the situation is more complicated when looking at the comparison of performance between problem solving and science. Of the seven countries/economies which outperformed England in problem solving, two had performed at the same level as England in science (Macao-China and Chinese Taipei). Three countries which had outperformed England in science were at the same level as England in problem solving, while Poland was again notable as the country which had outperformed England in science, yet scored significantly lower in problem solving. Five countries, including Italy, scored at the same level as England in problem solving, but had been outperformed by England for science.

Table 8.7 Countries' performance in PISA 2012 compared to England ranked by performance in problem solving

	Problem solving	Mathematics	Science	Reading
Singapore	^	^	^	^
Korea	^	^	^	^
Japan	^	^	^	^
Macao-China	^	^	*NS*	^
Hong Kong-China	^	^	^	^
Shanghai-China	^	^	^	^
Chinese Taipei	^	^	*NS*	^
Canada	*NS*	^	^	^
Australia	*NS*	^	*NS*	^
Finland*	*NS*	^	^	^
England				
Estonia*	*NS*	^	^	^
France*	*NS*	*NS*	v	*NS*
Netherlands*	*NS*	^	*NS*	^
Italy*	*NS*	v	v	v
Czech Republic*	*NS*	*NS*	*NS*	*NS*
Germany*	*NS*	^	*NS*	*NS*
United States	*NS*	v	v	*NS*
Belgium*	*NS*	^	v	^
Austria*	*NS*	^	v	v
Norway	v	*NS*	v	*NS*
Republic of Ireland*	v	*NS*	*NS*	^
Denmark*	v	*NS*	v	*NS*
Portugal*	v	*NS*	v	v
Sweden*	v	v	v	v
Russian Federation	v	v	v	v
Slovak Republic*	v	v	v	v
Poland*	v	^	^	^
Spain*	v	v	v	v
Slovenia*	v	*NS*	*NS*	v
Serbia	v	v	v	v
*Croatia**	v	v	v	v
Hungary*	v	v	v	v
Turkey	v	v	v	v
Israel	v	v	v	v
Chile	v	v	v	v
*Cyprus**	v	v	v	v
*Bulgaria**	v	v	v	v

^ Country with a mean score significantly higher than England's
v Country with a mean score significantly lower than England's
NS Country with a mean score not significantly different from England's

8.7 Summary

PISA 2012 was the first round of PISA which featured a computer based assessment of problem solving competency alongside the assessments of mathematics, science and reading.

Pupils in England performed well in the assessment of problem solving. The seven countries outperforming England were the East Asian countries/economies that had also been high achievers in the assessments of mathematics, science and reading.

The difference in scores between the top and bottom five per cent of attainment is in line with the OECD average. Many comparison countries have a smaller gap between these two levels, including all seven comparison countries whose pupils had outperformed pupils in England.

Pupils in England show greater proficiency at problem solving than the average across the OECD. A smaller proportion of pupils in England performed below proficiency Level 1 and greater proportions achieved each of the Levels 1 to 6 than found, on average, across the OECD. However, pupils in the seven highest performing countries, amongst others, continued to show higher levels of achievement than pupils in England.

Across the OECD, boys scored significantly higher than girls; however, this was not found to be the case in England. Some significant differences were found in England for items assessing different problem solving processes, sometimes favouring girls and sometimes boys. There was no strong general trend within or across countries.

Performance in problem solving correlated strongly with performance in the three other subjects assessed in PISA. Correlations were stronger in England than the OECD average. While mathematics was the subject most strongly correlated with problem solving performance, it was still less strong than the correlations between mathematics and either science or reading scores.

Countries outperforming England on problem solving also outperform England in mathematics and reading. For science, of the seven countries that outperformed England in problem solving, only five also outperformed England in science. In comparison with their scores on mathematics, science and reading, pupils in Italy did well on problem solving, achieving a score comparable with England’s. For the other subjects, scores for Italy were significantly below England’s. In contrast, pupils in Poland performed much less well on problem solving: their score was significantly lower than England’s, yet in mathematics, science and reading their score was significantly better than England’s. Pupils in the Republic of Ireland had outperformed pupils in England on reading, and achieved the same level as pupils in England in mathematics and science, but for problem solving their score was significantly lower than England’s.

Overall, pupils in England performed well in the assessment of problem solving competency and were only outperformed by those countries achieving the highest levels of attainment in the curriculum subject assessments in PISA 2012.

References

Bradshaw, J., Sturman, L., Vappula, H., Ager, R. and Wheater, R. (2007). *Achievement of 15-Year-Olds in England: PISA 2006 National Report* (OECD Programme for International Student Assessment). Slough: NFER NFER [online].
Available: http://www.nfer.ac.uk/nfer/publications/NPC02/NPC02.pdf [28 March, 2014].

Bradshaw, J., Ager, R., Burge, B. and Wheater, R. (2010). *PISA 2009: Achievement of 15-Year-Olds in England*. Slough: NFER [online]. Available: http://www.nfer.ac.uk/nfer/publications/NPDZ01/NPDZ01.pdf [28 March, 2014].

Mullis, I., Martin, M., Foy, P. and Drucker, K. (2012). *PIRLS 2011 International Results in Reading.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center,

Lynch School of Education, Boston College [online]. Available: http://timss.bc.edu/pirls2011/downloads/P11_IR_FullBook.pdf [28 March, 2014].

Mullis, I.V.S., Martin, M.O., Foy, P. and Drucker, K.T. (2012). *PIRLS 2011 International Results in Reading*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College [online]. Available: http://timss.bc.edu/pirls2011/international-results-pirls.html [28 March, 2014].

OECD (2013). 'PISA 2012 mathematics framework.' In: *PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy.* Paris: OECD Publishing [online]. Available: http://www.oecd.org/pisa/pisaproducts/PISA%202012%20framework%20e-book_final.pdf [28 March, 2014].

OECD (2013). *PISA 2012 Results: Ready to Learn: Students' Engagement, Drive and Self-Beliefs (Volume III).* Paris: OECD [online]. Available: http://www.oecd.org/pisa/keyfindings/pisa-2012-results-volume-iii.htm [28 March, 2014].

OECD (forthcoming). *PISA 2012 Technical Report*. Paris: OECD.

OECD (2014). *PISA 2012 Results: Creative Problem Solving: Students' Skills in Tackling Real-Life Problems (Volume V)*. Paris: OECD [online]. Available: http://www.oecd-ilibrary.org/education/pisa-2012-results-skills-for-life-volume-v_9789264208070-en [28 March, 2014].

Sturman, L., Burge, B., Cook, R. and Weaving, H. (2012). *TIMSS 2011:Mathematics and Science Achievement in England.* Slough: NFER [online]. Available: http://www.nfer.ac.uk/nfer/publications/TMEZ01/TMEZ01.pdf [28 March, 2014].

Appendix A Background to the survey

The Programme for International Student Assessment (PISA) is a survey of educational achievement organised by the Organisation for Economic Co-operation and Development (OECD). The following sections outline the development of the survey, what PISA measures, how to interpret the PISA scales, how PISA is administered and details of the PISA sample in England. These sections outline some of the detailed international requirements that countries must meet in order to ensure confidence in the findings.

A1 The development of the survey

The Australian Council for Educational Research (ACER) led the international consortium that designed and implemented the PISA 2012 survey on behalf of the OECD. The 2012 survey built on the experiences of the three previous cycles. By using standardised survey procedures and tests, the survey aims to collect data from around the world that can be compared despite differences in language and culture.

The framework and specification for the survey were agreed internationally by the PISA Governing Board, which comprises of representatives from each participating country, and both the international consortium and participating countries submitted test questions for inclusion in the survey. After the questions were reviewed by an expert panel (convened by the international PISA consortium), countries were invited to comment on their difficulty, cultural appropriateness, and curricular and non-curricular relevance.

A field trial was carried out in every participating country in 2011 and the outcomes of this were used to finalise the contents and format of the tests and questionnaires for the main survey in 2012.

In England, Wales and Northern Ireland, pupils sat the two-hour assessment in November 2012 under test conditions, following the standardised procedures implemented by all countries. In Scotland, the PISA survey was carried out earlier in 2012. With the focus in this round on mathematics, around two-thirds of the questions were on this subject. A proportion of the questions used in the two-hour test were ones used in previous cycles. This provides continuity between cycles that can act as a measure of change. Further details on the test administration are included in A4 below.

Strict international quality standards are applied to all stages of the PISA survey to ensure equivalence in translation and adaptation of instruments, sampling procedures and survey administration in all participating countries.

A2 What PISA measures

This section briefly describes the purposes of the assessment of mathematics, science and reading in PISA 2012. Full details of the framework for the assessment of each subject are in OECD 2012.

A2.1 Mathematics

Mathematics was the main focus in the 2012 and 2003 PISA surveys.

PISA aims to assess pupils' ability to put their mathematical knowledge to functional use in different situations in adult life, rather to assess what is taught in participating countries. Although PISA does not aim to assess mastery of a curriculum, further analysis of PISA items against the Key Stage 3 and Key Stage 4 curricula in England has shown a good match between the PISA processes and concepts in mathematics and the range of knowledge, skills and understanding in the National Curriculum (Burdett and Sturman, 2012).

PISA defines this ability as:

> *an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals in recognising the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens.* (OECD, 2013)

In order to demonstrate this capacity, pupils need to have factual knowledge of mathematics, skills to carry out mathematical operations and methods, and an ability to combine these elements creatively in response to external situations.

PISA recognises the limitations of using a timed assessment in collecting information about something as complex as mathematics in this large-scale survey. It aims to tackle this by having a balanced range of questions that assess different elements of the pupil's mathematical processing ability. This is the process through which a pupil interprets a problem as mathematical and draws on his/her mathematical knowledge and skills to provide a sensible solution to the problem.

PISA prefers context-based questions which require the pupil to engage with the situation and decide how to solve the problem. Most value is placed on tasks that could be met in the real world, in which a person would authentically use mathematics and appropriate mathematical tools, such as a ruler or calculator in a paper based assessment, to solve these problems. Some more abstract questions that are purely mathematical are also included in the PISA survey.

Pupils were asked to show their responses to questions in different ways. About a third of the questions were open response which required the pupils to develop their own responses. These questions tended to assess broad mathematical constructs. A question in this category typically accepted several different responses as correct and worthy of marks. The rest of the questions were either multiple choice or simple open response questions, with approximately the same number of each. These questions, which tended to assess lower-order skills, had only one correct response. Some examples of PISA mathematics questions are included in Chapter 2.

A2.2 Science

Science was the main focus in PISA 2006 and a minor domain in 2012. It will be the main focus of PISA 2015.

The survey aims to measure not just science as it may be defined within the curriculum of participating countries, but the scientific understanding which is needed in adult life. PISA defines this as the capacity to identify questions, acquire new knowledge, explain scientific phenomena, and draw evidence-based conclusions about science-related issues (OECD, 2007). Those with this capacity also understand the characteristic features of science as a form of human knowledge and enquiry, are aware of how science and technology shape their lives and environments, and are willing and able to engage in science-related issues and with the ideas of science, as a reflective citizen. Therefore, PISA assessments measure not only scientific knowledge, but also scientific competencies and understanding of scientific contexts.

Scientific knowledge constitutes the links that aid understanding of related phenomena. In PISA, while the scientific concepts are familiar (relating to physics, chemistry, biological sciences and earth and space sciences), pupils are asked to *apply* them to the content of the test items and not simply to recall facts.

Scientific competencies are centred on the ability to acquire, interpret and act upon evidence. Three processes are identified in PISA: firstly, identifying scientific issues; secondly, explaining phenomena scientifically; and, thirdly, using scientific evidence.

Scientific contexts concern the application of scientific knowledge and the use of scientific processes. This covers personal, social and global contexts.

The science questions in PISA 2012 were of three types: open constructed response items which required pupils to write longer answers; short open response which required answers of a few words; or closed response (e.g. multiple choice). Approximately a third were of the longer open constructed type which required pupils to develop and explain their response. Such questions were generally two or three mark items.

Although PISA does not aim to assess mastery of a curriculum, further analysis of PISA items against the Key Stage 3 and Key Stage 4 curricula in England has shown a good match between the content areas in PISA science and the range of knowledge, skills and understanding in the National Curriculum (Burdett and Sturman, 2012).

A2.3 Reading

Reading was the main focus in the first PISA study in 2000 and also in 2009. It was a minor domain in PISA 2012.

Reading in PISA focuses on the ability of pupils to use information from texts in situations which they encounter in their life. Reading in PISA is defined as ‘understanding, using, reflecting on and engaging with written texts, in order to achieve one’s goals, to develop one’s knowledge and potential, and to participate in society’ (OECD, 2009).

The concept of reading in PISA is defined by three dimensions: the format of the reading material, the type of reading task or reading aspects, and the situation or the use for which the text was constructed.

The first dimension, the text format, divides the reading material or texts into continuous and non-continuous texts. Continuous texts are typically composed of sentences which are organised into paragraphs. Non-continuous texts are not organised in this type of linear format and may require, for example, interpretation of tables or diagrams. Such texts require a different reading approach to that needed with continuous text.

The second dimension is defined by three reading aspects: retrieval of information, interpretation of texts and reflection on and evaluation of texts. Tasks in which pupils retrieve information involve finding single or multiple pieces of information in a text. In interpretation tasks pupils are required to construct meaning and draw inferences from written information. The third type of task requires pupils to reflect on and evaluate texts. In these tasks pupils need to relate information in a text to their prior knowledge, ideas and experiences.

The third dimension is that of situation or context. The texts in the PISA assessment are categorised according to their content and the intended purpose of the text. There are four situations: reading for private use (personal), reading for public use, reading for work (occupational) and reading for education.

The reading items included in PISA 2012 were of three types: open constructed response, short open response or closed response (e.g. multiple choice). Approximately half the questions were of the open response type, while the rest were closed response. Approximately a third were of the longer open constructed type which required pupils to develop and explain their response. Such questions were generally two or three mark questions. The remainder of the open response questions required only short answers.

A2.4 Problem solving

The computer based assessment of problem solving was new to PISA 2012. There was a paper based assessment of problem solving in PISA 2003, in which the UK did not participate.

The tasks included in the assessment were intended to measure an individual's capacity to recognise a problem, plan and carry out actions to address it and monitor and evaluate progress to reaching a solution. In order to assess problem solving, items were designed to be independent of knowledge of curriculum subjects.

The PISA framework for assessing problem solving competency identifies three aspects: the nature of the problem situation, the problem solving processes used to find a solution and the problem context. These are explained below.

The nature of the problem situation can be conceived as having one of two forms: it can be *interactive*, where some information has to be uncovered by exploring the problem situation or *static* where all relevant information for solving the problem is disclosed at the outset.

The four problem solving processes are:

- *exploring and understanding* the information provided with the problem,
- *representing and formulating*: constructing graphical, tabular, symbolic or verbal representations of the problem situation and formulating hypotheses about the relevant factors and relationships between them,
- *planning and executing*: devising a plan by setting goals and sub-goals, and executing the sequential steps identified in the plan,
- *monitoring and reflecting*: monitoring progress, reacting to feedback, and reflecting on the solution, the information provided with the problem, or the strategy adopted.

The problem contexts for the items were designed around everyday situations and were classified by whether they involved technological devices (such as a digital clock or ticket machine) and whether the problem was in a personal or social environment. Contexts considered personal involved the self, family or close peers, while social ones involved the community of society in general.

A variety of response formats were used, including many that were only possible because it was a computer based assessment (such as choosing from drop down menus).

A3 What the scales mean

PISA uses proficiency levels to describe the types of skills that pupils are likely to demonstrate and the tasks that they are able to complete. Test questions that focus on simple tasks are categorised at lower levels whereas those that are more demanding are categorised at higher levels. The question categorisations are based on both quantitative and qualitative analysis, taking into account question difficulty as well as expert views on the specific cognitive demands of each individual question. All PISA questions have been categorised in this manner.

Pupils described as being at a particular level not only demonstrate the knowledge and skills associated with that level but also the proficiencies required at lower levels. For example, all pupils proficient at Level 3 are also considered to be proficient at Levels 1 and 2. The proficiency level of a pupil is the highest level at which they answer more than half of the questions correctly.

The table below shows the score points for each level in each subject.

	Below Level 1	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**
Science	below 335	335-410	410-484	484-559	559-633	633-708	above 708
Mathematics	below 358	358-420	420-482	482-545	545-607	607-669	above 669
Problem solving	below 358	358-422	423-487	488-552	553-617	618-682	above 682

	Below Level 1b	Level 1b	Level 1a	Level 2	Level 3	Level 4	Level 5	Level 6
Reading	below 262	262-335	335-407	407-480	480-553	553-626	626-698	above 698

Every cycle of PISA focuses on a different subject and no one pupil is presented with all PISA questions. Instead, statistical methods are used to estimate the likelihood that the pupil would be able to answer correctly the questions which they have not actually done.

The mean score for each subject scale was set to 500 among OECD countries in the PISA cycle when the subject was the major domain for the first time. Thus, the reading scale was set to 500 in its first year in 2000. Similarly the mathematics scale was set to 500 in 2003 and the science scale was set to a mean of 500 in 2006. The mean for problem solving was set to 500 for PISA 2012. The method by which these scales are derived is explained further in Appendix F and in the PISA Technical Report (OECD, forthcoming).

As with any repeated measurement that uses samples, the mean will vary slightly from year to year without necessarily indicating any real change in the global level of skills.

A4 Survey administration

The survey administration was carried out internationally on behalf of OECD by a consortium led by the Australian Council for Educational Research (ACER). The consortium worked with the PISA National Centre within each country, through the National Project Manager (NPM). For England, Wales, Northern Ireland and Scotland, the National Foundation for Educational Research (NFER) was the PISA National Centre.

National Centres were responsible for making local adaptations to instruments and manuals and for translation where necessary. NFER made appropriate adaptations to all PISA instruments and accompanying documentation. All materials were translated into Welsh and pupils in Wales were asked to choose the language in which they wished to complete tests and questionnaires.

National Centres were also responsible for supplying the information necessary for sampling to be carried out. School samples were selected by the PISA consortium, while pupil samples within schools were selected by NFER using software supplied by the consortium.

Test items were organised into 13 test booklets with items repeated across booklets. Approximately half the total test items assessed mathematics while the others were divided between science and reading. All pupils were assessed in mathematics, which was the main focus of PISA 2012. Random sub-samples of pupils were also assessed in science and reading, with approximately 70 per cent of pupils taking the tests in each. In addition to the tests, there was a School Questionnaire and three Student Questionnaires. Each pupil completed one questionnaire. All Student Questionnaires contained a set of core questions that asked about pupils'

backgrounds. The remaining questions were divided into three sets of questions and pupils answered two of the three sets of questions.

Tests and questionnaires were generally administered to pupils in a single session, with a two-hour period for the tests and approximately half an hour, in addition, for completion of the student questionnaire. The total length of a survey session was around three and a half hours. The survey was administered by test administrators employed and trained by NFER. In England, up to 14 students per school that participated in the problem solving assessment usually returned for one hour in the afternoon to carry out the assessment.

In each country participating in PISA, the minimum number of participating schools was 150, and the minimum number of pupils 4500. In the case of the UK and of some other countries, the number exceeds this. In some cases this is due to the need to over-sample some parts of the country. In the case of the UK, for example, larger samples were drawn for Wales, Scotland and Northern Ireland than would be required for a representative UK sample. This was to make it possible to provide separate PISA results for the four constituent parts of the UK. In some countries additional samples were drawn for other purposes, for example to enable reporting of results for a sub-group such as a separate language group. In very small countries with less than 150 schools the survey was completed as a school census with all secondary schools included.

The pupils included in the PISA survey are generally described as ‘15-year-olds’, but there is a small amount of leeway in this definition depending on the time of testing. In the case of England, Wales and Northern Ireland the sample consisted of pupils aged from 15 years and two months to 16 years and two months at the beginning of the testing period.

Countries were required to carry out the survey during a six-week period between March and August 2012. However England, Wales and Northern Ireland were permitted to test outside this period because of the problems for schools caused by the overlap with the GCSE preparation and examination period. In England, Wales and Northern Ireland the survey took place in November-December 2012.

A5 The PISA sample

Countries must follow strict international sampling procedures to ensure comparability of countries’ samples. The first stage of sampling was agreement of the school stratification variables to be used for each country. Table A.1 shows the variables which were used for sampling of schools in England for PISA 2012.

Table A.1 Stratification variables for England

Variables	Levels
School type	Maintained selective Maintained non-selective Independent
Region	North Midlands South Greater London
Gender	Male Female Mixed
GCSE school performance	Band 1 (lowest) Band 2 Band 3 Band 4 Band 5 (highest) Band not known
Local Authority	Varies within region

Countries are allowed to exempt schools from the sampling frame if it is expected that the majority of pupils would not be eligible to participate in PISA (see below). In England, special schools and Pupil Referral Units were excluded from the sampling frame on this basis.

Following agreement of the sampling plan and the establishment of population estimates in the age group, the list of all eligible schools and their populations was sent to the PISA consortium. The consortium carried out the school sampling then sent the list of selected schools back to NFER.

The schools which had been selected in the sample were then invited to participate, and those which agreed were asked to supply details of all pupils who would be in Year 11 at the time of the beginning of the PISA survey period in November 2012. In addition they were asked to supply details of any who were born in the relevant period but were in other year groups.

When the pupil data was obtained from schools, the Keyquest software supplied by the PISA consortium was used to randomly select 30 pupils within each school from those who met the PISA age definition.

The PISA study has strict sampling requirements regarding both the participation rate which is acceptable and the replacement of schools which decline. Within each country three separate samples are selected, the first being the main sample and the other two back-up samples. In the back-up samples each school is a replacement for a specific school in the main sample. So, if a main sample school declines to participate, there are two other schools which can be used as

replacements for that school. In England, for PISA 2012, there were 192 schools in the main sample, with a corresponding number in each back-up sample.

School recruitment is an issue to which particular attention has to be given in PISA. According to the PISA sampling rules, an acceptable school response in the main sample is 85 per cent. If the response from the main sample meets this percentage, replacement of non-participating schools is not necessary. If the response from the main sample is below this percentage, but above 65 per cent, it is still possible to achieve an acceptable response by using replacement schools from the back-up samples. However, the target then moves upwards – for example, with a main sample response of 70 per cent, the after-replacement target is 94 per cent.

There is also a response rate requirement for pupils within each school. It is possible for pupils to be excluded from participation and not counted within the total because they have special needs such that they could not participate, because they have limited language skills, or because they are no longer at the school. The remaining pupils are deemed eligible for PISA participation, and at least 50 per cent of these must participate for the school to be counted as a participating school.

In England, a total of 170 schools and 4185 pupils took part in PISA 2012. The required pupil participation rate, of at least 50 per cent of sampled pupils, was achieved in all but one participating school. The final response rate for England was 77.6 per cent of main sample schools and 88.0 per cent after replacement. Not all students that participated in PISA 2012 participated in the assessment of problem solving. In England, a total of 1458 pupils in 137 schools completed the assessment of problem solving.

The international response rate for the United Kingdom is calculated based on the results for England, Wales, Northern Ireland and Scotland, with weighting according to the population in each country as well as school size. The school response rate for the England, Wales and Northern Ireland combined sample was 78.5 per cent of main sample schools, and 88.3 per cent after replacement. This fully met the PISA 2012 participation requirements and so NFER were not required to carry out non-response bias analysis.

The final response requirement was for the total number of participating pupils, and the target here was for 80 per cent overall. Across England, Wales and Northern Ireland, the pupil response rate target was met with a final weighted response rate of 86.4 per cent. A total of 396 schools and 9714 pupils participated across England, Wales and Northern Ireland. This is a good response rate and means that UK findings are regarded by PISA as fully comparable with other countries.

Appendix B

B1 Significant differences in mean scores on the mathematics scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	613	(3.3)	^
Singapore	573	(1.3)	^
Hong Kong-China	561	(3.2)	^
Chinese Taipei	560	(3.3)	^
Korea	554	(4.6)	^
Macao-China	538	(1.0)	^
Japan	536	(3.6)	^
Liechtenstein	535	(4.0)	^
Switzerland	531	(3.0)	^
Netherlands*	523	(3.5)	^
Estonia*	521	(2.0)	^
Finland*	519	(1.9)	^
Canada	518	(1.8)	^
Poland*	518	(3.6)	^
Belgium*	515	(2.1)	^
Germany*	514	(2.9)	^
Vietnam	511	(4.8)	^
Austria*	506	(2.7)	^
Australia	504	(1.6)	^
Republic of Ireland*	501	(2.2)	*NS*
Slovenia*	501	(1.2)	*NS*
Denmark*	500	(2.3)	*NS*
New Zealand	500	(2.2)	*NS*
Czech Republic*	499	(2.9)	*NS*
Scotland	498	(2.6)	*NS*
England	495	(3.9)	
France*	495	(2.5)	*NS*
United Kingdom*	494	(3.3)	
OECD Average	**494**	**(0.5)**	*NS*
Iceland	493	(1.7)	*NS*
*Latvia**	491	(2.8)	*NS*
Luxembourg*	490	(1.1)	*NS*
Norway	489	(2.7)	*NS*
Portugal*	487	(3.8)	*NS*
Northern Ireland	487	(3.1)	*NS*
Italy*	485	(2.0)	v
Spain*	484	(1.9)	v
Russian Federation	482	(3.0)	v
Slovak Republic*	482	(3.4)	v
United States	481	(3.6)	v
*Lithuania**	479	(2.6)	v
Sweden*	478	(2.3)	v
Hungary*	477	(3.2)	v
*Croatia**	471	(3.5)	v
Wales	468	(2.2)	v
Israel	466	(4.7)	v
Greece*	453	(2.5)	v
Serbia	449	(3.4)	v
Turkey	448	(4.8)	v
*Romania**	445	(3.8)	v
Cyprus	440	(1.1)	v
*Bulgaria**	439	(4.0)	v
United Arab Emirates	434	(2.4)	v
Kazakhstan	432	(3.0)	v
Chile	423	(3.1)	v
Mexico	413	(1.4)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^	significantly higher
NS	no significant difference
v	significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B2 Mean score, variation and gender differences in student performance on the mathematics scale

	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean score	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	504	(1.6)	96	(1.2)	510	(2.4)	498	(2.0)	**12**	(3.1)	348	(2.9)	382	(2.3)	437	(2.0)	571	(2.3)	630	(3.0)	663	(3.4)	315
Austria*	506	(2.7)	92	(1.7)	517	(3.9)	494	(3.3)	**22**	(4.9)	353	(4.1)	384	(3.9)	440	(3.2)	572	(3.5)	624	(3.8)	654	(4.3)	301
Belgium*	515	(2.1)	102	(1.4)	518	(2.8)	512	(2.6)	6	(3.4)	343	(4.5)	378	(4.0)	444	(3.1)	589	(2.4)	646	(2.7)	677	(2.9)	335
*Bulgaria**	439	(4.0)	94	(2.2)	438	(4.7)	440	(4.2)	-2	(4.1)	290	(5.7)	320	(4.8)	372	(4.7)	503	(5.2)	565	(5.6)	597	(6.2)	307
Canada	518	(1.8)	89	(0.8)	523	(2.1)	513	(2.1)	**10**	(2.0)	370	(2.8)	402	(2.4)	457	(2.1)	580	(2.3)	633	(2.3)	663	(2.7)	293
Chile	423	(3.1)	81	(1.5)	436	(3.8)	411	(3.1)	**25**	(3.6)	299	(4.1)	323	(3.7)	365	(3.5)	476	(4.2)	532	(4.2)	563	(4.1)	264
Chinese Taipei	560	(3.3)	116	(1.9)	563	(5.4)	557	(5.7)	5	(8.9)	363	(5.6)	402	(4.8)	478	(4.8)	645	(3.4)	703	(4.9)	738	(5.1)	375
*Croatia**	471	(3.5)	88	(2.5)	477	(4.4)	465	(3.7)	**12**	(4.1)	334	(4.2)	360	(3.3)	408	(3.6)	531	(4.5)	589	(7.3)	623	(8.8)	289
Cyprus	440	(1.1)	93	(0.8)	440	(1.5)	440	(1.6)	0	(2.2)	287	(2.8)	320	(2.6)	376	(1.6)	503	(2.0)	561	(2.1)	595	(3.1)	308
Czech Republic*	499	(2.9)	95	(1.6)	505	(3.7)	493	(3.6)	**12**	(4.6)	344	(6.4)	377	(4.9)	432	(3.9)	566	(3.3)	621	(3.6)	653	(4.0)	309
Denmark*	500	(2.3)	82	(1.3)	507	(2.9)	493	(2.3)	**14**	(2.3)	363	(4.6)	393	(4.0)	444	(3.3)	556	(2.7)	607	(3.1)	635	(4.2)	272
England	495	(3.9)	96	(2.0)	502	(5.0)	489	(4.5)	**13**	(5.5)	335	(5.7)	370	(6.0)	430	(5.0)	562	(4.2)	618	(4.9)	652	(5.8)	316
Estonia*	521	(2.0)	81	(1.2)	523	(2.6)	518	(2.2)	**5**	(2.6)	389	(3.5)	417	(3.0)	465	(2.7)	576	(2.7)	626	(3.2)	657	(4.1)	268
Finland*	519	(1.9)	85	(1.2)	517	(2.6)	520	(2.2)	-3	(2.9)	376	(4.5)	409	(3.3)	463	(2.5)	577	(2.4)	629	(3.1)	657	(3.2)	281
France*	495	(2.5)	97	(1.7)	499	(3.4)	491	(2.5)	**9**	(3.4)	330	(5.0)	365	(4.7)	429	(2.7)	565	(3.4)	621	(3.5)	652	(3.7)	321
Germany*	514	(2.9)	96	(1.6)	520	(3.0)	507	(3.4)	**14**	(2.8)	353	(5.4)	385	(4.7)	447	(3.6)	583	(3.6)	637	(3.8)	667	(4.1)	314
Greece*	453	(2.5)	88	(1.3)	457	(3.3)	449	(2.6)	**8**	(3.2)	308	(4.6)	338	(3.8)	393	(3.6)	513	(2.8)	567	(3.1)	597	(3.7)	289
Hong Kong-China	561	(3.2)	96	(1.9)	568	(4.6)	553	(3.9)	**15**	(5.7)	391	(5.9)	430	(6.2)	499	(4.7)	629	(3.5)	679	(4.2)	709	(4.3)	318
Hungary*	477	(3.2)	94	(2.4)	482	(3.7)	473	(3.6)	**9**	(3.7)	327	(4.6)	358	(4.2)	411	(3.3)	540	(4.8)	603	(6.4)	637	(7.9)	310
Iceland	493	(1.7)	92	(1.3)	490	(2.3)	496	(2.3)	**-6**	(3.0)	339	(4.1)	372	(2.8)	431	(2.6)	557	(3.0)	612	(3.3)	641	(3.7)	302
Israel	466	(4.7)	105	(1.8)	472	(7.8)	461	(3.5)	12	(7.6)	292	(7.3)	328	(5.7)	393	(5.1)	541	(5.3)	603	(6.0)	639	(6.1)	347
Italy*	485	(2.0)	93	(1.1)	494	(2.4)	476	(2.2)	**18**	(2.5)	333	(2.6)	366	(2.2)	421	(2.3)	550	(2.7)	607	(3.0)	639	(3.4)	306
Japan	536	(3.6)	94	(2.2)	545	(4.6)	527	(3.6)	**18**	(4.3)	377	(6.1)	415	(5.1)	473	(4.2)	603	(4.4)	657	(5.1)	686	(5.5)	309
Kazakhstan	432	(3.0)	71	(1.8)	432	(3.4)	432	(3.3)	0	(2.9)	319	(3.1)	343	(2.5)	383	(2.8)	478	(4.4)	527	(5.7)	554	(6.0)	235
Korea	554	(4.6)	99	(2.1)	562	(5.8)	544	(5.1)	**18**	(6.2)	386	(7.4)	425	(5.8)	486	(4.8)	624	(5.1)	679	(6.0)	710	(7.5)	323
*Latvia**	491	(2.8)	82	(1.5)	489	(3.4)	493	(3.2)	-4	(3.6)	360	(4.8)	387	(4.4)	434	(3.3)	546	(3.8)	597	(3.7)	626	(4.6)	266
Liechtenstein	535	(4.0)	95	(3.7)	546	(6.0)	523	(5.8)	**23**	(8.8)	370	(16.8)	403	(11.2)	470	(8.0)	606	(5.0)	656	(9.2)	680	(12.5)	310
*Lithuania**	479	(2.6)	89	(1.4)	479	(2.8)	479	(3.0)	0	(2.4)	334	(3.9)	364	(3.5)	418	(3.1)	540	(3.3)	596	(3.5)	627	(4.0)	293
Luxembourg*	490	(1.1)	95	(0.9)	502	(1.5)	477	(1.4)	**25**	(2.0)	334	(3.3)	363	(3.0)	422	(1.5)	558	(1.6)	613	(2.2)	644	(2.3)	310
Macao-China	538	(1.0)	94	(0.9)	540	(1.4)	537	(1.3)	3	(1.9)	379	(3.9)	415	(2.8)	476	(1.7)	605	(1.7)	657	(2.3)	685	(2.4)	306
Mexico	413	(1.4)	74	(0.7)	420	(1.6)	406	(1.4)	**14**	(1.2)	295	(1.8)	320	(1.9)	362	(1.6)	462	(1.7)	510	(2.0)	539	(2.1)	245
Netherlands*	523	(3.5)	92	(2.1)	528	(3.6)	518	(3.9)	**10**	(2.8)	367	(4.8)	397	(5.5)	457	(5.1)	591	(4.3)	638	(3.7)	665	(4.0)	297
New Zealand	500	(2.2)	100	(1.2)	507	(3.2)	492	(2.9)	**15**	(4.3)	340	(4.9)	371	(3.6)	428	(3.2)	570	(2.8)	632	(3.0)	665	(4.4)	325
Northern Ireland	487	(3.1)	93	(2.0)	492	(5.0)	481	(5.4)	10	(8.3)	332	(6.9)	365	(6.2)	422	(3.7)	553	(4.2)	609	(5.5)	638	(3.9)	305
Norway	489	(2.7)	90	(1.3)	490	(2.8)	488	(3.4)	2	(3.0)	341	(5.1)	373	(3.9)	428	(2.9)	552	(3.3)	604	(3.4)	638	(5.1)	297
Poland*	518	(3.6)	90	(1.9)	520	(4.3)	516	(3.8)	4	(3.4)	373	(3.9)	402	(2.8)	454	(3.3)	580	(4.9)	636	(6.0)	669	(7.1)	296
Portugal*	487	(3.8)	94	(1.4)	493	(4.1)	481	(3.9)	**11**	(2.5)	333	(4.5)	363	(4.2)	421	(5.0)	554	(4.3)	610	(3.9)	640	(4.1)	307
Republic of Ireland*	501	(2.2)	85	(1.3)	509	(3.3)	494	(2.6)	**15**	(3.8)	359	(5.0)	391	(3.6)	445	(3.2)	559	(2.4)	610	(2.5)	640	(3.2)	280
*Romania**	445	(3.8)	81	(2.2)	447	(4.3)	443	(4.0)	4	(3.6)	322	(3.9)	344	(3.5)	386	(3.8)	497	(4.8)	553	(6.1)	588	(7.4)	266
Russian Federation	482	(3.0)	86	(1.6)	481	(3.7)	483	(3.1)	-2	(3.0)	341	(4.2)	371	(3.9)	423	(3.1)	540	(3.6)	595	(4.7)	626	(5.3)	285
Scotland	498	(2.6)	86	(1.6)	506	(3.0)	491	(3.2)	**14**	(3.3)	358	(4.8)	388	(4.7)	439	(3.5)	558	(3.1)	611	(3.7)	640	(4.8)	282
Serbia	449	(3.4)	91	(2.2)	453	(4.1)	444	(3.7)	**9**	(3.9)	306	(4.4)	335	(4.1)	386	(3.7)	508	(4.4)	567	(5.8)	603	(6.7)	296
Shanghai-China	613	(3.3)	101	(2.3)	616	(4.0)	610	(3.4)	6	(3.3)	435	(6.9)	475	(5.8)	546	(4.4)	685	(3.5)	737	(3.5)	765	(5.6)	331
Singapore	573	(1.3)	105	(0.9)	572	(1.9)	575	(1.8)	-3	(2.5)	393	(3.6)	432	(3.6)	501	(2.7)	650	(1.9)	707	(2.3)	737	(2.5)	344
Slovak Republic*	482	(3.4)	101	(2.5)	486	(4.1)	477	(4.1)	**9**	(4.5)	314	(6.7)	352	(6.2)	413	(4.2)	553	(4.7)	613	(5.3)	647	(6.7)	334
Slovenia*	501	(1.2)	92	(1.0)	503	(2.0)	499	(2.0)	3	(3.1)	357	(3.9)	384	(2.5)	434	(2.0)	566	(2.1)	624	(2.9)	655	(4.3)	298
Spain*	484	(1.9)	88	(0.7)	492	(2.4)	476	(2.0)	**16**	(2.2)	339	(3.6)	370	(3.1)	424	(2.6)	546	(2.1)	597	(2.4)	626	(2.0)	287
Sweden*	478	(2.3)	92	(1.3)	477	(3.0)	480	(2.4)	-3	(3.0)	329	(4.4)	360	(3.5)	415	(2.9)	543	(2.7)	596	(2.9)	627	(3.6)	298
Switzerland	531	(3.0)	94	(1.5)	537	(3.5)	524	(3.1)	**13**	(2.7)	374	(3.9)	408	(3.3)	466	(3.4)	597	(3.6)	651	(4.3)	681	(4.7)	308
Turkey	448	(4.8)	91	(3.1)	452	(5.1)	444	(5.7)	8	(4.7)	313	(4.3)	339	(3.3)	382	(3.6)	507	(8.0)	577	(9.7)	614	(9.4)	302
United Arab Emirates	434	(2.4)	90	(1.2)	432	(3.8)	436	(3.0)	-5	(4.7)	297	(3.0)	323	(2.5)	370	(2.9)	494	(2.9)	555	(3.9)	591	(3.4)	294
United Kingdom*	494	(3.3)	95	(1.7)	500	(4.2)	488	(3.8)	**12**	(4.7)	336	(4.7)	371	(5.0)	429	(4.2)	560	(3.7)	616	(4.1)	648	(5.1)	312
United States	481	(3.6)	90	(1.3)	484	(3.8)	479	(3.9)	5	(2.8)	339	(4.2)	368	(3.9)	418	(3.7)	543	(4.4)	600	(4.3)	634	(5.4)	295
Vietnam	511	(4.8)	86	(2.7)	517	(5.6)	507	(4.7)	**10**	(3.0)	371	(8.1)	401	(7.4)	454	(5.3)	568	(5.5)	623	(6.8)	654	(7.9)	283
Wales	468	(2.2)	85	(1.3)	473	(2.6)	464	(2.9)	**9**	(3.4)	329	(4.9)	360	(3.6)	410	(2.7)	526	(2.8)	578	(3.4)	610	(5.0)	281
OECD average	494	(0.5)	92	(0.3)	499	(0.6)	489	(0.5)	**11**	(0.6)	343	(0.8)	375	(0.7)	430	(0.6)	558	(0.6)	614	(0.7)	645	(0.8)	301

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

14 countries with scores below 430 omitted

Note: Values that are statistically significant are indicated in bold

B3 Mean performance on each mathematics content category sub-scale

	Mean Score									
	Overall mathematics score		Quantity		Uncertainty and data		Change and relationships		Space and shape	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Australia	504	(1.6)	500	(1.9)	508	(1.5)	509	(1.7)	497	(1.8)
Austria*	506	(2.7)	510	(2.9)	499	(2.7)	506	(3.4)	501	(3.1)
Belgium*	515	(2.1)	519	(2.0)	508	(2.5)	513	(2.6)	509	(2.4)
*Bulgaria**	439	(4.0)	443	(4.3)	432	(3.9)	434	(4.5)	442	(4.3)
Canada	518	(1.8)	515	(2.2)	516	(1.8)	525	(2.0)	510	(2.1)
Chile	423	(3.1)	421	(3.3)	430	(2.9)	411	(3.5)	419	(3.2)
Chinese Taipei	560	(3.3)	543	(3.1)	549	(3.2)	561	(3.5)	592	(3.8)
*Croatia**	471	(3.5)	480	(3.7)	468	(3.5)	468	(4.2)	460	(3.9)
Cyprus	440	(1.1)	439	(1.1)	442	(1.1)	440	(1.2)	436	(1.1)
Czech Republic*	499	(2.9)	505	(3.0)	488	(2.8)	499	(3.5)	499	(3.4)
Denmark*	500	(2.3)	502	(2.4)	505	(2.4)	494	(2.7)	497	(2.5)
England	495	(3.9)	495	(4.5)	503	(3.6)	498	(4.1)	477	(4.1)
Estonia*	521	(2.0)	525	(2.2)	510	(2.0)	530	(2.3)	513	(2.5)
Finland*	519	(1.9)	527	(1.9)	519	(2.4)	520	(2.6)	507	(2.1)
France*	495	(2.5)	496	(2.6)	492	(2.7)	497	(2.7)	489	(2.7)
Germany*	514	(2.9)	517	(3.1)	509	(3.0)	516	(3.8)	507	(3.2)
Greece*	453	(2.5)	455	(3.0)	460	(2.6)	446	(3.2)	436	(2.6)
Hong Kong-China	561	(3.2)	566	(3.4)	553	(3.0)	564	(3.6)	567	(4.0)
Hungary*	477	(3.2)	476	(3.4)	476	(3.3)	481	(3.5)	474	(3.4)
Iceland	493	(1.7)	496	(1.9)	496	(1.8)	487	(1.9)	489	(1.5)
Israel	466	(4.7)	480	(5.2)	465	(4.7)	462	(5.3)	449	(4.8)
Italy*	485	(2.0)	491	(2.0)	482	(2.0)	477	(2.1)	487	(2.5)
Japan	536	(3.6)	518	(3.6)	528	(3.5)	542	(4.0)	558	(3.7)
Kazakhstan	432	(3.0)	428	(3.5)	414	(2.6)	433	(3.2)	450	(3.9)
Korea	554	(4.6)	537	(4.1)	538	(4.2)	559	(5.2)	573	(5.2)
*Latvia**	491	(2.8)	487	(2.9)	478	(2.8)	496	(3.4)	497	(3.3)
Liechtenstein	535	(4.0)	538	(4.1)	526	(3.9)	542	(4.0)	539	(4.5)
*Lithuania**	479	(2.6)	483	(2.8)	474	(2.7)	479	(3.2)	472	(3.1)
Luxembourg*	490	(1.1)	495	(1.0)	483	(1.0)	488	(1.0)	486	(1.0)
Macao-China	538	(1.0)	531	(1.1)	525	(1.1)	542	(1.2)	558	(1.4)
Mexico	413	(1.4)	414	(1.5)	413	(1.2)	405	(1.6)	413	(1.6)
Netherlands*	523	(3.5)	532	(3.6)	532	(3.8)	518	(3.9)	507	(3.5)
New Zealand	500	(2.2)	499	(2.4)	506	(2.6)	501	(2.5)	491	(2.4)
Northern Ireland	487	(3.1)	491	(3.7)	496	(3.4)	486	(3.8)	463	(3.6)
Norway	489	(2.7)	492	(2.9)	497	(3.0)	478	(3.1)	480	(3.3)
Poland*	518	(3.6)	519	(3.5)	517	(3.5)	509	(4.1)	524	(4.2)
Portugal*	487	(3.8)	481	(4.0)	486	(3.8)	486	(4.1)	491	(4.2)
Republic of Ireland*	501	(2.2)	505	(2.6)	509	(2.5)	501	(2.6)	478	(2.6)
*Romania**	445	(3.8)	443	(4.5)	437	(3.3)	446	(3.9)	447	(4.1)
Russian Federation	482	(3.0)	478	(3.0)	463	(3.3)	491	(3.4)	496	(3.9)
Scotland	498	(2.6)	501	(3.0)	504	(2.6)	497	(3.1)	482	(3.1)
Serbia	449	(3.4)	456	(3.7)	448	(3.3)	442	(4.1)	446	(3.9)
Shanghai-China	613	(3.3)	591	(3.2)	592	(3.0)	624	(3.6)	649	(3.6)
Singapore	573	(1.3)	569	(1.2)	559	(1.5)	580	(1.5)	580	(1.5)
Slovak Republic*	482	(3.4)	486	(3.5)	472	(3.6)	474	(4.0)	490	(4.1)
Slovenia*	501	(1.2)	504	(1.2)	496	(1.2)	499	(1.1)	503	(1.4)
Spain*	484	(1.9)	491	(2.3)	487	(2.3)	482	(2.0)	477	(2.0)
Sweden*	478	(2.3)	482	(2.5)	483	(2.5)	469	(2.8)	469	(2.5)
Switzerland	531	(3.0)	531	(3.1)	522	(3.2)	530	(3.4)	544	(3.1)
Turkey	448	(4.8)	442	(5.0)	447	(4.6)	448	(5.0)	443	(5.5)
United Arab Emirates	434	(2.4)	431	(2.7)	432	(2.4)	442	(2.6)	425	(2.4)
United Kingdom*	494	(3.3)	494	(3.8)	502	(3.0)	496	(3.4)	475	(3.5)
United States	481	(3.6)	478	(3.9)	488	(3.5)	488	(3.5)	463	(4.0)
Vietnam	511	(4.8)	509	(5.5)	519	(4.5)	509	(5.1)	507	(5.1)
Wales	468	(2.2)	465	(2.3)	483	(2.7)	470	(2.5)	444	(2.6)
OECD average	494	(0.5)	495	(0.5)	493	(0.5)	493	(0.6)	490	(0.5)

	Difference from overall mean			
	Quantity	Uncertainty and data	Change and relationships	Space and shape
Australia	-4	4	5	-8
Austria*	5	-7	1	-5
Belgium*	4	-7	-1	-6
*Bulgaria**	4	-7	-4	3
Canada	-3	-2	7	-8
Chile	-1	8	-12	-4
Chinese Taipei	-16	-11	1	32
*Croatia**	9	-3	-3	-11
Cyprus	-1	3	0	-3
Czech Republic*	6	-11	0	0
Denmark*	2	5	-6	-3
England	0	8	3	-18
Estonia*	4	-10	9	-8
Finland*	8	0	2	-12
France*	1	-3	2	-6
Germany*	4	-5	2	-6
Greece*	2	7	-7	-17
Hong Kong-China	4	-8	3	6
Hungary*	-2	-1	4	-3
Iceland	4	3	-6	-4
Israel	13	-1	-4	-17
Italy*	5	-3	-9	2
Japan	-18	-8	6	21
Kazakhstan	-4	-18	1	18
Korea	-16	-16	5	19
*Latvia**	-3	-12	6	6
Liechtenstein	3	-9	7	4
*Lithuania**	4	-5	0	-7
Luxembourg*	5	-7	-2	-3
Macao-China	-8	-13	4	20
Mexico	0	0	-9	-1
Netherlands*	9	9	-5	-16
New Zealand	-1	6	1	-9
Northern Ireland	4	9	-1	-23
Norway	3	7	-12	-10
Poland*	1	-1	-8	7
Portugal*	-6	-1	-1	4
Republic of Ireland*	4	7	0	-24
*Romania**	-1	-8	1	3
Russian Federation	-4	-19	9	14
Scotland	2	6	-2	-17
Serbia	7	-1	-7	-3
Shanghai-China	-22	-21	11	36
Singapore	-5	-14	7	6
Slovak Republic*	5	-10	-7	8
Slovenia*	3	-5	-2	2
Spain*	7	2	-3	-7
Sweden*	3	4	-9	-10
Switzerland	0	-9	-1	13
Turkey	-6	-1	0	-5
United Arab Emirates	-3	-2	8	-9
United Kingdom*	0	8	2	-19
United States	-4	7	7	-18
Vietnam	-2	8	-2	-4
Wales	-4	14	1	-25
OECD average	1	-1	**-1**	-4

OECD countries (not italicised)
14 countries with scores below 430 omitted

Countries not in OECD (italicised)

*EU countries

B4 Mean performance on each mathematics process sub-scale

	Mean Score							
	Overall mathematics score		Formulate		Employ		Interpret	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Australia	504	(1.6)	498	(1.9)	500	(1.7)	514	(1.7)
Austria*	506	(2.7)	499	(3.2)	510	(2.5)	509	(3.3)
Belgium*	515	(2.1)	512	(2.4)	516	(2.1)	513	(2.4)
*Bulgaria**	439	(4.0)	437	(4.2)	439	(4.1)	441	(4.2)
Canada	518	(1.8)	516	(2.2)	517	(1.9)	521	(2.0)
Chile	423	(3.1)	420	(3.2)	416	(3.3)	433	(3.1)
Chinese Taipei	560	(3.3)	578	(4.0)	549	(3.1)	549	(3.0)
*Croatia**	471	(3.5)	453	(4.0)	478	(3.7)	477	(3.5)
Cyprus	440	(1.1)	437	(1.2)	443	(1.1)	436	(1.3)
Czech Republic*	499	(2.9)	495	(3.4)	504	(2.9)	494	(3.0)
Denmark*	500	(2.3)	502	(2.4)	495	(2.4)	508	(2.5)
England	495	(3.9)	491	(4.4)	493	(3.6)	502	(4.2)
Estonia*	521	(2.0)	517	(2.3)	524	(2.1)	513	(2.1)
Finland*	519	(1.9)	519	(2.4)	516	(1.8)	528	(2.2)
France*	495	(2.5)	483	(2.8)	496	(2.3)	511	(2.5)
Germany*	514	(2.9)	511	(3.4)	516	(2.8)	517	(3.2)
Greece*	453	(2.5)	448	(2.3)	449	(2.7)	467	(3.1)
Hong Kong-China	561	(3.2)	568	(3.7)	558	(3.1)	551	(3.4)
Hungary*	477	(3.2)	469	(3.6)	481	(3.2)	477	(3.1)
Iceland	493	(1.7)	500	(1.7)	490	(1.6)	492	(1.9)
Israel	466	(4.7)	465	(4.7)	469	(4.6)	462	(5.2)
Italy*	485	(2.0)	475	(2.2)	485	(2.1)	498	(2.1)
Japan	536	(3.6)	554	(4.2)	530	(3.5)	531	(3.5)
Kazakhstan	432	(3.0)	442	(3.8)	433	(3.2)	420	(2.6)
Korea	554	(4.6)	562	(5.1)	553	(4.3)	540	(4.2)
*Latvia**	491	(2.8)	488	(3.0)	495	(2.8)	486	(3.0)
Liechtenstein	535	(4.0)	535	(4.4)	536	(3.7)	540	(4.1)
*Lithuania**	479	(2.6)	477	(3.1)	482	(2.7)	471	(2.8)
Luxembourg*	490	(1.1)	482	(1.0)	493	(0.9)	495	(1.1)
Macao-China	538	(1.0)	545	(1.4)	536	(1.1)	530	(1.0)
Mexico	413	(1.4)	409	(1.7)	413	(1.4)	413	(1.3)
Netherlands*	523	(3.5)	527	(3.8)	518	(3.4)	526	(3.6)
New Zealand	500	(2.2)	496	(2.5)	495	(2.2)	511	(2.5)
Northern Ireland	487	(3.1)	479	(3.8)	486	(3.1)	496	(3.5)
Norway	489	(2.7)	489	(3.1)	486	(2.7)	499	(3.1)
Poland*	518	(3.6)	516	(4.2)	519	(3.5)	515	(3.5)
Portugal*	487	(3.8)	479	(4.3)	489	(3.7)	490	(4.0)
Republic of Ireland*	501	(2.2)	492	(2.4)	502	(2.4)	507	(2.5)
*Romania**	445	(3.8)	445	(4.1)	446	(4.1)	438	(3.1)
Russian Federation	482	(3.0)	481	(3.6)	487	(3.1)	471	(2.9)
Scotland	498	(2.6)	490	(3.3)	496	(2.8)	510	(2.7)
Serbia	449	(3.4)	447	(3.8)	451	(3.4)	445	(3.4)
Shanghai-China	613	(3.3)	624	(4.1)	613	(3.0)	579	(2.9)
Singapore	573	(1.3)	582	(1.6)	574	(1.2)	555	(1.4)
Slovak Republic*	482	(3.4)	480	(4.1)	485	(3.4)	473	(3.3)
Slovenia*	501	(1.2)	492	(1.5)	505	(1.2)	498	(1.4)
Spain*	484	(1.9)	477	(2.2)	481	(2.0)	495	(2.2)
Sweden*	478	(2.3)	479	(2.7)	474	(2.5)	485	(2.4)
Switzerland	531	(3.0)	538	(3.1)	529	(2.9)	529	(3.4)
Turkey	448	(4.8)	449	(5.2)	448	(5.0)	446	(4.6)
United Arab Emirates	434	(2.4)	426	(2.7)	440	(2.4)	428	(2.4)
United Kingdom*	494	(3.3)	489	(3.7)	492	(3.1)	501	(3.5)
United States	481	(3.6)	475	(4.1)	480	(3.5)	489	(3.9)
Vietnam	511	(4.8)	497	(5.1)	523	(5.1)	497	(4.5)
Wales	468	(2.2)	457	(2.4)	466	(2.2)	483	(2.6)
OECD average	494	(0.5)	492	(0.5)	493	(0.5)	497	(0.5)

	Difference from overall mean		
	Formulate	Employ	Interpret
Australia	-6	-4	10
Austria*	-6	4	3
Belgium*	-2	1	-2
*Bulgaria**	-2	0	2
Canada	-2	-2	3
Chile	-3	-6	10
Chinese Taipei	19	-11	-11
*Croatia**	-19	6	6
Cyprus	-3	3	-4
Czech Republic*	-4	5	-5
Denmark*	2	-5	8
England	-5	-2	6
Estonia*	-3	4	-8
Finland*	0	-3	9
France*	-12	1	16
Germany*	-3	2	3
Greece*	-5	-4	14
Hong Kong-China	7	-3	-10
Hungary*	-8	4	0
Iceland	7	-3	0
Israel	-2	2	-5
Italy*	-10	0	13
Japan	18	-6	-5
Kazakhstan	10	1	-12
Korea	8	-1	-14
*Latvia**	-3	5	-4
Liechtenstein	0	1	5
*Lithuania**	-1	3	-8
Luxembourg*	-8	3	5
Macao-China	7	-2	-9
Mexico	-4	0	0
Netherlands*	4	-4	3
New Zealand	-4	-5	11
Northern Ireland	-7	-1	9
Norway	0	-3	9
Poland*	-2	1	-3
Portugal*	-8	2	3
Republic of Ireland*	-9	1	5
*Romania**	0	1	-6
Russian Federation	-1	5	-11
Scotland	-9	-3	11
Serbia	-2	2	-3
Shanghai-China	12	0	-34
Singapore	8	1	-18
Slovak Republic*	-1	4	-8
Slovenia*	-9	4	-3
Spain*	-8	-3	11
Sweden*	1	-4	7
Switzerland	7	-2	-2
Turkey	1	0	-2
United Arab Emirates	-8	6	-6
United Kingdom*	-5	-2	7
United States	-6	-1	8
Vietnam	-14	12	-15
Wales	-11	-3	15
OECD average	-2	-1	3

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

14 countries with scores below 430 omitted

B5 Mean score, variation and gender differences in student performance on the mathematics sub-scale quantity

	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	500	(1.9)	104	(1.3)	505	(2.7)	495	(2.2)	**10**	(3.1)	330	(2.8)	367	(2.2)	429	(2.0)	572	(2.7)	634	(3.1)	669	(3.5)	339
Austria*	510	(2.9)	91	(1.7)	519	(3.6)	502	(3.8)	**17**	(4.8)	358	(5.1)	391	(3.9)	446	(3.8)	576	(3.6)	627	(3.9)	656	(5.3)	298
Belgium*	519	(2.0)	104	(1.4)	524	(2.8)	513	(2.5)	**11**	(3.4)	341	(4.6)	381	(4.0)	447	(3.1)	594	(2.5)	650	(2.4)	681	(2.5)	340
*Bulgaria**	443	(4.3)	102	(2.8)	442	(5.1)	443	(4.7)	-1	(4.6)	280	(7.1)	313	(5.6)	373	(4.5)	513	(5.7)	576	(5.8)	612	(8.3)	332
Canada	515	(2.2)	99	(1.0)	520	(2.5)	511	(2.4)	**9**	(2.3)	349	(3.0)	386	(3.1)	448	(2.3)	585	(2.6)	643	(3.1)	676	(3.2)	327
Chile	421	(3.3)	90	(1.6)	433	(4.0)	411	(3.4)	**22**	(3.6)	280	(4.4)	310	(4.2)	359	(4.0)	482	(4.2)	541	(4.0)	575	(4.3)	296
Chinese Taipei	543	(3.1)	108	(1.8)	548	(4.8)	540	(5.0)	8	(7.5)	357	(5.9)	396	(5.1)	470	(4.6)	622	(3.2)	677	(3.1)	707	(3.5)	350
*Croatia**	480	(3.7)	93	(2.5)	488	(4.6)	472	(4.0)	**15**	(4.5)	332	(4.3)	363	(3.8)	414	(3.5)	543	(5.3)	603	(7.4)	637	(8.3)	305
Cyprus	439	(1.1)	100	(1.1)	439	(1.8)	438	(1.8)	1	(2.7)	276	(3.0)	310	(2.5)	370	(2.1)	508	(3.3)	568	(2.4)	604	(3.4)	329
Czech Republic*	505	(3.0)	101	(2.0)	510	(3.5)	500	(4.0)	**10**	(4.5)	336	(6.5)	373	(5.8)	438	(4.4)	576	(3.5)	633	(3.6)	668	(4.5)	333
Denmark*	502	(2.4)	91	(1.3)	510	(3.2)	495	(2.4)	**15**	(3.0)	354	(4.3)	387	(3.8)	441	(2.9)	565	(2.9)	619	(3.7)	648	(3.2)	295
England	495	(4.5)	103	(2.2)	502	(5.7)	489	(4.8)	**14**	(5.6)	324	(8.9)	361	(8.0)	425	(6.5)	569	(4.3)	627	(4.2)	661	(4.6)	337
Estonia*	525	(2.2)	86	(1.2)	528	(2.6)	521	(2.5)	**7**	(2.6)	382	(4.6)	415	(3.2)	466	(2.8)	583	(2.6)	636	(3.3)	667	(4.4)	285
Finland*	527	(1.9)	87	(1.0)	525	(2.6)	528	(2.1)	-3	(2.8)	382	(4.0)	415	(2.9)	469	(2.5)	586	(2.3)	638	(3.3)	669	(3.8)	287
France*	496	(2.6)	103	(1.8)	501	(3.7)	492	(2.7)	**9**	(3.8)	324	(6.0)	362	(4.9)	425	(2.9)	570	(3.1)	628	(3.6)	661	(4.5)	337
Germany*	517	(3.1)	100	(1.9)	524	(3.3)	510	(3.6)	**14**	(2.9)	348	(6.4)	384	(5.1)	449	(4.0)	588	(3.4)	643	(4.1)	674	(4.2)	325
Greece*	455	(3.0)	97	(1.6)	461	(4.0)	450	(3.1)	**10**	(3.8)	295	(5.0)	330	(4.4)	388	(4.0)	523	(3.4)	579	(3.7)	613	(4.6)	318
Hong Kong-China	566	(3.4)	101	(2.0)	570	(4.4)	561	(4.2)	9	(5.1)	383	(7.5)	430	(6.0)	501	(4.9)	637	(3.4)	688	(4.2)	718	(3.6)	335
Hungary*	476	(3.4)	99	(2.2)	480	(3.8)	472	(3.9)	**8**	(3.8)	314	(5.9)	350	(4.3)	406	(4.0)	545	(5.0)	606	(6.5)	641	(5.9)	327
Iceland	496	(1.9)	102	(1.5)	494	(2.6)	499	(2.5)	-5	(3.4)	322	(4.9)	362	(4.7)	429	(2.5)	567	(3.2)	627	(3.6)	661	(3.3)	339
Israel	480	(5.2)	116	(2.1)	486	(8.6)	473	(3.8)	13	(8.2)	284	(9.1)	327	(6.2)	398	(6.1)	563	(5.9)	629	(6.1)	667	(6.5)	383
Italy*	491	(2.0)	101	(1.0)	499	(2.5)	482	(2.3)	**17**	(2.7)	321	(3.2)	360	(2.7)	423	(2.2)	561	(2.5)	619	(2.6)	652	(2.8)	331
Japan	518	(3.6)	94	(2.2)	527	(4.5)	508	(3.5)	**19**	(4.0)	359	(7.4)	395	(5.2)	456	(4.2)	584	(4.0)	638	(4.2)	670	(4.7)	311
Kazakhstan	428	(3.5)	79	(2.1)	429	(3.7)	427	(4.1)	2	(3.5)	305	(3.4)	331	(3.0)	373	(2.8)	479	(5.0)	533	(6.3)	564	(6.9)	259
Korea	537	(4.1)	94	(2.0)	543	(5.0)	531	(5.0)	**12**	(5.9)	377	(7.1)	416	(6.1)	477	(4.6)	604	(4.3)	654	(4.9)	682	(6.1)	305
*Latvia**	487	(2.9)	84	(1.5)	487	(3.5)	487	(3.3)	0	(3.5)	350	(6.3)	381	(4.3)	430	(3.2)	546	(3.5)	596	(4.0)	624	(4.3)	275
Liechtenstein	538	(4.1)	100	(3.6)	548	(6.3)	527	(6.4)	**22**	(9.7)	364	(13.9)	398	(13.3)	467	(8.5)	615	(6.0)	660	(9.9)	686	(10.9)	322
*Lithuania**	483	(2.8)	93	(1.4)	484	(3.1)	482	(3.2)	3	(2.8)	331	(4.5)	363	(4.2)	420	(3.6)	547	(3.4)	605	(3.7)	637	(4.6)	306
Luxembourg*	495	(1.0)	100	(0.9)	506	(1.5)	483	(1.3)	**23**	(2.0)	326	(3.8)	362	(2.9)	424	(2.0)	567	(1.6)	623	(2.2)	656	(2.9)	330
Macao-China	531	(1.1)	92	(1.0)	533	(1.5)	528	(1.4)	**5**	(1.9)	375	(2.8)	411	(2.7)	469	(1.9)	595	(1.8)	646	(1.9)	675	(3.6)	300
Mexico	414	(1.5)	87	(0.9)	422	(1.7)	406	(1.7)	**16**	(1.4)	271	(2.8)	304	(2.2)	355	(1.7)	472	(1.9)	526	(2.2)	559	(2.3)	288
Netherlands*	532	(3.6)	97	(2.3)	537	(3.8)	527	(4.0)	**10**	(3.1)	365	(7.0)	398	(6.0)	463	(5.0)	604	(3.7)	653	(3.1)	682	(3.4)	317
New Zealand	499	(2.4)	103	(1.3)	506	(3.3)	492	(3.1)	**14**	(4.4)	331	(4.3)	365	(3.9)	426	(3.3)	572	(2.8)	634	(3.4)	667	(4.1)	337
Northern Ireland	491	(3.7)	100	(2.6)	495	(5.6)	487	(5.9)	8	(8.8)	324	(6.4)	360	(5.4)	422	(5.4)	561	(4.9)	620	(5.3)	653	(7.7)	328
Norway	492	(2.9)	95	(1.6)	494	(3.0)	491	(3.5)	3	(3.2)	335	(6.1)	372	(4.5)	429	(3.5)	556	(3.2)	613	(3.5)	648	(4.4)	313
Poland*	519	(3.5)	89	(1.6)	521	(4.1)	516	(3.7)	5	(3.4)	375	(4.4)	406	(3.8)	457	(3.5)	579	(4.5)	634	(5.3)	664	(6.6)	289
Portugal*	481	(4.0)	96	(1.5)	487	(4.4)	475	(4.1)	**12**	(2.6)	321	(5.7)	355	(5.8)	415	(4.9)	550	(4.2)	604	(3.9)	636	(4.2)	315
Republic of Ireland*	505	(2.6)	92	(1.4)	512	(3.7)	498	(3.0)	**14**	(4.4)	350	(4.6)	386	(4.6)	443	(3.2)	569	(3.0)	624	(3.1)	653	(3.6)	303
*Romania**	443	(4.5)	94	(2.5)	444	(5.2)	442	(4.8)	2	(4.3)	298	(5.0)	327	(4.7)	376	(4.6)	505	(5.6)	567	(7.2)	605	(7.6)	307
Russian Federation	478	(3.0)	93	(1.6)	478	(3.5)	478	(3.2)	0	(3.2)	326	(4.9)	360	(3.9)	417	(3.7)	540	(4.2)	598	(5.0)	632	(5.8)	306
Scotland	501	(3.0)	92	(1.7)	506	(3.5)	495	(3.5)	**11**	(3.4)	348	(6.4)	383	(5.7)	438	(4.4)	565	(3.5)	620	(3.7)	650	(5.3)	302
Serbia	456	(3.7)	97	(2.6)	460	(4.3)	452	(4.3)	8	(4.4)	303	(6.0)	334	(4.9)	390	(4.4)	521	(4.6)	582	(5.6)	619	(8.4)	317
Shanghai-China	591	(3.2)	98	(2.4)	596	(3.8)	586	(3.5)	**9**	(3.3)	419	(7.2)	460	(5.8)	528	(4.5)	658	(3.2)	710	(4.2)	741	(6.3)	322
Singapore	569	(1.2)	104	(0.9)	566	(1.8)	572	(1.7)	**-6**	(2.4)	390	(3.5)	428	(2.9)	500	(1.9)	642	(2.1)	699	(2.2)	731	(3.6)	341
Slovak Republic*	486	(3.5)	105	(2.2)	492	(4.1)	481	(4.2)	**11**	(4.5)	312	(7.9)	350	(5.8)	414	(4.8)	560	(4.3)	621	(4.2)	658	(5.3)	346
Slovenia*	504	(1.2)	94	(1.0)	508	(1.8)	500	(2.1)	**7**	(3.0)	351	(3.9)	382	(2.4)	438	(2.3)	570	(2.1)	629	(2.7)	661	(3.8)	310
Spain*	491	(2.3)	101	(1.0)	501	(2.7)	481	(2.4)	**20**	(2.3)	321	(3.8)	360	(4.0)	423	(3.3)	562	(2.2)	618	(2.0)	651	(2.9)	330
Sweden*	482	(2.5)	97	(1.3)	478	(3.1)	485	(2.9)	**-7**	(3.2)	320	(4.9)	357	(4.0)	417	(3.2)	549	(3.1)	607	(3.1)	639	(3.9)	320
Switzerland	531	(3.1)	96	(1.4)	536	(3.8)	526	(3.0)	**10**	(3.0)	369	(4.5)	404	(3.3)	467	(3.3)	598	(3.8)	652	(4.8)	684	(4.5)	315
Turkey	442	(5.0)	97	(3.0)	449	(5.5)	435	(5.7)	**14**	(5.1)	295	(5.0)	324	(4.0)	373	(4.0)	506	(8.0)	576	(9.3)	613	(8.6)	319
United Arab Emirates	431	(2.7)	101	(1.2)	428	(4.3)	434	(3.5)	-7	(5.5)	273	(2.8)	304	(3.2)	360	(3.0)	500	(3.6)	567	(4.0)	603	(3.9)	330
United Kingdom*	494	(3.8)	102	(1.9)	501	(4.8)	488	(4.1)	**13**	(4.7)	325	(7.2)	362	(6.4)	424	(5.5)	567	(3.9)	625	(3.7)	658	(4.3)	334
United States	478	(3.9)	99	(1.7)	481	(4.3)	475	(4.1)	6	(3.1)	322	(5.5)	354	(5.5)	408	(4.0)	545	(4.9)	610	(5.1)	646	(5.5)	325
Vietnam	509	(5.5)	93	(2.7)	512	(6.2)	506	(5.4)	**6**	(3.0)	354	(9.4)	391	(8.5)	446	(5.8)	571	(6.1)	629	(6.7)	662	(8.5)	308
Wales	465	(2.3)	92	(1.3)	470	(2.8)	460	(2.9)	**10**	(3.3)	313	(4.8)	346	(3.9)	402	(3.1)	527	(2.5)	582	(3.6)	615	(4.1)	302
OECD average	495	(0.5)	97	(0.3)	501	(0.6)	490	(0.6)	**11**	(3.0)	334	(0.9)	369	(0.8)	429	(0.6)	563	(0.6)	620	(0.7)	653	(0.8)	320

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
14 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold

B6 Mean score, variation and gender differences in student performance on the mathematics sub-scale uncertainty and data

	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	508	(1.5)	97	(1.1)	511	(2.3)	504	(1.9)	**7**	(3.0)	349	(2.5)	384	(2.2)	441	(1.8)	575	(2.0)	633	(2.7)	666	(3.1)	316
Austria*	499	(2.7)	95	(1.9)	508	(3.6)	489	(3.6)	**18**	(4.7)	339	(7.0)	374	(4.8)	433	(3.8)	567	(3.0)	618	(3.1)	647	(3.9)	308
Belgium*	508	(2.5)	110	(2.3)	511	(3.2)	504	(2.9)	**7**	(3.5)	323	(7.8)	366	(5.4)	435	(3.3)	585	(2.8)	647	(3.4)	681	(3.2)	358
*Bulgaria**	432	(3.9)	90	(2.4)	430	(4.7)	433	(4.2)	-3	(4.4)	285	(6.7)	318	(5.4)	370	(4.3)	493	(4.7)	549	(5.5)	581	(6.3)	296
Canada	516	(1.8)	90	(0.9)	521	(2.2)	512	(2.0)	**9**	(2.1)	367	(2.9)	401	(2.4)	456	(2.4)	579	(2.3)	632	(2.5)	661	(2.6)	294
Chile	430	(2.9)	76	(1.4)	440	(3.6)	421	(2.8)	**19**	(3.1)	309	(3.9)	335	(3.4)	378	(3.1)	481	(3.6)	531	(4.0)	561	(4.1)	252
Chinese Taipei	549	(3.2)	108	(2.1)	550	(5.0)	547	(5.6)	4	(8.5)	364	(6.6)	403	(4.7)	474	(4.4)	627	(3.9)	684	(4.6)	716	(4.7)	352
*Croatia**	468	(3.5)	90	(2.2)	473	(4.3)	463	(3.8)	**10**	(4.2)	324	(4.3)	354	(3.4)	405	(3.4)	529	(4.7)	587	(6.4)	619	(7.0)	295
Cyprus	442	(1.1)	90	(1.1)	440	(1.7)	444	(1.8)	-4	(2.8)	292	(2.8)	326	(2.9)	381	(1.8)	504	(2.1)	557	(2.4)	589	(3.4)	297
Czech Republic*	488	(2.8)	92	(2.0)	493	(3.4)	483	(3.3)	**11**	(3.9)	338	(6.3)	371	(4.3)	426	(3.5)	551	(3.2)	606	(3.5)	638	(3.5)	301
Denmark*	505	(2.4)	84	(1.3)	512	(2.9)	498	(2.5)	**14**	(2.5)	363	(4.4)	396	(3.8)	448	(3.2)	564	(2.7)	613	(3.5)	641	(4.6)	278
England	503	(3.6)	98	(1.9)	511	(4.9)	497	(4.1)	**14**	(5.5)	340	(5.7)	377	(4.8)	437	(4.5)	572	(3.9)	628	(4.5)	662	(4.9)	322
Estonia*	510	(2.0)	81	(1.1)	513	(2.5)	507	(2.2)	**6**	(2.5)	378	(4.0)	408	(2.9)	456	(2.5)	565	(2.4)	615	(2.7)	645	(4.1)	267
Finland*	519	(2.4)	91	(1.4)	516	(2.9)	521	(2.6)	**-5**	(2.8)	367	(4.6)	403	(3.3)	460	(2.6)	580	(2.8)	634	(3.0)	664	(3.8)	297
France*	492	(2.7)	103	(1.8)	492	(3.7)	492	(2.8)	1	(3.7)	317	(6.7)	355	(4.2)	421	(3.7)	567	(3.3)	622	(4.0)	653	(3.4)	335
Germany*	509	(3.0)	101	(1.8)	516	(3.2)	502	(3.6)	**14**	(3.0)	340	(4.6)	376	(4.2)	439	(3.7)	581	(3.9)	639	(4.4)	669	(5.0)	329
Greece*	460	(2.6)	87	(1.4)	463	(3.5)	458	(2.7)	5	(3.6)	312	(4.4)	347	(4.3)	402	(3.5)	519	(3.1)	572	(3.3)	602	(3.5)	290
Hong Kong-China	553	(3.0)	91	(1.8)	559	(4.4)	547	(3.5)	**12**	(5.3)	392	(5.6)	430	(4.8)	494	(4.0)	617	(3.3)	666	(3.5)	694	(4.9)	302
Hungary*	476	(3.3)	94	(2.5)	479	(3.5)	472	(4.0)	7	(3.7)	318	(6.2)	353	(4.8)	412	(3.8)	541	(4.6)	599	(6.7)	632	(7.2)	313
Iceland	496	(1.8)	98	(1.7)	491	(2.4)	501	(2.5)	**-11**	(3.3)	329	(4.0)	365	(3.9)	430	(3.1)	565	(2.6)	620	(3.0)	652	(3.6)	323
Israel	465	(4.7)	108	(2.0)	471	(7.9)	459	(3.4)	11	(7.7)	283	(8.0)	323	(6.3)	391	(5.5)	542	(5.4)	605	(6.2)	641	(5.8)	358
Italy*	482	(2.0)	96	(1.1)	490	(2.4)	475	(2.2)	**15**	(2.5)	321	(2.9)	359	(2.7)	418	(2.4)	549	(2.4)	605	(2.6)	637	(2.8)	316
Japan	528	(3.5)	90	(2.0)	534	(4.6)	522	(3.4)	**12**	(4.2)	376	(6.3)	410	(5.1)	468	(4.4)	591	(4.1)	642	(4.6)	671	(4.9)	295
Kazakhstan	414	(2.6)	58	(1.3)	413	(3.0)	414	(2.9)	-1	(2.5)	318	(2.8)	339	(2.9)	374	(2.7)	453	(3.4)	490	(3.9)	511	(5.3)	193
Korea	538	(4.2)	97	(1.9)	546	(5.3)	528	(4.8)	**18**	(5.8)	374	(7.0)	413	(5.7)	473	(4.1)	606	(4.8)	661	(4.8)	690	(5.6)	316
*Latvia**	478	(2.8)	79	(1.2)	477	(3.2)	480	(3.2)	-3	(3.1)	350	(5.4)	378	(3.4)	424	(2.9)	533	(3.5)	581	(2.9)	607	(5.1)	258
Liechtenstein	526	(3.9)	97	(3.3)	536	(6.1)	514	(5.7)	**22**	(9.0)	359	(11.8)	390	(12.6)	456	(9.1)	599	(5.9)	648	(8.6)	679	(11.4)	321
*Lithuania**	474	(2.7)	91	(1.3)	472	(3.0)	475	(3.0)	-2	(2.6)	324	(4.0)	357	(3.7)	412	(3.4)	536	(3.2)	593	(4.4)	624	(4.5)	300
Luxembourg*	483	(1.0)	100	(1.0)	494	(1.5)	471	(1.4)	**23**	(2.1)	319	(3.4)	352	(2.5)	411	(2.0)	555	(1.6)	613	(2.2)	645	(2.6)	326
Macao-China	525	(1.1)	89	(0.9)	526	(1.6)	524	(1.5)	2	(2.2)	374	(2.7)	409	(2.3)	467	(1.6)	587	(1.9)	637	(2.1)	666	(2.3)	292
Mexico	413	(1.2)	67	(0.7)	417	(1.4)	409	(1.3)	**9**	(1.1)	303	(1.8)	328	(2.0)	368	(1.5)	457	(1.4)	499	(1.8)	524	(2.1)	221
Netherlands*	532	(3.8)	99	(2.6)	536	(4.0)	527	(4.4)	**9**	(3.3)	367	(7.4)	399	(6.3)	461	(5.2)	606	(4.7)	659	(4.2)	687	(4.1)	320
New Zealand	506	(2.6)	106	(1.6)	509	(3.9)	502	(3.1)	8	(4.7)	332	(5.3)	370	(4.5)	432	(3.2)	580	(3.3)	644	(3.8)	680	(4.5)	348
Northern Ireland	496	(3.4)	95	(2.3)	501	(5.2)	491	(5.5)	10	(8.2)	336	(7.1)	373	(5.6)	428	(4.9)	564	(4.2)	619	(5.5)	651	(5.9)	315
Norway	497	(3.0)	91	(2.1)	496	(3.2)	497	(3.5)	-1	(3.0)	345	(5.6)	381	(4.4)	437	(3.1)	558	(2.8)	613	(3.6)	644	(4.3)	299
Poland*	517	(3.5)	87	(1.9)	518	(4.0)	516	(3.8)	2	(3.4)	374	(3.6)	403	(3.7)	456	(3.4)	578	(3.8)	630	(5.8)	660	(6.8)	286
Portugal*	486	(3.8)	91	(1.5)	492	(4.1)	480	(3.8)	**12**	(2.4)	334	(5.2)	366	(4.4)	422	(5.5)	550	(4.0)	604	(3.7)	632	(3.9)	298
Republic of Ireland*	509	(2.5)	88	(1.4)	516	(3.7)	501	(2.9)	**14**	(4.3)	361	(5.9)	395	(4.4)	450	(3.5)	569	(2.7)	619	(2.5)	648	(3.2)	288
*Romania**	437	(3.3)	76	(1.8)	437	(3.9)	436	(3.6)	1	(3.5)	314	(4.6)	340	(4.1)	384	(3.4)	487	(3.7)	536	(4.9)	567	(5.9)	253
Russian Federation	463	(3.3)	85	(1.5)	461	(3.8)	465	(3.4)	-5	(3.0)	323	(5.9)	355	(4.8)	406	(3.5)	521	(3.4)	572	(4.0)	601	(4.8)	279
Scotland	504	(2.6)	87	(1.7)	510	(2.9)	498	(3.5)	**12**	(3.5)	358	(6.3)	393	(4.8)	446	(3.7)	565	(3.0)	615	(3.0)	646	(4.4)	288
Serbia	448	(3.3)	86	(1.9)	454	(4.1)	443	(3.4)	**12**	(3.8)	310	(5.7)	341	(4.1)	391	(3.9)	505	(4.5)	559	(4.7)	592	(5.4)	283
Shanghai-China	592	(3.0)	96	(1.9)	594	(3.7)	590	(3.1)	4	(3.2)	427	(5.9)	464	(5.1)	528	(4.1)	660	(3.2)	712	(3.6)	741	(5.7)	314
Singapore	559	(1.5)	104	(0.8)	558	(2.0)	561	(2.0)	-4	(2.7)	384	(3.4)	421	(2.8)	487	(2.8)	634	(2.0)	692	(2.4)	725	(2.6)	341
Slovak Republic*	472	(3.6)	100	(2.5)	477	(4.2)	466	(4.0)	**11**	(4.2)	305	(7.7)	343	(5.9)	405	(4.8)	541	(4.4)	599	(4.7)	633	(5.8)	328
Slovenia*	496	(1.2)	92	(0.9)	495	(1.7)	497	(2.1)	-3	(2.9)	347	(3.1)	378	(2.3)	430	(2.0)	562	(2.2)	619	(2.4)	648	(3.2)	301
Spain*	487	(2.3)	94	(1.1)	495	(2.8)	478	(2.3)	**16**	(2.3)	329	(4.6)	367	(3.5)	425	(2.8)	552	(2.5)	605	(2.4)	635	(2.6)	307
Sweden*	483	(2.5)	93	(1.3)	482	(3.2)	483	(2.7)	-1	(3.1)	327	(5.8)	363	(3.4)	420	(3.2)	547	(3.4)	603	(3.2)	634	(4.1)	306
Switzerland	522	(3.2)	97	(1.6)	529	(3.6)	514	(3.3)	**14**	(2.8)	357	(4.7)	396	(3.6)	457	(3.4)	589	(3.9)	644	(4.3)	677	(4.4)	320
Turkey	447	(4.6)	91	(2.7)	452	(5.0)	443	(5.3)	9	(4.6)	307	(3.8)	336	(3.3)	383	(3.6)	506	(7.2)	573	(9.0)	610	(8.4)	303
United Arab Emirates	432	(2.4)	86	(1.1)	428	(3.7)	435	(3.1)	-7	(4.7)	296	(3.3)	324	(2.7)	372	(2.4)	489	(3.2)	546	(3.5)	581	(4.0)	286
United Kingdom*	502	(3.0)	97	(1.6)	509	(4.1)	496	(3.5)	**13**	(4.7)	341	(5.0)	378	(4.0)	436	(3.7)	570	(3.3)	626	(3.7)	659	(4.3)	318
United States	488	(3.5)	89	(1.5)	489	(3.8)	487	(3.8)	2	(2.8)	344	(4.9)	374	(3.9)	426	(4.1)	551	(4.2)	604	(4.3)	635	(4.6)	291
Vietnam	519	(4.5)	79	(2.4)	520	(5.1)	519	(4.1)	1	(2.6)	385	(8.4)	416	(6.8)	466	(5.9)	574	(3.9)	619	(4.8)	646	(6.7)	261
Wales	483	(2.7)	88	(1.3)	487	(3.2)	478	(3.2)	**9**	(3.4)	336	(4.8)	369	(3.9)	423	(3.8)	543	(2.9)	596	(4.1)	627	(4.4)	291
OECD average	493	(0.5)	93	(0.3)	497	(0.6)	489	(0.5)	**9**	(0.6)	338	(0.9)	373	(0.7)	430	(0.6)	558	(0.6)	613	(0.7)	644	(0.8)	306

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
14 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold

B7 Mean score, variation and gender differences in student performance on the mathematics sub-scale change and relationships

	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	509	(1.7)	104	(1.2)	515	(2.5)	503	(2.2)	**12**	(3.2)	339	(2.8)	375	(2.4)	437	(2.1)	581	(2.4)	645	(2.9)	680	(3.7)	341
Austria*	506	(3.4)	109	(2.7)	518	(4.8)	495	(4.1)	**23**	(5.8)	326	(7.2)	365	(5.2)	433	(4.6)	584	(4.7)	643	(4.6)	677	(6.7)	350
Belgium*	513	(2.6)	116	(3.2)	517	(3.6)	509	(2.9)	**8**	(4.1)	312	(7.9)	362	(5.6)	443	(3.5)	596	(2.5)	653	(2.6)	684	(2.9)	372
*Bulgaria**	434	(4.5)	109	(2.5)	433	(5.3)	436	(4.9)	-2	(5.0)	263	(6.7)	299	(5.4)	358	(4.7)	507	(5.7)	579	(6.7)	620	(7.7)	358
Canada	525	(2.0)	94	(0.9)	532	(2.2)	518	(2.2)	**14**	(2.0)	367	(3.1)	403	(2.7)	461	(2.2)	591	(2.8)	647	(2.5)	679	(2.9)	312
Chile	411	(3.5)	95	(1.6)	428	(4.5)	396	(3.4)	**32**	(4.1)	263	(5.2)	293	(3.8)	345	(3.5)	475	(4.6)	537	(4.7)	574	(5.5)	310
Chinese Taipei	561	(3.5)	121	(2.2)	563	(5.7)	559	(5.8)	4	(9.0)	355	(6.4)	398	(5.7)	476	(5.0)	648	(3.7)	714	(5.2)	752	(5.4)	396
*Croatia**	468	(4.2)	103	(2.8)	470	(5.1)	465	(4.6)	5	(4.9)	301	(5.9)	336	(5.5)	395	(4.5)	539	(5.5)	602	(7.3)	640	(9.0)	339
Cyprus	440	(1.2)	102	(1.0)	439	(1.9)	441	(1.8)	-2	(2.8)	272	(3.4)	310	(2.8)	371	(1.9)	509	(2.5)	572	(2.7)	608	(3.5)	336
Czech Republic*	499	(3.5)	112	(3.3)	503	(4.5)	496	(4.2)	7	(5.3)	317	(11.2)	364	(6.5)	430	(4.5)	576	(3.6)	636	(3.5)	674	(4.2)	357
Denmark*	494	(2.7)	91	(1.3)	502	(3.3)	486	(2.7)	**16**	(2.8)	345	(4.7)	377	(3.7)	432	(3.1)	557	(3.1)	613	(3.5)	643	(4.0)	298
England	498	(4.1)	100	(2.1)	506	(5.3)	490	(4.6)	**15**	(5.6)	333	(6.2)	368	(6.2)	430	(5.3)	568	(4.5)	628	(5.1)	662	(5.4)	329
Estonia*	530	(2.3)	84	(1.1)	533	(2.8)	527	(2.4)	**6**	(2.7)	394	(4.4)	422	(2.6)	472	(2.8)	587	(2.6)	639	(3.7)	669	(4.1)	276
Finland*	520	(2.6)	97	(2.3)	521	(3.2)	520	(2.8)	1	(3.0)	363	(5.9)	400	(3.5)	458	(2.7)	584	(2.5)	643	(3.4)	677	(4.4)	314
France*	497	(2.7)	107	(2.4)	503	(3.7)	491	(2.8)	**11**	(3.6)	313	(9.6)	355	(6.3)	425	(3.6)	572	(3.2)	632	(4.2)	667	(4.9)	354
Germany*	516	(3.8)	114	(3.4)	521	(3.9)	510	(4.2)	**11**	(3.0)	321	(8.4)	368	(6.6)	443	(4.4)	597	(3.7)	656	(4.2)	688	(5.4)	368
Greece*	446	(3.2)	101	(1.6)	448	(4.3)	444	(3.1)	4	(3.7)	278	(5.6)	317	(5.4)	378	(4.1)	515	(3.7)	574	(3.9)	609	(4.7)	331
Hong Kong-China	564	(3.6)	103	(2.2)	572	(5.0)	556	(4.3)	**16**	(5.9)	380	(7.9)	426	(7.1)	497	(4.9)	636	(3.6)	691	(4.0)	723	(5.3)	343
Hungary*	481	(3.5)	100	(2.7)	485	(4.0)	479	(4.0)	6	(3.8)	320	(6.9)	352	(5.5)	411	(3.9)	550	(4.9)	614	(7.0)	651	(7.3)	331
Iceland	487	(1.9)	100	(1.5)	485	(2.5)	488	(2.5)	-3	(3.4)	318	(5.0)	355	(4.4)	420	(3.0)	557	(2.7)	614	(3.2)	647	(3.6)	329
Israel	462	(5.3)	117	(2.4)	469	(8.9)	456	(4.0)	13	(8.6)	266	(9.1)	308	(7.4)	382	(6.3)	545	(5.5)	613	(6.0)	651	(6.6)	385
Italy*	477	(2.1)	100	(1.3)	486	(2.4)	467	(2.3)	**19**	(2.6)	310	(3.3)	348	(2.9)	410	(2.5)	546	(2.5)	604	(2.9)	638	(3.4)	328
Japan	542	(4.0)	107	(2.4)	553	(5.0)	531	(4.2)	**22**	(4.8)	362	(7.0)	404	(5.8)	470	(4.5)	618	(5.0)	680	(6.0)	715	(7.1)	353
Kazakhstan	433	(3.2)	84	(1.9)	429	(3.7)	437	(3.6)	**-8**	(3.6)	298	(3.0)	327	(3.3)	375	(2.7)	489	(4.4)	541	(6.1)	573	(6.4)	275
Korea	559	(5.2)	107	(2.7)	569	(6.6)	548	(5.4)	**21**	(6.5)	382	(8.4)	422	(6.2)	488	(5.1)	633	(5.7)	692	(7.0)	727	(9.0)	346
*Latvia**	496	(3.4)	90	(1.8)	492	(4.0)	501	(3.6)	**-9**	(3.7)	347	(6.4)	381	(4.4)	434	(3.9)	558	(4.2)	613	(3.9)	642	(4.5)	295
Liechtenstein	542	(4.0)	104	(3.6)	552	(6.3)	531	(6.5)	**21**	(10.0)	363	(17.8)	400	(11.4)	469	(8.2)	621	(6.4)	675	(11.8)	703	(11.6)	340
*Lithuania**	479	(3.2)	92	(1.6)	480	(3.5)	479	(3.3)	1	(2.5)	330	(5.0)	364	(4.2)	417	(3.5)	542	(3.6)	599	(4.1)	632	(4.9)	301
Luxembourg*	488	(1.0)	102	(1.0)	500	(1.5)	475	(1.3)	**25**	(1.9)	317	(3.4)	352	(2.6)	415	(2.0)	562	(1.9)	619	(2.3)	652	(3.0)	335
Macao-China	542	(1.2)	100	(1.1)	542	(1.7)	543	(1.5)	0	(2.0)	375	(3.5)	413	(2.5)	478	(1.7)	612	(2.1)	667	(2.8)	700	(3.5)	324
Mexico	405	(1.6)	87	(0.8)	410	(1.9)	399	(1.7)	**11**	(1.5)	264	(2.6)	295	(2.3)	347	(1.9)	462	(1.9)	516	(2.1)	549	(2.4)	285
Netherlands*	518	(3.9)	103	(3.2)	522	(4.3)	514	(4.2)	**8**	(3.4)	345	(10.0)	388	(6.5)	453	(5.2)	593	(4.0)	642	(3.7)	669	(3.7)	324
New Zealand	501	(2.5)	112	(1.6)	509	(3.6)	492	(3.5)	**17**	(5.0)	319	(5.1)	356	(4.1)	422	(3.5)	578	(3.7)	646	(4.1)	686	(4.7)	367
Northern Ireland	486	(3.8)	99	(2.3)	491	(5.6)	479	(5.8)	12	(8.4)	321	(7.4)	358	(6.2)	416	(5.1)	555	(5.1)	614	(6.3)	651	(5.6)	329
Norway	478	(3.1)	102	(1.3)	479	(3.2)	476	(3.8)	3	(3.4)	306	(5.2)	346	(4.7)	409	(3.4)	547	(3.4)	608	(4.1)	644	(4.7)	338
Poland*	509	(4.1)	100	(2.1)	510	(4.7)	509	(4.3)	1	(3.6)	347	(4.4)	380	(4.0)	440	(4.1)	578	(5.2)	641	(6.8)	677	(9.3)	330
Portugal*	486	(4.1)	98	(1.4)	490	(4.4)	482	(4.1)	**9**	(2.6)	323	(5.6)	356	(4.7)	417	(5.4)	556	(4.0)	615	(4.0)	645	(3.9)	323
Republic of Ireland*	501	(2.6)	87	(1.5)	508	(3.6)	494	(3.1)	**13**	(4.3)	355	(6.1)	389	(4.8)	443	(3.3)	561	(2.6)	613	(2.5)	642	(3.5)	287
*Romania**	446	(3.9)	89	(2.4)	446	(4.7)	445	(4.1)	1	(3.9)	307	(4.4)	336	(4.6)	382	(3.9)	504	(5.0)	566	(6.8)	602	(7.1)	295
Russian Federation	491	(3.4)	93	(1.8)	489	(4.0)	493	(3.5)	-5	(3.1)	338	(5.5)	371	(4.7)	428	(4.0)	553	(3.8)	611	(5.0)	644	(6.3)	306
Scotland	497	(3.1)	93	(2.1)	506	(3.5)	487	(3.6)	**19**	(3.5)	344	(7.0)	380	(4.9)	434	(4.0)	561	(3.3)	618	(4.4)	650	(6.8)	306
Serbia	442	(4.1)	104	(2.7)	445	(4.9)	439	(4.6)	5	(4.7)	274	(7.6)	311	(5.7)	371	(4.9)	512	(4.4)	578	(6.3)	618	(6.5)	344
Shanghai-China	624	(3.6)	112	(2.4)	629	(4.4)	619	(3.9)	**10**	(3.9)	431	(6.7)	473	(6.5)	547	(5.4)	704	(3.6)	764	(4.1)	797	(5.3)	367
Singapore	580	(1.5)	114	(0.9)	581	(2.2)	580	(1.9)	1	(2.6)	387	(4.4)	428	(3.9)	502	(2.7)	662	(2.1)	725	(2.8)	759	(2.8)	373
Slovak Republic*	474	(4.0)	114	(2.9)	476	(4.9)	472	(4.5)	4	(4.9)	282	(9.2)	327	(6.9)	401	(5.5)	553	(4.6)	617	(4.8)	655	(6.7)	373
Slovenia*	499	(1.1)	100	(1.0)	501	(1.7)	497	(2.2)	4	(3.1)	338	(2.9)	372	(2.7)	429	(2.3)	570	(2.2)	632	(3.8)	667	(3.7)	329
Spain*	482	(2.0)	93	(0.8)	490	(2.5)	473	(2.1)	**17**	(2.2)	326	(3.0)	361	(3.1)	420	(2.9)	547	(2.1)	600	(1.9)	630	(1.9)	304
Sweden*	469	(2.8)	107	(1.6)	466	(3.6)	472	(3.1)	-5	(3.8)	291	(5.4)	331	(4.1)	397	(4.0)	544	(3.4)	606	(3.8)	641	(4.0)	350
Switzerland	530	(3.4)	103	(1.6)	536	(3.9)	524	(3.6)	**12**	(3.0)	359	(4.1)	396	(3.4)	459	(3.7)	602	(4.0)	661	(4.8)	695	(5.3)	336
Turkey	448	(5.0)	92	(3.1)	448	(5.4)	449	(5.7)	-1	(4.7)	310	(4.7)	336	(4.9)	383	(3.9)	508	(7.3)	575	(9.1)	612	(10.6)	301
United Arab Emirates	442	(2.6)	95	(1.2)	440	(4.2)	445	(3.0)	-4	(5.0)	294	(3.9)	325	(3.0)	376	(2.8)	505	(3.4)	570	(3.8)	607	(4.2)	313
United Kingdom*	496	(3.4)	99	(1.8)	504	(4.4)	489	(3.9)	**15**	(4.8)	333	(5.3)	368	(5.2)	429	(4.4)	565	(3.9)	626	(4.4)	659	(5.2)	326
United States	488	(3.5)	95	(1.4)	490	(3.9)	486	(3.9)	4	(3.2)	339	(4.2)	368	(4.0)	421	(4.1)	552	(4.2)	614	(4.3)	649	(5.1)	310
Vietnam	509	(5.1)	94	(2.7)	514	(5.9)	506	(4.9)	**8**	(3.2)	355	(8.0)	389	(7.1)	445	(6.1)	572	(5.7)	631	(6.6)	664	(6.7)	309
Wales	470	(2.5)	90	(1.3)	476	(3.0)	463	(3.0)	**13**	(3.3)	321	(4.8)	353	(4.9)	409	(3.3)	532	(2.9)	584	(3.7)	616	(5.2)	295
OECD average	493	(0.6)	101	(0.4)	498	(0.7)	487	(0.6)	**11**	(0.7)	325	(1.1)	362	(0.8)	424	(0.7)	563	(0.7)	622	(0.8)	657	(0.9)	332

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
14 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold

B8 Mean score, variation and gender differences in student performance on the mathematics sub-scale space and shape

	All students				Gender differences						Percentiles												
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		Difference between 5th and 95th percentile
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	497	(1.8)	102	(1.4)	506	(2.5)	486	(2.3)	**20**	(3.2)	334	(2.9)	368	(2.4)	425	(2.0)	564	(2.5)	630	(3.4)	669	(4.1)	335
Austria*	501	(3.1)	98	(2.2)	519	(4.5)	483	(3.4)	**37**	(5.4)	340	(4.6)	375	(4.1)	432	(3.7)	569	(3.8)	627	(5.2)	662	(7.1)	322
Belgium*	509	(2.4)	108	(1.5)	518	(3.0)	500	(2.8)	**18**	(3.5)	330	(4.5)	368	(4.2)	434	(3.6)	585	(2.9)	649	(3.1)	684	(3.1)	354
*Bulgaria**	442	(4.3)	95	(2.2)	442	(5.0)	442	(4.6)	0	(4.2)	291	(5.4)	321	(5.8)	376	(4.9)	506	(5.2)	569	(5.4)	604	(6.4)	313
Canada	510	(2.1)	95	(0.9)	515	(2.4)	505	(2.3)	**10**	(2.2)	355	(2.9)	388	(2.6)	444	(2.3)	576	(2.7)	636	(3.2)	670	(3.1)	314
Chile	419	(3.2)	86	(1.5)	435	(3.8)	404	(3.2)	**31**	(3.5)	288	(4.3)	313	(3.7)	358	(3.3)	475	(4.3)	533	(4.5)	569	(4.7)	281
Chinese Taipei	592	(3.8)	136	(2.3)	596	(6.2)	589	(6.4)	7	(10.0)	362	(5.3)	407	(5.5)	494	(5.5)	693	(4.1)	764	(5.4)	803	(5.9)	441
*Croatia**	460	(3.9)	88	(3.4)	468	(4.7)	452	(4.1)	**15**	(3.9)	328	(3.6)	354	(3.1)	399	(3.1)	516	(4.9)	575	(8.1)	615	(13.4)	287
Cyprus	436	(1.1)	92	(1.0)	439	(1.6)	433	(1.5)	**6**	(2.3)	289	(2.5)	320	(2.4)	373	(2.2)	498	(2.1)	555	(2.8)	592	(3.6)	303
Czech Republic*	499	(3.4)	102	(1.9)	509	(4.2)	487	(3.7)	**22**	(4.4)	331	(7.1)	369	(4.8)	428	(4.7)	569	(4.0)	630	(4.2)	666	(4.8)	335
Denmark*	497	(2.5)	84	(1.2)	504	(3.0)	490	(2.5)	**14**	(2.3)	357	(4.6)	388	(3.8)	441	(3.3)	553	(2.9)	604	(3.7)	633	(4.1)	276
England	477	(4.1)	100	(2.0)	484	(5.1)	471	(4.9)	**13**	(5.8)	314	(6.6)	348	(5.6)	408	(4.8)	544	(5.1)	607	(4.8)	643	(5.8)	329
Estonia*	513	(2.5)	94	(1.1)	515	(3.0)	510	(3.0)	4	(3.1)	364	(4.2)	395	(3.8)	449	(3.4)	575	(2.7)	634	(3.2)	671	(4.8)	307
Finland*	507	(2.1)	90	(1.3)	506	(2.7)	507	(2.3)	-1	(2.8)	361	(4.2)	393	(2.7)	446	(2.5)	567	(2.7)	624	(3.1)	658	(3.8)	297
France*	489	(2.7)	99	(1.9)	497	(3.6)	481	(2.9)	**16**	(3.4)	326	(4.4)	360	(3.7)	418	(3.7)	558	(3.7)	619	(4.4)	652	(5.4)	326
Germany*	507	(3.2)	98	(1.9)	515	(3.4)	499	(3.7)	**16**	(2.8)	346	(5.6)	379	(5.1)	440	(4.2)	575	(3.8)	633	(4.5)	667	(5.2)	321
Greece*	436	(2.6)	90	(1.4)	442	(3.3)	431	(2.8)	**11**	(3.3)	290	(5.6)	324	(3.4)	375	(3.0)	497	(3.3)	552	(3.9)	585	(4.3)	295
Hong Kong-China	567	(4.0)	107	(2.3)	576	(5.6)	555	(4.5)	**21**	(6.4)	382	(7.1)	422	(6.4)	495	(5.1)	642	(4.5)	701	(4.8)	734	(5.2)	352
Hungary*	474	(3.4)	96	(2.7)	482	(3.8)	465	(4.1)	**17**	(3.9)	325	(4.0)	354	(4.0)	406	(3.3)	536	(5.3)	604	(7.2)	643	(10.4)	318
Iceland	489	(1.5)	88	(1.3)	485	(2.0)	493	(2.2)	**-8**	(3.0)	339	(3.7)	373	(3.1)	430	(2.6)	549	(2.4)	604	(2.4)	634	(3.3)	295
Israel	449	(4.8)	105	(1.9)	456	(8.0)	443	(3.6)	13	(7.7)	278	(7.0)	314	(5.7)	376	(4.9)	522	(5.4)	586	(6.0)	622	(5.7)	344
Italy*	487	(2.5)	106	(1.4)	498	(2.8)	476	(2.7)	**23**	(2.6)	316	(2.8)	354	(2.8)	415	(2.5)	559	(3.5)	627	(3.9)	665	(4.2)	348
Japan	558	(3.7)	100	(2.4)	566	(4.6)	548	(4.0)	**18**	(4.7)	393	(6.2)	429	(4.9)	489	(4.2)	627	(4.8)	688	(5.2)	723	(6.3)	330
Kazakhstan	450	(3.9)	85	(2.3)	454	(4.2)	446	(4.3)	**8**	(3.5)	317	(4.3)	344	(3.9)	391	(3.3)	506	(5.4)	562	(6.6)	595	(8.2)	278
Korea	573	(5.2)	112	(2.4)	583	(6.6)	562	(5.9)	**20**	(7.0)	388	(7.1)	428	(5.6)	495	(5.3)	653	(6.2)	716	(7.5)	753	(8.6)	365
*Latvia**	497	(3.3)	88	(1.5)	496	(3.8)	497	(3.6)	-1	(3.4)	356	(5.6)	386	(4.2)	437	(3.3)	556	(4.1)	611	(5.2)	645	(5.2)	289
Liechtenstein	539	(4.5)	99	(4.3)	550	(6.2)	527	(7.5)	**23**	(10.4)	373	(18.5)	406	(13.5)	475	(10.8)	611	(8.4)	667	(11.0)	695	(13.2)	322
*Lithuania**	472	(3.1)	98	(1.7)	471	(3.3)	473	(3.5)	-2	(2.8)	313	(4.6)	347	(4.1)	404	(4.2)	539	(3.5)	600	(4.7)	637	(5.0)	324
Luxembourg*	486	(1.0)	96	(1.1)	503	(1.4)	469	(1.5)	**34**	(2.1)	332	(3.1)	364	(2.6)	418	(2.2)	554	(2.1)	612	(3.0)	645	(3.2)	312
Macao-China	558	(1.4)	109	(1.0)	561	(2.0)	554	(1.6)	**7**	(2.4)	375	(3.4)	416	(2.4)	485	(2.5)	635	(2.1)	697	(2.6)	732	(3.6)	358
Mexico	413	(1.6)	82	(0.9)	423	(1.9)	402	(1.7)	**21**	(1.4)	280	(3.1)	309	(2.4)	358	(1.9)	466	(1.9)	519	(2.4)	550	(2.3)	270
Netherlands*	507	(3.5)	94	(2.3)	515	(3.5)	499	(4.0)	**16**	(2.8)	350	(6.5)	385	(5.2)	442	(4.2)	573	(4.5)	628	(4.8)	660	(6.5)	310
New Zealand	491	(2.4)	100	(1.7)	504	(3.5)	477	(3.1)	**27**	(4.6)	334	(5.5)	366	(4.3)	421	(3.2)	558	(2.9)	624	(4.7)	663	(5.5)	330
Northern Ireland	463	(3.6)	99	(2.5)	467	(5.4)	460	(5.4)	7	(8.1)	304	(7.8)	340	(5.1)	397	(4.5)	529	(4.3)	591	(6.6)	626	(6.8)	322
Norway	480	(3.3)	102	(1.4)	481	(3.4)	478	(4.1)	3	(3.3)	312	(6.3)	351	(4.6)	412	(3.2)	548	(3.9)	610	(4.2)	647	(5.1)	335
Poland*	524	(4.2)	101	(2.2)	528	(4.9)	520	(4.4)	**8**	(3.8)	370	(4.0)	398	(3.4)	450	(3.6)	593	(6.0)	660	(6.8)	697	(7.8)	327
Portugal*	491	(4.2)	109	(1.9)	498	(4.6)	483	(4.4)	**15**	(2.9)	318	(6.7)	351	(5.5)	414	(4.5)	568	(4.7)	633	(4.6)	669	(5.1)	351
Republic of Ireland*	478	(2.6)	94	(1.4)	490	(3.7)	465	(3.0)	**25**	(4.3)	323	(4.9)	357	(4.2)	415	(3.4)	542	(2.8)	598	(2.8)	631	(3.9)	308
*Romania**	447	(4.1)	91	(2.6)	452	(4.7)	443	(4.4)	**10**	(4.1)	306	(4.4)	335	(3.9)	383	(3.6)	505	(5.3)	567	(7.6)	607	(7.8)	300
Russian Federation	496	(3.9)	95	(2.1)	498	(4.6)	494	(3.8)	4	(3.1)	344	(3.9)	376	(3.7)	430	(4.2)	560	(5.1)	622	(6.2)	657	(7.9)	313
Scotland	482	(3.1)	95	(1.8)	492	(3.4)	471	(3.7)	**21**	(3.4)	328	(6.3)	361	(5.2)	417	(4.0)	546	(3.7)	606	(4.2)	642	(5.4)	315
Serbia	446	(3.9)	98	(2.5)	452	(4.5)	441	(4.2)	**11**	(3.9)	293	(5.4)	324	(5.0)	377	(4.3)	510	(4.6)	576	(6.8)	616	(9.0)	323
Shanghai-China	649	(3.6)	114	(2.5)	649	(4.4)	649	(3.7)	0	(3.8)	445	(8.2)	493	(7.1)	575	(5.6)	728	(3.1)	787	(4.3)	822	(5.3)	376
Singapore	580	(1.5)	117	(1.1)	577	(2.3)	582	(1.9)	-5	(3.0)	380	(4.1)	423	(3.6)	500	(2.1)	664	(2.5)	727	(2.8)	764	(3.5)	383
Slovak Republic*	490	(4.1)	109	(2.7)	496	(4.7)	482	(4.7)	**15**	(4.8)	311	(8.5)	351	(6.3)	416	(4.5)	564	(5.5)	632	(6.3)	670	(6.9)	359
Slovenia*	503	(1.4)	99	(1.2)	506	(2.0)	500	(2.2)	**6**	(3.1)	345	(3.8)	379	(2.8)	433	(2.1)	572	(3.2)	636	(4.2)	671	(3.1)	325
Spain*	477	(2.0)	94	(0.9)	486	(2.5)	468	(2.3)	**18**	(2.4)	324	(3.6)	357	(2.9)	412	(2.3)	542	(2.5)	599	(2.4)	631	(2.5)	308
Sweden*	469	(2.5)	94	(1.6)	470	(3.0)	467	(2.8)	3	(3.1)	313	(5.7)	348	(3.6)	405	(3.1)	533	(3.1)	590	(3.1)	623	(5.0)	310
Switzerland	544	(3.1)	101	(1.7)	554	(3.5)	535	(3.4)	**19**	(3.1)	375	(4.7)	413	(3.9)	475	(3.4)	614	(4.5)	675	(4.4)	711	(5.4)	336
Turkey	443	(5.5)	109	(3.8)	449	(5.8)	437	(6.8)	12	(6.1)	280	(5.3)	312	(3.9)	365	(4.1)	512	(9.2)	597	(12.2)	641	(12.1)	360
United Arab Emirates	425	(2.4)	97	(1.4)	424	(3.5)	425	(3.5)	-1	(5.0)	274	(3.7)	304	(3.1)	356	(2.7)	490	(3.1)	553	(4.0)	591	(3.9)	316
United Kingdom*	475	(3.5)	99	(1.8)	482	(4.3)	469	(4.2)	**13**	(5.0)	313	(5.5)	347	(4.6)	407	(4.1)	542	(4.1)	605	(4.3)	641	(4.9)	328
United States	463	(4.0)	96	(1.5)	467	(4.3)	460	(4.4)	**7**	(3.3)	314	(4.4)	342	(4.4)	396	(3.9)	527	(5.2)	591	(5.2)	631	(6.2)	317
Vietnam	507	(5.1)	99	(2.8)	519	(5.9)	496	(5.0)	**23**	(3.2)	346	(7.6)	382	(6.3)	439	(5.3)	573	(6.6)	637	(7.4)	674	(8.4)	328
Wales	444	(2.6)	89	(1.3)	449	(2.8)	439	(3.3)	**10**	(3.4)	299	(4.2)	330	(4.2)	383	(3.1)	505	(3.2)	559	(4.4)	592	(5.8)	292
OECD average	490	(0.5)	98	(0.3)	497	(0.7)	482	(0.6)	**15**	(0.7)	331	(0.9)	365	(0.7)	422	(0.6)	556	(0.7)	618	(0.8)	653	(1.0)	322

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

14 countries with scores below 430 omitted

Note: Values that are statistically significant are indicated in bold

B9 Mean score, variation and gender differences in student performance on the mathematics sub-scale formulating

	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	498	(1.9)	110	(1.5)	506	(2.8)	489	(2.3)	**17**	(3.5)	323	(3.3)	359	(2.6)	421	(1.8)	573	(2.7)	643	(3.8)	683	(4.7)	360
Austria*	499	(3.2)	105	(2.1)	515	(4.6)	484	(3.6)	**32**	(5.5)	328	(6.6)	365	(4.9)	425	(3.9)	575	(3.9)	635	(5.0)	668	(5.4)	341
Belgium*	512	(2.4)	111	(1.5)	520	(3.2)	505	(2.6)	**15**	(3.4)	328	(5.3)	367	(4.1)	435	(3.3)	591	(2.9)	656	(3.1)	692	(3.6)	365
*Bulgaria**	437	(4.2)	99	(2.4)	439	(4.8)	434	(4.9)	5	(4.6)	282	(6.4)	313	(5.0)	368	(4.4)	503	(5.7)	567	(6.9)	607	(7.3)	325
Canada	516	(2.2)	101	(0.9)	522	(2.6)	510	(2.4)	**13**	(2.4)	350	(2.8)	385	(2.7)	446	(2.7)	587	(2.8)	648	(3.6)	685	(3.2)	334
Chile	420	(3.2)	88	(1.6)	434	(3.8)	406	(3.3)	**29**	(3.7)	284	(4.6)	311	(4.3)	359	(3.5)	477	(3.7)	535	(4.9)	573	(5.4)	289
Chinese Taipei	578	(4.0)	137	(2.4)	584	(6.3)	573	(6.9)	11	(10.5)	345	(6.7)	393	(6.2)	482	(6.0)	678	(4.1)	751	(5.5)	791	(6.7)	446
*Croatia**	453	(4.0)	96	(3.0)	461	(5.1)	444	(4.2)	**16**	(4.7)	304	(3.7)	332	(3.5)	384	(3.2)	515	(5.1)	580	(8.6)	622	(13.0)	318
Cyprus	437	(1.2)	93	(0.9)	441	(1.6)	432	(1.8)	**9**	(2.5)	290	(3.2)	320	(2.3)	372	(1.9)	498	(2.0)	559	(2.5)	596	(4.0)	307
Czech Republic*	495	(3.4)	103	(2.6)	503	(4.3)	486	(3.8)	**17**	(4.4)	330	(7.5)	365	(5.1)	425	(4.2)	565	(3.6)	626	(4.6)	663	(4.3)	333
Denmark*	502	(2.4)	89	(1.3)	511	(2.8)	494	(2.6)	**17**	(2.5)	355	(4.9)	387	(4.3)	441	(3.3)	565	(2.7)	618	(3.7)	649	(4.2)	293
England	491	(4.4)	105	(2.3)	497	(5.6)	485	(5.2)	12	(6.2)	319	(7.7)	355	(7.6)	418	(6.0)	563	(4.7)	630	(5.9)	665	(5.8)	346
Estonia*	517	(2.3)	91	(1.1)	523	(2.9)	512	(2.4)	**11**	(2.7)	371	(3.5)	402	(3.9)	454	(2.8)	578	(3.0)	637	(3.1)	673	(4.2)	302
Finland*	519	(2.4)	97	(1.4)	520	(3.0)	518	(2.6)	2	(3.0)	359	(4.9)	393	(3.4)	453	(2.5)	585	(3.0)	645	(3.3)	678	(3.8)	319
France*	483	(2.8)	106	(2.0)	491	(3.8)	476	(3.0)	**15**	(3.9)	309	(5.7)	346	(4.1)	410	(3.3)	558	(3.8)	620	(4.1)	656	(6.0)	348
Germany*	511	(3.4)	105	(1.7)	520	(3.6)	501	(3.9)	**19**	(3.2)	337	(4.7)	372	(4.5)	438	(4.2)	586	(4.3)	647	(4.3)	681	(5.3)	344
Greece*	448	(2.3)	89	(1.6)	454	(3.2)	442	(2.6)	**13**	(3.4)	303	(5.3)	334	(3.8)	387	(3.4)	507	(2.9)	563	(3.7)	596	(3.9)	292
Hong Kong-China	568	(3.7)	115	(2.1)	579	(5.3)	557	(4.8)	**22**	(7.1)	369	(7.0)	415	(7.0)	493	(5.2)	649	(4.1)	711	(4.0)	744	(5.0)	375
Hungary*	469	(3.6)	101	(2.9)	478	(4.0)	461	(4.2)	**17**	(3.9)	312	(5.5)	344	(4.1)	398	(3.9)	536	(5.2)	605	(8.4)	645	(9.5)	332
Iceland	500	(1.7)	94	(1.2)	499	(2.4)	501	(2.4)	-1	(3.3)	344	(4.5)	377	(3.9)	436	(2.5)	565	(3.0)	623	(3.1)	654	(4.4)	309
Israel	465	(4.7)	109	(2.5)	472	(7.7)	457	(3.6)	**15**	(7.3)	284	(7.9)	323	(6.1)	388	(5.4)	541	(5.9)	605	(6.2)	643	(6.4)	359
Italy*	475	(2.2)	102	(1.2)	487	(2.6)	463	(2.4)	**24**	(2.6)	309	(3.0)	345	(2.6)	406	(2.4)	545	(2.7)	608	(3.4)	645	(3.5)	336
Japan	554	(4.2)	110	(2.7)	563	(5.2)	544	(4.4)	**19**	(4.9)	370	(7.5)	410	(6.6)	481	(5.2)	631	(4.7)	695	(5.8)	730	(6.5)	359
Kazakhstan	442	(3.8)	82	(2.1)	446	(4.1)	438	(4.2)	**7**	(3.3)	313	(3.7)	339	(3.9)	385	(3.8)	496	(5.0)	548	(6.3)	582	(7.5)	269
Korea	562	(5.1)	111	(2.4)	573	(6.5)	550	(5.8)	**22**	(7.0)	377	(7.5)	417	(6.0)	487	(5.2)	642	(6.2)	704	(6.9)	738	(8.5)	361
*Latvia**	488	(3.0)	90	(1.6)	487	(4.0)	489	(3.4)	-2	(4.3)	343	(5.4)	373	(4.4)	426	(3.1)	549	(4.0)	606	(5.2)	639	(4.7)	296
Liechtenstein	535	(4.4)	101	(3.6)	548	(6.4)	520	(6.5)	**28**	(9.7)	362	(20.2)	395	(11.8)	467	(8.7)	608	(8.3)	665	(12.0)	698	(12.5)	337
*Lithuania**	477	(3.1)	102	(1.6)	479	(3.3)	476	(3.6)	3	(2.9)	312	(5.3)	348	(4.4)	407	(4.1)	547	(3.9)	613	(5.0)	651	(6.1)	338
Luxembourg*	482	(1.0)	102	(1.0)	498	(1.4)	465	(1.5)	**33**	(2.1)	317	(3.4)	349	(2.5)	409	(2.0)	554	(1.9)	615	(2.5)	650	(3.4)	333
Macao-China	545	(1.4)	112	(1.2)	549	(1.7)	540	(2.2)	**9**	(2.7)	360	(3.2)	400	(3.7)	471	(2.2)	623	(2.4)	685	(2.6)	721	(3.4)	361
Mexico	409	(1.7)	86	(0.8)	419	(1.9)	400	(1.8)	**20**	(1.7)	270	(2.8)	301	(2.1)	351	(1.9)	466	(2.1)	521	(2.4)	555	(2.3)	285
Netherlands*	527	(3.8)	101	(2.4)	535	(3.8)	519	(4.2)	**16**	(2.8)	358	(5.6)	393	(5.0)	455	(5.2)	600	(4.9)	657	(5.4)	689	(6.3)	330
New Zealand	496	(2.5)	109	(1.4)	507	(3.6)	484	(3.3)	**23**	(4.8)	326	(4.2)	359	(3.6)	417	(2.9)	571	(3.3)	641	(4.7)	683	(5.4)	357
Northern Ireland	479	(3.8)	100	(2.4)	484	(5.4)	474	(5.8)	10	(8.2)	317	(7.2)	350	(6.5)	409	(5.8)	548	(4.5)	609	(5.8)	648	(7.4)	331
Norway	489	(3.1)	100	(1.5)	490	(3.1)	488	(3.7)	2	(3.2)	328	(5.4)	363	(4.5)	421	(3.7)	557	(3.4)	618	(4.2)	655	(4.8)	327
Poland*	516	(4.2)	102	(2.1)	522	(4.8)	509	(4.4)	**13**	(3.8)	353	(4.8)	387	(4.2)	443	(4.0)	585	(5.7)	650	(7.1)	687	(8.9)	334
Portugal*	479	(4.3)	107	(1.5)	487	(4.6)	471	(4.3)	**17**	(2.8)	304	(4.9)	339	(4.8)	401	(5.1)	554	(5.0)	619	(4.7)	655	(5.6)	351
Republic of Ireland*	492	(2.4)	95	(1.4)	502	(3.7)	482	(2.8)	**20**	(4.4)	335	(4.5)	369	(4.4)	427	(3.5)	557	(2.4)	615	(3.1)	650	(3.3)	314
*Romania**	445	(4.1)	93	(2.7)	449	(4.7)	441	(4.2)	7	(3.8)	301	(4.9)	329	(3.6)	380	(4.0)	505	(5.5)	567	(7.4)	604	(8.1)	303
Russian Federation	481	(3.6)	95	(2.1)	484	(4.4)	479	(3.5)	5	(3.4)	327	(4.5)	358	(3.6)	416	(4.0)	546	(4.3)	605	(5.7)	639	(7.6)	311
Scotland	490	(3.3)	99	(2.1)	499	(3.6)	481	(4.2)	**18**	(4.0)	330	(7.4)	364	(5.4)	423	(5.3)	557	(3.7)	620	(5.1)	658	(5.6)	328
Serbia	447	(3.8)	98	(2.5)	453	(4.4)	441	(4.3)	**12**	(4.3)	294	(6.3)	326	(3.9)	379	(4.1)	509	(4.7)	576	(6.8)	617	(7.9)	323
Shanghai-China	624	(4.1)	119	(2.8)	629	(4.9)	620	(4.2)	**8**	(3.9)	413	(8.9)	462	(7.4)	547	(5.1)	710	(3.9)	769	(5.2)	807	(7.5)	394
Singapore	582	(1.6)	122	(1.3)	581	(2.2)	582	(2.1)	-1	(2.9)	374	(3.5)	419	(3.2)	496	(3.0)	670	(2.4)	737	(2.9)	773	(4.8)	398
Slovak Republic*	480	(4.1)	110	(2.7)	488	(4.8)	472	(4.7)	**16**	(4.8)	301	(8.4)	341	(6.2)	405	(4.4)	557	(5.6)	623	(6.0)	662	(7.3)	361
Slovenia*	492	(1.5)	104	(1.2)	496	(2.4)	488	(2.2)	**8**	(3.6)	328	(4.8)	360	(3.0)	418	(2.7)	565	(2.7)	630	(3.7)	667	(3.6)	340
Spain*	477	(2.2)	102	(1.1)	486	(2.8)	467	(2.3)	**19**	(2.6)	305	(4.5)	346	(3.7)	408	(2.9)	547	(2.4)	607	(2.9)	640	(2.9)	335
Sweden*	479	(2.7)	102	(1.5)	480	(3.4)	478	(2.9)	2	(3.3)	313	(6.0)	348	(3.9)	407	(3.3)	550	(2.9)	612	(3.8)	647	(4.0)	334
Switzerland	538	(3.1)	104	(1.6)	548	(3.5)	528	(3.4)	**20**	(3.1)	361	(4.2)	402	(3.8)	468	(3.7)	611	(3.8)	672	(4.2)	707	(4.5)	345
Turkey	449	(5.2)	96	(3.1)	454	(5.4)	444	(6.0)	**10**	(4.8)	307	(4.9)	334	(3.9)	380	(4.1)	512	(8.0)	583	(10.5)	622	(9.2)	315
United Arab Emirates	426	(2.7)	100	(1.4)	427	(3.7)	425	(3.6)	2	(4.9)	271	(3.2)	302	(2.7)	354	(3.0)	494	(3.4)	559	(4.5)	599	(3.8)	327
United Kingdom*	489	(3.7)	104	(2.0)	495	(4.6)	483	(4.4)	**12**	(5.3)	319	(6.2)	355	(6.2)	417	(5.0)	560	(4.0)	626	(5.2)	663	(4.6)	344
United States	475	(4.1)	98	(1.6)	479	(4.2)	471	(4.6)	**8**	(3.0)	323	(4.4)	352	(4.9)	406	(4.4)	540	(5.6)	606	(6.0)	645	(5.8)	322
Vietnam	497	(5.1)	98	(3.0)	507	(5.9)	489	(5.0)	**18**	(3.2)	336	(8.4)	373	(7.0)	432	(6.1)	561	(5.8)	624	(8.0)	661	(8.6)	325
Wales	457	(2.4)	93	(1.4)	463	(2.7)	452	(3.2)	11	(3.6)	308	(4.3)	339	(3.8)	395	(3.3)	521	(3.0)	577	(4.1)	612	(5.1)	304
OECD average	492	(0.5)	101	(0.3)	499	(0.7)	484	(0.6)	**16**	(0.7)	327	(0.9)	362	(0.8)	421	(0.6)	562	(0.7)	624	(0.8)	660	(0.9)	332

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

14 countries with scores below 430 omitted

Note: Values that are statistically significant are indicated in bold.

B10 Mean score, variation and gender differences in student performance on the mathematics sub-scale employing

	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	500	(1.7)	95	(1.1)	505	(2.3)	495	(2.0)	**10**	(2.9)	345	(3.1)	378	(2.2)	435	(1.9)	567	(2.1)	624	(2.6)	655	(3.2)	311
Austria*	510	(2.5)	87	(1.6)	520	(3.5)	499	(3.2)	**20**	(4.6)	366	(4.7)	397	(3.4)	448	(3.2)	572	(2.9)	621	(3.6)	649	(3.4)	283
Belgium*	516	(2.1)	101	(1.6)	521	(2.7)	510	(2.7)	**11**	(3.4)	342	(5.1)	380	(3.8)	446	(3.0)	590	(2.6)	644	(2.9)	673	(2.4)	331
*Bulgaria**	439	(4.1)	96	(2.3)	437	(5.0)	441	(4.3)	-4	(4.4)	287	(5.7)	318	(5.1)	371	(4.8)	506	(5.1)	567	(6.2)	603	(7.1)	315
Canada	517	(1.9)	87	(0.9)	521	(2.1)	512	(2.2)	**10**	(2.2)	370	(2.9)	403	(2.6)	457	(2.3)	578	(2.1)	629	(2.3)	657	(2.9)	287
Chile	416	(3.3)	86	(1.5)	430	(4.1)	404	(3.3)	**26**	(3.8)	283	(4.4)	309	(4.1)	356	(3.7)	474	(4.3)	532	(4.6)	563	(4.3)	281
Chinese Taipei	549	(3.1)	110	(1.9)	551	(5.1)	547	(5.2)	4	(8.1)	359	(5.4)	398	(5.0)	473	(4.6)	630	(3.4)	683	(4.1)	715	(5.0)	355
*Croatia**	478	(3.7)	91	(2.5)	481	(4.6)	474	(3.9)	7	(4.3)	334	(4.2)	363	(3.8)	413	(3.6)	538	(4.9)	597	(6.9)	633	(9.7)	299
Cyprus	443	(1.1)	91	(0.9)	443	(1.5)	443	(1.6)	0	(2.1)	295	(2.7)	327	(2.0)	381	(1.9)	505	(1.8)	561	(2.1)	594	(3.7)	299
Czech Republic*	504	(2.9)	94	(1.8)	509	(3.6)	498	(3.6)	**12**	(4.5)	349	(6.5)	384	(4.8)	440	(4.1)	569	(3.4)	623	(3.6)	656	(3.6)	307
Denmark*	495	(2.4)	81	(1.3)	500	(3.0)	489	(2.4)	**12**	(2.6)	360	(5.3)	390	(3.3)	438	(2.9)	551	(2.8)	599	(2.9)	626	(3.6)	266
England	493	(3.6)	95	(1.8)	499	(4.7)	487	(4.2)	**12**	(5.2)	335	(5.9)	369	(5.5)	428	(5.4)	559	(3.8)	615	(4.3)	647	(4.8)	313
Estonia*	524	(2.1)	79	(1.1)	527	(2.4)	522	(2.4)	4	(2.5)	394	(4.1)	423	(2.8)	471	(2.4)	578	(2.8)	628	(3.1)	656	(3.7)	262
Finland*	516	(1.8)	81	(0.9)	514	(2.5)	517	(1.9)	-3	(2.7)	380	(3.7)	411	(3.0)	463	(1.9)	571	(2.4)	619	(2.8)	646	(2.7)	266
France*	496	(2.3)	97	(1.8)	501	(3.3)	492	(2.5)	**8**	(3.5)	331	(6.1)	367	(4.6)	429	(2.7)	567	(3.4)	620	(3.8)	650	(3.4)	319
Germany*	516	(2.8)	95	(1.6)	521	(3.0)	510	(3.3)	**11**	(2.8)	354	(6.4)	389	(4.7)	451	(3.9)	584	(3.7)	636	(3.0)	663	(3.7)	309
Greece*	449	(2.7)	90	(1.4)	452	(3.6)	446	(2.9)	6	(3.4)	299	(5.8)	332	(3.8)	387	(3.6)	511	(3.8)	565	(3.0)	596	(4.0)	297
Hong Kong-China	558	(3.1)	89	(1.9)	563	(4.3)	552	(3.7)	**11**	(5.0)	396	(6.0)	438	(5.8)	501	(4.3)	620	(3.1)	666	(3.6)	690	(3.8)	294
Hungary*	481	(3.2)	95	(2.4)	486	(3.7)	477	(3.7)	**8**	(3.6)	327	(5.0)	359	(4.2)	415	(4.2)	547	(4.9)	608	(6.1)	640	(6.9)	312
Iceland	490	(1.6)	90	(1.1)	487	(2.2)	493	(2.2)	**-7**	(3.1)	340	(4.2)	372	(3.2)	429	(2.4)	553	(2.7)	604	(3.2)	635	(3.1)	295
Israel	469	(4.6)	105	(2.1)	473	(7.7)	464	(3.5)	9	(7.5)	292	(7.8)	330	(6.3)	397	(5.5)	544	(4.8)	603	(5.5)	636	(4.7)	344
Italy*	485	(2.1)	93	(1.2)	494	(2.4)	476	(2.3)	**17**	(2.5)	332	(2.5)	365	(2.7)	422	(2.2)	550	(2.6)	606	(3.0)	637	(3.1)	305
Japan	530	(3.5)	90	(2.1)	539	(4.4)	521	(3.5)	**17**	(4.1)	376	(6.1)	412	(5.2)	471	(4.1)	595	(4.2)	645	(4.0)	673	(4.8)	296
Kazakhstan	433	(3.2)	79	(2.1)	433	(3.5)	432	(3.6)	0	(3.2)	308	(3.4)	334	(3.9)	378	(2.9)	485	(4.5)	536	(6.0)	567	(6.9)	259
Korea	553	(4.3)	95	(2.0)	561	(5.5)	544	(4.9)	**17**	(6.0)	395	(6.5)	430	(5.2)	489	(4.5)	620	(5.0)	672	(5.6)	700	(6.8)	306
*Latvia**	495	(2.8)	79	(1.5)	492	(3.3)	498	(3.2)	**-6**	(3.3)	364	(5.2)	393	(3.4)	441	(3.6)	550	(3.5)	598	(4.2)	626	(3.7)	262
Liechtenstein	536	(3.7)	94	(3.2)	545	(5.7)	527	(5.9)	**18**	(9.1)	374	(10.8)	407	(9.9)	469	(7.4)	608	(5.5)	654	(8.9)	685	(11.8)	311
*Lithuania**	482	(2.7)	86	(1.4)	481	(2.9)	483	(3.0)	-1	(2.3)	341	(4.2)	371	(3.5)	423	(3.8)	542	(3.3)	594	(3.9)	623	(4.0)	282
Luxembourg*	493	(0.9)	93	(0.8)	505	(1.2)	481	(1.3)	**24**	(1.8)	340	(2.4)	371	(2.8)	426	(1.6)	560	(1.3)	614	(2.3)	642	(2.6)	302
Macao-China	536	(1.1)	90	(1.0)	537	(1.3)	535	(1.7)	2	(2.1)	386	(3.6)	421	(2.9)	478	(2.2)	598	(1.6)	646	(1.9)	672	(2.4)	286
Mexico	413	(1.4)	78	(0.9)	420	(1.5)	407	(1.6)	**13**	(1.3)	287	(2.5)	315	(2.0)	360	(1.6)	465	(1.7)	514	(2.0)	544	(2.1)	257
Netherlands*	518	(3.4)	88	(2.2)	522	(3.7)	515	(3.8)	**8**	(2.8)	367	(7.1)	398	(5.4)	457	(5.1)	584	(4.5)	628	(3.6)	650	(3.8)	284
New Zealand	495	(2.2)	100	(1.2)	502	(3.2)	488	(2.9)	**14**	(4.2)	335	(4.3)	367	(3.4)	424	(2.7)	566	(3.0)	626	(3.1)	660	(3.9)	325
Northern Ireland	486	(3.1)	93	(2.1)	491	(5.1)	481	(5.6)	10	(8.8)	334	(4.9)	364	(4.9)	420	(4.5)	552	(4.5)	609	(5.6)	638	(5.4)	305
Norway	486	(2.7)	89	(1.3)	487	(2.7)	486	(3.4)	2	(2.9)	341	(5.5)	374	(3.8)	426	(3.1)	548	(2.8)	600	(4.0)	632	(3.7)	291
Poland*	519	(3.5)	88	(1.7)	518	(4.1)	519	(3.7)	-1	(3.5)	377	(3.6)	406	(3.7)	456	(3.5)	580	(4.3)	636	(5.3)	666	(6.5)	289
Portugal*	489	(3.7)	94	(1.4)	493	(4.0)	484	(3.8)	**9**	(2.5)	330	(4.5)	364	(4.7)	422	(5.0)	556	(3.6)	610	(3.5)	640	(3.9)	310
Republic of Ireland*	502	(2.4)	84	(1.3)	509	(3.4)	496	(2.7)	**13**	(3.9)	360	(4.4)	394	(4.6)	447	(3.5)	561	(2.6)	609	(3.0)	637	(3.1)	276
*Romania**	446	(4.1)	87	(2.3)	447	(4.6)	444	(4.4)	2	(3.7)	312	(4.2)	337	(4.1)	383	(4.4)	504	(5.2)	563	(7.0)	597	(7.2)	285
Russian Federation	487	(3.1)	87	(1.6)	485	(3.5)	489	(3.3)	-4	(2.9)	343	(4.3)	374	(4.1)	428	(3.3)	546	(3.8)	599	(4.7)	628	(5.0)	286
Scotland	496	(2.8)	89	(1.7)	504	(3.4)	488	(3.3)	**16**	(3.6)	347	(5.5)	380	(5.8)	436	(4.0)	558	(3.1)	611	(3.9)	640	(4.8)	292
Serbia	451	(3.4)	92	(2.3)	456	(4.1)	446	(3.8)	**9**	(4.1)	305	(4.9)	335	(4.8)	387	(3.9)	512	(4.1)	572	(5.4)	609	(6.8)	303
Shanghai-China	613	(3.0)	93	(2.2)	614	(3.6)	611	(3.2)	3	(3.1)	447	(6.5)	486	(6.5)	553	(4.7)	679	(2.7)	726	(2.8)	752	(3.6)	304
Singapore	574	(1.2)	98	(1.0)	571	(1.8)	577	(1.7)	**-6**	(2.4)	404	(3.1)	441	(2.7)	507	(2.2)	645	(1.8)	696	(1.8)	724	(3.8)	320
Slovak Republic*	485	(3.4)	101	(2.4)	489	(3.9)	481	(4.2)	7	(4.4)	316	(7.2)	355	(5.9)	418	(4.6)	556	(3.9)	614	(4.5)	645	(5.6)	330
Slovenia*	505	(1.2)	90	(1.0)	506	(2.0)	503	(2.0)	3	(3.1)	361	(3.4)	389	(2.6)	440	(2.5)	569	(2.0)	626	(3.3)	656	(3.9)	295
Spain*	481	(2.0)	87	(0.8)	488	(2.5)	474	(2.1)	**14**	(2.3)	336	(3.6)	367	(3.2)	422	(2.7)	544	(2.1)	592	(2.0)	619	(2.1)	283
Sweden*	474	(2.5)	90	(1.5)	471	(3.1)	476	(2.6)	-5	(2.9)	325	(4.6)	357	(4.2)	413	(2.9)	536	(3.3)	591	(3.5)	621	(3.4)	296
Switzerland	529	(2.9)	90	(1.5)	534	(3.3)	525	(3.0)	**9**	(2.7)	377	(4.1)	411	(3.1)	468	(3.1)	593	(4.0)	644	(4.3)	675	(4.5)	298
Turkey	448	(5.0)	94	(3.1)	451	(5.4)	445	(5.8)	6	(5.0)	308	(6.0)	333	(4.3)	380	(3.9)	510	(8.0)	582	(9.6)	616	(9.0)	308
United Arab Emirates	440	(2.4)	92	(1.2)	437	(3.7)	443	(3.1)	-6	(4.9)	297	(3.4)	325	(2.8)	374	(2.7)	502	(3.1)	563	(3.7)	597	(3.5)	300
United Kingdom*	492	(3.1)	94	(1.5)	498	(4.0)	486	(3.6)	**12**	(4.4)	335	(5.0)	368	(4.7)	427	(4.5)	557	(3.2)	613	(3.9)	645	(4.0)	310
United States	480	(3.5)	90	(1.4)	481	(3.8)	479	(3.7)	2	(2.8)	337	(3.9)	365	(4.0)	416	(3.5)	541	(4.2)	600	(4.8)	631	(5.3)	294
Vietnam	523	(5.1)	88	(2.6)	527	(5.9)	519	(4.9)	**8**	(3.1)	377	(8.8)	409	(7.7)	464	(5.6)	583	(5.7)	637	(7.0)	668	(7.8)	291
Wales	466	(2.2)	85	(1.3)	470	(2.7)	461	(2.7)	**9**	(3.2)	325	(4.0)	356	(4.1)	408	(3.1)	524	(3.0)	574	(3.3)	605	(3.9)	280
OECD average	493	(0.5)	91	(0.3)	498	(0.6)	489	(0.5)	**9**	(0.6)	343	(0.9)	375	(0.7)	431	(0.6)	557	(0.6)	611	(0.7)	641	(0.7)	298

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

14 countries with scores below 430 omitted

Note: Values that are statistically significant are indicated in bold

B11 Mean score, variation and gender differences in student performance on the mathematics sub-scale interpreting

	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	514	(1.7)	101	(1.1)	519	(2.4)	509	(2.0)	**9**	(2.9)	348	(3.3)	384	(2.3)	445	(2.0)	584	(2.2)	645	(2.8)	680	(3.3)	332
Austria*	509	(3.3)	106	(2.0)	517	(4.5)	501	(4.1)	**16**	(5.6)	331	(5.8)	368	(4.9)	433	(4.6)	587	(3.9)	644	(4.6)	677	(5.2)	346
Belgium*	513	(2.4)	106	(1.5)	518	(3.2)	508	(2.6)	**10**	(3.5)	335	(4.6)	374	(3.5)	439	(3.6)	590	(2.8)	649	(3.2)	681	(2.9)	346
*Bulgaria**	441	(4.2)	99	(2.4)	437	(5.1)	445	(4.4)	-8	(4.8)	282	(6.6)	314	(6.1)	372	(5.1)	510	(4.8)	570	(5.4)	604	(6.0)	322
Canada	521	(2.0)	93	(0.9)	526	(2.3)	517	(2.3)	**9**	(2.2)	366	(2.9)	401	(2.7)	459	(2.5)	585	(2.6)	641	(2.8)	672	(3.2)	306
Chile	433	(3.1)	82	(1.7)	444	(3.9)	422	(3.0)	**22**	(3.3)	305	(5.1)	331	(3.9)	376	(3.7)	488	(3.9)	540	(4.6)	572	(4.7)	267
Chinese Taipei	549	(3.0)	105	(1.8)	550	(4.7)	548	(4.9)	3	(7.4)	366	(5.3)	407	(5.1)	478	(4.0)	625	(3.4)	680	(3.8)	710	(4.8)	345
*Croatia**	477	(3.5)	93	(2.1)	484	(4.2)	470	(3.8)	**15**	(4.0)	328	(4.1)	358	(4.2)	412	(3.5)	541	(4.5)	600	(6.1)	636	(6.8)	308
Cyprus	436	(1.3)	101	(1.1)	434	(1.8)	438	(1.8)	-4	(2.5)	269	(3.1)	305	(2.7)	367	(2.1)	505	(2.3)	565	(2.8)	601	(4.1)	332
Czech Republic*	494	(3.0)	103	(2.5)	498	(3.9)	490	(3.7)	9	(4.6)	327	(7.0)	367	(5.6)	427	(4.1)	564	(3.0)	622	(3.7)	656	(3.5)	329
Denmark*	508	(2.5)	90	(1.3)	515	(3.0)	501	(2.7)	**14**	(2.5)	359	(4.6)	391	(3.9)	447	(3.1)	570	(3.1)	624	(3.5)	653	(4.0)	294
England	502	(4.2)	103	(2.3)	509	(5.5)	495	(4.4)	**14**	(5.6)	331	(7.6)	369	(6.3)	432	(5.6)	573	(3.9)	634	(4.5)	669	(5.5)	338
Estonia*	513	(2.1)	87	(1.1)	515	(2.8)	511	(2.3)	4	(3.0)	372	(3.2)	401	(3.4)	454	(2.9)	571	(2.8)	625	(3.2)	656	(3.6)	284
Finland*	528	(2.2)	88	(1.1)	523	(3.0)	534	(2.1)	**-11**	(2.9)	379	(3.8)	415	(3.7)	471	(2.6)	588	(2.3)	639	(3.0)	669	(4.1)	290
France*	511	(2.5)	107	(2.0)	513	(3.7)	509	(2.8)	4	(4.0)	329	(5.9)	370	(4.9)	438	(3.6)	588	(3.7)	646	(3.8)	678	(4.4)	350
Germany*	517	(3.2)	105	(2.2)	522	(3.4)	511	(3.6)	**12**	(3.0)	338	(6.5)	376	(4.6)	445	(4.2)	592	(3.5)	650	(4.2)	680	(4.0)	342
Greece*	467	(3.1)	98	(1.8)	471	(4.0)	463	(3.1)	**8**	(3.7)	304	(5.6)	340	(4.6)	400	(4.1)	536	(3.6)	593	(4.3)	626	(4.4)	322
Hong Kong-China	551	(3.4)	93	(1.9)	557	(4.8)	545	(3.8)	**12**	(5.5)	385	(5.9)	425	(5.7)	492	(4.9)	616	(3.9)	666	(4.8)	696	(5.1)	311
Hungary*	477	(3.1)	100	(2.2)	479	(3.7)	475	(3.6)	4	(4.0)	307	(5.9)	344	(5.2)	410	(3.7)	547	(4.4)	605	(4.9)	638	(6.4)	331
Iceland	492	(1.9)	101	(1.2)	487	(2.6)	498	(2.5)	**-11**	(3.4)	321	(5.4)	360	(3.8)	424	(2.9)	563	(3.0)	619	(2.7)	653	(3.6)	331
Israel	462	(5.2)	114	(2.2)	470	(9.1)	453	(3.4)	**17**	(8.9)	272	(7.5)	312	(6.1)	381	(6.0)	542	(6.1)	610	(6.5)	648	(7.5)	376
Italy*	498	(2.1)	107	(1.2)	507	(2.7)	489	(2.5)	**18**	(3.0)	321	(3.1)	360	(3.1)	426	(2.6)	573	(2.7)	636	(3.1)	671	(3.0)	350
Japan	531	(3.5)	92	(2.0)	539	(4.5)	522	(3.4)	**17**	(4.2)	375	(6.1)	411	(4.7)	469	(4.3)	595	(3.9)	648	(4.6)	677	(5.1)	303
Kazakhstan	420	(2.6)	64	(1.3)	418	(3.1)	423	(2.8)	-5	(2.8)	317	(3.1)	339	(2.5)	377	(2.5)	463	(3.6)	504	(4.8)	528	(4.4)	210
Korea	540	(4.2)	98	(1.8)	545	(5.4)	535	(4.9)	10	(6.0)	373	(6.9)	412	(5.7)	476	(4.5)	609	(4.4)	662	(4.8)	693	(5.8)	320
*Latvia**	486	(3.0)	89	(1.6)	486	(3.6)	487	(3.6)	-1	(3.8)	340	(5.7)	373	(4.2)	426	(3.2)	547	(3.6)	600	(3.9)	632	(4.7)	292
Liechtenstein	540	(4.1)	107	(3.6)	553	(6.4)	526	(6.4)	**27**	(10.1)	355	(18.4)	393	(9.7)	466	(10.1)	620	(7.0)	672	(10.5)	706	(16.9)	351
*Lithuania**	471	(2.8)	91	(1.5)	470	(3.0)	471	(3.2)	-1	(2.6)	322	(3.7)	354	(4.2)	408	(3.4)	533	(3.8)	591	(4.0)	622	(4.7)	301
Luxembourg*	495	(1.1)	106	(0.9)	505	(1.6)	485	(1.5)	**20**	(2.3)	322	(4.3)	355	(3.0)	420	(1.9)	571	(1.6)	631	(2.2)	665	(3.0)	343
Macao-China	530	(1.0)	92	(0.9)	530	(1.4)	529	(1.5)	2	(2.0)	374	(3.7)	409	(2.4)	469	(2.0)	594	(2.0)	645	(2.5)	674	(3.0)	300
Mexico	413	(1.3)	73	(0.8)	418	(1.5)	408	(1.4)	**10**	(1.3)	294	(2.1)	321	(1.8)	365	(1.7)	461	(1.7)	506	(1.9)	533	(2.3)	239
Netherlands*	526	(3.6)	100	(2.5)	530	(3.8)	521	(4.0)	**10**	(2.9)	357	(7.4)	389	(5.6)	455	(5.6)	599	(4.1)	653	(3.6)	682	(4.9)	325
New Zealand	511	(2.5)	108	(1.4)	516	(3.7)	505	(3.1)	**11**	(4.7)	334	(4.7)	370	(4.0)	434	(3.5)	587	(3.3)	650	(3.6)	684	(4.1)	351
Northern Ireland	496	(3.5)	102	(2.4)	500	(5.2)	491	(5.8)	8	(8.4)	328	(8.3)	366	(6.0)	425	(4.5)	565	(4.1)	628	(6.0)	662	(6.3)	334
Norway	499	(3.1)	98	(1.6)	500	(3.2)	498	(3.7)	2	(3.1)	336	(5.8)	373	(4.1)	433	(3.6)	565	(3.1)	623	(3.9)	658	(4.3)	321
Poland*	515	(3.5)	89	(1.9)	517	(4.2)	513	(3.7)	3	(3.6)	368	(4.3)	400	(4.0)	452	(3.5)	577	(4.2)	630	(5.4)	662	(7.7)	293
Portugal*	490	(4.0)	94	(1.8)	496	(4.5)	484	(4.0)	**12**	(2.9)	333	(6.8)	369	(5.3)	425	(5.2)	557	(3.8)	612	(3.7)	642	(3.5)	308
Republic of Ireland*	507	(2.5)	91	(1.4)	515	(3.5)	498	(3.3)	**17**	(4.5)	353	(5.3)	389	(4.6)	446	(3.5)	569	(2.6)	622	(2.5)	654	(4.2)	301
*Romania**	438	(3.1)	74	(1.9)	441	(3.8)	435	(3.4)	5	(3.4)	321	(4.4)	345	(3.8)	387	(3.4)	487	(3.8)	535	(4.6)	563	(6.4)	242
Russian Federation	471	(2.9)	89	(1.6)	469	(3.8)	473	(3.0)	-4	(3.4)	324	(4.8)	357	(4.0)	411	(3.7)	531	(3.5)	586	(3.9)	618	(4.6)	294
Scotland	510	(2.7)	90	(1.9)	516	(3.3)	504	(3.2)	**12**	(3.7)	360	(7.3)	396	(5.6)	449	(3.9)	571	(3.1)	626	(4.2)	658	(6.2)	298
Serbia	445	(3.4)	92	(2.2)	448	(4.3)	443	(3.5)	6	(4.1)	297	(6.2)	328	(5.6)	383	(3.9)	506	(4.4)	566	(5.0)	599	(6.7)	302
Shanghai-China	579	(2.9)	98	(2.0)	582	(3.5)	576	(3.2)	**7**	(3.3)	412	(6.2)	448	(4.8)	514	(4.2)	647	(3.4)	700	(4.1)	732	(6.0)	320
Singapore	555	(1.4)	106	(0.9)	553	(1.9)	557	(2.0)	-5	(2.9)	377	(3.5)	414	(2.3)	482	(2.1)	629	(2.4)	688	(2.1)	721	(3.4)	344
Slovak Republic*	473	(3.3)	103	(2.1)	478	(4.1)	468	(3.7)	**9**	(4.2)	304	(5.7)	339	(5.0)	402	(4.6)	545	(4.4)	606	(4.1)	639	(5.1)	335
Slovenia*	498	(1.4)	95	(0.9)	498	(2.1)	497	(2.1)	1	(3.2)	347	(3.5)	378	(2.6)	431	(2.6)	566	(2.5)	623	(2.2)	654	(4.2)	307
Spain*	495	(2.2)	98	(0.8)	505	(2.5)	485	(2.5)	**21**	(2.3)	330	(3.3)	367	(3.4)	429	(2.8)	564	(2.6)	619	(2.3)	652	(2.5)	321
Sweden*	485	(2.4)	99	(1.3)	484	(3.3)	486	(2.5)	-2	(3.4)	320	(5.1)	357	(3.8)	418	(3.1)	553	(3.2)	612	(3.1)	646	(3.1)	325
Switzerland	529	(3.4)	101	(1.5)	535	(3.9)	523	(3.5)	**12**	(2.8)	357	(4.9)	396	(3.9)	462	(3.5)	600	(4.3)	655	(4.9)	687	(5.3)	330
Turkey	446	(4.6)	95	(3.0)	451	(5.1)	442	(5.5)	9	(5.0)	304	(4.2)	332	(3.8)	380	(3.1)	506	(7.3)	576	(9.5)	616	(10.3)	312
United Arab Emirates	428	(2.4)	90	(1.2)	424	(4.1)	431	(3.0)	-7	(5.3)	286	(3.4)	315	(2.7)	365	(2.5)	487	(3.1)	548	(3.8)	583	(4.4)	297
United Kingdom*	501	(3.5)	102	(2.0)	508	(4.6)	494	(3.8)	**14**	(4.7)	333	(6.5)	370	(5.2)	432	(4.4)	571	(3.3)	632	(4.0)	666	(4.8)	333
United States	489	(3.9)	96	(1.6)	493	(4.4)	486	(3.9)	**7**	(3.0)	336	(5.1)	367	(5.1)	422	(4.3)	556	(4.6)	615	(4.0)	649	(5.3)	313
Vietnam	497	(4.5)	81	(2.3)	500	(5.2)	494	(4.3)	**5**	(2.7)	361	(6.9)	391	(6.4)	442	(5.6)	551	(4.9)	600	(5.9)	631	(6.6)	270
Wales	483	(2.6)	93	(1.4)	489	(3.3)	477	(3.1)	**12**	(3.8)	330	(5.0)	362	(4.5)	421	(3.5)	546	(3.2)	603	(4.6)	637	(4.5)	307
OECD average	497	(0.5)	98	(0.3)	502	(0.7)	492	(0.6)	**9**	(0.7)	335	(0.9)	370	(0.7)	430	(0.6)	565	(0.6)	622	(0.7)	655	(0.8)	320

OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries
14 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold

B12 Significant differences in mean scores on the quantity scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	591	(3.2)	^
Singapore	569	(1.2)	^
Hong Kong-China	566	(3.4)	^
Chinese Taipei	543	(3.1)	^
Liechtenstein	538	(4.1)	^
Korea	537	(4.1)	^
Netherlands*	532	(3.6)	^
Switzerland	531	(3.1)	^
Macao-China	531	(1.1)	^
Finland*	527	(1.9)	^
Estonia*	525	(2.2)	^
Belgium*	519	(2.0)	^
Poland*	519	(3.5)	^
Japan	518	(3.6)	^
Germany*	517	(3.1)	^
Canada	515	(2.2)	^
Austria*	510	(2.9)	^
Vietnam	509	(5.5)	*NS*
Republic of Ireland*	505	(2.6)	*NS*
Czech Republic*	505	(3.0)	*NS*
Slovenia*	504	(1.2)	*NS*
Denmark*	502	(2.4)	*NS*
Scotland	501	(3.0)	*NS*
Australia	500	(1.9)	*NS*
New Zealand	499	(2.4)	*NS*
Iceland	496	(1.9)	*NS*
France*	496	(2.6)	*NS*
England	495	(4.5)	
OECD Average	**495**	**(0.5)**	*NS*
Luxembourg*	495	(1.0)	*NS*
United Kingdom	494	(3.8)	
Norway	492	(2.9)	*NS*
Northern Ireland	491	(3.7)	*NS*
Spain*	491	(2.3)	*NS*
Italy*	491	(2.0)	*NS*
*Latvia**	487	(2.9)	*NS*
Slovak Republic*	486	(3.5)	*NS*
*Lithuania**	483	(2.8)	v
Sweden*	482	(2.5)	v
Portugal*	481	(4.0)	v
*Croatia**	480	(3.7)	v
Israel	480	(5.2)	v
United States	478	(3.9)	v
Russian Federation	478	(3.0)	v
Hungary*	476	(3.4)	v
Wales	465	(2.3)	v
Serbia	456	(3.7)	v
Greece*	455	(3.0)	v
*Romania**	443	(4.5)	v
*Bulgaria**	443	(4.3)	v
Turkey	442	(5.0)	v
Cyprus	439	(1.1)	v
United Arab Emirates	431	(2.7)	v
Kazakhstan	428	(3.5)	v
Chile	421	(3.3)	v
Mexico	414	(1.5)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^	significantly higher
NS	no significant difference
v	significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B13 Significant differences in mean scores on the uncertainty and data scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	592	(3.0)	^
Singapore	559	(1.5)	^
Hong Kong-China	553	(3.0)	^
Chinese Taipei	549	(3.2)	^
Korea	538	(4.2)	^
Netherlands*	532	(3.8)	^
Japan	528	(3.5)	^
Liechtenstein	526	(3.9)	^
Macao-China	525	(1.1)	^
Switzerland	522	(3.2)	^
Vietnam	519	(4.5)	^
Finland*	519	(2.4)	^
Poland*	517	(3.5)	^
Canada	516	(1.8)	^
Estonia*	510	(2.0)	*NS*
Germany*	509	(3.0)	*NS*
Republic of Ireland*	509	(2.5)	*NS*
Belgium*	508	(2.5)	*NS*
Australia	508	(1.5)	*NS*
New Zealand	506	(2.6)	*NS*
Denmark*	505	(2.4)	*NS*
Scotland	504	(2.6)	*NS*
England	503	(3.6)	
United Kingdom	502	(3.0)	
Austria*	499	(2.7)	*NS*
Norway	497	(3.0)	*NS*
Northern Ireland	496	(3.4)	*NS*
Slovenia*	496	(1.2)	v
Iceland	496	(1.8)	*NS*
OECD Average	**493**	**(0.5)**	v
France*	492	(2.7)	v
United States	488	(3.5)	v
Czech Republic*	488	(2.8)	v
Spain*	487	(2.3)	v
Portugal*	486	(3.8)	v
Luxembourg*	483	(1.0)	v
Wales	483	(2.7)	v
Sweden*	483	(2.5)	v
Italy*	482	(2.0)	v
*Latvia**	478	(2.8)	v
Hungary*	476	(3.3)	v
*Lithuania**	474	(2.7)	v
Slovak Republic*	472	(3.6)	v
*Croatia**	468	(3.5)	v
Israel	465	(4.7)	v
Russian Federation	463	(3.3)	v
Greece*	460	(2.6)	v
Serbia	448	(3.3)	v
Turkey	447	(4.6)	v
Cyprus	442	(1.1)	v
*Romania**	437	(3.3)	v
United Arab Emirates	432	(2.4)	v
*Bulgaria**	432	(3.9)	v
Chile	430	(2.9)	v
Kazakhstan	414	(2.6)	v
Mexico	413	(1.2)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^	significantly higher
NS	no significant difference
v	significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B14 Significant differences in mean scores on the change and relationships scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	624	(3.6)	^
Singapore	580	(1.5)	^
Hong Kong-China	564	(3.6)	^
Chinese Taipei	561	(3.5)	^
Korea	559	(5.2)	^
Macao-China	542	(1.2)	^
Japan	542	(4.0)	^
Liechtenstein	542	(4.0)	^
Estonia*	530	(2.3)	^
Switzerland	530	(3.4)	^
Canada	525	(2.0)	^
Finland*	520	(2.6)	^
Netherlands*	518	(3.9)	^
Germany*	516	(3.8)	^
Belgium*	513	(2.6)	^
Vietnam	509	(5.1)	*NS*
Poland*	509	(4.1)	*NS*
Australia	509	(1.7)	^
Austria*	506	(3.4)	*NS*
Republic of Ireland*	501	(2.6)	*NS*
New Zealand	501	(2.5)	*NS*
Czech Republic*	499	(3.5)	*NS*
Slovenia*	499	(1.1)	*NS*
England	498	(4.1)	
Scotland	497	(3.1)	*NS*
France*	497	(2.7)	*NS*
*Latvia**	496	(3.4)	*NS*
United Kingdom	496	(3.4)	
Denmark*	494	(2.7)	*NS*
OECD Average	**493**	**(0.6)**	*NS*
Russian Federation	491	(3.4)	*NS*
United States	488	(3.5)	*NS*
Luxembourg*	488	(1.0)	v
Iceland	487	(1.9)	v
Portugal*	486	(4.1)	v
Northern Ireland	486	(3.8)	v
Spain*	482	(2.0)	v
Hungary*	481	(3.5)	v
*Lithuania**	479	(3.2)	v
Norway	478	(3.1)	v
Italy*	477	(2.1)	v
Slovak Republic*	474	(4.0)	v
Wales	470	(2.5)	v
Sweden*	469	(2.8)	v
*Croatia**	468	(4.2)	v
Israel	462	(5.3)	v
Turkey	448	(5.0)	v
Greece*	446	(3.2)	v
*Romania**	446	(3.9)	v
United Arab Emirates	442	(2.6)	v
Serbia	442	(4.1)	v
Cyprus	440	(1.2)	v
*Bulgaria**	434	(4.5)	v
Kazakhstan	433	(3.2)	v
Chile	411	(3.5)	v
Mexico	405	(1.6)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^ significantly higher

NS no significant difference

v significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B15 Significant differences in mean scores on the space and shape scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	649	(3.6)	^
Chinese Taipei	592	(3.8)	^
Singapore	580	(1.5)	^
Korea	573	(5.2)	^
Hong Kong-China	567	(4.0)	^
Macao-China	558	(1.4)	^
Japan	558	(3.7)	^
Switzerland	544	(3.1)	^
Liechtenstein	539	(4.5)	^
Poland*	524	(4.2)	^
Estonia*	513	(2.5)	^
Canada	510	(2.1)	^
Belgium*	509	(2.4)	^
Netherlands*	507	(3.5)	^
Germany*	507	(3.2)	^
Vietnam	507	(5.1)	^
Finland*	507	(2.1)	^
Slovenia*	503	(1.4)	^
Austria*	501	(3.1)	^
Czech Republic*	499	(3.4)	^
*Latvia**	497	(3.3)	^
Denmark*	497	(2.5)	^
Australia	497	(1.8)	^
Russian Federation	496	(3.9)	^
Portugal*	491	(4.2)	^
New Zealand	491	(2.4)	^
OECD Average	**490**	**(0.5)**	^
Slovak Republic*	490	(4.1)	^
France*	489	(2.7)	^
Iceland	489	(1.5)	^
Italy*	487	(2.5)	^
Luxembourg*	486	(1.0)	^
Scotland	482	(3.1)	*NS*
Norway	480	(3.3)	*NS*
Republic of Ireland*	478	(2.6)	*NS*
England	477	(4.1)	
Spain*	477	(2.0)	*NS*
United Kingdom	475	(3.5)	
Hungary*	474	(3.4)	*NS*
*Lithuania**	472	(3.1)	*NS*
Sweden*	469	(2.5)	*NS*
United States	463	(4.0)	v
Northern Ireland	463	(3.6)	v
*Croatia**	460	(3.9)	v
Kazakhstan	450	(3.9)	v
Israel	449	(4.8)	v
*Romania**	447	(4.1)	v
Serbia	446	(3.9)	v
Wales	444	(2.6)	v
Turkey	443	(5.5)	v
*Bulgaria**	442	(4.3)	v
Greece*	436	(2.6)	v
Cyprus	436	(1.1)	v
United Arab Emirates	425	(2.4)	v
Chile	419	(3.2)	v
Mexico	413	(1.6)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^ significantly higher

NS no significant difference

v significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B16 Significant differences in mean scores on the formulate scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	624	(4.1)	^
Singapore	582	(1.6)	^
Chinese Taipei	578	(4.0)	^
Hong Kong-China	568	(3.7)	^
Korea	562	(5.1)	^
Japan	554	(4.2)	^
Macao-China	545	(1.4)	^
Switzerland	538	(3.1)	^
Liechtenstein	535	(4.4)	^
Netherlands*	527	(3.8)	^
Finland*	519	(2.4)	^
Estonia*	517	(2.3)	^
Canada	516	(2.2)	^
Poland*	516	(4.2)	^
Belgium*	512	(2.4)	^
Germany*	511	(3.4)	^
Denmark*	502	(2.4)	^
Iceland	500	(1.7)	^
Austria*	499	(3.2)	*NS*
Australia	498	(1.9)	*NS*
Vietnam	497	(5.1)	*NS*
New Zealand	496	(2.5)	*NS*
Czech Republic*	495	(3.4)	*NS*
Republic of Ireland*	492	(2.4)	*NS*
Slovenia*	492	(1.5)	*NS*
OECD Average	**492**	**(0.5)**	*NS*
England	491	(4.4)	
Scotland	490	(3.3)	*NS*
United Kingdom	489	(3.7)	
Norway	489	(3.1)	*NS*
*Latvia**	488	(3.0)	*NS*
France*	483	(2.8)	*NS*
Luxembourg*	482	(1.0)	*NS*
Russian Federation	481	(3.6)	*NS*
Slovak Republic*	480	(4.1)	*NS*
Northern Ireland	479	(3.8)	*NS*
Sweden*	479	(2.7)	v
Portugal*	479	(4.3)	*NS*
*Lithuania**	477	(3.1)	v
Spain*	477	(2.2)	v
United States	476	(4.1)	v
Italy*	475	(2.2)	v
Hungary*	469	(3.6)	v
Israel	465	(4.7)	v
Wales	457	(2.4)	v
*Croatia**	453	(4.0)	v
Turkey	449	(5.2)	v
Greece*	448	(2.3)	v
Serbia	447	(3.8)	v
*Romania**	445	(4.1)	v
Kazakhstan	442	(3.8)	v
*Bulgaria**	437	(4.2)	v
Cyprus	437	(1.2)	v
United Arab Emirates	426	(2.7)	v
Chile	420	(3.2)	v
Mexico	409	(1.7)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^ significantly higher

NS no significant difference

v significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B17 Significant differences in mean scores on the employ scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	613	(3.0)	^
Singapore	574	(1.2)	^
Hong Kong-China	558	(3.1)	^
Korea	553	(4.3)	^
Chinese Taipei	549	(3.1)	^
Liechtenstein	536	(3.7)	^
Macao-China	536	(1.1)	^
Japan	530	(3.5)	^
Switzerland	529	(2.9)	^
Estonia*	524	(2.1)	^
Vietnam	523	(5.1)	^
Poland*	519	(3.5)	^
Netherlands*	518	(3.4)	^
Canada	517	(1.9)	^
Germany*	516	(2.8)	^
Belgium*	516	(2.1)	^
Finland*	516	(1.8)	^
Austria*	510	(2.5)	^
Slovenia*	505	(1.2)	^
Czech Republic*	504	(2.9)	^
Republic of Ireland*	502	(2.4)	^
Australia	500	(1.7)	*NS*
France*	496	(2.3)	*NS*
Scotland	496	(2.8)	*NS*
*Latvia**	495	(2.8)	*NS*
New Zealand	495	(2.2)	*NS*
Denmark*	495	(2.4)	*NS*
OECD Average	**493**	**(0.5)**	*NS*
Luxembourg*	493	(0.9)	*NS*
England	493	(3.6)	
United Kingdom	492	(3.1)	
Iceland	490	(1.6)	*NS*
Portugal*	489	(3.7)	*NS*
Russian Federation	487	(3.1)	*NS*
Norway	486	(2.7)	*NS*
Northern Ireland	486	(3.1)	*NS*
Italy*	485	(2.1)	*NS*
Slovak Republic*	485	(3.4)	*NS*
*Lithuania**	482	(2.7)	v
Spain*	481	(2.0)	v
Hungary*	481	(3.2)	v
United States	480	(3.5)	v
*Croatia**	478	(3.7)	v
Sweden*	474	(2.5)	v
Israel	469	(4.6)	v
Wales	466	(2.2)	v
Serbia	451	(3.4)	v
Greece*	449	(2.7)	v
Turkey	448	(5.0)	v
*Romania**	446	(4.1)	v
Cyprus	443	(1.1)	v
United Arab Emirates	440	(2.4)	v
*Bulgaria**	439	(4.1)	v
Kazakhstan	433	(3.2)	v
Chile	416	(3.3)	v
Mexico	413	(1.4)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^ significantly higher

NS no significant difference

v significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B18 Significant differences in mean scores on the interpret scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	579	(2.9)	^
Singapore	555	(1.4)	^
Hong Kong-China	551	(3.4)	^
Chinese Taipei	549	(3.0)	^
Liechtenstein	540	(4.1)	^
Korea	540	(4.2)	^
Japan	531	(3.5)	^
Macao-China	530	(1.0)	^
Switzerland	529	(3.4)	^
Finland*	528	(2.2)	^
Netherlands*	526	(3.6)	^
Canada	521	(2.0)	^
Germany*	517	(3.2)	^
Poland*	515	(3.5)	^
Australia	514	(1.7)	^
Belgium*	513	(2.4)	^
Estonia*	513	(2.1)	^
New Zealand	511	(2.5)	*NS*
France*	511	(2.5)	*NS*
Scotland	510	(2.7)	*NS*
Austria*	509	(3.3)	*NS*
Denmark*	508	(2.5)	*NS*
Republic of Ireland*	507	(2.5)	*NS*
England	502	(4.2)	
United Kingdom	501	(3.5)	
Norway	499	(3.1)	*NS*
Italy*	498	(2.1)	*NS*
Slovenia*	498	(1.4)	*NS*
Vietnam	497	(4.5)	*NS*
OECD Average	**497**	**(0.5)**	*NS*
Northern Ireland	496	(3.5)	*NS*
Spain*	495	(2.2)	*NS*
Luxembourg*	495	(1.1)	*NS*
Czech Republic*	494	(3.0)	*NS*
Iceland	492	(1.9)	v
Portugal*	490	(4.0)	*NS*
United States	490	(3.9)	v
*Latvia**	486	(3.0)	v
Sweden*	485	(2.4)	v
Wales	483	(2.6)	v
*Croatia**	477	(3.5)	v
Hungary*	477	(3.1)	v
Slovak Republic*	473	(3.3)	v
Russian Federation	471	(2.9)	v
*Lithuania**	471	(2.8)	v
Greece*	467	(3.1)	v
Israel	462	(5.2)	v
Turkey	446	(4.6)	v
Serbia	445	(3.4)	v
*Bulgaria**	441	(4.2)	v
*Romania**	438	(3.1)	v
Cyprus	436	(1.3)	v
Chile	433	(3.1)	v
United Arab Emirates	428	(2.4)	v
Kazakhstan	420	(2.6)	v
Mexico	413	(1.3)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

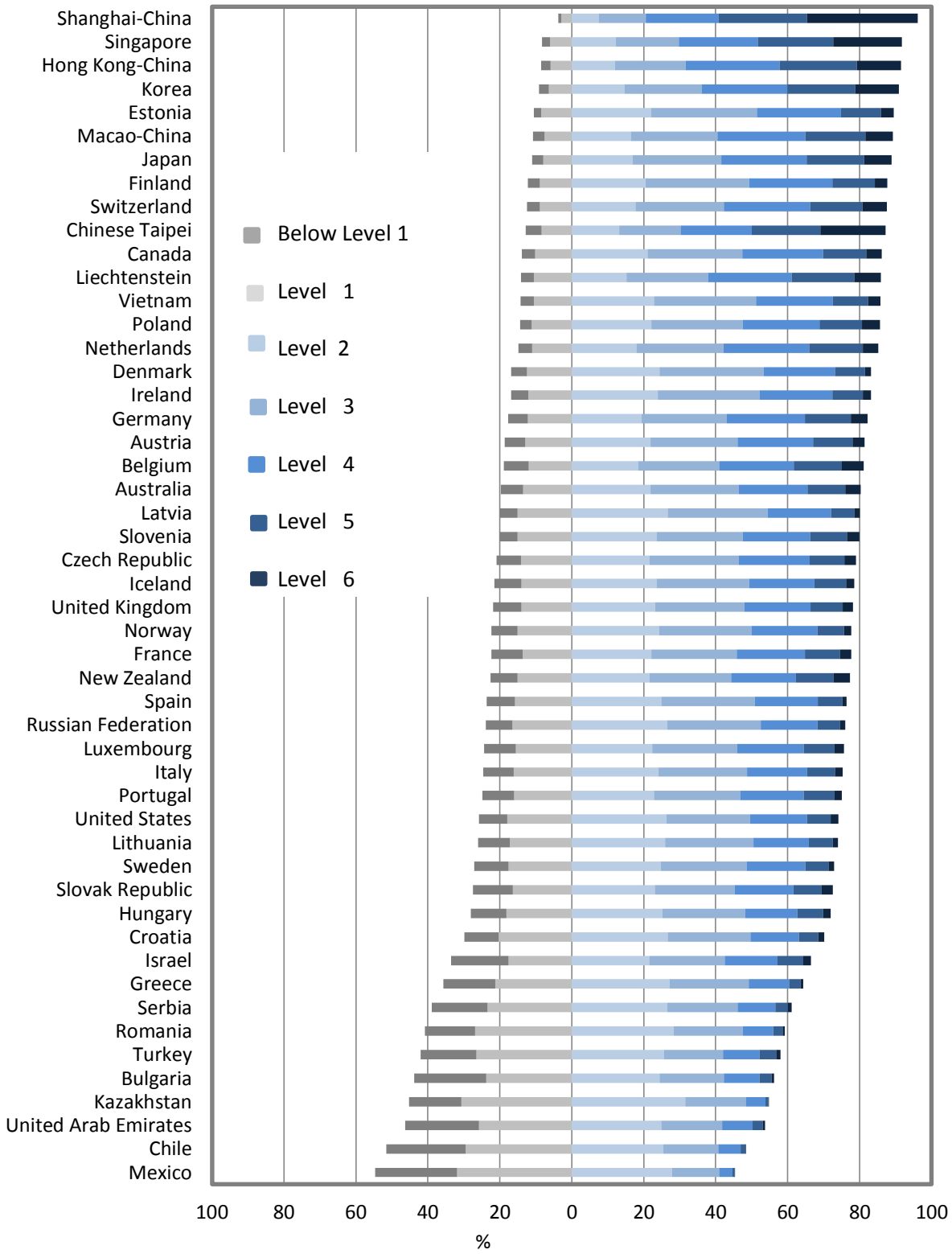
^ significantly higher

NS no significant difference

v significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

B19 Summary of the percentage of students at each level of proficiency on the mathematics scale



14 countries with scores below 430 omitted
Countries are ranked in descending order of the percentage of students at Levels 2, 3, 4, 5 and 6.
Source: OECD, PISA 2012 database, Table I.2.1a.

B20 Percentage of students at each level of proficiency on the mathematics scale

	Proficiency levels													
	Below Level 1		Level 1		Level 2		Level 3		Level 4		Level 5		Level 6	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.
Australia	6.1	(0.4)	13.5	(0.6)	21.9	(0.8)	24.6	(0.6)	19.0	(0.5)	10.5	(0.4)	4.3	(0.4)
Austria*	5.7	(0.6)	13.0	(0.7)	21.9	(0.9)	24.2	(0.8)	21.0	(0.9)	11.0	(0.7)	3.3	(0.4)
Belgium*	7.0	(0.6)	11.9	(0.6)	18.4	(0.6)	22.6	(0.7)	20.7	(0.6)	13.4	(0.5)	6.1	(0.4)
*Bulgaria**	20.0	(1.5)	23.8	(0.9)	24.4	(1.1)	17.9	(0.9)	9.9	(0.8)	3.4	(0.5)	0.7	(0.2)
Canada	3.6	(0.3)	10.2	(0.4)	21.0	(0.6)	26.4	(0.6)	22.4	(0.5)	12.1	(0.5)	4.3	(0.3)
Chile	22.0	(1.4)	29.5	(1.0)	25.3	(1.0)	15.4	(0.8)	6.2	(0.6)	1.5	(0.2)	0.1	(0.0)
Chinese Taipei	4.5	(0.5)	8.3	(0.6)	13.1	(0.6)	17.1	(0.6)	19.7	(0.8)	19.2	(0.9)	18.0	(1.0)
*Croatia**	9.5	(0.7)	20.4	(1.0)	26.7	(0.9)	22.9	(1.1)	13.5	(0.8)	5.4	(0.8)	1.6	(0.5)
Cyprus	19.0	(0.6)	23.0	(0.7)	25.5	(0.6)	19.2	(0.6)	9.6	(0.4)	3.1	(0.2)	0.6	(0.2)
Czech Republic*	6.8	(0.8)	14.2	(1.0)	21.7	(0.8)	24.8	(1.1)	19.7	(0.9)	9.6	(0.7)	3.2	(0.3)
Denmark*	4.4	(0.5)	12.5	(0.7)	24.4	(1.0)	29.0	(1.0)	19.8	(0.7)	8.3	(0.6)	1.7	(0.3)
England	8.0	(0.9)	13.7	(0.9)	22.8	(0.9)	24.5	(1.0)	18.7	(0.9)	9.3	(0.7)	3.1	(0.5)
Estonia*	2.0	(0.3)	8.6	(0.6)	22.0	(0.8)	29.4	(0.8)	23.4	(0.9)	11.0	(0.7)	3.6	(0.4)
Finland*	3.3	(0.4)	8.9	(0.5)	20.5	(0.7)	28.8	(0.8)	23.2	(0.8)	11.7	(0.6)	3.5	(0.3)
France*	8.7	(0.7)	13.6	(0.8)	22.1	(1.0)	23.8	(0.8)	18.9	(0.8)	9.8	(0.5)	3.1	(0.4)
Germany*	5.5	(0.7)	12.2	(0.8)	19.4	(0.8)	23.7	(0.8)	21.7	(0.7)	12.8	(0.7)	4.7	(0.5)
Greece*	14.5	(0.9)	21.2	(0.8)	27.2	(1.0)	22.1	(0.9)	11.2	(0.8)	3.3	(0.4)	0.6	(0.1)
Hong Kong-China	2.6	(0.4)	5.9	(0.6)	12.0	(0.8)	19.7	(1.0)	26.1	(1.1)	21.4	(1.0)	12.3	(0.9)
Hungary*	9.9	(0.8)	18.2	(1.0)	25.3	(1.2)	23.0	(1.0)	14.4	(0.9)	7.1	(0.7)	2.1	(0.5)
Iceland	7.5	(0.5)	14.0	(0.8)	23.6	(0.9)	25.7	(0.9)	18.1	(0.8)	8.9	(0.6)	2.3	(0.4)
Israel	15.9	(1.2)	17.6	(0.9)	21.6	(0.9)	21.0	(0.9)	14.6	(0.9)	7.2	(0.7)	2.2	(0.4)
Italy*	8.5	(0.4)	16.1	(0.5)	24.1	(0.5)	24.6	(0.6)	16.7	(0.5)	7.8	(0.4)	2.2	(0.2)
Japan	3.2	(0.5)	7.9	(0.7)	16.9	(0.8)	24.7	(1.0)	23.7	(0.9)	16.0	(0.9)	7.6	(0.8)
Kazakhstan	14.5	(0.9)	30.7	(1.4)	31.5	(0.9)	16.9	(1.1)	5.4	(0.8)	0.9	(0.3)	0.1	(0.0)
Korea	2.7	(0.5)	6.4	(0.6)	14.7	(0.8)	21.4	(1.0)	23.9	(1.2)	18.8	(0.9)	12.1	(1.3)
*Latvia**	4.8	(0.5)	15.1	(1.0)	26.6	(1.3)	27.8	(0.9)	17.6	(0.9)	6.5	(0.6)	1.5	(0.3)
Liechtenstein	3.5	(1.3)	10.6	(1.8)	15.2	(2.5)	22.7	(2.8)	23.2	(3.0)	17.4	(3.2)	7.4	(1.9)
*Lithuania**	8.7	(0.7)	17.3	(0.9)	25.9	(0.8)	24.6	(1.0)	15.4	(0.7)	6.6	(0.5)	1.4	(0.2)
Luxembourg*	8.8	(0.5)	15.5	(0.5)	22.3	(0.7)	23.6	(0.7)	18.5	(0.6)	8.6	(0.4)	2.6	(0.2)
Macao-China	3.2	(0.3)	7.6	(0.5)	16.4	(0.7)	24.0	(0.7)	24.4	(0.9)	16.8	(0.6)	7.6	(0.3)
Mexico	22.8	(0.7)	31.9	(0.6)	27.8	(0.5)	13.1	(0.4)	3.7	(0.2)	0.6	(0.1)	0.0	(0.0)
Netherlands*	3.8	(0.6)	11.0	(0.9)	17.9	(1.1)	24.2	(1.2)	23.8	(1.1)	14.9	(1.0)	4.4	(0.6)
New Zealand	7.5	(0.6)	15.1	(0.7)	21.6	(0.8)	22.7	(0.8)	18.1	(0.8)	10.5	(0.7)	4.5	(0.4)
Northern Ireland	8.6	(1.1)	15.5	(1.3)	23.8	(1.1)	24.3	(1.4)	17.5	(1.0)	8.1	(0.7)	2.2	(0.4)
Norway	7.2	(0.8)	15.1	(0.9)	24.3	(0.8)	25.7	(1.0)	18.3	(1.0)	7.3	(0.6)	2.1	(0.3)
Poland*	3.3	(0.4)	11.1	(0.8)	22.1	(0.9)	25.5	(0.9)	21.3	(1.1)	11.7	(0.8)	5.0	(0.8)
Portugal*	8.9	(0.8)	16.0	(1.0)	22.8	(0.9)	24.0	(0.8)	17.7	(0.9)	8.5	(0.7)	2.1	(0.3)
Republic of Ireland*	4.8	(0.5)	12.1	(0.7)	23.9	(0.7)	28.2	(0.9)	20.3	(0.8)	8.5	(0.5)	2.2	(0.2)
*Romania**	14.0	(1.2)	26.8	(1.2)	28.3	(1.1)	19.2	(1.1)	8.4	(0.8)	2.6	(0.4)	0.6	(0.3)
Russian Federation	7.5	(0.7)	16.5	(0.8)	26.6	(1.0)	26.0	(1.0)	15.7	(0.8)	6.3	(0.6)	1.5	(0.3)
Scotland	4.9	(0.6)	13.3	(1.0)	24.8	(1.1)	27.2	(1.0)	18.8	(1.0)	8.5	(0.7)	2.4	(0.4)
Serbia	15.5	(1.2)	23.4	(0.9)	26.5	(1.1)	19.5	(1.0)	10.5	(0.7)	3.5	(0.5)	1.1	(0.3)
Shanghai-China	0.8	(0.2)	2.9	(0.5)	7.5	(0.6)	13.1	(0.8)	20.2	(0.8)	24.6	(1.0)	30.8	(1.2)
Singapore	2.2	(0.2)	6.1	(0.4)	12.2	(0.7)	17.5	(0.7)	22.0	(0.6)	21.0	(0.6)	19.0	(0.5)
Slovak Republic*	11.1	(1.0)	16.4	(0.9)	23.1	(1.1)	22.1	(1.1)	16.4	(1.1)	7.8	(0.6)	3.1	(0.5)
Slovenia*	5.1	(0.5)	15.0	(0.7)	23.6	(0.9)	23.9	(1.0)	18.7	(0.8)	10.3	(0.6)	3.4	(0.4)
Spain*	7.8	(0.5)	15.8	(0.6)	24.9	(0.6)	26.0	(0.6)	17.6	(0.6)	6.7	(0.4)	1.3	(0.2)
Sweden*	9.5	(0.7)	17.5	(0.8)	24.7	(0.9)	23.9	(0.8)	16.3	(0.7)	6.5	(0.5)	1.6	(0.3)
Switzerland	3.6	(0.3)	8.9	(0.6)	17.8	(1.1)	24.5	(1.0)	23.9	(0.8)	14.6	(0.8)	6.8	(0.7)
Turkey	15.5	(1.1)	26.5	(1.3)	25.5	(1.2)	16.5	(1.0)	10.1	(1.1)	4.7	(0.8)	1.2	(0.5)
United Arab Emirates	20.5	(0.9)	25.8	(0.8)	24.9	(0.7)	16.9	(0.6)	8.5	(0.5)	2.9	(0.3)	0.5	(0.1)
United Kingdom*	7.8	(0.8)	14.0	(0.8)	23.2	(0.8)	24.8	(0.8)	18.4	(0.8)	9.0	(0.6)	2.9	(0.4)
United States	8.0	(0.7)	17.9	(1.0)	26.3	(0.8)	23.3	(0.9)	15.8	(0.9)	6.6	(0.6)	2.2	(0.3)
Vietnam	3.6	(0.8)	10.6	(1.3)	22.8	(1.3)	28.4	(1.5)	21.3	(1.2)	9.8	(1.0)	3.5	(0.7)
Wales	9.6	(0.7)	19.4	(0.7)	27.5	(0.9)	25.1	(1.0)	13.1	(0.7)	4.3	(0.5)	1.0	(0.2)
OECD average	8.0	(0.1)	15.0	(0.1)	22.5	(0.1)	23.7	(0.2)	18.2	(0.1)	9.3	(0.1)	3.3	(0.1)

OECD countries (not italicised) *Countries not in OECD (italicised)* **EU countries*

14 countries with scores below 430 omitted

B21 Mean mathematics performance in PISA 2006, 2009 and 2012

	PISA 2006		PISA 2009		PISA 2012		Change between 2006 and 2012 (PISA 2012 - PISA 2006)		Change between 2009 and 2012 (PISA 2012 - PISA 2009)	
	Mean score	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score dif.	S.E.
Australia	520	(2.2)	514	(2.5)	504	(1.6)	**-16**	(3.1)	**-10**	(3.4)
Austria*	505	(3.7)	m	m	506	(2.7)	0	(4.8)	m	m
Belgium*	520	(3.0)	515	(2.3)	515	(2.1)	-6	(3.9)	-1	(3.4)
*Bulgaria**	413	(6.1)	428	(5.9)	439	(4.0)	**25**	(7.5)	11	(7.2)
Canada	527	(2.0)	527	(1.6)	518	(1.8)	**-9**	(3.1)	**-9**	(2.9)
Chile	411	(4.6)	421	(3.1)	423	(3.1)	**11**	(5.7)	2	(4.6)
Chinese Taipei	549	(4.1)	543	(3.4)	560	(3.3)	10	(5.5)	**17**	(5.0)
*Croatia**	467	(2.4)	460	(3.1)	471	(3.5)	4	(4.5)	**11**	(4.9)
Czech Republic*	510	(3.6)	493	(2.8)	499	(2.9)	**-11**	(4.8)	6	(4.3)
Denmark*	513	(2.6)	503	(2.6)	500	(2.3)	**-13**	(3.8)	-3	(3.8)
Dubai (UAE)	m	m	453	(1.1)	464	(1.2)	m	m	**11**	(2.2)
England	495	(2.5)	493	(2.9)	495	(3.9)	0	(4.7)	2	(4.9)
Estonia*	515	(2.7)	512	(2.6)	521	(2.0)	6	(3.7)	**8**	(3.6)
Finland*	548	(2.3)	541	(2.2)	519	(1.9)	**-30**	(3.3)	**-22**	(3.3)
France*	496	(3.2)	497	(3.1)	495	(2.5)	-1	(4.3)	-2	(4.2)
Germany*	504	(3.9)	513	(2.9)	514	(2.9)	10	(5.0)	1	(4.3)
Greece*	459	(3.0)	466	(3.9)	453	(2.5)	-6	(4.1)	**-13**	(4.9)
Hong Kong-China	547	(2.7)	555	(2.7)	561	(3.2)	**14**	(4.4)	7	(4.5)
Hungary*	491	(2.9)	490	(3.5)	477	(3.2)	**-14**	(4.5)	**-13**	(4.9)
Iceland	506	(1.8)	507	(1.4)	493	(1.7)	**-13**	(2.9)	**-14**	(2.7)
Israel	442	(4.3)	447	(3.3)	466	(4.7)	**25**	(6.5)	**20**	(5.9)
Italy*	462	(2.3)	483	(1.9)	485	(2.0)	**24**	(3.4)	2	(3.1)
Japan	523	(3.3)	529	(3.3)	536	(3.6)	**13**	(5.1)	7	(5.1)
Kazakhstan	m	m	405	(3.0)	432	(3.0)	m	m	**27**	(4.5)
Korea	547	(3.8)	546	(4.0)	554	(4.6)	6	(6.1)	8	(6.3)
*Latvia**	486	(3.0)	482	(3.1)	491	(2.8)	4	(4.3)	**9**	(4.4)
Liechtenstein	525	(4.2)	536	(4.1)	535	(4.0)	10	(6.0)	-1	(5.9)
*Lithuania**	486	(2.9)	477	(2.6)	479	(2.6)	-8	(4.2)	2	(4.0)
Luxembourg*	490	(1.1)	489	(1.2)	490	(1.1)	0	(2.1)	1	(2.2)
Macao-China	525	(1.3)	525	(0.9)	538	(1.0)	**13**	(2.2)	**13**	(2.0)
Mexico	406	(2.9)	419	(1.8)	413	(1.4)	**8**	(3.5)	-5	(2.7)
Netherlands*	531	(2.6)	526	(4.7)	523	(3.5)	-8	(4.6)	-3	(6.1)
New Zealand	522	(2.4)	519	(2.3)	500	(2.2)	**-22**	(3.6)	**-20**	(3.5)
Northern Ireland	494	(2.8)	492	(3.1)	487	(3.1)	-7	(4.2)	-5	(4.4)
Norway	490	(2.6)	498	(2.4)	489	(2.7)	0	(4.1)	**-9**	(3.9)
Poland*	495	(2.4)	495	(2.8)	518	(3.6)	**22**	(4.6)	**23**	(4.8)
Portugal*	466	(3.1)	487	(2.9)	487	(3.8)	**21**	(5.1)	0	(5.0)
Republic of Ireland*	501	(2.8)	487	(2.5)	501	(2.2)	0	(3.9)	**14**	(3.7)
*Romania**	415	(4.2)	427	(3.4)	445	(3.8)	**30**	(5.8)	**17**	(5.3)
Russian Federation	476	(3.9)	468	(3.3)	482	(3.0)	6	(5.1)	**14**	(4.7)
Scotland	506	(3.6)	499	(3.3)	498	(2.6)	-7	(4.5)	-1	(4.2)
Serbia	435	(3.5)	442	(2.9)	449	(3.4)	**13**	(5.1)	6	(4.7)
Shanghai-China	m	m	600	(2.8)	613	(3.3)	m	m	**13**	(4.6)
Singapore	m	m	562	(1.4)	573	(1.3)	m	m	**11**	(2.5)
Slovak Republic*	492	(2.8)	497	(3.1)	482	(3.4)	**-10**	(4.7)	**-15**	(4.9)
Slovenia*	504	(1.0)	501	(1.2)	501	(1.2)	-3	(2.2)	0	(2.3)
Spain*	480	(2.3)	483	(2.1)	484	(1.9)	4	(3.3)	1	(3.2)
Sweden*	502	(2.4)	494	(2.9)	478	(2.3)	**-24**	(3.6)	**-16**	(4.0)
Switzerland	530	(3.2)	534	(3.3)	531	(3.0)	1	(4.6)	-3	(4.7)
Turkey	424	(4.9)	445	(4.4)	448	(4.8)	**24**	(7.0)	3	(6.7)
United Arab Emirates - Ex. Dubai	m	m	411	(3.2)	423	(3.2)	m	m	12	(4.7)
United Kingdom*	495	(2.1)	492	(2.4)	494	(3.3)	-2	(4.2)	2	(4.4)
United States	474	(4.0)	487	(3.6)	481	(3.6)	7	(5.6)	-6	(5.3)
Wales	484	(2.9)	472	(3.0)	468	(2.2)	**-16**	(3.6)	-4	(3.7)

OECD countries (not italicised) *Countries not in OECD (italicised)* **EU countries*

14 countries with scores below 430 omitted

Notes: Values that are statistically significant are indicated in bold

m *indicates a missing value*

For Costa Rica and Malaysia the change between PISA 2009 and PISA 2012 represents change between 2010 and 2012 because these countries implemented the PISA 2009 assessment in 2010 as part of PISA 2009+. In the United Arab Emirates, Dubai took the PISA 2009 assessment in 2009 and the rest of the United Arab Emirates in 2010 as part of PISA+. Results are thus reported separately.

B22 Mark schemes for the example PISA items

DVD Rental: a released quantity question from PISA 2012

Question 2: DVD RENTAL *PM977Q02 – 00 11 12 21 22 23 24 99*

What is the minimum number of DVDs a member needs to rent so as to cover the cost of the membership fee? Show your work.

.....

.....

.....

Number of DVDs: .....

DVD RENTAL SCORING 2

QUESTION INTENT:

Description: Calculate and compare numbers in an everyday situation

Mathematical content area: Quantity

Context: Personal

Process: Formulate

Full Credit

Code 21: 15. *[Algebraic solution with correct reasoning].*

- $3.20x = 2.50x + 10$
  $0.70x = 10$
  $x = 10 / 0.70 = 14.2$ approximately
  but whole number solution is required: 15 DVDs
- $3.20x > 2.50x + 10$ *[Same steps as previous solution but worked as an inequality].*

Code 22: 15. *[Arithmetical solution with correct reasoning].*

- For a single DVD, a member saves 0.70 zeds. Because a member has already paid 10 zeds at the beginning, they should at least save this amount for the membership to be worthwhile. 10 / 0.70 = 14.2... So 15 DVDs.

Code 23: 15. *[Solve correctly using systematic trial and error, where student chooses a number and finds the fee for members and non-members, and uses this to locate the correct number (15) for which a member pays less than a non-member].*

- 10 DVDs = 32 zeds non-members and 25 zeds + 10 zeds = 35 zeds for members.
  Therefore try a higher number than 10. 15 DVDs is 54 zeds for non-members and 37.50 + 10 = 47.50 zeds for members.
  Therefore try a smaller value: 14 DVDs = 44.80 zeds for non-members and 35 +10 = 45 zeds for members.
  Therefore 15 DVDs is the answer.

Code 24: 15. With other correct reasoning.

Partial Credit

Code 11: 15. No reasoning or working.

Code 12: Correct calculation but with incorrect rounding or no rounding to take into account context.

- 14
- 14.2
- 14.3
- 14.28 …

No Credit

Code 00: Other responses.

Code 99: Missing.

Based on the chart above, are the following statements about these three penguin types true or false?

Circle "True" or "False" for each statement.

Statement	Is the statement true or false?
In 2000, the average number of chicks raised per penguin couple was larger than 0.6.	True / False
In 2006, on average, less than 80% of penguin couples raised a chick.	True / False
By about 2015 these three penguin types will be extinct.	True / False
The average number of Magellanic penguin chicks raised per penguin couple decreased between 2001 and 2004.	True / False

UNIT PENGUINS SCORING 4

QUESTION INTENT:

Description: Analyse different statements concerning a given bar chart

Mathematical content area: Uncertainty and data

Context: Scientific

Process: Interpret

Full Credit

Code 1: Four correct responses: True, True, False, True in that order.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 4: SAILING SHIPS

PM923Q04 – 0 1 9

Due to high diesel fuel costs of 0.42 zeds per litre, the owners of the ship *NewWave* are thinking about equipping their ship with a kite sail.

It is estimated that a kite sail like this has the potential to reduce the diesel consumption by about 20% overall.

Name: *NewWave*

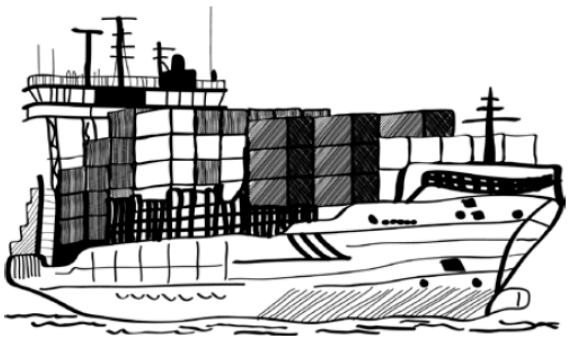
Type: freighter

Length: 117 metres

Breadth: 18 metres

Load capacity: 12 000 tons

Maximum speed: 19 knots



Diesel consumption per year without a kite sail: approximately 3 500 000 litres

The cost of equipping the *NewWave* with a kite sail is 2 500 000 zeds.

After about how many years would the diesel fuel savings cover the cost of the kite sail? Give calculations to support your answer.

.....

.....

.....

.....

.....

.....

.....

Number of years:.....

SAILING SHIPS SCORING 4

QUESTION INTENT:

Description: Solve a real world situation involving cost savings and fuel consumption

Mathematical content area: Change and relationships

Context: Scientific

Process: Formulate

Full Credit

Code 1: A solution from 8 to 9 years is provided with adequate (mathematical) calculations.

- Diesel consumption per year without a sail: 3.5 million litres, price 0.42 zed/litre, costs for diesel without a sail 1 470 000 zeds. If 20% is saved with the sail this results in a saving of 1 470 000 x 0.2 = 294 000 zeds per year. Thus: 2 500 000 / 294 000 $\approx$ 8.5, i.e.: After about 8 to 9 years, the sail becomes (financially) worthwhile.

No Credit

Code 0: Other responses.

Code 9: Missing.

Question 1: OIL SPILL

PM00RQ01 – 0 1 9

Using the map scale, estimate the area of the oil spill in square kilometres (km^2).

Answer: .....km^2

OIL SPILL SCORING 1

QUESTION INTENT:

Description: Estimation of an irregular area on a map, using a given scale
Mathematical content area: Space and shape
Context: Scientific
Process: Employ

Full Credit

Code 1: Answers in the range from 2200 to 3300.

No Credit

Code 0: Other responses.

Code 9: Missing.

Appendix C

C1 Significant differences in mean scores on the science scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	580	(3.0)	^
Hong Kong-China	555	(2.6)	^
Singapore	551	(1.5)	^
Japan	547	(3.6)	^
Finland*	545	(2.2)	^
Estonia*	541	(1.9)	^
Korea	538	(3.7)	^
Vietnam	528	(4.3)	^
Poland*	526	(3.1)	^
Canada	525	(1.9)	^
Liechtenstein	525	(3.5)	*NS*
Germany*	524	(3.0)	*NS*
Chinese Taipei	523	(2.3)	*NS*
Netherlands*	522	(3.5)	*NS*
Republic of Ireland*	522	(2.5)	*NS*
Australia	521	(1.8)	*NS*
Macao-China	521	(0.8)	*NS*
England	516	(4.0)	
New Zealand	516	(2.1)	*NS*
Switzerland	515	(2.7)	*NS*
Slovenia*	514	(1.3)	*NS*
United Kingdom*	514	(3.4)	
Scotland	513	(3.0)	*NS*
Czech Republic*	508	(3.0)	*NS*
Northern Ireland	507	(3.9)	*NS*
Austria*	506	(2.7)	v
Belgium*	505	(2.1)	v
*Latvia**	502	(2.8)	v
OECD average	**501**	**(0.5)**	v
France*	499	(2.6)	v
Denmark*	498	(2.7)	v
United States	497	(3.8)	v
Spain*	496	(1.8)	v
*Lithuania**	496	(2.6)	v
Norway	495	(3.1)	v
Hungary*	494	(2.9)	v
Italy*	494	(1.9)	v
*Croatia**	491	(3.1)	v
Luxembourg*	491	(1.3)	v
Wales	491	(3.0)	v
Portugal*	489	(3.7)	v
Russian Federation	486	(2.9)	v
Sweden*	485	(3.0)	v
Iceland	478	(2.1)	v
Slovak Republic*	471	(3.6)	v
Israel	470	(5.0)	v
Greece*	467	(3.1)	v
Turkey	463	(3.9)	v
United Arab Emirates	448	(2.8)	v
*Bulgaria**	446	(4.8)	v
Chile	445	(2.9)	v
Serbia	445	(3.4)	v
Thailand	444	(2.9)	v
*Romania**	439	(3.3)	v
Cyprus	438	(1.2)	v
Mexico	415	(1.3)	v

14 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^	significantly higher
NS	no significant difference
v	significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

C2 Mean score, variation and gender differences in student performance on the science scale

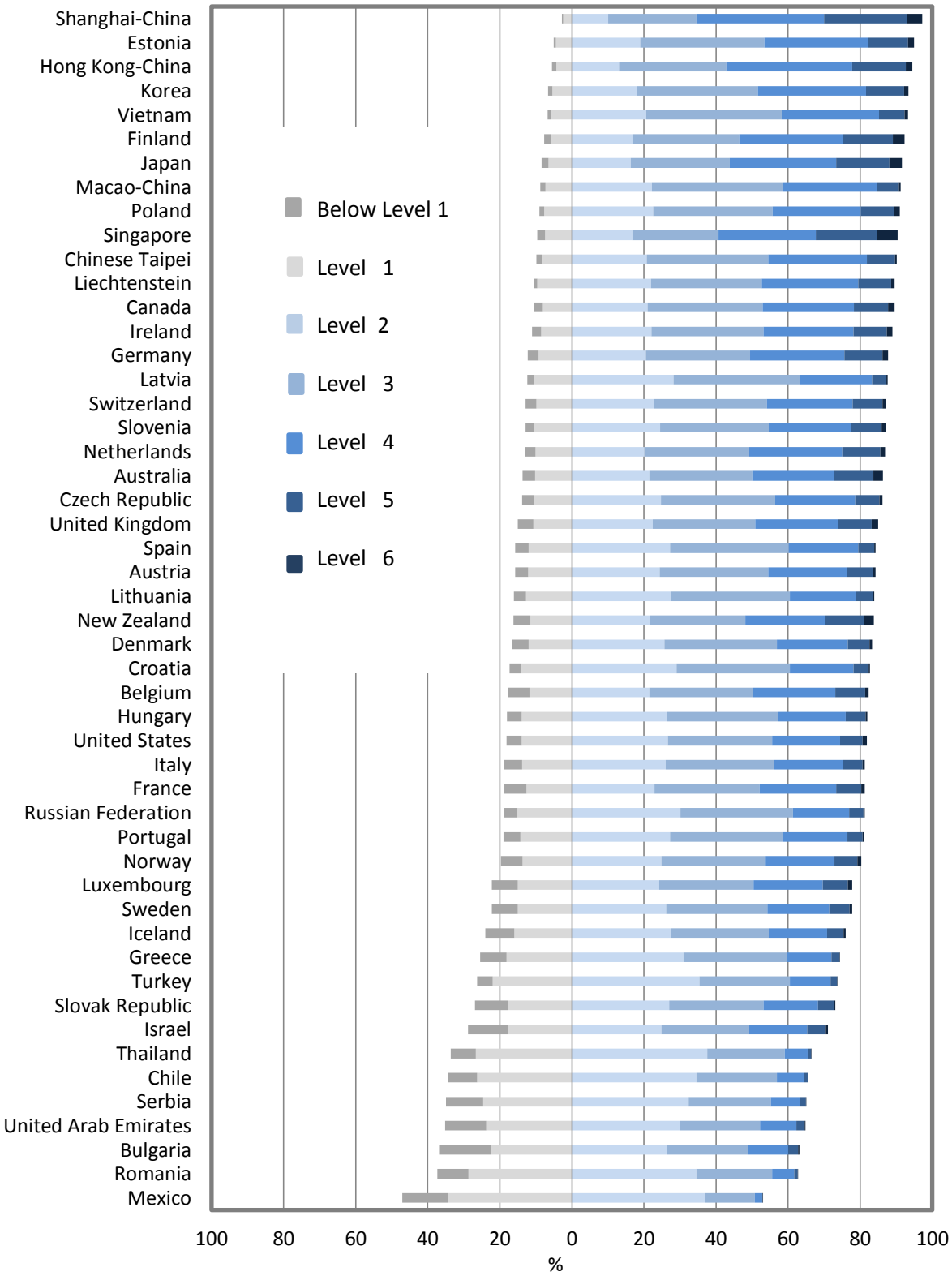
	All students				Gender differences						Percentiles												Difference between 5th and 95th percentile
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	521	(1.8)	100	(1.0)	524	(2.5)	519	(2.1)	5	(3.0)	353	(3.5)	391	(2.6)	453	(2.1)	592	(2.5)	650	(2.7)	682	(2.9)	329
Austria*	506	(2.7)	92	(1.6)	510	(3.9)	501	(3.4)	9	(5.0)	350	(4.9)	383	(5.3)	442	(3.5)	571	(3.1)	623	(3.4)	650	(3.3)	300
Belgium*	505	(2.1)	101	(1.4)	505	(2.9)	506	(2.6)	0	(3.6)	326	(5.5)	369	(4.5)	439	(3.1)	579	(2.0)	630	(2.1)	658	(2.9)	332
*Bulgaria**	446	(4.8)	102	(2.5)	437	(5.6)	457	(4.6)	**-20**	(4.5)	280	(7.5)	315	(5.3)	374	(5.6)	519	(5.1)	580	(6.1)	612	(6.2)	332
Canada	525	(1.9)	91	(0.9)	527	(2.4)	524	(2.0)	3	(2.1)	370	(3.3)	407	(2.7)	467	(2.1)	588	(2.4)	639	(2.5)	670	(3.3)	300
Chile	445	(2.9)	80	(1.5)	448	(3.7)	442	(2.9)	**7**	(3.3)	317	(4.1)	343	(3.8)	388	(3.3)	500	(3.6)	552	(3.7)	581	(3.7)	264
Chinese Taipei	523	(2.3)	83	(1.4)	524	(3.9)	523	(4.0)	1	(6.4)	379	(4.1)	411	(4.3)	469	(3.8)	582	(2.4)	626	(2.2)	652	(3.1)	273
*Croatia**	491	(3.1)	85	(1.8)	490	(3.9)	493	(3.3)	-2	(3.8)	350	(4.9)	380	(4.0)	433	(3.3)	551	(4.2)	602	(5.2)	630	(5.9)	280
Cyprus	438	(1.2)	97	(1.1)	431	(1.8)	444	(1.7)	**-13**	(2.5)	274	(3.3)	313	(2.9)	373	(2.0)	503	(2.4)	561	(2.5)	594	(3.4)	320
Czech Republic*	508	(3.0)	91	(2.1)	509	(3.7)	508	(3.5)	1	(4.0)	356	(7.2)	392	(5.5)	449	(4.0)	572	(3.2)	622	(3.7)	650	(3.1)	294
Denmark*	498	(2.7)	93	(1.7)	504	(3.5)	493	(2.5)	**10**	(2.7)	338	(5.9)	378	(4.3)	438	(3.8)	563	(3.2)	615	(4.1)	644	(3.7)	306
England	516	(4.0)	101	(2.2)	523	(5.4)	509	(4.3)	**14**	(5.5)	343	(7.0)	384	(5.9)	449	(5.6)	587	(4.1)	642	(4.2)	674	(5.6)	331
Estonia*	541	(1.9)	80	(1.1)	540	(2.5)	543	(2.3)	-2	(2.7)	409	(3.0)	439	(3.3)	487	(2.7)	597	(2.6)	645	(3.1)	672	(4.5)	263
Finland*	545	(2.2)	93	(1.2)	537	(3.0)	554	(2.3)	**-16**	(3.0)	386	(5.7)	424	(3.9)	486	(2.8)	609	(2.4)	662	(2.9)	692	(2.6)	306
France*	499	(2.6)	100	(2.2)	498	(3.8)	500	(2.4)	-2	(3.7)	323	(7.8)	366	(6.0)	433	(3.4)	570	(3.0)	622	(4.1)	651	(4.7)	328
Germany*	524	(3.0)	95	(2.0)	524	(3.1)	524	(3.5)	-1	(3.0)	361	(5.6)	397	(4.8)	461	(3.8)	592	(3.1)	642	(3.9)	671	(3.7)	310
Greece*	467	(3.1)	88	(1.5)	460	(3.8)	473	(3.0)	**-13**	(3.1)	317	(5.2)	352	(5.1)	408	(4.5)	528	(3.5)	578	(3.6)	608	(4.1)	292
Hong Kong-China	555	(2.6)	83	(1.8)	558	(3.6)	551	(3.1)	7	(4.2)	403	(7.1)	446	(5.1)	505	(3.8)	613	(3.0)	655	(3.4)	679	(3.4)	276
Hungary*	494	(2.9)	90	(1.9)	496	(3.4)	493	(3.3)	3	(3.3)	345	(6.0)	376	(4.6)	432	(4.3)	558	(3.5)	610	(4.7)	639	(4.0)	294
Iceland	478	(2.1)	99	(1.5)	477	(2.7)	480	(2.9)	-3	(3.6)	310	(5.0)	348	(3.4)	413	(2.5)	548	(3.2)	603	(3.7)	635	(5.3)	325
Israel	470	(5.0)	108	(2.1)	470	(7.9)	470	(4.0)	-1	(7.6)	286	(8.7)	328	(6.4)	396	(5.7)	548	(5.7)	608	(5.4)	640	(5.1)	354
Italy*	494	(1.9)	93	(1.1)	495	(2.2)	492	(2.4)	3	(2.5)	336	(3.2)	371	(2.8)	431	(2.5)	559	(2.0)	611	(2.5)	641	(2.6)	305
Japan	547	(3.6)	96	(2.2)	552	(4.7)	541	(3.5)	**11**	(4.3)	379	(7.0)	421	(6.4)	485	(4.5)	614	(3.6)	664	(4.3)	693	(4.7)	314
Korea	538	(3.7)	82	(1.8)	539	(4.7)	536	(4.2)	3	(5.1)	396	(6.3)	431	(4.9)	485	(4.0)	595	(4.1)	639	(4.3)	664	(5.3)	268
*Latvia**	502	(2.8)	79	(1.4)	495	(3.6)	510	(2.8)	**-15**	(3.6)	370	(5.5)	400	(4.5)	449	(3.2)	557	(3.6)	603	(3.2)	628	(4.7)	258
Liechtenstein	525	(3.5)	86	(4.1)	533	(5.8)	516	(5.7)	17	(9.1)	383	(11.1)	408	(10.0)	464	(8.4)	588	(8.2)	635	(9.3)	656	(12.2)	273
*Lithuania**	496	(2.6)	86	(1.7)	488	(3.0)	503	(2.6)	**-15**	(2.3)	352	(6.3)	383	(4.0)	438	(3.2)	555	(3.0)	605	(3.6)	634	(3.8)	283
Luxembourg*	491	(1.3)	103	(1.0)	499	(1.7)	483	(1.7)	**15**	(2.2)	318	(3.6)	355	(3.1)	419	(2.2)	566	(1.9)	624	(2.9)	655	(2.9)	337
Macao-China	521	(0.8)	79	(0.7)	520	(1.3)	521	(1.2)	-1	(1.7)	383	(3.9)	416	(2.7)	469	(1.9)	575	(1.7)	619	(1.8)	643	(2.3)	260
Mexico	415	(1.3)	71	(0.9)	418	(1.5)	412	(1.3)	**6**	(1.1)	300	(2.6)	325	(2.1)	368	(1.6)	462	(1.5)	505	(1.9)	532	(2.1)	232
Netherlands*	522	(3.5)	95	(2.2)	524	(3.7)	520	(3.9)	3	(2.9)	357	(5.9)	393	(5.4)	458	(5.0)	591	(3.9)	641	(4.1)	667	(4.0)	310
New Zealand	516	(2.1)	105	(1.4)	518	(3.2)	513	(3.3)	5	(4.9)	339	(4.5)	377	(4.5)	444	(3.0)	591	(3.1)	649	(3.0)	682	(3.9)	343
Northern Ireland	507	(3.9)	101	(2.7)	510	(6.3)	504	(5.8)	5	(9.2)	338	(7.6)	375	(7.3)	438	(5.2)	578	(5.2)	635	(6.5)	669	(7.4)	331
Norway	495	(3.1)	100	(1.9)	493	(3.2)	496	(3.7)	-4	(3.2)	325	(6.6)	365	(5.2)	429	(3.7)	564	(3.3)	620	(3.4)	651	(3.9)	326
Poland*	526	(3.1)	86	(1.5)	524	(3.7)	527	(3.2)	-3	(3.0)	382	(4.7)	415	(4.0)	467	(3.3)	584	(4.0)	637	(5.0)	668	(4.9)	286
Portugal*	489	(3.7)	89	(1.6)	488	(4.1)	490	(3.8)	-2	(2.6)	337	(6.0)	372	(5.6)	430	(4.8)	551	(3.6)	602	(3.6)	630	(4.1)	293
Republic of Ireland*	522	(2.5)	91	(1.6)	524	(3.4)	520	(3.1)	4	(4.4)	366	(5.8)	404	(4.8)	462	(3.1)	586	(2.4)	637	(2.6)	666	(3.4)	300
*Romania**	439	(3.3)	79	(2.0)	436	(3.7)	441	(3.5)	-5	(3.2)	316	(4.0)	340	(3.2)	383	(3.4)	492	(4.6)	543	(5.1)	573	(5.6)	257
Russian Federation	486	(2.9)	85	(1.3)	484	(3.5)	489	(2.9)	-6	(2.9)	347	(3.8)	377	(4.1)	428	(3.6)	544	(3.3)	596	(4.9)	627	(5.1)	280
Scotland	513	(3.0)	89	(2.0)	517	(3.3)	510	(3.6)	**7**	(3.3)	365	(6.9)	400	(4.5)	454	(3.7)	574	(3.2)	627	(4.2)	658	(5.3)	293
Serbia	445	(3.4)	87	(1.9)	443	(4.0)	447	(3.8)	-4	(3.9)	303	(5.6)	333	(5.2)	385	(4.5)	504	(3.5)	558	(3.9)	590	(5.8)	287
Shanghai-China	580	(3.0)	82	(1.8)	583	(3.5)	578	(3.1)	5	(2.7)	435	(6.2)	472	(5.4)	527	(3.7)	639	(3.2)	681	(3.2)	704	(3.3)	269
Singapore	551	(1.5)	104	(1.2)	551	(2.1)	552	(1.9)	-1	(2.6)	374	(4.0)	412	(3.2)	480	(2.6)	627	(2.6)	681	(3.4)	714	(3.2)	340
Slovak Republic*	471	(3.6)	101	(2.8)	475	(4.3)	467	(4.2)	7	(4.5)	300	(8.5)	339	(5.7)	403	(5.2)	542	(4.0)	599	(4.9)	632	(6.3)	332
Slovenia*	514	(1.3)	91	(1.2)	510	(1.9)	519	(1.9)	**-9**	(2.8)	364	(3.0)	397	(3.5)	451	(2.2)	578	(2.0)	631	(3.2)	661	(3.3)	297
Spain*	496	(1.8)	86	(0.9)	500	(2.3)	493	(1.9)	**7**	(2.1)	349	(3.9)	384	(3.1)	440	(2.3)	557	(1.8)	605	(2.0)	632	(2.0)	283
Sweden*	485	(3.0)	100	(1.5)	481	(3.9)	489	(2.8)	**-7**	(3.3)	314	(5.3)	354	(4.7)	419	(4.1)	554	(3.2)	611	(3.4)	643	(3.1)	328
Switzerland	515	(2.7)	91	(1.1)	518	(3.3)	512	(2.7)	**6**	(2.6)	358	(3.8)	394	(3.4)	455	(3.8)	579	(3.1)	630	(3.3)	658	(4.0)	300
Thailand	444	(2.9)	76	(1.7)	433	(3.3)	452	(3.4)	**-19**	(3.4)	323	(4.3)	349	(3.4)	392	(2.6)	494	(3.8)	544	(5.4)	575	(6.0)	252
Turkey	463	(3.9)	80	(1.9)	458	(4.5)	469	(4.3)	**-10**	(4.2)	339	(3.6)	363	(3.5)	407	(3.5)	518	(5.8)	573	(6.3)	602	(5.9)	263
United Arab Emirates	448	(2.8)	94	(1.1)	434	(4.1)	462	(3.7)	**-28**	(5.1)	299	(3.0)	328	(3.2)	382	(3.5)	512	(3.5)	572	(3.4)	605	(3.7)	306
United Kingdom*	514	(3.4)	100	(1.8)	521	(4.5)	508	(3.7)	**13**	(4.7)	344	(5.8)	384	(4.9)	448	(4.6)	584	(3.5)	639	(3.9)	672	(5.0)	327
United States	497	(3.8)	94	(1.5)	497	(4.1)	498	(4.0)	-2	(2.7)	344	(5.4)	377	(4.9)	431	(4.4)	563	(4.2)	619	(4.5)	652	(5.5)	308
Vietnam	528	(4.3)	77	(2.3)	529	(5.0)	528	(4.1)	1	(2.8)	398	(7.7)	428	(7.0)	478	(5.2)	580	(4.0)	625	(5.5)	652	(6.5)	254
Wales	491	(3.0)	94	(1.6)	496	(3.4)	485	(3.5)	**11**	(3.5)	334	(6.2)	370	(4.5)	428	(4.1)	556	(3.4)	609	(3.9)	639	(5.4)	305
OECD average	501	(0.5)	93	(0.3)	502	(0.6)	500	(0.5)	**1**	(0.6)	344	(0.9)	380	(0.8)	439	(0.6)	566	(0.6)	619	(0.6)	648	(0.7)	304

14 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold.
OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

C3 Summary descriptions for the six levels of proficiency in science

Level	Characteristics of tasks
6	At Level 6, students can consistently identify, explain and apply scientific knowledge and *knowledge about science* in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they demonstrate willingness to use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on personal, social or global situations.
5	At Level 5, students can identify the scientific components of many complex life situations, apply both scientific concepts and *knowledge about science* to these situations, and can compare, select and evaluate appropriate scientific evidence for responding to life situations. Students at this level can use well-developed inquiry abilities, link knowledge appropriately and bring critical insights to situations. They can construct explanations based on evidence and arguments based on their critical analysis.
4	At Level 4, students can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. They can select and integrate explanations from different disciplines of science or technology and link those explanations directly to aspects of life situations. Students at this level can reflect on their actions and they can communicate decisions using scientific knowledge and evidence.
3	At Level 3, students can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena and apply simple models or inquiry strategies. Students at this level can interpret and use scientific concepts from different disciplines and can apply them directly. They can develop short statements using facts and make decisions based on scientific knowledge.
2	At Level 2, students have adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving.
1	At Level 1, students have such a limited scientific knowledge that it can only be applied to a few, familiar situations. They can present scientific explanations that are obvious and follow explicitly from given evidence.

C4 Summary of percentage of students at each level of proficiency on the science scale



14 countries with scores below 430 omitted
Countries are ranked in descending order of the percentage of students at Levels 2, 3, 4, 5 and 6.
Source: OECD, PISA 2012 database, Table I.5.1a.

C5 Percentage of students at each level of proficiency on the science scale

	All students													
	Below Level 1		Level 1		Level 2		Level 3		Level 4		Level 5		Level 6	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.
Australia	3.4	(0.3)	10.2	(0.4)	21.5	(0.5)	28.5	(0.7)	22.8	(0.6)	10.9	(0.5)	2.6	(0.3)
Austria*	3.6	(0.5)	12.2	(0.9)	24.3	(1.0)	30.1	(0.9)	21.9	(0.8)	7.0	(0.6)	0.8	(0.2)
Belgium*	5.8	(0.5)	11.8	(0.6)	21.5	(0.7)	28.7	(0.7)	22.9	(0.6)	8.3	(0.4)	1.0	(0.1)
*Bulgaria**	14.4	(1.3)	22.5	(1.2)	26.3	(1.1)	22.5	(1.1)	11.2	(0.8)	2.8	(0.5)	0.3	(0.1)
Canada	2.4	(0.2)	8.0	(0.4)	21.0	(0.7)	32.0	(0.5)	25.3	(0.6)	9.5	(0.5)	1.8	(0.2)
Chile	8.1	(0.8)	26.3	(1.1)	34.6	(1.1)	22.4	(1.0)	7.5	(0.6)	1.0	(0.1)	0.0	(0.0)
Chinese Taipei	1.6	(0.3)	8.2	(0.6)	20.8	(0.9)	33.7	(1.0)	27.3	(1.0)	7.8	(0.6)	0.6	(0.1)
*Croatia**	3.2	(0.4)	14.0	(0.7)	29.1	(1.0)	31.4	(1.2)	17.6	(1.2)	4.3	(0.7)	0.3	(0.2)
Cyprus	14.4	(0.5)	23.7	(0.7)	30.3	(0.9)	21.3	(0.7)	8.4	(0.4)	1.8	(0.3)	0.2	(0.1)
Czech Republic*	3.3	(0.6)	10.5	(1.0)	24.7	(1.0)	31.7	(1.2)	22.2	(1.0)	6.7	(0.5)	0.9	(0.2)
Denmark*	4.7	(0.5)	12.0	(0.7)	25.7	(0.8)	31.3	(0.9)	19.6	(0.8)	6.1	(0.7)	0.7	(0.2)
England	4.3	(0.6)	10.6	(1.0)	21.9	(1.1)	28.0	(1.1)	23.4	(1.1)	9.8	(0.8)	1.9	(0.4)
Estonia*	0.5	(0.1)	4.5	(0.4)	19.0	(0.9)	34.5	(0.9)	28.7	(1.0)	11.1	(0.7)	1.7	(0.3)
Finland*	1.8	(0.3)	5.9	(0.5)	16.8	(0.7)	29.6	(0.8)	28.8	(0.7)	13.9	(0.6)	3.2	(0.4)
France*	6.1	(0.7)	12.6	(0.7)	22.9	(1.1)	29.2	(1.1)	21.3	(0.9)	6.9	(0.7)	1.0	(0.2)
Germany*	2.9	(0.5)	9.3	(0.7)	20.5	(0.8)	28.9	(0.9)	26.2	(1.0)	10.6	(0.8)	1.6	(0.3)
Greece*	7.4	(0.7)	18.1	(1.1)	31.0	(1.1)	28.8	(1.0)	12.2	(0.8)	2.3	(0.4)	0.2	(0.1)
Hong Kong-China	1.2	(0.2)	4.4	(0.5)	13.0	(0.7)	29.8	(1.1)	34.9	(1.0)	14.9	(0.9)	1.8	(0.4)
Hungary*	4.1	(0.6)	14.0	(1.0)	26.4	(1.1)	30.9	(1.2)	18.7	(1.0)	5.5	(0.7)	0.5	(0.2)
Iceland	8.0	(0.6)	16.0	(0.7)	27.5	(0.9)	27.2	(0.9)	16.2	(0.7)	4.6	(0.6)	0.6	(0.2)
Israel	11.2	(1.1)	17.7	(0.9)	24.8	(0.9)	24.4	(1.2)	16.1	(1.1)	5.2	(0.6)	0.6	(0.2)
Italy*	4.9	(0.3)	13.8	(0.5)	26.0	(0.6)	30.1	(0.7)	19.1	(0.6)	5.5	(0.4)	0.6	(0.1)
Japan	2.0	(0.4)	6.4	(0.6)	16.3	(0.8)	27.5	(0.9)	29.5	(1.1)	14.8	(0.9)	3.4	(0.5)
Korea	1.2	(0.2)	5.5	(0.6)	18.0	(1.0)	33.6	(1.1)	30.1	(1.2)	10.6	(0.9)	1.1	(0.4)
*Latvia**	1.8	(0.4)	10.5	(0.9)	28.2	(1.2)	35.1	(1.0)	20.0	(1.0)	4.0	(0.5)	0.3	(0.1)
Liechtenstein	0.8	(0.7)	9.6	(1.9)	22.0	(3.9)	30.8	(3.8)	26.7	(2.6)	9.1	(1.5)	1.0	(1.0)
*Lithuania**	3.4	(0.5)	12.7	(0.8)	27.6	(1.0)	32.9	(1.1)	18.3	(0.9)	4.7	(0.5)	0.4	(0.1)
Luxembourg*	7.2	(0.4)	15.1	(0.7)	24.2	(0.6)	26.2	(0.6)	19.2	(0.5)	7.0	(0.5)	1.2	(0.2)
Macao-China	1.4	(0.2)	7.4	(0.5)	22.2	(0.6)	36.2	(0.8)	26.2	(0.7)	6.2	(0.3)	0.4	(0.1)
Mexico	12.6	(0.5)	34.4	(0.6)	37.0	(0.6)	13.8	(0.5)	2.1	(0.2)	0.1	(0.0)	0.0	c
Netherlands*	3.1	(0.5)	10.1	(0.8)	20.1	(1.3)	29.1	(1.3)	25.8	(1.2)	10.5	(1.0)	1.3	(0.3)
New Zealand	4.7	(0.4)	11.6	(0.8)	21.7	(0.9)	26.4	(0.9)	22.3	(0.9)	10.7	(0.6)	2.7	(0.3)
Northern Ireland	4.7	(0.7)	12.1	(1.3)	23.7	(1.5)	27.8	(1.5)	21.4	(1.3)	8.3	(0.9)	2.0	(0.5)
Norway	6.0	(0.6)	13.6	(0.7)	24.8	(0.8)	28.9	(0.9)	19.0	(0.8)	6.4	(0.6)	1.1	(0.2)
Poland*	1.3	(0.3)	7.7	(0.7)	22.5	(1.0)	33.1	(0.9)	24.5	(1.0)	9.1	(0.8)	1.7	(0.4)
Portugal*	4.7	(0.7)	14.3	(1.1)	27.3	(1.0)	31.4	(1.3)	17.8	(1.1)	4.2	(0.5)	0.3	(0.1)
Republic of Ireland*	2.6	(0.4)	8.5	(0.8)	22.0	(1.2)	31.1	(1.0)	25.0	(0.9)	9.3	(0.6)	1.5	(0.3)
*Romania**	8.7	(0.8)	28.7	(1.3)	34.6	(1.2)	21.0	(1.1)	6.2	(0.8)	0.9	(0.3)	0.0	c
Russian Federation	3.6	(0.4)	15.1	(1.0)	30.1	(1.1)	31.2	(0.9)	15.7	(1.0)	3.9	(0.5)	0.3	(0.2)
Scotland	2.7	(0.4)	9.4	(0.7)	24.9	(1.2)	32.4	(1.2)	21.8	(1.0)	7.5	(0.7)	1.3	(0.3)
Serbia	10.3	(1.0)	24.7	(1.2)	32.4	(1.2)	22.8	(1.1)	8.1	(0.6)	1.6	(0.4)	0.1	(0.1)
Shanghai-China	0.3	(0.1)	2.4	(0.4)	10.0	(0.9)	24.6	(0.9)	35.5	(1.1)	23.0	(1.1)	4.2	(0.6)
Singapore	2.2	(0.3)	7.4	(0.5)	16.7	(0.7)	24.0	(0.7)	27.0	(0.9)	16.9	(0.9)	5.8	(0.4)
Slovak Republic*	9.2	(0.9)	17.6	(1.1)	27.0	(1.3)	26.2	(1.6)	15.0	(1.0)	4.3	(0.6)	0.6	(0.2)
Slovenia*	2.4	(0.2)	10.4	(0.5)	24.5	(1.0)	30.0	(1.0)	23.0	(0.9)	8.4	(0.7)	1.2	(0.2)
Spain*	3.7	(0.3)	12.0	(0.5)	27.3	(0.6)	32.8	(0.6)	19.4	(0.5)	4.5	(0.3)	0.3	(0.1)
Sweden*	7.3	(0.6)	15.0	(0.8)	26.2	(0.8)	28.0	(0.8)	17.2	(0.8)	5.6	(0.4)	0.7	(0.1)
Switzerland	3.0	(0.3)	9.8	(0.6)	22.8	(0.8)	31.3	(0.7)	23.7	(0.9)	8.3	(0.7)	1.0	(0.2)
Thailand	7.0	(0.6)	26.6	(1.3)	37.5	(1.1)	21.6	(1.1)	6.4	(0.7)	0.9	(0.3)	0.1	(0.0)
Turkey	4.4	(0.5)	21.9	(1.3)	35.4	(1.4)	25.1	(1.3)	11.3	(1.3)	1.8	(0.3)	0.0	c
United Arab Emirates	11.3	(0.8)	23.8	(1.0)	29.9	(0.8)	22.3	(0.9)	10.1	(0.6)	2.3	(0.2)	0.3	(0.1)
United Kingdom*	4.3	(0.5)	10.7	(0.9)	22.4	(1.0)	28.4	(1.0)	23.0	(0.9)	9.3	(0.7)	1.8	(0.3)
United States	4.2	(0.5)	14.0	(1.1)	26.7	(1.1)	28.9	(1.1)	18.8	(1.1)	6.3	(0.6)	1.1	(0.2)
Vietnam	0.9	(0.3)	5.8	(0.9)	20.7	(1.4)	37.5	(1.5)	27.0	(1.5)	7.1	(0.9)	1.0	(0.3)
Wales	5.2	(0.6)	14.2	(0.8)	27.1	(1.3)	29.5	(1.3)	18.4	(0.9)	4.9	(0.6)	0.8	(0.2)
OECD average	4.8	(0.1)	13.0	(0.1)	24.5	(0.2)	28.8	(0.2)	20.5	(0.2)	7.2	(0.1)	1.2	(0.0)

14 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold.
c *indicates there are too few observations or no observation to provide reliable estimates*
OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

C6 Mean science performance in PISA 2006, 2009 and 2012

	PISA 2006		PISA 2009		PISA 2012		Change between 2006 and 2012 (PISA 2012 - PISA 2006)		Change between 2009 and 2012 (PISA 2012 - PISA 2009)	
	Mean score	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score dif.	S.E.
Australia	527	(2.3)	527	(2.5)	521	(1.8)	-5	(4.5)	-6	(3.7)
Austria*	511	(3.9)	m	m	506	(2.7)	-5	(5.9)	m	m
Belgium*	510	(2.5)	507	(2.5)	505	(2.1)	-5	(4.8)	-1	(3.8)
*Bulgaria**	434	(6.1)	439	(5.9)	446	(4.8)	12	(8.5)	7	(7.8)
Canada	534	(2.0)	529	(1.6)	525	(1.9)	**-9**	(4.5)	-3	(3.2)
Chile	438	(4.3)	447	(2.9)	445	(2.9)	7	(6.3)	-3	(4.6)
Chinese Taipei	532	(3.6)	520	(2.6)	523	(2.3)	-9	(5.5)	3	(4.0)
*Croatia**	493	(2.4)	486	(2.8)	491	(3.1)	-2	(5.3)	5	(4.7)
Czech Republic*	513	(3.5)	500	(3.0)	508	(3.0)	-5	(5.8)	8	(4.7)
Denmark*	496	(3.1)	499	(2.5)	498	(2.7)	3	(5.4)	-1	(4.2)
Dubai (UAE)	m	m	466	(1.2)	474	(1.4)	m	m	**8**	(2.7)
England	516	(2.7)	515	(3.0)	516	(4.0)	0	(4.8)	1	(5.0)
Estonia*	531	(2.5)	528	(2.7)	541	(1.9)	**10**	(4.7)	**14**	(3.9)
Finland*	563	(2.0)	554	(2.3)	545	(2.2)	**-18**	(4.6)	**-9**	(3.8)
France*	495	(3.4)	498	(3.6)	499	(2.6)	4	(5.5)	1	(4.9)
Germany*	516	(3.8)	520	(2.8)	524	(3.0)	8	(6.0)	4	(4.5)
Greece*	473	(3.2)	470	(4.0)	467	(3.1)	-7	(5.7)	-3	(5.5)
Hong Kong-China	542	(2.5)	549	(2.8)	555	(2.6)	**13**	(5.0)	6	(4.3)
Hungary*	504	(2.7)	503	(3.1)	494	(2.9)	-10	(5.3)	-8	(4.8)
Iceland	491	(1.6)	496	(1.4)	478	(2.1)	**-13**	(4.4)	**-17**	(3.2)
Israel	454	(3.7)	455	(3.1)	470	(5.0)	**16**	(7.1)	**15**	(6.2)
Italy*	475	(2.0)	489	(1.8)	494	(1.9)	**18**	(4.5)	5	(3.3)
Japan	531	(3.4)	539	(3.4)	547	(3.6)	**15**	(6.1)	7	(5.4)
Korea	522	(3.4)	538	(3.4)	538	(3.7)	**16**	(6.1)	0	(5.4)
*Latvia**	490	(3.0)	494	(3.1)	502	(2.8)	**13**	(5.4)	8	(4.6)
Liechtenstein	522	(4.1)	520	(3.4)	525	(3.5)	3	(6.5)	5	(5.3)
*Lithuania**	488	(2.8)	491	(2.9)	496	(2.6)	8	(5.1)	4	(4.4)
Luxembourg*	486	(1.1)	484	(1.2)	491	(1.3)	5	(3.9)	**7**	(2.7)
Macao-China	511	(1.1)	511	(1.0)	521	(0.8)	**10**	(3.8)	**10**	(2.4)
Mexico	410	(2.7)	416	(1.8)	415	(1.3)	5	(4.6)	-1	(3.0)
Netherlands*	525	(2.7)	522	(5.4)	522	(3.5)	-3	(5.7)	0	(6.8)
New Zealand	530	(2.7)	532	(2.6)	516	(2.1)	**-15**	(4.9)	**-16**	(3.9)
Northern Ireland	508	(3.3)	511	(4.4)	507	(3.9)	-1	(5.1)	-1	(5.9)
Norway	487	(3.1)	500	(2.6)	495	(3.1)	8	(5.6)	-5	(4.5)
Poland*	498	(2.3)	508	(2.4)	526	(3.1)	**28**	(5.3)	**18**	(4.4)
Portugal*	474	(3.0)	493	(2.9)	489	(3.7)	**15**	(6.0)	-4	(5.1)
Republic of Ireland*	508	(3.2)	508	(3.3)	522	(2.5)	**14**	(5.3)	**14**	(4.5)
*Romania**	418	(4.2)	428	(3.4)	439	(3.3)	**20**	(6.4)	**11**	(5.1)
Russian Federation	479	(3.7)	478	(3.3)	486	(2.9)	7	(5.8)	8	(4.8)
Scotland	515	(4.0)	514	(3.5)	513	(3.0)	-1	(5.0)	-1	(4.6)
Serbia	436	(3.0)	443	(2.4)	445	(3.4)	9	(5.8)	2	(4.6)
Shanghai-China	m	m	575	(2.3)	580	(3.0)	m	m	6	(4.3)
Singapore	m	m	542	(1.4)	551	(1.5)	m	m	**10**	(2.9)
Slovak Republic*	488	(2.6)	490	(3.0)	471	(3.6)	**-17**	(5.7)	**-19**	(5.1)
Slovenia*	519	(1.1)	512	(1.1)	514	(1.3)	-5	(3.9)	2	(2.6)
Spain*	488	(2.6)	488	(2.1)	496	(1.8)	8	(4.7)	**8**	(3.4)
Sweden*	503	(2.4)	495	(2.7)	485	(3.0)	**-19**	(5.2)	**-10**	(4.5)
Switzerland	512	(3.2)	517	(2.8)	515	(2.7)	4	(5.4)	-1	(4.4)
Thailand	421	(2.1)	425	(3.0)	444	(2.9)	**23**	(5.1)	**19**	(4.6)
Turkey	424	(3.8)	454	(3.6)	463	(3.9)	**40**	(6.5)	10	(5.7)
United Arab Emirates	m	m	429	(3.3)	439	(3.8)	m	m	10	(5.4)
United Kingdom*	515	(2.3)	514	(2.5)	514	(3.4)	-1	(5.4)	0	(4.7)
United States	489	(4.2)	502	(3.6)	497	(3.8)	9	(6.7)	-5	(5.6)
Wales	505	(3.5)	496	(3.5)	491	(3.0)	**-14**	(4.6)	-5	(4.6)

14 countries with scores below 430 omitted
Notes: Values that are statistically significant are indicated in bold.
m *indicates a missing value*
For Costa Rica and Malaysia the change between PISA 2009 and PISA 2012 represents change between 2010 and 2012 because these countries implemented the PISA 2009 assessment in 2010 as part of PISA 2009+.
In the United Arab Emirates, Dubai took the PISA 2009 assessment in 2009 and the rest of the United Arab Emirates in 2010 as part of PISA+. Results are thus reported separately.
OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

Appendix D

D1 Significant differences in mean scores on the reading scale

	Mean score		
	Mean	S.E.	Significance
Shanghai-China	570	(2.9)	^
Hong Kong-China	545	(2.8)	^
Singapore	542	(1.4)	^
Japan	538	(3.7)	^
Korea	536	(3.9)	^
Finland*	524	(2.4)	^
Republic of Ireland*	523	(2.6)	^
Canada	523	(1.9)	^
Chinese Taipei	523	(3.0)	^
Poland*	518	(3.1)	^
Estonia*	516	(2.0)	^
Liechtenstein	516	(4.1)	^
New Zealand	512	(2.4)	^
Australia	512	(1.6)	^
Netherlands*	511	(3.5)	^
Belgium*	509	(2.2)	^
Switzerland	509	(2.6)	*NS*
Macao-China	509	(0.9)	^
Vietnam	508	(4.4)	*NS*
Germany*	508	(2.8)	*NS*
Scotland	506	(3.0)	*NS*
France*	505	(2.8)	*NS*
Norway	504	(3.2)	*NS*
England	500	(4.2)	
United Kingdom*	499	(3.5)	
Northern Ireland	498	(3.9)	*NS*
United States	498	(3.7)	*NS*
OECD average	**496**	**(0.5)**	*NS*
Denmark*	496	(2.6)	*NS*
Czech Republic*	493	(2.9)	*NS*
Italy*	490	(2.0)	v
Austria*	490	(2.8)	v
*Latvia**	489	(2.4)	v
Hungary*	488	(3.2)	v
Spain*	488	(1.9)	v
Luxembourg*	488	(1.5)	v
Portugal*	488	(3.8)	v
Israel	486	(5.0)	v
*Croatia**	485	(3.3)	v
Sweden*	483	(3.0)	v
Iceland	483	(1.8)	v
Slovenia*	481	(1.2)	v
Wales	480	(2.7)	v
*Lithuania**	477	(2.5)	v
Greece*	477	(3.3)	v
Turkey	475	(4.2)	v
Russian Federation	475	(3.0)	v
Slovak Republic*	463	(4.2)	v
Cyprus	449	(1.2)	v
Serbia	446	(3.4)	v
United Arab Emirates	442	(2.5)	v
Chile	441	(2.9)	v
Thailand	441	(3.1)	v
Costa Rica	441	(3.5)	v
*Romania**	438	(4.0)	v
*Bulgaria**	436	(6.0)	v
Mexico	424	(1.5)	v

13 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^	significantly higher
NS	no significant difference
v	significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

D2 Mean score, variation and gender differences in student performance on the reading scale

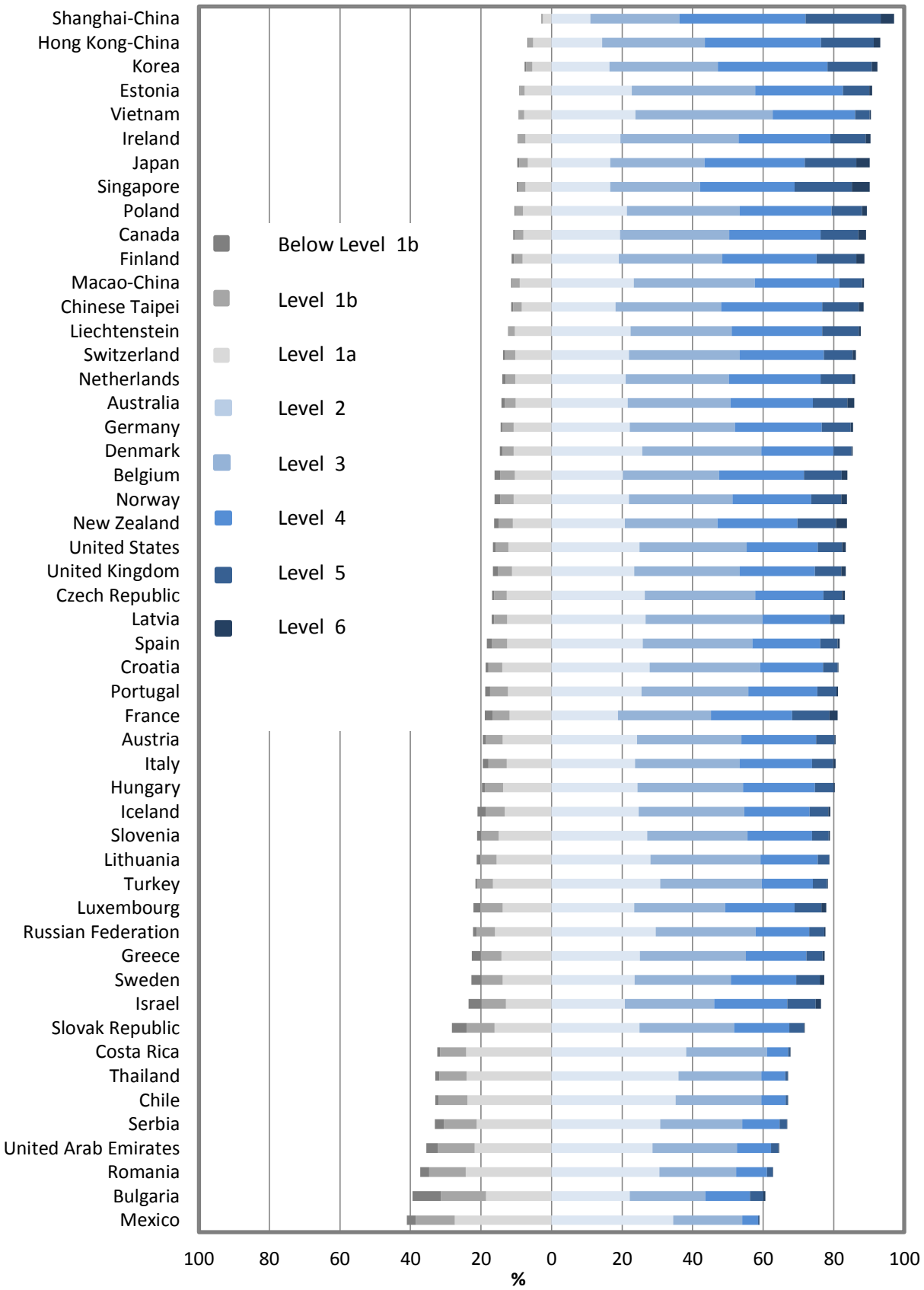
	All students				Gender differences						Percentiles												
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		Difference between 5th and 95th percentile
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	512	(1.6)	97	(1.0)	495	(2.3)	530	(2.0)	**-34**	(2.9)	347	(3.0)	386	(2.4)	448	(2.2)	579	(1.9)	634	(2.3)	664	(3.1)	318
Austria*	490	(2.8)	92	(1.8)	471	(4.0)	508	(3.4)	**-37**	(5.0)	329	(6.3)	365	(5.1)	427	(3.9)	557	(3.0)	603	(2.5)	629	(3.7)	300
Belgium*	509	(2.2)	103	(1.7)	493	(2.9)	525	(2.6)	**-32**	(3.4)	324	(6.5)	372	(4.3)	444	(3.2)	583	(2.7)	635	(2.3)	663	(2.6)	339
*Bulgaria**	436	(6.0)	119	(2.8)	403	(6.3)	472	(5.6)	**-70**	(5.2)	233	(9.2)	275	(8.0)	353	(8.2)	523	(6.0)	585	(6.1)	619	(6.3)	386
Canada	523	(1.9)	92	(0.9)	506	(2.3)	541	(2.1)	**-35**	(2.1)	363	(3.3)	403	(2.8)	464	(2.3)	587	(2.2)	638	(2.6)	667	(2.7)	305
Chile	441	(2.9)	78	(1.4)	430	(3.8)	452	(2.9)	**-23**	(3.3)	310	(4.6)	339	(4.2)	388	(3.8)	496	(3.3)	541	(3.3)	567	(3.4)	258
Chinese Taipei	523	(3.0)	91	(1.8)	507	(4.3)	539	(4.3)	**-32**	(6.4)	361	(5.5)	399	(5.2)	467	(4.4)	587	(2.8)	633	(3.6)	659	(4.7)	298
Costa Rica	441	(3.5)	74	(1.6)	427	(3.9)	452	(3.5)	**-25**	(2.6)	315	(5.4)	344	(5.4)	391	(4.3)	490	(4.2)	536	(5.0)	563	(4.9)	247
*Croatia**	485	(3.3)	86	(2.1)	461	(4.1)	509	(3.3)	**-48**	(4.0)	337	(5.9)	370	(5.1)	427	(4.4)	546	(3.8)	593	(4.9)	622	(5.1)	284
Cyprus	449	(1.2)	111	(1.3)	418	(1.9)	481	(1.9)	**-64**	(3.0)	249	(4.0)	297	(3.3)	378	(2.4)	528	(2.1)	583	(2.6)	616	(3.3)	366
Czech Republic*	493	(2.9)	89	(1.9)	474	(3.3)	513	(3.4)	**-39**	(3.7)	344	(6.0)	378	(4.7)	434	(3.7)	554	(3.6)	604	(3.8)	634	(4.3)	290
Denmark*	496	(2.6)	86	(2.2)	481	(3.3)	512	(2.6)	**-31**	(2.8)	347	(6.9)	385	(5.1)	442	(3.5)	555	(2.4)	602	(2.8)	629	(4.4)	281
England	500	(4.2)	98	(2.6)	487	(5.4)	512	(4.5)	**-24**	(5.4)	328	(8.5)	371	(8.3)	438	(5.8)	568	(3.8)	621	(4.5)	652	(5.2)	324
Estonia*	516	(2.0)	80	(1.2)	494	(2.4)	538	(2.3)	**-44**	(2.4)	381	(4.4)	412	(3.4)	463	(3.0)	571	(2.4)	618	(2.8)	645	(4.3)	263
Finland*	524	(2.4)	95	(1.3)	494	(3.1)	556	(2.4)	**-62**	(3.1)	360	(5.7)	399	(4.3)	463	(3.5)	590	(2.3)	639	(2.5)	669	(3.5)	309
France*	505	(2.8)	109	(2.3)	483	(3.8)	527	(3.0)	**-44**	(4.2)	312	(7.7)	358	(5.4)	435	(4.3)	584	(3.6)	639	(3.9)	669	(5.0)	357
Germany*	508	(2.8)	91	(1.7)	486	(2.9)	530	(3.1)	**-44**	(2.5)	346	(5.2)	384	(4.8)	447	(3.6)	574	(3.1)	621	(3.2)	646	(3.3)	300
Greece*	477	(3.3)	99	(2.1)	452	(4.1)	502	(3.1)	**-50**	(3.7)	302	(8.8)	346	(6.0)	416	(4.5)	545	(3.4)	597	(3.9)	626	(4.5)	325
Hong Kong-China	545	(2.8)	85	(1.8)	533	(3.8)	558	(3.3)	**-25**	(4.7)	391	(6.4)	430	(5.4)	493	(4.4)	604	(3.0)	648	(3.4)	672	(4.1)	281
Hungary*	488	(3.2)	92	(1.9)	468	(3.9)	508	(3.3)	**-40**	(3.6)	327	(6.0)	363	(5.2)	427	(4.6)	555	(3.3)	603	(3.9)	630	(4.7)	303
Iceland	483	(1.8)	98	(1.4)	457	(2.4)	508	(2.5)	**-51**	(3.3)	308	(5.7)	352	(4.1)	422	(2.9)	551	(2.9)	602	(2.4)	631	(3.2)	323
Israel	486	(5.0)	114	(2.5)	463	(8.2)	507	(3.9)	**-44**	(7.9)	282	(9.5)	329	(7.5)	414	(6.8)	568	(4.5)	624	(4.5)	656	(4.8)	374
Italy*	490	(2.0)	97	(0.9)	471	(2.5)	510	(2.3)	**-39**	(2.6)	317	(3.5)	359	(2.9)	427	(2.6)	559	(2.1)	609	(2.2)	636	(2.1)	319
Japan	538	(3.7)	99	(2.3)	527	(4.7)	551	(3.6)	**-24**	(4.1)	364	(7.7)	409	(6.5)	475	(4.8)	607	(3.8)	658	(4.4)	689	(5.1)	325
Korea	536	(3.9)	87	(2.0)	525	(5.0)	548	(4.5)	**-23**	(5.4)	382	(8.6)	424	(6.2)	483	(4.3)	596	(4.1)	640	(4.0)	665	(4.8)	282
*Latvia**	489	(2.4)	85	(1.7)	462	(3.3)	516	(2.7)	**-55**	(4.0)	341	(5.9)	375	(5.6)	434	(3.0)	548	(2.9)	593	(2.8)	619	(4.1)	278
Liechtenstein	516	(4.1)	88	(4.2)	504	(6.2)	529	(5.8)	**-24**	(8.7)	360	(9.7)	391	(9.5)	452	(7.8)	584	(6.9)	630	(10.6)	649	(13.7)	288
*Lithuania**	477	(2.5)	86	(1.5)	450	(2.8)	505	(2.6)	**-55**	(2.3)	331	(5.1)	363	(4.0)	419	(3.9)	538	(2.8)	585	(3.1)	612	(3.6)	281
Luxembourg*	488	(1.5)	105	(1.0)	473	(1.9)	503	(1.8)	**-30**	(2.0)	304	(3.8)	347	(2.7)	418	(2.4)	564	(2.2)	620	(2.3)	651	(2.4)	347
Macao-China	509	(0.9)	82	(0.7)	492	(1.4)	527	(1.1)	**-36**	(1.7)	366	(3.3)	400	(2.4)	457	(1.8)	566	(1.4)	611	(1.6)	637	(2.1)	270
Mexico	424	(1.5)	80	(1.0)	411	(1.7)	435	(1.6)	**-24**	(1.4)	288	(3.0)	319	(2.5)	370	(1.9)	479	(1.8)	525	(1.9)	552	(2.0)	264
Netherlands*	511	(3.5)	93	(3.0)	498	(4.0)	525	(3.5)	**-26**	(3.1)	349	(8.3)	386	(6.6)	451	(5.1)	579	(3.7)	625	(3.6)	650	(3.8)	300
New Zealand	512	(2.4)	106	(1.6)	495	(3.3)	530	(3.5)	**-34**	(5.0)	332	(4.7)	374	(4.9)	443	(3.2)	586	(3.1)	645	(4.0)	679	(4.9)	347
Northern Ireland	498	(3.9)	95	(2.7)	484	(5.4)	512	(5.2)	**-27**	(7.6)	333	(9.6)	373	(7.1)	436	(5.0)	565	(5.7)	618	(5.3)	646	(5.9)	313
Norway	504	(3.2)	100	(1.9)	481	(3.3)	528	(3.9)	**-46**	(3.3)	330	(8.1)	375	(4.8)	442	(4.0)	573	(3.4)	627	(3.9)	658	(4.2)	328
Poland*	518	(3.1)	87	(1.6)	497	(3.7)	539	(3.1)	**-42**	(2.9)	366	(5.9)	404	(4.6)	461	(3.2)	579	(3.6)	626	(4.8)	655	(6.2)	289
Portugal*	488	(3.8)	94	(1.9)	468	(4.2)	508	(3.7)	**-39**	(2.7)	320	(6.9)	362	(6.0)	429	(4.9)	554	(3.5)	604	(3.5)	631	(3.8)	311
Republic of Ireland*	523	(2.6)	86	(1.7)	509	(3.5)	538	(3.0)	**-29**	(4.2)	373	(7.1)	410	(5.7)	469	(3.6)	582	(2.7)	631	(3.2)	659	(3.2)	286
*Romania**	438	(4.0)	90	(2.0)	417	(4.5)	457	(4.2)	**-40**	(4.1)	290	(5.3)	322	(4.4)	375	(4.4)	501	(5.5)	555	(5.3)	586	(6.3)	296
Russian Federation	475	(3.0)	91	(1.5)	455	(3.5)	495	(3.2)	**-40**	(3.0)	323	(4.8)	359	(4.5)	415	(4.0)	537	(3.9)	592	(4.2)	623	(5.1)	300
Scotland	506	(3.0)	87	(1.8)	493	(3.2)	520	(3.5)	**-27**	(3.4)	357	(7.2)	394	(5.1)	450	(3.9)	565	(3.6)	614	(3.8)	645	(4.8)	288
Serbia	446	(3.4)	93	(2.0)	423	(3.9)	469	(3.8)	**-46**	(3.8)	290	(6.0)	325	(5.5)	384	(4.4)	509	(4.1)	566	(4.6)	596	(5.6)	307
Shanghai-China	570	(2.9)	80	(1.8)	557	(3.3)	581	(2.8)	**-24**	(2.5)	431	(5.1)	463	(4.6)	518	(3.6)	626	(2.8)	667	(3.5)	690	(4.7)	259
Singapore	542	(1.4)	101	(1.2)	527	(1.9)	559	(1.9)	**-32**	(2.6)	369	(3.6)	408	(2.9)	475	(2.1)	614	(2.1)	668	(3.2)	698	(3.7)	329
Slovak Republic*	463	(4.2)	104	(3.3)	444	(4.6)	483	(5.1)	**-39**	(4.6)	274	(10.4)	321	(8.4)	396	(6.8)	538	(4.1)	591	(5.2)	620	(5.5)	346
Slovenia*	481	(1.2)	92	(0.9)	454	(1.7)	510	(1.8)	**-56**	(2.7)	324	(2.9)	362	(2.5)	420	(1.9)	548	(2.1)	598	(2.5)	626	(3.7)	301
Spain*	488	(1.9)	92	(1.1)	474	(2.3)	503	(1.9)	**-29**	(2.0)	327	(4.6)	367	(3.6)	430	(2.6)	552	(2.1)	601	(2.3)	630	(2.1)	303
Sweden*	483	(3.0)	107	(1.8)	458	(4.0)	509	(2.8)	**-51**	(3.6)	297	(6.5)	343	(5.4)	416	(4.3)	558	(3.3)	614	(4.2)	647	(4.2)	350
Switzerland	509	(2.6)	90	(1.1)	491	(3.1)	527	(2.5)	**-36**	(2.6)	352	(4.6)	388	(3.9)	451	(3.3)	573	(2.8)	622	(3.2)	648	(3.9)	296
Thailand	441	(3.1)	78	(1.8)	410	(3.6)	465	(3.3)	**-55**	(3.2)	310	(5.0)	341	(4.4)	389	(3.5)	494	(3.7)	541	(4.4)	569	(6.2)	259
Turkey	475	(4.2)	86	(2.4)	453	(4.6)	499	(4.3)	**-46**	(4.0)	335	(5.3)	365	(4.6)	417	(4.0)	534	(5.6)	588	(6.8)	620	(7.9)	285
United Arab Emirates	442	(2.5)	95	(1.1)	413	(3.9)	469	(3.2)	**-55**	(4.8)	281	(3.9)	316	(3.7)	376	(3.1)	508	(2.8)	562	(3.1)	595	(3.4)	314
United Kingdom*	499	(3.5)	97	(2.3)	487	(4.5)	512	(3.8)	**-25**	(4.6)	330	(7.4)	372	(7.0)	438	(4.8)	567	(3.4)	619	(3.8)	650	(4.3)	320
United States	498	(3.7)	92	(1.6)	482	(4.1)	513	(3.8)	**-31**	(2.6)	342	(7.2)	378	(4.8)	436	(4.5)	561	(3.9)	614	(4.0)	646	(4.7)	303
Vietnam	508	(4.4)	74	(2.6)	492	(5.0)	523	(4.0)	**-31**	(2.6)	379	(9.6)	411	(8.2)	462	(5.4)	559	(3.9)	599	(5.0)	623	(5.3)	245
Wales	480	(2.7)	90	(1.7)	466	(3.2)	493	(3.2)	**-27**	(3.5)	325	(6.3)	365	(4.7)	421	(3.7)	541	(3.2)	593	(3.9)	624	(4.6)	299
OECD average	496	(0.5)	94	(0.3)	478	(0.6)	515	(0.5)	**-38**	(0.6)	332	(1.1)	372	(0.9)	435	(0.7)	563	(0.6)	613	(0.6)	642	(0.7)	310

13 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold.
OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

D3 Summary descriptions for the seven levels of proficiency in reading

Level	Characteristics of tasks
6	Tasks at this level typically require the reader to make multiple inferences, comparisons and contrasts that are both detailed and precise. They require demonstration of a full and detailed understanding of one or more texts and may involve integrating information from more than one text. Tasks may require the reader to deal with unfamiliar ideas, in the presence of prominent competing information, and to generate abstract categories for interpretations. *Reflect and evaluate* tasks may require the reader to hypothesise about or critically evaluate a complex text on an unfamiliar topic, taking into account multiple criteria or perspectives, and applying sophisticated understandings from beyond the text. There is limited data about *access and retrieve* tasks at this level, but it appears that a salient condition is precision of analysis and fine attention to detail that is inconspicuous in the texts.
5	Tasks at this level that involve retrieving information require the reader to locate and organise several pieces of deeply embedded information, inferring which information in the text is relevant. Reflective tasks require critical evaluation or hypothesis, drawing on specialised knowledge. Both interpretative and reflective tasks require a full and detailed understanding of a text whose content or form is unfamiliar. For all aspects of reading, tasks at this level typically involve dealing with concepts that are contrary to expectations.
4	Tasks at this level that involve retrieving information require the reader to locate and organise several pieces of embedded information. Some tasks at this level require interpreting the meaning of nuances of language in a section of text by taking into account the text as a whole. Other interpretative tasks require understanding and applying categories in an unfamiliar context. Reflective tasks at this level require readers to use formal or public knowledge to hypothesise about or critically evaluate a text. Readers must demonstrate an accurate understanding of long or complex texts whose content or form may be unfamiliar.
3	Tasks at this level require the reader to locate, and in some cases recognise the relationship between, several pieces of information that must meet multiple conditions. Interpretative tasks at this level require the reader to integrate several parts of a text in order to identify a main idea, understand a relationship or construe the meaning of a word or phrase. They need to take into account many features in comparing, contrasting or categorising. Often the required information is not prominent or there is much competing information; or there are other text obstacles, such as ideas that are contrary to expectation or negatively worded. Reflective tasks at this level may require connections, comparisons, and explanations, or they may require the reader to evaluate a feature of the text. Some reflective tasks require readers to demonstrate a fine understanding of the text in relation to familiar, everyday knowledge. Other tasks do not require detailed text comprehension but require the reader to draw on less common knowledge.
2	Some tasks at this level require the reader to locate one or more pieces of information, which may need to be inferred and may need to meet several conditions. Others require recognising the main idea in a text, understanding relationships, or construing meaning within a limited part of the text when the information is not prominent and the reader must make low level inferences. Tasks at this level may involve comparisons or contrasts based on a single feature in the text. Typical reflective tasks at this level require readers to make a comparison or several connections between the text and outside knowledge, by drawing on personal experience and attitudes.
1a	Tasks at this level require the reader to locate one or more independent pieces of explicitly stated information; to recognise the main theme or author's purpose in a text about a familiar topic, or to make a simple connection between information in the text and common, everyday knowledge. Typically the required information in the text is prominent and there is little, if any, competing information. The reader is explicitly directed to consider relevant factors in the task and in the text.
1b	Tasks at this level require the reader to locate a single piece of explicitly stated information in a prominent position in a short, syntactically simple text with a familiar context and text type, such as a narrative or a simple list. The text typically provides support to the reader, such as repetition of information, pictures or familiar symbols. There is minimal competing information. In tasks requiring interpretation the reader may need to make simple connections between adjacent pieces of information.

D4 Summary of percentage of students at each level of proficiency on the reading scale



13 countries with scores below 430 omitted

Countries are ranked in descending order of the percentage of students at Levels 2, 3, 4, 5 and 6.

Source: OECD, PISA 2012 database, Table I.4.1a.

D5 Percentage of students at each level of proficiency on the reading scale

	Proficiency levels															
	Below Level 1b		Level 1b		Level 1a		Level 2		Level 3		Level 4		Level 5		Level 6	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.
Australia	0.9	(0.1)	3.1	(0.2)	10.2	(0.4)	21.6	(0.5)	29.1	(0.5)	23.3	(0.5)	9.8	(0.5)	1.9	(0.2)
Austria*	0.8	(0.2)	4.8	(0.6)	13.8	(0.8)	24.2	(0.9)	29.6	(0.9)	21.2	(0.9)	5.2	(0.6)	0.3	(0.1)
Belgium*	1.6	(0.3)	4.1	(0.4)	10.5	(0.6)	20.2	(0.6)	27.3	(0.7)	24.0	(0.6)	10.7	(0.5)	1.6	(0.2)
*Bulgaria**	8.0	(1.1)	12.8	(1.2)	18.6	(1.1)	22.2	(1.2)	21.4	(1.1)	12.7	(1.0)	3.8	(0.6)	0.5	(0.2)
Canada	0.5	(0.1)	2.4	(0.2)	8.0	(0.4)	19.4	(0.6)	31.0	(0.7)	25.8	(0.6)	10.8	(0.5)	2.1	(0.2)
Chile	1.0	(0.2)	8.1	(0.8)	23.9	(1.1)	35.1	(1.1)	24.3	(1.1)	6.9	(0.6)	0.6	(0.1)	0.0	(0.0)
Chinese Taipei	0.6	(0.1)	2.5	(0.3)	8.4	(0.7)	18.1	(0.8)	29.9	(0.9)	28.7	(1.0)	10.4	(0.7)	1.4	(0.3)
Costa Rica	0.8	(0.2)	7.3	(1.0)	24.3	(1.2)	38.1	(1.4)	22.9	(1.4)	6.0	(0.8)	0.6	(0.2)	0.0	c
*Croatia**	0.7	(0.2)	4.0	(0.6)	13.9	(1.0)	27.8	(1.1)	31.2	(1.2)	17.8	(1.1)	4.2	(0.7)	0.2	(0.1)
Cyprus	6.1	(0.3)	9.7	(0.4)	17.0	(0.6)	25.1	(0.8)	24.9	(0.7)	13.2	(0.6)	3.5	(0.3)	0.5	(0.1)
Czech Republic*	0.6	(0.3)	3.5	(0.6)	12.7	(0.9)	26.4	(1.3)	31.3	(1.2)	19.4	(1.1)	5.3	(0.5)	0.8	(0.2)
Denmark*	0.8	(0.3)	3.1	(0.4)	10.7	(0.8)	25.8	(0.9)	33.6	(0.8)	20.5	(0.9)	5.1	(0.6)	0.4	(0.1)
England	1.6	(0.3)	4.0	(0.6)	11.1	(0.9)	23.1	(1.2)	29.5	(1.2)	21.5	(1.3)	7.8	(0.7)	1.3	(0.3)
Estonia*	0.2	(0.1)	1.3	(0.3)	7.7	(0.6)	22.7	(0.9)	35.0	(1.1)	24.9	(1.1)	7.5	(0.7)	0.9	(0.2)
Finland*	0.7	(0.2)	2.4	(0.4)	8.2	(0.6)	19.1	(0.8)	29.3	(0.7)	26.8	(0.8)	11.3	(0.6)	2.2	(0.3)
France*	2.1	(0.4)	4.9	(0.4)	11.9	(0.7)	18.9	(0.8)	26.3	(0.8)	23.0	(0.7)	10.6	(0.6)	2.3	(0.4)
Germany*	0.5	(0.2)	3.3	(0.4)	10.7	(0.7)	22.1	(0.9)	29.9	(0.9)	24.6	(0.9)	8.3	(0.6)	0.7	(0.2)
Greece*	2.6	(0.4)	5.9	(0.6)	14.2	(0.8)	25.1	(1.1)	30.0	(1.0)	17.2	(1.2)	4.6	(0.6)	0.5	(0.1)
Hong Kong-China	0.2	(0.1)	1.3	(0.2)	5.3	(0.6)	14.3	(0.8)	29.2	(1.2)	32.9	(1.4)	14.9	(1.0)	1.9	(0.4)
Hungary*	0.7	(0.2)	5.2	(0.6)	13.8	(0.9)	24.3	(1.2)	29.9	(1.0)	20.4	(1.0)	5.3	(0.7)	0.4	(0.1)
Iceland	2.3	(0.3)	5.4	(0.5)	13.3	(0.6)	24.7	(0.9)	29.9	(1.1)	18.6	(1.1)	5.2	(0.4)	0.6	(0.2)
Israel	3.8	(0.6)	6.9	(0.7)	12.9	(1.0)	20.8	(0.9)	25.3	(0.8)	20.6	(1.0)	8.1	(0.8)	1.5	(0.3)
Italy*	1.6	(0.2)	5.2	(0.3)	12.7	(0.5)	23.7	(0.6)	29.7	(0.5)	20.5	(0.6)	6.1	(0.3)	0.6	(0.1)
Japan	0.6	(0.2)	2.4	(0.4)	6.7	(0.7)	16.6	(0.9)	26.7	(1.0)	28.4	(1.1)	14.6	(1.0)	3.9	(0.6)
Korea	0.4	(0.1)	1.7	(0.4)	5.5	(0.6)	16.4	(0.9)	30.8	(1.0)	31.0	(1.1)	12.6	(1.0)	1.6	(0.3)
*Latvia**	0.7	(0.2)	3.7	(0.5)	12.6	(1.0)	26.7	(1.3)	33.1	(1.1)	19.1	(0.9)	3.9	(0.6)	0.3	(0.1)
Liechtenstein	0.0	c	1.9	(1.0)	10.5	(1.8)	22.4	(3.4)	28.6	(4.5)	25.7	(2.4)	10.4	(2.4)	0.6	c
*Lithuania**	1.0	(0.2)	4.6	(0.5)	15.6	(1.1)	28.1	(1.1)	31.1	(0.9)	16.3	(0.8)	3.1	(0.3)	0.2	(0.1)
Luxembourg*	2.0	(0.2)	6.3	(0.3)	13.8	(0.8)	23.4	(0.7)	25.8	(0.6)	19.7	(0.6)	7.5	(0.3)	1.4	(0.2)
Macao-China	0.3	(0.1)	2.1	(0.2)	9.0	(0.4)	23.3	(0.6)	34.3	(0.7)	24.0	(0.6)	6.4	(0.5)	0.6	(0.2)
Mexico	2.6	(0.2)	11.0	(0.5)	27.5	(0.7)	34.5	(0.6)	19.6	(0.5)	4.5	(0.3)	0.4	(0.1)	0.0	(0.0)
Netherlands*	0.9	(0.5)	2.8	(0.5)	10.3	(0.9)	21.0	(1.3)	29.2	(1.3)	26.1	(1.4)	9.0	(0.7)	0.8	(0.2)
New Zealand	1.3	(0.3)	4.0	(0.5)	11.0	(0.7)	20.8	(0.8)	26.3	(1.1)	22.7	(1.1)	10.9	(0.6)	3.0	(0.4)
Northern Ireland	1.1	(0.3)	4.1	(0.7)	11.5	(1.3)	24.4	(1.4)	29.8	(1.5)	20.8	(1.3)	7.1	(0.8)	1.2	(0.3)
Norway	1.7	(0.3)	3.7	(0.4)	10.8	(0.7)	21.9	(1.0)	29.4	(1.4)	22.3	(1.2)	8.5	(0.6)	1.7	(0.3)
Poland*	0.3	(0.1)	2.1	(0.4)	8.1	(0.7)	21.4	(0.9)	32.0	(0.9)	26.0	(1.0)	8.6	(0.8)	1.4	(0.4)
Portugal*	1.3	(0.3)	5.1	(0.5)	12.3	(1.0)	25.5	(1.2)	30.2	(1.5)	19.7	(1.1)	5.3	(0.6)	0.5	(0.1)
Republic of Ireland*	0.3	(0.1)	1.9	(0.4)	7.5	(0.7)	19.6	(1.2)	33.4	(1.2)	26.0	(0.9)	10.1	(0.7)	1.3	(0.3)
*Romania**	2.5	(0.4)	10.3	(0.8)	24.4	(1.3)	30.6	(1.1)	21.8	(1.2)	8.7	(0.9)	1.5	(0.4)	0.1	c
Russian Federation	1.1	(0.2)	5.2	(0.5)	16.0	(1.0)	29.5	(1.1)	28.3	(1.0)	15.3	(0.9)	4.2	(0.5)	0.5	(0.1)
Scotland	0.5	(0.2)	2.7	(0.5)	9.3	(0.9)	23.9	(1.2)	33.8	(1.3)	22.0	(1.0)	6.9	(0.6)	0.9	(0.3)
Serbia	2.6	(0.4)	9.3	(0.7)	21.3	(1.1)	30.8	(1.2)	23.3	(1.1)	10.5	(0.8)	2.0	(0.4)	0.2	(0.1)
Shanghai-China	0.1	(0.1)	0.3	(0.1)	2.5	(0.3)	11.0	(0.9)	25.3	(0.8)	35.7	(1.1)	21.3	(1.0)	3.8	(0.7)
Singapore	0.5	(0.1)	1.9	(0.3)	7.5	(0.4)	16.7	(0.7)	25.4	(0.7)	26.8	(0.8)	16.2	(0.7)	5.0	(0.4)
Slovak Republic*	4.1	(0.8)	7.9	(0.8)	16.2	(1.1)	25.0	(1.1)	26.8	(1.4)	15.7	(1.0)	4.1	(0.6)	0.3	(0.2)
Slovenia*	1.2	(0.1)	4.9	(0.4)	15.0	(0.7)	27.2	(0.8)	28.4	(0.9)	18.2	(0.6)	4.7	(0.5)	0.3	(0.1)
Spain*	1.3	(0.2)	4.4	(0.4)	12.6	(0.5)	25.8	(0.8)	31.2	(0.7)	19.2	(0.6)	5.0	(0.3)	0.5	(0.1)
Sweden*	2.9	(0.4)	6.0	(0.6)	13.9	(0.7)	23.5	(0.9)	27.3	(0.7)	18.6	(0.9)	6.7	(0.5)	1.2	(0.2)
Switzerland	0.5	(0.1)	2.9	(0.3)	10.3	(0.6)	21.9	(0.9)	31.5	(0.7)	23.8	(0.8)	8.2	(0.6)	1.0	(0.2)
Thailand	1.2	(0.3)	7.7	(0.8)	24.1	(1.0)	36.0	(1.1)	23.5	(1.1)	6.7	(0.8)	0.8	(0.2)	0.1	(0.0)
Turkey	0.6	(0.2)	4.5	(0.6)	16.6	(1.1)	30.8	(1.4)	28.7	(1.3)	14.5	(1.4)	4.1	(0.8)	0.3	(0.1)
United Arab Emirates	3.3	(0.3)	10.4	(0.6)	21.8	(0.7)	28.6	(0.7)	24.0	(0.8)	9.7	(0.6)	2.1	(0.3)	0.2	(0.1)
United Kingdom*	1.5	(0.3)	4.0	(0.5)	11.2	(0.8)	23.5	(1.0)	29.9	(1.1)	21.3	(1.1)	7.5	(0.6)	1.3	(0.2)
United States	0.8	(0.2)	3.6	(0.5)	12.3	(0.9)	24.9	(1.0)	30.5	(0.9)	20.1	(1.1)	6.9	(0.6)	1.0	(0.2)
Vietnam	0.1	(0.1)	1.5	(0.5)	7.8	(1.1)	23.7	(1.4)	39.0	(1.5)	23.4	(1.5)	4.2	(0.7)	0.4	(0.2)
Wales	1.0	(0.2)	4.9	(0.5)	14.7	(0.9)	28.5	(1.3)	29.8	(0.9)	16.3	(0.8)	4.2	(0.5)	0.5	(0.1)
OECD average	1.3	(0.1)	4.4	(0.1)	12.3	(0.1)	23.5	(0.2)	29.1	(0.2)	21.0	(0.2)	7.3	(0.1)	1.1	(0.0)

13 countries with scores below 430 omitted
Note: Values that are statistically significant are indicated in bold.
c indicates there are too few observations or no observation to provide reliable estimates
OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

D6 Mean reading performance in PISA 2006, 2009 and 2012

	PISA 2006		PISA 2009		PISA 2012		Change between 2006 and 2012 (PISA 2012 - PISA 2006)		Change between 2009 and 2012 (PISA 2012 - PISA 2009)	
	Mean score	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score dif.	S.E.
Australia	513	(2.1)	515	(2.3)	512	(1.6)	-1	(6.2)	-3	(3.8)
Austria*	490	(4.1)	m	m	490	(2.8)	-1	(7.4)	m	m
Belgium*	501	(3.0)	506	(2.3)	509	(2.2)	8	(6.7)	3	(4.1)
*Bulgaria**	402	(6.9)	429	(6.7)	436	(6.0)	**34**	(10.7)	7	(9.4)
Canada	527	(2.4)	524	(1.5)	523	(1.9)	-4	(6.4)	-1	(3.6)
Chile	442	(5.0)	449	(3.1)	441	(2.9)	-1	(8.0)	-8	(5.0)
Chinese Taipei	496	(3.4)	495	(2.6)	523	(3.0)	**27**	(7.2)	**28**	(4.8)
Costa Rica	m	m	443	(3.2)	441	(3.5)	m	m	-2	(5.4)
*Croatia**	477	(2.8)	476	(2.9)	485	(3.3)	7	(7.1)	9	(5.1)
Czech Republic*	483	(4.2)	478	(2.9)	493	(2.9)	10	(7.5)	**15**	(4.8)
Denmark*	494	(3.2)	495	(2.1)	496	(2.6)	2	(6.9)	1	(4.3)
Dubai (UAE)	m	m	459	(1.1)	468	(1.3)	m	m	**9**	(3.1)
England	496	(2.7)	495	(2.8)	500	(4.2)	4	(4.9)	5	(5.0)
Estonia*	501	(2.9)	501	(2.6)	516	(2.0)	**16**	(6.6)	**15**	(4.2)
Finland*	547	(2.1)	536	(2.3)	524	(2.4)	**-23**	(6.4)	**-12**	(4.2)
France*	488	(4.1)	496	(3.4)	505	(2.8)	**18**	(7.5)	10	(5.2)
Germany*	495	(4.4)	497	(2.7)	508	(2.8)	13	(7.6)	**10**	(4.7)
Greece*	460	(4.0)	483	(4.3)	477	(3.3)	**17**	(7.6)	-6	(6.0)
Hong Kong-China	536	(2.4)	533	(2.1)	545	(2.8)	9	(6.7)	**11**	(4.4)
Hungary*	482	(3.3)	494	(3.2)	488	(3.2)	6	(7.2)	-6	(5.2)
Iceland	484	(1.9)	500	(1.4)	483	(1.8)	-2	(6.2)	**-18**	(3.5)
Israel	439	(4.6)	474	(3.6)	486	(5.0)	**47**	(8.8)	12	(6.7)
Italy*	469	(2.4)	486	(1.6)	490	(2.0)	**21**	(6.4)	4	(3.6)
Japan	498	(3.6)	520	(3.5)	538	(3.7)	**40**	(7.6)	**18**	(5.7)
Korea	556	(3.8)	539	(3.5)	536	(3.9)	**-20**	(7.8)	-3	(5.9)
*Latvia**	479	(3.7)	484	(3.0)	489	(2.4)	9	(7.1)	5	(4.6)
Liechtenstein	510	(3.9)	499	(2.8)	516	(4.1)	5	(8.0)	**16**	(5.6)
*Lithuania**	470	(3.0)	468	(2.4)	477	(2.5)	7	(6.8)	**9**	(4.3)
Luxembourg*	479	(1.3)	472	(1.3)	488	(1.5)	8	(5.9)	**16**	(3.3)
Macao-China	492	(1.1)	487	(0.9)	509	(0.9)	**17**	(5.8)	**22**	(2.9)
Mexico	410	(3.1)	425	(2.0)	424	(1.5)	**13**	(6.5)	-2	(3.6)
Netherlands*	507	(2.9)	508	(5.1)	511	(3.5)	4	(7.2)	3	(6.7)
New Zealand	521	(3.0)	521	(2.4)	512	(2.4)	-9	(6.8)	**-9**	(4.2)
Northern Ireland	495	(3.5)	499	(4.1)	498	(3.9)	2	(5.3)	-2	(5.7)
Norway	484	(3.2)	503	(2.6)	504	(3.2)	**20**	(7.2)	1	(4.9)
Poland*	508	(2.8)	500	(2.6)	518	(3.1)	11	(7.0)	**18**	(4.8)
Portugal*	472	(3.6)	489	(3.1)	488	(3.8)	**15**	(7.6)	-2	(5.5)
Republic of Ireland*	517	(3.5)	496	(3.0)	523	(2.6)	6	(7.1)	**28**	(4.7)
*Romania**	396	(4.7)	424	(4.1)	438	(4.0)	**42**	(8.3)	**13**	(6.3)
Russian Federation	440	(4.3)	459	(3.3)	475	(3.0)	**35**	(7.7)	**16**	(5.2)
Scotland	499	(4.0)	500	(3.2)	506	(3.0)	7	(5.0)	6	(4.4)
Serbia	401	(3.5)	442	(2.4)	446	(3.4)	**45**	(7.4)	4	(5.0)
Shanghai-China	m	m	556	(2.4)	570	(2.9)	m	m	**14**	(4.5)
Singapore	m	m	526	(1.1)	542	(1.4)	m	m	**16**	(3.1)
Slovak Republic*	466	(3.1)	477	(2.5)	463	(4.2)	-4	(7.6)	**-15**	(5.5)
Slovenia*	494	(1.0)	483	(1.0)	481	(1.2)	**-13**	(5.8)	-2	(3.1)
Spain*	461	(2.2)	481	(2.0)	488	(1.9)	**27**	(6.3)	7	(3.8)
Sweden*	507	(3.4)	497	(2.9)	483	(3.0)	**-24**	(7.2)	**-14**	(4.9)
Switzerland	499	(3.1)	501	(2.4)	509	(2.6)	10	(6.9)	9	(4.4)
Thailand	417	(2.6)	421	(2.6)	441	(3.1)	**24**	(6.9)	**20**	(4.8)
Turkey	447	(4.2)	464	(3.5)	475	(4.2)	**28**	(8.2)	11	(6.1)
United Arab Emirates	m	m	423	(3.7)	432	(3.3)	m	m	9	(5.6)
United Kingdom*	495	(2.3)	494	(2.3)	499	(3.5)	4	(7.0)	5	(4.9)
United States	c	c	500	(3.7)	498	(3.7)	c	c	-2	(5.8)
Wales	481	(3.7)	476	(3.4)	480	(2.7)	-1	(4.6)	4	(4.3)

13 countries with scores below 430 omitted
Notes: Values that are statistically significant are indicated in bold.
c *indicates there are too few observations or no observation to provide reliable estimates*
m *indicates a missing value*
For Costa Rica and Malaysia the change between PISA 2009 and PISA 2012 represents change between 2010 and 2012 because these countries implemented the PISA 2009 assessment in 2010 as part of PISA 2009+.
In the United Arab Emirates, Dubai took the PISA 2009 assessment in 2009 and the rest of the United Arab Emirates in 2010 as part of PISA+. Results are thus reported separately.
OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

Appendix E

PISA index of economic, social and cultural status and performance in mathematics, by national quarters of the index

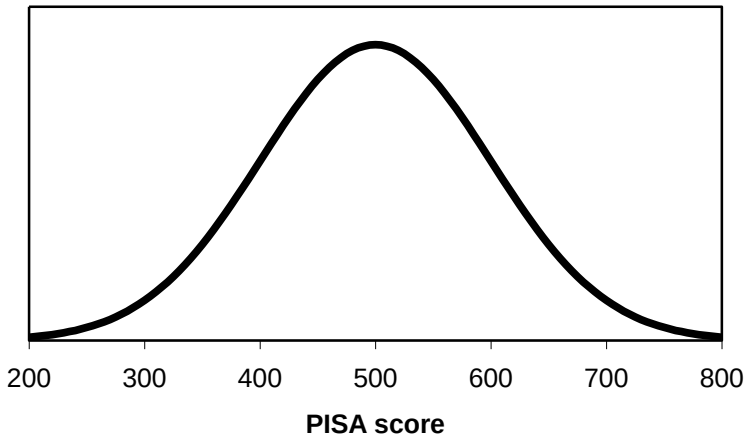
	PISA index of economic, social and cultural status (ESCS)										Performance on the mathematics scale, by national quarters of this index								Score point difference in mathematics associated with one unit increase in the ESCS		Increased likelihood of students in the bottom quarter of the ESCS index scoring in the bottom quarter of the mathematics performance distribution		Strength of the relationship between mathematics performance and the ESCS Percentage of explained variance in mathematics performance	
	All students		Bottom quarter		Second quarter		Third quarter		Top quarter		Bottom quarter		Second quarter		Third quarter		Top quarter							
	Mean index	S.E.	Mean index	S.E.	Mean index	S.E.	Mean index	S.E.	Mean index	S.E.	Mean score	S.E.	Mean score	S.E.	Mean score	S.E.	Mean score	S.E.	Effect	S.E.	Ratio	S.E.	%	S.E.
Iceland	0.78	(0.01)	-0.34	(0.02)	0.57	(0.02)	1.19	(0.02)	1.71	(0.01)	464	(2.9)	481	(3.2)	508	(3.4)	526	(3.7)	**31**	(2.1)	**1.75**	(0.11)	**7.7**	(1.0)
Norway	0.46	(0.02)	-0.56	(0.02)	0.27	(0.02)	0.79	(0.02)	1.35	(0.02)	459	(4.1)	479	(3.7)	504	(3.9)	522	(3.7)	**32**	(2.4)	**1.83**	(0.12)	**7.4**	(1.0)
Denmark*	0.43	(0.02)	-0.70	(0.03)	0.16	(0.04)	0.81	(0.03)	1.44	(0.02)	460	(3.4)	489	(3.4)	513	(2.9)	545	(3.4)	**39**	(1.7)	**2.36**	(0.16)	**16.5**	(1.4)
Canada	0.41	(0.02)	-0.75	(0.02)	0.16	(0.02)	0.79	(0.02)	1.44	(0.01)	486	(2.3)	509	(2.5)	529	(2.5)	558	(2.9)	**31**	(1.2)	**1.84**	(0.08)	**9.4**	(0.7)
Finland*	0.36	(0.02)	-0.68	(0.02)	0.13	(0.02)	0.73	(0.02)	1.28	(0.01)	488	(3.1)	509	(2.5)	529	(3.2)	555	(2.6)	**33**	(1.8)	**1.89**	(0.10)	**9.4**	(0.9)
United Arab Emirates	0.32	(0.02)	-0.82	(0.03)	0.19	(0.02)	0.67	(0.01)	1.26	(0.01)	391	(3.2)	427	(2.4)	454	(3.6)	466	(4.2)	**33**	(1.9)	**2.09**	(0.10)	**9.8**	(1.0)
Liechtenstein	0.30	(0.05)	-0.89	(0.08)	0.01	(0.06)	0.66	(0.07)	1.42	(0.06)	490	(9.4)	552	(11.4)	543	(12.0)	563	(11.5)	**28**	(5.8)	**2.44**	(0.46)	**7.6**	(3.1)
Northern Ireland	0.29	(0.02)	-0.76	(0.02)	-0.08	(0.03)	0.61	(0.04)	1.38	(0.02)	444	(4.6)	471	(5.4)	502	(4.6)	541	(5.4)	**45**	(3.0)	**2.17**	(0.17)	**16.7**	(1.9)
England	0.29	(0.02)	-0.76	(0.03)	0.02	(0.04)	0.62	(0.03)	1.27	(0.02)	460	(5.0)	478	(5.4)	511	(4.6)	546	(4.5)	**41**	(2.8)	**1.88**	(0.14)	**12.4**	(1.4)
Sweden*	0.28	(0.02)	-0.82	(0.02)	0.02	(0.02)	0.65	(0.02)	1.25	(0.01)	442	(2.9)	470	(3.9)	495	(3.4)	518	(3.9)	**36**	(1.9)	**1.94**	(0.11)	**10.6**	(1.1)
United Kingdom*	0.27	(0.02)	-0.78	(0.02)	0.00	(0.03)	0.61	(0.02)	1.26	(0.02)	458	(4.2)	477	(4.1)	508	(4.2)	545	(3.9)	**41**	(2.4)	**1.86**	(0.11)	**12.5**	(1.2)
Australia	0.25	(0.01)	-0.84	(0.02)	0.05	(0.02)	0.61	(0.01)	1.18	(0.01)	462	(2.2)	492	(2.0)	521	(2.9)	550	(2.6)	**42**	(1.3)	**2.12**	(0.09)	**12.3**	(0.8)
Netherlands*	0.23	(0.02)	-0.82	(0.03)	0.02	(0.03)	0.58	(0.02)	1.15	(0.02)	484	(5.2)	513	(3.9)	537	(4.8)	565	(5.1)	**40**	(3.1)	**1.99**	(0.14)	**11.5**	(1.7)
Germany*	0.19	(0.02)	-0.99	(0.03)	-0.16	(0.03)	0.52	(0.04)	1.42	(0.02)	467	(5.1)	502	(3.9)	540	(3.8)	569	(4.3)	**43**	(2.0)	**2.40**	(0.16)	**16.9**	(1.4)
Wales	0.19	(0.02)	-0.82	(0.02)	-0.12	(0.03)	0.50	(0.02)	1.19	(0.02)	436	(3.5)	461	(3.0)	473	(3.7)	512	(3.4)	**35**	(2.2)	**1.80**	(0.13)	**10.4**	(1.3)
United States	0.17	(0.04)	-1.14	(0.05)	-0.11	(0.04)	0.60	(0.04)	1.35	(0.04)	442	(3.9)	462	(4.5)	494	(5.4)	532	(4.7)	**35**	(1.7)	**2.05**	(0.16)	**14.8**	(1.3)
Switzerland	0.17	(0.02)	-1.00	(0.02)	-0.12	(0.03)	0.52	(0.03)	1.29	(0.02)	488	(4.0)	519	(4.0)	543	(3.9)	575	(4.6)	**38**	(1.8)	**2.07**	(0.12)	**12.8**	(1.2)
Israel	0.17	(0.03)	-0.98	(0.04)	-0.03	(0.04)	0.58	(0.03)	1.12	(0.02)	409	(5.3)	452	(5.5)	491	(6.3)	524	(5.6)	**51**	(2.6)	**2.49**	(0.18)	**17.2**	(1.5)
Belgium*	0.15	(0.02)	-1.05	(0.03)	-0.19	(0.03)	0.55	(0.02)	1.27	(0.02)	469	(4.0)	497	(3.2)	534	(2.9)	567	(2.9)	**43**	(1.9)	**2.21**	(0.12)	**15.0**	(1.3)
Scotland	0.13	(0.02)	-0.96	(0.02)	-0.18	(0.03)	0.49	(0.03)	1.18	(0.02)	463	(4.0)	487	(4.2)	504	(3.5)	546	(4.6)	**37**	(2.4)	**1.95**	(0.14)	**12.9**	(1.4)
Republic of Ireland*	0.13	(0.02)	-0.97	(0.02)	-0.19	(0.03)	0.48	(0.03)	1.20	(0.02)	462	(4.4)	489	(3.2)	512	(2.9)	545	(3.3)	**38**	(1.8)	**2.11**	(0.12)	**14.6**	(1.2)
*Estonia**	0.11	(0.01)	-0.92	(0.02)	-0.23	(0.02)	0.44	(0.02)	1.16	(0.01)	496	(3.0)	508	(3.2)	523	(3.6)	558	(2.9)	**29**	(1.7)	**1.62**	(0.11)	**8.6**	(0.9)
Cyprus	0.09	(0.01)	-1.06	(0.02)	-0.28	(0.01)	0.43	(0.02)	1.25	(0.02)	398	(2.5)	428	(2.6)	448	(2.8)	492	(2.8)	**38**	(1.6)	**2.01**	(0.14)	**14.1**	(1.1)
Austria*	0.08	(0.02)	-0.97	(0.03)	-0.25	(0.02)	0.33	(0.03)	1.19	(0.03)	458	(4.2)	495	(4.2)	519	(3.8)	552	(4.2)	**43**	(2.2)	**2.34**	(0.16)	**15.8**	(1.5)
Luxembourg*	0.07	(0.01)	-1.42	(0.02)	-0.26	(0.02)	0.57	(0.02)	1.41	(0.01)	438	(2.9)	470	(2.7)	508	(2.6)	546	(2.7)	**37**	(1.2)	**2.38**	(0.14)	**18.3**	(1.1)
Slovenia*	0.07	(0.01)	-1.03	(0.01)	-0.31	(0.02)	0.39	(0.02)	1.22	(0.02)	458	(2.6)	486	(3.1)	511	(3.1)	552	(3.2)	**42**	(1.5)	**2.04**	(0.12)	**15.6**	(1.0)
New Zealand	0.04	(0.02)	-1.05	(0.02)	-0.22	(0.03)	0.39	(0.02)	1.04	(0.02)	445	(3.2)	493	(4.0)	514	(4.0)	559	(3.6)	**52**	(1.9)	**2.61**	(0.19)	**18.4**	(1.3)
Korea	0.01	(0.03)	-0.97	(0.03)	-0.23	(0.03)	0.33	(0.03)	0.92	(0.02)	516	(4.9)	538	(4.8)	567	(6.3)	595	(6.6)	**42**	(3.3)	**1.77**	(0.11)	**10.1**	(1.4)
OECD average	0.00	(0.00)	-1.15	(0.00)	-0.32	(0.00)	0.34	(0.01)	1.15	(0.00)	452	(0.7)	482	(0.6)	506	(0.7)	542	(0.8)	**39**	(0.4)	**2.15**	(0.02)	**14.6**	(0.2)
France*	-0.04	(0.02)	-1.10	(0.02)	-0.30	(0.02)	0.29	(0.02)	0.95	(0.01)	442	(3.5)	476	(3.1)	511	(4.2)	561	(4.0)	**57**	(2.2)	**2.57**	(0.16)	**22.5**	(1.3)
Italy*	-0.05	(0.01)	-1.29	(0.01)	-0.41	(0.02)	0.25	(0.02)	1.24	(0.02)	447	(2.4)	475	(2.6)	498	(2.6)	522	(2.8)	**30**	(1.2)	**1.92**	(0.08)	**10.1**	(0.6)
Greece*	-0.06	(0.03)	-1.34	(0.03)	-0.46	(0.03)	0.32	(0.04)	1.22	(0.02)	413	(3.8)	439	(3.9)	459	(3.5)	502	(3.7)	**34**	(1.8)	**2.06**	(0.17)	**15.5**	(1.5)
Czech Republic*	-0.07	(0.02)	-0.98	(0.02)	-0.37	(0.02)	0.16	(0.02)	0.93	(0.02)	450	(4.4)	486	(4.5)	508	(4.3)	552	(4.0)	**51**	(2.7)	**2.27**	(0.18)	**16.2**	(1.5)
Japan	-0.07	(0.02)	-0.99	(0.02)	-0.35	(0.02)	0.20	(0.02)	0.85	(0.02)	500	(5.2)	528	(4.1)	551	(4.3)	575	(5.9)	**41**	(3.9)	**1.96**	(0.13)	**9.8**	(1.6)
Russian Federation	-0.11	(0.02)	-1.10	(0.03)	-0.37	(0.03)	0.22	(0.03)	0.82	(0.02)	445	(4.8)	468	(4.3)	496	(3.6)	521	(5.1)	**38**	(3.2)	**1.96**	(0.16)	**11.4**	(1.7)
*Lithuania**	-0.13	(0.02)	-1.34	(0.02)	-0.48	(0.03)	0.30	(0.03)	1.00	(0.02)	439	(3.7)	465	(3.6)	492	(4.2)	522	(3.5)	**36**	(1.8)	**2.16**	(0.12)	**13.8**	(1.2)
Slovak Republic*	-0.18	(0.03)	-1.25	(0.04)	-0.57	(0.02)	0.02	(0.04)	1.06	(0.03)	416	(6.6)	473	(3.8)	496	(4.4)	545	(6.2)	**54**	(2.9)	**2.99**	(0.22)	**24.6**	(2.1)
Spain*	-0.19	(0.03)	-1.50	(0.02)	-0.60	(0.03)	0.17	(0.03)	1.16	(0.03)	442	(2.8)	471	(2.4)	495	(2.8)	533	(2.5)	**34**	(1.1)	**2.20**	(0.11)	**15.8**	(1.0)
Poland*	-0.21	(0.03)	-1.22	(0.02)	-0.69	(0.02)	-0.01	(0.05)	1.08	(0.03)	473	(3.6)	501	(4.0)	526	(5.2)	571	(6.3)	**41**	(2.4)	**2.19**	(0.17)	**16.6**	(1.7)
Hungary*	-0.25	(0.03)	-1.46	(0.04)	-0.65	(0.03)	0.09	(0.04)	1.01	(0.03)	422	(4.8)	464	(3.7)	487	(4.6)	539	(6.6)	**47**	(2.8)	**2.74**	(0.22)	**23.1**	(2.3)
*Latvia**	-0.26	(0.03)	-1.39	(0.03)	-0.64	(0.04)	0.11	(0.04)	0.90	(0.02)	453	(4.4)	472	(3.4)	508	(4.7)	532	(4.7)	**35**	(2.1)	**2.07**	(0.18)	**14.7**	(1.7)
Singapore	-0.26	(0.01)	-1.46	(0.02)	-0.54	(0.02)	0.09	(0.02)	0.88	(0.02)	523	(2.9)	557	(3.1)	589	(3.1)	627	(2.8)	**44**	(1.4)	**2.17**	(0.12)	**14.4**	(0.9)
*Bulgaria**	-0.28	(0.04)	-1.59	(0.06)	-0.67	(0.03)	0.10	(0.04)	1.06	(0.03)	384	(5.1)	424	(4.1)	449	(6.1)	501	(5.9)	**42**	(2.7)	**2.52**	(0.18)	**22.3**	(2.3)
Serbia	-0.30	(0.02)	-1.37	(0.02)	-0.70	(0.03)	-0.05	(0.03)	0.95	(0.03)	416	(4.4)	436	(3.7)	450	(4.7)	495	(5.0)	**34**	(2.4)	**1.73**	(0.12)	**11.7**	(1.4)
Kazakhstan	-0.32	(0.02)	-1.31	(0.02)	-0.57	(0.03)	0.02	(0.03)	0.60	(0.02)	405	(4.0)	427	(3.5)	437	(3.7)	458	(5.2)	**27**	(2.8)	**1.81**	(0.16)	**8.0**	(1.7)
*Croatia**	-0.34	(0.02)	-1.35	(0.02)	-0.70	(0.02)	-0.14	(0.03)	0.84	(0.02)	438	(3.6)	459	(3.8)	472	(4.8)	517	(5.9)	**36**	(2.6)	**1.78**	(0.13)	**12.0**	(1.4)
Shanghai-China	-0.36	(0.04)	-1.63	(0.05)	-0.70	(0.04)	0.06	(0.04)	0.83	(0.03)	562	(6.3)	602	(4.7)	628	(3.8)	660	(5.3)	**41**	(2.7)	**2.21**	(0.15)	**15.1**	(1.9)
Chinese Taipei	-0.40	(0.02)	-1.47	(0.03)	-0.70	(0.03)	-0.11	(0.03)	0.68	(0.03)	497	(5.1)	546	(4.5)	572	(4.1)	626	(5.3)	**58**	(2.5)	**2.46**	(0.14)	**17.9**	(1.4)
*Romania**	-0.47	(0.04)	-1.58	(0.05)	-0.80	(0.03)	-0.26	(0.04)	0.76	(0.05)	407	(4.5)	428	(3.8)	444	(4.0)	501	(7.7)	**38**	(2.9)	**2.09**	(0.15)	**19.3**	(2.4)
Portugal*	-0.48	(0.05)	-1.85	(0.03)	-1.06	(0.04)	-0.23	(0.07)	1.21	(0.07)	441	(4.5)	474	(4.9)	495	(4.8)	548	(5.2)	**35**	(1.6)	**2.31**	(0.14)	**19.6**	(1.8)
Chile	-0.58	(0.04)	-1.97	(0.05)	-1.02	(0.04)	-0.27	(0.05)	0.95	(0.03)	378	(4.0)	409	(3.9)	429	(3.6)	477	(5.4)	**34**	(1.6)	**2.37**	(0.16)	**23.1**	(1.9)
Hong Kong-China	-0.79	(0.05)	-2.00	(0.03)	-1.20	(0.05)	-0.46	(0.07)	0.50	(0.06)	532	(4.8)	554	(3.8)	567	(4.5)	600	(5.8)	**27**	(2.6)	**1.70**	(0.12)	**7.5**	(1.5)
Macao-China	-0.89	(0.01)	-1.91	(0.01)	-1.23	(0.01)	-0.68	(0.01)	0.28	(0.02)	521	(2.6)	535	(2.5)	543	(2.3)	558	(2.5)	**17**	(1.5)	**1.36**	(0.07)	**2.6**	(0.4)
Mexico	-1.11	(0.02)	-2.66	(0.02)	-1.65	(0.03)	-0.74	(0.03)	0.61	(0.03)	385	(1.9)	407	(1.9)	417	(1.9)	447	(2.4)	**19**	(0.8)	**1.85**	(0.07)	**10.4**	(0.8)
Turkey	-1.46	(0.04)	-2.74	(0.03)	-1.96	(0.03)	-1.21	(0.05)	0.07	(0.06)	412	(4.5)	436	(4.2)	447	(6.0)	498	(8.3)	**32**	(2.4)	**1.84**	(0.11)	**14.5**	(1.8)
Vietnam	-1.81	(0.05)	-3.08	(0.03)	-2.27	(0.03)	-1.63	(0.05)	-0.26	(0.09)	473	(6.1)	499	(5.0)	519	(5.7)	555	(8.2)	**29**	(2.6)	**2.00**	(0.16)	**14.6**	(2.3)

14 countries with mathematics mean scores below 430 omitted
Note: Values that are statistically significant are indicated in bold
OECD countries (not italicised) *Countries not in OECD (italicised)* *EU countries

Appendix F

Notes on PISA International Scale Scores

PISA defines an international scale for each subject in such a way that, for each subject when it is first run as a major focus[5], the 'OECD population' has a Normal distribution with a mean of 500 and standard deviation of 100. This is illustrated in the 'bell-shaped' curve below.



How the OECD population is defined is rather complex:

1. The sample of pupils within each OECD country is selected;
2. Their results are weighted in such a way that each country in the study (i.e. UK as a whole, not England) has an equal weight;
3. Pupils' scores are adjusted to have the above distribution within this hypothetical population.

Thus the important unit is the country, not the student – Russia and Hong Kong have the same weights in the scale, despite differences in size.

PISA scores are thus defined on a scale which does not relate directly to any other test measure. In particular, there is no easy or valid way to relate them to 'months of progress' or any measure of individual development.

[5] This means that the mean of 500 for OECD countries relates to the year 2000 for Reading, 2003 for Mathematics and 2006 for Science.

Appendix G

G1 Significant differences in mean scores on problem solving

	Mean score		Significance
	Mean	S.E.	
Singapore	562	(1.2)	^
Korea	561	(4.3)	^
Japan	552	(3.1)	^
Macao-China	540	(1.0)	^
Hong Kong-China	540	(3.9)	^
Shanghai-China	536	(3.3)	^
Chinese Taipei	534	(2.9)	^
Canada	526	(2.4)	*NS*
Australia	523	(1.9)	*NS*
Finland*	523	(2.3)	*NS*
England	517	(4.2)	
Estonia*	515	(2.5)	*NS*
France*	511	(3.4)	*NS*
Netherlands*	511	(4.4)	*NS*
Italy*	510	(4.0)	*NS*
Czech Republic*	509	(3.1)	*NS*
Germany*	509	(3.6)	*NS*
United States	508	(3.9)	*NS*
Belgium*	508	(2.5)	*NS*
Austria*	506	(3.6)	*NS*
Norway	503	(3.3)	v
OECD average	**500**	**(0.7)**	v
Republic of Ireland*	498	(3.2)	v
Denmark*	497	(2.9)	v
Portugal*	494	(3.6)	v
Sweden*	491	(2.9)	v
Russian Federation	489	(3.4)	v
Slovak Republic*	483	(3.6)	v
Poland*	481	(4.4)	v
Spain*	477	(4.1)	v
Slovenia*	476	(1.5)	v
Serbia	473	(3.1)	v
*Croatia**	466	(3.9)	v
Hungary*	459	(4.0)	v
Turkey	454	(4.0)	v
Israel	454	(5.5)	v
Chile	448	(3.7)	v
Cyprus	445	(1.4)	v
*Bulgaria**	402	(5.1)	v

6 countries with scores below 430 omitted
Simple comparison P-value = 5%

Key

^ significantly higher

NS no significant difference

v significantly lower

OECD countries (not italicised)
Countries not in OECD (italicised)

*EU countries

G2 Mean score, variation and gender differences in student performance on problem solving

	All students				Gender differences						Percentiles												
	Mean score		Standard deviation		Boys		Girls		Difference (B - G)		5th		10th		25th		75th		90th		95th		Difference between 5th and 95th percentile
	Mean	S.E.	S.D.	S.E.	Mean score	S.E.	Mean score	S.E.	Score dif.	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	Score	S.E.	
Australia	523	(1.9)	97	(1.0)	524	(2.4)	522	(2.2)	2	(2.6)	358	(3.5)	396	(2.7)	459	(2.4)	591	(2.2)	646	(2.3)	677	(2.8)	320
Austria*	506	(3.6)	94	(2.9)	512	(4.4)	500	(4.1)	**12**	(4.8)	345	(8.7)	384	(6.8)	446	(4.6)	572	(3.7)	623	(4.4)	650	(4.9)	305
Belgium*	508	(2.5)	106	(1.8)	512	(3.1)	504	(3.1)	**8**	(3.7)	317	(6.8)	364	(4.8)	441	(3.4)	583	(2.6)	637	(2.5)	665	(3.3)	348
*Bulgaria**	402	(5.1)	107	(3.5)	394	(5.8)	410	(5.3)	**-17**	(4.9)	220	(10.2)	263	(8.6)	331	(6.1)	476	(5.3)	535	(7.1)	571	(7.6)	351
Canada	526	(2.4)	100	(1.7)	528	(2.8)	523	(2.5)	**5**	(2.2)	357	(4.3)	398	(3.8)	462	(3.1)	594	(2.8)	649	(3.3)	684	(4.4)	327
Chile	448	(3.7)	86	(1.7)	455	(4.5)	441	(3.7)	**13**	(3.8)	304	(5.7)	337	(5.5)	390	(4.8)	507	(3.5)	557	(4.2)	587	(4.0)	283
Chinese Taipei	534	(2.9)	91	(1.9)	540	(4.5)	528	(4.1)	12	(6.3)	377	(6.7)	414	(5.1)	475	(4.1)	601	(2.9)	646	(3.2)	674	(3.2)	297
*Croatia**	466	(3.9)	92	(2.0)	474	(4.8)	459	(4.0)	**15**	(4.4)	314	(5.6)	349	(4.9)	404	(4.0)	530	(4.6)	585	(5.1)	616	(6.2)	302
Cyprus	445	(1.4)	99	(1.0)	440	(1.8)	449	(2.0)	**-9**	(2.5)	278	(4.3)	315	(2.8)	378	(2.4)	513	(2.7)	571	(2.8)	604	(3.5)	326
Czech Republic*	509	(3.1)	95	(2.0)	513	(3.9)	505	(3.5)	8	(4.1)	344	(6.6)	384	(5.7)	447	(4.5)	575	(2.9)	626	(4.0)	656	(3.8)	312
Denmark*	497	(2.9)	92	(1.9)	502	(3.7)	492	(2.9)	**10**	(3.1)	339	(5.7)	377	(5.2)	438	(3.8)	560	(3.3)	611	(4.5)	641	(4.9)	302
England	517	(4.2)	97	(2.4)	520	(5.4)	514	(4.6)	6	(5.5)	352	(9.2)	391	(6.0)	455	(5.7)	584	(4.1)	636	(4.5)	667	(5.0)	315
Estonia*	515	(2.5)	88	(1.5)	517	(3.3)	513	(2.6)	5	(3.1)	368	(4.2)	400	(4.6)	458	(3.4)	576	(3.1)	626	(3.7)	654	(4.0)	287
Finland*	523	(2.3)	93	(1.2)	520	(2.8)	526	(2.6)	**-6**	(3.0)	364	(4.8)	401	(3.1)	462	(3.5)	587	(3.1)	640	(3.6)	671	(3.9)	307
France*	511	(3.4)	96	(4.1)	513	(4.0)	509	(3.5)	5	(3.1)	340	(10.5)	387	(6.8)	455	(4.1)	577	(3.5)	626	(3.8)	653	(4.8)	313
Germany*	509	(3.6)	99	(2.5)	512	(4.1)	505	(3.7)	**7**	(2.9)	335	(7.0)	377	(6.9)	444	(5.3)	579	(4.0)	629	(4.3)	659	(5.8)	324
Hong Kong-China	540	(3.9)	92	(2.2)	546	(4.6)	532	(4.8)	**13**	(5.2)	379	(6.7)	421	(6.7)	483	(5.6)	601	(3.7)	654	(4.1)	684	(4.9)	304
Hungary*	459	(4.0)	104	(2.7)	461	(5.0)	457	(4.3)	3	(4.8)	277	(8.4)	319	(8.8)	391	(6.1)	532	(5.4)	591	(5.5)	622	(5.8)	345
Israel	454	(5.5)	123	(3.2)	457	(8.9)	451	(4.1)	6	(8.5)	242	(10.6)	291	(7.8)	372	(6.2)	543	(6.2)	611	(6.7)	647	(7.5)	405
Italy*	510	(4.0)	91	(2.1)	518	(5.2)	500	(4.5)	**18**	(5.7)	356	(7.2)	394	(5.8)	451	(5.2)	572	(4.5)	621	(4.6)	649	(5.5)	293
Japan	552	(3.1)	85	(1.9)	561	(4.1)	542	(3.0)	**19**	(3.7)	405	(6.5)	441	(5.5)	498	(3.8)	610	(3.4)	658	(3.7)	685	(4.4)	280
Korea	561	(4.3)	91	(1.8)	567	(5.1)	554	(5.1)	**13**	(5.5)	406	(6.6)	443	(5.9)	505	(5.1)	625	(4.6)	672	(4.4)	698	(5.1)	292
Macao-China	540	(1.0)	79	(0.8)	546	(1.5)	535	(1.3)	**10**	(2.0)	405	(3.3)	437	(3.0)	488	(1.5)	595	(1.6)	640	(2.1)	664	(2.2)	259
Netherlands*	511	(4.4)	99	(3.0)	513	(4.9)	508	(4.5)	5	(3.3)	336	(8.6)	378	(8.5)	448	(5.9)	581	(4.8)	633	(4.8)	662	(5.1)	326
Norway	503	(3.3)	103	(1.9)	502	(3.6)	505	(3.8)	-3	(3.6)	328	(6.7)	370	(4.9)	436	(3.9)	574	(3.8)	633	(4.3)	665	(6.0)	337
Poland*	481	(4.4)	96	(3.4)	481	(4.9)	481	(4.6)	0	(3.3)	318	(8.9)	358	(6.3)	421	(5.4)	546	(4.6)	600	(4.8)	632	(6.0)	313
Portugal*	494	(3.6)	88	(1.6)	502	(4.0)	486	(3.6)	**16**	(2.6)	345	(5.5)	381	(4.3)	436	(4.2)	555	(3.7)	604	(4.2)	633	(5.4)	288
Republic of Ireland*	498	(3.2)	93	(2.0)	501	(4.8)	496	(3.2)	5	(5.0)	340	(6.5)	378	(5.0)	438	(4.0)	562	(3.5)	615	(3.8)	647	(4.6)	307
Russian Federation	489	(3.4)	88	(2.0)	493	(3.9)	485	(3.7)	**8**	(3.1)	345	(4.7)	377	(4.8)	431	(4.0)	547	(4.1)	602	(6.1)	635	(5.9)	290
Serbia	473	(3.1)	89	(1.9)	481	(3.8)	466	(3.2)	**15**	(3.5)	322	(6.4)	357	(6.1)	414	(4.3)	535	(3.4)	586	(3.4)	616	(3.4)	294
Shanghai-China	536	(3.3)	90	(2.2)	549	(3.4)	524	(3.8)	**25**	(2.9)	381	(7.0)	419	(5.7)	479	(3.9)	599	(3.9)	648	(4.7)	676	(4.9)	295
Singapore	562	(1.2)	95	(1.0)	567	(1.8)	558	(1.7)	**9**	(2.5)	398	(3.0)	436	(2.9)	500	(2.0)	629	(1.9)	681	(2.1)	710	(3.4)	312
Slovak Republic*	483	(3.6)	98	(2.7)	494	(4.2)	472	(4.1)	**22**	(4.4)	314	(7.1)	354	(6.2)	420	(4.8)	550	(4.2)	606	(5.2)	639	(6.9)	324
Slovenia*	476	(1.5)	97	(1.3)	474	(2.1)	478	(2.2)	-4	(3.0)	310	(5.4)	350	(3.8)	413	(3.0)	545	(2.3)	599	(2.8)	628	(3.7)	318
Spain*	477	(4.1)	104	(2.9)	478	(4.8)	476	(4.1)	2	(3.4)	292	(10.4)	338	(7.8)	411	(5.3)	549	(3.9)	605	(4.3)	638	(5.0)	346
Sweden*	491	(2.9)	96	(1.8)	489	(3.7)	493	(3.1)	-4	(3.6)	328	(7.6)	365	(4.0)	428	(3.7)	557	(2.9)	612	(3.7)	643	(4.4)	316
Turkey	454	(4.0)	79	(2.2)	462	(4.3)	447	(4.6)	**15**	(4.0)	328	(4.5)	354	(4.3)	399	(4.0)	508	(5.7)	560	(6.8)	590	(8.0)	262
United States	508	(3.9)	93	(2.3)	509	(4.2)	506	(4.2)	3	(3.1)	352	(7.1)	388	(6.0)	446	(4.9)	571	(4.1)	626	(4.4)	658	(5.3)	306
OECD average	500	(0.7)	96	(0.4)	503	(0.8)	497	(0.7)	**7**	(0.8)	336	(1.4)	375	(1.1)	438	(0.9)	567	(0.7)	620	(0.8)	650	(1.0)	314

6 countries with scores below 430 omitted

Note: Values that are statistically significant are indicated in bold.
OECD countries (not italicised)

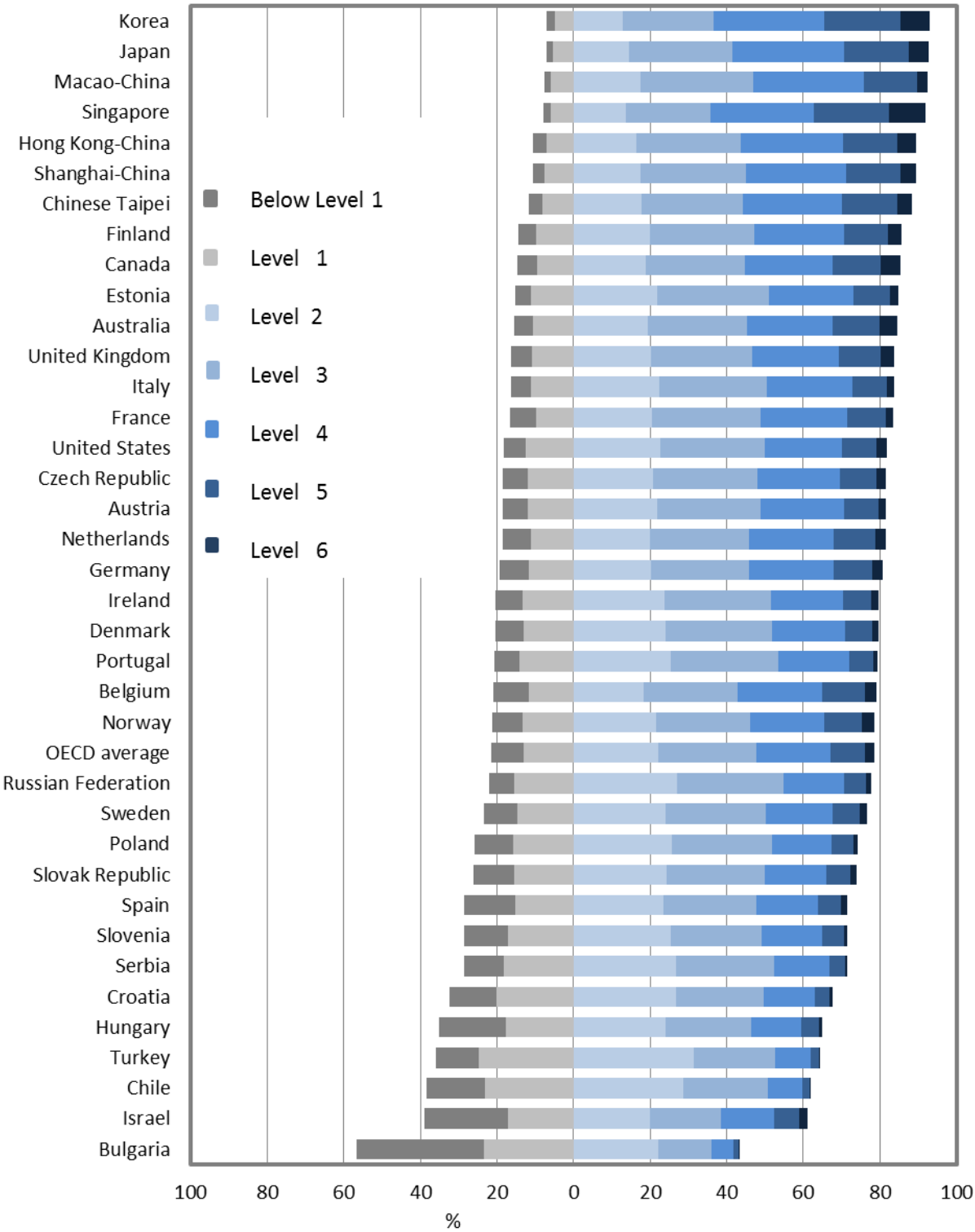
Countries not in OECD (italicised)

*EU countries

G3 Summary descriptions for the seven levels of proficiency in problem solving

Level	Characteristics of tasks
6	At Level 6, students can develop complete, coherent mental models of diverse problem scenarios, enabling them to solve complex problems efficiently. They can explore a scenario in a highly strategic manner to understand all information pertaining to the problem. The information may be presented in different formats, requiring interpretation and integration of related parts. When confronted with very complex devices, such as home appliances that work in an unusual or unexpected manner, they quickly learn how to control the devices to achieve a goal in an optimal way. Level 6 problem-solvers can set up general hypotheses about a system and thoroughly test them. They can follow a premise through to a logical conclusion or recognise when there is not enough information available to reach one. In order to reach a solution, these highly proficient problem-solvers can create complex, flexible, multi-step plans that they continually monitor during execution. Where necessary, they modify their strategies, taking all constraints into account, both explicit and implicit.
5	At Level 5, students can systematically explore a complex problem scenario to gain an understanding of how relevant information is structured. When faced with unfamiliar, moderately complex devices, such as vending machines or home appliances, they respond quickly to feedback in order to control the device. In order to reach a solution, Level 5 problem-solvers think ahead to find the best strategy that addresses all the given constraints. They can immediately adjust their plans or backtrack when they detect unexpected difficulties or when they make mistakes that take them off course.
4	At Level 4, students can explore a moderately complex problem scenario in a focused way. They grasp the links among the components of the scenario that are required to solve the problem. They can control moderately complex digital devices, such as unfamiliar vending machines or home appliances, but they don't always do so efficiently. These students can plan a few steps ahead and monitor the progress of their plans. They are usually able to adjust these plans or reformulate a goal in light of feedback. They can systematically try out different possibilities and check whether multiple conditions have been satisfied. They can form an hypothesis about why a system is malfunctioning, and describe how to test it.
3	At Level 3, students can handle information presented in several different formats. They can explore a problem scenario and infer simple relationships among its components. They can control simple digital devices, but have trouble with more complex devices. Problem-solvers at Level 3 can fully deal with one condition, for example, by generating several solutions and checking to see whether these satisfy the condition. When there are multiple conditions or inter-related features, they can hold one variable constant to see the effect of change on the other variables. They can devise and execute tests to confirm or refute a given hypothesis. They understand the need to plan ahead and monitor progress, and are able to try a different option if necessary.
2	At Level 2, students can explore an unfamiliar problem scenario and understand a small part of it. They try, but only partially succeed, to understand and control digital devices with unfamiliar controls, such as home appliances and vending machines. Level 2 problem-solvers can test a simple hypothesis that is given to them and can solve a problem that has a single, specific constraint. They can plan and carry out one step at a time to achieve a sub-goal, and have some capacity to monitor overall progress towards a solution.
1	At Level 1, students can explore a problem scenario only in a limited way, but tend to do so only when they have encountered very similar situations before. Based on their observations of familiar scenarios, these students are able only to partially describe the behaviour of a simple, everyday device. In general, students at Level 1 can solve straightforward problems provided there is only a simple condition to be satisfied and there are only one or two steps to be performed to reach the goal. Level 1 students tend not to be able to plan ahead or set sub-goals.

G4 Summary of percentage of students at each level of problem solving proficiency



6 countries with scores below 430 omitted

Countries are ranked in descending order of the percentage of students at Levels 2, 3, 4, 5 and 6.

Source: OECD, PISA 2012 database, Table V.2.1

G5 Percentage of students at each level of proficiency in problem solving

	All students													
	Below Level 1		Level 1		Level 2		Level 3		Level 4		Level 5		Level 6	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.	%	S.E.
Australia	5.0	(0.3)	10.5	(0.5)	19.4	(0.5)	25.8	(0.7)	22.6	(0.5)	12.3	(0.5)	4.4	(0.3)
Austria*	6.5	(0.9)	11.9	(0.8)	21.8	(1.1)	26.9	(1.2)	21.9	(1.0)	9.0	(0.8)	2.0	(0.4)
Belgium*	9.2	(0.6)	11.6	(0.6)	18.3	(0.7)	24.5	(0.6)	22.0	(0.7)	11.4	(0.7)	3.0	(0.3)
*Bulgaria**	33.3	(1.9)	23.3	(1.1)	22.1	(1.0)	14.1	(0.8)	5.6	(0.7)	1.4	(0.3)	0.2	(0.1)
Canada	5.1	(0.4)	9.6	(0.4)	19.0	(0.6)	25.8	(0.7)	22.9	(0.6)	12.4	(0.6)	5.1	(0.4)
Chile	15.1	(1.3)	23.1	(1.1)	28.6	(1.0)	22.2	(1.0)	8.8	(0.7)	1.9	(0.3)	0.2	(0.1)
Chinese Taipei	3.4	(0.6)	8.2	(0.6)	17.8	(0.8)	26.3	(1.0)	25.9	(1.0)	14.6	(0.7)	3.8	(0.4)
*Croatia**	12.0	(1.0)	20.2	(1.0)	26.8	(1.2)	22.9	(1.1)	13.2	(1.1)	4.0	(0.6)	0.8	(0.2)
Cyprus	19.6	(0.6)	20.9	(0.6)	25.5	(0.8)	20.4	(0.9)	10.1	(0.6)	3.0	(0.3)	0.5	(0.2)
Czech Republic*	6.5	(0.7)	11.9	(0.9)	20.7	(1.0)	27.2	(0.9)	21.8	(0.9)	9.5	(0.7)	2.4	(0.3)
Denmark*	7.3	(0.7)	13.1	(0.7)	24.1	(0.8)	27.8	(0.9)	19.0	(1.1)	7.2	(0.7)	1.6	(0.3)
England	5.5	(0.8)	10.8	(0.8)	20.2	(1.3)	26.5	(0.9)	22.7	(1.1)	10.9	(0.8)	3.3	(0.6)
Estonia*	4.0	(0.5)	11.1	(0.8)	21.8	(0.7)	29.2	(1.0)	22.2	(0.8)	9.5	(0.7)	2.2	(0.3)
Finland*	4.5	(0.4)	9.9	(0.5)	20.0	(0.9)	27.1	(1.1)	23.5	(0.8)	11.4	(0.6)	3.6	(0.5)
France*	6.6	(0.9)	9.8	(0.7)	20.5	(1.0)	28.4	(1.1)	22.6	(0.9)	9.9	(0.7)	2.1	(0.3)
Germany*	7.5	(0.8)	11.8	(0.9)	20.3	(0.9)	25.6	(1.0)	22.0	(1.0)	10.1	(1.0)	2.7	(0.4)
Hong Kong-China	3.3	(0.5)	7.1	(0.7)	16.3	(1.0)	27.4	(1.4)	26.5	(1.0)	14.2	(1.1)	5.1	(0.6)
Hungary*	17.2	(1.3)	17.8	(0.9)	23.9	(1.2)	22.4	(0.9)	13.0	(1.0)	4.6	(0.7)	1.0	(0.2)
Israel	21.9	(1.4)	17.0	(0.9)	20.1	(0.8)	18.5	(0.9)	13.7	(0.9)	6.7	(0.8)	2.1	(0.4)
Italy*	5.2	(0.7)	11.2	(1.1)	22.5	(1.0)	28.0	(1.1)	22.3	(1.1)	8.9	(0.9)	1.8	(0.3)
Japan	1.8	(0.4)	5.3	(0.6)	14.6	(0.9)	26.9	(1.1)	29.2	(1.0)	16.9	(1.0)	5.3	(0.7)
Korea	2.1	(0.3)	4.8	(0.6)	12.9	(0.9)	23.7	(1.0)	28.8	(0.9)	20.0	(1.2)	7.6	(0.9)
Macao-China	1.6	(0.2)	6.0	(0.4)	17.5	(0.6)	29.5	(0.8)	28.9	(0.9)	13.8	(0.6)	2.8	(0.3)
Netherlands*	7.4	(1.0)	11.2	(1.0)	19.9	(1.2)	26.0	(1.3)	22.0	(1.2)	10.9	(1.0)	2.7	(0.5)
Norway	8.1	(0.7)	13.2	(0.7)	21.5	(0.9)	24.7	(0.8)	19.4	(0.8)	9.7	(0.7)	3.4	(0.4)
Poland*	10.0	(1.1)	15.7	(1.0)	25.7	(0.9)	26.0	(1.0)	15.7	(1.0)	5.8	(0.7)	1.1	(0.2)
Portugal*	6.5	(0.6)	14.1	(1.0)	25.5	(0.9)	28.1	(1.0)	18.4	(0.9)	6.2	(0.6)	1.2	(0.3)
Republic of Ireland*	7.0	(0.8)	13.3	(0.9)	23.8	(0.8)	27.8	(0.9)	18.8	(0.8)	7.3	(0.6)	2.1	(0.3)
Russian Federation	6.8	(0.7)	15.4	(1.1)	27.0	(0.9)	27.9	(1.2)	15.7	(0.9)	5.9	(0.7)	1.4	(0.3)
Serbia	10.3	(1.0)	18.3	(0.8)	26.7	(1.4)	25.8	(1.1)	14.3	(0.8)	4.1	(0.4)	0.6	(0.2)
Shanghai-China	3.1	(0.5)	7.5	(0.6)	17.5	(0.8)	27.4	(1.1)	26.2	(1.0)	14.1	(0.9)	4.1	(0.6)
Singapore	2.0	(0.2)	6.0	(0.4)	13.8	(0.6)	21.9	(0.7)	27.0	(1.0)	19.7	(0.7)	9.6	(0.4)
Slovak Republic*	10.7	(1.1)	15.4	(1.1)	24.3	(1.0)	25.6	(1.3)	16.2	(1.2)	6.3	(0.6)	1.6	(0.5)
Slovenia*	11.4	(0.6)	17.1	(1.0)	25.4	(1.2)	23.7	(0.8)	15.8	(0.8)	5.8	(0.5)	0.9	(0.2)
Spain*	13.1	(1.2)	15.3	(0.8)	23.6	(0.9)	24.2	(1.0)	15.9	(0.8)	6.2	(0.6)	1.6	(0.3)
Sweden*	8.8	(0.7)	14.6	(0.8)	23.9	(0.9)	26.3	(0.8)	17.6	(0.7)	7.0	(0.5)	1.8	(0.3)
Turkey	11.0	(1.1)	24.8	(1.3)	31.4	(1.4)	21.2	(1.2)	9.4	(1.1)	2.0	(0.5)	0.2	(0.1)
United States	5.7	(0.8)	12.5	(0.9)	22.8	(1.0)	27.0	(1.0)	20.4	(0.9)	8.9	(0.7)	2.7	(0.5)
OECD average	8.2	(0.2)	13.2	(0.2)	22.0	(0.2)	25.6	(0.2)	19.6	(0.2)	8.9	(0.1)	2.5	(0.1)

6 countries with scores below 430 omitted
OECD countries (not italicised)
Countries not in OECD (italicised)
*EU countries

G6 Example of a PISA 2012 problem solving question

MP3 PLAYER

A friend gives you an MP3 player that you can use for playing and storing music. You can change the type of music, and increase or decrease the volume and the bass level by clicking the three buttons on the player.
(▶, ◉, ◀)

Click RESET to return the player to its original state.

The nature of this task is *interactive*, because pupils need to try the buttons and observe the changes in order to find out how the MP3 player works.

Question 1: MP3 PLAYER *CP043Q03*

The bottom row of the MP3 player shows the settings that you have chosen. Decide whether each of the following statements about the MP3 player is true or false. Select "True" or "False" for each statement to show your answer.

Statement	True	False
You need to use the middle button (◉) to change the type of music.	○	○
You have to set the volume before you can set the bass level.	○	○
Once you have increased the volume, you can only decrease it if you change the type of music you are listening to.	○	○

The problem solving process for Question 1 is exploring and understanding: pupils must use the onscreen MP3 to find out how it works in order to say which statements are true or false.

Question 2: MP3 PLAYER *CP043Q02*

Set the MP3 player to Rock, Volume 4, Bass 2.

Do this using as few clicks as possible. There is no RESET button.

Question 2 is classified as a planning and executing task. They must plan how to set the MP3 player and then do so in the most efficient way.

Question 3: MP3 PLAYER *CP043Q01*

Shown below are four pictures of the MP3 player's screen. Three of the screens cannot happen if the MP3 player is working properly. The remaining screen shows the MP3 player when it is working properly.

Which screen shows the MP3 player working properly?

Question 3 involves representing and formulating - pupils have to form a mental representation of the way the MP3 player works in order to select the correct answer.

Question 4: MP3 PLAYER *CP043Q04*

Describe how you could change the way the MP3 player works so that there is no need to have the bottom button ( ). You must still be able to change the type of music, and increase or decrease the volume and the bass level.

Question 4 is classified as a monitoring and reflecting item for which pupils must reconceptualise the way that the MP3 player works.

For further examples of problem solving items, see Figures V.1.4 to V.1.23 in Chapter 1 of Volume V of the international report. (OECD, 2014)

Department for Education

© 2014 National Foundation for Educational Research

Ref: DFE- RR307

ISBN: 978-1-78105-282-2

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