

# 1 Executive summary

## 1.1 The 2007 TIMSS survey

The 2007 Trends in International Mathematics and Science Study, TIMSS 2007, is the fourth in a series of comparative international surveys of mathematics and science achievement. TIMSS is administered on a four-yearly cycle, so the 2007 survey updates the picture of performance from 2003. England has participated in all of the TIMSS studies, so comparisons with all of the earlier ones can be made where appropriate. The 2007 study was similar in structure to that in 2003, with two grades tested: grade 4 pupils (year 5 in England) and grade 8 pupils (year 9 in England). TIMSS 2007 involved approximately 425,000 pupils in 59 countries around the world. England met the stringent sampling standards for both pupils and schools in both grades. Some 143 primary schools and 137 secondary schools participated.

## 1.2 England's overall performance in the 2007 TIMSS survey

### Grade 4 science (year 5)

- England's score, 542, was one of the highest, and is statistically significantly higher than the TIMSS scale average of 500.
- Only three countries, Singapore (587), Chinese Taipei (557), and Hong Kong (554) had scores that were statistically significantly higher than England's.
- Seven other countries, Japan (548), the Russian Federation, Latvia, the United States, Hungary, Italy and Kazakhstan (533), performed at a similar level to England.
- England outscored all other countries including Germany, Australia, Austria, Sweden, New Zealand and Scotland.
- England's high level of performance in 2003 was maintained: the 2007 score of 542 was similar to the 540 achieved in 2003. Performance in 2003 was higher than in the earlier 1995 survey (528)
- In summary, England's performance in science at year 5 remains amongst the best in the world.

### Grade 4 mathematics (year 5)

- England's score, 541, was again very high, and significantly higher than in 2003.
- Only four countries outscored England: Hong Kong (607), Singapore (599), Chinese Taipei (576), and Japan (568).
- There is a larger gap between England and the highest scoring Pacific Rim countries in grade 4 mathematics than in grade 4 science.

#### Erratum

Due to a labelling error in the international dataset, all findings related to the cognitive domains of 'Knowing' and 'Applying' have been inadvertently reversed in the national report for England. Findings reported as 'Knowing' actually relate to the 'Applying' domain, and findings reported as 'Applying' actually relate to the 'Knowing' domain. This applies to chapters 1, 5 and 6 of the national report and to the separate executive summary booklet.

- Four countries produced scores not significantly different from England's: Kazakhstan (549), the Russian Federation, Latvia and the Netherlands (535).
- Countries outperformed by England included the United States, Germany, Denmark, Italy, Sweden, Scotland, Australia and New Zealand.
- England improved on its level of performance in 2003: the 2007 score of 541 was 10 points higher than the 531 achieved in 2003. This was continued improvement as the 2003 score was much higher than in the earlier 1995 survey (484).
- As in science, England's performance in mathematics at year 5 is amongst the best in the world and continues to improve.

### **Grade 8 science (year 9)**

- England's score for grade 8 science, 542, was again one of the highest.
- Four countries, Singapore (567), Chinese Taipei (561), Japan (554) and Korea (553) outperformed England.
- Four countries, Hungary (539), the Czech Republic, Slovenia and Hong Kong (530) performed at a similar level to England.
- Countries outperformed by England included the Russian Federation, the United States, Italy, Sweden, Scotland and Australia.
- England maintained the high standard set in 2003 but did not improve on it. The scores for the two surveys, 542 in 2007 and 544 in 2003 were very similar.
- As at year 5 science, England's performance at year 9 was amongst the best in the world.

### **Grade 8 mathematics (year 9)**

- In grade 8 mathematics England's score, 513, was high enough for only five countries to have significantly higher levels of performance.
- The countries that outscored England, all from the Pacific Rim, were Chinese Taipei (598), Korea (597), Singapore (593), Hong Kong (572) and Japan (570).
- England performed similarly to Hungary (517), the Russian Federation, the United States, Lithuania and the Czech Republic (504).
- The differences in scores between England's group and the top five countries is much larger in grade 8 mathematics than in science or grade 4 mathematics: 57 scale points behind Japan and 85 points lower than Chinese Taipei.
- Countries outscored by England included Australia, Sweden, Scotland, Italy and Norway.
- England's performance level has improved from that shown in 2003. The 2007 score, 513, was significantly higher than the 2003 score of 498, a 15 point increase.

## Summary of overall performance

- The only countries to outscore England in any of the four assessments were Asian Pacific Rim countries.
- No European country outperformed England in any of the four assessments, and nor did the United States or Australia.
- England's performance in both grades and subjects was very strong.
- In mathematics England's scores have improved in both grades, a continued increase at grade 4 and the first upward trend at grade 8.
- In science the previous high standard has been maintained at both grades.

Exhibit 1.1, below, shows England's overall position in all four assessments compared with that of other participants.

**Exhibit 1.1** Summary of England's standing in TIMSS 2007

TIMSS 2007	Grade 4 <i>Total 36 countries</i>		Grade 8 <i>Total 49 countries</i>			
	Science	Mathematics	Science	Mathematics	Scale Score	Scale Score
	Scale Score	Scale Score	Scale Score	Scale Score	Scale Score	Scale Score
<b>HIGHER Countries performing at a significantly higher level than England</b>	<b>3 countries</b>	<b>4 countries</b>	<b>4 countries</b>	<b>5 countries</b>		
	Singapore 587	Hong Kong 607	Singapore 567	Chinese Taipei 598		
	Chinese Taipei 557	Singapore 599	Chinese Taipei 561	Korea 597		
	Hong Kong 554	Chinese Taipei 576	Japan 554	Singapore 593		
		Japan 568	Korea 553	Hong Kong 572		
				Japan 570		
<b>SIMILAR Countries performing at a similar level to England</b>	<b>8 countries</b>	<b>5 countries</b>	<b>5 countries</b>	<b>6 countries</b>		
	Japan 548					
	Russian Federation 546	Kazakhstan 549				
	Latvia 542	Russian Federation 544				
	<b>England 542</b>	<b>England 541</b>	<b>England 542</b>	<b>England 513</b>		
	United States 539	Latvia 537	Hungary 539	Russian Federation 512		
	Hungary 536	Netherlands 535	Czech Republic 539	United States 508		
	Italy 535		Slovenia 538	Lithuania 506		
	Kazakhstan 533		Hong Kong 530	Czech Republic 504		
<b>LOWER Countries performing at a significantly lower level than England</b>	<b>25 countries</b>	<b>27 countries</b>	<b>40 countries</b>	<b>38 countries</b>		
	<i>Including ...</i>	<i>Including ...</i>	<i>Including ...</i>	<i>Including ...</i>		
	Germany 528	United States 529	Russian Federation 530	Australia 496		
	Australia 527	Germany 525	United States 520	Sweden 491		
	Austria 526	Denmark 523	Australia 515	Scotland 487		
	Sweden 525	Australia 516	Sweden 511	Italy 480		
	New Zealand 504	Italy 507	Scotland 496	Norway 469		
	Scotland 500	Sweden 503	Italy 495			
		Scotland 494				
		New Zealand 492				

## 1.3 England's performance at the international benchmarks

The international benchmarks are score levels which can be used to compare country performance at different attainment levels. The benchmark scores are

625	for the advanced benchmark
550	for the high benchmark
475	for the intermediate
400	for the low benchmark

These can be compared to the scale average of 500. A score of 625, advanced benchmark, represents a very high level of performance. England's performance at these bench marks can be summarised as:

### Grade 4 science (year 5)

- |                    |                |                        |               |
|--------------------|----------------|------------------------|---------------|
| Advanced Benchmark | High Benchmark | Intermediate Benchmark | Low Benchmark |
| 14%                | 48%            | 81%                    | 95%           |
- England's distribution was close to that of other countries with similar overall scores to England, such as Hungary, Japan and the United States.
  - The proportions reaching each benchmark were similar to those in 2003, reflecting England's similar overall scores in the two surveys.

### Grade 4 mathematics (year 5)

- |                    |                |                        |               |
|--------------------|----------------|------------------------|---------------|
| Advanced Benchmark | High Benchmark | Intermediate Benchmark | Low Benchmark |
| 16%                | 48%            | 79%                    | 94%           |
- England's distribution was close to that of several other countries with similar overall scores to England, such as the Russian Federation, but ahead of the Netherlands and Latvia at the advanced and high benchmarks.
  - The proportions reaching each benchmark in grade 4 mathematics and grade 4 science were very similar, as were England's overall scores.
  - England's overall rise in score was reflected by increases in the proportions of pupils reaching the high and intermediate benchmarks but not the advanced benchmark. The improved performance was mainly from middle attainers.

### Grade 8 science (year 9)

- |                    |                |                        |               |
|--------------------|----------------|------------------------|---------------|
| Advanced Benchmark | High Benchmark | Intermediate Benchmark | Low Benchmark |
| 17%                | 48%            | 79%                    | 94%           |

- The proportion of pupils in England at the advanced benchmark was the equal of that of Japan and Korea, countries which outscored England overall. These two countries, however, had higher proportions than England at the other benchmarks.
- Compared with other countries with similar overall scores, the tendency was for England to do rather better at the advanced and high benchmarks, but not as well at the intermediate and low benchmarks.
- The proportions reaching each benchmark in grade 8 science were similar to both grade 4 science and grade 4 mathematics, reflecting England's similar overall scores of 541 or 542 in these three assessments.
- The proportions reaching each benchmark were similar to those in 2003, as suggested by England's similar overall scores in the two surveys.

### Grade 8 Mathematics (year 9)

- |                      |                |                        |               |
|----------------------|----------------|------------------------|---------------|
| • Advanced Benchmark | High Benchmark | Intermediate Benchmark | Low Benchmark |
| 8%                   | 35%            | 69%                    | 90%           |
- The proportions of pupils reaching the four benchmarks were lower than for science and for grade 4 mathematics, reflected in England's overall score of 513 as opposed to 541/2 elsewhere.
  - The proportions of pupils at the benchmarks were close to that of other countries with similar overall scores to England, for example Hungary, the United States and the Russian Federation.
  - England's overall rise in score was reflected by increases in the proportions of pupils reaching the high and intermediate benchmarks but not the advanced benchmark. As in grade 4 mathematics, the improved performance was mainly from middle attainers.

### Summary of performance at the international benchmarks

- The proportion of pupils reaching each international benchmark in England was usually very close to that of countries performing at a similar level overall, but behind that of the high scoring Pacific Rim countries.
- The proportion of pupils reaching each international benchmark in England was very similar for grade 4 mathematics and science and for grade 8 science, around 15 per cent for the advanced benchmark, 48 per cent for high, 80 per cent for intermediate and 94 per cent for low. This reflected England's very close overall scores in these three assessments. The proportions in grade 8 mathematics were lower, matching the lower overall score for this assessment.
- The improvement in performance in mathematics at both grades was accompanied by higher numbers of pupils reaching the high and intermediate benchmarks, but not the advanced benchmark. The improved overall performance was associated most strongly by improvement in the middle score range.

## 1.4 England's performance in the content and cognitive domains

In TIMSS 2007 items were designed to address different content areas of the TIMSS assessment framework, which vary by grade and subject. Items were also designed to make different cognitive demands on pupils - assessing knowing, applying or reasoning. These cognitive categories were the same for both grades and subjects.

England's performance in the separate areas was compared to England's mean score across the areas, in order to identify which were relative strengths or weaknesses in each case. A relative weakness in one area does not necessarily imply that performance in that area was low: it might still be well above the scale average of 500. This was so for England, in all but one case.

### Grade 4 science (year 5)

- England's performance was strong in all content areas but was best in physical science, (physics and chemistry), 543, and this was ahead of that in life science (biology), 532. England's score in earth science was 538.
- The scores for knowing, applying and reasoning were quite similar, between 536 and 543.

### Grade 4 mathematics (year 5)

- England's performance was strong in all content areas but was best in data display (547) and geometric shapes and measures (548). Performance in number was significantly lower, at 531, indicating a relative weakness in, for example, computation.
- The scores for knowing, applying and reasoning were again quite similar, between 537 and 544.

### Grade 8 science (year 9)

- England's general performance was very high, but particular strengths were physics (545) and biology (541). The lowest performance was earth science (529). The score for chemistry was 534, lower than for physics.
- In the cognitive domains England scored at a high level in each one, but better in reasoning (547) than in knowing (538) and applying (530), a pattern not seen at grade 4.

### Grade 8 mathematics (year 9)

- In grade 8 mathematics England showed a sharp profile of differences in the content areas. The score for data and chance, 547, was much higher than for number and geometry, both 510. Performance was weakest in algebra (492).
- In the cognitive domains England produced higher scores in reasoning (518) and knowing (514) than in applying (503). Better performance in items classified as testing reasoning than in those testing applying was also apparent at grade 8 science.

## Summary of performance in the content and cognitive domains

Within England's high level of performance, relative strengths and weaknesses were:

- In grade 4 science England's performance in the different content areas was reasonably consistent, but at grade 8 greater differences were evident, pupils scoring highest in physics and lowest in earth science.
- Differences in mathematics content areas were more marked. In grade 4 the score for number was significantly lower than that for geometric shapes and measures or for data display. At grade 8, data display was England's real strength and algebra a large weakness.
- In the cognitive domains performance at grade 4 was reasonably consistent. In grade 8 science items assessing reasoning were England's strong point while in grade 8 mathematics scores for applying were lower than those for knowing and reasoning.
- Countries outscoring England overall showed varied profiles across both the content and cognitive domains in both subjects and grades. No one pattern of performance was associated with higher score levels than that of England.
- Similarly, countries scoring at a similar level to England displayed a range of different relative strengths and weaknesses in both the content and cognitive domains.

## 1.5 Gender differences

As well as looking at overall performance international studies such as TIMSS also allow us to look at patterns of performance by gender, and to compare these with those found in other countries.

### At subject level

- England was one of only seven of the 26 countries which tested both grades to show no overall gender differences in mathematics or science at either grade. Japan, Chinese Taipei and Hong Kong, all high scoring Asian Pacific Rim countries, also shared this pattern.
- At grade 4 all but one of our Western European neighbours that participated in TIMSS 2007 showed at least one overall gender difference. These included Scotland, Germany, Austria, Italy and the Netherlands.
- At grade 8 a number of developed countries showed at least one overall gender difference. These included the United States, Italy, Korea, Australia, and Singapore.

### Below subject level

- Below subject level (for example, in different content areas) gender differences were unusual in England but some were found. None of these differences was large enough to lead to an overall difference at subject level. The only differences found are summarised below.
- In grade 4 science girls outscored boys on life science while the reverse was true for earth science. Girls also outscored boys on items addressing reasoning.

- In grade 4 mathematics, girls outscored boys on items assessing geometric shapes and measures.
- In grade 8 science boys outperformed girls in physics and earth science. Boys also outscored girls on items assessing knowing and applying, but not reasoning.
- In grade 8 mathematics boys outperformed girls in number.

### Trends over time

- In grade 4 science there were no changes over time by gender, matching the overall lack of change over this period.
- In grade 4 mathematics girls improved their performance from 2003 to 2007, building on their gain from 1995 to 2003. Boys consolidated their gain from 1995 to 2003.
- In grade 8 science there was no change over time by gender, matching the overall lack of trend over this period.
- In grade 8 mathematics boys improved their performance from 2003 to 2007, building on their gain from 1995 to 2003. Girls consolidated their gains from 1995 and 1999 to 2003.

### Gender differences in TIMSS compared with those from other sources

- The lack of overall gender differences in mathematics and science in TIMSS 2007 is broadly in line with what is currently found in other national assessments.
- The overall gender differences in favour of boys found in the 2006 PISA assessment of scientific literacy in 15 year olds were not found in TIMSS, possibly because of differences in focus between the two assessments.

### Summary of gender differences

- England was relatively unusual in showing no overall gender differences for mathematics and science in either grade.
- Girls improved their performance in grade 4 mathematics, while at grade 8 the boys improved on previous mathematics performance.

## 1.6 Attitudes

International Surveys also provide rich information on how pupils view different subjects and aspects of the schools they attend. Further, they allow the relationships between attitudes and performance to be investigated. It should be noted that highly positive attitudes are often a feature of developing countries.

### Grade 4 science (year 5)

- Fifty-nine per cent of pupils had highly positive attitudes to science, fewer than in countries scoring at a higher level than England or at a similar level.

- The percentage of pupils with highly positive attitudes has fallen by 13 percentage points since the last comparable data, in 1995. Another high scoring country, Singapore, has also seen such a decline.
- Fifty-five per cent of pupils had a high level of self-confidence in learning science. This was comparable to, or higher than, other high scoring countries.
- Significantly more boys than girls showed a high level of confidence in learning science, although there were no differences in attainment.
- The level of high self-confidence in England has not changed since 2003 or the earlier surveys.

#### **Grade 4 mathematics (year 5)**

- Sixty-two per cent of pupils had highly positive attitudes to mathematics, similar to or lower than in most countries scoring at a higher level than England or at a similar level.
- As in science the percentage of pupils with highly positive attitudes to mathematics has fallen, by 14 percentage points, since the last comparable data, in 1995. As in science, Singapore has also seen such a decline.
- Sixty-four per cent of pupils had a high level of self-confidence in learning mathematics. As in science, this was comparable to, or higher than, other high scoring countries.
- The level of high self-confidence in England has increased by 5 percentage points since 2003.
- Significantly more boys than girls showed a high level of confidence in learning mathematics, although there were no differences in attainment.

#### **Grade 8 science (year 9)**

Comparisons with other countries in this section are with countries with integrated science data: that is, pupils were asked about science rather than separately about physics, chemistry or biology.

- Fifty-five per cent of pupils had highly positive attitudes to science. This is within the range shown by other high scoring countries.
- The percentage of pupils with highly positive attitudes has fallen by 21 percentage points since the last comparable data, in 1999. Several high scoring countries, including Singapore and Chinese Taipei, have also seen such a decline.
- Fifty-two per cent of pupils placed a high value on science. This is within the range shown by other high scoring countries.
- More pupils placed a high value on science in 2007 than had done so in 2003, seven per cent more.
- Fifty-three per cent of pupils had a high level of self-confidence in learning science. This was greater than the proportion in the highest scoring countries.

- Significantly more boys than girls showed a high level of confidence in learning science at grade 8, as they did at grade 4, although there were no differences in attainment.
- The level of high self-confidence in science in England has not changed since 2003.

### Grade 8 mathematics (year 9)

- Forty per cent of pupils had highly positive attitudes to mathematics. Only three countries scoring at a higher level than England or at a similar level had significantly higher proportions of pupils in this category.
- As in science the percentage of pupils with highly positive attitudes to mathematics has fallen, by 25 percentage points since the last comparable data, in 1999. Six other countries scoring at a higher level than England or at a similar level also showed a decline, but none on as large a scale as England's.
- Seventy-four per cent of pupils placed a high value on mathematics, a much higher proportion than in science. This is higher than in four of the five countries which outperformed England, and at a similar level to countries performing like England.
- More pupils placed a high value on mathematics in 2007 than had done so in 2003, 10 percentage points more.
- Fifty-three per cent of pupils had a high level of self-confidence in learning mathematics. This is higher than in any of the five countries which outperformed England, and at a higher level than most of the countries performing at a similar level to England.
- The level of high self-confidence in England has increased by 6 percentage points since 2003.
- Significantly more boys than girls showed a high level of confidence in learning mathematics at grade 8, as they did at grade 4, although there were no differences in attainment.

### Attitudes

- Between half and two thirds of pupils have a high level of enjoyment and confidence in their learning in mathematics and science, with the exception of mathematics at grade 8, where the comparable figure for enjoyment was only 40 per cent.
- England's profile, of high performance but relatively low enjoyment, was common in other high scoring countries.
- In each area, boys had higher levels of confidence than girls, despite no overall differences in attainment.
- At grade 8, pupils generally valued their learning in mathematics, despite their relative lack of enjoyment of it; they clearly recognise that it can be useful to them. The same is true of science to a lesser extent.

## 1.7 The teachers and schools

Salient findings derived from the reports of headteachers, teachers and pupils are summarised below:

### Grade 4 (year 5)

- Teachers and headteachers continue to perceive school climate in a positive light. The percentage of pupils taught in schools concentrated at the high and medium parts of the scale is greater than the international average.
- There has been a significant increase in the percentage of pupils taught at schools where teachers' perception of school safety is high.
- Pupil and teacher perceptions of safety differed. Ratings of school safety from pupils were lower than those given by teachers. This occurred in several countries and was not confined to England.
- Schools in England are well-resourced compared with the international average, with almost all pupils taught at schools that are resourced at a high or medium level. This applies to both science and mathematics resources.

### Grade 8 (year 9)

- There has been no significant change in headteachers' perceptions of school climate since 2003. Only four per cent of grade 8 pupils are taught at schools where the headteachers' rating of school climate is low.
- The percentage of pupils taught in schools where the teachers give a high rating of school climate has increased significantly since 2003.
- Teachers' perceptions of good school safety have increased since 2003. Nearly all pupils are now taught in schools where teachers' perceptions of safety are high or medium.
- There has also been a significant increase in the percentage of pupils who gave their schools a high rating for safety. As with grade 4, there is a discrepancy between the perceptions of teachers and pupils, but the difference is not as large in grade 8.
- Grade 8 headteachers, mathematics and science teachers indicate that their schools are well resourced compared with the international average.
- England's grade 8 science pupils are more likely to spend their lesson time doing practical science activities than many of their international counterparts. However, pupils in England do not necessarily relate the science they cover in lessons to their daily lives.
- Grade 8 mathematics pupils in England have a different view from their teachers about the amount of time they spend on practical mathematics activities. Reports from pupils suggest that a greater percentage of pupil time is spent on practical activities than is suggested by the teacher reports.
- Pupils of science and mathematics at grade 8 continue to be tested less frequently than pupils in other participating countries.

### Summary: the teachers and schools

- Teachers' perceptions of the climate in their schools were positive.
- The views of teachers on school safety were also positive, but pupils' views were less so than those of their teachers.
- At both grades school staff reported that their schools were well resourced.

## 1.8 The pupils and the home

Important findings derived from the reports of headteachers, teachers and pupils are summarised below:

### Grade 4 (year 5)

- The majority of grade 4 pupils in England have access to a number of books in the home. Over 40 per cent of grade 4 pupils report that they have at least 100 books in the home, nearly double the international average.
- As in 2003, the vast majority of pupils (95 per cent) have a computer in their home and 86 per cent of grade 4 pupils in England have internet connections in their home.
- There have been significant changes in computer use. The percentage of pupils who use a computer at home but not at school has increased, while the percentage of pupils who use a computer in school but not at home has decreased. It is possible that this apparent reduction in the use of computers in school may be a result of the use of whiteboards and other more integrated technology in the classroom.
- England's grade 4 pupils receive less homework in both science and mathematics than pupils in other countries. In addition, teachers in England place less emphasis on homework than teachers in other countries.

### Grade 8 (year 9)

- The percentage of pupils reporting that they have more than 200 books in the home has decreased significantly since 2003. This, at 18 per cent, is still above the international average of 12 per cent, and higher than many other countries. The majority of grade 8 pupils in England continue to have access to a sizeable number of books in the home.
- As at grade 4, the vast majority of grade 8 pupils in England (98 per cent) have a computer at home and 92 per cent of pupils also reported having an internet connection at home. These are among the highest percentages internationally.
- There has been a significant decrease in the percentage of pupils reporting that they are using computers at home and in school. As at grade 4, it is possible that this is a result of better integration of other technology in the classroom.
- England's grade 8 pupils report receiving less homework than pupils in most of the other countries taking part in TIMSS 2007. Only five per cent of the pupils reported high ratings

on time spent doing mathematics homework and seven per cent reported high ratings on time spent doing science homework.

- There has been a significant decrease in the percentage of pupils taught in schools where the science teachers placed a high emphasis on homework. This reduction brings England's data closer to the international average. The amount of mathematics homework given has remained stable.

### **Summary: the pupils and the home**

- Computers in the home were almost universal with around 90 per cent of pupils also having internet access.
- The amount of books in the home remains high, but grade 8 pupils reported having fewer books than in 2003.

## **1.9 Factors associated with attainment and attitudes**

### **Attainment**

The relationships between different variables and attainment have been explored, using a statistical technique called multi-level modelling. This allows us to predict how an outcome might change for one variable if the size of a related variable changes. For example, it allows us to describe relationships such as, the higher pupils' attainment was at the end of key stage 1, the higher their attainment was likely to be in TIMSS at grade 4 (year 5).

The multi-level modelling analysis describes associations, but cannot attribute causality. Being confident in mathematics, for example, is associated with achievement in grade 4 mathematics, but we cannot say if one causes the other, or if a third factor causes these two to be associated.

- Most of the factors associated with achievement are unsurprising, such as prior attainment, attitudes and measures of socio-economic status. These are generally in the expected direction for example higher prior attainment having a positive association with attainment in TIMSS.
- Other factors associated with achievement relate to activities in the classroom. There is a mixture of positive and negative findings, associated with higher or lower achievers respectively.
- Out-of-school activities such as watching television and playing computer games are associated negatively with achievement.
- At grade 4, being born in the UK was associated positively with attainment, but this effect did not continue into grade 8.

## Attitudes

Clear findings were:

- Enjoyment of science and confidence in science were strongly associated with each other, but this relationship was weaker in mathematics.
- Boys generally held more positive attitudes to their learning. Boys were more positive than girls about science, more confident about mathematics at both grades and enjoyed mathematics more at grade 4. Despite this, there were no overall differences in attainment in either subject at either grade.
- Activities such as reading a book for enjoyment, doing homework and playing a musical instrument were positively associated with attitudes to science and enjoyment of mathematics (but not to confidence in mathematics).
- Activities such as watching television/videos, playing computer games, playing/talking with friends, using the internet and listening to music were negatively associated with attitudes to science and enjoyment of mathematics (but not to confidence in mathematics).
- Independent working in the classroom was a positive predictor of attitudes to science and confidence in mathematics at grade 4, but a negative predictor of enjoyment of mathematics at grade 8.
- Pupils' perception of the extent of bullying in their school was a negative predictor of:
  - attitudes to science at grade 4
  - confidence in mathematics at grade 4 and at grade 8.
- Prior attainment was a significant positive predictor of:
  - attitudes to science at grade 8
  - confidence in mathematics at both grade 4 and grade 8.