



National Audit Office

DEPARTMENT FOR CHILDREN, SCHOOLS AND FAMILIES

Mathematics Performance in Primary Schools: Getting the Best Results

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Mathematics Performance in Primary Schools:
Getting the Best Results

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Achievement	A measure of how much progress a pupil has made between attainment levels.
Attainment level	Absolute level expected to be achieved by pupils at certain points in their education. Each level was originally designed to be the equivalent of two year's learning for the average (median) child. At primary school, standards range between levels 1 and 5. Most seven year olds are expected to achieve level 2. Most 11 year olds are expected to achieve level 4. Each level can be broken down into more precise sub-levels – for example level 2 has sub-levels 2C, 2B and 2A where 'C' is the lowest sub-level and 'A' is the highest. National data is only collected by sub-level at level 2. Level descriptions provide teachers with the basis for making assessments and set out the types and range of performance that pupils working at that level should typically demonstrate.
Capita Strategic Children's Services	A subsidiary of Capita Group Plc that, since April 2005, has been contracted by the Department for Children, Schools and Families to deliver the National Strategies programme (inclusive of the Primary and Secondary National Strategies) at a national and regional level. From September 1997 to March 2005, CfBT Education Services delivered the contract.
Community schools	Schools that are maintained by the local authority. The local authority is the admissions authority with main responsibility for deciding arrangements for admitting pupils.
Foundation schools	Schools that are maintained by the local authority. They may have a foundation (generally religious) that appoints some, but not most, of the governing body. The governing body is the admissions authority.
Free school meals	The percentage of pupils receiving free schools meals is used as a measure of deprivation based on household income. Pupils entitled to free school meals are those within families who receive Income Support. Those within families who receive support under Part VI of the Immigration and Asylum Act 1999 may also be entitled.
Formative assessment	Ongoing day-to-day assessment of pupils by teachers and support staff to gather information on what a child or group of children understands or does not understand and how future teaching will be adapted to account for this (assessment for learning).
Hard to shift schools	Schools with results that have been persistently below the Government's primary mathematics target (at least 65 per cent of pupils achieving level 4 at Key Stage 2) for at least four years.

London Challenge	Targeted school improvement programme set up in 2003, initially for five years, and designed to turn round London's major school problems including excessive teacher turnover and pupil mobility. The initial focus was on secondary schools but from 2006 funding was provided to 60 primary schools in eight local authorities and a team of local authority advisers working with other primary schools. £40 million is invested annually in London Challenge schools.
Key Stage 1 mathematics	Key Stage 1 covers years 1 and 2 of primary school. During this Stage, pupils are expected to learn to develop knowledge and understanding of mathematics through practical activity, exploration and discussion. They should learn to count, read, write and order numbers to 100 and beyond; develop a range of mental calculation skills for use in different settings; learn about shape and space through practical activity linking to their understanding of their environment; begin to grasp mathematical language to talk about methods and explain reasoning when solving problems.
Key Stage 2 mathematics	Key Stage 2 covers years 3 to 6 of primary school. During this Stage, pupils are expected to learn to use the number system more confidently. They should move from counting reliably to calculating fluently with all four number operations; always try to tackle a problem with mental methods before using any other approach; explore features of shape and space and develop their measuring skills in a range of contexts; discuss and present their methods and reasoning using a wider range of mathematical language, diagrams and charts.
Leading Teachers' Programme	National programme that provides for teachers identified as strong in teaching mathematics or other subjects to undertake at least ten days work each year in other local schools identified as requiring support.
Local Authority Primary National Strategy Advisers	Local authority staff who advise schools on using the Primary National Strategy's programmes and resources. They are known as consultants but to avoid confusion with the general meaning, i.e. people contracted to provide services for a fee, we refer to them as "advisers" throughout this report. Most local authorities employ at least one lead adviser, who would previously have been an experienced headteacher, and a team of advisers specialising in curriculum areas, particularly mathematics and literacy. They would previously have had primary teaching experience.
Numeracy	A proficiency that requires an inclination and ability to solve number problems in a variety of contexts resulting in children who are confident enough to tackle mathematical problems without going immediately to teachers or friends for help (as defined in the 1999 primary framework).
RAISE (Reporting and Analysis for Improvement through School Self-Evaluation) online	Website accessed by schools and hosted by the Department for Children, Schools and Families and Ofsted, which provides interactive analysis of school and pupil performance data. It replaced the Ofsted Performance Assessment reports and the Department's Pupil Achievement Tracker.
School Improvement Partner	Since 1 April 2008, every maintained school in England has had an accredited School Improvement Partner (SIP) assigned to it. He or she is often a retired headteacher and acts for the local authority as the main channel for the communication about school improvement. They provide professional challenge and support to the school, assisting its leadership to evaluate performance, identify priorities for improvement and plan effective change.

Summative assessment	A formal assessment of what has been learned by pupils, which is typically termly or annually or at the end of a Key Stage, to ascertain the level a child has reached (assessment of learning).
Voluntary aided schools	Schools that are maintained by the local authority, with a foundation (generally religious) that appoints most of the governing body. The governing body is the admissions authority.
Voluntary controlled schools	Schools that are maintained by the local authority, with a foundation (generally religious) which appoints some, but not most, of the governing body. The local authority is the admissions authority.
Year 6 'booster' classes	Classes, usually extra-curricular, designed to provide additional support for children in year 6 who, with intensive targeted support, are identified as possibly being able to attain level 4 in the Key Stage 2 national tests. The lessons are used alongside and in addition to the work planned in the daily mathematics lessons for that term.



1 Understanding basic mathematics is an essential life skill. This examination of mathematics performance in primary schools was undertaken because of the importance of pupils gaining a solid grounding in mathematics. Pupils who master mathematics in their early school years are in a good position to progress to further studies, including in other subjects which require a good grasp of mathematics. Those who do not are generally less able to make progress and are likely to be disadvantaged in the labour market. Our analysis of pupils' achievement shows a strong link between succeeding early and continuing to succeed. Of those pupils who did not reach the expected performance level in mathematics and English by the end of primary school, only three per cent achieved the Government's target of five GCSEs at A*- C including mathematics and English by age 16.

2 Since the late 1990s, the Department for Children, Schools and Families (the Department) has had a specific Strategy aimed at improving performance in primary mathematics which, along with its strategy to improve primary literacy, cost £207 million to implement in 2007-08. The Strategy aims to raise performance through extensive teaching and learning resources, which have been web-based since 2006, supported by training and professional development programmes for teachers. In 2007, the Department commissioned Sir Peter Williams to undertake an independent review of the quality of primary mathematics teaching and his report was published in June 2008. Our work has been informed by Sir Peter Williams' review, and by the work of the Office for Standards in Education (Ofsted) and the experts named in paragraph 13 of our methodology at Appendix 1.

3 Drawing on their evidence on teaching quality and good pedagogical practice, we have evaluated performance in primary mathematics and the impact of the Strategy and related interventions, which entailed detailed examination of data on pupil performance and characteristics, and of qualitative data on how the Strategy is being implemented. In particular this report evaluates the Department's performance in:

- raising attainment and progress in mathematics and narrowing achievement gaps between certain pupils and their peers; and
- the delivery and effectiveness of the Primary National Strategy's resources and interventions and their impact on pupil and school performance.

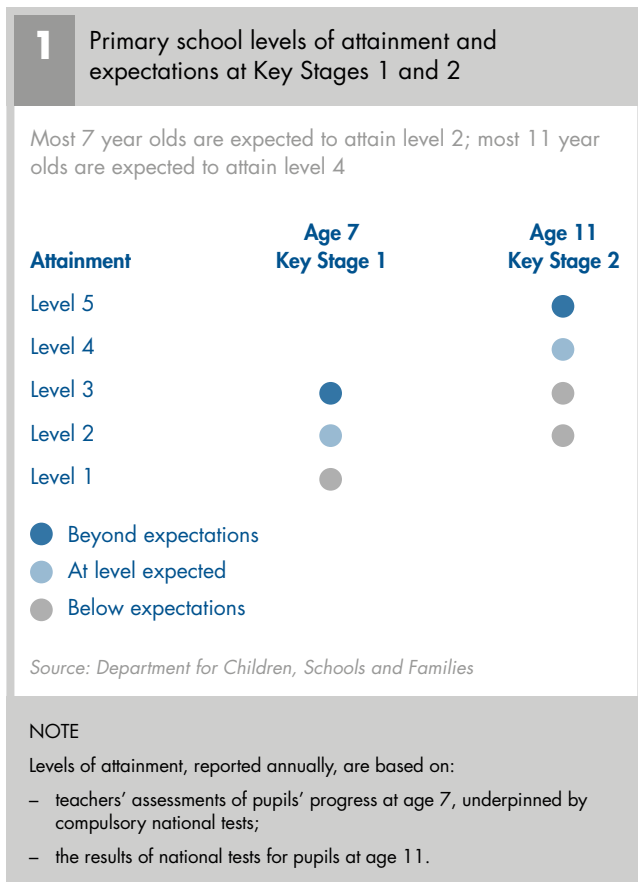
In the last part of the report, we identify what more the Department, local authorities and primary schools can do to raise performance in mathematics.

4 To inform our findings we conducted independent statistical analyses of national performance data, and validated and used some of the Department's data and analysis. We visited and surveyed 28 primary schools around England representing a range of school sizes and intakes. To illustrate good practice, the majority of the schools we selected had a strong performance in mathematics, but for comparative purposes, a minority of those we selected were schools where mathematics teaching had been identified as a weakness. We surveyed more than 1,000 pupils in their first two years of secondary school to ask for their reflections on learning mathematics at primary school and the transition to secondary. Appendix 1 gives further details of our methodology.

Main findings

5 Primary school pupils aged 5 to 11 are taught a broad range of subjects within the National Curriculum, with a focus on the core subjects of mathematics, English and science. Appendix 2 illustrates what pupils typically learn in mathematics and are assessed on during their primary education. On an average school day, teachers spend about an hour teaching mathematics (around 20 per cent of total teaching time) as well as encouraging pupils to develop and apply their mathematical skills in other subjects. Mathematics teaching in primary schools can stretch across all subjects of the primary curriculum, emphasising its relevance to almost all aspects of daily life. Based on the average teaching time devoted to the subject, we estimate that some £2.3 billion was spent on teaching mathematics in primary schools in 2006-07 out of a total expenditure of £10 billion on primary teaching and teaching support staff.

6 The National Curriculum sets standards of achievement. At primary school, standards range between level 1 and 5, with pupils expected to achieve certain levels by the end of the Key Stages (**Figure 1**).



Pupil attainment and achievement in primary mathematics

7 **After significant early increases, improvements in attainment in primary mathematics have slowed in recent years.** Pupils reaching the expected standard at Key Stage 2 (age 11) rose from 59 to 72 per cent between 1998 and 2000 (**Figure 2**). Since 2000 the trend has, however, levelled off, with continuing small increases in most years at Key Stage 2. At Key Stage 1 (age 7) the proportion of pupils reaching the expected standard has remained at around 90 per cent. In 2007 nearly a quarter of pupils did not reach the expected standard before entering secondary school. Some six per cent (34,000) of these 11-year-olds had only acquired mathematical skills at or below those expected of a seven-year-old.

8 **The Department has not met its key performance target for the last spending round and meeting its targets for 2011 will be a considerable challenge.** The 2007 Key Stage 2 results in mathematics were the highest recorded, with 77 per cent of pupils achieving the expected level, but this was eight percentage points below the target of 85 per cent that had been set for 2006. The Government has set two new targets for 2011 – a combined target for attainment in English and mathematics (78 per cent of pupils achieving the expected level in both subjects) and a target for progress between Key Stages 1 and 2 (in mathematics, 84.5 per cent of pupils progressing by two National Curriculum levels). Modelling by the Department indicates that meeting the targets will be difficult: based on average rates of improvement from 2004 to 2007, only 74 per cent of pupils will achieve the target in both subjects, and only 78 per cent will make two levels of progress in mathematics – shortfalls of 4 and 6.5 percentage points respectively. A step change in performance will therefore be needed to meet the targets.

9 **A significant minority of pupils of all abilities could make more progress in mathematics during their time at primary school.** For pupils who find mathematics relatively difficult, the Department recognises that more needs to be done to provide additional support to help them progress, and from September 2008 is piloting a new programme, *Every Child Counts*, to target this group. More able pupils also need support to make as much progress as they can in the subject. In 2007, there were some 66,000 pupils who did not make the nationally expected level of progress by the end of primary school, even though their earlier attainment suggested that they could.

10 There are persistent gaps between the mathematics performance of primary school pupils from different backgrounds and with different characteristics.

We found that:

- The outcomes for both girls and boys are improving with boys doing slightly better than girls at Key Stage 2, in contrast to their performance in other subjects. The differences between boys' and girls' outcomes are more pronounced in respect of the progress made between Key Stages 1 and 2. For girls who achieved the lowest two categories of level 2 at Key Stage 1 (sub-levels 2B and 2C), the differences in their progress compared with boys have more than doubled over the last three years to four and eight percentage points respectively.
- There is considerable variation at both Key Stages according to ethnicity. Pupils from Chinese and Indian ethnic groups do consistently better than white pupils. Pupils from Black African, Black Caribbean, Pakistani and Bangladeshi ethnic groups do significantly less well, though the gap has narrowed in recent years.
- There is a very large gap in attainment between pupils from disadvantaged backgrounds and their peers. At Key Stage 2 the difference is currently 20 percentage points, with only a small narrowing of the gap over the past three years.

School and local authority performance in primary mathematics

11 Attainment has improved in the last five years.

We found that:

- In 2007 nearly 85 per cent of primary schools achieved the Department's target for the proportion of pupils reaching the expected standard at Key Stage 2, up from 73 per cent in 2003. Over the same period, the rate of improvement in the percentage of pupils reaching the expected standard was faster in schools with the highest proportion of pupils taking free school meals than in those with the lowest. However, some three per cent of schools have not met the Department's target for the past four years or more.
- Most local authorities have achieved year-on-year improvements, although there is considerable variation in the attainment in mathematics at Key Stage 2. In 2007 the percentage of pupils achieving the expected level at Key Stage 2 mathematics ranged from 66 per cent in some local authorities to 84 per cent in others, and there was a link with relative levels of deprivation.

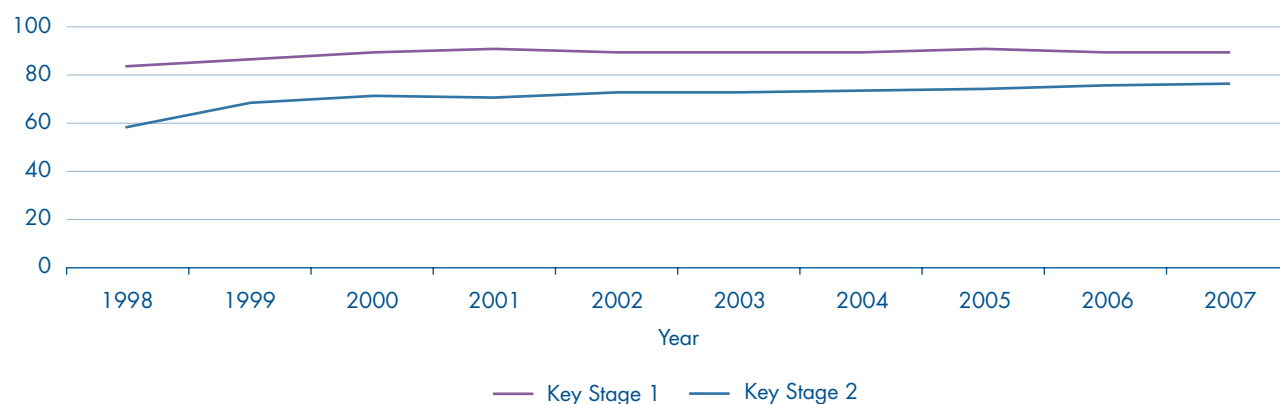
The impact of improvement programmes on primary mathematics

12 The Primary National Strategy has contributed to improvements in primary mathematics teaching and learning but weaknesses persist. The Strategy's resources and professional development programmes for

2 Percentage of pupils reaching the expected level in mathematics at Key Stage 1 and Key Stage 2, 1998-2007

After significant early increases, improvements in attainment in primary mathematics have slowed in recent years.

Percentage of pupils achieving expected level



Source: Statistical First Releases 1998-2007

NOTE

Provisional national attainment data for 2008 for Key Stages 1 and 2 was released in August 2008. The data showed that for Key Stage 1, mathematics attainment at level 2 or above remained at 90 per cent. At Key Stage 2, mathematics attainment at level 4 or above increased by 1 percentage point from 2007, to 78 per cent. As a result of problems that arose in the delivery of the 2008 Key Stage 2 and Key Stage 3 tests (paragraph 1.8) and the consequent unavailability of pupil-level data, our analyses in the remainder of this report use data up to 2007 only.

teachers have led to more consistency in primary schools' planning and delivery of mathematics teaching, which has contributed to a rise in national performance although weaknesses persist. In particular, using and applying mathematics is often under-emphasised in schools. To help address these concerns, a revised primary mathematics framework was introduced in September 2007, but it is too early to assess how far the new framework will lead to future significant improvements in primary school pupils' achievement in mathematics.

13 Quality of teaching is a key determinant in improving pupils' performance in mathematics.

The review by Sir Peter Williams (paragraph 2) identified the need for primary teachers to gain a better knowledge of mathematics. The Government has accepted the review's recommendations in full, including that every primary school should have access to a mathematics specialist within ten years. Other recommendations focus on the continuing professional development of teachers and those who support them.

14 Assessment of pupils' progress is one of the weakest aspects of teaching mathematics in primary schools. Ofsted and other experts have consistently reported that, in mathematics, teachers' continuous assessment of pupils as they learn is weak, with focus on written work that is easy to assess, rather than on skills such as using and applying mathematics and pupils' understanding of concepts such as number. In May 2008 the Department allocated some £50 million to primary and secondary schools annually until 2011 to support improvements in pupil assessment. In 2008-09, £30 million of this amount is allocated to primary schools.

15 The Department has well-established systems for working with its contractor to deliver the Primary National Strategy. With its main contractor, Capita Strategic Children's Services (Capita), the Department has established a systematic process for the planning and implementation of the National Strategy, including the primary mathematics programme. Capita's contract runs from 2005 to 2010 at a cost of £80 million a year.

16 The Primary National Strategy's website is the major source of advice but its complexity is hindering its effectiveness. Most of the teachers and mathematics experts we consulted considered the website to be a valuable tool, but all found it complex and not user-friendly. Part of the difficulty is the amount of material on the website, much of it useful, but some of which could be removed. The Department is planning more work to make the website easier to navigate.

17 Changes in local authority staffing over the last decade have led to a decline in the number of senior staff available to lead improvements in the teaching of mathematics. Much of the training provided by local authorities to schools now concentrates on whole-school improvement and the practical application of the revised mathematics framework and the Primary National Strategy, rather than improving teachers' knowledge of mathematics. Most local authorities target proportionately more training and advice at schools that are performing poorly or have relatively high numbers of low attaining pupils than at middle-performing schools where gains could also be made.

Value for money conclusion

18 Since 1999-2000, there has been a real terms increase of over 30 per cent in expenditure on primary schools (excluding capital spending). Within the current total of around £10 billion for primary teaching and teaching support staff, we estimate that primary schools spend some £2.3 billion on teaching mathematics. In addition, the cost of implementing the Department's comprehensive Strategy for improving the achievement of primary school pupils in mathematics and literacy in 2007-08 totalled £207 million.

By bringing greater structure and consistency to the way primary mathematics is planned and taught, the Strategy initially helped to improve test results at Key Stage 2 when children finish their primary education. Our analysis also shows that support targeted at the lower performing primary schools, often located in the more disadvantaged areas, has had an impact on mathematics performance.

Since 2000 mathematics attainment at Key Stage 1 has, however, levelled off, with continuing small increases in most years at Key Stage 2. It is too early to tell whether the 2007 revisions to the Department's Strategy will deliver the step change required if targets that have been set for 2011 are to be achieved.

Reasons for the slowing trend include the relatively greater difficulty in improving the mathematics skills of the remaining pupils, for some of whom the barriers to improvement are likely to be high. There are, however, some groups of pupils who could, with help and within existing resources, further improve their mathematics skills at primary level. Aspects of the teaching of mathematics, such as pupil assessment and the deployment of support tools and training for teachers, could also be considerably improved.

Our recommendations

19 As the body responsible and accountable at the national level for the education of primary school pupils, the following recommendations are directed primarily at the Department. All will, however, require responses by local authorities and schools, as the bodies in the lead locally on improving the performance of primary pupils in mathematics, and their roles and responsibilities are emphasised as necessary throughout this report.

a **The Department's target that measures the number of pupils progressing through two or more National Curriculum levels is a useful indicator, both nationally and at school level. It would be possible to further increase the utility of the indicator by more routine analysis of progress between sub-levels of attainment, which would identify those schools whose pupils could be making much more progress, including from a position of relatively high attainment.**

The Department should identify and consult with local authorities that are particularly effective at challenging performance in the schools where pupils are making the least progress. Building on the recent work to improve the assessment of pupil progress, it should issue guidance on how more sophisticated use of data would enable local authorities and schools to agree more stretching targets for increasing rates of progress in mathematics.

b **Girls' progression in mathematics between Key Stage 1 and Key Stage 2 is lower than for boys and the gap is especially marked for girls starting from a lower level in mathematics at age 7.**

The Department should identify what teaching approaches and resources are used for the teaching of mathematics skills to girls who find the subject relatively difficult and why these approaches and/or resources may be hindering their progress. Through the Primary National Strategy's website, the Department should promote and disseminate guidance on what works well in helping girls to make progress.

c **The Primary National Strategy's website is a valuable resource, but teachers have found it large and complex. While work is being done to make it more user-friendly, teachers need more personalised assistance if they are to use it for the maximum benefit of their pupils.**

When reviewing the updated website's content and usability, the Department should use the management information obtained from user feedback to identify strengths and weaknesses to help inform further improvements. As part of his or her continuing professional development, the school's mathematics coordinator should develop a sound understanding of the primary mathematics framework and its resources, and should actively assist other teachers to make the best use of them.

d **Teachers need more subject-based training in mathematics aimed at directly enhancing their practice in the classroom and their use of formative assessment to track pupils' achievement and help them to progress.**

The Department and local authorities should facilitate better collaboration between schools so that best practice is shared. High performing schools could be encouraged to release their leading mathematics teachers for a proportion of their time to other local schools that are performing less well: for example, by allocating some school improvement funding to schools to cover costs and provide incentives to collaborate; by promoting the development benefits of cross-teacher exchanges and peer review; and by secondary teachers teaching year 6 classes, as well as observing the teaching methods used by primary teachers, in the run up to the secondary school transfer.

e **The Department's Strategy has achieved a more consistent approach across schools in the teaching and assessment of mathematics, but there is a further need to increase pupils' enjoyment of the subject. Both are necessary for pupils to remain motivated and do their best in mathematics.**

Supported by the relevant national advisory agencies, including the National Centre for Excellence in the Teaching of Mathematics and BECTA, the Department should better signpost schools to the Information Communication Technology applications and other resources that are proven to engage pupils most effectively in meaningful mathematics learning. It should provide clear continuing professional development guidance on how to make best use of these resources in the classroom, and draw on good practice overseas from countries that perform strongly in primary mathematics, such as the Netherlands and Latvia.



Trends in attainment and progress in primary mathematics

1.1 This part of the report evaluates progress against the Department's targets for primary school mathematics and the performance of pupils and schools, including by gender, ethnicity and relative deprivation. It also compares performance in England by local authority.

1.2 As a result of problems that arose in the delivery of the 2008 Key Stage 2 and Key Stage 3 tests (paragraph 1.8) and the consequent unavailability of pupil-level data, our analyses of trends and progress use data up to 2007 only.

School spending and expenditure on teaching primary mathematics

1.3 The Department influences delivery of its policies by schools through a combination of grant distribution, regulation, and agreements on priorities and performance targets. Grants include the Dedicated Schools Grant, a ring-fenced grant from the Department for schools via local authorities, which covers funding delegated to schools and other provision for pupils. The Dedicated Schools Grant constitutes almost 60 per cent of the Department's overall spending (£28 billion of £49 billion total in 2007-08 for all schools, excluding sixth forms and the Teachers' Pension Scheme payments). It is allocated to local authorities using a formula based on pupil numbers and characteristics, and the Department allocates additional funding to schools for specific government priorities.

1.4 In 2006-07, some £13.4 billion (excluding capital spending) was spent by maintained primary schools, an increase in real terms of 31 per cent since 1999-2000 when the Department's National Strategy to improve numeracy in primary schools was formally implemented in schools (**Figure 3**).¹ Of this, some £10 billion was

spent on teaching staff, including headteachers and teaching support staff. Based on information on teaching time obtained from our case study schools, we estimate that nationally some £2.3 billion was spent on teaching primary mathematics in 2006-07 and the average cost per pupil was £572.² There are 17,400 primary schools in England, with 4.1 million children taught by around 198,000 full-time equivalent teachers. The average size of a primary school class, taught by one teacher, decreased from 27.7 pupils in 1998 to 26.2 pupils in 2008. During this time, the number of teaching assistants supporting teachers in the classroom has increased from 45,000 to 115,000 and the average pupil-to-adult ratio is 12, down from 17.8 in 1998.

The Department's targets for primary mathematics

1.5 In its Children's Plan, published in December 2007, the Department set out ambitions to achieve world class standards in education and close the gap in educational achievement for children from disadvantaged backgrounds. It acknowledges that while test results have improved in mathematics and the number of under performing schools has declined, there are still a significant minority of pupils not reaching national standards and not achieving all they can at school.

1.6 **Figure 4 on page 14** sets out the Department's targets for primary education for 2006 to 2011, as measured by pupil performance in National Curriculum tests, and our assessment of progress against them. Mathematics is a fundamental component of the targets because it is important for life skills and employability, and underpins further study in key subjects such as science and engineering. New targets for 2011 add measures for

¹ School-based expenditure, i.e. only expenditure incurred directly by schools. Figures for 2007-08 will not be available until autumn 2008. The National Numeracy Strategy was launched in 1998 and has been formally implemented in schools since September 1999.

² We have calculated these figures using the following assumptions: Teaching staff spending 20 per cent of their time teaching mathematics and teaching support staff (we estimate that teaching assistants account for half of support staff expenditure) spending 33 per cent of their time supporting the teaching of mathematics.

pupil progress, narrowing the gap between children from low income and disadvantaged backgrounds and their peers, and increasing achievements of children in care. The overall attainment target now combines English and mathematics, although the Department will continue to publish figures separately for both.

1.7 The Government set the new targets taking account of trends in pupil attainment and progression. They are based on the assumption that all maintained mainstream schools are capable of achieving the average performance of the top 50 per cent of schools. The initiatives described later in this report (Figure 14 on page 23), especially those introduced since 2006 and related to improving pupils' progress in mathematics, were designed to help meet the targets.

1.8 The Qualifications and Curriculum Authority has responsibility for ensuring that standards in pupil testing remain consistent from year to year and has standard maintenance procedures that are subject to endorsement by an external observer. The Key Stage 2 tests are marked externally by an agency contracted by the National Assessment Agency, which is a subsidiary of the Qualifications and Curriculum Authority. To improve confidence, the Government announced last year the establishment of an independent regulator of

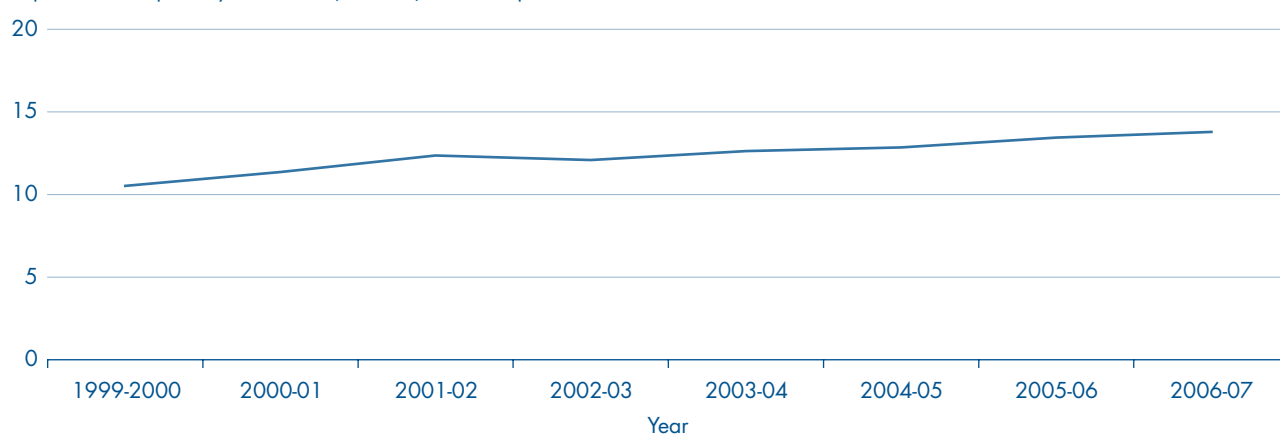
qualifications and tests in England. The Office of the Qualifications and Examinations Regulator (Ofqual) was set up in interim form in April 2008. As a result of problems that arose in the delivery of the 2008 Key Stage 2 and Key Stage 3 tests, leading to delays in the release of results to schools, Ofqual asked Lord Sutherland to lead an inquiry into the administration of these tests. The inquiry is due to report its findings in autumn 2008.

Trends in attainment in primary mathematics

1.9 Figure 2 in the Summary shows the proportion of pupils who reached the expected level of attainment in mathematics at the two Key Stages in primary school from 1998 to 2007. Ninety per cent of Key Stage 1 pupils have achieved the expected level or above in mathematics for the past three years. In 2007, 77 per cent of primary school pupils met the target level at Key Stage 2. Though the highest recorded level, it is significantly short of the target of 85 per cent. Attainment at Key Stage 2 increased considerably from 1998 to 2000 but subsequently improvements at both Key Stages have levelled off. 32 per cent of pupils achieved the higher level – level 5 – in mathematics at Key Stage 2 in 2007.

3 Expenditure by maintained primary schools has risen, in real terms, from 1999-2000 to 2006-2007

Expenditure on primary education (£ billion) 2007-08 prices



Source: Local Authority Revenue Outturn returns

NOTE

Figures are calculated in real terms based on 2007-08 prices and include only expenditure incurred directly by schools. This expenditure consists of the pay of teachers and school-based support staff as well as school premises costs, books and equipment, and certain other supplies and services, less any recurrent capital spending and income from sales, fees and charges and rents and rates. It excludes the central cost of support services such as school transport, local authority administration and the financing of capital expenditure.

4 Public Service Agreement targets for Key Stage 2 performance and progress 2006 to 2011

The 2004 Spending Review set the following targets up to 2008:	Outturn	Result
Pupils		
■ By 2006, 85 per cent of pupils to achieve level 4 in mathematics and English, sustained to 2008.	In 2006, 76 per cent of pupils achieved level 4 at Key Stage 2 in mathematics. In 2007, 77 per cent did so.	● Not met
Schools		
■ By 2008, the proportion of schools in which fewer than 65 per cent of pupils achieve level 4 in mathematics and English to be reduced by 40 per cent.	At 2003 (baseline year) 3,683 primary schools had fewer than 65 per cent of their pupils achieving level 4 in mathematics. By 2007, this had reduced to 2,074 schools, representing a fall of 44 per cent.	● Met early
The 2007 Spending Review set the following targets to be met by 2011:	Predictions based on current averages	NAO assessment of progress to date
Pupils		
■ Increase the proportion of pupils achieving level 4 in both mathematics and English to 78 per cent.	In 2007, 71 per cent of pupils achieved level 4 or above in both mathematics and English. Based on the average improvement between 2004 and 2007, the proportion would increase to 74 per cent by 2011.	● At risk
■ Increase the proportion of pupils progressing by two National Curriculum levels in mathematics by 11 percentage points from the proportion in 2006 of 73.5 per cent (in English by 9 percentage points from the proportion in 2006 of 80.9 per cent).	In 2007, 76 per cent of pupils progressed two or more levels in mathematics. Based on the average improvement between 2004 and 2007, the proportion would rise to 78 per cent in 2011; a shortfall of 6.5 percentage points from the target of 84.5 per cent (11 plus 73.5).	● At risk
■ Narrow the attainment gap between pupils eligible for free school meals and their peers achieving the expected level.	There is no specific measure for this target, but the baseline is 2006 performance in mathematics and English combined – an attainment gap of 25 percentage points. 2007 performance narrowed the gap slightly to 24 percentage points.	● At risk
	The mathematics attainment gap narrowed slightly between 2006 and 2007 and was 20 percentage points in 2007 compared with 21 percentage points in 2006.	
■ Increase the proportion of children in care achieving level 4 in mathematics and English to 55 per cent and 60 per cent respectively	In 2006 – the baseline year – 40.9 per cent of children in care reached level 4 in mathematics, and 42.8 per cent in English. In 2007, the proportions had improved to 43.4 per cent and 45.9 per cent respectively.	● At risk

Source: National Audit Office analysis of Statistical First Releases, 2003–2007 and the National Strategy's Strategic Plan 2008–2011

NOTE

Figures for the 2008 schools target contains information for all schools with Key Stage 2 results. It differs from results published by the Department because we include schools which have subsequently closed or merged.

1.10 In 2007, around 10 per cent of pupils at Key Stage 1 and 23 per cent at Key Stage 2 did not achieve expected attainment levels. Each year around six per cent of pupils (34,000 in 2007) enter secondary school with mathematical skills at or below the level expected of an average seven year old.

Pupils' progress in mathematics between Key Stages 1 and 2

1.11 The Department expects the majority of pupils to make at least two National Curriculum levels of progress between Key Stages 1 (age 7) and Key Stage 2 (age 11). Each level is divided into three sub-levels, progression being between C to A in each level, although sub-level data is only collected nationally for level 2 at Key Stage 1. Other sub-level data is used locally but without the degree of consistency that would be required for reliable national reporting.

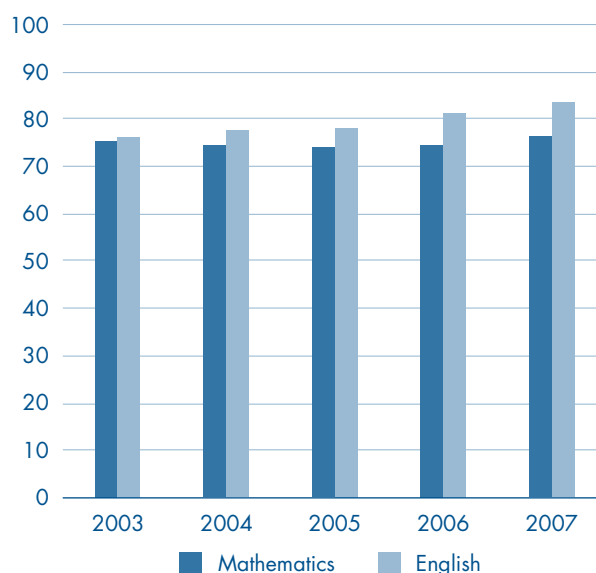
1.12 The proportion of pupils who have made two full levels of progress in mathematics has been between 74 and 76 per cent for the past five years and is consistently lower than the equivalent progress made in English (Figure 5). Progress through two levels provides a relative measure of performance alongside absolute attainment, though most of the schools we visited consider that measurement by sub-levels through to Key Stage 2 is more meaningful. For example, currently a pupil moving from sub-level 2A at Key Stage 1 to sub-level 4C at Key Stage 2 (4 sub-levels) would count towards the school meeting the target, whereas a pupil progressing from sub-level 2C to 3A (5 sub-levels) would not.

1.13 Figure 6 overleaf charts pupil progression between Key Stages 1 and 2 in mathematics for pupils who achieved different levels of attainment at Key Stage 1. It shows that while most pupils made two or more levels of progress by the end of Key Stage 2, some pupils did not. In particular, the Department recognises that progress of two levels from sub-level 2C is too low at only 48 per cent in 2007, having stayed below 50 per cent since 2003. By contrast, 70 per cent of pupils progressed from level 2C to level 4 or better in English in 2007. The *Every Child Counts* intervention programme (paragraph 2.4 and Figure 14), which the Department intends to introduce nationally in 2010, aims to increase the rate of progress of pupils who find mathematics relatively difficult at Key Stage 1.

5 Percentage of pupils progressing by two or more levels between Key Stages 1 and 2 in mathematics and English: data for 2003 to 2007

Between 74 per cent and 76 per cent of pupils made two levels of progress in mathematics, consistently below the equivalent progress made in English.

Percentage of pupils making two levels of progress



Source: National Audit Office analysis of national pupil database

NOTES

Based on maths test at Key Stage 1 and a combination of reading and writing tests for English at Key Stage 1, following the national statistics method.

A pupil must have a record in both Key Stage 1 and Key Stage 2 to be included in the data set.

1.14 Figure 6 also indicates that there are large groups of more able pupils who could be making more progress. In 2007, over 66,000 pupils were not moving on enough in mathematics by the end of primary school given their prior attainment. This number includes:

- some 20 per cent of pupils at age 7 who had attained sub-level 2B in mathematics (20,400), and five per cent who had attained sub-level 2A (6,800), but who then made only one level of progress (to level 3) by age 11;
- some 25 per cent of the most able pupils who had attained level 3 at the end of Key Stage 1 (37,600), and might have been expected to progress to level 5 at Key Stage 2 with relative ease, but who only progressed to level 4; and
- a small number of pupils (1,800) who achieved one of these levels at Key Stage 1 but did not make at least one level of progress at Key Stage 2.

Gaps in achievement between certain types of pupils and their peers

1.15 There are persistent gaps between the mathematics outcomes of primary school pupils from different backgrounds and/or with different characteristics particularly in respect of gender, ethnicity and socio-economic background.

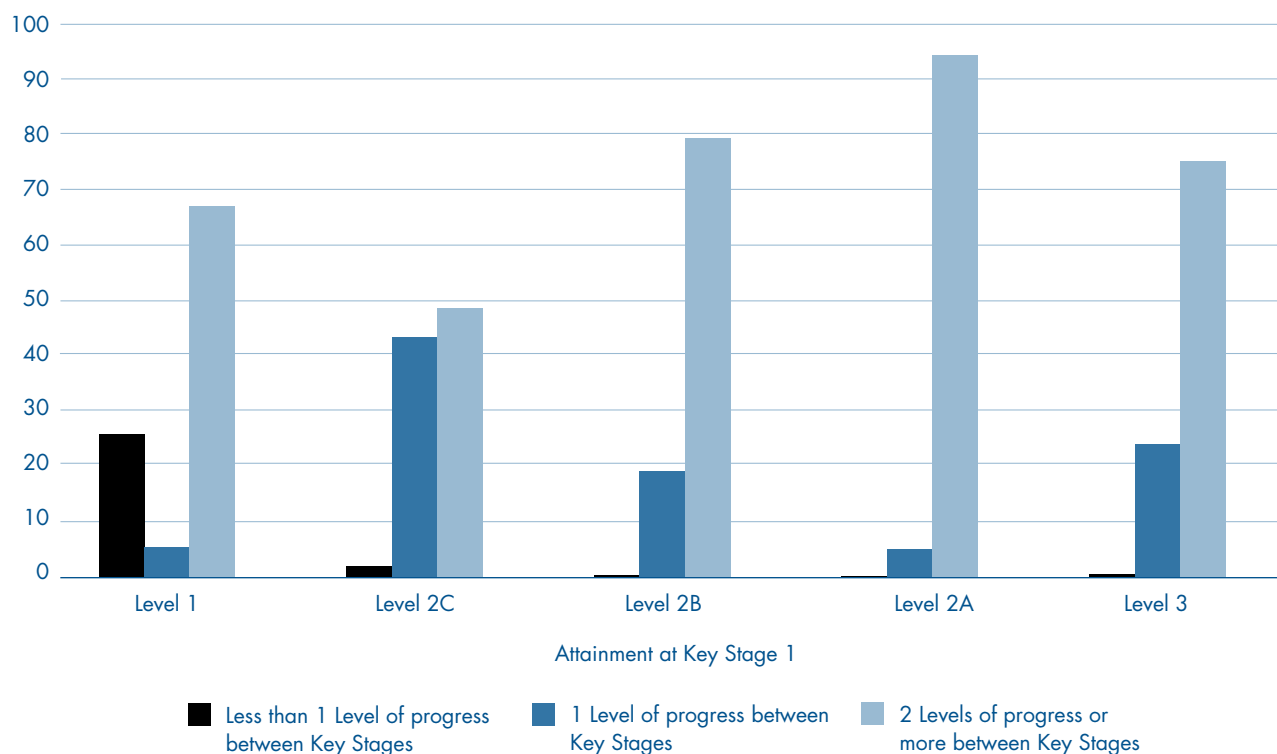
Gender

1.16 Mathematics is the only core subject where at Key Stage 2 boys achieve better results than girls. As in other subjects, girls do better at Key Stage 1. However, at Key Stage 2 the position is reversed, and in 2007, 78 per cent of boys achieved level 4 or above compared with 76 per cent of girls. **Figure 7** shows that the gap in progress made by boys over girls is significant for pupils starting from levels 2C or 2B at Key Stage 1. For both these cohorts of pupils, after a temporary narrowing, the gap

6 Pupil progression: attainment at Key Stage 2 in mathematics compared with attainment at Key Stage 1, 2007

For all levels of attainment at Key Stage 1, most pupils made two or more levels of progress by the end of Key Stage 2.

Percentage of pupils progressing from Key Stage 1 to Key Stage 2



Source: National Audit Office analysis of national pupil database

NOTE

Figure 20 in Appendix 3 gives more detail on the levels of attainment achieved by pupils at Key Stage 2 by prior attainment.

has more than doubled since 2004. Over the same period, there has been a fairly consistent gender gap of around five percentage points in the rate of progress made by the most able pupils who attained level 3 at age 7. Our more detailed analyses show that the gap is still material when controlling for other pupil characteristics such as deprivation (Appendix 3, Figure 21) and is replicated across local authorities (Appendix 3, Figure 22).

Ethnicity

1.17 Figure 8 overleaf shows the proportion of pupils from different ethnic groups achieving the target levels or above at Key Stage 2 in 2007. There are differences between the groups that are consistent over time:

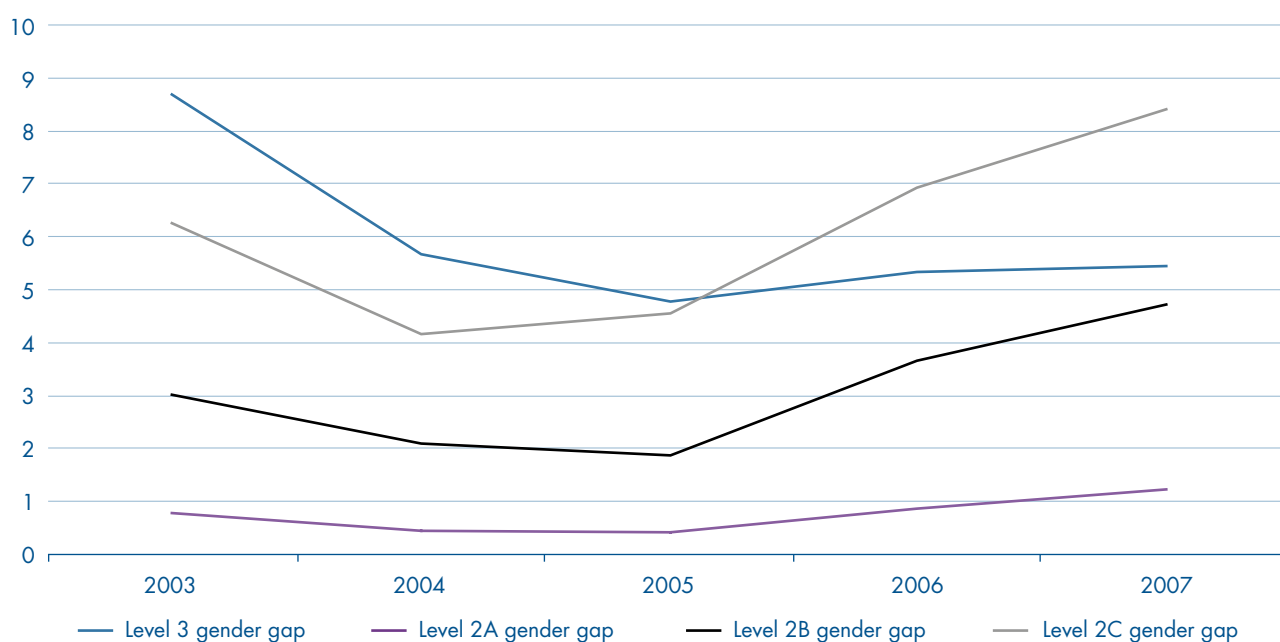
- pupils from Pakistani, Bangladeshi, Black Caribbean and Black African ethnic groups attain below the national average at both Key Stages 1 and 2;
- pupils of Chinese ethnicity consistently attain significantly above, and pupils of Indian ethnicity somewhat above the national average at both Key Stages; and
- pupils from Gypsy/Romany and Traveller of Irish Heritage ethnic groups attain considerably below the national average although very small numbers of pupils were recorded in these two categories. At Key Stage 2 around one third attain the target level compared to more than three-quarters of all pupils.

1.18 At Key Stage 2 all ethnic groups showed improved attainment between 2002-03 and 2006-07, with the largest increase for Pakistani and Bangladeshi pupils. At Key Stage 1 improvement was less marked, and for most ethnic minority groups, attainment declined over the last three years.

7 Percentage gap between boys' and girls' making two levels of progress in mathematics between Key Stage 1 and Key Stage 2: data for 2003 to 2007

After narrowing between 2003 and 2004, the gap between boys making two levels of progress and girls making two levels of progress has since more than doubled for pupils starting from levels 2b or 2c at Key Stage 1.

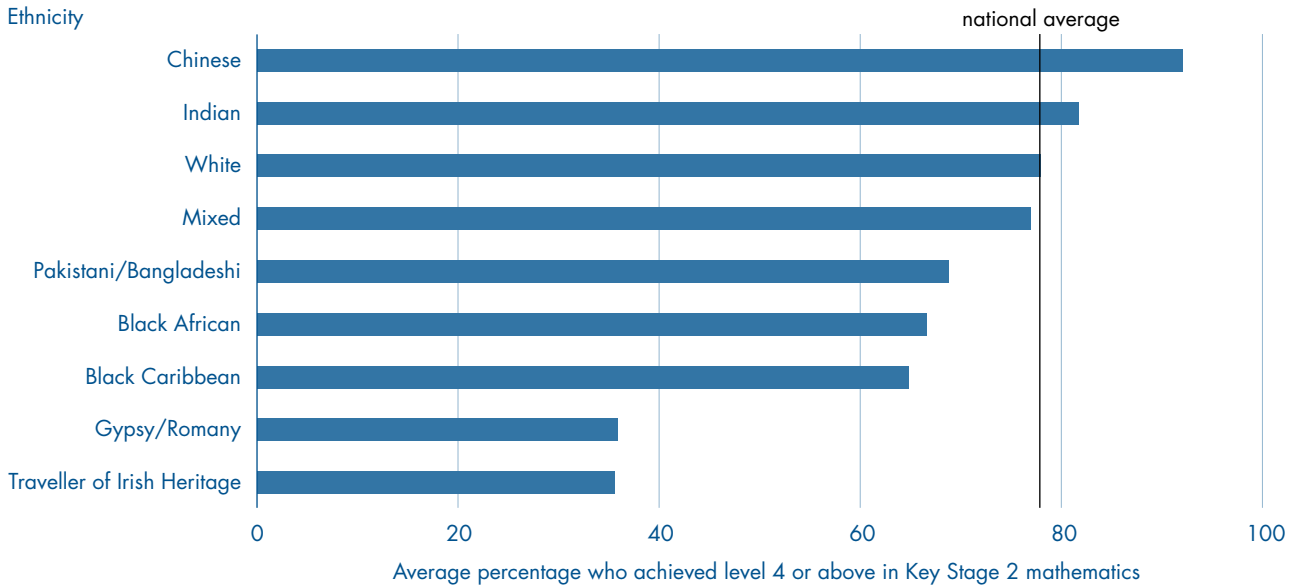
Gap between boys making two levels of progress over girls (per cent)



Source: National Audit Office analysis of national pupil database

8 Attainment by ethnicity at Key Stage 2 mathematics, 2007

Pupils of Chinese ethnicity and Indian ethnicity consistently attain above the national average of 77 per cent, whereas pupils from Pakistani, Bangladeshi, Black Caribbean and Black African ethnic groups and pupils from Gypsy/Romany and Traveller of Irish Heritage ethnic groups attain below the national average.



Source: National Audit Office analysis of national pupil database

Socio-economic background

1.19 After controlling for other pupil characteristics, the biggest attainment gap is between pupils receiving free school meals (FSM) and those who do not.³

Figure 9 shows that mathematics attainment levels for both groups have increased in recent years, but non-FSM pupils still perform much better generally, and the attainment gap has not narrowed greatly. In 2007, the gap was 20 percentage points and the slight reduction in the gap mainly represented FSM boys.

Performance in mathematics at school level

1.20 Many more primary schools are now meeting the schools' Key Stage 2 target in mathematics, which is that at least 65 per cent of pupils should achieve at level 4 or above by Key Stage 2. Over a quarter – 26.9 per cent – of schools did not meet the target in 2003. By 2007 the proportion of schools not meeting the target had fallen by almost 12 percentage points to 15.3 per cent.

9 The attainment gap between pupils receiving free school meals and their peers: achieving level 4 at Key Stage 2 mathematics, 2005-07

The attainment gap between pupils receiving free school meals and their peers has not narrowed greatly over the last three years.

Pupils	Percentage achieving level 4 or above at Key Stage 2 in mathematics		
	2005	2006	2007
Receiving free school meals	57	58	60
Not receiving free school meals	79	79	80
Attainment gap	22	21	20

Source: Statistical First Releases 2005–2007

³ Free school meals is only a limited measure of deprivation based on household income. And some families will be eligible for FSM but choose not to receive it. Our more detailed analysis shows the gap is also apparent using other measures of deprivation, including the Income Deprivation Affecting Children Index (Appendix 3, Figure 23).

1.21 One of the Department's public service agreement targets in the Spending Review 2004 was to reduce the number of primary schools not achieving the Key Stage 2 target by 40 per cent by 2008 compared with the number that did not achieve it in 2003. 2074 schools did not meet the target in 2007, compared with 3683 schools that did not meet it in 2003. This represents a reduction in the number of schools not meeting the target of 44 per cent, achieved in the year before 2008, the year that was targeted in the Spending Review.

1.22 There remain some 604 'hard to shift' schools that have been persistently below the mathematics target for at least four years. While a range of factors are likely to affect performance in these schools, our analysis shows that, on average, they had 1.5 to 2 times the proportion of pupils with special educational needs in 2007 (**Figure 10**).

1.23 **Figure 11** compares the attainment performance in mathematics for different types of primary schools without controlling for other factors. It shows that voluntary aided schools (largely faith schools) have, on average, more pupils achieving the target level in mathematics than the other school types. By 2007 all other schools (community) were achieving the level of performance that the voluntary controlled and foundation schools had achieved by 2003.

1.24 There is a significant gap in performance between schools relative to deprivation. For example, only around half of schools with the highest proportion of pupils taking free school meals had 65 per cent or more of pupils achieving level 4 in mathematics in 2007, compared with more than 90 per cent in schools with the lowest proportion of pupils taking free school meals.⁴ However, between 2003 and 2007 the rate of improvement in the percentage of pupils reaching level 4 was faster in schools with the highest proportion of pupils taking free school meals than in those with the lowest – 7 percentage points compared with 4 percentage points. The position was reversed for pupils reaching the higher level 5, with the rate of improvement greater in schools with the lowest proportion of pupils taking free school meals – 5 percentage points compared with 2 percentage points.

10 Proportion of pupils with special educational needs in 'hard to shift' primary schools compared with other schools, 2007

On average, primary schools that have been below the mathematics target for at least 4 years have 1.5 to 2 times the proportion of pupils with special educational needs.

Average proportion (per cent) of pupils with special educational needs with:

	A statement	School Action Plus	School Action
Hard to shift schools	3.96	12.68	22.20
All other schools	2.20	7.22	13.70

Source: National Audit Office analysis of national pupil database

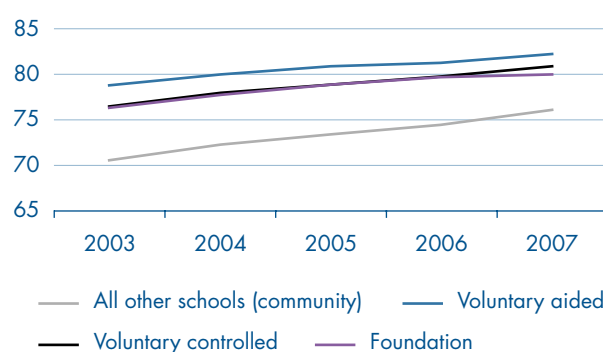
NOTE

Data is collected nationally for three categories of pupils with special educational needs. Pupils with statements who are given extra support by the local authority; pupils supported at School Action, whose schools meet the pupils' needs without a statement; and pupils supported at School Action Plus, who require further support than under School Action, and whose schools meet the pupils' needs without a statement.

11 Proportion of pupils achieving level 4 or above at Key Stage 2 mathematics by school type, 2003 to 2007

Voluntary aided schools have, on average, more pupils achieving the target level in mathematics than the other school types.

Average proportion of pupils achieving level 4 or above (per cent)



Source: National Audit Office analysis of national pupil database.

NOTE

The performances of voluntary controlled and foundation schools were approximately the same.

⁴ Schools with the highest proportion of pupils receiving free school meals are schools that were in the top 20 per cent of schools nationally in 2003 under this indicator. Schools with the lowest proportion of pupils receiving free school meals were in the bottom 20 per cent of schools nationally in 2003 under this indicator.

Performance in mathematics at local authority level

1.25 Performance varies across English regions and between local authorities, with the percentage of pupils achieving level 4 or above at Key Stage 2 ranging from 66 per cent to 84 per cent. **Figure 12** and our analysis in Appendix 3, Figure 24 show a link between performance and the level of deprivation in a local authority.

1.26 The majority of local authorities have demonstrated year-on-year improvements in mathematics attainment. Out of 150 local authorities, only three did not improve the percentage of pupils reaching level 4 at Key Stage 2 between 2003 and 2007 (**Figure 13**). During this period all but two local authorities increased the proportion of schools with at least 65 per cent of pupils achieving at least level 4 in mathematics. Our more detailed analysis (Appendix 3, Figure 25) shows that local authorities starting from relatively low levels of attainment and with relatively high deprivation were most likely to be among the authorities that achieved the greatest improvements, though a significant attainment gap persists.

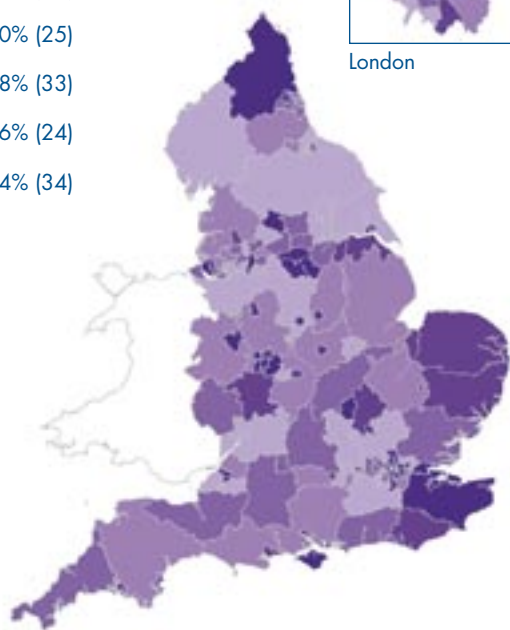
1.27 The Department's Strategy for improving performance, which we evaluate in Part 2, contributed to major initial improvements in primary mathematics. Since then performance has levelled off, and we discussed this issue at the 28 primary schools that we visited, and with other key stakeholders. As the majority of pupils are now meeting national expectations it is inevitably more difficult to make further improvements; and a minority of pupils will struggle with mathematics and may not be able to meet expected levels. However, the Department is still some way off meeting its targets. Addressing the weaknesses that persist in primary mathematics teaching in some of the ways we set out in Part 3, would facilitate the necessary step change in performance and enable more pupils starting secondary school to do so with a solid grounding in mathematics.

12 Distribution of pupils achieving level 4 or above at Key Stage 2 in mathematics, at local authority level, 2007

Over a third of the local variation in attainment can be explained by the differing proportion of children who are receiving free school meals.

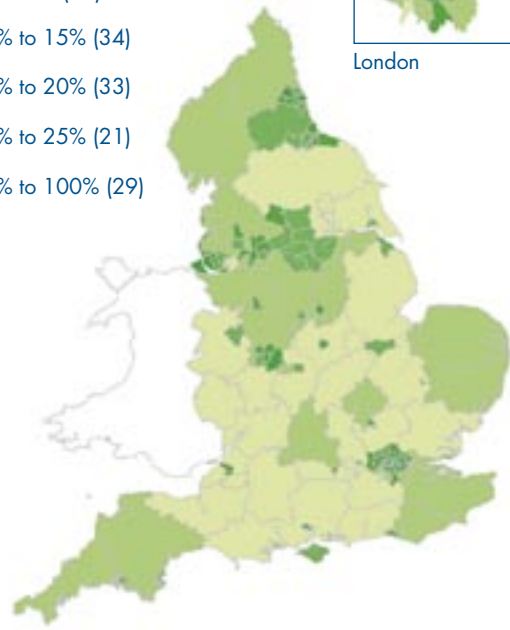
Proportion of pupils achieving level 4 + in 2006–07

- 80% to 84% (34)
- 78% to 80% (25)
- 76% to 78% (33)
- 74% to 76% (24)
- 66% to 74% (34)



Proportion of pupils receiving free school meals

- 0 to 10% (33)
- 10% to 15% (34)
- 15% to 20% (33)
- 20% to 25% (21)
- 25% to 100% (29)

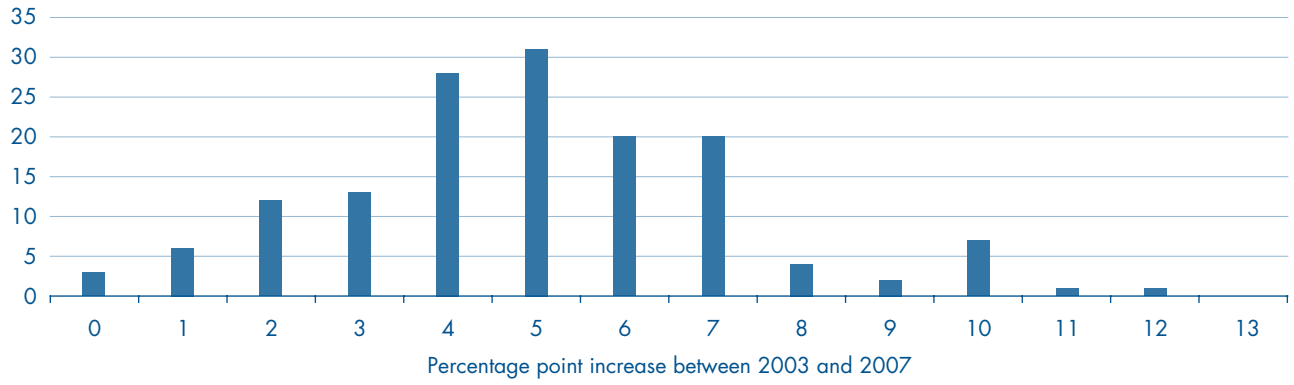


Source: National Audit Office analysis of national pupil database

13 Proportion of pupils reaching level 4 at Key Stage 2 by local authority in 2007 compared with 2003

There have been year-on-year improvements in mathematics attainment in the great majority of local authority areas.

Number of local authorities



Source: Statistical First Releases 2003–2007



The impact of improvement programmes on primary mathematics

2.1 This part of the report evaluates:

- programmes to improve performance in primary mathematics, and in particular the implementation and impact of the Primary National Strategy; and
- the impact of wider programmes to support school improvement on pupil mathematics attainment and progress, and school and local authority performance.

The main programmes to improve primary mathematics

2.2 Figure 14 sets out the Department's main reforms to raise performance in primary mathematics. In 2003, the key policy to raise standards, the National Numeracy Strategy, was combined with the National Literacy Strategy to form the Primary National Strategy. From 2004-05 to 2007-08, the Department allocated £721 million (with a provisional allocation of £195 million for 2008-09) to support schools and local authorities in implementing the Strategy. Local authorities decide the precise allocations between English and mathematics taking account of local needs. Appendix 4 outlines the national approaches to raising mathematics standards and performance in Wales, Scotland and Northern Ireland, which have some similarities with the approach taken in England.

2.3 The Primary National Strategy aims to embed effective teaching and learning in all schools. It seeks to raise performance through a combination of extensive guidance and training materials, teacher observation

of their peers, and a comprehensive programme of training and professional development for subject teachers and school managers delivered largely by some 1,400 advisers⁵, including over 400 mathematics advisers, who are employed by local authorities but draw advice from the National Strategies' regional advisers. The amount of support individual schools receive is related to need, but all have access to training materials.

2.4 At the centre of the Strategy are the mathematics and literacy frameworks, and guidance on how to teach the curriculum, with an emphasis on planning and pupil assessment. They are non-statutory but are widely used. In 2007 the frameworks were revised drawing on good practice and research with a view to making the curriculum clearer and more manageable for teachers. In addition, there are two initiatives being piloted to provide intensive support to underachieving pupils: *Making Good Progress* (2007) and *Every Child Counts* (2008).

2.5 In 2007, the Department commissioned Sir Peter Williams to consider whether the quality of primary mathematics teaching needs to improve and his report, the *Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools* was published in June 2008. Sir Peter's principal recommendation was that there should be a mathematics specialist for each primary school to be achieved over 10 years from 2009. Other key recommendations focus on the continuing professional development of teachers and those who support them (paragraph 3.5 and Figure 19). The Department has accepted all the review's recommendations.

⁵ Local authority staff who advise schools on using the Primary National Strategy's programmes and resources are known as consultants. To avoid confusion with the general use of the word "consultant", meaning people contracted to provide services for a fee, we use "adviser" throughout this report.

14 Main programmes to improve primary mathematics

Date	Reform	Description of reform
1999	National Numeracy Strategy	Concerned with lesson structure and content; included a three-part daily mathematics lesson of around an hour: (1) whole-class mental arithmetic; (2) main teaching activity; and (3) a plenary with emphasis on interactive whole-class teaching. Lessons had an increased emphasis on number and calculation, and a detailed week-by-week framework, which introduced mathematical skills at an earlier age. (Paragraphs 2.11 to 2.13)
2003	Primary National Strategy	Web-based Strategy that brings together the National Literacy and National Numeracy Strategies. It encourages schools to be more flexible and creative in managing the curriculum and provides materials to support pupils of different abilities. It introduced the three WAVE intervention programmes for all pupils (Wave 1), identified groups of pupils (Wave 2) and identified individual pupils (Wave 3). (Paragraphs 2.11 to 2.13)
2006	National Centre for Excellence in the Teaching of Mathematics	The Department established the National Centre in response to the recommendations of Professor Adrian Smith's 2004 report into post-14 Mathematics Education <i>Making Mathematics Count</i> . The Centre operates as a virtual web portal, with a network of regional coordinators providing a physical presence, and aims to enhance professional development for mathematics teachers in all education sectors in England. It receives annual funding of £5 million. (Paragraphs 2.26 to 2.27)
2006	Revised Primary Framework for Mathematics	This encourages teachers to depart from a rigid use of the daily mathematics lesson and apply their teaching approach and pedagogy according to individual pupils. It supports curriculum planning for different levels of attainment and provides a detailed outline of mathematics teaching for each year. Supporting materials target pupils making slow progress and link to levels rather than age-related expectations. (Paragraphs 2.14 to 2.16)
2007	<i>Making Good Progress</i> Pilots	These are running from 2007 to 2009 in 386 primary schools across 10 local authorities and are aimed at improving teachers' ongoing assessment and tracking of pupils. They include one-to-one tuition for pupils who are making less progress, and are trialing new tests which pupils take when ready. Provisional funding for 2008-09 is £7 million.
2008	<i>Every Child Counts</i> Pilots	This programme mirrors the <i>Every Child a Reader</i> recovery programme and starts in 2010; pilots started in autumn 2008, with plans to reach 30,000 pupils by 2011. It is aimed at pupils aged 6-7 who do not show expected progress in mathematics. They receive intensive daily support, both one-to-one and in groups. Funding for 2007-08 and provisional funding for 2008-09 is £1.3 million.

Source: National Audit Office review

NOTE

The impact of the Primary National Strategy, including the National Numeracy Strategy and the Revised Primary Framework for Mathematics is evaluated at paragraphs 2.13 – 2.19. We review the impact of the National Centre for Excellence in Mathematics at paragraphs 2.26 – 2.27. It is too early to assess the impact of the *Making Good Progress* and *Every Child Counts* pilots.

Delivery arrangements for the Primary National Strategy

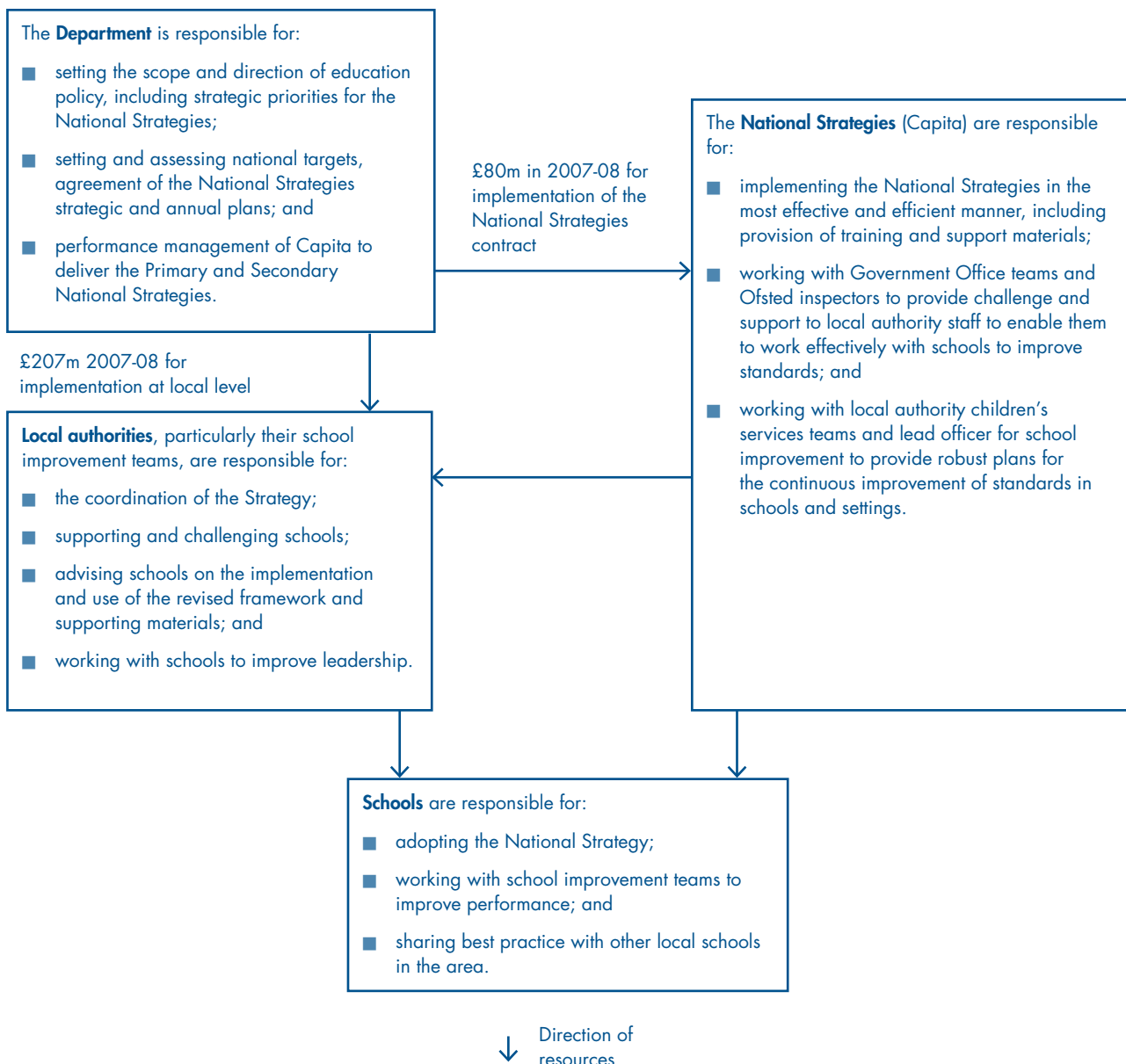
2.6 Figure 15 sets out the roles and responsibilities for the delivery of the Primary National Strategy.

2.7 In 2005, following a competitive bidding process, the Department awarded a contract to Capita Strategic Children's Services (Capita) to deliver the National Strategies (primary and secondary). Capita are responsible for centrally managing the National Strategies, including the production of materials, provision of advice and guidance, and provision of a regional field force to challenge and support local authorities and schools.

2.8 The contract runs from 2005 to 2010, with arrangements beyond 2010 currently under discussion. The cost of the contract for running all the National Strategies programmes was £80 million in 2007-08, which includes the production and distribution of free resources and training materials to schools. The Department estimates that, of this £80 million, some £3 million was spent on the primary mathematics element.

2.9 The Department draws up a strategic plan which sets out priorities for three years and feeds into a detailed annual plan agreed between the Department and Capita, as contractor for the National Strategies. The Department reviews performance against five key contract

15 Delivery of the Primary National Strategy



Source: National Audit Office review

performance indicators: relationship management, management reporting, delivery of the annual plan, corporate services, and technology. Between April 2007 and May 2008 performance was judged more than satisfactory for all five indicators. There are, however, no incentives in the contract for exceptional performance or penalties if agreed outcomes are not achieved.

2.10 The overall delivery of the contract was assessed as 'green' at May 2008. However, there were six specific issues outstanding at both February 2007 and April 2008, of which four remained unchanged, suggesting little progress in resolving them. The Department rated as 'red' the National Strategies' stock management, which poses a moderate risk of a major impact on the successful delivery of the contract.

National programmes' impact on performance in mathematics

The Primary National Strategy

2.11 It is difficult to evaluate directly the impact of the Primary National Strategy or the earlier National Numeracy Strategy on the achievements of pupils in mathematics, as many factors influence the outcomes including the personal development and behaviour of pupils and their home environment. However, our review of the evidence has found that these interventions have led to greater structure and consistency in planning lessons and teaching mathematics, which have helped improve performance.

2.12 Ofsted considers that the Strategy has helped raise achievement, though a 2008 review by the Inspectorate found that its impact had been good in just over half of the primary schools inspected over the previous two years.⁶ The main reason identified for its lack of impact was that schools had a limited understanding of the principles of the Strategy. The review also stressed the importance of strong school leadership in ensuring the Strategy's recommended approaches to teaching are consistently applied.

2.13 Weaknesses remain, in particular teaching mathematical concepts; the use and application of mathematics; teaching the 'middle years' (years 3 and 4) when pupil progress tends to slow down; and the formative assessment of pupils. Ofsted's programme of mathematics inspections from 2005 to 2007 found teaching and learning to be no better than satisfactory in a third of the primary schools surveyed.⁷ A major change in teaching and learning of the subject is required if there

is to be a further step-change in attainment. The revision of the primary mathematics framework, which schools have started to use since September 2007, is intended to address the need for change, for example by giving greater attention to using and applying mathematics, by providing materials targeted at under-achieving pupils, and by supporting more accurate pupil assessment and more focused learning.

The revised primary framework

2.14 While most of the schools we visited are using the revised framework at least to some extent, views were mixed as to whether it will help raise performance. The most commonly mentioned benefit was clearer targets, objectives and outcomes. However just over a quarter of respondents to our survey considered that the framework had so far had little or no impact on raising attainment in mathematics; and nearly a third said that it had had little or no impact on raising enjoyment. Suggestions for improvements included better links between planning and pupil assessment, more cross-curricular links, and improvements to the online lesson planning tool.

2.15 Local authorities support schools in using both the framework and the materials for teaching and assessment. The majority of schools that we visited considered that training on the revised primary framework was good or very good, but over a quarter felt it was poor or very poor. In larger local authorities in particular, continuing professional development on the framework has been targeted at schools where many pupils are not reaching expected levels of attainment; and some authorities have paid less attention to schools whose pupils have higher attainment at age 7 but do not make the amount of progress that might be expected by age 11 (often referred to as 'coasting schools'). The Department has identified continuing professional development in using the framework and associated resources as a key area requiring further improvement.

2.16 The revised framework is designed to provide pupils with a more coherent learning experience through their primary school years. However the Primary National Strategy's website shows increasing downloads of materials focused on year 6. We also found from our visits that schools still tend to make the greatest use of resources to prepare pupils for the Key Stage 2 tests in year 6; the schools estimated that they spent from £1,000 to £3,000 on additional teaching support staff for this year group. Of our survey respondents, 40 per cent estimated that they spent more than 60 per cent of their teaching

⁶ Ofsted, *Evaluation of the Primary and Secondary National Strategies 2005-07*, February 2008.

⁷ Ofsted, *Mathematics: understanding the score*, September 2008.

time preparing for the Key Stage 2 tests. Ofsted and other commentators have suggested that too much emphasis is placed on intensive provision in year 6, including “booster” classes, rather than developing more lasting styles of mathematics teaching and learning embedded in earlier years.

2.17 For continuing professional development, from 2007-08 the National Strategies has sought to achieve a more equitable distribution of teaching resources of all kinds, including participation by the best mathematics teachers, across the primary curriculum. Material provided to schools in 2007-08 focused on years 1, 3 and 5, and in 2008-09 the focus of resources is on years 2, 3 and 4.

2.18 A consistent finding from our school visits was the difficulties teachers have in using the Primary National Strategy’s website. The site is a valuable source of ideas and support but can seem impenetrable. Some material on the site is outdated or has been superseded. We found particular concern over the complexity of the framework’s interactive lesson planning tool, which the Department wants to see widely used in schools. Current take-up of the tool is low, with schools preferring to use their own planning systems.

2.19 Following consultation with users, the website is to be relaunched from November 2008. It is designed to put all relevant material in one place. It is also planned to provide considerably improved search capabilities, as well as a better understanding of the needs of users through more sophisticated analysis of how teachers are using the website. It is too early to assess the impact of these changes.

National whole school improvement programmes targeted at under-performance

2.20 In addition to whole-school improvement programmes outside of the National Strategies, such as the London Challenge, two programmes within the Strategies were aimed at raising achievement principally in mathematics and English:

- The Intensifying Support Programme (from 2007 renamed the Improving School Programme) was targeted at under-performing schools and sought to raise standards and improve the quality of teaching and learning in English and mathematics and establish new ways of working with targeted schools and local authorities.
- The Primary Leadership Programme, which ended in 2006, aimed to improve the quality of teaching and learning and leadership capacity, particularly in under-performing schools.

2.21 From 2003 to 2007, £78.6 million was spent supporting schools on these programmes, with over 10,000 primary schools involved in the Primary Leadership Programme and over 2,200 schools involved in the Intensifying Support Programme. Both programmes have been generally well received by primary schools taking part, and independent reviews have found a positive impact on performance. For example, schools that participated in the Intensifying Support Programme for at least one year between 2003 and 2007 achieved a 3.4 percentage point increase in the proportion of pupils achieving level 4 or above in 2007 compared to 2006, whereas schools not on the Programme achieved a smaller, 0.7 percentage point, increase. Provisional figures for 2008 (paragraph 1.2) indicate that schools participating in the Programme have made a similar improvement this year, and that for hard to shift schools (paragraph 1.22) participating in the programme, a strong improvement is indicated.

2.22 Improvements in results can, however, prove difficult to sustain over time, particularly in the hard to shift schools. Better coordination of school activity is also needed so that individual schools are not overburdened by the demands of participation. Our analysis indicates that some 1,300 schools that were part of the Intensifying Support Programme also participated in the Primary Leadership Programme, including over 200 in the same year.

2.23 The strategic plan for the National Strategies has made the development of a clear and consistent approach to school improvement a priority over the next three years. This includes seconding a senior mathematics adviser to the *Making Good Progress* pilot until April 2009, so that the emerging findings of the pilot can be incorporated into the National Strategies’ mathematics planning.

Bespoke support to targeted local authorities

2.24 The number of Primary National Strategy advisers employed in local authorities has been reducing gradually, and from 2007 the emphasis has been on offering bespoke support, particularly to schools and local authorities that are underperforming. Using bi-monthly management information, support in raising mathematics performance has been targeted at certain local authorities where the numbers of pupils involved are large or where underperformance is significant, and on smaller high-priority local authorities where there are concerns about the authorities’ capacity to make a difference. The nature and level of support is determined annually in joint planning between Regional Advisers and the authorities concerned, with progress reviewed every school term. A consistent feature has been to challenge the local authorities’ low expectations of the progress pupils should make in mathematics, and set appropriately challenging targets.

2.25 In 2006-07 34 local authorities received targeted support. **Figure 16** shows that, of these authorities, 79 per cent increased the proportion of pupils achieving the target level or above at Key Stage 2 by at least one percentage point compared to 53 per cent of all other local authorities. Half of those targeted achieved increases of two percentage points or more in 2007 compared with 2006, although one in five made either no gains or their performance worsened.

Impact of the National Centre for Excellence in the Teaching of Mathematics

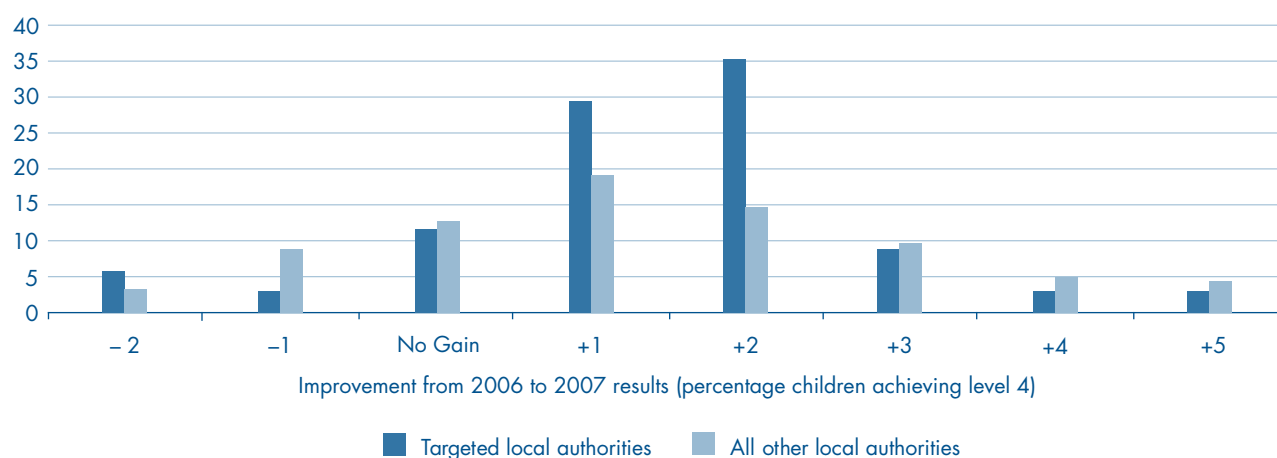
2.26 The National Centre for Excellence in the Teaching of Mathematics operates as a web portal, providing online materials for professional development and classroom use at both primary and secondary level. It also functions as a communication tool for the teaching community through

online fora and blogs. In 2007-08, the portal received over 960,000 hits; a 200 per cent rise on the previous year. A more detailed analysis, however, showed that almost two-thirds of visitors visited the portal on one occasion only between July 2007 and May 2008, and the average time spent on it was three and a half minutes.⁸

2.27 An evaluation of the Centre commissioned by the Department and published in September 2008 found that although the Centre had considerable potential to deliver positive impacts to the teaching staff engaging with it, the impacts had generally not yet been evidenced by changes in the classroom or the professional development culture. The evaluation concluded that it would be timely for the Centre to review its objectives and concentrate on achieving greater and more visible impacts on teaching staff and pupils, including contributing to an increased take-up of professional development opportunities.⁹

16 Targeted local authorities achieved better results in mathematics at Key Stage 2 in 2006-07

Percentage of local authorities



Source: Statistical First Releases 2003-2007

⁸ GHK Consulting, *National Centre for Excellence in the Teaching of Mathematics*, Research Report DCSF – RW062.

⁹ GHK Consulting, *National Centre for Excellence in the Teaching of Mathematics*, Research Report DCSF – RW062.



Further actions needed to improve performance in primary mathematics

3.1 This part of the report considers areas where the Department, local authorities and schools will need to improve performance if the Department's targets for 2011 are to be met, and if greater numbers of pupils are to enter secondary school with a secure foundation and interest in mathematics.

Prospects for meeting targets for primary mathematics by 2011

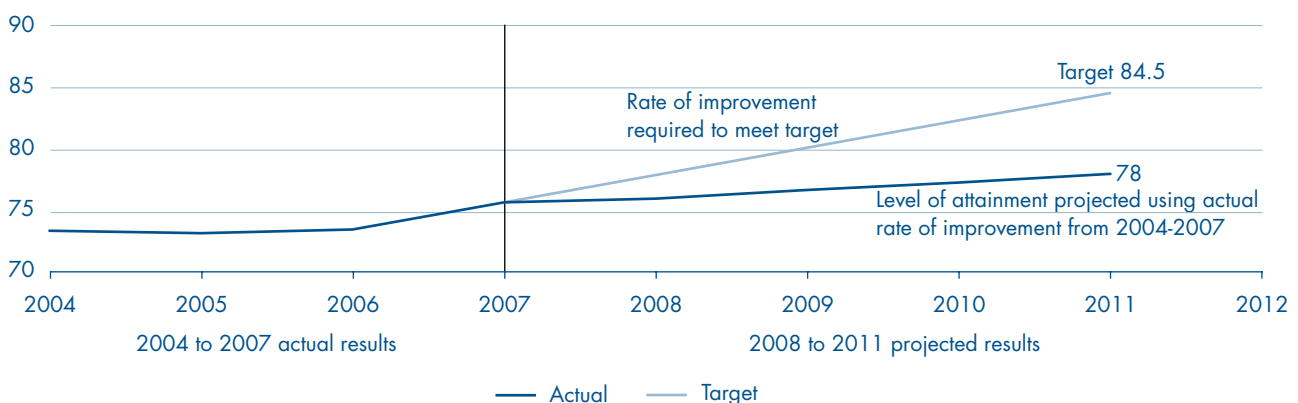
3.2 Based on the average rate of improvement in performance between 2004 and 2007, achievement in combined mathematics and English at Key Stage 2 is projected to increase to 74 per cent by 2011, compared with a target of 78 per cent. **Figure 17** shows that the progression target in mathematics of 84.5 per cent may be missed by some 6.5 percentage points; meeting the

progression target would require an extra 12,000 pupils each year to make the expected level of progress by the end of primary school. It will be equally important to improve achievement among relatively high attaining pupils who could achieve more than simply reaching the expected levels of performance, to narrow the gender gap, and to narrow the gap between pupils from low income and disadvantaged backgrounds and their peers.

3.3 Gaps in achievement persist in part because they are difficult to remedy. The research demonstrates that the reasons for them are complex and reflect relationships between individual characteristics and family background including parental qualifications. Nevertheless, improvements in achievement have illustrated the impact that teachers, schools, and school and subject leaders can clearly have. Through our review of the evidence of good practice and visits to schools, we identify below

17 Projected progress in mathematics at Key Stage 2 suggests the 2011 target is at risk

Percentage attaining level 4 in mathematics



Source: National Strategies Strategic Plan 2008-11

NOTE

An annual increase of some 12,000 pupils that is required to meet the target can be broken down as an additional 8,000 pupils progressing from level 2C to level 4 (a 17.5 per cent increase) and an additional 4,000 pupils progressing from level 2B to level 4 (a 5 per cent increase).

four areas which, if given appropriate attention, can be particularly effective in raising the achievement of pupils in mathematics:

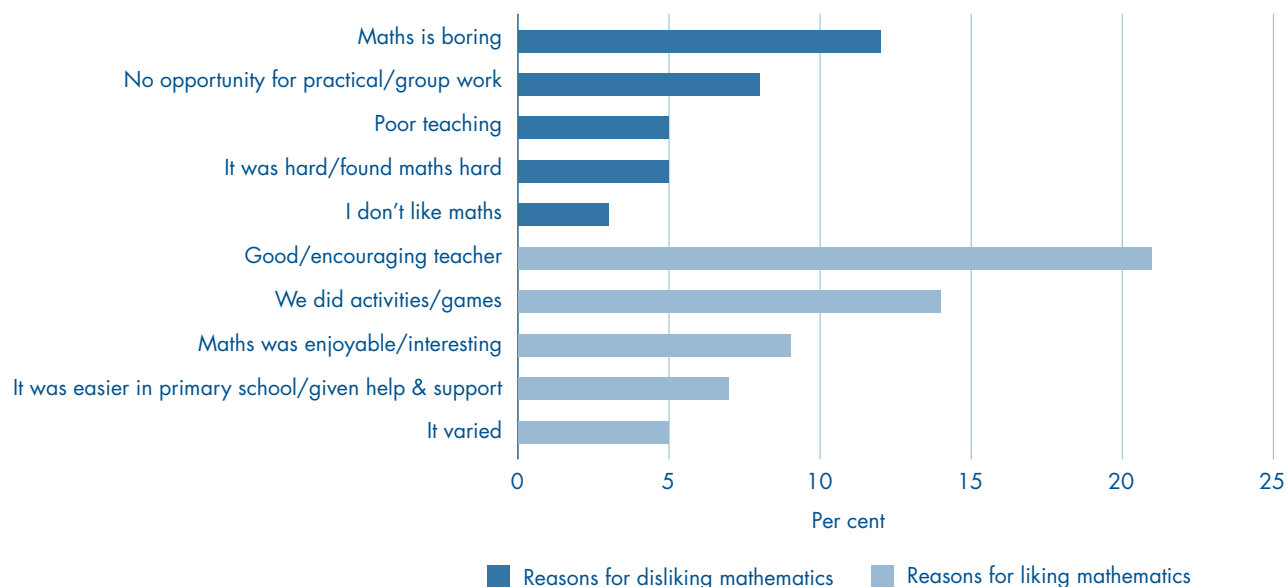
- high quality teaching of mathematics (paragraphs 3.4 to 3.15);
- effective use of pupil performance data (paragraphs 3.16 to 3.17);
- strong school leadership (paragraphs 3.18 to 3.21); and
- strong relationships with parents/carers and secondary schools (paragraphs 3.22 to 3.25).

The quality of teaching of mathematics

3.4 Teaching quality is a key determinant in improving the educational performance of pupils.¹⁰ Reflecting the research in this area, our survey of secondary school pupils found that the most common spontaneously given reason for their positive reflections on their primary mathematics learning was a good and encouraging teacher (**Figure 18**). Good teaching of mathematics, as with other subjects, broadly consists of two mutually reinforcing aspects: subject knowledge and pedagogy.

18 A good and encouraging teacher was the most common reason secondary school pupils gave when asked why they liked or disliked mathematics when they were at primary school

Reasons for views



Source: Ipsos MORI Young People Omnibus 2008 conducted for the National Audit Office

NOTE

Base – 1,129 secondary school pupils in years 7 or 8. A fuller breakdown of results accompanies this report and can be found on our website at: www.nao.org.uk

¹⁰ Several studies point to the prime importance of teaching quality including Sammons, P et al (2008), *Effective Pre-School and Primary Education 3-11 Project* (EPPE 3-11); *The Influence of School and Teaching Quality on Children's Progress in Primary School*, DCSF research report – RR028; Barber, & Mourshed, 2007, *How the best performing school systems come out on top*, McKinsey & Company.

Subject knowledge

3.5 As noted earlier (paragraph 2.5), the Williams Review's principal finding was that for performance to markedly improve, so must the subject knowledge of primary mathematics teachers; and the review made recommendations to foster greater subject specialism (Figure 19).

19 The main findings and recommendations of the Williams Review on primary mathematics teaching

Key findings

A combination of deep subject knowledge and pedagogical skills is required to promote effective learning in mathematics.

There is a need for every primary school to have access to a specialist mathematics teacher to champion mathematics in the school and act as mentor and coach.

The presumption that mathematics is fully addressed within the core curriculum of both undergraduate and postgraduate primary teacher training courses is not universally a safe assumption. The focus should be on continuing professional development.

Key recommendations

When the second GCSE in mathematical thinking is firmly established in schools, the Government should review whether attainment of a minimum of grade C at both GCSE I and the new GCSE II mathematics should become a requirement for entry into initial teacher training.

13,000 specialist mathematics teachers should be trained over 10 years from 2009 so that the majority of primary schools have one such teacher and appropriate arrangements are made for small and rural schools.

The National Strategies, in partnership with the National Centre for Excellence in the Teaching of Mathematics, should develop refresher continuing professional development training for all local authority mathematics advisers.

Source: Sir Peter Williams' *Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools, Final Report, June 2008*

3.6 The minimum mathematics qualification required for entry to both undergraduate and postgraduate primary teacher training courses is demonstration of a standard equivalent to a grade C in mathematics at GCSE. Undergraduates starting initial teacher training courses must also pass professional skills tests in numeracy, literacy and Information Communication Technology (ICT), and all trainees must demonstrate they can teach the core National Curriculum subjects competently and using the Primary National Strategy, prior to gaining Qualified Teacher Status. It is not known how many trainee primary teachers have studied the subject at A-level or equivalent, since the Training and Development Agency for Schools does not as yet collect this data. With regard to higher qualifications, the percentage of graduate primary teacher trainees with first degrees in a science, technology, engineering or mathematics (STEM) discipline decreased from around four per cent to two per cent between 2004 and 2006, during which time the total cohort of primary teacher trainees on postgraduate courses each year numbered around 10,000.¹¹ There are no mandatory qualifications for teaching assistants; most gain qualifications once employed or as a volunteer in a school, including training to achieve higher level status. Research has found that just over half of teaching assistants were educated beyond the GCSE or O level standard.¹²

3.7 There is no national data on the career development of teachers after qualifying, but available evidence indicates that relatively few primary teachers take up continuing professional development (CPD) in mathematics and the take-up has decreased over the last ten years. Changes in local authority funding and staffing structures over the last decade have led to a decline in the number of senior staff with specific responsibility for mathematics in many authorities and this has contributed to the decrease in mathematics CPD. Much of the training provided to schools now concentrates on general school improvement and has shifted away from subject-specific CPD. A prerequisite to being a local authority primary mathematics adviser is previous primary teaching experience in mathematics, but all the advisers we spoke with agreed with the Williams Review's recommendation that they should receive refresher training to update their subject knowledge and teaching skills. They suggested that focussing such training on early years work (including Key Stage 1) and using and applying mathematics would be most beneficial to them.

11 The Royal Society (2007), *The UK's science and mathematics teaching workforce*.

12 Blatchford et al (2006), *Deployment and Impact of Support Staff in Schools: Report on findings from the Second National Questionnaire Survey of Schools, Support Staff and Teachers*, DCSF research report – RR005.

3.8 To improve specialist CPD capacity, the Department has encouraged schools and teachers to collaborate with their peers and share good practice. In 2004, it gave one-off funding of £17,000 (plus £2,000 for networks specialising in mathematics expertise) to those lead schools that wanted to develop local networks of primary schools to aid teaching improvement in mathematics and English. When funding ended in 2006, a total of £38.5 million had been spent on the programme. The intention was that by 2008, the majority of primary schools would have access to an effective network. However a 2007 survey of teachers indicated that the majority of schools were no longer engaged in local mathematics networks¹³; and other evidence suggests that the networks have had only limited effect, with only the larger local authorities able to provide sustained support and funding.

3.9 Efforts have recently refocused on teacher-to-teacher coaching and mentoring through encouraging joint work such as peer observation and lesson study. From September 2007 the Leading Teachers' programme provided for those teachers identified as strong in teaching mathematics to undertake ten days outreach work each year in other local schools identified as requiring support. At present the take-up of the programme is low.

Pedagogy

3.10 Reflecting on their experiences of mathematics at primary school, the most common reason given by secondary school pupils we surveyed for disliking the subject was that it was boring (Figure 18). Evidence from Ofsted and members of our expert panel (paragraph 14 of Appendix 1) indicates that high performing teachers motivate pupils by making mathematics satisfying and engaging to learn. They convey the essence of mathematics and its relevance to real life, linking it with a wide range of oral, written and physical activities including puzzles and mental games. Many teachers we spoke with felt teaching assistants helped to increase pupils' engagement in the lessons, particularly for lower attaining groups, although there is little quantitative evidence of their impact on attainment. Teaching mathematics creatively across the curriculum can prove more of a challenge and, in the schools we visited, examples were generally restricted to science and Information and Communication Technology. Internationally, countries that perform strongly in primary

mathematics, such as the Netherlands and Latvia, are sources of effective practice. In the Netherlands, the development of *Realistic Mathematics* education provides a good example of pedagogical practice, and in Latvia pupils are stretched and motivated through encouragement and support in participation in national mathematics competitions (Appendix 5).

3.11 Information and Communication Technology, and in particular interactive whiteboards, can enhance mathematics teaching and learning if used effectively. However some schools we visited had doubts about how much value technology added. Primary schools spend an estimated average of £50,000 annually on costs associated with ICT¹⁴, including opportunity costs such as staff training; but use of the technology is sometimes relatively unsophisticated and training is often limited to learning about the software rather than how it can best be used in the classroom. Ofsted has found that high performing teachers use ICT as just one of a range of carefully planned resources.

3.12 Motivated pupils of all abilities we spoke with perceived themselves to be good mathematicians. To build this confidence, research shows that high performing teachers are able to differentiate learning effectively, so that pupils have the right degree of challenge and support. In doing so, they make effective use of assessment techniques. Such techniques can significantly and cost-effectively improve pupil performance (**Case Example 1 overleaf**).¹⁵ Nationally there is considerable scope for improvement in pupil assessment; Ofsted consistently finds it to be one of the weakest aspects of teaching. In mathematics, assessment tends to focus on written work that can be more easily measured, but is under-developed in those areas not well understood or taught such as using and applying and mathematical concepts. For the latter, members of our expert panel (Appendix 1, paragraph 14) stated that good mathematics teachers know how to deconstruct and then reconstruct concepts such as multiplication and division in language that can be understood by, and engages, their pupils. In English, teachers may more easily explain how to improve a piece of work without the original work being seen as "wrong" in the pupil's eyes. Experts commented that in mathematics, teachers commonly tend to move pupils on to new topics if their work is correct rather than stretch pupil understanding by teaching current topics in greater depth.

¹³ The National Centre for Excellence in the Teaching of Mathematics, *Survey of Continuing Professional Development*, 2007.

¹⁴ Becta, *Managing ICT costs in schools*, 2006.

¹⁵ Studies have found that the proper use of formative assessment is significantly more cost-effective than the reduction of class sizes to achieve a similar gain in pupil achievement. Wiliam, D (2007), *Content then process: teacher learning communities in the service of formative assessment*, In D. B. Reeves (Ed.), *Ahead of the curve: the power of assessment to transform teaching and learning*, Bloomington.

3.13 In May 2008, the Department allocated some £50 million to primary and secondary schools annually until 2011 to support improvements in pupil assessment. In 2008-09, £30 million of this amount is allocated to primary schools with funding decisions on the split between primary and secondary schools for subsequent years still to be confirmed. In addition, the Primary National Strategy website has added resources to assist schools to develop their understanding of how to assess pupil progress. It is too early to conclude on their impact on schools.

CASE EXAMPLE 1

Assessment for Learning

Fellside Community Primary School

The Year 6 teacher (who is also the Deputy Head and mathematics coordinator) makes extensive use of assessment techniques in her daily mathematics class of 30 pupils, which are informed by a detailed prior knowledge of her pupils' ability and their particular learning styles. The techniques include:

- sharing the lesson objective clearly with the pupils at start and end of the lesson;
- asking open questions and waiting long enough for answers to allow pupils more space to think;
- purposefully directing more challenging questions towards the most able pupils;
- directing specific questions to the children who find mathematics difficult, and making sure they have time to respond and others do not 'jump in' with the answer;
- encouraging pupils to talk through their mathematical thinking, including suggesting and explaining alternative methods of calculation or ways of solving the particular problem.

In the main part of the lesson the teacher sets guided work for smaller groups of children within the class, and allocates teaching assistant support as appropriate. Rather than simply setting higher level exercises, the tasks given to the more able pupils help them develop a deeper understanding of the topic and to "think like mathematicians" – to enquire and question. Pupils work with their peers or individually, as appropriate to the task.

Regular assessment and feedback are used as positive motivational tools and are not regarded negatively by pupils. When marking pupils' work, the teacher makes sure she always gives comments that indicate strengths and how to improve. Pupils also self-assess their own work to indicate whether they feel they have understood the topic and made good progress.

Source: National Audit Office

3.14 While most of the schools we visited differentiated learning in mixed ability classes (and in the case of smaller schools, in mixed age classes), some chose to set pupils by ability. Staff in these schools informed us that setting had improved performance across the ability range, but stressed that the success of the arrangements depended on their fluidity so pupils could easily transfer between sets and making sure that expectations for all pupils are suitably high. Reviews of the literature in this area have concluded that there are no significant differences between setting and mixed ability teaching in overall attainment outcomes, and low achieving pupils can make less progress in classes that are set by ability.¹⁶ The Department's view is that setting can be a positive factor in improving performance if done well, but that in a number of schools setting is not implemented effectively.

3.15 High performing schools adjust their teaching approaches to take account of the preferred learning styles of pupils as well as levels of ability. As an example from a school we visited, Hasland Junior School holds an annual 'brain week' at the start of the autumn term, where teaching staff collectively discuss and identify the ways in which their current cohorts of pupils learn best. The teachers target resources and adjust their teaching styles accordingly for the year ahead. Experts we consulted (Appendix 1, paragraph 14) suggested that, for mathematics teaching, while 'hard thinking' methods such as the oral repetition of multiplication tables and whole-class question-and-answer sessions are important, they may not suit the learning styles of all pupils. For example, some pupils may prefer to work on their own or in small groups.

Current and reliable data through pupil data systems

3.16 Through national data analysis tools such as RAISE (Reporting and Analysis for Improvement through School Self-Evaluation) online, schools have access to detailed pupil performance data and all the schools we visited had systems in place to track pupil progress and attainment. However the national data model can encourage schools to give undue weight to historical performance and not give sufficient attention to sub-level performance (paragraph 1.11). Many local authorities similarly tend to set targets for schools based on performance of pupils who have since moved on rather than the current cohort. The evidence also indicates that many schools are better at identifying pupils working at relatively low levels who are not catching up, rather than more able pupils who could move on more quickly.

16 Kutnick et al (2005), *The Effects of Pupil Grouping: Literature review*, DCSF research report – RR668.

3.17 Monitoring systems worked best when they were simple to use and regularly updated, identified pupils individually, and compared class and year group profiles against local and national expectations. The best systems could also easily identify the impact of particular interventions on pupil achievement. It is important that the data (suitably anonymised) are accessible, including to teaching assistants, governors and local authority advisers, to underpin the shared understanding of performance and expectations that is necessary in setting challenging but realistic targets and deploying resources to best effect.

School leadership

3.18 There is a well established link between the overall effectiveness of schools and the quality of their leadership and management, which was illustrated in many of our visits to schools (**Case Example 2**).¹⁷ Strong leadership manifests itself in:

- a clear vision and dedication to school improvement and prioritisation of teaching for learning;
- high expectations of what should be taught and how and strong promotion of an achievement 'can do' culture;
- active management of the curriculum;
- extensive involvement of all staff in decision making; and
- sufficient allocation of teachers' time for curriculum planning and professional development.

3.19 Nationally Ofsted rated the quality of leadership in primary schools as good or outstanding in over 60 per cent of schools inspected in 2006-07. Further improvements would be very likely to have a substantial impact on pupil achievement. The role of headteacher is, however, challenging. The role is increasingly diverse, involving operational matters such as financial, human resources and facilities' management as well as the professional leadership of teaching staff. The National College for School Leadership estimates that well-qualified and well-deployed school business managers can release up to 30 per cent of a headteacher's time from these activities. Some primary schools may not be of sufficient size to justify a full-time business manager, but it is possible to share such a post across two or more schools.

3.20 Leadership of mathematics in a primary school similarly needs to be supported by appropriate expertise. All the schools we visited that achieved good results in mathematics had a strong mathematics coordinator, often an assistant or deputy headteacher, who worked closely with the headteacher and led on mathematics teaching and learning practice in the school. These coordinators identified gaps in teachers' mathematics knowledge and led school training sessions to enable teachers to become familiar with mathematics teaching resources, and monitored standards and the quality of teaching. They also organised regular pupil progress meetings to allow staff to reflect on the impact of their mathematics teaching methods.

3.21 Headteachers are also better placed to provide clear leadership of mathematics if they are appropriately supported and challenged by governors. In particular, governors need a sound understanding of pupil performance data so that they can challenge potential areas of weakness and apply pressure where changes need to be made. Allocating subject responsibilities to specific governors helps individuals to develop more in-depth expertise. Some governing bodies also have particular governance arrangements that help governors collectively to apply concentrated attention to specific parts of the curriculum (**Case Example 3 overleaf**).

CASE EXAMPLE 2

Strong School Leadership

Parkinson Lane Community Primary School

The school was underperforming when a new headteacher took over. In a short period he has turned the school around such that now there is a waiting list for enrolment, and pupils are motivated, challenged and encouraged to learn. The school ethos is to make education fun and enjoyable, and the headteacher and his team have created a climate of celebration.

The school is in a deprived and largely ethnic minority area, but in 2007 came in the top 20 of schools in the country for adding value to the pupils' performance between the ages of seven and 11 based on their background. The school has been awarded Artsmark Gold, Kelloggs Best Breakfast Club in the UK, and achieved Health School Investor in People and Pupils status. Mathematics teaching has been developed to show pupils how it can be applied to real life issues and activities.

Source: National Audit Office

17 James C, Connolly M, Dunning G, Elliot T (2006), *How Very Effective Primary Schools Work*, Paul Chapman Publishing.

Relationships with parents and secondary schools

Parents and carers

3.22 Family involvement in their children's education has a positive impact on pupil achievement. However some schools, particularly those in more disadvantaged areas, can face considerable barriers. In addition to practical obstacles that make certain social and ethnic groups harder to reach, such as lack of time or child care and language problems, engaging families in their child's mathematics education can be especially problematic when the adults themselves have their own difficulties with the subject. In a recent report on adult learning, we found that 15 to 20 per cent of adults do not have basic functional numeracy skills.¹⁸

3.23 Illustrative of the good practice recognised by Ofsted and others, many schools we visited were making concerted efforts to support parents and carers in helping their children learn mathematics and to involve them in school activities. Examples included family learning events ranging from informal coffee mornings to parental classes on the curriculum, as well as readily understandable material explaining the school's approach to teaching mathematics (**Case Example 4**). Some schools which had high levels of parental involvement stressed the importance of educating parents on how the school taught mathematics to ensure a consistent approach to teaching and learning mathematics with a clear focus on progression; they found the less able pupils in particular became confused and demotivated by learning different techniques at home and at school.

Secondary schools

3.24 A close and mutually supportive relationship between a primary school and the local secondary school(s) is particularly important for continuity in learning in mathematics and other subjects when pupils make the transition. Research has shown that the transfer can result in a dip in motivation and progress, with up to 30 per cent of pupils making no progress in mathematics between year 6 and year 7.¹⁹ In our survey of secondary school pupils, although almost half of those who were in Year 7 found the step up in mathematics learning from the last year of primary school somewhat harder; nearly one fifth thought it was a lot harder suggesting that more could be done to prepare for the transition. Of the pupils we surveyed, 30 per cent were enjoying the subject less in secondary school.

CASE EXAMPLE 3

Effective school governor arrangements

South Farnham Community Junior School

The school has 18 governors working across four sub-groups – finance, personnel, building and health and safety, and curriculum – who meet once a term.

All governors sit on the curriculum sub-group, and each term go into a subject in depth, including mathematics once every two years. This involves a presentation by the subject teacher and class observations of each year group. The aim is to achieve a full understanding of how the subject is being taught, and to make observations accordingly. The governors produce an informal report, and any relevant comments are fed back to teachers via school management. The governors' report is used as a baseline to check that any required changes have been made when the subject is next reviewed.

Source: National Audit Office

CASE EXAMPLE 4

How schools support families to help children learn mathematics

Robert Mellors Primary and Nursery School, Nottingham

A termly mathematics newsletter focuses on particular topics. The subtraction newsletter, for example, described the seven methods the school uses to teach the subject. The methods are presented in simple language and clearly illustrated with diagrams alongside a variety of games that parents can play with their children to practice subtraction. A family mathematics day is also held at the school every term.

Feedback is positive with many adults surprised to find that the method they learned at school is only one of the techniques their children are being taught.

St Anthony's Primary School, Birmingham

Inspire workshops – a local authority-led programme aimed to encourage the involvement of families in their children's literacy and numeracy – are held once or twice a term and are advertised to parents and carers as an opportunity to come and spend an hour at the school in a lesson with their child. It enables them to see what their child is doing and encourages more active involvement in the child's learning.

The success of the programme has been demonstrated by high levels of attendance – 90 per cent of parents or carers attended a session during the year.

Source: National Audit Office

¹⁸ National Audit Office Report by the Comptroller and Auditor General, *Skills for Life: Progress in Improving Adult Literacy and Numeracy*, HC 482 Session 2007-2008.

¹⁹ Galton et al (2003), *Transfer and Transitions in the Middle Years of Schooling (7-14): Continuities and Discontinuities in Learning*, DCSF research report – RR443.

3.25 Although we found examples of good practice (**Case Example 5**), most primary schools we visited felt their transition arrangements could be improved, particularly those with pupils moving to a number of different secondary schools. Nationally Ofsted rates transition arrangements in relation to the continuity of teaching, learning and assessment as weak. Some teachers commented that their secondary counterparts tended not to rely on the pupil performance data they provided, preferring instead to re-assess pupils on entry to the secondary school after the summer break. Evidence of concentrated, short-term interventions in year 6 (paragraph 2.16) may account for some differential in pupil performance pre and post summer, and the unwillingness of secondary teachers to rely on test scores.

CASE EXAMPLE 5

Effective secondary school transition arrangements

Harrow Gate Primary School

This school has close links and coordination with secondary schools. There are opportunities for induction, taster days and visits between the school and a number of secondary schools, which improves the transition experience for pupils.

In particular, the following initiatives were in place to introduce pupils to secondary schools and help them to feel comfortable with the process of transfer:

- The school year runs from June to June. There is an established transition programme with the main secondary school, Bishopgarth, where 98 per cent of pupils transfer, so they can attend before summer holidays. Visits to the secondary school were for whole classes where they could see examples of work and sample lessons.
- Secondary mathematics and other subject teachers observe Year 6 lessons and vice versa with some cross-teaching.
- Joint Virtual Learning Environment lessons in mathematics and other subjects are coordinated by a teacher in secondary school.

The schools concerned felt these initiatives enabled pupils to adjust socially and institutionally to the new school, and enable them to maintain their curriculum interest and continuity.

Source: National Audit Office

APPENDIX ONE

Study methodology

1 The Comptroller and Auditor General decided to conduct a value for money study on mathematics performance in primary schools for the following reasons:

- A good start in learning and understanding mathematics at primary school paves the way for future success at secondary school and beyond, and has a longer term impact on the social and economic benefits/costs to the nation. There is a strong correlation between success in mathematics at primary school and continuing to succeed at GCSE level, and between underachieving at primary school and continuing to underachieve. Able mathematicians, who are motivated to pursue careers in related professions while at school, are vital to the national economy. Conversely, pupils who underachieve in mathematics (and literacy) at primary school are more likely to be excluded and to truant from secondary school than their peers; to experience poor health outcomes in later life and social exclusion.
- The National Numeracy Strategy, now subsumed into the Primary National Strategy, has been used in maintained primary schools in England since 1999. Unlike literacy, the teaching of which in primary schools underwent significant change in response to a review by Sir Jim Rose in 2006, the teaching and learning of primary mathematics had not been reviewed by Government for almost a decade. During this time, total spending by primary schools has increased by over 30 per cent in real-terms but there is still a significant minority of pupils who are entering secondary school without achieving expected levels of attainment, including in mathematics.

2 In 2007, the Department commissioned Sir Peter Williams to consider whether the quality of primary mathematics teaching needs to improve, and his report was published in June 2008. In setting the scope for our study and carrying it out, we have been informed by regular discussions with Sir Peter Williams' review team and with Ofsted throughout our study, and have drawn on their evidence on teaching quality and good pedagogical practice.

3 This report is based on:

- quantitative analyses of the national pupil database;
- case studies of 28 primary schools;
- semi-structured interviews with officials at the Department for Children, Schools and Families, experts in the field and other key stakeholders;
- omnibus survey of 11 and 12 year old secondary school pupils;
- literature review;
- international comparisons.

Quantitative analyses

4 The Department's national pupil database (anonymised) formed the basis of our analysis. It includes information about individuals' personal characteristics including age, ethnicity, and pupils receiving free school meals. Our analysis included pupils from mainstream maintained schools and therefore excludes all pupils from independent and special schools. Our main quantitative analysis included:

- how pupil attainment in mathematics has changed over time;
- how a cohort of pupils progressed from Key Stage 1 to Key Stage 4 in mathematics;
- how pupil progression in mathematics is affected by prior attainment;
- the extent to which specific groups of pupils are under or over performing in mathematics and the relationship between attainment in mathematics and attainment in other core subjects.

5 We aggregated pupil level data from the national pupil database to school and local authority level. Analysis of school level data included attainment trends, hard to shift schools, school progression and the extent to which attainment varies substantially between different primary schools, and whether there is regional and/or local authority variation, and variation between different funding types.

6 The number and proportion of children reaching specific test levels can be affected by a number of factors which mean that small year on year changes should not necessarily be considered significant, particularly at the local authority level. The biggest administrative change to the 2008 national tests was the removal of borderlining (the process of checking test scripts that fall just below level thresholds) which is estimated to reduce the percentage achieving the expected level by up to 0.2 percentage points in mathematics.

Visits to primary schools

7 We visited 28 primary schools. Since the main research objective of these visits was to identify examples of good practice, the schools we selected generally achieved strong or improving outcomes in mathematics compared with clusters of other schools of similar profiles and pupil intakes; but for comparative purposes, we also selected a minority where weaknesses in performance have been identified by Ofsted and/or the schools themselves. Our sample represented a range of sizes – from a school intake of around 70 pupils to nearly 600 – and school type and included both urban and rural locations. We visited at least one school in every English region including London. The schools were:

Barlby Primary School, Kensington and Chelsea;
 Bonner Primary School, Tower Hamlets;
 Calstock Community Primary School, Cornwall;

Chilcote Primary School, Birmingham;
 Clenchwarton Community Primary School, Norfolk;
 Copeland Road Primary School, Durham;
 Cuckoo Hall Primary School, Enfield;
 Dedham Church of England Voluntary Controlled Primary School, Essex;
 Deptford Park Primary School, Lewisham;
 Fellside Community Primary School, Gateshead;
 Fossdene Primary School, Greenwich;
 Greenhill Primary School, Oldham;
 Harrow Gate Primary School, Stockton-on-Tees;
 Hasland Junior School, Derbyshire;
 Molehill Copse Primary School, Kent;
 Myrtle Park Primary School, Bradford;
 Old Trafford Community School, Lancashire;
 Parkinson Lane Community Primary School, Calderdale;
 Robert Mellors Primary and Nursery School, Nottinghamshire;
 St Anthony's Catholic Primary School, Solihull;
 St Edwards RC Primary School, Middlesbrough;
 St Joseph's RC Junior Infant and Nursery School, Oldham;
 St Martin's Catholic Primary School, Halton;
 Seagrave Primary School, Nottingham;
 South Farnham Community Junior School, Surrey;
 Waycroft Primary School, Bristol;
 Wolverton Primary School, Warwickshire; and
 Yalding, St Peter and St Paul Church of England Primary School, Kent.

8 During each visit we conducted in-depth interviews with the headteacher and mathematics coordinator. In many cases we also interviewed the Chair of Governors, and year 6 teachers and, where possible, parents. We ran teacher and teaching assistant focus groups and met with pupils, and undertook lay observations of classroom practice. Our topic guide for the visits included:

- the impact of the Primary National Strategy and the revised framework;
- leadership and management of the school;
- use of resources to improve performance in mathematics; and
- best practice in teaching and learning mathematics.

Survey of secondary school pupils

9 We added five questions to an annual Ipsos MORI survey that went to a nationally representative sample of 350 secondary schools across the country. In total, 100 schools participated and the researchers interviewed a year 7 or 8 class in 48 of them. The survey was answered by 1,129 11–13 year olds and data was weighted by gender, age and region. The overall aim of the survey was to gather information regarding year 7 and 8 pupils' perceptions of mathematics. The survey covered the following areas:

- what pupils thought of mathematics in primary school;
- the transition from primary school mathematics to secondary school mathematics; and
- how useful pupils think mathematics is.

Literature review

10 We commissioned RAND consultants to review and synthesise published research and evaluations on mathematics education and attainment. This included material by the Department and Ofsted since the introduction of the National Numeracy Strategy in 1999, and searches of academic and other literature. The consultants considered whether lessons learned as a result of the Department's own evaluations of relevant programmes and pilots had been taken account of in subsequent policy direction.

11 Given the large amount of literature on this subject, RAND were asked to concentrate on reviewing the evidence on the effectiveness of reforms in England and identify international evidence on the effects of different teaching modes and conditions on pupil attainment in mathematics. The output of their review was a report which we used as evidence to inform our study.

International comparisons

12 Comparing standards of education and pupil attainment in different countries is difficult due to differences between the countries studied in respect of educational philosophy, education system structure, curriculum and language. The International Association for the Evaluation of Educational Achievement conducts a four yearly survey, the Trends in International Mathematics and Science Study (TIMSS), that began in 1995 and uses a number of techniques adjudged by experts to overcome the main comparative research difficulties, including reporting on the extent and significance of national differences. TIMSS 2007 is due to be published in December 2008.

13 Drawing from the Association's recently published survey, TIMSS 2003, and other literature and expert opinion, we undertook further qualitative research on two countries that are high performing in primary mathematics, the Netherlands and Latvia, to gain a deeper understanding of their primary education structure and teaching and learning strategies employed to improve attainment in mathematics, including targeted interventions. Pacific-Rim countries including Singapore, Japan and Chinese Taipei also tend to be high performing in primary mathematics but it was felt the cultural differences would make comparisons difficult. Our review of good practice identified in their national approaches is detailed in Appendix 5.

Reference panel and our consultation with stakeholder groups

14 We shared our findings with a reference panel for comment. The members were:

- Professor Mike Askew, Mathematics Education Specialist, Kings College, London;
- Professor Margaret Brown, Mathematics Education Specialist, Kings College, London;

- Alison Brunt, Assistant Director, Early Years Foundation Stage/Primary, The National Centre for Excellence in the Teaching of Mathematics;
- Steven Ive, Headteacher and Mathematics Subject Coordinator, Kennington Church of England Junior School;
- Lynne McClure, Mathematics Consultant, Editor of Primary Mathematics Journal for the Mathematics Association.

Throughout our study we consulted widely about the impact of the Primary National Strategy and best practice in raising attainment in mathematics. We interviewed the following experts and stakeholders:

- Paul Bennett, Operational Director – Strategic Initiatives (Primary), the National College for School Leadership;
- Rob Eastaway, Author, Mathematics Communicator, ex-President of the UK Mathematical Association (2007-2008);
- Jean Gross, Director, Every Child a Chance Trust, KPMG Foundation;
- Dr Sue Horner, Head of Standards and Assessment Policy, Curriculum Division, Qualifications and Curriculum Authority;
- Jane Jones, Specialist Adviser for Mathematics, Ofsted;
- Diane Levine, Head of Educational Research and Analysis, BECTA;
- Tony Lovatt, Chair, National Primary Head Teachers' Association;
- Jacquie Nunn, Director, Initial Teacher Training Development, Training and Development Agency for Schools;
- Vanessa Pittard, Director E-Strategy, BECTA;
- Dr Alison Price, Westminster Institute of Education, Oxford Brookes University;
- Professor Dylan William, Deputy Director, Institute of Education, University of London;
- Sir Peter Williams and the Secretariat of the Williams Review of Mathematics.

APPENDIX TWO

Level descriptions in primary mathematics and illustrative assessment questions

	Level 1	Level 2
Using and applying mathematics		Expected level for children who are aged six and seven.
Pupils expected to:	<ul style="list-style-type: none">■ represent their work with objects or pictures and discuss it;■ recognise and use a simple pattern or relationship.	<ul style="list-style-type: none">■ use mathematical language, symbols and simple diagrams;■ explain why an answer is correct.
Number and algebra		
Pupils expected to:	<ul style="list-style-type: none">■ count, order, add and subtract numbers when solving problems involving up to 10 objects;■ read and write the numbers involved.	<ul style="list-style-type: none">■ count sets of objects reliably;■ begin to understand the place value of each digit in a number and use this to order numbers to 100;■ understand subtraction is the inverse of addition;■ mentally solve number problems involving money and measures;■ recognise sequences of numbers.

Level 3

- begin to organise their work and check results;
- discuss their work and explain their thinking;
- use and interpret mathematical symbols and diagrams.

Jonathan reached a speed of 35kph on his trial bike. Caroline went at 46kph. How much faster did Caroline go than Jonathan?

- show understanding of place value in numbers up to 1,000 and make approximations;
- begin to use decimal notation and to recognise negative numbers;
- use mental recall of addition and subtraction facts to 20 in solving problems involving large numbers;
- mentally add and subtract numbers with 2 digits and numbers with 3 digits using written methods;
- understand the 2,3,4,5 and 10 multiplication and division factors;
- use simple fractions.

Level 4

Expected level for children completing primary school (typically aged ten or eleven).

- develop and use their own strategies for solving problems;
- present information and results in a clear and organised way;
- search for solutions by trying out ideas of their own.

Nick looks at this sequence. The difference between the numbers increases by the same amount every time.

6, 9, 13, _ , _

He says the next two numbers must be 16 and 19. Is Nick correct? Explain your answer.

- multiply and divide whole numbers by 10 or 100;
- use a range of mental methods of computation, including mental recall of multiplication facts up to 10×10 ;
- use efficient written methods of addition and subtraction and short multiplication and division;
- add and subtract decimals to two places and order decimals to three places;
- check the reasonableness of answers;
- recognise and describe number patterns and relationships;
- begin to use simple formulae;
- use and interpret coordinates in the first quadrant.

Write the answers to these calculations, using your knowledge of adding and subtracting two-digit numbers.

- $4.5 + 6.6 =$
- $7.5 + 7.5 =$
- $8.2 - 5.3 =$
- $5.1 - 2.5 =$

Level 5

High achieving children might reach this level before leaving primary school.

Expected level of achievement for secondary school children aged twelve or thirteen (Year 8).

- identify and obtain necessary information to solve problems;
- describe situations mathematically using symbols, words and diagrams;
- draw conclusions and give an explanation of their reasoning;

Timmy wants to juggle 3 balls for 1 minute. If 3 in every 5 attempts are successful, how many goes does he need to have before he has been unsuccessful 10 times?

- multiply and divide whole numbers and decimals by 10, 100 and 1,000;
- order, add and subtract negative numbers in context;
- reduce a fraction to its simplest form;
- calculate fractional or percentage parts of quantities and measurements;
- use appropriate non-calculator method for solving problems;
- check their solutions by applying inverse operations or estimating using approximations;
- use brackets appropriately;
- use and interpret coordinates in all four quadrants.

Which is larger, $\frac{3}{7}$ or $\frac{4}{9}$? Make sure you show your working!

Shape, space and measures

Pupils expected to:

Level 1

- use everyday language to describe properties and positions of 2-D and 3-D shapes.

They measure and order objects using direct comparison, and order events.

Level 2

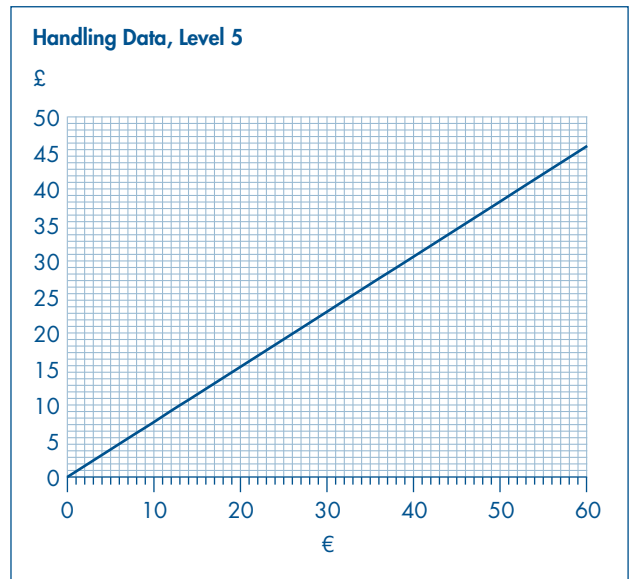
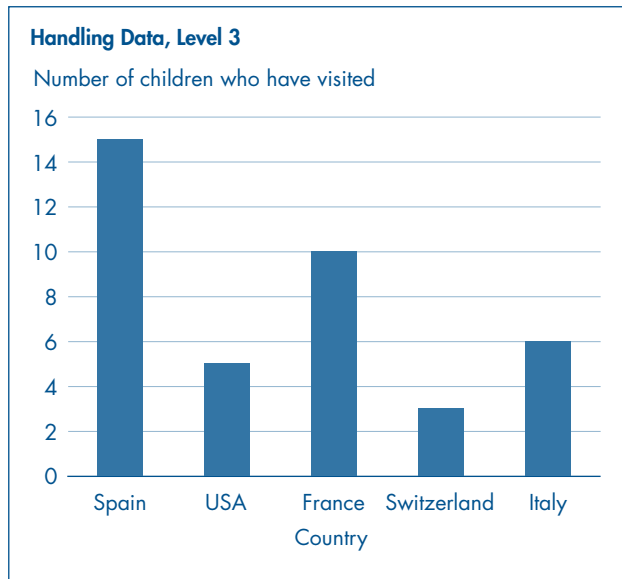
- use mathematical names for common 3-D and 2-D shapes and describe their properties;
- distinguish between straight and turning movements, understand angle as a measurement of turn, and recognise right angles in turns;
- begin to use everyday non-standard units to measure length and mass.

Handling Data

Pupils expected to:

- sort objects and classify them, demonstrating the criterion they have used.

- sort objects and classify them using more than one criterion;
- record results in simple lists, tables and block graphs.



NOTE

Illustrative assessment questions © Rising Stars UK Ltd, 2008.

Level 3

- classify 3-D and 2-D shapes in various ways using mathematical properties such as reflective symmetry for 2-D shapes;
- use non-standard units, standard metric units of length, capacity and mass, and standard units of time, in a range of contexts.

Complete these sentences.

- a. A cube has _ faces.
- b. A sphere has _ edges.
- c. A cuboid has _ vertices.
- d. A triangular prism has _ faces.
- e. A cone has _ edge.
- f. A cylinder has _ vertices.

- extract and interpret information presented in simple tables and lists;
- construct bar chart and pictograms where necessary;
- interpret information presented to them in these forms.

As part of a project, the Tigers group had to investigate which countries the children in their class had visited on holiday. They made a bar chart of their results.

- a. How many children had been to the USA?
- b. How many more children had visited Spain than Italy?
- c. 7 of the children who had been to France went this year. How many went before this year?
- d. Next month, 5 children are going on an exchange trip to Switzerland. Change the graph to show how it will look after the visit.

Level 4

- make 3-D mathematical models by linking given faces or edges, draw common 2-D shapes in different orientations on grids;
- reflect simple shapes in a mirror line;
- choose and use appropriate units and instruments, interpreting, with appropriate accuracy, numbers on a range of measuring instruments;
- find perimeters of simple shapes and find areas by counting squares.

A regular octagon has a perimeter of 40cm. What is the length of one side?

- understand and use the mode and range to describe sets of data;
- group data, where appropriate, in equal class intervals, represent collected data in frequency diagrams and interpret such diagrams;
- construct and interpret simple line graphs.

Level 5

- measure and draw angles to the nearest degree, and use language associated with angle;
- know the angle sum of a triangle and that of angles at a point;
- identify all the symmetries of 2-D shapes;
- know the rough metric equivalents of imperial units;
- make sensible estimates of a range of measures;
- understand and use the formula for the area of a rectangle.

- understand and use the mean of discrete data;
- compare two simple distributions, using the range and one of the mode, median or mean;
- interpret graphs and diagrams and draw conclusions;
- find and justify probabilities by selecting and using methods based on equally likely outcomes and experimental evidence.

Using this conversion graph, complete these price tags.

- a. £1 = €
- b. £5 = €
- c. _20 = _26

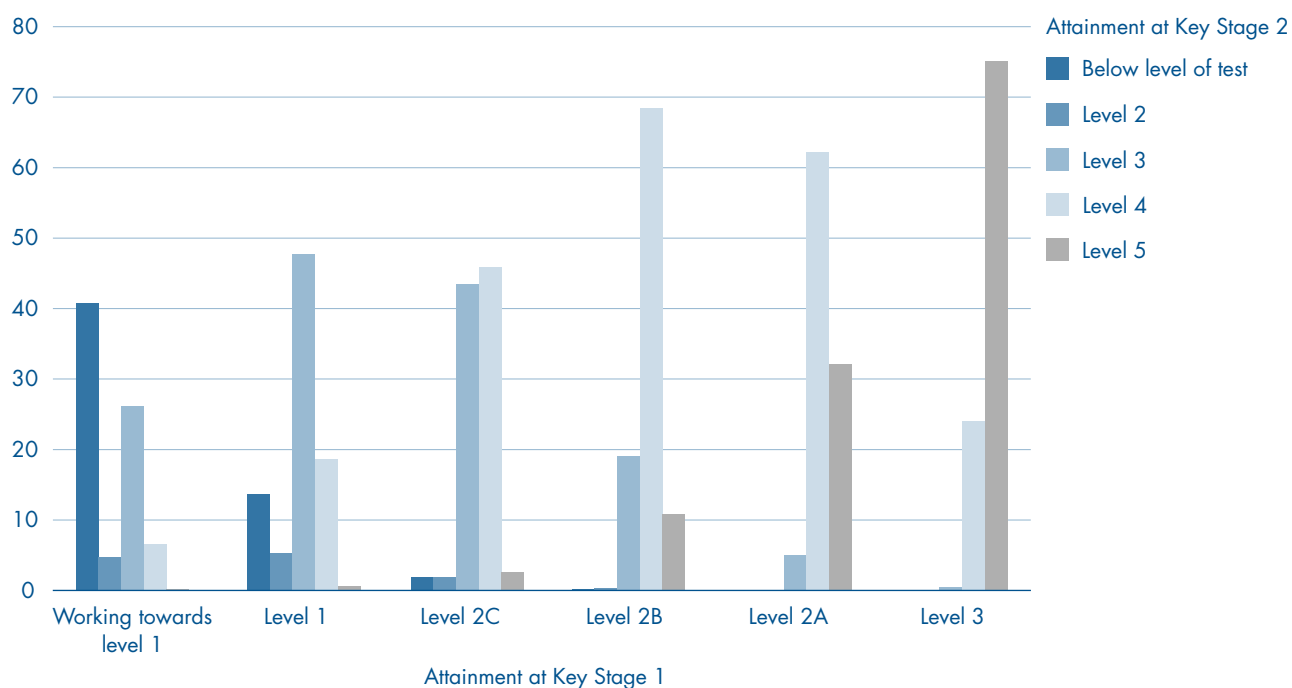
APPENDIX THREE

Supplementary statistics

20 Pupil progression between Key Stages 1 and 2 in mathematics, according to attainment at Key Stage 1: data for 2007

Over 40 per cent of all pupils who achieved level 2C at Key Stage 1 and around 25 per cent who achieved level 3 made only one level of progress by the end of Key Stage 2.

Percentage of pupils progressing from Key Stage 1 to Key Stage 2



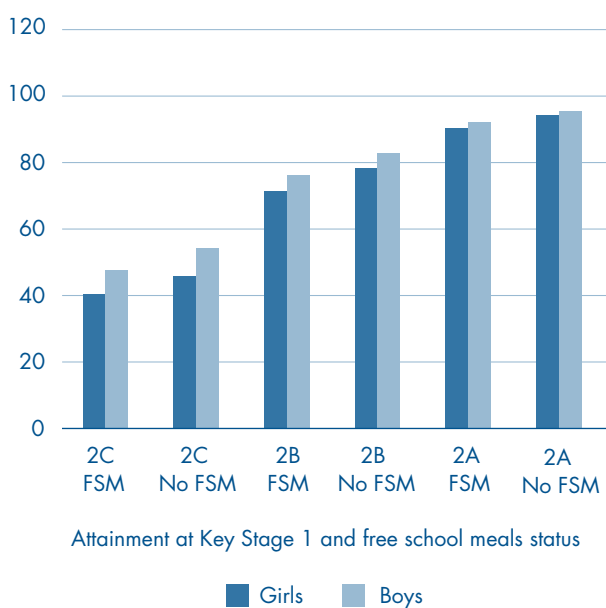
Source: National Audit Office analysis of the national pupil database

21 Progress in mathematics from Key Stage 1 sub-levels to Key Stage 2 level 4 or above, by free school meals and gender, 2007

The attainment gap between girls and boys is biggest at the lower sub-levels of level 2 attainment at Key Stage 1 and follows the same pattern whether pupils are taking free school meals or not.

Progress in maths between Key Stage 1 and 2 by gender and free school meals status

Percentage attaining level 4 at Key Stage 2



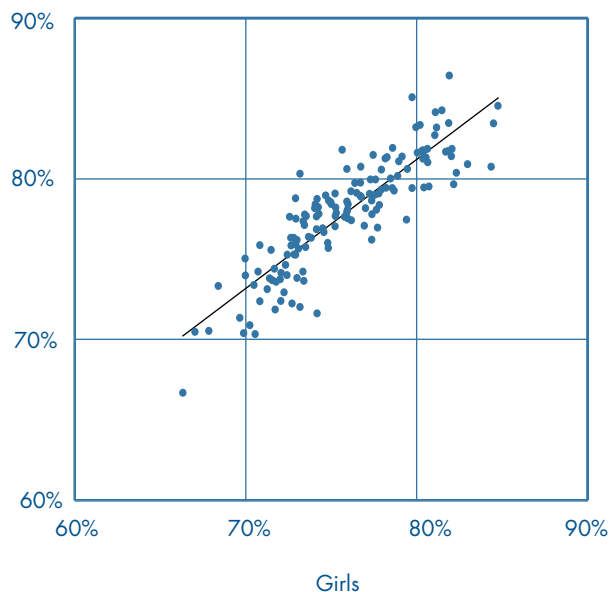
Source: National Audit Office analysis of national pupil database

22 Attainment of level 4 or more at Key Stage 2, by gender among local authorities, 2007

Boys' attainment in mathematics is on average 2 percentage points above that of girls at the local authority level.

Proportion of pupils achieving level 4+ in mathematics

Boys



Source: National Audit Office analysis of national pupil database

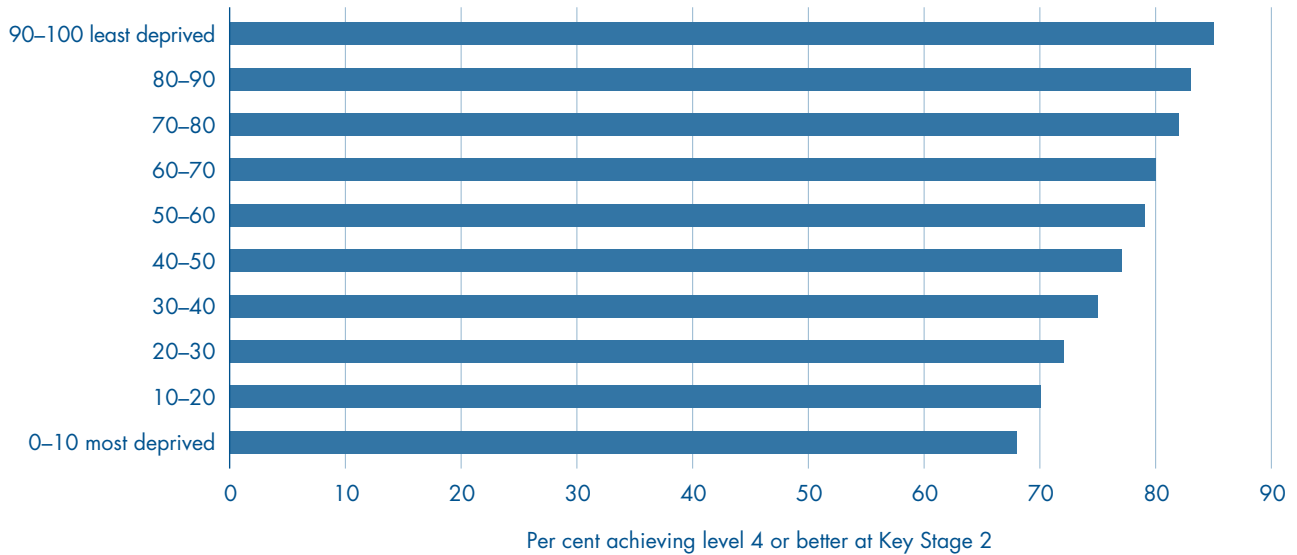
NOTE

Each point represents a local authority's 2007 average mathematics Key Stage 2 attainment at level 4 or above for boys and girls. Along the x-axis lies the proportion of girls who attained level 4 or better in mathematics. The y-axis shows the proportion of boys. A line of best fit has been added to show the overall relationship between boys' and girls' attainment as an average in local authorities.

23 Attainment of level 4 at Key Stage 2 mathematics, by deprivation, 2007

Pupils from more deprived backgrounds have lower average levels of attainment in mathematics than their peers in less deprived areas.

Per cent



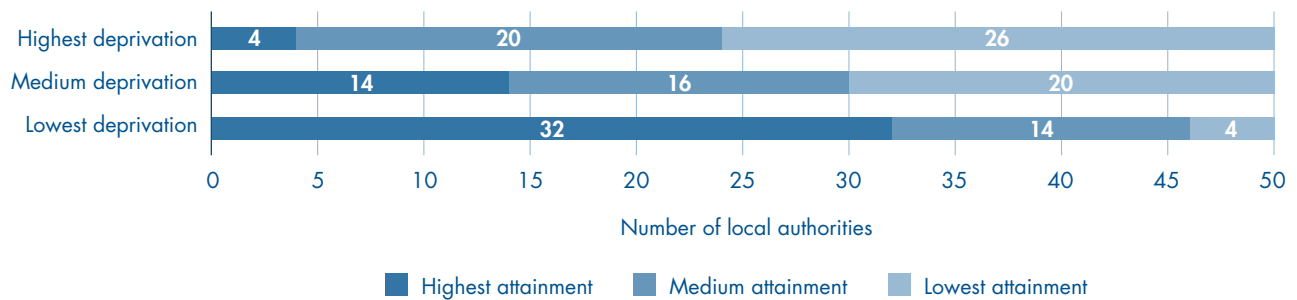
Source: Statistical First Release 2007

NOTE

Deprivation measured with the Income Deprivation Affecting Children Index.

24 Attainment of level 4 at Key Stage 2 in mathematics, by deprivation at local authority level, 2007

There is a strong link between the level of deprivation of a local authority and attainment levels at Key Stage 2 mathematics.



Source: National Audit Office analysis of the national pupil database

NOTE

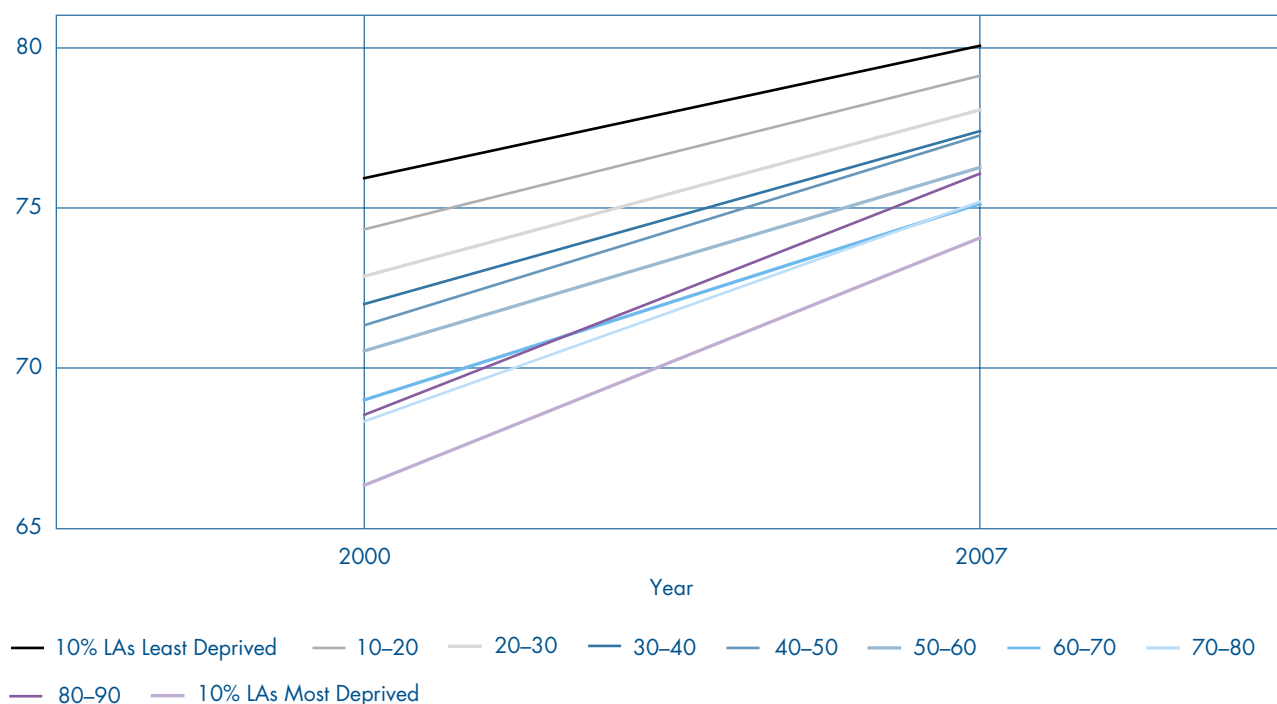
The percentage of each local authority's pupils attaining level 4 at Key Stage 2, divided into three equal sized groups. Deprivation measured with the Income Deprivation Affecting Children Index, also divided into equal thirds.

25 Size of improvements at local authority level, by deprivation, 2000–2007

The most deprived local authorities have made the most progress in terms of percentage of pupils achieving level 4 or above in mathematics. However a significant attainment gap between the most and the least deprived local authorities is still evident.

Improvement in children attaining level 4 by local authority

Percentage attaining level 4 mathematics



Source: National Audit Office analysis of Statistical First Releases 2000-2007

NOTE

Local authorities were ranked according to their deprivation levels in 2007, and grouped into clusters of 15 local authorities. The average progress made by each group is shown.

APPENDIX FOUR

Approaches to improving primary mathematics performance in Wales, Northern Ireland and Scotland

Wales

The Welsh Assembly Government launched 'Raising Standards of Numeracy in Primary Schools: A Framework for Action in Wales' in 1999, which required local authorities to develop locally based strategies to improve numeracy. In 2005, the Government published a strategy to improve basic literacy and numeracy in Wales through an all-age approach to raising standards and focussing on priority groups, including pupils underachieving in primary school. Total spending on primary education in Wales was £763 million in 2006-07²⁰ (excluding capital spend).

Welsh and English children follow a broadly similar National Curriculum in mathematics although, since 2000, Wales produces separate National Curriculum Orders for the subject. In 2004, Wales removed national testing and from 2005 statutory assessment is by teacher assessment only.

The current Welsh target for attainment at Key Stage 2 is for 80 per cent of pupils to achieve the core subject indicator (level 4 in English or Welsh, Mathematics and Science in combination) by 2010 with an interim milestone of 75 per cent in 2007. 75.5 per cent achieved this level or above in 2008.

The Welsh curriculum and assessment framework has undergone substantial change. The Foundation Phase (for 3–7 year olds) is being rolled out and a revised school curriculum for 7–16 year olds is being phased in, both from September 2008. Children will continue to be statutorily assessed by teacher assessment at 7, 11 and 14.

Northern Ireland

Northern Ireland's 'Strategy for the Promotion of Literacy and Numeracy in Primary and Secondary Schools' was launched in 1998, and to 2007 the Executive had spent £40 million on specific literacy and numeracy programmes, in addition to normal spending on the school curriculum. Total spending on primary education in Northern Ireland in 2006-07 was £497 million.²¹

In response to a critical report by the Public Accounts Committee, in 2008 the Executive established a Literacy and Numeracy Taskforce to raise standards particularly for children from disadvantaged backgrounds.

Until 2007, pupils in Northern Ireland followed the Northern Ireland National Curriculum. Statutory assessment in mathematics at the end of Key Stages 1 and 2 took place using externally provided short informal tests, the marking of which was externally moderated. The Northern Irish target for attainment at Key Stage 2 is for 80 per cent of pupils to achieve level 4 in mathematics. 77 per cent of pupils achieved this level or above in 2007.

The Northern Irish curriculum and assessment framework is undergoing substantial change. From 2007 to 2010, Key Stage tests are gradually being replaced by annual assessments, which will be known as 'Pupil Profiles'.

²⁰ HM Treasury *Public Expenditure Statistical Analyses*, Chapter 10 database.

²¹ HM Treasury *Public Expenditure Statistical Analyses*, Chapter 10 database.

Scotland

In 2004, the Scottish Executive (now Scottish Government) launched the 'Curriculum for Excellence' (CfE), which aims to create a single, coherent curriculum for children in Scotland aged 3–18. CfE aspires to enable all children and young people in Scotland to become successful learners, confident individuals, responsible citizens and effective contributors and should be embedded into Scottish schools during 2009 and 2010. Mathematics is one of the eight curriculum areas within Curriculum for Excellence and there is a strong numeracy focus across the curriculum. Total spending on primary education in Scotland was £1.68 billion in 2006-07.²²

Under the existing 5–14 curriculum guidelines, learning and teaching guidance places a strong emphasis on planned active learning, the development of mathematical thinking skills as well as the use of mathematics within relevant contexts.

The Scottish Government does not carry out national testing of all pupils. Pupil assessment in mathematics is undertaken throughout the school year, once a teacher feels a pupil is secure at a given level. This information is not collected or published centrally by the Government.

Since 2005 the Scottish Survey of Achievement (SSA), a sample-based survey methodology, was introduced to provide information on educational attainment at the national level. The SSA is designed to minimise the burden on schools, pupils and teachers resulting from national monitoring and to have minimal impact on teaching practice. Reflecting the Scottish education system the SSA tests pupils at primary years 3, 5, and 7 as well as the second year of secondary school. Some information is available on pupil attainment in the core skill of numeracy from the 2005 and 2006 surveys.²³

Over the last four years, the SSA has adopted a rotating subject focus with mathematics covered in detail in 2008. The results from the 2008 Mathematics SSA will be published next year.

22 Statistics Publication Notice Education Series: *Expenditure on School Education in Scotland, 2006-07* <http://www.scotland.gov.uk/Publications/2008/02/06111814/0>

23 *2005 Scottish Survey of Achievement: English Language and Core Skills* <http://www.scotland.gov.uk/Publications/2006/06/23121326/0>; *2006 Scottish Survey of Achievement: Social Subjects (Enquiry Skills) and Core Skills* <http://www.scotland.gov.uk/Publications/2007/06/21120102/0>

APPENDIX FIVE

Approaches to improving primary mathematics performance in the Netherlands and Latvia

The Netherlands

Background

In the Netherlands it is compulsory for all children to attend primary school full-time from the age of 5 until 12, although in practice nearly all children start school at aged 4. Following primary education, all children in the Netherlands go on to secondary education following one of three routes; pre-vocational, senior general or pre-university education. Each primary school is legally obliged to issue advice on the type of secondary education their pupils should go on to. To inform this advice, secondary schools often require pupils in their final year of primary school to take independent attainment tests. Over 85 per cent of primary schools choose to take a particular test administered by a private company, the National Institute for Educational Measurement (CITO), which assesses what a child has learnt during their primary education and predicts the chances of their success in the different types of secondary education. CITO also develops tests for measuring pupil progress as children go through their education.

Engaging pupils in mathematics learning

The Freudenthal Institute for Science and Mathematics Education in the Netherlands and its predecessors have been involved in the inception and development of the Dutch approach to teaching mathematics – ‘Realistic Mathematics Education’ (RME). The aim of RME is that the teaching of mathematics should stay close to topics that are relevant to the student. It is a teaching method in which pupils are active participants in the educational process; learn in a way that is based on their questions and experience of real life; use the same models at various levels of understanding and development, giving the curriculum a longitudinal coherence; are taught different elements of mathematics as a whole; are taught in a

way which encourages interaction between pupils, with pupils following individual learning paths; have a learning environment in which they can construct mathematics insights and tools for themselves through a guided opportunity to ‘re-invent’ mathematics.

The Freudenthal Institute has also initiated other important initiatives to encourage enjoyment in mathematics, particularly among primary school pupils.

KidzKount is a web-based interactive programme, developed by the Institute and offered to Dutch schools free of charge. It is aimed at 5–12 year olds, with users able to change the level of the exercises to match age and ability. Research has shown that it is used mainly outside school hours in the early evening. It covers a wide range of mathematical concepts, looking at numbers in a concentrated manner, and pupils using it tend to regard it as a series of games rather than learning exercises. The website is available in English (www.fi.uu.nl/rekenweb/en/) and can be obtained and hosted by overseas Departments of Education at minimal cost. In 2007 the site was accessed over 22 million times.

Big Arithmetic Day is held in April each year. All primary schools in the Netherlands are invited to participate. Those that do (around 20 per cent) are given a specific topic to work on – in 2008 it was ‘time’, in 2009 it will be ‘money’. Each year of the primary school is given a project to do around the given subject based on their expected level of ability, working in small groups. In 2008 when the subject was ‘time’, younger children were tasked with making a clock and comparing it with their classroom clock, and older children studied timezones. Projects are designed to have a practical, real life focus. The day starts with teachers, pupils and parents gathering in the school playground, and ends with the pupils taking something home from the day to discuss with their parents.

Latvia

Background

Latvia has an integrated system of compulsory state education spanning the ages of 7 to 16 and, unlike England, there is no automatic change of school at age 11. Through their pre-school education, pupils are expected to have basic reading, writing and some numeracy skills by the time they start school at 7. Pupils are tested in nationwide examinations at ages 9, 13 and 16. Each set of examinations includes mathematics. For some the exam at 13 is key as after that pupils may change schools depending on their results. At 16, those pupils who continue are said to go into secondary education.

Engaging pupils in mathematics learning

The Ministry of Education and Science sets standards for the teaching of mathematics, the latest of which emphasise the need for pupils to acquire independent research skills. But teachers have flexibility to develop their own teaching standard, based on that produced by the Ministry, and this creates an opportunity to teach more flexibly and with greater creativity.

The Latvian education system provides support for pupils covering the full range of ability – the gifted and talented, the less able, and the ‘average’ pupil. The less able can receive individual extra tuition, similar to that which will be provided in England through the *Every Child Counts* initiative.

For the gifted and talented pupils there is an opportunity for students to enter mathematics competitions which can be at school, state or nation (the Maths Olympiad) level. The objective is to identify outstanding pupils, and the competitions require a non-standard approach to solving problems, which requires pupils to think more creatively. In the Maths Olympiad 5 examinations are taken lasting five hours. Anecdotal evidence from the Latvian Union of Mathematics Teachers suggests that pupils undertaking such competitions tend to achieve better careers subsequently. In addition the University of Riga has created a School of Mathematics where pupils at both primary and secondary school can undertake (mainly on-line) extra after-hours mathematics studies. In most cases those who participate are the brighter pupils as identified by teachers, though any pupil can volunteer to take part.

For all pupils in primary and secondary schools, including the ‘average’ performers, two one-hour sessions of support classes are provided after school. The objective is to help, for example, those who have missed a class through sickness or holidays or those who have difficulty understanding a particular concept. Anecdotal evidence suggests that this can really help to improve pupils’ understanding, and reduce errors in examinations.