



*Rhagoriaeth i bawb – Excellence for all*

Arolygiaeth Ei Mawrhydi dros Addysg  
a Hyfforddiant yng Nghymru

Her Majesty's Inspectorate  
for Education and Training in Wales

# Numeracy in key stages 2 and 3: a baseline study

## June 2013



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Publication Section

Estyn

Anchor Court

Keen Road

Cardiff

CF24 5JW or by email to [publications@estyn.gsi.gov.uk](mailto:publications@estyn.gsi.gov.uk)

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<b>Contents</b>	<b>Page</b>
<b>Introduction</b>	<b>1</b>
<b>Background</b>	<b>1</b>
<b>Main findings</b>	<b>3</b>
<b>Recommendations</b>	<b>6</b>
<b>The national context</b>	<b>7</b>
School inspections	7
National curriculum teacher assessment of mathematics	7
Mathematical literacy in PISA 2009	10
<b>Baseline findings from surveyed schools</b>	<b>11</b>
Standards in lessons and pupils' work	11
Essential Skills Wales qualifications	12
<b>Provision across the curriculum</b>	<b>13</b>
Planning	13
Tracking and monitoring intervention programmes and all pupil progress	16
Teaching and assessment	18
<b>Leadership and management</b>	<b>20</b>
Leading and co-ordinating a whole-school approach	20
Numeracy priorities in school improvement plans	22
Professional development for numeracy	23
<b>Pupil attitudes</b>	<b>25</b>
<b>Appendices:</b>	
<b>Evidence base</b>	
<b>References</b>	
Estyn publications	
Other publications	
<b>The remit author and survey team</b>	

## Introduction

- 1 This report is the first in a series in response to a request for advice from the Welsh Government in the Minister's annual remit letter to Estyn for 2012-2013. It looks at standards in numeracy at key stages 2 and 3 and how a sample of primary and secondary schools is developing pupils' numeracy skills across the curriculum. Inspectors will revisit the same schools over the next two years and later reports will focus on the implementation and impact of the numeracy component of the Literacy and Numeracy Framework (LNF), which becomes statutory in September 2013.
- 2 The intended audience for this report is the Welsh Government, headteachers and practitioners in schools, and officers and advisers in local authorities and regional consortia.

## Background

- 3 Numeracy is an essential skill. It is the ability to apply simple numerical facts, skills and reasoning to real-life problems. If pupils do not have a basic level of mathematical knowledge and understanding, they will not be able to develop effective numeracy skills. The Welsh Government states that, although there is more to developing numeracy than teaching the rules and procedures of mathematics, it is imperative that schools teach the fundamental mathematical techniques to a standard that allows pupils to be numerate (National Literacy and Numeracy Framework, 2013).
- 4 Over recent years, Her Majesty's Chief Inspector of Education and Training in Wales' Annual Reports and a number of thematic reports have noted that a minority of pupils have weak numeracy skills. Although many pupils acquire skills in their mathematics lessons, generally they do not apply them well enough across the curriculum. Even when pupils do well in teacher assessments or external examinations in mathematics, their numeracy skills are not always secure enough to apply these skills fully and confidently to solve problems in a range of everyday contexts.
- 5 The most common shortcomings in pupils' numeracy skills identified in the report on 'Improving numeracy in key stages 2 and key stage 3' (Estyn, 2010), included too many pupils who:
  - have difficulty in recalling basic number facts, including multiplication facts, which slows their ability to perform basic calculations;
  - do not have effective strategies to help them calculate mentally;
  - are not confident in using an efficient written method for routine calculations;
  - do not fully understand place value; and
  - have difficulty in working with fractions, decimals and percentages.

In addition, in key stage 3, too many pupils:

- cannot estimate the results of written or mental calculations or reflect on whether their answers are reasonable; and
- use calculators for simple calculations, where a mental or written method would be more appropriate.

- 6 Over the past few years, changes to the National Curriculum Subject Orders, the Skills Framework 3-19, and Essential Skills Wales qualifications have given a stronger focus to numeracy. Despite this stronger focus, inspections of primary and secondary schools between 2010 and 2012 show that schools do not cover the full range of numeracy skills, and planning for developing numeracy across the curriculum is less advanced than for literacy.
- 7 In 2012, the Welsh Government introduced the National Numeracy Programme. This programme sets out, among others, the following actions:
  - from September 2013, the numeracy component of the Literacy and Numeracy Framework will replace the 'developing number across the curriculum' component of the Skills Framework for pupils from the Foundation Phase through to key stage 3;
  - from May 2013, the Welsh Government will introduce national numerical procedural tests for pupils from Year 2 to Year 9; and
  - from May 2014, pupils in Year 2 to Year 9 will sit statutory tests in both numerical procedures and numerical reasoning.
- 8 The four strands of the numeracy component of the Literacy and Numeracy Framework are:
  - developing numerical reasoning;
  - using number skills;
  - using measuring skills; and
  - using data skills.

## Main findings

- 9 This report is the first in a series to look at standards in numeracy at key stages 2 and 3 and at how schools are developing pupils' numeracy skills across the curriculum. It provides a baseline for later reports, which will focus on the impact of the numeracy component of the Literacy and Numeracy Framework.
- 10 In 2012, about four-fifths of pupils achieved the expected level in National Curriculum teacher assessments of mathematics at the end of key stages 2 and 3. This was a slight improvement on previous years. At both key stages, girls generally outperform boys.
- 11 In the 2009 PISA mathematical literacy tests for 15-year-olds, 20% did not reach the level 2 PISA baseline in the UK overall. Level 2 in PISA means being able to answer straightforward questions involving familiar contexts. In Wales, 26% of pupils did not reach this level. Wales also had the lowest percentage of high-achieving pupils in mathematical literacy compared with other UK countries.
- 12 In about two-fifths of the primary schools and a half of the secondary schools inspected in 2010-2012, many pupils have weak numeracy skills or do not apply them well enough across the curriculum. There has been little progress in pupils' numeracy over recent years.
- 13 A majority of pupils in the schools surveyed have sound measuring and data skills, but around half of the pupils do not have a secure grasp of basic number skills and do not recall key number facts readily.
- 14 In many of the surveyed schools, there is limited evidence of pupils applying numeracy skills at a high level. Too often, pupils have difficulty recalling basic number facts and do not have effective strategies to help them with mental calculations. Difficulty in recalling number facts slows pupils' ability to perform basic calculations. Many of the schools move too quickly to introduce a written technique for solving number problems before pupils have developed a sound understanding of number and place value. Many pupils have difficulty working with decimals, fractions and percentages and do not understand the relationship between, for example,  $\frac{2}{5}$ ths, 0.4 and 40%. Pupils' lack of understanding of key numerical facts and relationships means that they struggle to apply numerical reasoning skills to solve written problems, especially problems that involve more than one process.
- 15 Overall, a significant minority of pupils in the surveyed schools either do not have or do not apply their numeracy skills in line with the expectations of the numeracy component of the Literacy and Numeracy Framework. Too often, numeracy co-ordinators focus on developing pupils' measuring and data skills, but do not pay enough attention to how the school develops pupils' number skills and numerical reasoning in mathematics lessons and across the curriculum.
- 16 Around half of the secondary schools visited do not enter key stage 3 pupils for Essential Skills Wales (ESW) Application of Number qualifications or only enter Year 9 pupils for level 1. This means that pupils do not always study at a level that is

suitable to their individual needs. In a majority of schools, too much time is spent on completing the paperwork for these qualifications rather than on improving pupils' actual skills.

- 17 Many schools do not have a clear policy on how to develop pupils' numeracy skills in mathematics and across the curriculum. Too often, there is no agreed, whole-school approach to building pupils' numeracy skills or to performing basic calculations. This leads to a lack of consistency in using numeracy skills across classes and departments that confuses pupils. A very few schools have stand-alone, detailed numeracy development plans that show how specific initiatives and strategies are co-ordinated in a whole-school approach.
- 18 In a very few of the primary schools surveyed, provision for numeracy is highly effective and teachers offer well-planned and imaginative opportunities to apply and develop pupils' skills across the curriculum. In these schools, numeracy skills are taught systematically in mathematics and pupils are given enough opportunities to apply their skills in meaningful contexts in subjects other than mathematics. In the other primary schools surveyed, pupils tend to repeat skills at the same level year-on-year. This is often because schemes of work do not link well enough to the expectations of the mathematics curriculum or to a progressive numeracy framework.
- 19 Only a few of the secondary schools visited give numeracy a high enough priority in their school improvement plans. These schools have usually carried out a thorough audit of provision, leading to comprehensive plans for developing numeracy across the curriculum. In these schools, there is an agreed, co-ordinated approach to teaching and learning numeracy. However, most secondary schools are only starting to plan for numeracy across the curriculum. While the majority of mathematics departments provide a suitable range of experiences for pupils to develop numeracy skills, the opportunities for pupils to apply these skills in other subjects, such as science and geography, are often too narrow and mainly involve simple graphical or data work.
- 20 In very few schools are teachers' assessment and marking of pupils' work of a consistently high standard, where an agreed policy is followed by all staff. In these schools, staff assess work against an agreed numeracy mark scheme and provide appropriate suggestions on how to improve work further. Only a minority of primary schools and a few secondary schools have effective systems to track and record pupils' numeracy skills across the curriculum beyond mathematics. Where schools have effective systems, teachers are clear about the skills each pupil has or has not mastered and use this information well to plan further reinforcement activities. A few local authorities produce high-quality materials to support their schools to assess and track pupils' numeracy skills across the curriculum.
- 21 Most schools have well-established links with their partner primary or secondary schools. Many primary and secondary schools have common, transitional units of work, but only a minority focus on numeracy and only a very few arrange joint development activities that focus on a coherent approach to developing pupils' numeracy skills. Very few primary schools pass on information about pupils' standards in numeracy to secondary schools, although they generally transfer information about standards in mathematics.

- 22 Nearly all of the secondary schools but only around half of the primary schools visited provide effective numeracy intervention programmes for pupils who find mathematics a challenge. Most of the schools that have an intervention programme track pupils' progress well over the course of the programme and a majority continue to monitor pupil progress after the end of the intervention and provide top-up support if necessary.
- 23 In a minority of primary and secondary school improvement plans, there is a focus on building the capacity of staff and leaders to support numeracy. A significant minority of teachers need training and support to deliver the numeracy component of the Literacy and Numeracy Framework. Overall, there has been less training for teachers to develop pupils' numeracy than for literacy. Most schools have not carried out a formal audit of staff confidence and competence in teaching numeracy.
- 24 Most primary pupils and many secondary pupils believe that numeracy and literacy skills are equally as important to succeed in their next stage of education or employment. A few key stage 3 pupils say that they find it difficult to apply their numeracy skills in other subjects because, although they learn skills in mathematics lessons, their understanding is not secure enough to apply them in unfamiliar contexts. A majority of pupils struggle to give examples of how numeracy is relevant to their everyday lives.



## Recommendations

### **Schools should:**

- R1 make sure that pupils master basic number skills thoroughly in mathematics lessons and have effective strategies to recall essential number facts quickly and accurately;
- R2 agree whole-school approaches to performing simple calculations;
- R3 provide more opportunities for pupils to use numeracy skills, particularly number skills and numerical reasoning, in subjects across the curriculum;
- R4 make sure that numeracy activities stretch pupils appropriately, including the more able;
- R5 assess and track pupils' progress in numeracy skills across the curriculum and use assessment information to plan better numeracy activities;
- R6 design transitional primary/secondary school activities to support consistency and progression in pupils' numeracy skills;
- R7 provide opportunities for numeracy co-ordinators and mathematics departments to work together with other teachers to improve their knowledge, skills and confidence to develop pupils' numeracy skills; and
- R8 monitor and evaluate the impact of strategies for improving numeracy.

### **Local authorities and regional consortia should:**

- R9 support schools to help staff to improve their knowledge, skills and confidence to develop pupils' numeracy through their subjects; and
- R10 share best practice between schools.

## The national context

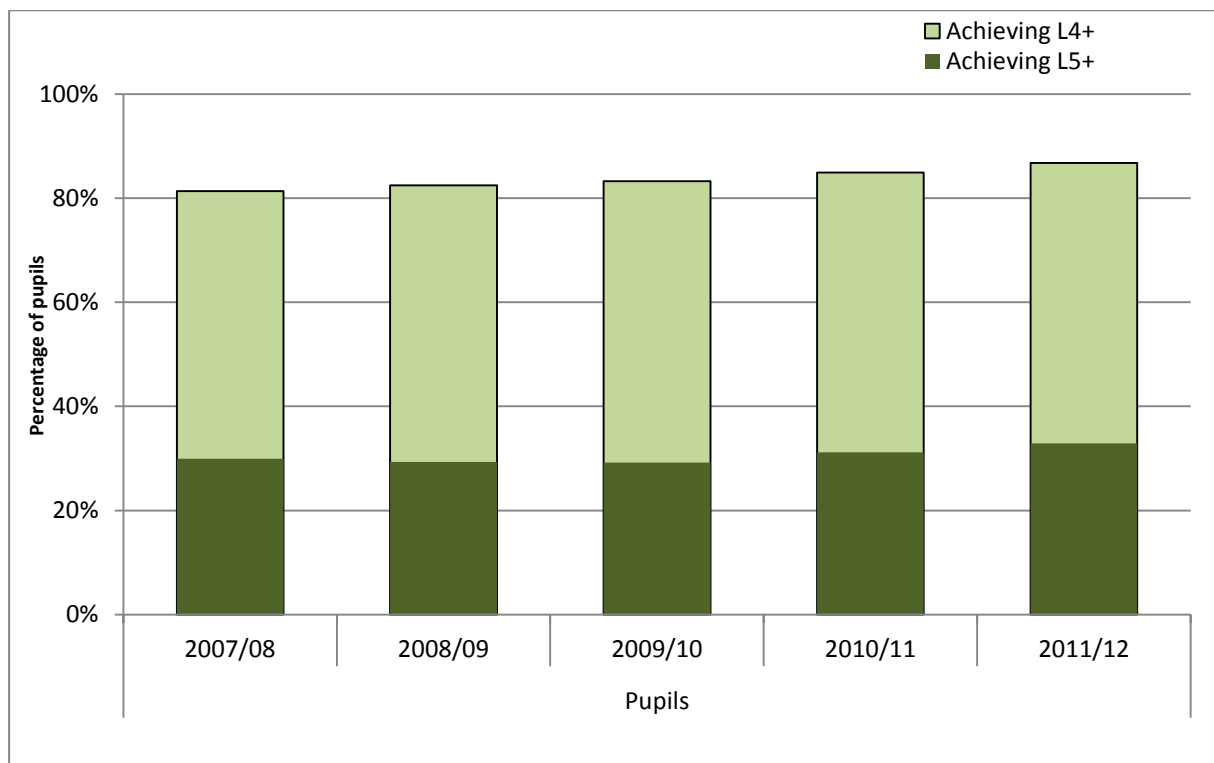
### School inspections

- 25 Many primary school pupils acquire appropriate skills in their mathematics lessons. However, in around two-fifths of schools, pupils' ability to solve problems and use their numerical reasoning skills across the curriculum is limited. In most secondary schools where pupils' standards are good or excellent overall, many pupils have suitable numeracy skills, which they apply well in a range of subjects such as science and geography. In many schools with adequate or unsatisfactory standards, overall pupils either have underdeveloped numeracy skills or do not apply them well across the curriculum.

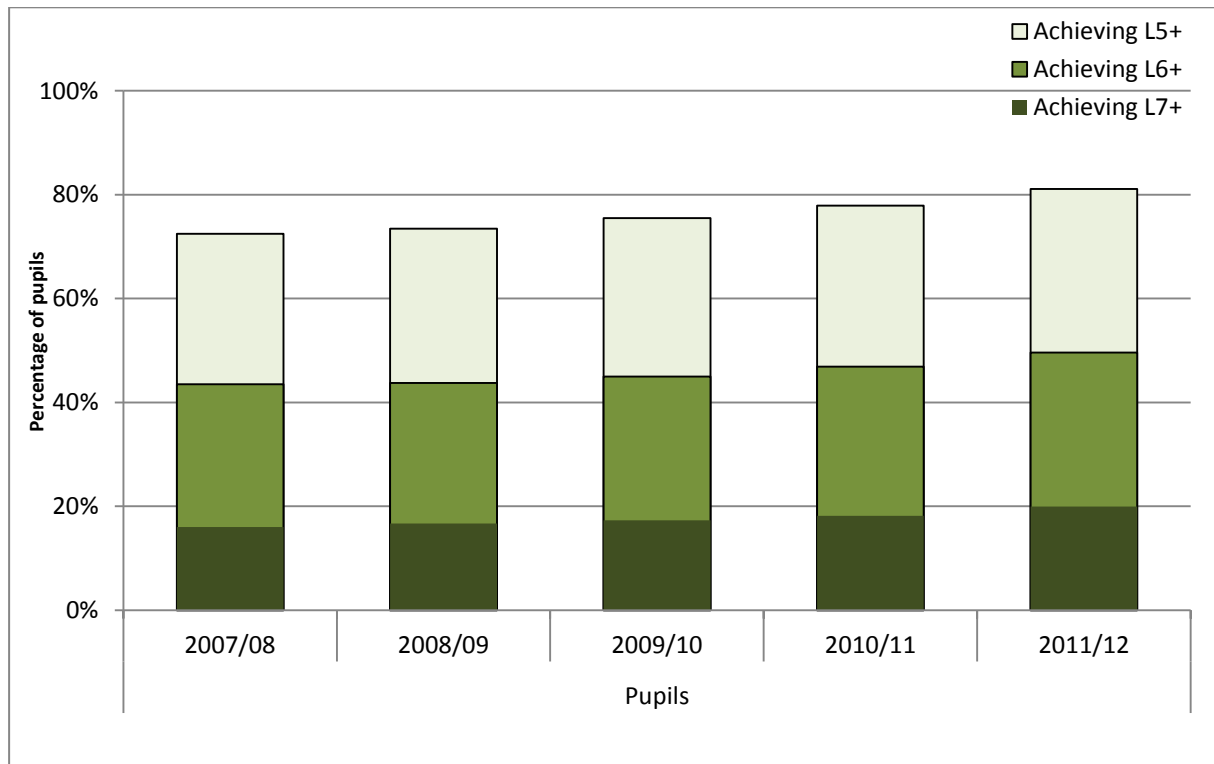
### National Curriculum teacher assessments in mathematics

- 26 The outcomes of National Curriculum teacher assessments in mathematics at the end of key stages 2 and 3 give an indication of standards of numeracy. Until the introduction of statutory numeracy tests and the Literacy and Numeracy Framework, these teacher assessments are the only national measures available to evaluate numeracy skills at key stages 2 and 3 in all schools.
- 27 Below are two charts that show the percentage of pupils in Wales achieving at least levels 4 and level 5 in mathematics at key stage 2 and the percentage of pupils achieving at least levels 5 and levels 6 and 7 in mathematics at key stage 3, over the past five years.

#### Key stage 2 – Percentage of pupils achieving the expected level (level 4) and the expected level plus one (level 5), 2008-2012

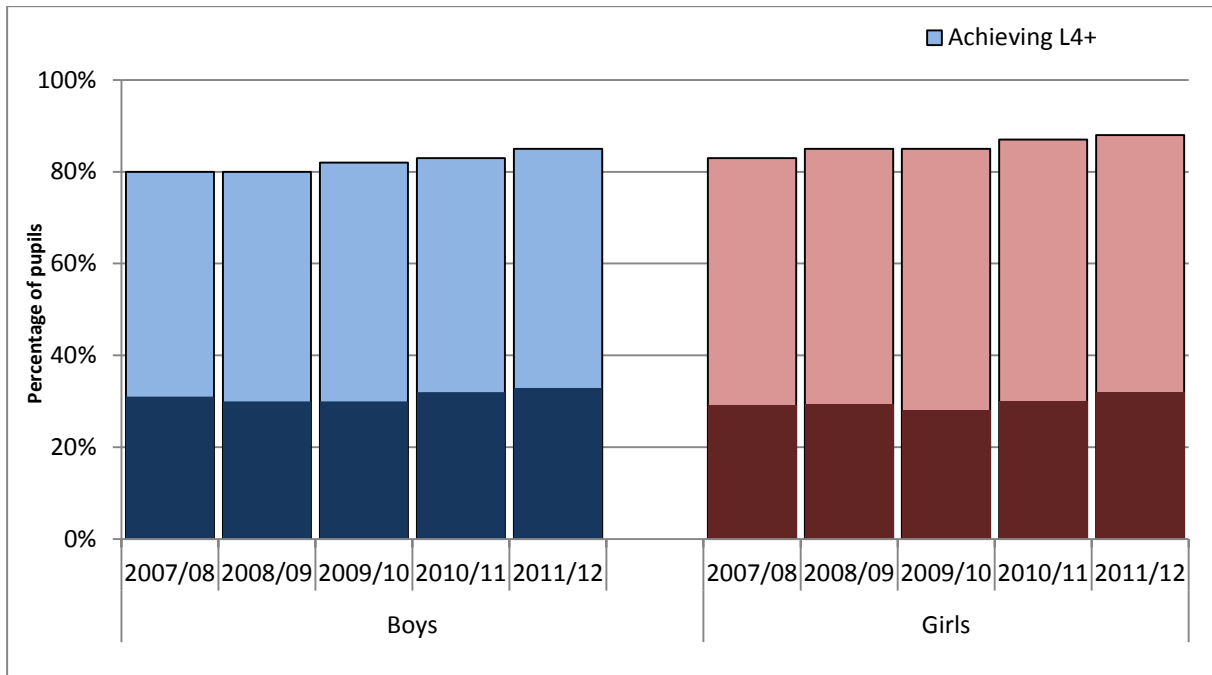


**Key stage 3 – percentage of pupils achieving the expected level (level 5) the expected level plus one (level 6) and expected level plus two (level 7), 2008-2012**



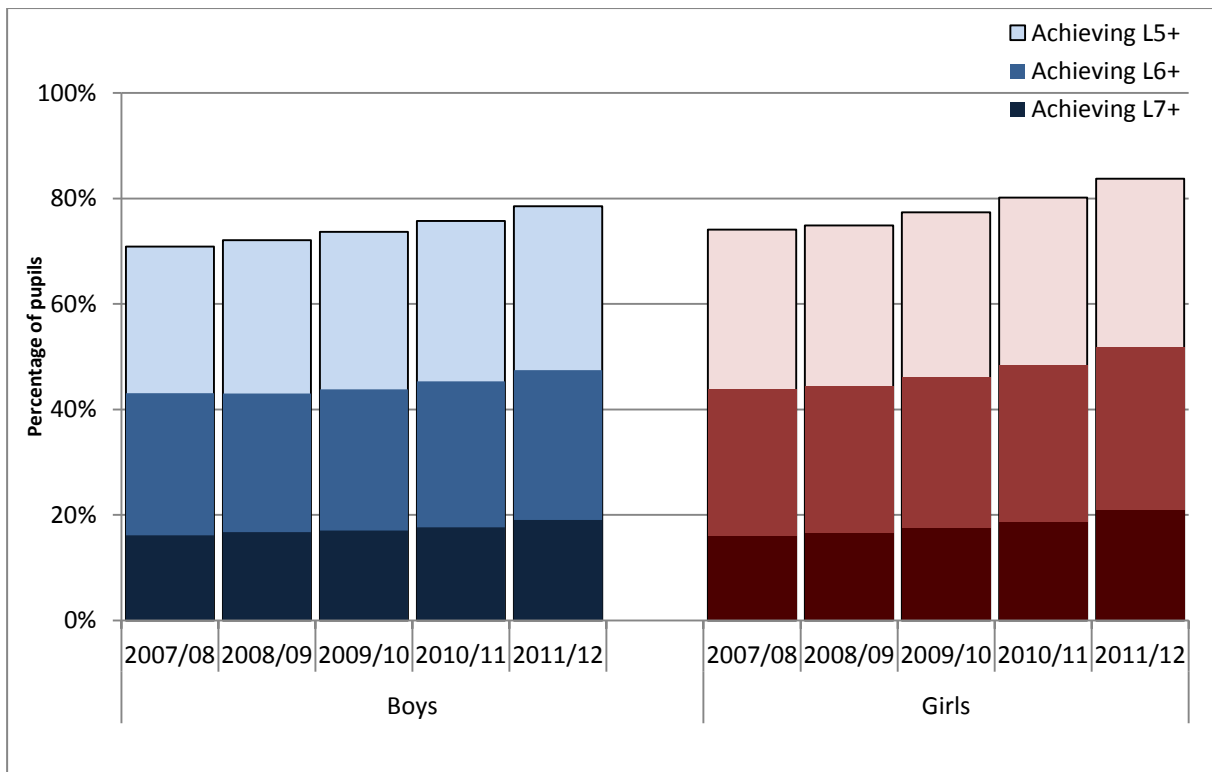
- 28 The percentage of key stage 2 pupils achieving the expected level 4 or above in mathematics in 2012 has improved steadily on previous years. There was a similar trend of improvement in the percentage of pupils achieving the expected level 5 or above at key stage 3.
- 29 Over the past five years, the percentage of pupils achieving the higher level 5 or above at key stage 2 has improved by three percentage points. In key stage 3, there has been a steady trend of improvement. In 2012, almost half of Year 9 pupils achieved higher than the expected level.
- 30 In 2012, the percentage of pupils achieving at least the expected level in mathematics at key stage 2 continued to be higher than the percentage achieving at least the expected level in English or Welsh first language.
- 31 At key stage 3, in 2012 the percentage of pupils achieving the expected level in mathematics continued to be higher than the percentage achieving the expected level in English. However, more pupils achieved the expected level in Welsh first language than in mathematics.
- 32 The charts below show separately the percentage of boys and girls achieving at least levels 4 and 5 in mathematics at key stage 2 and the percentage of pupils achieving at least levels 5, 6 and 7 in mathematics at key stage 3 over the past five years.

**Key stage 2 – percentage achieving the expected level (level 4) and the expected level plus one (level 5), by gender, 2008-2012**



- 33 In key stage 2, there has been an upward trend in the performance of both boys and girls at the expected level 4 and the higher levels 5 and 6. At the expected level, girls perform better than boys, by just over three percentage points. At the higher levels, boys perform slightly better than girls, by around one percentage point.

**Key stage 3 – percentage achieving the expected level (level 5) the expected level plus one (level 6) and expected level plus two (level 7), by gender, 2008-2012**



- 34 At key stage 3, a higher percentage of girls than boys have consistently achieved the expected level 5. In 2012, the difference rose to over five percentage points. In the same year, over half of the girls achieved level 6 or above in mathematics. This was four and a half percentage points above the outcomes for boys. Up until 2009, a slightly higher percentage of boys than girls achieved the higher levels 7 and 8. Since 2010, this trend has reversed and in 2012 girls achieved nearly two percentage points higher in the level 7 and level 8 indicators than boys.
- 35 A higher proportion of pupils achieve the expected level 4 at the end of key stage 2 in Wales than in England in teacher assessments. Over the past four years, the difference has been between three and five percentage points. However, a higher proportion of more able pupils achieve the higher level 5 in England than in Wales. The difference is generally about five percentage points. By the end of key stage 3, a higher proportion of pupils achieve the expected level 5 in England than in Wales. In 2012, the difference was two percentage points. The difference increased to 11 percentage points for more able pupils achieving the higher level 6 or above.

#### **Mathematical literacy in PISA 2009**

- 36 The 2009 PISA assessment for mathematical literacy (numeracy) focused on the capacity of 15-year-old pupils to analyse, reason and communicate effectively as they pose, formulate, solve and interpret mathematical problems in a variety of situations. There is a good match between these processes and those specified in the skills sections of the National Curriculum programmes of study for mathematics, and in the numeracy component of the Literacy and Numeracy Framework.
- 37 In the 2009 PISA results for mathematical literacy, Wales' performance ranked 40th out of the 67 participating countries. This was below the Organisation for Economic Co-operation and Development average and significantly lower than the other three UK nations.
- 38 In the UK overall, slightly over 20% of pupils did not reach the PISA baseline of level 2. This means that these pupils were only able to answer questions involving familiar contexts and the questions were quite straight forward. The proportion of pupils not reaching the baseline was higher in Wales than the other UK nations, at just over 26%.
- 39 Wales also had the lowest percentage of highest achieving pupils of the four UK nations. Only 5% of pupils in Wales achieved the highest levels (levels 5 and 6), compared with nearly 10% in England and over 12% in Scotland.

## Baseline findings from surveyed schools

### Standards in lessons and pupils' work

- 40 In many of the schools surveyed, there is limited evidence of pupils applying their numeracy skills at an appropriately high level. Too often pupils have difficulty recalling basic number facts and do not have effective strategies to help them calculate mentally. For example, they do not know their number bonds to 100 and have difficulty finding a strategy to work out a solution to simple problems. Around half of pupils in Year 6 cannot quickly recall multiplication facts and only a minority have appropriate strategies to try to work out an answer to a problem such as six multiplied by seven. This difficulty in recalling number facts slows their ability to perform basic calculations. Many schools move too quickly to introducing a standard written format for solving number problems before pupils have a sound understanding of place value. For example, pupils add noughts when multiplying by 100 or 1000 but cannot explain why. When adding numbers such as 346 and 258, pupils do not understand that they are adding  $300+40+6$  to  $200+50+8$ , and say "6 plus 8 is 14, so 4 down carry 1" without understanding what this means or why it works. Many pupils also have difficulty working with decimals, fractions and percentages and do not understand the relationship between, for example,  $\frac{2}{5}$ ths, 0.4 and 40%. Pupils' lack of understanding of key numerical facts and relationships means that many struggle to apply their numerical reasoning skills to solve written problems especially those problems that involve more than one process.
- 41 In a few lessons in Year 6, pupils develop their numerical reasoning skills well. They transfer their mathematical skills to a variety of contexts and a majority can explain their results using appropriate mathematical language. A majority understand the importance of measuring accurately and can convert between the main metric units. They construct simple bar and line graphs labelled in 2s, 5s and 10s. However, only a minority can calculate the steps in a scale rising in intervals of 0.5 or use simple ratio and proportion.
- 42 In Year 6 pupils' workbooks in science, geography and design and technology, there is limited evidence of pupils applying number skills or numerical reasoning skills. The examples of pupils using number skills are usually at a simple level and generally only involve addition and subtraction. A majority of pupils have a sound grasp of measures and record measurements in different ways. Pupils' use of data is the most advanced aspect of their numeracy. Many pupils represent data using an appropriate range of charts, tables and graphs and extract relevant information. A few more able pupils can use "mean" and "range" to describe a data set.
- 43 In a majority of the Year 9 lessons, pupils have secure measuring skills and measure length, weight, time and temperature accurately. But a minority of pupils are unable to convert a fraction of a minute accurately. For example, they record 1.5 minutes as 1 minute 50 seconds rather than as 1 minute 30 seconds. Pupils' application of their data skills is generally sound. The majority of pupils can construct and interpret graphs and diagrams to represent data and they choose an appropriate scale. However, a few pupils do not examine their results critically enough or consider the impact of extreme values.

- 44 In Year 9 work in science, geography and design and technology, there is also limited evidence of pupils applying their number skills or numerical reasoning skills. In a very few schools, pupils' work demonstrates that their numeracy skills are well developed. In these schools, pupils select, trial and evaluate a variety of possible approaches in different contexts across the curriculum, for example modelling the size of a product against material costs and quantity for production in design technology. Many pupils' work show that they have sound measuring skills and that they can use their data skills appropriately in science and geography. They plan how to collect data to test hypotheses and make decisions about how best to record the data. Many pupils use terms such as mode, mean and median in their writing, but only a very few more able pupils compare two data sets well and draw accurate conclusions.
- 45 Overall, the numeracy standards in the surveyed schools are generally similar to the findings from inspections in the current cycle. In all aspects of numeracy, at key stage 2 and 3, but particularly for number and numerical reasoning, there are few examples of pupils applying their skills at a high enough level.

#### **Essential Skills Wales qualifications**

- 46 None of the primary schools visited enters their pupils for the ESW Application of Number qualification. However, one primary school works closely with other primaries and its partner secondary school to teach level 1 to Year 6 pupils. Pupils have to wait until they enter their secondary school to gain the qualification because primary schools are not registered centres for pupils to sit ESW qualifications.
- 47 Around half of the secondary schools visited do not enter key stage 3 pupils for ESW Application of Number qualifications or only enter Year 9 pupils for level 1. This means that pupils do not always study at a level that is suitable to their individual needs. The other half of schools visited enter nearly all of their pupils for either level 1 or level 2. In these schools, at least a majority of pupils achieve level 2 by the end of Year 9.
- 48 Although pupils may have gained ESW Application of Number qualifications, this does not necessarily mean that they can apply their skills consistently and at an appropriate level across all subjects. In a majority of the schools visited, there is an imbalance between the time spent on completing the paperwork relating to Essential Skills Wales qualifications and the time spent on improving pupils' actual skills and transferring these skills to support learning across the curriculum.

## Provision across the curriculum

### Planning

- 49 In the primary and secondary schools inspected during the last two years, improving the provision for numeracy skills across the curriculum was identified as an important area for development in around two-fifths of schools. Overall, school inspections identify that, in a majority of schools, planning for numeracy skills is weaker than that for literacy.
- 50 In many of the schools visited, auditing provision for developing and improving pupils' numeracy skills is a priority in school improvement plans for 2012-2013. Most schools have previously audited their schemes of work to identify where pupils could use their numeracy skills. However, this generally means that they insert an icon into planning documentation to confirm that numeracy activities should take place, rather than indicating how a particular skill would be used or applied and at what level. Only a very few schools have carried out a recent, thorough audit that has led to clear and comprehensive planning for developing numeracy skills across subjects and departments.
- 51 A few of the primary schools visited that have been particularly successful in planning for the progressive development of numeracy skills have usually worked closely with the numeracy team from their local authority. The case study below shows how a local authority has supported its primary schools.

### Working with the local authority to improve numeracy

#### Context

Newport local authority is located in the south east of Wales. It is the third largest urban area in Wales with a total population of 145,785. Sixteen per cent of the 94 areas in Newport are in the 10% most deprived areas in Wales. In 2012, the percentage of pupils entitled to free school meals in Newport was higher than the Wales average.

#### Strategy

The local authority wanted to help its schools to adapt readily to the Welsh Government's National Numeracy Programme and to make sure that the teaching of numeracy continued to improve.

#### Action

The local authority already had a detailed framework for year-on-year progression in numeracy skills. To make sure these were delivered effectively by schools and to support assessment, they devised materials to help schools plan, teach, assess and track pupils' numeracy skills.

The progression framework is cross-referenced to a range of materials produced by the local authority, which support the teaching of numeracy and identify the most effective resources and visual prompts to help pupils to improve their skills.



The skills progression is referenced to tracking sheets for teachers to assess pupils' skills. The authority has also devised an on-line year-specific numeracy test. This test enables schools to focus on pupils' numeracy skills and their ability to apply these skills in a range of contexts. The test is closely aligned to the teaching and planning materials and provides schools with detailed feedback at pupil, class and year-group level, identifying which aspects need further consolidation.

The authority has also introduced an 'outstanding teachers of numeracy' initiative. This is to develop a core team of knowledgeable practitioners who share good practice in the teaching, assessment and tracking of numeracy within their own schools and across the authority. The aim is to develop a hub of schools with outstanding numeracy teachers than are able to support other schools.

### **Outcomes**

Schools are more confident in setting local targets for numeracy. They are also well prepared to adapt to the numeracy component of the Literacy and Numeracy Framework. The group of outstanding teachers are benefitting from their training and from the opportunities to share good practice with each other and within their own school.

- 52 Most primary school schemes of work identify opportunities for pupils to use measuring and data skills in science and to a lesser extent in geography and design technology. Around half of schools identify opportunities for pupils to use numerical reasoning skills in subjects other than mathematics. However, only a very few schemes of work provide enough opportunities for pupils to use number skills at an appropriate level across the curriculum.
- 53 In many of the primary schools visited, planning for the development of pupils' numerical reasoning and number, measuring and data skills is not progressive. Schemes of work in different subjects do not link well enough to the numeracy expectations in the school's mathematics scheme of work. This means that too often pupils tend to repeat skills at the same level year-on-year. In addition, the level of challenge for numeracy in most schemes of work is below the level of expectation cited for each year group in the numeracy component of the Literacy and Numeracy Framework.
- 54 In a few secondary schools, the numeracy co-ordinator or mathematics department has a detailed overview of where numeracy is developed across the curriculum. Nearly all of these schools are currently mapping coverage against the numeracy component of the Literacy and Numeracy Framework requirements to identify any gaps in their provision. However, in a majority of secondary schools, subject schemes of work do not have enough detail about numeracy. The schemes identify opportunities to use numeracy as part of the subject-specific activity, but provide few or no details about the aspect of numeracy or the level of application required. In schools that provide details about the aspect and level of numeracy covered in different subjects, there is too much variation in the quality of schemes of work between different departments within the school.

- 55 A majority of primary and secondary schools are in the early stages of adapting schemes of work or specific tasks to suit the needs of pupils of different ability. In many of these schools, current planning does not provide enough opportunities for more able pupils to use their numeracy skills at a high enough level.
- 56 When planning for the transition of pupils from key stage 2 to key stage 3, all primary schools provide their partner secondary schools with pupils' levels in mathematics and most give details about pupils who have received numeracy intervention. Otherwise, very few primary schools pass on information about pupils' standards in numeracy and, although many primary and secondary schools have common, transitional units of work, only a minority of these units focus on numeracy.
- 57 Most schools have well-established links with their partner primary or secondary school, but very few arrange joint development days with a regular focus on developing the provision for aspects of numeracy. The case study below illustrates how the introduction of transitional numeracy units has contributed to improving pupils' numeracy.

### **Improving numeracy through transitional work**

#### **Context**

St Richard Gwyn is an 11-16 mixed comprehensive with 657 pupils on roll and is the only Catholic high school in the Vale of Glamorgan. The school's intake is from a varied social background. The percentage of pupils eligible for free school meals is around 14%, which is below the national average of 17.4% for secondary schools. Academic ability on entry is below national averages and for the last three years nearly a third of pupils entering the school have had a reading age two years or more below their actual age

#### **Strategy**

To develop a whole-school approach to numeracy, including the introduction of transitional units of work and targeted intervention schemes to improve pupils' numeracy.

#### **Action**

Almost one-quarter of pupils entering the school at key stage 3 were below the expected level in National Curriculum assessments in mathematics (level 4). The school recognised that a key driver to improving pupils' levels of attainment in mathematics was to improve the provision and outcomes for pupils' numeracy across the curriculum.

In 2009, the school conducted a thorough audit of its provision of numeracy across the curriculum. At about the same time, the school conducted a survey to identify teachers' approach and confidence in delivering numeracy as part of their subject area.

As a result of the audit and survey, a numeracy working party of teachers from different subjects was established. The school appointed a numeracy co-ordinator to

lead the development of the working party, with a brief to improve pupils' numeracy skills and provision.

The activities the school has undertaken to improve pupils' numeracy include:

- strengthening links with pupils' primary schools to provide a transition unit on aspects of numeracy, with the secondary school staff teaching in the primary schools: producing a curriculum map and subject schemes of work that clearly identify strands and elements of pupils' numeracy skills;
- staff development activities to agree common approaches to delivering the different elements of numeracy, such as presenting and analysing data, and mental and written methods for calculating; these are shared with pupils' primary schools; and
- introducing intervention strategies, which include commercial schemes and peer and local employer mentoring.

### **Outcomes**

In 2012, the percentage of key stage 4 pupils achieving the level 2 threshold in mathematics improved by 11 percentage points from the 2008 results. At key stage 3, almost half of the pupils involved in the intervention schemes achieved higher National Curriculum level outcomes in mathematics than they had been predicted to get on entry to the school.

### **Tracking and monitoring intervention programmes and all pupils' progress**

- 58 Around half of the primary schools visited have well-established catch-up programmes to improve pupils' basic numeracy skills. These programmes target pupils at risk of not achieving the expected level at the end of key stage 2 and most are generally effective in securing the necessary improvements. In the remaining half of primary schools visited, numeracy catch-up programmes only started in September 2012 or are planned to start in January 2013. Many of these schools said that their focus had previously been on literacy catch-up and that they were only now starting to give significant attention to numeracy.
- 59 Nearly all of the secondary schools visited have effective numeracy intervention programmes for pupils in Year 7. These sessions help pupils to improve their basic numeracy skills. Most schools visited track these pupils' progress well over the course of the year and around half continue to monitor pupils through Year 8 and Year 9 and provide top-up support if necessary. For example, one school organises 'Maths in Action' days to help pupils to use the skills they have learnt in numeracy catch-up sessions in real-life situations. Together with the school's catch-up programme, this has helped pupils to achieve higher outcomes at the end of key stage 3. A few schools have recently added numeracy lessons, as well as the usual mathematics lessons, for all pupils in Year 7. These additional lessons support pupils in developing their number and reasoning skills.
- 60 A few of the secondary schools visited focus on developing the numeracy skills of all pupils. Typically, this involves regular additional basic and key skills sessions. For

example, pupils are baseline-assessed for numeracy levels from pre-entry to level 3. Further diagnostic assessments are completed and staff provide pupils with individual action plans that they work on in subsequent sessions. At the end of each unit of work, a 'skills understanding and check' is completed and further work planned if necessary.

- 61 The case study below shows how one secondary school uses individual learning programmes effectively for all its pupils and how this has helped almost all pupils to achieve at least the expected level at the end of key stage 3.

### **The effective use of individual learning programmes to improve standards in numeracy**

#### **Context**

Elfed High School is an English-medium 11-18 mixed comprehensive school serving Buckley in Flintshire. A total of 15.2% of pupils are entitled to free school meals, which is below the average of 17.4% for secondary schools in Wales.

#### **Strategy**

Five years ago, the school introduced a computer-based system to support the development of pupils' numeracy skills. The system is now available on line and is accessed by pupils in school and at home.

#### **Action**

Pupils' numeracy skills are assessed on entry to the school and each pupil achieves one of six ability levels. There is a three-tier intervention system that identifies pupils who require catch-up sessions. Pupils also take regular diagnostic assessments and work at improving an area of numeracy identified for development. Pupils are supported to develop their numeracy skills effectively by their teachers and are also supported by Year 12 and Year 13 A-level mathematics pupil volunteers.

When pupils reach the next level for the area requiring improvement, they receive a certificate and points as part of the school's rewards system. The computer-based system then automatically moves them to work on a new area or level.

Each teacher has a copy of the pupils' levels and they differentiate numeracy work in lessons across the curriculum to meet pupils' needs effectively.

Leaders use the system to diagnose which aspects of pupils' numeracy require support. They use this information well to develop staff training and to feed into all schemes of work. For example, in the first term of 2011-2012, percentages were identified as a target area for improvement across the curriculum. In the second term staff moved on to develop pupils' skills in collecting and presenting discrete and continuous data. Leaders monitor the system on a regular basis and provide feedback to pupils and staff.

## Outcomes

Since the introduction of the scheme, the percentage of Year 11 pupils achieving the level 2 threshold in mathematics has risen from just over 50% in 2007, to 84% in 2012. A high percentage of pupils obtain level 2 in ESW Application of Number.

- 62 Nearly all primary schools visited have useful systems to track and record pupils' progress across the key stage in mathematics. A majority use this information well to inform their mathematics planning and the make-up of teaching groups and numeracy catch-up programmes. Only a minority of schools have systems to track pupils' progress and application of numeracy skills beyond mathematics. Where schools have effective systems, teachers are clear about the skills each pupil has or has not mastered and they use this information well to plan for further reinforcement across the curriculum.
- 63 All of the secondary schools' mathematics departments assess and track pupils' progress in mathematics regularly. However, only a very few departments share this information with staff in other subject departments. As a result, too few teachers in other departments know pupils' levels of numerical ability. This means that it is difficult for them to plan numeracy activities that meet the needs of different groups of pupils.
- 64 One of the surveyed secondary schools has developed an effective tracking system for pupils' numeracy. In this school, all teachers know pupils' key stage 2 assessment levels and standardised test results and they monitor pupils' standards of numeracy in their own subjects. This information feeds into a whole-school information database. The school identifies pupils who are underachieving and puts in place effective levels of support and challenge to help them.
- 65 A few local authorities produce high-quality materials to support their schools to assess and track pupils' numeracy skills across the curriculum. These local authorities provide materials that match progression in teaching to assessment objectives and produce numeracy tests that link to these.

## Teaching and assessment

- 66 In a minority of Year 6 lessons observed, teachers develop pupils' numerical reasoning skills well. This is usually because they:
- give clear explanations using key numerical terms;
  - explain the relevance of the task to real-life activities;
  - provide good opportunities for pupils to share their knowledge and understanding with their peers;
  - match work well to the different abilities within the class;
  - provide good visual prompts and models; and
  - support pupils well over the course of the lesson.

- 67 However, in a majority of Year 6 lessons pupils do not develop their numeracy skills well enough, most commonly because:
- there are too few opportunities for pupils to practise and rehearse strategies before being asked to apply them to a problem;
  - the pace of the lesson is too slow; and
  - the level of numerical challenge is either too high or too low.
- 68 In the minority of Year 9 lessons observed, teachers:
- focus well on developing numeracy as well as subject-specific skills;
  - ask challenging questions that require pupils to use their reasoning skills and provide good explanations;
  - have high expectations of what their pupils can achieve; and
  - provide good visual prompts and cues that pupils can refer to help them work out a numeracy related problem.
- 69 However, in many Year 9 lessons, teachers do not know the numeracy levels of their pupils and they do not provide appropriate support for lower ability pupils or those who struggle with aspects of numeracy. In this context, a minority of teachers use 'tricks' rather than sound strategies to help pupils solve numerical problems.
- 70 Staff in all of the primary schools visited said that teachers would know the pupils' levels of numeracy as they generally have the same class teacher for all subjects. However, inspectors found that in around half of primary lessons teachers did not extend or challenge the most able pupils well enough. The picture is similar in secondary schools.
- 71 In a majority of the primary schools visited, teachers apply the school's marking policy consistently and give clear and useful guidance to pupils on how they can improve their numeracy work. In a very few primary schools, the marking policy is understood by pupils and they use the agreed marking code to assess their own work and that of their peers. In a minority of primary schools, there are few comments that relate to numeracy in subjects other than mathematics or where comments are made there is no evidence that pupils are given time to return to their work to make the necessary improvements.
- 72 In a very few secondary schools, marking is of a consistently high standard and an agreed policy is applied by all departments. In these schools, all staff and pupils mark work against the agreed numeracy criteria and provide appropriate suggestions on how to improve work further. Although most schools visited have an agreed marking policy, staff do not always apply it consistently across or within departments or give the same level of priority to developing numeracy skills within their subject. In a minority of schools, there are very few comments relating to pupils' numeracy and little evidence of pupils marking the work of peers or self-marking.

## Leadership and management

### Leading and co-ordinating whole-school approaches to numeracy

- 73 Many schools do not have a clear policy on how to develop pupils' numeracy skills either within mathematics or across the curriculum. This leads to a lack of consistency across classes and departments. Too often, there is not a systematic approach to build pupils' knowledge and skills progressively. For example, leaders do not set out clearly how teachers should build pupils' understanding of mental and written calculations or how pupils should be supported by the consistent use of resources. They move too quickly to formal written methods before pupils have a good enough understanding of place value or the number system.
- 74 Nearly all primary schools visited during this survey have numeracy co-ordinators who are responsible for developing numeracy across the curriculum. Many of them are members of the senior leadership team and have appropriate experience of numeracy as mathematics coordinators.
- 75 All the secondary schools visited have numeracy co-ordinators, although in a minority of schools this is a very recent appointment. A minority of secondary co-ordinators are senior leaders. In nearly all the secondary schools, a member of the senior leadership team has responsibility for numeracy at a strategic level. Most co-ordinators have a background in numeracy either as head of mathematics or as an experienced member of the mathematics department.
- 76 In a few primary schools, the approach to planning the development of pupils' numeracy skills is co-ordinated very well. In these schools, the co-ordinators monitor planning and the work in pupils' books, and observe lessons to ensure that all staff plan and provide numeracy activities at an appropriate level across all subjects. One school has developed a very useful document that sets out age-related expectations for numeracy skills. Staff use this document to plan for the development of pupils' numeracy skills at an appropriate level across the curriculum. In a majority of schools, teams of staff plan together and discuss how they will develop pupils' numeracy skills. However, overall, there is not enough monitoring by the numeracy co-ordinators to ensure consistent levels of expectation and that pupils' develop all aspects of numeracy. Too often, co-ordinators focus on the development of pupils' data skills and do not pay enough attention to how well the school progressively develops numerical reasoning and number skills across the curriculum.
- 77 In a few secondary schools, there is a co-ordinated and consistent approach to numeracy across the school. In these schools, co-ordinators and their teams have an awareness of the numeracy skills developed in all subjects. Staff have received training on how best to teach aspects of numeracy within their subject and all subject departments have a member of the mathematics department as a link to support them in their planning for and delivery of numeracy. However, in many schools, there is no co-ordinated strategy to ensure the level of challenge within numeracy progressively increases throughout the key stage. Even in well-co-ordinated schools, the level of numerical challenge in subjects other than mathematics is often too low. In a majority of secondary schools, co-ordinating numeracy provision across the school is in its very early stages of development.

- 78 The case study below shows how one primary school has led numeracy effectively to bring about improvements in pupils' standards and the quality of provision.

### **Improving whole school numeracy through effective leadership**

#### **Context**

Marshfield Primary School is situated in a semi-rural area on the border between Newport and Cardiff in Newport local authority. The school serves an economically prosperous catchment area and just over 4% of the pupils are entitled to free school meals.

#### **Strategy**

The school has a strong tradition of developing literacy and numeracy skills across the curriculum. An audit of skills demonstrated that numeracy skills were not as well developed as literacy. From 2011 to 2013, the school gave a high priority to improving pupils' numeracy by focusing on leadership, management and provision.

#### **Action**

The school concentrates on the role of the numeracy co-ordinator, staff training, sharing good practice, improving planning and assessment, and monitoring and evaluating the impact of these actions.

The deputy headteacher is responsible for numeracy across the school. The school had decided that the appointment of the deputy headteacher in this role was important because of the cross-cutting nature of the role. The deputy headteacher is also the key stage 2 subject leader for mathematics and works very closely with the Foundation Phase subject leader. This means that they are well placed to consider transition, progression and continuity issues.

The school prioritises training for staff in teaching numeracy. In addition, the deputy headteacher is one of 15 teachers receiving training from the local authority and carrying out action research as an outstanding teacher of numeracy. There is a professional network in the school, led by the deputy headteacher, to disseminate the good practice from their involvement in the local authority initiative and to improve the teaching of numeracy.

The school has a very thorough approach to planning. There is a clear year-by-year progression in numeracy skills and also a portfolio demonstrating where numeracy can be used in each subject in each year group. All staff make sure that they include opportunities to use and reinforce numeracy skills whenever relevant. Expectations are clearly set out so that staff know what is expected and where they could plan for numeracy. Planning is monitored by senior staff to make sure numeracy is included appropriately. Numeracy is also a focus during lesson observations and book monitoring.

#### **Outcomes**

Standards of numeracy have improved across the school. Monitoring shows that all aspects are delivered more consistently than before. The school is well placed to adapt to the numeracy component of the Literacy and Numeracy Framework and is already cross-referencing this in day- to-day lesson planning.



- 79 In around half of the primary schools visited, there are working groups with a focus on numeracy. A few schools are developing a progressive and consistent approach to help teachers to improve opportunities for pupils to use their skills across the curriculum. For example, one school has worked closely with the local authority and other schools across the authority to agree a common approach for developing pupils' data and number skills. The co-ordinator is part of the local authority's team of outstanding teachers. They attend regular training and network meetings with other members of the team and share this training in their own school with staff to improve the teaching of numeracy both within mathematics and across the curriculum.
- 80 In a majority of the secondary schools visited, there are internal networks of professional practice with a focus on numeracy. A few schools have worked with their own and other local authorities to develop numeracy toolkits and resource packs for all subject departments at key stage 3. These packs have given staff a greater awareness of the strategies and approaches relating to supporting pupils' numeracy skills. Two schools also use internal working groups to investigate effective ways to approach PISA-style questions that require pupils to use their mathematical reasoning skills. In both schools, after action research was completed, the working group led whole-staff training to outline strategies of how staff could help pupils to use their numerical reasoning skills and break down questions into component parts.

#### **Numeracy priorities in school improvement plans**

- 81 Only half of the primary and secondary schools visited have a discrete numeracy policy and very few policies state clearly the schools' expectations with regard to standards and provision for numeracy.
- 82 Developing pupils' literacy skills is the highest priority for most schools. A very few schools have separate, detailed numeracy development plans that show how specific initiatives and strategies will be developed. A minority of schools' plans focus solely on improving the basic numeracy skills of those pupils who are predicted lower than the expected level at the end of the key stage. These plans do not address how to develop whole-school numeracy. In a few schools, development plans make no explicit reference to improving the overall standards or provision in numeracy. A minority of primary and secondary school improvement plans have a focus on building the capacity of staff to support numeracy and have clear and measurable success criteria.
- 83 A minority of primary and secondary schools use Estyn thematic reports and best practice case studies to inform their self-evaluation or improvement planning. Many schools are aware of the numeracy component of the Literacy and Numeracy Framework and a few are using the draft document to guide their audit of provision.
- 84 Only a few schools have a clear focus on numeracy in their monitoring and evaluation processes. For example, in a very few schools, leaders and co-ordinators compare pupils' standards of numeracy in mathematics with the standards of numeracy they achieve in other subjects. In these schools, co-ordinators use a robust evidence base to judge standards and the quality of provision. Their evaluations lead to clear school improvement targets linked to improving pupils' standards in numeracy.

- 85 Many schools are only beginning to focus on numeracy in their monitoring and evaluations processes. Generally, schools judge pupils' standards in numeracy through their end-of-year or end-of-term assessments in mathematics. However, these assessments often rely heavily on computation skills and do not measure pupils' standards in numerical reasoning, number, measuring or data skills well enough.

### **Professional development for numeracy**

- 86 A few secondary schools have undertaken an audit of teachers' knowledge, skills, understanding and confidence in teaching numeracy. In these schools, a majority of teachers feel confident to deliver numeracy. Leaders in other primary and secondary schools visited have not undertaken a formal audit, although many think teachers' confidence in teaching numeracy is too variable. They believe a significant minority of teachers will need training and support in order to deliver the requirements of the numeracy component of the Literacy and Numeracy Framework.
- 87 In primary and secondary schools, the training of teachers to develop pupils' numeracy is not as advanced as for literacy. Most schools are only starting to develop staff confidence and skills in teaching numeracy across the curriculum. Although many schools have planned numeracy training, this has not taken place yet. In secondary schools, where training has occurred, this has usually taken the form of 'twilight' sessions to raise staff awareness. In most schools, it is too early to judge the impact of these professional development activities.
- 88 A few primary schools have good levels of training and support from their local authority to help them provide whole-staff training to deliver numeracy across the curriculum. This training involves supporting newly qualified teachers and training co-ordinators so that they can support staff in their school effectively. A minority of primary schools have had very little support from their local authority and have found it difficult to access training or additional support to develop teachers' skills in delivering numeracy.
- 89 Many schools and local authorities provide specific training for support staff in delivering numeracy intervention programmes. In around half of the primary and secondary schools visited, support staff take a leading role in delivering and managing numeracy support. However, only a minority of schools involve support staff in whole-school numeracy training. Only a very few schools know what levels of competency in numeracy support staff have and provide on-going training to help them develop their own skills.

- 90 The case study below shows how a secondary school's robust selection procedures for learning support staff help to ensure that all those who support pupils' learning have the required level of numeracy and literacy skills.

### **Selecting learning support staff**

#### **Context**

Bryngwyn School is an 11-16, mixed, community school, in Carmarthenshire. Four per cent of pupils have a statement of special educational needs. A further 29% of pupils have special educational needs but no statement. Twenty-nine per cent of pupils live in the 20% most deprived areas of Wales and the proportion of pupils entitled to free school meals is just over 19%.

#### **Strategy**

The school has a strong tradition of improving pupils' numeracy and literacy skills. Within this context, they feel strongly that learning support staff should have the appropriate literacy and numeracy skills to support pupils effectively.

#### **Action**

All selection procedures for learning support staff involve the completion of rigorous numeracy and literacy tasks. Prospective learning support staff must display that they are competent in these areas themselves. In the numeracy task, candidates scrutinise an example of a pupil's work, such as an extract from an exam or test paper. Candidates need to check the answers, highlight areas in need of attention and offer possible targets for improvement. In the literacy task, candidates redraft an unpunctuated paragraph particularly with the intention of making it more accessible for pupils. Responses reveal not only a basic command of literacy, spelling and grammar but also an understanding of why literacy is so important in enabling pupils to access the curriculum.

Candidates' responses are scrutinised alongside other traditional selection procedures such as skills and experience match and performance at interview. The selection procedure is challenging and helps members of the selection panel to gain a full picture of each candidate's potential.

#### **Outcomes**

The school is confident that all newly appointed support staff have sound numeracy and literacy skills. As a result, staff have the basic skills to support pupils effectively in intervention programmes and in developing their literacy and numeracy skills across the curriculum.

## **Pupils' attitudes**

- 91 Most primary pupils in the surveyed schools are positive about numeracy and think that good numeracy skills are as important as good literacy skills. Many think that good numeracy skills will help them to get on well in secondary school and will be useful in helping them find a well-paid job. Nearly all pupils know that being able to add and subtract helps them to work out how to spend their pocket money. However, beyond pocket money, a majority of pupils struggle to give examples of how numeracy is relevant to their everyday lives. Most pupils think they need to improve their numeracy skills, but only a very few can explain how they will do this.
- 92 Many secondary school pupils think that numeracy and literacy skills are both important and that good numeracy skills will help them to progress further in education or employment. Around half of pupils can relate numeracy to their everyday lives, but a significant minority only regards numeracy as relevant to their schoolwork. Many pupils think that they are improving their numeracy skills because their tests results are improving.
- 93 A few secondary school pupils say that it is often difficult to apply their numeracy skills in other subjects because although they use the skills in mathematics lessons their understanding of why they are doing it is unclear. These pupils say that they revise techniques for tests and examinations in mathematics, but soon forget the reasoning and processes.
- 94 A very few secondary schools pupils have negative attitudes to numeracy and do not think being numerate is a necessary life skill. For example, one pupil acknowledged the need to be able to read well but thought that technical aids such as calculators and mobile phones could be used effectively to supplement poor number skills.

## Evidence base

Inspectors visited a representative sample of 11 primary and 12 secondary schools across Wales, inspected between 2010 and 2012. In each school, inspectors interviewed senior leaders and numeracy co-ordinators and observed Year 6 or Year 9 lessons in science, geography or design and technology. Inspectors also scrutinised the school improvement plan, schemes of work and pupils' books in mathematics, science, geography and design and technology and spoke to groups of Year 6 or Year 9 pupils.

The findings and recommendations in this report also draw on:

- primary and secondary school inspection reports;
- end of key stage data for the period 2010 to 2012; and
- the publications listed in the References section.

The schools visited as part of this remit were:

- Bassaleg School, Newport
- Brynmill Primary School, Swansea
- Brynnau Primary School, Rhondda Cynon Taf
- Bryntirion Comprehensive School, Bridgend
- Elfed High School, Flintshire
- Litchard Primary School, Bridgend
- Marshfield Primary School, Newport
- Mountain Lane Community Primary School, Flintshire
- Olfchfa School, Swansea
- Penycae Community Primary School, Wrexham
- Prestatyn High School, Denbighshire
- Sandfields Comprehensive School, Port Talbot
- Stebonheath Primary School, Carmarthenshire
- St Helen's RC Junior School, Vale of Glamorgan
- St Richard Gwyn Catholic High School, Vale of Glamorgan
- Traethmelyn Primary School, Port Talbot
- Ysgol Bryngwyn School, Carmarthenshire
- Ysgol Gyfun Gymraeg Glantaf, Cardiff
- Ysgol Melyd, Denbighshire
- Ysgol Morfa Rhianedd, Conwy
- Y Pant Comprehensive, Rhondda Cynon Taf
- Ysgol y Creuddyn, Conwy
- Ysgol y Grango, Wrexham

## References

### Estyn publications

Her Majesty's Chief Inspector of Education and Training in Wales Annual Reports 2010-2011 and 2011-2012

An evaluation of the impact of the non-statutory Skills framework for 3 to 19-year-olds in Wales at key stage 3 (2012)

An evaluation of the impact of the non-statutory Skills framework for 3 to 19-year-olds in Wales at key stage 2 (2011)

Improving numeracy at key stages 2 and 3 (2010)

Closing the gap between boys' and girls' attainment in schools (2008)

### Other publications

National Numeracy Programme, Welsh Government (2012)

National Literacy and Numeracy Framework, Welsh Government (2013)

Programme for International Student Assessment, OECD (2006, 2009)

## The remit author and survey team

Liz Miles HMI	Remit author
Richard Hawkley HMI	Team inspector
Sue Morgan AI	Team inspector
Mererid Stone HMI	Team inspector
Terwyn Tomas HMI	Team inspector
Denise Wade HMI	Team inspector