



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: an interim report

November 2014

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Introduction

This report is the second in a series published in response to a request for advice 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 over a three-year period. For this report, inspectors re-visited the schools that participated in the 2013 numeracy baseline study to evaluate progress over the last 12 months. Inspectors will visit the same schools next year for a final time to assess whether or what progress has been made, with particular reference to how schools have been implementing the numeracy component of the National Literacy and Numeracy Framework, which became statutory in September 2013.

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

Over the last few years, Her Majesty's Chief Inspector of Education and Training in Wales' Annual Reports, Estyn thematic reports and the findings from Programme for International Student Assessment (PISA) 2012 have demonstrated evidence that too many pupils in Wales do not develop their numeracy skills well enough.

To improve pupils' numeracy skills, the Welsh Government introduced the National Numeracy Programme in 2012. Since the introduction of this programme, the Welsh Government has also introduced:

- statutory National Numeracy Tests for pupils from Year 2 to Year 9, focusing on procedural¹ numeracy skills only (May 2013);
- a National Support Programme to help ensure the successful implementation of the National Literacy and Numeracy Framework (June 2013);
- the statutory numeracy component of the National Literacy and Numeracy Framework for pupils from the Foundation Phase through to key stage 3. This replaced the 'developing number across the curriculum' component of the Skills Framework (September 2013); and
- statutory tests for pupils in Year 2 to Year 9, focusing on numerical reasoning², to be taken in conjunction with the national tests for procedural numeracy skills (May 2014).

The key aim of the numeracy aspect of the National Literacy and Numeracy Framework is to help raise standards of numeracy in schools by assisting teachers of all subjects to identify and provide appropriate opportunities for pupils to apply their numeracy skills across the curriculum. The numeracy aspects of the National

¹ The procedural tests measure pupils' number, measuring and data skills.

² The reasoning tests measure how well pupils can use what they know to solve everyday problems.

Literacy and Numeracy Framework, together with the national tests, are expected to provide a more robust system for developing and monitoring pupils' progress in numeracy. The four strands of the numeracy component of the National Literacy and Numeracy Framework are:

- developing numerical reasoning;
- using number skills;
- using measuring skills; and
- using data skills.

The National Support Programme was established by the Welsh Government to provide hands-on support, tailored to the needs of individual schools, to support the successful implementation of the National Literacy and Numeracy Framework. The support is provided by 'partners', who are literacy or numeracy specialists. They work closely with schools, supporting and challenging headteachers to transform expectations and classroom practice. The programme is intended to support all schools between 2013 and 2016.

Most of the Welsh Government's actions mentioned above, were implemented after the issue of Estyn's 2013 baseline study (Numeracy in key stages 2 and 3: a baseline study). The aim of this second in a series of three surveys is to evaluate the effectiveness of numeracy strategies and gauge how far schools have made progress since the first, baseline survey. This means judging how well schools have responded to recently introduced Welsh Government initiatives and evaluating whether pupils' numeracy skills are improving. This study also evaluates how well schools have addressed the main issues identified in the baseline survey. The recommendations for schools from that survey were:

- 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.

Main findings

- 1 In just under half of primary and secondary schools inspected in 2013-2014, pupils develop good or better numeracy skills. In the remaining schools, pupils' numerical skills are at best average. This is because only around half of schools have developed suitable provision for numeracy, although this is an increase on the baseline survey.
- 2 The schools in the survey have made progress in developing their numeracy provision since the baseline survey. This is beginning to have an impact on pupil standards in both primary and secondary schools. In the main, pupils in these schools show a secure grasp of basic mathematical skills. This is an improvement from the baseline survey as measured against the first recommendation (R1). In particular, the introduction of the National Literacy and Numeracy Framework has helped the schools to plan more effectively, and teachers are beginning to plan better quality activities to support and extend pupils' numeracy skills (R3 and R4). Standards and the quality of teaching are higher and leadership across the schools has also improved, albeit marginally. On the whole, there is a greater focus on improving numeracy. Teachers have received better quality training, which has developed their numerical skills and led to improved planning and consistent numerical methodology across these schools (R2 and R7).
- 3 Despite making progress since the baseline survey, there is still a lot for these schools to do before many of the strategies have a consistent impact on standards. In particular, schools have made limited progress with:
 - assessing and tracking of pupils' numeracy skills (R5);
 - improving the continuity and progression of experience by pupils between primary schools and between primary and secondary schools (R7); and
 - monitoring and evaluating the quality of numeracy standards and provision in schools (R8).
- 4 In the majority of schools in the survey, pupils demonstrate secure numeracy skills and can generally transfer them across the curriculum and use them to analyse data and solve problems. The majority of pupils in the survey have an appropriate understanding of times-tables, the four rules of number, place value and fractions. However, there are still too many pupils who lack confidence with division and percentages. These deficiencies impede pupils' ability to interpret results and solve problems.
- 5 Pupils' numerical reasoning skills are still not strong enough. Too many pupils are unfamiliar with problem-solving procedures such as identifying, collecting, organising, calculating, interpreting and evaluating. Many pupils misunderstand cause and effect and do not check their answers for reasonableness or accuracy, or to identify silly mistakes.
- 6 In many of the schools visited, teachers' planning for the development of pupils' numeracy skills is generally better than reported in the baseline survey and in comparison with that of schools inspected through the regular inspection cycle. However, in around half of schools, planning is still superficial, and only a few schools do enough to challenge more able pupils. In most primary and secondary schools, planning and provision for numeracy are weaker than for literacy.

- 7 In nearly all the schools, planning and developing numerical reasoning are proving to be more difficult than planning for using mathematical skills across the curriculum. Most schools are just beginning to identify and use tasks that are suitable for developing pupils' reasoning skills of planning, communicating and reviewing. This is the case in both mathematics lessons and in subjects across the curriculum.
- 8 The quality of teaching to develop numeracy is good in just over half of the lessons observed. This is an improvement on the baseline study. In the lessons where teaching is less successful, this is often because teachers lack the mathematical subject knowledge to address pupils' misconceptions. In primary and secondary schools where teachers lack the relevant knowledge, pupils make limited progress and in a few cases they become more confused.
- 9 In general, the quality of marking pupils' numeracy work across the curriculum is not good enough. As noted in the baseline survey, teachers do not routinely identify numerical errors in pupils' work in subjects other than in mathematics. When compared with the baseline study, the tracking of pupils' numeracy skills across the curriculum remains at an early stage of development. Nearly all schools are taking a 'wait and see' approach in anticipation that a national tracking system may be developed.
- 10 Leadership for numeracy is good in only a minority of schools. This is a slight improvement compared with the baseline study. In the schools where leadership for numeracy is strongest, strategies to develop numeracy feature strongly in school development plans and leaders in these schools allocate worthwhile time, training and resources to support the development of numeracy. However, even in the schools where leadership is good, improving pupils' numerical reasoning remains an important area to develop.
- 11 The majority of schools have agreed approaches for performing simple calculations. This is an improvement on the baseline survey. However, staff are inconsistent in how they implement of these agreed approaches in around half of schools. As a result, too many pupils in these schools lack confidence in basic number work, such as multiplication and division.
- 12 Similar to the findings of the baseline survey, the monitoring of pupils numeracy skills through lesson observation and work scrutiny remains underdeveloped. Nearly all schools fail to use of these techniques systematically to evaluate provision. Most schools are too reliant on test data, such as the National Numeracy Tests data, skills qualifications or results in mathematics to provide proxy measures for the quality of their provision.
- 13 Since the introduction of the National Literacy and Numeracy Framework and National Support Programme, the amount of training time schools allocate for developing numeracy has increased significantly. In a few primary schools surveyed and in most secondary schools, senior leaders report that improving the numerical skills of staff remains a priority to enable numeracy provision to be effective across the school.
- 14 Since the baseline survey, there has been little progress on collaboration between primary and secondary partner schools across key stages 2 and 3. This remains an important area for improvement.

Recommendations

These recommendations supersede the recommendations from the baseline survey.

Schools should:

- R1 ensure that pupils master important number skills, such as division, work with metric measures, percentages, ratio and proportion, in mathematics lessons;
- R2 develop pupils' numerical reasoning skills in mathematics lessons and in other subjects;
- R3 extend the opportunities for pupils of all abilities to use their numeracy skills in subjects across the curriculum;
- R4 support staff to widen their knowledge and understanding of strategies to use numeracy across the curriculum;
- R5 improve the assessment and tracking of pupils' numeracy skills;
- R6 strengthen procedures for evaluating numeracy provision; and
- R7 work more closely with cluster schools to develop greater consistency in teaching and assessing pupils' numeracy skills.

Local authorities and regional consortia should:

- R8 support schools to help staff to improve their knowledge, skills and confidence in developing pupils' numeracy skills through their subjects; and
- R9 share best practice between schools.

The Welsh Government should:

- R10 consider developing a national system for tracking pupils' numeracy skills.

The national context

School inspections

- 15 Evidence from school inspections in the academic year 2013-2014 indicates that in just under half of schools pupils develop good or better numeracy skills. However, in the remaining schools, pupils' numerical skills are adequate or unsatisfactory. Standards and provision are slightly better in primary schools than in secondary schools.
- 16 In the good schools, pupils collect, present and interpret information competently using a variety of related graphs and tables. Most pupils use a range of calculation methods accurately and can explain their strategies when solving problems.
- 17 However, in around half the schools inspected where pupils' numeracy standards are adequate or lower, too many pupils struggle to use basic number techniques fluently, such as division or converting between metric measures, when required to use them across the curriculum. Many pupils do not have a sound understanding of the appropriate types of graphs and charts to use to present different types of data.
- 18 These findings from school inspections do not support the strong increase in standards seen in teacher assessment outcomes at both key stages 2 and 3 over recent years.

National Curriculum teacher assessments in mathematics

- 19 The proportion of key stage 2 pupils achieving the expected level 4 or above in mathematics has improved steadily over the last five years, increasing by nearly six percentage points and is currently 89%. At key stage 3, the percentage of pupils achieving the expected level 5 or above in mathematics has increased faster, increasing by around 11 percentage points and is currently 86%.
- 20 Over the past five years, the proportion of pupils achieving the higher level 5 or above at key stage 2 has improved by nine percentage points. In key stage 3, the proportion of pupils achieving the higher level 6 and above has increased strongly. In 2013, over half of Year 9 pupils achieved level 6 and around a quarter of pupils achieved level 7 or above.
- 21 At key stage 2, there are no significant differences between the achievement of boys and girls, although boys have improved faster at level 4 and above and girls at level 5 and above. At key stage 3, girls have improved faster than boys across at level 5 and above, with the gap between girls' and boys' performance at level 5 and above currently around four percentage points.
- 22 At both key stage 2 and 3, pupils eligible for free school meals achieve considerably less well than other pupils. The gap between pupils eligible for free school meals and those who are not is 15 percentage points in the expected level for mathematics at key stage 2, increasing to 23 percentage points at key stage 3.

National numeracy tests

- 23 In 2013, pupils from Year 2 to Year 9 inclusive sat the first national numeracy tests for measuring procedural numeracy skills, with calculated standardised scores³ providing a measure of relative performance. From 2014 onwards, pupils will sit an additional reasoning test, which will assess pupils' ability to apply their numerical reasoning skills to unfamiliar contexts.
- 24 In 2014, a higher proportion of boys compared to girls across all year groups achieved a standardised score greater than 115⁴ in the procedural tests. In 2014, the average gap between boys and girls with a standardised score greater than 115 in the procedural tests is 4.3 percentage points. In 2014, the same proportion of boys and girls across all year groups achieved a standardised score less than 85⁵ in the procedural tests.
- 25 In 2014, a higher proportion of boys compared to girls across all year groups achieved a standardised score greater than 115⁶ in the reasoning tests. In 2014, the average gap between boys and girls with a standardised score greater than 115 in the reasoning tests is 2.5 percentage points. However, in 2014, a greater proportion of boys compared to girls across all year groups achieved a standardised score less than 85 in the reasoning tests. The average gap between boys and girls with a standardised score less than 85 in the reasoning tests is 0.7 percentage points.
- 26 In 2014, Ceredigion, the Vale of Glamorgan and Monmouthshire local authorities had the highest proportion of pupils with standardised scores greater than 115 in the procedural tests. Blaenau Gwent, Rhondda Cynon Taf and Caerphilly local authorities had the highest proportion of pupils with standardised scores less than 85 in the procedural tests.
- 27 In 2014, Ceredigion and Isle of Anglesey local authorities had the highest proportion of pupils with standardised scores greater than 115 in the reasoning tests. Blaenau Gwent, Merthyr Tydfil and Caerphilly local authorities had the highest proportion of pupils with standardised scores less than 85 in the reasoning tests.

³ Standardised scores from national tests indicate how well a pupil has done compared with other pupils of the same age.

⁴ A score of 115 or more might indicate that a pupil has stronger numeracy skills than pupils of the same age.

⁵ A standardised score of less than 85 might indicate that a pupil has weaker numeracy skills than pupils of the same age.

⁶ A score of 115 or more might indicate that a pupil has stronger numeracy skills than pupils of the same age.

Standards observed in surveyed schools

Standards in lessons and pupils' work

- 28 Pupils' numeracy skills in the primary and secondary schools surveyed have improved when compared with the baseline survey. However, while pupils can apply the numeracy skills that they have, they are nevertheless often limited by the low levels of their mathematical understanding and skills.
- 29 In the majority of schools surveyed, pupils in key stage 2 and key stage 3 demonstrate some secure age-appropriate numeracy skills and are generally able to transfer them across the curriculum and use them to analyse data and solve problems. For example, in primary schools, pupils apply mathematical skills in practical day-to-day applications to plan trips, analyse food content and use recipes. In secondary schools, there are good examples of pupils working with data in geography to interpret and analyse patterns associated with volcanic activity and population growth. However, in both key stages, overall, there are still too many pupils who lack confidence with important mathematical skills. They do not choose the right mathematical skills or use their skills correctly to solve problems. Many pupils do not select appropriate axes and scales when displaying their results in graphs. In other instances, pupils have difficulty working with calculators when entering negative values or when interpreting answers with long decimals. These deficiencies impede their ability to solve problems and interpret results.
- 30 The majority of pupils at key stage 2 and key stage 3 display an age-appropriate understanding of times-tables, the four rules of number, and other key number aspects such as place value and work with fractions. However, important weaknesses remain. Pupils in both key stages find division difficult and struggle to calculate answers accurately whether using mental or written techniques. They also struggle to work out two-step operations when calculating fractions of a quantity, for example working out three-fifths of 60. For a significant minority of pupils, working with metric measures, percentages, ratio and proportion is challenging.
- 31 At key stage 2 and key stage 3, pupils' numerical reasoning skills are not strong enough. Many pupils are unfamiliar with problem-solving procedures such as identifying, collecting, organising, calculating, interpreting and evaluating, and are heavily reliant on teachers for guidance and direction. For example, in primary schools, pupils present their results in a variety of suitable forms, but often do not interpret or explain their findings. Many pupils miss central links between cause and effect. For example, in science at key stage 3, pupils incorrectly interpret the speed of sound through materials with different densities, suggesting that faster speeds would lead to longer times.
- 32 Linked to weak numerical reasoning skills, pupils in both key stages do not routinely check their answers for accuracy, reasonableness or to identify silly mistakes. For example, at the end of key stage 2, there are instances of pupils using mixed units when dealing with money and recording heart rates at 33 beats per minute. In key stage 3, examples include pupils calculating mean values that are higher than the numbers involved in the calculation and drawing uneven graphs for fixed rate currency conversions.

- 33 In the majority of primary and secondary schools visited, pupils use their mathematics skills well to support their learning across the curriculum. At key stage 2, pupils extract and interpret information well from a variety of sources such as flight schedules, shopping catalogues and nutritional information printed on food packaging. In science, pupils make good use of tables to collect and organise data from experiments. In the other subjects, they work well with money converting between different currencies using difficult exchange rates. At key stage 3, they read scales accurately to one decimal place and they use standard form precisely to represent very large or very small numbers. The majority of pupils select and construct accurate graphs to present their findings and use good subject terminology, such as control variables, when describing their work. In geography, pupils use grid references, graphs and map distances well, calculating accurately using a variety of scales. Pupils calculate angles and construct pie charts accurately dealing well with a range of difficult numbers generated from real data. In design and technology, pupils draw three dimensional shapes precisely. They draw plans and elevations using pencils, rulers and protractors accurately and they can convert between units of time, substitute into and rearrange compound formulae.
- 34 In only a minority of schools do pupils at key stage 2 and key stage 3 develop their problem-solving skills well in mathematics lessons. For example, they use a wide range of mathematical skills to solve problems, associated with parallel lines, scale, speed distance time graphs, contextualised percentage and proportion problems linked to profit and loss, weight change, VAT and saving and investing. The best examples include extended tasks that involve pupils in multi-step processes such as researching, planning, presenting and evaluating work. These lead to evaluative reports that balance the pros and cons of using different strategies in scenarios such as reducing household bills or planning holiday trips.
- 35 However, in a majority of primary and secondary schools, where pupils' numeracy skills are less well developed, pupils do not get enough opportunities to apply their problem-solving skills in mathematics lessons, with activities focused too much on procedural work. In these schools, opportunities for pupils to apply their mathematics skills across the curriculum are also limited and the opportunities taken are often undemanding and lack depth and challenge. For example, in one primary school visited, pupils analysed transportation methods that led to useful work in collecting data, but the results were not presented in a useful format and no firm conclusions were drawn.
- 36 In a few primary and secondary schools, where standards are poor, the work of too many pupils is untidy and careless. In particular, they display a lack of precision and accuracy in graph work, with poorly chosen scales, unlabelled axes and blank headings, which makes interpretation of their results difficult. In these schools, pupils do not regularly correct or refine their work. This remains the case even when teachers identify numerical errors or suggest improvements, resulting in pupils repeating the same mistakes.

Provision

Planning and resourcing

- 37 In the primary and secondary schools inspected since the introduction of the National Literacy and Numeracy Framework in 2013, around half have developed appropriate plans for improving pupils' numeracy skills across the curriculum. This is a small increase when compared with the first year of this survey. However, planning and provision for numeracy remain weaker than for literacy. Too often, schools' plans and actions to improve numeracy provision are at early stages of development. This is common to primary and secondary schools.
- 38 In many of the primary and secondary schools surveyed, planning and provision for numeracy is generally further developed than in the schools inspected through the regular inspection cycle. Good features in the schools surveyed include:
- detailed audits of provision mapped against the National Literacy and Numeracy Framework to identify gaps;
 - adapted schemes of work to identify where provision meets the needs of the National Literacy and Numeracy Framework;
 - resources clearly identified or in the process of being developed to meet the needs of National Literacy and Numeracy Framework;
 - lesson planning adapted to include a focus on numeracy;
 - information about pupils' numerical strengths and weaknesses shared with staff to help with lesson planning;
 - regular training for staff focusing on numeracy development;
 - consistent methodologies agreed across the school, for example in relation to calculation methods and constructing graphs;
 - "how to do" resources available for teachers to look up methodologies;
 - analysis of test data and other sources used to identify common weaknesses in pupils' numeracy skills and to inform planning;
 - creative use of non-lesson time, such as registration periods to focus on numeracy skills development; and
 - effective catch-up programmes used to support pupils with weak basic numeracy skills.

A digital, whole-school numeracy map with planning, lesson and best practice resources

Context

St Richard Gwyn Catholic High School is an 11-16 mixed comprehensive with 670 pupils on roll and is the only Catholic high school in the Vale of Glamorgan. In their most recent inspection in 2011, both overall judgements were good. The percentage of pupils eligible for free school meals is around 14%, which is below the national average of 17.7% for secondary schools.

Strategy

The school's strategy has been to use the findings from self-evaluation to update and improve their provision for numeracy across the school and hence drive up pupils' standards in numeracy.

Action

To prepare for the implementation of the National Literacy and Numeracy Framework, work was carried out in the summer term 2013 to evaluate the current whole-school provision for numeracy. This exercise demonstrated that the school's provision was not detailed or precise enough to improve standards in numeracy strands in line with expectations in the National Literacy and Numeracy Framework.

As a result, evidence was collected from each curriculum area and cross-referenced with the numeracy strands in the National Literacy and Numeracy Framework. Alongside this, numeracy plans were refined in specific subjects through co-ordinated meetings with heads of department to ensure all strands were being sufficiently covered across the curriculum. A digital whole-school numeracy map was developed that records all of the numeracy strands from the National Literacy and Numeracy Framework taught across the curriculum in Year 7, Year 8 and Year 9. The map includes timetables for the delivery of each strand, subject-specific details of how the strands link to topics, as well as links to resources which illustrate each numeracy objective clearly.

Evidence from the school's monitoring cycle also highlighted the need to improve the consistency of approach with teaching numerical processes across the school. To support this, the whole-school numeracy map includes links to video resources, created by the school, that illustrate examples for all the numeracy strands in the National Literacy and Numeracy Framework. These provide all staff with detailed explanations of the different numerical skills and how they are taught within the mathematics department. In-service training has been provided to staff support staff with using these resources. All resources are accessible through the school's virtual learning environment, which allows staff, pupils, parents and guardians to access them whenever they need to.

Outcomes

The strategy has improved provision for the development of pupils' numeracy skills across the school and has led to more focused numeracy activities being planned and delivered by teachers. Importantly, the strategy is improving the knowledge and confidence of staff to support the development of pupils' numeracy skills in their subjects.

- 39 In many of the primary and secondary schools visited, planning for the development of pupils' numeracy skills is generally better compared with the baseline survey. Where schemes of work have been adapted, there are better links between cross-curricular work and the mathematics curriculum. The improvement in planning is evident from the lessons observed in the surveyed schools where standards are

judged to be good in three-in-five lessons observed: an increase on the baseline survey. However, in around half of schools planning is still too superficial and does not raise standards. In these instances, planned activities noted in lessons and books are often at too low a level and provide limited challenge for more able pupils. In the main, planned activities that do not support or develop pupils' numeracy skills well enough are either underdeveloped or tokenistic.

- 40 In nearly all schools visited, planning and development for numerical reasoning are proving to be more difficult than planning for using mathematical skills across the curriculum. Most primary and secondary schools are just beginning to identify and use purposeful tasks that are suitable for developing pupils' reasoning skills, such as planning, communicating and reviewing. This is an important shortcoming in mathematics lessons as well as in subjects across the curriculum.
- 41 In a majority of schools visited, teachers are uncertain of what the term 'numerical reasoning' means and how it translates into classroom activities. Staff believe that the Welsh Government's recently published support materials for schools that exemplify numerical reasoning in the classroom are beginning to help, although it is too early to evaluate their impact.
- 42 Most schools have suitable catch-up programmes in place to support pupils with weak numeracy skills. These programmes are generally effective in securing improvements in pupils' basic numeracy skills.

Teaching

- 43 Overall, the quality of teaching to support pupils' numeracy development is good in just over half of the lessons observed for this survey. This is an improvement on the baseline study. Teaching is more consistent in secondary schools, although the best practice was observed in primary schools.
- 44 In the successful lessons observed:
- teachers have good mathematical knowledge;
 - teaching is enthusiastic and engages pupils;
 - pupils are prepared well for the numerical demands in lessons;
 - activities are well planned, naturally support pupils' numeracy skills and cater well for pupils with additional learning needs, including the more able pupils;
 - rich tasks require pupils to plan, communicate and evaluate their work;
 - activities and discussions relate to real-life situations;
 - teachers monitor and assess pupils' progress well, supporting and guiding individually or at a class level when needed;
 - teaching assistants support pupils effectively;
 - teachers deal well with pupils' common numerical mistakes and misconceptions and pupils have regular opportunities to review their progress and learning; and
 - teachers use a range of questioning styles successfully to test and deepen pupils' knowledge and understanding.

Good practice lesson, a science theme in a primary school

Context

Litchard Primary School in Bridgend has around 400 pupils on roll. Approximately 26% of pupils are eligible for free-school meals, which is above the national average of 20.7% for primary schools.

Strategy

The teacher plans activities in such a way that all pupils follow the main body of the lesson, but the tasks for more able pupils and less able pupils are adapted accordingly to provide appropriate levels of challenge. In addition, a teaching assistant provides very effective support to pupils, when appropriate.

Action

A mixed-ability Year 5 class of 20 pupils are using their numerical skills to support their scientific work on the volume of blood in different sizes of body.

The teacher starts the lesson with an enthusiastic question and answer session. This engages pupils, tests their knowledge and understanding of previous work and prepares them well for the lesson content. Purposeful links are made with real-life contexts to do with the volume of blood in human bodies, blood donors and blood transfusions. This captures the pupils' imagination well and provides a meaningful context in which to set the work. The lesson contains a range of well-planned activities, including practical work, such as measuring heights and volumes. These allow pupils to practise and apply a range of mathematical skills in a scientific context to solve problems.

The teacher accepts all pupils' responses in discussion and deals effectively with pupils' mistakes and misconceptions, often using other pupils to provide support or further ideas. The teacher uses the pupils to generate real-life data which the class then interpret. Throughout the lesson, the teacher creates opportunities for pupils to discuss their learning and focus on problem solving and numerical skills.

Impact

All pupils are well behaved and engage exceptionally well with their learning. They work well in pairs and groups and support each other effectively. They demonstrate a secure knowledge and understanding of previously learnt work and show a good understanding of time-tables and the metric system. Most display good mensuration skills and calculate accurately when working to one decimal place. Many pupils display good reasoning skills and identify patterns effectively by arranging data in a tabular format. These pupils evaluate their work well and are able to suggest refinements to improve the accuracy of their work. Nearly all pupils make good progress in their subject-specific and numeracy skills.

Good practice lesson, project work in a primary school

Context

Mountain Lane Primary School in Buckley in Flintshire and has just over 450 pupils on roll. Approximately 6% of pupils are eligible for free-school meals, which is below the national average of 20.7% for primary schools.

Strategy

The school has made good progress in mapping the skills of the numeracy framework to topics and themes across a range of subjects. In this lesson, a mixed-ability Year 5 class of 27 pupils are following a project on South Africa. In mathematics lessons, they had been using calculators effectively to develop their understanding of currency conversion.

Action

Using an exchange rate of £1 = £17.78 ZKR, all pupils use a calculator correctly to calculate whether articles for sale in a supermarket in Wales are more or less expensive than a similar article in a South Africa. The class teacher makes good use of internet links to obtain relevant data for pupils to use.

Pupils work individually to solve problems. The teacher challenges the pupils' numeracy skills at a level equivalent to their number skills in mathematics effectively. The classroom assistant supports the less able successfully and the teacher differentiates the activity well by requiring more able pupils to convert pound sterling with decimals. The teacher actively encourages pupils to check their answers with their peers and to resolve errors where differences in calculations occurred. This helps pupils to explain their reasoning and consolidates their understanding.

Impact

Most pupils make rapid progress in being able to accurately convert prices from South African Rand to Sterling or vice versa. Most are able to check the validity of the calculator display to ensure their answers are reasonable.

As the lesson develops, the teacher encourages more able pupils to look for patterns in their answers. As a result, they become increasingly able to predict accurately what their answers would be before using the calculator to check if they are correct.

In the plenary session, many pupils explain articulately how they would be able to use these skills in their own life, for instance, when on holiday abroad.

- 45 In just under half of lessons, where teaching is less successful, teachers often lack sufficient mathematical subject knowledge to plan and deliver effective lessons. This is the case in both primary and secondary schools. For example, in some lessons, teachers offer incorrect strategies to manipulate numbers and in others they struggle to explain numerical concepts and processes clearly. As a result, teachers in these lessons are not able to address pupils' numerical misconceptions, and in a few cases pupils become more confused. Pupils in these lessons make limited progress.

46 In the less successful lessons:

- activities are undemanding, superficial or too difficult;
- activities do not involve all pupils;
- teachers do not use tasks that naturally support the subject and the development of skills;
- there is limited discussion of methodologies and strategies to solve problems;
- teachers do not identify mistakes in pupils' work;
- teachers and pupils do not review learning and the use of numerical skills;
- teachers spend too much time talking;
- teachers do not make sure that pupils make appropriate progress; and
- teaching assistants do not support pupils with difficulties well enough.

Assessment, tracking and reporting

- 47 In general, the quality of marking for numeracy across the curriculum in primary and secondary schools is not good enough. In a few schools, teachers use common marking strategies for numerical work. In these schools, a consistent approach to marking in areas such as graph work ensures that pupils' work in this area is consistently good across most year groups in primary schools and subjects in secondary schools. However, too many teachers do not routinely identify numerical errors in pupils' work in subjects other than in mathematics. For example, in key stage 2, pupils' scientific work on forces have calculation and rounding errors, which are either marked correct or are not marked at all. In key stage 3, in several design and technology workbooks, pupils repeatedly make mistakes converting between metric units, and teachers' marking does not identify this or give correct answers. In primary and secondary schools, there too many examples of incorrect workings either marked as correct or not marked at all. In addition, on the occasions when pupils attempt to draw conclusions from numerical activities, they often respond incorrectly and misconceptions are not addressed.
- 48 Pupils consistently correct their work in only a few schools. In many primary and secondary schools, teachers' comments on how to improve the quality of pupils' work, such as correcting scales on graphs, often go unheeded.
- 49 The tracking of pupils' numeracy skills across the curriculum is at an early stage of development. In a few schools, all teachers have access to useful information on pupils' attainment in mathematics and results from tests such as the National Numeracy Test for procedural skills. Teachers in these schools use this information appropriately to inform their planning. However, in terms of tracking pupils' numeracy skills across the curriculum, nearly all schools consider that this is a complex process and they are taking a 'wait and see' approach in the hope that a national system is developed.

Leadership and management

Leadership for developing numeracy

- 50 The quality of leadership for developing numeracy is good in only a minority of the surveyed schools. This represents a slight improvement compared to the first year of the study. Leadership is marginally stronger in secondary schools than in primary schools. This is largely due to a more focused approach and a greater drive by leaders to develop numeracy provision and raise standards.
- 51 In many schools, the development of numeracy is less well developed than that of literacy and many of the strategies and systems to support the development of numeracy in schools are only just beginning to be set up. Additionally, due to the potential for further change nationally, many schools are “holding back” to see how things will develop. For example, many schools are reluctant to drive forward developments suspecting that significant changes may take place as a result of the current review of the National Curriculum.
- 52 In most schools, strategies to develop numeracy feature strongly in development plans and nearly all primary and secondary schools have numeracy co-ordinators with management responsibilities. Schools welcome the numeracy framework and say that it has raised expectations for all staff of what can be achieved by pupils as they move through school. However, in a minority of schools, although the focus on numeracy has increased, numeracy is still not seen as a main priority. This is the case in a few primary schools where the development of pupils’ literacy skills takes greater priority and in a few secondary schools where performance in GCSEs and banding outcomes are viewed as more important.
- 53 The majority of schools have agreed approaches for performing simple calculations. This is an improvement on the baseline survey. However, the implementation of these approaches by staff in around half of schools is inconsistent. This means that a significant minority of pupils in these schools still lack confidence in basic aspects of number work such as multiplication and division.
- 54 In the schools where leadership is strongest, numeracy has been an important focus of the schools’ work for a few years with senior staff leading the development. Strategies to develop numeracy feature strongly in development plans and leaders in these schools allocate worthwhile time, training and resources to support the development of numeracy.
- 55 Typically, in these schools, teachers now plan more systematically for the development of pupils’ numeracy skills. Mathematics co-ordinators or mathematics departments work closely with other teachers and departments to support them with planning purposeful activities and to strengthen pedagogy. In these schools, teachers have a better understanding of pupils’ mathematical abilities and lessons cater for pupils’ needs more effectively. In addition, leaders have ensured that teachers improve their understanding of different methodologies for teaching mathematics, in areas such as calculation and graph work. As a result, there is a greater consistency of approach by teachers, which is helping pupils to improve.

- 56 In the schools where leadership is less effective, numeracy is still not a high priority. In these schools, too many initiatives have only recently started and planning for numeracy is superficial, with whole-school approaches to numerical procedures not in place or not adhered to consistently by staff. This means that the quality of numerical activities experienced by pupils and the standards pupils' achieve are too variable and are generally left to chance.
- 57 Even in the schools where leadership is good, improving pupils' numerical reasoning remains an important area to develop. In nearly all the schools visited, teachers are in the process of identifying opportunities and creating extended activities to develop pupils' numerical reasoning skills such as planning, communicating and evaluating. This is equally the case for work in mathematics and in subjects across the curriculum.

Improving quality in numeracy

- 58 In primary and secondary schools, the monitoring of pupils' numeracy skills through lesson observation and work scrutiny is underdeveloped. Nearly all schools fail to make enough use of these techniques to evaluate the quality of their provision. Only a very few schools carry out reviews of numeracy across the schools. In one school, leaders constructed a useful self-evaluation document after reviewing numeracy across the school. However, in the main, schools are too reliant on test data, such as the National Numeracy Test data, skills qualifications or results in mathematics to provide proxy measures for the quality of their provision.
- 59 A few schools are beginning to develop systems that focus on identifying the standards of pupils' numeracy skills. However, most schools take a tick-box approach to identifying whether work seen in lessons and books contains numeracy activities rather than focusing on the quality of the activities and the skills demonstrated by pupils. In a few schools, there are weak quality assurance systems to review the quality of provision in mathematics and numeracy across the curriculum.

Professional development and partnerships

- 60 The training of staff to develop pupils' numeracy skills has improved from the baseline survey. In all of the primary and secondary schools surveyed, staff have received training to assist with the implementation of the National Literacy and Numeracy Framework. In a few primary and most secondary schools, leaders report that improving the numerical skills of staff is still a challenge. This is evident in the lessons observed and in pupils' books, where too many teachers lack appropriate mathematical knowledge to plan and deliver numeracy lessons effectively. The involvement of support staff in training remains weak in a majority of schools.
- 61 In a minority of schools, leaders have arranged helpful sessions to audit the numeracy skills of staff. In a few schools, teachers completed questions from the national numeracy procedural tests. This proved to be an insightful process and identified that a high proportion of staff were uncertain about how to approach many key aspects of mathematics. Findings from these activities have been used to provide whole-school and individual training support to address the issues identified. These approaches have improved the confidence of staff to teach numeracy and have also improved the consistency of methodology used by staff across these schools.

- 62 The work with partner schools across key stages 2 and 3 remains an area for improvement. Although the National Literacy and Numeracy Framework has provided a framework for schools to develop greater continuity and progression in pupils' numeracy skills as they move from Year 6 to Year 7, schools' work in this area has been weak. This is because they do not focus well enough on the inconsistencies in mathematics and numeracy provision between primary schools and between primary and secondary schools.
- 63 Many schools have working groups that focus on numeracy. These range from transition, regional, internal cross curricular and information and communication technology groups. In one primary school, a useful working group makes extensive use of the Learning Wales website to develop the use of technology for pupils at home. However, the impact of these working groups on pupils' numeracy skills is unclear due to limited evaluation by senior and middle leaders.
- 64 Many of the schools surveyed were visited in the early stages of phase 2 of the National Support Programme. This phase of the programme involved reviewing the school's progress in implementing the Literacy and Numeracy Framework and agreeing the school's literacy and numeracy improvement priorities. The quality of the support provided by partners to the schools visited as part of this survey of numeracy has been variable. In the schools where support has been good, school leaders report that the partners have helped schools to evaluate the quality of their numeracy provision accurately. These partners have also brokered useful support for those schools, including providing access to exemplar lessons or demonstrations to help teachers to plan lessons. In the schools where the support from partners has been least effective, leaders say that partners lack the necessary experience of the age-range of pupils in the school they are supporting. The National Support Programme section on the Learning Wales website is difficult to use and materials are often unnecessarily lengthy.

Regional support for numeracy

- 65 The four regional consortia are at different stages of development. Regional consortia staff acknowledge that support for numeracy is less developed than that for literacy. The strategic approach, support systems and number of dedicated staff for numeracy vary considerably between the regional consortia. Areas for further development by the regional consortia are to:
- improve the numerical knowledge of non-specialist teachers;
 - improve teachers' abilities to develop numerical reasoning;
 - use lead practitioners and departments to develop good practice;
 - challenge, support and strengthen mathematics departments in secondary schools, particularly those where standards are weak;
 - ensure effective communication between National Support Programme partners and regional officers; and
 - continue to move from local authority specific approaches to regional approaches.

Pupils' attitudes

- 66 Many pupils interviewed for the survey are positive about their experiences with numeracy and mathematics in primary and secondary schools. There were no discernible differences between the attitudes of boys and girls.
- 67 Nearly all pupils consider that the amount of numeracy-related work in schools has increased since last year. Most pupils believe that they use their numeracy skills across the curriculum and a majority say they do this with little difficulty. However, only a few pupils say they use their numeracy skills fairly regularly to solve extended tasks.
- 68 Many pupils in both key stages understand the importance of numeracy and mathematics to their future lives and careers. They are able to cite a number of areas where these would be important, for example, careers in computing, engineering and medicine, and in everyday life situations such as dealing with and understanding utility bills, pensions and government taxes. This awareness of the importance of numeracy and mathematical skills in future life represents an improvement from the baseline survey.
- 69 Although many pupils present a positive picture of numeracy provision in the schools surveyed, a few common concerns are evident. These concerns are that:
- pupils identify division, percentages, ratio, fractions and metric measures as areas of mathematics they often find difficult;
 - heavily contextualised problems are regarded as difficult and “require a lot of thought”;
 - tokenistic or superficial numeracy activities are evident in a minority of lessons;
 - teachers working outside their areas of expertise struggle to deal with numerical issues;
 - discrete numeracy lessons taught by non-mathematics specialist have little value;
 - teachers use too many different methodologies for written processes, such as multiplication and division;
 - parents of pupils in many schools do not understand the methods for calculation and therefore cannot help their children with these aspects;
 - the quality of teaching of times-tables varies between primary schools;
 - calculators tend to be used frequently outside of mathematics lessons; and
 - in a few secondary schools, using calculators is the norm in mathematics lessons.

Evidence base

Inspectors visited a representative sample of 12 primary and 12 secondary schools across Wales, inspected between 2010 and 2012. All but one of these schools were in the 2013 baseline survey. The school visits took place in the spring term 2014. In each school, inspectors interviewed senior leaders and numeracy co-ordinators and observed Year 5, Year 6, Year 8 or Year 9 lessons in science, geography or design and technology. Inspectors also scrutinised the school improvement plan, schemes of work and pupils' work in mathematics, science, geography and design and technology. Inspectors also met with groups of Year 6 or Year 9 pupils.

The findings and recommendations in this report also draw on:

- primary and secondary school inspection reports for 2012-2013 and 2013-2014;
- PISA 2012 outcomes;
- National Numeracy Tests outcomes 2013 and 2014;
- end of key stage data for the period 2010 to 2014;
- views from regional consortia; 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 Gymraeg Melin Gruffydd⁷, Cardiff
- Ysgol Melyd, Denbighshire
- Ysgol Morfa Rhianedd, Conwy
- Y Pant Comprehensive, Rhondda Cynon Taf
- Ysgol y Creuddyn, Conwy
- Ysgol y Grango, Wrexham

⁷ Ysgol Gymraeg Melin Gruffydd did not take part in the first year of the survey.

Glossary/references

PISA The programme for international student assessment. PISA is an international study that was launched by the OECD in 1997. It aims to evaluate education systems worldwide every three years by assessing 15-year-olds' competencies in the key subjects of reading, mathematics and science.

Estyn publications

Her Majesty's Chief Inspector of Education and Training in Wales Annual Report 2012-2013

Numeracy in key stages 2 and 3: a baseline study (2013)

Good practice in mathematics at key stage 4 (2013)

Improving numeracy at key stages 2 and 3 (2010)

Other publications

Achievement of 15-Year-Olds in Wales: PISA 2012 National Report, NfER (2013)

National Literacy and Numeracy Framework, Welsh Government (2013)

National Support Programme, CfBT & Welsh Government (2013)

Programme for International Student Assessment, OECD (2006, 2009, 2012)

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