Report summary

Mathematics: made to measure

The responsibility of mathematics education is to enable all pupils to develop conceptual understanding of the mathematics they learn, its structures and relationships, and fluent recall of mathematical knowledge and skills to equip them to solve familiar problems as well as tackling creatively the more complex and unfamiliar ones that lie ahead.

That responsibility is not being met for all pupils. Pupils of different ages, needs and abilities receive significantly unequal curricular opportunities, as well as teaching of widely varying quality, even within the same year group and school. The quality of teaching, assessment and the curriculum that pupils experience varies unacceptably. The disparity in children's pre-school knowledge of mathematics grows so that by the time they leave compulsory education at 16 years, the gap between the mathematical outcomes of the highest and lowest attainers is vast. The 10% not reaching the expected level at age 7 becomes 20% by age 11 and, in 2011, 36% did not gain grade C at GCSE. Pupils known to be eligible for free school meals achieve markedly less well than their peers and increasingly so as they move through their schooling. Key differences and inequalities extend beyond the teaching: they are rooted in the curriculum and the ways in which schools promote or hamper progression in the learning of mathematics.

For most of the period under review, considerable resources were deployed through the National Strategies to improve teaching and learning in mathematics through better assessment, curriculum planning and leadership and management. Teachers' use of assessment to promote learning has improved since the previous survey, but the quality of teaching and curriculum planning was much the same. Leadership and management of mathematics in secondary schools have strengthened, driven at least in part by the increased emphasis on mathematics in the data used to measure schools' performance. Schools have adopted a wide range of strategies to improve pupils' attainment, particularly at GCSE. However, the impact has been mixed.

Schools' work in mathematics was judged to be outstanding in 11% of the schools visited in the survey, good in 43%, and satisfactory in 42%. It was inadequate in two primary and nine secondary schools. This profile is very similar to the figures

presented in the previous report, *Mathematics: understanding the score*.[1] Indeed, many of the findings of that report still hold true today.

Attainment has risen in the Early Years Foundation Stage, stagnated in Key Stage 1, and shown only slow improvement in the proportions of pupils reaching the expected levels in Key Stages 2 and 3. GCSE and A-level results continue to rise, as a consequence of the high priority accorded to them by teachers and leaders in secondary schools, but without corresponding evidence of pupils' better understanding of mathematics to equip them for the next stages of their education and future lives. More-able pupils in Key Stages 1 to 4 were not consistently challenged. More than 37,000 pupils who had attained Level 5 at primary school gained no better than grade C at GCSE in 2011. Nevertheless, one clear success has been the dramatic increase in the take-up of AS/A level mathematics and further mathematics against a background of changes to the secondary curriculum and examination specifications.

The most common strategies to raise attainment focused the use of assessment data to track pupils' progress in order to intervene to support pupils at risk of underachievement, and in secondary schools to exploit early entry and resit opportunities on modular courses. Leaders monitored the quality of teaching more frequently than previously and through a wider range of activities such as learning walks and scrutiny of pupils' books. While weak performance was generally challenged robustly, attention to the mathematical detail, so crucial in improving teachers' expertise, was lacking. Moreover, information gleaned from monitoring and data analysis was rarely used to secure better quality provision, usually because analysis was linked to intervention and revision and monitoring focused on generic characteristics rather than pinpointing the subject-specific weaknesses or inconsistencies that impeded better teaching and greater coherence of learning.

Inspection evidence showed very strongly that the 35 schools whose mathematics work was outstanding had a consistently higher standard of teaching, better assessment and a well-organised, mathematically rich curriculum. They used a variety of strategies to improve all pupils' learning of mathematics, such as revising schemes of work, helping staff to enhance their subject expertise, and extending intervention programmes to all pupils who were in need of support, not just those at key borderlines or about to take national assessments. The schools focused on building pupils' fluency with, and understanding of, mathematics. Pupils of all ages and abilities tackled varied questions and problems, showing a preparedness to grapple with challenges, and explaining their reasoning with confidence.

This experience contrasts sharply with the satisfactory teaching that enabled pupils to pass tests and examinations but presented mathematics as sets of disconnected facts and methods that pupils needed to memorise and replicate. Too many pupils

[1] *Mathematics; understanding the score* (070063), Ofsted, 2008; www.ofsted.gov.uk/resources/070063.

who start behind their peers receive such teaching and do not, therefore, catch up. Improving the consistency and quality of teaching within a school is crucial if all pupils, rather than some, are to make sustained good progress. It is important to have clear guidance, understood by all staff, on approaches to secure conceptual understanding and progression in lessons. This is especially important to support less experienced, temporary and non-specialist teachers.

Being 'made to measure' might describe schools' perceptions of, and reaction to, the pressures to raise standards. However, the aim for all schools should be to secure high calibre, 'made-to-measure' mathematics provision to optimise every pupil's chance of the best mathematics education.

Key findings

- Children's varying pre-school experiences of mathematics mean they start school with different levels of knowledge of number and shape. For too many pupils, this gap is never overcome: their attainment at 16 years can largely be predicted by their attainment at age 11, and this can be tracked back to the knowledge and skills they have acquired by age 7. Low attainment too often becomes a self-fulfilling prophecy. Pupils known to be eligible for free school meals fare particularly badly.
- The best schools tackled mathematical disadvantage with expert insight and ambitious determination, with policies and approaches understood and implemented consistently by all staff to the benefit of all pupils. Developing such expertise should be the goal for all schools.
- Despite the wide variation in outcomes, too many able pupils across the 3–16 age range are underachieving. Many more pupils could gain the highest grades at GCSE and be better prepared to continue to A level. Without this, the future supply of mathematicians and the national challenge of meeting the diverse mathematical needs of our technologically advanced world and our economic well-being are threatened.
- Attainment in GCSE and AS/A-level examinations in mathematics has risen. At the same time, however, successive changes in GCSE and A-level specifications and structure have reduced the demand of the examinations for many pupils. Those pupils attaining the highest grades at GCSE are increasingly opting to study AS and/or A-level mathematics, leading to a rapid growth in uptake.
- Attainment in national Key Stage 2 mathematics tests has shown incremental rises in the proportions of pupils attaining the expected Level 4 and the higher Level 5. Improvements have also been made in children's knowledge and skills in the Early Years Foundation Stage. Teacher assessments at the end of Key Stage 1, however, indicate that attainment has plateaued and the downward trend in the proportion reaching the higher Level 3 shows no sign of being reversed.
- Schools have implemented a wide variety of strategies to improve performance in mathematics. The most common strategy has been better monitoring of pupils'

attainment and progress coupled with greater use of intervention programmes. In most primary schools, intervention has become more focused and timely in helping pupils overcome difficulties and close gaps. It remained centred on examination performance in the majority of secondary schools, linked to widespread use of early GCSE entry and repeated sitting of units. This has encouraged short-termism in teaching and learning and has led to underachievement at GCSE, particularly for able pupils, as well as a lack of attention to the attainment of the least able. In the better schools, high- attaining pupils' needs are met through depth of GCSE study and additional qualifications.

- Despite these strategies, the percentage of pupils not reaching the expected level or grade for their age increases as pupils progress through their mathematical education, and is more marked for some groups than others. This suggests, strongly, that attaining a key threshold does not represent adequate mastery of skills and sufficient depth of conceptual understanding to prepare pupils for the next stage of mathematics education.
- The quality of teaching varied by key stage, leading to uneven learning and progress as pupils moved through their mathematics education. In each phase, those pupils nearest to external assessments received better teaching. Less experienced, temporary and non-specialist teachers were more likely to teach lower sets or younger pupils. Learning and progress were good or outstanding in nearly two thirds of lessons in Key Stage 4 higher sets, double the proportion observed in lower sets where around one in seven lessons was inadequate.
- Teaching was strongest in the Early Years Foundation Stage and upper Key Stage 2 and markedly weakest in Key Stage 3. Teaching in the sixth form was slightly stronger than at GCSE. Year 1 was the weak spot in primary teaching.
- While the best teaching developed pupils' conceptual understanding alongside their fluent recall of knowledge, and confidence in problem solving, too much teaching concentrated on the acquisition of disparate skills that enabled pupils to pass tests and examinations but did not equip them for the next stage of education, work and life. Teachers' use of assessment in lessons has improved although it remained a weak aspect of teaching. Monitoring of each pupil's understanding was not strong enough to ensure that pupils learnt and progressed as well as they could.
- Very few schools provided curricular guidance for staff, underpinned by professional development that focused on enhancing subject knowledge and expertise in the teaching of mathematics, to ensure consistent implementation of approaches and policies.
- Schools were more aware than at the time of the previous survey of the need to improve pupils' problem-solving and investigative skills, but such activities were rarely integral to learning except in the best schools where they were at the heart of learning mathematics. Many teachers continued to struggle to develop skills of using and applying mathematics systematically.

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