1 Primary mathematics teaching today

Introduction and context

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Mathematics matters

Why is skill in mathematics important? Why should we not just accept that some people ‘don’t get it’?

Before addressing these questions, it is necessary to clarify the language and terminology used. It is important to note that the term ‘numeracy’ is not interchangeable with the term ‘mathematics’ (although often portrayed as such in the media). It is, however, a central and fundamental part of mathematics, and in general, those who exhibit difficulties in numeracy are likely to have difficulty across the whole discipline. While one result of poorly developed numeracy (and mathematics) might be lack of progress at school, there are clear indicators that its impact is much wider, and indeed more serious than this. A functional level of numeracy is an essential life skill, and those who fail to achieve this level of competency will find themselves challenged in many aspects of life, from shopping to reading a bus timetable. Effective mathematics teaching and learning is clearly a key part of early education.

The current situation in mathematics teaching and learning

Pupil attainment

The attainment of English pupils in mathematics is, according to the Royal Society of Arts (RSA) (Norris 2012: 4), ‘at best stable, or even in decline’ (although Ian Thompson, in Chapter 10, questions this analysis) and yet using numeracy skills is something we take for granted each time we try to calculate the special offer deals, pay our bills, measure out
the ingredients for a recipe or reckon an aggregate sports score. It lies at the heart of much of the modern technology that forms such a big part of our lives (mobile phones, computers, calculators, even most modern cars). It is in high demand from employers as many jobs require the ability to analyse spreadsheets and data sets (Hastings 2006) – and this now includes all teachers:

Basic numeracy and quantitative skills are increasingly necessary in all jobs and life-skills, for tasks including budgeting and data-handling. And the changing nature of the international economy means that maths skills and knowledge are in higher demand than ever.

(Norris 2012: 4)

In 2005, primary school test results showed that schools in England were still far short of the government’s target of 85 per cent of 11 year olds reaching the required level in English and mathematics with improvements of just 1.3 per cent in mathematics. And in 2008, 78 per cent of 11 year olds reached the expected level 4 in mathematics – a rise of just six percentage points since 2000, and an increase in the gap between attainment at 7 and at 11. The league tables for 2011 show that 1310 primary schools in England fell below the expected standards (Standards and Testing Agency 2011).

The Trends in International Mathematics and Science Study (TIMMS 2007) survey reveals England lying in seventh place both for grade 4 (Year 5) and grade 7 (Year 8) behind Hong Kong, Singapore, Japan and Taipei in both stages. This at least has shown an improvement since the previous TIMSS, which placed England tenth. The Organization for Economic Co-operation and Development (OECD) league tables for 2009 places the UK twenty-seventh with Shanghai, Singapore, Hong Kong, Korea, Taipei and Finland occupying the top six slots (OECD 2009).

In December 2011, Schools Minister Nick Gibb compared England to three regions and countries around the world – Massachusetts (the highest performing US state for mathematics), Singapore and Hong Kong – and expressed concern at the over-reliance on calculators in English schools, signalling that it contributed to poor mathematical skill development. Singapore’s success was achieved through enhancing teacher expertise and curriculum coherence – the former by impressive Continuing Professional Development (CPD) and the latter by ‘approving’ text books and teaching materials (Oates 2010).

Public concern about low levels of mathematics attainment, poor teaching and mathematics anxiety can also be seen in headlines such as ‘Poor numeracy is blighting Britain’s economic performance and ruining lives, says a new charity launched to champion better maths skills’
Alongside these concerns about pupil attainment, there were similar and linked concerns expressed about teacher expertise.

**Teacher expertise**

In March 2003, Charles Clarke, then Secretary of State for Education and Skills, said:

> It is a combination of deep subject knowledge and a range of appropriate teaching and learning techniques which make for the most powerful interactions between teachers and pupils. Enhancing subject specialism therefore needs to be seen not as an end in itself, but as a way of bringing about excellence in teaching and learning to improve standards in our schools.

(Charles Clarke, cited by Williams 2008: 8)

This increasing emphasis on subject specialisms became particularly important in primary schools where it was noted that less than 3 per cent of postgraduate trainee teachers have a mathematics-related degree. It is interesting to note that this lack of specialist mathematics knowledge in primary school teachers is not a new phenomenon. As far back as 1959, in an article reprinted by the *Times Educational Supplement* (TES) in 2011, the then new chief education officer for Surrey, a Mr A.M. Baird, was quoted as saying that ‘until recently, academic standards in maths [for trainee teachers] had been too low’ (TES 2011).

In order to address the problem of lack of teacher expertise, a review of mathematics teaching in Early Years settings and primary schools was commissioned following Gordon Brown’s (2007) identification of primary mathematics teaching as a key focus for his Government. This review had the specific purpose of identifying effective mathematical pedagogies, provision for all, effective early intervention for those identified, the appropriate range of conceptual and subject knowledge in mathematics for primary aged pupils (including the ways through which Initial Teacher Training (ITT) and continuing professional development could secure that), effective design and sequence of the mathematics curriculum, and finally, the ways in which parents and families could be best supported in order to help their children develop in mathematics. The outcome of this process resulted in the Williams Review (published in 2008), which highlighted the ‘importance of a young child’s ability to count, calculate and work confidently with mathematical ideas’ (Williams 2008: 5) and recognized the role that teachers have in this development. Teachers’ skills and fluency in the subject need to be such that they have
the ‘confidence and flexibility’ (Williams 2008: 5) to be a good teacher of mathematics and extend the children’s knowledge, skills and understanding. Mathematics as an academic discipline is unique in that it combines both practical applications with abstract concepts. Effective mathematics teaching involves teachers in crafting these together in a complementary and meaningful way.

The impact of poor mathematics attainment

Recent studies show that the impact of poor numeracy is far reaching. In *The Long Term Costs of Numeracy Difficulties*, the Every Child a Chance Trust (2009) stated that the UK government’s 2003 Skills for Life survey (in which over 8,000 adults in England had mathematics skills tested) found that 15 million adults were judged to have numeracy skills at or below entry level 3 (equivalent to the skills expected of an 11 year old) and that 6.8 million had skills at or below entry level 2 (the standard expected for a 9 year old). The report summarized that:

- About 15 million adults in the UK have very poor numeracy skills.
- One in six companies currently have to provide remedial mathematics classes for their employees.
- Each year over 30,000 11 year olds (over 5 per cent of their age group) leave primary school with numeracy skills at or below the level expected of the average 7 year old.
- Numeracy failure carries high social costs – the proportion of the prison population with very poor numeracy skills, for example, is even greater than the proportion with poor literacy skills.

Numeracy failure starts early and, if not dealt with, becomes embedded. Studies conducted by the Centre for Research on the Wider Benefits of Learning (Duckworth 2007) show that those who are very low attainers in mathematics at 7 years are likely to remain so at 11. Children leaving Key Stage 1 at 7 years old without having mastered the most basic numeracy skills will in almost all cases be identified by their primary school as having special educational needs (SEN) and be placed on the ‘School Action’ or ‘School Action Plus’ stages of the national SEN Code of Practice. ‘By the age of 11, 34 per cent of children with very poor numeracy skills will have Statements of special educational needs’ (Every Child a Chance Trust 2009: 10).

The educational effects of numeracy problems include high rates of truancy and a greater risk of exclusion at secondary school (a higher percentage than would be expected) and a greater likelihood of ending up as not in employment, education or training (NEET) once they leave.
Added to this, numeracy difficulties are also linked to increased health risks and an increased risk of involvement with the criminal justice system. Furthermore, a 1997 report for the Basic Skills Agency found that 58 per cent of those with poor numeracy and competent literacy were likely to be found in the low wage bracket. This compares with just 30 per cent of those with competent numeracy and poor literacy (cited in Hastings 2006). A 2011 Skills for Life Survey produced for the Department for Business, Innovation and Skills showed that almost 25 per cent of participants achieved below entry level 3 in numeracy. Carol Taylor, the National Institute of Adult Continuing Education (NIACE) Director for Research and Development, expressed her concern at the 2011 figures, saying ‘One in six of the adult population . . . are seriously disadvantaged as employees, citizens and parents’ (Taylor 2011).

The government now recognizes the importance of mathematical skills to England’s economic future: ‘Science, Technology, Engineering and Mathematics (STEM) industries are becoming increasingly central to economic competitiveness and growth and will provide many of the jobs of tomorrow for young people’ (Norris 2012: 4).

Parents also recognize this. Extra mathematics lessons account for more than half of all private tuition outside school hours.

The implications for teachers

In a 2004 report into post-14 mathematics, Adrian Smith pointed out that in order to compete in the global economy, the UK needed more specialist mathematics teachers with better continuing professional development (Smith 2004), a point echoed four years later by the Williams Review (Williams 2008).

Laurie Jacques, speaking at the time in her capacity as director for policy and quality at the National Centre for Excellence in the Teaching of Mathematics (NCETM), argued that the low numbers of mathematics specialists entering primary schools clearly has an impact on mathematics leadership:

in a lot of schools they have acquired the [mathematics subject leader job] because no one else would take it on. As a result it has become a management rather than a leadership role; they do the admin and resources bit well, but they don’t necessarily focus on teaching and learning.

(Carrington 2010)

The National Audit Office (cited by Ward 2008) found that the biggest factor in whether pupils went to secondary school enjoying mathematics was whether they had been taught the subject by an enthusiastic teacher.
at primary level. Celia Hoyles, director of the NCETM, called for more and better subject training for teachers (Neumark 2010), saying that people are often put off mathematics at school, but good teachers can open up the door to understanding, and foster a more positive relationship with mathematics in children.

Also supporting the need for specialist mathematics training for primary school teachers was the production by the Office for Standards in Education, Children’s Services and Skills (Ofsted) in 2009 of the report Improving Practice in Mathematics Teaching at Primary Level, citing the fact that for many teachers, their knowledge of mathematics stopped at the course they studied at 16, and that while they might work hard to develop the skills they need to deliver to their classes, they fail to appreciate the wider view of the mathematics curriculum (Ofsted 2009: 12).

The Williams Review (2008) concluded that, given the changes in the methods of mathematics teaching, it was the teacher, rather than the parents, who would have the most influence over the learning outcomes. It further confirmed that just 13 per cent of primary school teachers (at that time) had a mathematics specialism, and a key recommendation was for ‘the presence of a Mathematics Specialist in every primary school, who will champion this challenging subject and act as the nucleus for achieving best pedagogical practice’ (Williams 2008: 1). This, the third of the ten recommendations, was the catalyst for a National CPD programme, the Mathematics Specialist Teacher (MaST) programme, which started in January 2010.

In November 2011 Ofsted’s report on primary mathematics reiterated many of these findings: that high quality teaching ‘secures pupils’ understanding of structure and relationships in number’; that successful schools swiftly recognize problems and equally quickly apply suitable interventions and that ‘clear, coherent calculation policies and guidance’ support staff and pupils in the development of mathematics skills (Ofsted 2011). Furthermore, such schools ‘recognise the importance of good subject knowledge and subject-specific teaching skills’ and aim to develop staff’s knowledge appropriately.

Michael Gove, MP, said at the Advisory Committee on Mathematics Education:

mathematical understanding is critical to our children’s future. Our economic future depends on stimulating innovation, developing technological breakthroughs, making connections between scientific disciplines. And none of that is possible without ensuring more and more of our young people are mathematically literate and mathematically confident.

(Michael Gove, cited in Ofsted 2011: 4)
Efforts are being made to address the problem; several programmes have been launched in the last few years to enhance the mathematical skills and knowledge of existing primary school teachers.

The continuing professional development (CPD) context

In recent years CPD initiatives have been developed to both support and encourage serving teachers to engage in award-bearing CPD programmes. Pitched at postgraduate level, they have provided opportunities for teachers to undertake periods of rigorous reflection on practice, small-scale practitioner inquiry projects, and develop strong understandings of theory–practice relationships. Changes in funding arrangements since the mid-1990s resulted in the development of closer links between schools and universities as organizational rather than individual need became the driver for programmes. Partnerships through which university faculties of education worked alongside groups of schools, local authority clusters or other collectives began to emerge. The years between 2006 and 2011 saw the introduction of the funded postgraduate professional development (PPD) initiative through which teachers in England were subsidized to access master's level professional development programmes. Programmes such as the Master’s in Teaching and Learning (MTL) in England (short-lived though it was), the Chartered Teacher Pathway in Scotland, and the current development in Wales of a Master's in Educational Practice all bear out both the desirability and the potency of highly contextualized professional development. In addition, their designation as master's level courses, rather than traditional ‘INSET’ (in-service training) programmes, which tended to train teachers in the use of specific resources or approaches (normally being completed in one-day or half-day sessions), suggests that the academic rigour is a valuable feature of them.

Despite recent changes in legislation and funding, the focus still remains on high quality professional development for practising teachers (in many cases linked to a specific subject or pedagogic focus). While the PPD funding stream was discontinued in 2011, there remained an emphasis on good quality CPD provision. The introduction of the National Scholarship Scheme in 2011, which called for applicants who wanted to ‘use this money for Master’s level development, or other highly valuable opportunities, such as subject specific seminars’, was as a direct result of the Schools White Paper, The Importance of Teaching (Department for Education (DFE) 2010). Master’s level professional development continues to be a central strand in educational initiatives and policy-making.
Recent initiatives in the teaching of mathematics

It is against this backdrop that we can begin to explore a range of recent initiatives in relation to the teaching of mathematics.

Every Child Counts

Every Child Counts was launched by the Every Child a Chance Trust in November 2007. Its aim was to develop a numeracy intervention scheme using highly trained teachers to teach children on a mainly one-to-one basis for around 12 weeks. Between 2007 and 2010, over 14,000 children received support. In 2009–10, 7820 children received specialist one-to-one teaching in numeracy.

The gains made by the 7820 children taught were assessed using a pre- and post-intervention mathematics test that provides standardized scores and a Number Age; this showed that they made an average gain in Number Age of 14 months in 21.5 hours of teaching – over four times the ‘normal’ rate of progress. They made an average standardized score gain of 15 points, taking them from well below average into the average range. Of the participating children, 91 per cent increased their confidence and attitude to mathematics, and 72 per cent achieved nationally expected levels in mathematics in National Assessments at the age of 7 years. Interestingly, the greatest gains were made by the lowest attaining children at point of entry to the programme.

Chartered Mathematics Teacher

The Chartered Mathematics Teacher (CMathTeach) is a professional recognition of excellence and experience in mathematics subject knowledge and pedagogy. Launched in 2009, its aim is to ‘reflect the balance between teaching skills (pedagogy) and mathematics knowledge that is necessary for a professional teacher to educate and inspire today’s students’ (CMathTeach 2009).

It is intended to classify a teacher as being at the forefront of the profession, exhibit standards of professional excellence across mathematics teaching in the twenty-first century, and recognise them as at the same level as a Chartered Mathematician.

Primary Mathematics Specialist Teacher Programme

The Primary Mathematics Specialist Teacher Programme (MaST) began in 2010 after being piloted as Fast Track the previous year. Providing
participants with a Postgraduate Certificate in Specialist Primary Mathematics and Mathematics Specialist Teacher status, it consists of a two year course covering subject knowledge, fit-for-purpose pedagogy, and working with colleagues in their school (and schools in the case of small schools) to provide effective professional development through classroom-based collaborative professional activity. Its aim is to develop teachers so they can implement improvements in the teaching and learning of mathematics for all children. During the programme, teachers improve their mathematics subject knowledge, extending their understanding of mathematics concepts and curriculum progression. Added to this, the development of a strong repertoire of teaching and leading strategies, ensures that they improve their competence and confidence to teach mathematics and also to lead their colleagues in schools.

**Conclusion**

This brief overview of a highly complex historical and cultural context highlights the importance of high quality mathematics education for all children, identifying its particular significance for primary school children. Its purpose is to map, rather than interrogate the terrain – that is the remit of later chapters. It describes a changing landscape, and one which begs many questions in its navigation. Not least among these questions is the nature of the evidence base on which change is made. Some of the research and reports cited in this contextual overview are the focus of question and critique in later chapters of the book. The notions and practices of teacher initial and continuing education and training are, at the time of writing, in a period of major transition. What does seem certain though, is that teachers will continue to be held accountable for pupil learning and performance. Clearly, the role of primary school teachers in building secure foundations is a key part of this. If through their improved subject knowledge and pedagogical skills they can begin to build a culture of success in, and indeed enjoyment of, mathematics in schools, then perhaps slowly but surely the gains will be evident not only in test scores, but also in society in general.

**References**

IMPROVING PRIMARY MATHEMATICS TEACHING AND LEARNING


