1 Swings and roundabouts

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Introduction

Ever since the practical use of numbers and number operations has been part of the curriculum for a significant proportion of the population in England, there has been a tension between accurate use of calculating procedures and the possession of the number sense which underlies the ability to apply such procedures sensibly. These two positions can be broadly characterized as procedural and conceptual, respectively.

Alongside this has been a different type of tension between individualistic progressive philosophies emphasizing the importance of autonomy of both pupils and teachers in order to lead to personal development and empowerment, and public education philosophies emphasizing a greater degree of state intervention in the curriculum and in teaching methods in order both to protect the equal entitlement of pupils and to meet the skilled person power requirements of the state (Ernest 1991).

Over the years the pendulum has swung back and forth in both of these dimensions as the primary mathematics roundabout has turned, depending on both the social and economic contexts. In prosperous times progressive and conceptual approaches have had the edge, whereas high unemployment and internationally uncompetitive industries have tended to fix the state’s attention on public education and the uniform teaching of procedural number skills. The political context has been important since it determined whose were the most powerful voices.

As with the inescapable tensions between the fundamental notions of cultural norms and individual rationality, and of freedom and equality, which respectively underlie the two dimensions, it is probably both proper and necessary that the emphases should shift from time to time to adapt to prevailing philosophies or circumstances.

In the sections which follow, these swings will be described, together with the people who have supported them. There is, however, one constant theme,
which is that of poor standards in number skills. By quoting hand-wringing sentiments spanning over 100 years, McIntosh (1981) demonstrated that there has never been a time when those who speak for the nation have been satisfied with the level of what is now generally known as ‘numeracy’ achieved by primary children. This has always provided a reason for yet another swing of the pendulum.

Pre-1950: the rise and fall of the first national curriculum

In the first half of the nineteenth century, the state had taken a relatively laissez-faire attitude to education, looking on while different private and charitable systems developed. However, by the end of the century concern over both increasing international industrial competition and the threats of insurrection among the uncivilized poor drove the state into action. The Newcastle Commission, set up to enquire into primary education in 1858, found that the majority of the pupils who did attend elementary schools were taught no arithmetic at all, and even when taught, the provision was judged to be generally ineffective.

This report formed the basis for state intervention to ensure in the 1870 Act each child’s entitlement to primary education, following a national curriculum introduced in the Revised Code of 1862, concentrating on the three Rs of reading, (w)riting and ‘rithmetic.

In the original version the curriculum for the first three standards (intended respectively for pupils aged 7–8, 8–10 and 10+) stated:

- **Standard I** Form on blackboard or slate, from dictation, figures up to 20; name at sight figures up to 20; add and subtract figures up to 10, orally, from examples on blackboard.
- **Standard II** A sum in simple addition or subtraction, and the multiplication table.
- **Standard III** A sum in any simple rule as far as short division.

This looks not unfamiliar, in relation to Levels 1 to 4 of the national curriculum introduced over 100 years later, and most primary teachers still refer to these objectives as the major targets for their own pupils.

As with the more recent 1988 national curriculum, it is interesting to note that there were two major changes made to the Revised Code within the first ten years, with the aim of raising standards. As with levels in the 1989 curriculum, the standards were not necessarily tied to age, recognizing that children progressed at different rates. The difference then was that each class was focused on and identified with one standard, so that classes were of mixed
age; slower children remained in the same class (for example, Standard II) until they had achieved that standard.

However, there were some authoritative sources even in the 1850s which considered that some form of number sense was at least as important as mechanical arithmetic. Thomas Tate, a mathematician and educationist, advised:

"Teachers of elementary schools . . . would confer a great benefit on society, by teaching the simple and fundamental principles of estimation, rather than waste the time of their pupils in giving sums . . . those investigations which have the greatest practical bearing invariably form the most healthful and instructive exercise to the intellectual powers."

(Quoted in Howson 1982: 120)

He added that ‘a good teacher will vary his methods of instruction’, and attacked the blind unreasoning attachment to any particular system of teaching, believing that a teacher’s judgement must be exercised in selecting those methods which are most suited to the existing conditions of his school.

Matthew Arnold, the most senior of Her Majesty’s Inspectors (HMI), also took a progressive line denouncing this system. He wrote in his 1869–70 report that however brilliant the committee who drew up the curriculum, ‘the teacher will in the end beat us by [getting] children through the examination without their really knowing of these matters’. He noted that although the children ‘sedulously practised all the year round’, the failure rate in arithmetic was considerable since the system gives ‘a mechanical turn to the school teaching’ and must be ‘trying to the intellectual life of the school’ (quoted in Howson 1982: 121).

For financial and educational reasons the Revised Code was abandoned in 1898, but in spite of the removal of curriculum constraints, it would appear that there was gradual evolution rather than radical change in the teaching of arithmetic in primary schools during the first half of the twentieth century (Pinner 1981). Generally, classes became smaller and teachers better trained, which led to more humane classrooms and less punishing arithmetic. Influences of continental thinkers such as Montessori and Froebel on teacher training colleges encouraged more practical activities to be introduced for younger children.

In primary education more generally, the 1931 Hadow Report fore-shadowed the later Plowden Report in taking a firmly progressive line backing themes rather than subjects, recommending that: ‘the curriculum of the primary school is to be thought of in terms of activity and experience rather than knowledge to be acquired and facts to be stored’ (Board of Education 1931: 93). A broader curriculum in mathematics was recommended with more emphasis on geometric form and practical measurement. The fact that too much time is
given to arithmetic was attributed to the influence of the examinations at 11+ which were then enabling increasing numbers of pupils from elementary schools to enter fee-paying grammar schools. Nevertheless a firmly traditional line was taken in relation to arithmetical skills: ‘it is however essential that adequate drill be provided in arithmetic’. Moreover it was not reasonable ‘to expect a child to justify the process he employs, say in subtraction or division; this is too hard an exercise of his reasoning powers’. The compromise was achieved by asserting that higher procedural arithmetic standards could be attained in less time, thus allowing the newer broader and more conceptual content.

1950–85: towards a progressive paradise (Piaget, Plowden, Nuffield and Cockcroft)

In 1955 the Mathematical Association finally produced the long-awaited report, *The Teaching of Mathematics in Primary Schools*, on which work had started 17 years earlier. The Second World War caused an interruption, but the greatest delay was because the new post-war committee changed the brief, since it ‘did not share the belief of its predecessor that a curriculum should be drawn up prescribing the mathematics to be taught at each stage of the primary years’.

After disagreements had required yet more membership changes, the eventual report set a radical tone for the second half of the century. It adopted an unequivocal child-centred position which merged the Piagetian view of learning, as the result of an individual child’s interaction with the physical environment, with the activity-oriented British primary tradition endorsed by the Hadow Report and to be further developed in the Plowden Report. A key member of the committee throughout was Elizabeth Williams, who, while at King’s College London in the 1930s and later as lecturer and principal at other teacher training colleges, was instrumental in introducing Piagetian ideas (Howson 1982). Older teachers will know her best through the classic text *Primary Mathematics Today*, published in collaboration with Hilary Shuard (Williams and Shuard 1970).

The key belief of the 1955 report was that:

> Children developing at their own individual rates learn through their active response to the experiences which come to them; through constructive play, experiment and discussion children become aware of relationships and develop mental structures which are mathematical in form and are the only sound basis for mathematical techniques.

(Mathematical Association 1955: v)

The broader curriculum recommended by Hadow was thus opened even wider,
with no one admitting that this might allow less time for number skills. Teachers were required, through their own reading and listening to children, to come to understand better how children learn, in much the same way as children were expected to come to understand mathematical concepts.

It is, of course, a long way from writing a report to seeing it implemented throughout England, but there were many allies in this task. Support from teacher trainers was significant, but there were also meetings with teachers all over the country. An energetic and inspiring travelling HMI, Edith Biggs, ran courses on the activity and investigation approach over more than 20 years (estimated by the Plowden Report (CACE 1967) to have directly involved more than 15 per cent of teachers).

An even more Piagetian line was followed by the Nuffield Mathematics Teaching Project (1964–71), led by Geoffrey Matthews, who became the first Professor of Mathematics Education at Chelsea College, part of London University, which later merged into King’s College. Using a conceptual progression based broadly on Piagetian research, a sequence of Teachers Guides were produced on a variety of mathematical topics, including, for the first time, logic, graphs leading to algebra, and probability. These explained the underlying mathematics with ideas for different approaches and activities, attractively illustrated with pupils’ work. The approach reflected the more structural ideas of modern mathematics like sets, number bases and properties of number operations (for example, commutativity), to help form a conceptual basis for calculation.

There was much debate about whether the project should have produced a set of pupil textbooks, but the philosophy was to treat the teachers in the same way as it was hoped that they would treat pupils; as one of the Nuffield team said later, ‘I do and I understand’ was the unofficial motto of the Project; well, it applied to teachers as well as children’. Teachers were encouraged to work together in local groups in each authority. An important and enduring innovation of the Nuffield Project was the creation of mathematics teachers’ centres where teachers could meet with advisers; many of these later became the first general purpose professional centres.

The end of the selection examinations at 11+ in most areas, following the change from selective to comprehensive schooling, provided additional freedom to enable teachers to work in new ways. There is no doubt that large numbers of teachers were inspired by the new approaches of Nuffield and Edith Biggs, but with considerable staff turnover it is not clear that there was a great deal of change in what most teachers did in their classrooms. This probably only really took place on a large scale after new pupil materials became available after 1970, the first scheme being written by Harold Fletcher, one of the Nuffield team. These published schemes, including eventually an official Nuffield scheme, permeated most schools. Translated to text, some of the practical and investigatory spirit was inevitably lost.
The major effects on classroom teaching of the various texts were a broadening of the curriculum and many activities attempting to build understanding through different diagrams and representations. This meant a much slower approach to calculation algorithms, with often a variety of different methods of recording calculations presented to children. Thus there was less time for practice, the belief being that better understanding avoided the need for constant mechanical drill.

Many teachers chose to stick closely to the books, and often to let children work through them on their own. There were several reasons for this. First, the lack of confidence of teachers in their own mathematics, and especially in modern mathematics, discouraged them from departing from well-written and apparently authoritative sets of texts with many attractive activities that pupils seemed to enjoy. There was also, especially following the 1967 Plowden Report, increasing emphasis on pupil autonomy; children were expected to be able to work on their own or in small groups and to organize themselves, with the teacher being seen as a resource to call upon rather than a classroom expositor.

However, a backlash against excessive freedom given to primary teachers and children gathered momentum during the 1970s. The well-publicized curricular anarchy at William Tyndale Junior School in London drew attention to the fact that with the demise of the 11+ there was no longer any control over what primary teachers taught. The Assessment of Performance Unit was launched in 1974 to monitor national standards at ages 11 and 15, and the idea of a common core curriculum began to be discussed. Certainly the texts like Nuffield which were published at the end of the 1970s tended to be less radical than those Fletcher and his colleagues published earlier.

Although there were occasional tirades against this ‘new’ mathematics in the primary schools, it was the perceived lack of numeracy of young employees, in a speech by Prime Minister James Callaghan at Ruskin College in 1976, which was used to justify a significant change in government policy towards exerting tighter control over the curriculum.

However, the Labour government was keen not to upset its allies in schools and local education authorities (LEAs), and started by asking LEAs to work with teachers to produce local curriculum guidelines. Mathematics advisers were appointed by LEAs which did not already have them, creating a national network for disseminating innovation. Advisers were able to draw on the expertise of a pool of teachers who had been appointed as mathematics coordinators in primary schools and had acquired a Diploma of the Mathematical Association, run mainly by teacher training colleges and universities. Guidelines were informed by the publication by DES/HMI of Mathematics 5–11: A Handbook of Suggestions (DES 1979); although progressive in tone, this detailed list of aims and objectives marked a much firmer line in steering the contents of the primary curriculum for the purposes of more uniform public education.
One of the final acts of the Labour government was to set up a Committee of Inquiry into the Teaching of Mathematics in Schools, chaired by Sir Wilfred Cockcroft, previously associated with the Nuffield Project. While the bulk of the report was aimed at secondary schools, the presence on the committee of Hilary Shuard, a forceful teacher trainer and Elizabeth Williams’s collaborator, ensured that primary interests were not forgotten.

In fact it found much less concern from employers about standards of arithmetic than had been expected, but the surveys undertaken revealed an adult population which was fearful of mathematics, suffering from both lack of confidence and an inability to apply what they had been taught at school. In regard to primary mathematics, this tended to reassure the committee, whose membership was in any case mainly drawn from the progressive-minded leaders within the professional bodies, that the previous more formal styles of teaching were to blame. The more practical and investigative style which had long been recommended for, but not necessarily implemented by, primary schools would encourage confidence and self-expression, and the ability to understand, and hence apply, knowledge; it was this which should be supported and extended into secondary schools.

Thus the findings led the Cockcroft Report, Mathematics Counts, published in 1982, to endorse the wide curriculum: ‘We believe that this broadening of the curriculum has had a beneficial effect both in improving children’s attitudes to mathematics and also in laying the foundations of better understanding’ (DES 1982: 83). There was, however, a new utilitarian emphasis, removing some of the last vestiges of the more esoteric structural content brought in by the original Nuffield Project.

The report contained a whole section emphasizing the importance of mental mathematics, including:

  young children should not be allowed to move too quickly to written work in mathematics. It follows that, in the early stages, mental and oral work should form a major part of the mathematics which is done. As a child grows older, he needs to begin to develop the methods of mental calculation which he will use throughout his life.

  (DES 1982: 92)

Two aspects of contemporary research informed the recommendations: first that both children and adults tended to apply idiosyncratic methods of calculation rather than standard school methods; second, that there was a seven-year gap between ages when the higher- and lower-attaining children grasped a mathematical concept, even though they might be in the same class. This result led to an emphasis on curricular differentiation, later also stressed by inspectors, which encouraged schools to continue many of the progressive organizational practices which they were already using, either allowing pupils
to work individually at their own pace through a scheme, or grouping children by attainment to do different work.

Even though an individual learning system may be in use the teacher will often assemble a small group to begin a new topic or to draw together common strands in work which is going on. On such occasions mental mathematics is easily and naturally introduced, both in the form of mental calculation and of questions which develop new ideas...

(DES 1982: 93)

Some whole-class teaching is recommended, but with an eye on the range of attainment:

there are some skills, puzzles and problems which are appropriate for every child no matter what stage of learning he may have reached and short class sessions can be arranged for work of this kind...some problems should be posed with general discussion in mind. Both children and their teachers learn from different strategies and methods which other members of the class use...it is valuable experience for children to explain the approach which has been used...

(DES 1982: 92)

In order to enable the Cockcroft recommendations to be put into effect in classrooms, advisory teachers (known as ‘Cockcroft missionaries’) were appointed by LEAs. Those appointed succeeded in enthusing other teachers about mathematical investigation in the same way as Edith Biggs had started to do 20 years earlier.

Hilary Shuard, emerging as the main champion of the progressive movement in primary mathematics, succeeded in 1985 in attracting funding for a major project, Primary Initiatives in Mathematics Education (PrIME). Although this had many foci, with groups of teachers working in different LEAs, the major innovation was in the Calculator Aware Number Curriculum Project (CAN). The basic principle of CAN was to put into effect the firm endorsement of sensible calculator use in primary schools made by the Cockcroft Report, and to fulfil the recommendation that research be undertaken to find how the use of calculators might change the primary mathematics curriculum. Children were given unrestricted access to calculators from the beginning, and there was a specific emphasis on mental calculation and investigational work with number. Teachers were asked not to teach pencil and paper algorithms at all.

The CAN project excited much national and international attention. Such results as are available suggest that pupils from the project developed better
mental facility and more positive attitudes, and performed better even in non-calculator written tests. However, it is not clear whether the effect was due to the increased emphasis on mental calculation, the in-service support, the investigative ethos or the calculator use. But the full effect was never to be found as it came to an abrupt end in 1989, due to other changes which are reported in the next section.

It is clear that the changes which took place in primary mathematics between 1950 and 1985 were significant, marking a shift in attention from the teacher to the learner. They were led by a set of inspired individuals with broadly similar views, all with strong mathematical backgrounds and earlier experience of teaching in secondary schools, who occupied high-status roles in the educational establishment. It was clear that by the end of the period most teachers had come to espouse the principles underlying the changes, even if they had not always fully implemented the principles in their practice.

1985–95: the second national curriculum and the national tests

The primary mathematics results in the international surveys carried out in 1990 by the International Assessment of Educational Progress (IAEP) and in 1994 as part of the Third International Mathematics and Science Study (TIMSS) demonstrated that many of the Cockcroft objectives were achieved. British pupils were comparatively confident, unusually including those pupils whose attainments were modest, and they generally enjoyed mathematics. There was some evidence that many children seemed to enjoy the greater control they had over their own pace of work. More importantly, British pupils did very well in tests in applying mathematics to solve practical problems, in both mathematics and science. The successful implementation of a wide curriculum was demonstrated by the fact that, in 1994, English primary children were top of the international table in geometry and, in 1990, were second in statistics.

However, comparatively low English results in the number category in both surveys suggested that these successes had been achieved at a cost. Concern about such international comparisons in secondary schools in the mid-1980s coincided with a continuing movement under the post-1979 Conservative government following that initiated under James Callaghan towards clearer curriculum specification and greater central control. In the White Paper Better Schools (DES 1985a) came the first announcement of the intention to formulate both national objectives, to be known as attainment targets, for age 11 in mathematics, and an associated system of assessment. Formative assessment for diagnostic and planning purposes was espoused as
a key aspect of assessment (see Hodgen and Askew, Chapter 10), but it was also pointed out that assessment results should also allow schools to evaluate their own practices against national standards.

The focus on targets and assessment at primary level reflected the national criteria for the new General Certificate of Secondary Education (GCSE) examinations which had been recently announced, to start in 1988. At primary level, also, many LEAs were already developing local assessment systems to match their new local curriculum guidelines, although these took a variety of forms ranging from written tests to practical tasks and included informal profiling. In many cases they were influenced by assessments developed by the Assessment of Performance Unit.

Related to the focus on clear targets to be found in Better Schools, a series of DES/HMI publications was being issued which contained objectives and assessment advice for each subject. Mathematics from 5 to 16 (DES 1985b) was, at primary level, an amalgamation of the 1979 DES/HMI publication Mathematics 5–11 with selected recommendations from the Cockcroft Report. Thus the 24 objectives were listed under the headings of facts, skills, conceptual structures, general strategies and personal qualities, and were themselves unspecific (for example, remembering notation, sensible use of a calculator, trial and error methods, a positive attitude to mathematics). However, a detailed list of what most 11-year-olds should know, under the content objectives only, was contained in the appendix. The list contained few surprises and reflected the contents of the more recent textbook series, emphasizing concepts rather than procedures, for example, including equivalence of fractions rather than the four rules for fractions. Pencil and paper multiplication and division was by single digits only, using calculators for more complex cases. While underlining the progressive credentials of HMI, it was nevertheless seen as a further step towards state prescription.

Deciding that mathematics would be an easier subject than English to tackle, the Secretary of State, Sir Keith Joseph, initiated a one-year feasibility study to start in September 1986, which would define a three- to four-year programme for research, development and implementation of national attainment targets at age 11 and corresponding assessment. The contract went to Brenda Denvir and myself, colleagues of Geoffrey Matthews at Chelsea College, then in the course of merging into King’s College London. Hilary Shuard was on the Steering Committee.

But the feasibility study was soon overtaken by events. A new Secretary of State, Kenneth Baker, swept in during the autumn of 1986, determined to make his mark. Persuaded by recent reports that low mathematical standards compared with our competitors were responsible for national industrial failure, he announced in January 1987 his decision to implement swiftly a full national curriculum determining what pupils should be taught in primary and secondary schools. This went considerably beyond the aim of his predecessor
who supported attainment targets but had no desire otherwise to control the
detail of the curriculum.

Ignoring the feasibility study, Baker announced at Easter that there would
be national testing at ages 7, 9 (later abandoned), 11 and 14, as well as GCSE at
16. The consultative document *The National Curriculum 5–16* (DES 1987) was
rushed out in July in order to form the core of a new and radical Education
Reform Bill that autumn. At the same time National Curriculum Working
Groups in mathematics and science were set up, as well as a Task Group on
Assessment and Testing (TGAT).

The brief was for the subject groups to draw up attainment targets for ages
7, 11, 14 and 16, with each target differentiated for three levels of attainment,
to frame a programme of study for each key stage (KS) of education covering
the two to four years prior to the tests, and to advise on teacher assessment and
national testing. In the case of the mathematics group, among those with
knowledge at primary level were Hilary Shuard (co-opted after initial objec-
tions from the Department for Education and Science (DfES)), a primary math-
ematics adviser, two primary heads and myself. Signifi-

cantly Anita Straker,
then developing new primary guidelines for the Inner London Education
Authority as an inspector, and writing innovative computer programs to teach
mathematics, was also drafted in as an adviser.

As with the Steering Committee for the mathematics feasibility project,
and not surprisingly in view of the shared membership, the group demanded a
revision of the brief so that attainment targets were written, not separately for
four key stages, but in the form of hierarchical strands, made up of statements
of attainment describing the important steps of progression in each target. The
statements of attainment could then be assigned to broad levels, each of which
could be described as being attained by average pupils of a specific age. This
would both ensure continuity through the 5–16 age range and cater for the
documented wide range of attainment among pupils of any specific age. The
result would be progressive and child centred to the extent that it would take
the progression in the learning of the child as the core of the system rather than
fixing a syllabus for each key stage and measuring each child’s attainment of it.

The TGAT group also favoured this solution, and persuaded Kenneth
Baker to adopt it. Experience of the graded assessment movement at secondary
level suggested that in order to characterize the progress in a wide span of
students from age 5 to 16, giving each child a reasonable chance of progressing
one level each year, then 20 levels would be needed. The TGAT group felt that
ten levels were enough, which gave an average progression rate of one level
every two years for students of average attainment. They defined level 2 as that
which could be achieved by the broad average group of students at age 7, level
3 at age 9, level 4 at age 11, level 5 at age 13, and level 6 at age 15. Other levels
would be defined around this. The working groups for each subject were then
asked to define these ten levels by attainment criteria in their subject. The
TGAT group also set a national system of labelling of year groups, from Year 1 to Year 11, and key stages, from KS1 to KS4, for the first time.

The TGAT group was also radical in proposing an assessment system which depended on ongoing teacher assessment. For moderation of teacher assessment only, there would be theme-based standard assessment tasks (SATs) at the end of Key Stages 1 and 2 which would sample the attainment targets across all the core subjects of English, mathematics and science. For example, a SAT on the topic of ‘pets’ might include questions on knowledge of essential functions of animals, a story about a school or home pet, and some work on measurement and growth of pets. It was also proposed that this might be accompanied by separate tests in English and mathematics at KS2, but again that since these would be only for moderation of teacher assessment, they would be short and would only need to lightly sample the curriculum.

The national curriculum proposed by the Mathematics Working Group was – not unexpectedly – strongly influenced by the Cockcroft ethos, with a broad curriculum including investigation and problem solving. Hilary Shuard also fought to maintain the principles of the Calculator Aware Number curriculum (CAN) with its strong emphasis on mental arithmetic, estimation and calculators. The eventual outcome mainly reflected this, but a compromise was negotiated with the DES to include some written arithmetic (for example, multiplication of a three-digit by a two-digit number), but avoiding specification of any particular standard method. To an extent the strands were research based, at primary level using studies like that of Denvir and Brown (1986), although in some areas of the primary curriculum there was little research to guide the progression and, especially in number, some political compromises were made. Generally the placing of statements had to be at slightly lower ages than research suggested in order to show positive expectations of improvement. So the conceptual spirit of primary mathematics remained largely intact, even if the progressive aspect was significantly dented by the first step in state control of both curriculum and assessment.

The proposals, both from TGAT and from the Mathematics Working Group, received a guarded welcome by teachers as being better than they had feared, and although cosmetic changes (for example, the organization of attainment targets, the degree of specificity, and references to ICT) were made to the format of the Order specifying the National Curriculum for Mathematics in 1991, 1995, 2000 and 2010, the content has remained substantially constant between 1989 and the present day.

The immediate effect in 1989 was for teachers to check that their text-books matched the attainment targets fairly closely, which was generally the case for those bought within the previous decade. These generally emphasized concepts rather than procedures, although many teachers supplemented them with practice on tables and written computation exercises. Schemes brought out supplements and new editions to fill a few gaps like probability, which was
now included in the curriculum, foreshadowed in the 1960s by one of the
Nuffield Teachers’ Guides.

The fact that the curriculum framework for attainment targets was struc-
tured by levels, rather than year groups, encouraged a continuing emphasis on
differentiation. This meant that the many schools which had, with the aim of
pupil autonomy, individualized their mathematics teaching, saw no need to
change. However, other teachers and schools, now wanting greater control
over pace and coverage, started revising the curriculum into modules, using
the national curriculum attainment targets as a basis. All the pupils would
then work on, say, multiplication or measurement at the same time, although
children in different attainment groups would be likely to be working on dif-
ferent activities within that topic, usually selected from different books in their
scheme. These teachers thus moved from being what Johnson and Millett
(1996) call scheme driven planners to scheme assisted planners, with the national
curriculum framework liberating them from the framework imposed by the
published scheme itself.

Although the ‘Using and Applying Mathematics’ attainment target was
supposed to incorporate problem-solving and investigation skills, reasoning
and communication into the teaching of content, in practice teachers felt they
were fulfilling the requirements by either using practical work with structural
apparatus like Unifix cubes, and/or real-world examples, often artificial ones of
shopping and cutting up fractions of cakes (Johnson and Millett 1996). At KS2,
the occasional investigations, introduced following the work of the Cockcroft
advisory teachers, were generally continued. Few had the resources, the con-
fidence or the insight to introduce a fully investigatory style to the teaching of
content, although some teachers used activities or games which incorporated
such principles, without always being able to justify them.

There were, however, changes during this period which did affect the
nature of primary mathematics teaching. The first was as a consequence of
national assessment. In the late 1980s and early 1990s, teachers, led initially
by LEAs, had put much effort into devising assessment and recording systems
as a result of the TGAT emphasis on ongoing teacher assessment. While these
assessment sheets relating to statements of attainment became denigrated as
bureaucratic ‘ticklists’, many teachers still found that focusing on assessing
pupils’ attainment of particular ideas and skills was helpful in monitoring
progress and in curriculum planning. The combination of teacher assessment
and the first national rounds of practical SATs at Key Stage 1 in 1991 and 1992
revealed that pupils’ attainment sometimes differed from teacher expectations
(Gipps et al. 1995).

However, the role of national assessment was evolving; rather than
topic-based tasks sampling the curriculum, to moderate teacher assessment as
envisioned by TGAT, the new minister, Kenneth Clarke, and the DES had taken
a further step towards central control by now requiring tests in each core
subject at each key stage with as far as possible a full coverage of the curriculum. This was closer to the original concept of Margaret Thatcher, which was of a national curriculum as a list of basic skills in literacy and numeracy and corresponding tests. By the time national assessment was finally introduced at Key Stage 2 in 1995, a national teacher boycott of all national assessment in 1993–94 had ensured that there was no longer any requirement for continuous assessment, and the tasks had become externally marked class tests. The next step in centralization was, against teacher opinion, to implement published league tables of performance. Although teachers were still expected to make a judgement on the basis of their views of the child’s attainment, this was no longer regarded as of importance and many teachers waited for the external test results before making their assessment.

This led in many schools to the tests slowly beginning to drive the curriculum, at least in Years 2 and 6. However, the style of written questions in the early years of the national tests had little effect on the curriculum, since they were similar to the style of work in most of the commonly used schemes. Before 1998 there were hardly any straightforward numerical calculations. Almost all items took the form of a word problem set in a real-world context or a puzzle, and thus required some degree of conceptual knowledge, including interpretation of the problem and selection of a strategy.

While assessment against specific criteria was confirming the range of attainment of different children in each class, it also made it clear to teachers that individualization of teaching was not necessarily delivering basic skills in number. Perhaps this was not surprising given that children did not have to react orally or quickly to mental calculations while working through books, and had very little opportunity to talk about the methods they had used, which were often primitive and slow.

Problems about pupil autonomy and progressive methods more generally were featured in research studies in Leicester, Inner London and Leeds; a report commissioned by the Secretary of State (known as the Three Wise Men report) (Alexander et al. 1992), brought these together, proposing more whole-class teaching in primary schools. However, momentum was lost due to a worsening of relations between the government and the teachers during the teacher boycott of national tests. Appeasement followed, led by Sir Ron Dearing, who negotiated a pause in innovation, which turned out to be rather briefer than expected.

1996–2010: the National Numeracy Strategy and the Primary National Strategy

Concern about low standards of number skills, and about teaching methods, surfaced again in 1996. First, unfavourable international comparisons were
highlighted both by leaked new TIMSS results for primary schools in 1995 and by a report reviewing earlier results which was co-authored by David Reynolds, later the chairman of the Numeracy Task Force. In June 1996 there was an announcement that mental arithmetic tests and non-calculator papers would be included in all the end of key stage national tests, persuading many more teachers to include whole-class sessions of mental arithmetic in their lessons, often guided by the mental mathematics pupil books written by Anita Straker.

This was followed by Ofsted reviews of weak literacy, and rather less weak numeracy, standards in inner city LEAs, initiated by the Chief Inspector, Chris Woodhead, a co-author of the ‘Three Wise Men report’. Press reports also highlighted an apparently successful introduction of Swiss-style number teaching into Barking and Dagenham schools, led by Professor Sig Prais, an economist and right-wing member of the National Curriculum Mathematic Working Group. Influenced by both of these, Gillian Shephard, the Tory Secretary of State, announced the launch of parallel National Numeracy and Literacy Projects involving schools in poorly performing LEAs. The aim was to raise standards in basic skills by a prescribed programme for each year, reducing differentiation and including a high proportion of whole-class teaching. Support would be offered by numeracy consultants, a revival of the Cockcroft advisory teachers, long since lost due to continual LEA cutbacks. Anita Straker was appointed as director of the National Numeracy Project, and worked with enormous energy to get the project started in autumn 1996.

Numeracy was being slowly redefined; where previously it had referred, first, broadly to scientific literacy and later to the ability to apply number ideas and skills in employment and everyday life, it now was taken to mean mainly abstract number skills, both written and mental, together with solving routine artificial word problems. The Numeracy Project relegated those parts of mathematics which dealt with anything other than pure number work, that is, measurement, space and shape, and data handling, introduced into most schools in the 1960s, to the margins, by producing, as well as new teaching methods for number, a framework specifying in detail a number curriculum which was to occupy most of the teaching time available.

Even before the Labour Party came into power in May 1997, it had already appointed a Literacy Task Force in 1996 and a Numeracy Task Force in April 1997, thus taking over the Conservatives’ growing focus on raising standards in basic skills in literacy and numeracy. David Reynolds, the chair of the Numeracy Task Force, had been a member of the Literacy Task Force and was not a mathematics educator but a researcher in international school improvement; his research and, as noted earlier, his comparison with other countries, had led him to suggest that there was significant room for improvement in English mathematical standards. Anita Straker was also a member; I was the only member who had previously been on the National Curriculum Working Group.
Almost the first move of the new Labour government in office was to announce the start of the National Literacy Strategy in September 1998; the National Numeracy Strategy would start the following year. Alongside this it set ambitious targets for the number of pupils who would reach the ‘age expectations’ in the national tests, in particular within five years 75 per cent should reach Level 4 of the national curriculum at the end of Key Stage 2 (age 11). So what had started as a set of levels devised in order to report each child’s attainment, with Level 4 defined as what could reasonably be attained by the broad average group of children at age 11, had now become the definition of a requirement that almost all children should reach.

Differentiated progress and differentiated teaching would no longer be tolerated as they were at odds with social justice and human rights; schools were now under pressure to meet externally set norms in national tests, whatever the nature of their intakes. If schools could not meet these norms, then they were not likely to be judged by Office for Standards in Education (Ofsted) inspectors as delivering a satisfactory education, and would be threatened first with shame, having their names publicly listed as a ‘failing school’, and finally, if insufficient improvement was made, with closure.

So the pendulum had swung back finally for the first time in over 100 years from a progressive system which valued autonomy in teachers and pupils, encouraging sensitivity to difference, towards a public education emphasis which decreed equal treatment for all students and all teachers. Perhaps the differentiation had for too long favoured the middle-class child and the middle-class school, and the weaker performance of other children – of whom less was expected – was not sufficiently serving either their own occupational ambitions or the raised standards of national economic performance, the latter being uppermost in the agenda of the new government.

As with the Literacy Task Force, the Numeracy Task Force was pressured into recommending the universal adoption of the National Numeracy Project to form the National Numeracy Strategy and to prepare appropriate plans and estimates for its universal implementation in September 1999. Although early evaluation reports did suggest the Numeracy Project was having a favourable effect on basic skill standards, the extension was required to go ahead before full evaluation results were available.

The National Numeracy Strategy issued *The National Numeracy Strategy Framework for Teaching Mathematics from Reception to Year 6* (DfEE 1999), piloted by the earlier project, which prescribed an extremely detailed curriculum, year by year, for primary mathematics. This was a large document and each teacher was provided with a personal copy. Each group of between three and ten lessons, on a schedule which went through each year, had a specified set of objectives with sets of examples to illustrate the type of work intended. Thus in any given week every class in the country in a particular year group would be engaged on
the same objectives on the same topic. This was a level of curricular prescription which had never before happened in English primary schools.

In 2000 the national curriculum was altered to correspond to this framework, although as before this only contained broader outlines of what should be taught during each key stage. While only this national curriculum was technically statutory, there were very strong pressures to implement the week-by-week detail in the framework, since schools were inspected regularly by Ofsted inspectors who were briefed that schools should be following the precise recommendations of the National Numeracy Strategy. Unless a school had exceptionally good test results, failure to comply would be regarded as the cause of lower standards.

Not only was there prescription of the curriculum, but also of the shape of each lesson, including the type of activity which should take place, and for how long. The lessons should commence with a mental/oral starter to revise mental arithmetic skills (5 to 10 minutes), then involve a presentation of new work by the teacher to the whole class using interactive questioning, followed by pupils working in groups to practise exercises, during which time the teacher would teach one group at a time, and finally a whole class plenary (10 to 15 minutes) to overview the topic and lead forward. The whole lesson would take 45 minutes or more with younger age groups increasing up to 60 minutes with Years 5 and 6. After initial guidance in the national project that no differentiation at all would be allowed, finally a degree of differentiation during the group work time was reluctantly approved, provided all groups worked on the same objectives and not more than three levels of differentiation occurred in any class.

The research base for this focus on whole class teaching and specification of pedagogic structure was fragile (Brown et al. 1998). The Numeracy Task Force commissioned a detailed review of the English 1994 TIMSS data to see whether more whole-class teaching was significantly associated with higher standards in numeracy. The results were not referred to in the final report or ever published since it was found that in Year 5 the opposite was the case; in Year 4 the results were inconclusive.

This was supported by a nationally financed research project aimed at determining characteristics of effective teachers of numeracy, which had noted that there was no particular pattern in the way effective teachers organized their classes or lessons (Askew et al. 1997). While some favoured individualized working through textbooks, others favoured only group working, and others taught whole classes. What seemed to differentiate effective teachers (here measuring effectiveness by the gains made across the year in average class performance) was not their pedagogic strategies but their well-developed personal philosophies of mathematics teaching and teaching methods. These emphasized connections, between different mathematical ideas, between mathematics and the real world, and between their knowledge of children and mathematics (see Askew, Chapter 2).
However, there were aspects of the National Numeracy Strategy which did reflect research findings. The opportunity was taken by English researchers like Ian Thompson, Julia Anghileri and Mike Askew to include research-validated didactic methods, some first used in the Netherlands. These included different forms of early counting, new mental calculation methods with an emphasis on working with complete numbers rather than splitting into separate digits, the greater use of hundred squares and the empty number line for addition and subtraction. Counting sticks were also encouraged for practice in multiplication, although with rather less research support or success, as these favoured a narrow concept of multiplication which was based on repeated addition only (see Delaney, Chapter 5).

So led by Anita Straker, who became the first National Numeracy Strategy director, the curriculum emphasis was very much on mental methods and on moving only slowly to written methods, and then to those like the grid method for multiplication and ‘chunking’ for division, which were likely to make conceptual sense to the child (see Thompson, Chapters 15 and 16). Teachers were recommended in their class teaching phases of lessons to ask children to explain their own methods and strategies for calculating, so that children would discuss different methods and learn from others. Nevertheless there was some inconsistency here, for in many cases the lesson objective selected from the framework was to introduce a certain specific procedure, often for mental calculation. This meant that teachers often started teaching by asking children what methods they chose to use and then had to ignore this information to require them all to practise the designated procedure. It might be expected that at least children would thus extend their repertoire of possible procedures on which to draw. However, many teachers came to feel that having too many possible strategies was confusing and chose to restrict the choice. Thus a generally conceptual orientation adopted by the strategy sometimes was interpreted as more procedural than intended (see Thompson, Chapter 12).

The implementation of the National Numeracy Strategy, like that of the National Literacy Strategy a year earlier, was undertaken with military precision; little expense was spared. Under the national director were regional directors who trained consultants appointed to each LEA. These consultants trained the teacher coordinator responsible for mathematics in each school, on three-day sessions, with head teachers and school governors attending for some sessions. The training was centrally designed, including the exact timetable to be followed, the training videos to be shown and the PowerPoint slides to be used. Where awkward questions were asked, consultants simply responded that ‘research had shown’ the strategy methods to be more effective than alternatives. In order to ensure every teacher in every school received exactly the same messages, coordinators were also issued with similar packages to be used on each of three national training days. The Canadian team
evaluating the implementation of both strategies noted that this was probably the largest national project implementation ever attempted, and were impressed by the thoroughness of the exercise (Earl et al. 2002).

With all this prescription it might have been expected that there would be significant teacher opposition, but in fact the strategy was widely welcomed by teachers. It benefited from lessons learnt from the introduction of the National Literacy Strategy and was perceived as a little less tightly controlled. Anita Straker was widely trusted by teachers and had assembled an able team. The project received support from most quarters, with the exception of higher education which had been left out of the strategy implementation plans. An additional factor may well have been that few primary teachers were confident about their mathematics expertise, especially since with primary training increasingly being cut from three- or four-year BEds to a one-year PGCE, the average amount of training in understanding and teaching primary mathematics received was rapidly declining. This meant that authoritative prescription delivered by friendly faces was widely welcomed.

Teachers were, however, generally exhausted by having to replan all their lessons, first in literacy and then in numeracy/mathematics over the period of two years. Tight timescales meant that no revised textbooks or other supportive materials were available, and in any case the use of these was generally frowned upon by the strategy which felt that teachers had more than enough support from its own productions, and other sources were only likely to be off-message. An interesting but unplanned consequence was that some schools introduced setting, especially where teachers were worried about teaching a uniform curriculum across the wide attainment spectrum, and/or where national test results were low and heads felt that they had to take radical action of some sort.

But however successful the implementation, the changes in national test results were disappointing. Strangely, the percentage of students achieving Level 4 at age 11 had increased significantly in the summer of 1999, just before the strategy was officially introduced, but the rise in the following few years was very small, and the national targets for increased performance were not met. Although the government explained the 1999 rise by the action of premature adopters, evidence suggests that this is unlikely to have been a significant factor. The fact that the trends in mathematics national test results were almost identical to those in English and science, although the National Literacy Strategy was introduced a year earlier and there was no national strategy for science, suggest that other factors were responsible for the 1999 increase, including a combination of increased pressure on teachers to coach Year 6 students for the tests, and a slippage in the test standards which evidence suggests took place between 1995 and 2000.

There was corroboration from other sources that the introduction of the National Numeracy Strategy, which was costing more than £50 million
per year, had only a small effect on test results. A five-year longitudinal study of primary numeracy financed by the Leverhulme Trust suggested a very small effect on Year 4 results, with declining performance in more than a third of schools in the sample (Brown et al. 2003). More worryingly for the Labour government was the finding from this study that the range of attainment had widened, not narrowed, as a result of more uniform teaching. It was the lowest achievers who had benefited least from the strategy, whereas the greatest gains were in the middle of the range. From the same source came some evidence also that while pupils’ knowledge of the number system and addition was enhanced, some areas like problem solving and multiplication seemed not to have improved. This suggested that improvements had been due more to improved teaching methods (didactics) in some areas than to the changes in lesson format and whole-class pedagogy.

There was some panic in the new Department for Education and Skills (DfES) when it became clear that national test results were still failing to rise significantly. The strategy director was called in to explain the failure and to take urgent action to address it. The blame was eventually laid rather unfairly at the hand of teachers, whom it was suggested were not implementing the guidance faithfully, when in fact there is substantial evidence that they were.

Thus a further turn of the centralization screw was made. Since teachers could not be trusted to interpret the guidance, they would be issued with lesson plans for every lesson, specifying exactly how it would be taught – little was missing other than some sets of examples for practice. This was all to be done quickly, with these ‘unit plans’ for lessons put on the Internet, starting in 2001–02 at least in some areas and for some year groups, and spreading more widely in 2002–03 and 2003–04. Although these had been trialled, clearly they were not always suitable for all classes in all schools, and there is some evidence that teachers sometimes misunderstood the point of activities that they were asked to deliver. Teachers who had recently bought and got used to new published schemes relating to the strategy, some at least as sound in quality as the unit plans, were forced to abandon them for the new orthodoxy.

But even after unit plans had been widely implemented, still only minor improvements were observed in national test results. Although teachers had broadly welcomed the unit plans at the start, as they discovered they did not always work well with their classes there was more scepticism. With new ministers and new strategy personnel, new regimes were also introduced for children with lower attainment who had appeared to suffer most in the early days of implementation, with more customized work in Wave 2 (for groups) and Wave 3 (for individuals with special needs).

So within the previous 50 years there had been enormous changes in primary mathematics. First, from a broad and conceptually based curriculum in which investigation and problem solving were encouraged, a curriculum was
now in place which emphasized abstract number knowledge and procedures and which downplayed applications and problem solving. While the overt advice of the strategy remained broadly conceptual, the pressure on teachers to move quickly through a tightly specified curriculum and to coach children to achieve high scores in national tests, led in many classes to a more procedural style of teaching. Children were focused on what has to be done to achieve high test scores rather than on learning to enjoy, explore and use mathematics. Nevertheless, England has still generally avoided the most mindless styles of teaching of formal written algorithms which pertain in many countries.

Perhaps more radical have been the changes in control of the curriculum and the possibility of adapting to the motivation and needs of individual children. From broadly progressive teaching methods, where well-trained teachers were trusted to find ways of exciting and communicating with their individual children, we had moved to a situation where each lesson in most year groups was centrally prescribed, in order to achieve a public education system which adopted methods previously used only in totalitarian countries to equalize experiences and outcomes for each child.

The reality, of course, is that change is never so extreme as it may seem from an abstract description of the system. Even in apparently progressive times, most schools, most of the time, have been dependent on published schemes to set their curriculum as well as their teaching activities. These schemes have generally covered a wide curriculum, but have always had a major emphasis on number work. Most schools have continued throughout to teach and test number bonds and multiplication tables, and calculators have been used sparingly, if at all, to teach number sense rather than as a substitute for traditional calculation methods. Thus the combined good sense and inertia of the teaching profession has substantially damped the pendulum swings recommended in the past, and no doubt will do so again.

Postscript: releasing the stranglehold post-2006

By 2006, with still no significant rise in national test results, it was decided that further changes were needed; since there was little potential left for greater control of the system, a new framework was issued which was distinctly lower key in its specification than its predecessor. Most teachers were expected to use it online; while this provided more flexible planning tools, it proved quite complex to access all the many different components, with much less of the training and implementation systems which had been used in 1999. The yearly schedules were now intended to be organized in slightly larger units of equal length to ensure less fragmentation in teaching, but since many units contained sections from different areas of mathematics, the effect was
scarcely noticeable. While it is difficult to get a clear overall picture of what is happening currently, it is clear that more decisions are being taken at school level than was the case in 2005.

National tests at age 7 have been abandoned in favour of teacher assessment with support from classroom tests, which leaves more freedom for Key Stage 1, and among considerable national opposition it is very possible that tests at age 11 will be replaced by single level tests and/or moderated teacher assessment in Key Stage 2. Single level tests may well lead to more domination of the curriculum by test preparation which could permeate the whole of KS2, but since different children will be practising for different tests the uniform curriculum may not hold for long.

Further, an official review by Sir Jim Rose (DCSF 2009) and an independent report by Professor Robin Alexander and colleagues from schools, local authorities and universities (Alexander 2009), became available in 2009. Both men were, perhaps ironically, co-authors of the Three Wise Men report in 1991 which launched the swing towards greater control of teaching. Both these recommended a new more progressive and less specified curriculum with wider aims, and the Rose Review led to a new version of the national curriculum to be implemented in 2011 which has less specified content and more emphasis on process.

So again the pendulum is swinging back; after concerns at much less improvement in standards than expected we move on in the only way possible, towards more progressive and greater conceptual emphasis once again. Maybe such swings are inevitable since standards will never be as high as we would wish, and there will always be someone with a new vision ready to keep the roundabout turning!

References


