

OBSERVATIONS ON THE LMS RESPONSE TO DRAFT
PROGRAMME OF STUDY IN MATHEMATICS, KEY STAGES 1–2

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Summary

The general response to the draft primary curriculum has been highly critical in some respects. But all responses appear to accept the fundamental idea that there is considerable scope for raised aspirations. This is remarkably positive.

Many responses also appear to welcome the idea of a clearer focus on core ideas and methods. For example, a survey completed by 5500 primary teachers revealed surprising support ($\sim 55\%$) for delaying calculator use until late primary. And apart from one or two interest groups there has been surprisingly little special pleading for the idea of preserving data handling as a separate Attainment Target: it would seem that many respondents accept the need for a reduced profile in Key Stages 1-2.

In short, the underlying balance of opinion is now clearer in some respects than one might have anticipated. So the criticisms alluded to in the first paragraph should not be classified as obstructionist, but as reflecting a desire to give the new curriculum a reasonable chance of succeeding.

The summary of these criticisms provided by the LMS has been widely appreciated and focuses on six main points:

- (i) There is an official insistence that a curriculum should concentrate on 'what' should be taught rather than 'how' it should be taught. This makes sense but can be taken too far: in mathematics the way a topic is developed over time may be designed to remain as part of students' mental superstructure. But the official line should make it even clearer to specify something even more basic than 'what'—namely 'how many hours' are to be devoted to mathematics in each School Year (the time devoted to mathematics in English schools is low).

- (ii) A main-school curriculum represents an 11 year journey. One cannot assess an outline of the early years without a clear idea of the mathematical destination it is leading towards. Since the primary curriculum (and the associated ‘leaks’ about developments at secondary level) raise very awkward questions, one cannot assess a draft for KS1–2 in isolation.
- (iii) The current draft is insensitive to ‘the way human beings learn’—in that it fails to convey the way in which the ‘mental universe of mathematics’ emerges from practical engagement with measures, shapes and quantities.
- (iv) The current draft is too ambitious—with unreal expectations in Years 1–2, and forcing material into Years 5–6 that belongs more properly in Years 7–8.
- (v) The current draft still ‘nibbles’ at the same material year-after-year, instead of preparing the ground well whilst delaying the formal introduction of hard ideas, and then making significant progress when they are eventually introduced.
- (vi) Like so much in education, the success of any change depends on maintaining the support of teachers. For it is teachers who must interpret and present the changes to parents, and who implement them in classrooms. This support will be difficult to generate and to sustain without delaying to allow a more realistic schedule, and without a clearer sense of the associated assessment, accountability, and training structures.

More detailed analysis

- (1) The official remit of the review[†] included the statement of its declared purpose as being

to ensure that all children have the opportunity to acquire a core of essential knowledge in the key subject disciplines.[‡]

It follows that the draft[§] cannot be intelligently assessed without some outline of what is deemed to constitute this ‘core of essential knowledge’ in elementary mathematics. Yet we are invited to comment on

[†]Department for Education. The National Curriculum Review, <http://www.education.gov.uk/inthenews/multimedia/a0073336/the-national-curriculum-review>.

[‡]Department for Education. *National Curriculum review launched: The remit for the review*, <http://www.education.gov.uk/inthenews/inthenews/a0073149/national-curriculum-review-launched>.

[§]*National Curriculum for mathematics Key Stages 1 and 2—Draft*, <http://tinyurl.com/MathsKS1-2>.

a draft of KS1-2 without any such outline of the core for KS1-4 to which it is supposed to contribute.

- (2) Any curriculum has to be constructed and assessed from two viewpoints:
- (i) top-down;
 - (ii) bottom-up.
- (i) The top-down viewpoint requires one to have a clear notion of where one is heading. Without a clear picture of what ‘core knowledge’ children should have the opportunity to acquire by the end of KS4, it is impossible to assess the content listed in KS1 and KS2.

This outline needs to be discussed and agreed as a matter of urgency before any draft for KS1/2 can be intelligently assessed.

In this regard, the leaked (*Daily Mail*) report[†] concerning the secondary curriculum is highly disturbing.

The existing reality in England (with 45% failing to achieve a grade C, and with those who take GCSE given very different experiences at Foundation and at Higher tiers) is such that we already have a kind of unregulated ‘parting of the ways’. Hence, were the idea to be presented sensitively, one might well find broad support for the idea that the curriculum should reflect this fact explicitly.

However, having done the necessary work as part of an internal exercise[‡] it is clear that the amount of (relatively concrete) material which everyone should have an opportunity to master in a modern society is clearly incompatible with the leaked reports about the intended secondary curriculum.

The simplest imaginable ‘basic list’ (including an understanding of, and an ability to use: numbers and quantities; calculation; fractions, and basic ratio and proportion; simple formulae; geometrical constructions; simple analysis of data; etc.) obliges one to think in

[†]Tim Shipman, Return of the O-Level: Gove announces radical plan to scrap GCSEs ‘to ensure UK has a world-class education system’ but lack of consultation angers Lib Dems. *Daily Mail*, 20 June 2012. <http://www.dailymail.co.uk/news/article-2162369/Michael-Gove-plans-scrap-dumbed-GCSEs-bring-O-Levels.html>.

[‡]A. D. Gardiner, A draft school mathematics curriculum for all written from a humane mathematical perspective: Key Stages 14, *The De Morgan Journal* 2 no. 3 (2012), 1–138, http://education.lms.ac.uk/wp-content/uploads/2012/02/KS_1-4_DMJ.pdf.

terms of a common curriculum which goes way beyond KS2, and which involves at least the first three secondary years (so running to at least Year 9).

- (ii) The bottom-up viewpoint obliges one to assess what we know about human development and about what it is reasonable for us to expect of (generalist) primary teachers. Both considerations reveal that the draft is over-ambitious, and indeed to such an extent that both teachers and pupils are likely to feel forced into using un-comprehended, instrumental methods, following rote procedures prematurely — which seems likely to guarantee an outcome that will undermine not only this but also any future attempts to ‘raise aspirations’.

Learning mathematics is like constructing a building: if all that is needed is a quick method, one may get away with flimsy foundations. But the more that will subsequently depend on what is being learned, the greater the effort that needs to go into laying strong foundations.

Mathematics teaching regularly fails students by trying to impose abstract methods without first laying the necessary foundations. The outcome is not unlike that of a marathon runner who sets off too fast, only to discover that his legs and lungs run out of steam.

It is therefore essential to ‘make haste slowly’: in seeking to raise aspirations in school mathematics for all, modest realism is far more effective than over-optimistic hubris.

- (3) The Numeracy Strategy was a bold experiment. And like many such experiments, it had significant shortcomings.

In particular, it paid too little attention to what was needed at KS2 in order to prepare pupils for the abstractions of secondary mathematics; and its determination to insist on ‘pitch-and-pace’ exacerbated the difficulties faced by the bottom 20%.

However, it had a marked impact on average performance by the end of KS2. This should have set the scene for a wider acceptance of the idea that we have traditionally expected too little. The Numeracy Strategy showed quite clearly that much more could be achieved than conventional British wisdom has assumed.

Hence one would like to be able to respond positively to a draft that

includes features which should be part of any improved curriculum (such as raised aspirations, a cleaner focus on key ideas and methods, integrating applications, postponing some harder material, etc.). However, the current draft leaves us feeling profoundly uneasy.

A sensible response to the Numeracy Strategy would be to build on its strengths, to identify and correct its flaws, and to raise aspirations modestly, in a way that might have been seen as challenging both to the profession and to the Department for Education, but that was seen to be potentially achievable. (If experience subsequently suggested that one could aim slightly higher, this could then have been considered further down the line.)

- (4) One of the central lessons of the Numeracy Strategy was the dramatic impact of the simple requirement that all pupils should have a daily ‘numeracy hour’. This had the effect of ensuring that all pupils spent a certain amount of time engaging with mathematics.

The simplest way of conveying the intended extent of the curriculum (see 2(i)) would be to follow most other jurisdictions by specifying a minimum number of hours to be devoted to mathematics lessons in each school year.

- (5) Having seen and commented on earlier versions of the curriculum, one has the clear impression that successive drafts—which at times appeared to be converging slowly towards an achievable version with sensible objectives—have somehow been sidelined in favour of a version whose origins and authors remain obscure, and which seems to be so unrealistic that it will undermine, rather than strengthen, school mathematics in England.
- (a) The comparisons made with ‘high-performing jurisdictions’ are routinely distorted. The English tradition is inclusive—so we view Sandwell and the City of London, Rotherham, and Richmond as parts of the whole. Even then there is little evidence to suggest we have much to learn from Alberta; and it is simply inappropriate to make comparisons with small and highly selective jurisdictions such as Massachusetts, Singapore, or Shanghai (which may be more compact, more homogeneous, and hence easier to manage, whose populations may be biased in favour of high performers and may exclude low performers in different ways).
- (b) Most of the content listed in the current draft deserves to be in-

cluded at some stage (if not in quite the crude form used). But the later material (e.g. fractions, ratio, probability) needs to move up to Years 7–8, and the earlier material needs to be modified, and given ‘room to breathe’ in order to recognise that our children start school younger than in other countries, so that more care and time is needed when preparing the ground for, and when introducing formal procedures.

- (c) Practice, mastery, and fluency are admirable objectives, and fully deserve increased attention; but for such increased attention to have the desired effect, it needs to be embedded in a humane education which recognises the need for sufficient prior activity and experience in order
 - (i) to generate ‘meaning’ in the pupil’s mind,
 - (ii) to support a degree of understanding, and
 - (iii) to develop pupil confidence when selecting and implementing the procedures to solve problems.

Hence the details of the content listed on every page need to be paced and shaped in a way that conveys clearly relevance of the opening

“Purpose of study”

and

“Aims”

if these are not to be forgotten in the heat of the daily classroom battle. This could be done, but is not an easy task. And its successful implementation will depend on facing up to the more serious criticisms indicated below.

- (6) The comments that follow are perhaps more serious. Taken together they mean that if the final version is to be ‘fit for purpose’, the publicly declared timetable must be revised (with implementation delayed by a whole year).
- (7) We share many of the objectives that were declared at the outset of the Curriculum review. But the internal struggles which appear to have given birth to this draft would seem to have caused key objectives to be forgotten.

We limit our comments here to just one such key objective. International comparisons suggested a strong central principle:

*prepare the ground well prior to engaging with hard ideas;
then engage sufficiently seriously to make significant progress.*

- (a) The draft ignores this principle from the outset (e.g. multiplication is introduced as repeated addition; so addition needs to be sufficiently robust before one can make sense of multiplication—yet the two themes appear together in Year 1!).
- (b) A corollary of this principle concerns the traditional English curricular disease of ‘nibbling’—where instead of devising approaches that allow pupils to make effective progress, we simply scratch the surface time and time again, in the hope that some pupils will sort things out for themselves while others merely go round and round in bemused circles. The current draft continues this doomed tradition—for example, in its approach to fractions. (The recent Kings College repeat of the CSMS study from the 1970s shows the need for a fundamental re-think of our approach to the teaching of fractions and ratio.)
- (c) The same error occurs ‘in the large’ when one forgets that a failed first encounter with a mathematical topic or method leaves an emotional scar that gets in the way of subsequent attempts to master the same material. In truth many of us experience this at some stage, when our repeated attempts to master some topic or method fail to take root, lead to failure, and may have to be revisited prior to re-examination. But the experience leaves its mark; so it is important, wherever possible (and especially with beginners), to move at such a pace that material is gradually absorbed and mastered before it is formally assessed.

Curriculum 2000 showed that when A level mathematics was assessed after just 1 year (rather than being used daily and having time to ‘bed in’ over 2 years), students concluded en masse that they should drop the subject altogether at the end of Year 12!

And the Department for Education’s own recent data on ‘early GCSE entry’ show that, far from improving the grade ultimately achieved, early entry has a negative effect on subsequent attempts at GCSE.

It is therefore worrying to find that the unrealistic aspirations of the current draft have been defended with the claim that ‘those who fail to master the (deliberately over-ambitious) KS2 curriculum can re-

peat it during KS3', as though the experience of early failure in mathematics is emotionally and educationally neutral. (As admitted above, such repetition may be to some extent unavoidable at later ages; but the goal of a primary curriculum should be to lay effective foundations in a way that develops confidence as well as competence, so that pupils enter the secondary phase as far as possible without a sense of failure.)

- (d) The principle enunciated above in italics draws attention to a much more basic oversight hinted at in 1, 2(i), and 2(ii) above.
- (8) A curriculum describes a journey lasting many years. Many of the important milestones which need to be specified as part of that journey will ultimately be replaced by later ideas and techniques. But they still need to be specified explicitly if teachers are not to by-pass them and focus solely on what is explicitly listed. This danger is far greater if the listing is over-ambitious (since teachers then feel under constant pressure to 'cover the listed material'). The detailed pedagogy perhaps may be left to other sources; but the listing must avoid being over-ambitious and must somehow routinely indicate as an integral part of the document the kind of preliminary experiences that are needed if the explicitly given ideas and processes are ultimately to be grasped.

To indicate the extent of this omission, we note:

- (i) The whole tenor of the draft is almost unbearably passive: pupils are 'taught'; they are expected to 'recognise', and to 'practise'. There is almost no mention of drawing, or weighing, or actively measuring, or making, or discovering, or exploring, or collecting, or describing, or comparing, or This requires a shift of focus, but could be easily corrected by such changes as replacing

"Pupils should be taught to:"

by

"Pupils should:"

and by adjusting the remaining language accordingly.

- (ii) Far too many items are listed *ab initio* in their ultimate 'disembodied' form. This abstract form may be the ultimate objective of successful mathematics teaching; but one needs to specify much more clearly the path to be followed which we hope will ultimately lead

pupils to that goal.

At present pupils are expected to “count” as though this were some abstract recitation of the number sequence. In reality counting and measuring are initially ways of organising experience: pupils count collections of objects with an educational objective. Counting and measuring emerge from attempts to assess quantity, or ‘amount’; that is, the underlying ideas begin life inextricably tied up with the stuff that is being counted or measured. Only slowly does this experience lead to an ability to imagine and work with the ‘disembodied’ mental counting sequence. Yet the current draft conveys the impression that the initial and intermediate stages of this development can be suppressed and are not part of the curriculum. Together with the over-ambitious listing, this seems bound to lead to attempts to move too quickly from the concrete to the abstract.

- (9) We too often imagine that mathematical ability is somehow ‘given’: it is not. All teaching assumes that the child can be formed, that ultimate success can be influenced by opportunity, by experience, and by instruction. As recent Ofsted reports (2008, 2012) emphasise, this fundamental belief includes the unfortunate possibility that children’s learning is often obstructed by poor teaching, or by an inadequate curriculum.

We envisage a ‘basic curriculum for all’—covering material that might constitute an improved basic GCSE—as requiring a common programme running to at least Year 9. This relatively concrete ‘basic curriculum for all’, which may also be characterised as “elementary mathematics for the general citizen”, serves two very different functions in a way that supports the political goal of social cohesion, of providing equal opportunities, while acknowledging different pathways; that is

- it would provide a suitable basis for the 50% or so who should study more abstract elementary mathematics (serious algebra, geometry, etc.) at KS4;

and

- it would also form the core of the mathematics required by the other 50% or so, who might address these basic topics throughout KS3/4, including in more practical contexts.

This model shows that the current Mathematics Linked Pair[†] needs to be adjusted in the way that originally found widespread support, but was blocked by QCDA[‡] and the National Qualifications Framework[§]: 50% or so of the cohort could then aim to take a single basic GCSE at age 16 or so, while the other 50% or so could prepare to take both this basic GCSE and a more abstract prerequisite for A level. (This will require a revision of the restrictive National Qualifications Framework, but we have been assured that this is not a problem.)

- (10) Finally, we hope that the Department for Education will not forget the most important principles in any National Curriculum reform—namely to keep the profession on-side, to make the pace of change realistic, and to provide the necessary training opportunities to ensure effective implementation.

[†]http://www.ocr.org.uk/qualifications/type/gcse_2010/maths/app_of_maths_pilot/.

[‡]<http://www.education.gov.uk/aboutdfe/armslengthbodies/a00200461/qcda>.

[§]Explaining the National Qualifications Framework, <http://www.ofqual.gov.uk/qualifications-assessments/89-articles/250-explaining-the-national-qualifications-framework>.