



## **ACME's response to the draft Primary National Curriculum for Mathematics published on 11 June 2012**

### **About ACME**

The Advisory Committee on Mathematics Education (ACME) is an independent committee, based at the Royal Society and operating under its auspices, that aims to influence Government strategy and policies with a view to improving the outcomes of mathematics teaching and learning in England and so secure a mathematically enabled population. ACME acts as a single voice for the mathematics community.

### **About this response**

On 11 June 2012 a draft National Curriculum for primary mathematics was published by the Department for Education for informal consultation, as a precursor to a more formal consultation in early 2013 and publication of the final version in September 2013. ACME was asked to lead on gathering the views of the mathematics community on the draft, and has used the feedback gathered to develop this response.

This document, and the views of ACME put forward within it, is informed by our consultations with the mathematics community. This document has also been reviewed by ACME's 'Outer Circle' of advisors before submission. It has been created for submission to the Department for Education, with the aim of informing further development of the draft curriculum.

ACME consulted the mathematics community during 18 June to 18 July 2012 primarily through a detailed questionnaire, which was posted on the ACME website and distributed through our contact lists. Written responses were supplemented by two workshops held on 18 June and 3 July, two smaller eSeminars held on 27 and 28 June (supported by the NCETM), and a discussion forum on the NCETM website. Questions were constructed to investigate themes highlighted by the Department for Education and by existing ACME statements and reports such as *Mathematical Needs*, and included detailed questions about structure, content and progression.

Almost 100 written submissions were received, from teachers and schools, Local Authority advisors, education researchers and many others. Crucially, the response list also includes:

- a joint response from the Association of Teachers of Mathematics (ATM) and the Mathematical Association (MA),
- the London Mathematical Society (LMS),
- Mathematics in Education and Industry (MEI), and
- the Royal Statistical Society (RSS).

The Institute of Mathematics and its Applications (IMA), whilst not considering itself expert in primary curriculum design, is supportive of the ACME response.

This process has allowed us to take a broad view from across the relevant stakeholders, and our response is informed by this breadth. Submissions from these organisations have been made publicly available on the ACME website, and all non-confidential responses have been made available to the Department for Education. Respondents worked hard against a short deadline at the end of term, and their thoughtful submissions are appreciated by ACME.

An independent summary of all 98 written submissions to ACME has been produced and is available as a separate document to show clearly ‘what the mathematics community told us’ – our submission should be read in conjunction with this as we reference the consultation summary extensively in the following pages. It should be noted that the separation of these two documents is to demonstrate the process that we have used – ‘what the mathematics community told us’ and ‘our interpretation of the policy implications’ – but in practice the two align very closely in their messages, and there is a large degree of consensus amongst all consultation responses from the various sectors.

ACME’s own submission is presented in two parts:

- Part A provides overarching messages and recommendations, highlighting the most important aspects to be addressed before formal consultation in 2013. Specific recommendations for action are highlighted with in bold.
- Part B provides detailed commentary on the statements included in the curriculum, with specific suggestions for changes, including correction of any mathematical errors, highlighting mismatches in progression between and within strands, noting potential improvements in phraseology, and suggestions for addition, movement or deletion of various statements.

The two parts must be viewed and acted on together – it is not sufficient to implement only the specifics highlighted in the second part, as the overarching issues also require focused attention by experienced curriculum developers. There may also be issues which have not become apparent in the time available to review the document – action on the parts identified does not guarantee a fully coherent and complete curriculum, and further involvement of mathematics experts will be required.

ACME has already made clear its views on the process for constructing this draft through a letter to the Secretary of State for Education which is available on our website. We will not repeat them here, except insofar as to reiterate the need for reassurances that the processes adopted going forward, including during the development of the Secondary curriculum, will be transparent and involve a group of mathematics curriculum experts working with officials.

We would be very happy to assist the Department in implementing the recommendations in this response.

## Executive summary

There are many aspects of the draft curriculum that we strongly support. We warmly welcome:

- The three Aims described in the draft curriculum, and in particular the comparable status they give mathematical fluency, problem solving and reasoning,
- The overall curriculum aim of educating all students to a level where they can engage successfully with mathematics in secondary school,
- The flexibility to alter the pace of learning within Key Stages according to professional discretion and judgment of pupils' needs,
- The emphasis given to spoken language in developing mathematical concepts and habits,
- The flexible and evolving use of technology to support and enhance the teaching and learning of mathematics,
- The connections made between fractions and division, the separation of perimeter and area, the need to compare quantities as one basis for understanding number, and the importance given to fluent use of multiplication facts.

Nevertheless, there are also many areas that require improvement and these must be pursued:

- The aims should be more fully reflected in the body of the document, especially in relation to mathematical problem solving and reasoning: this would support teachers in providing a fuller curriculum entitlement as envisaged in the Aims,
- In some strands, greater coherence in progression would better support robust learning,
- Specific mathematical errors in the draft should be corrected and future drafts should be reviewed for mathematical accuracy in advance of publication,
- Repositioning some statements in different years would better support deep and coherent medium-term learning as outlined in the Aims,
- Expectations in relation to exploring mathematics, reasoning, and making connections should be enhanced so as to support deeper conceptual understanding on which later learning can be built with confidence.

## Part A – overarching messages and areas that require focused attention

### 1. Aims of the curriculum

#### Recommendation 1: Aims of the National Curriculum

The Aims stated in the draft are as follows:

*The National Curriculum for mathematics aims to ensure all pupils:*

- *Become fluent in the fundamentals of mathematics so that they are efficient in using and selecting the appropriate written algorithms and mental methods, underpinned by mathematical concepts*
- *Can solve problems by applying their mathematics to a variety of problems with increasing sophistication, including in unfamiliar contexts and to model real-life scenarios*
- *Can reason mathematically by following a line of enquiry and develop and present a justification, argument or proof using mathematical language*

**ACME warmly welcomes these aims for the curriculum, and believes that they describe what pupils should be able to do at the end of compulsory education. A few small amendments may be necessary and these are included in Part A.**

#### Recommendation 2: description of key terms

Given that primary teachers are generally not specialists in mathematics, **ACME believes the impact of the Programme of Study document on the school curriculum would be significantly strengthened if the terms *fluency*, *problem solving* and *mathematical reasoning* were described in more detail somewhere within the document.**

We would be happy to support officials drafting this text, and a suggested starting point is given below:

- Mathematical fluency includes the rapid and accurate recall of skills and knowledge. It requires sufficient depth of conceptual understanding to be able to recognize and evaluate appropriate occasions for their use. Mathematical fluency refers not just to arithmetic, but to all areas of mathematics.
- Problem solving can be described as working on problems that have some non-routine features. Such problems may be drawn from cross-curricular contexts, from life outside the classroom or from within mathematics, but all have the common feature that some work, and thought, is required before routine procedures can be applied.

- Mathematical reasoning requires analysing information presented in different forms, recognising given information, identifying what additional information is needed and what forms of reasoning can provide it; identifying and conjecturing patterns, relationships, and generalisations; testing, inducing, deducing, and proving; and communicating ideas in mathematical language.

### **Recommendation 3: aims for the primary curriculum**

The challenge for the Key Stage 1 and 2 Programme of Study (PoS) is that it needs to articulate how pupils will move towards the overarching aims of the national curriculum during the primary phase.

**The specific aims of the primary phase should be more clearly articulated. The descriptions at the beginning of each Key Stage could be expanded upon.** The following text could be used or adapted to achieve this, and again, ACME would be happy to work with officials and any other experts they engage to ensure that the aims of the primary PoS are clearly identified and then articulated.

*Pupils should become fluent and confident in the use and understanding of number, place value, number representations and the basics of arithmetic calculation, making use of efficient mental and written methods. Pupils should be well prepared to engage with harder ideas when these are first met at secondary level, and this should include early experience of number relations and informal symbolization. Pupils should also learn to describe elementary geometric shapes, use appropriate vocabulary and understand basic properties associated with these shapes. Pupils should also have firsthand experiences related to developing concepts associated with quantities and their common measures, for example, length, area, volume, and time. They should be given opportunities for the collection and analysis of real data associated with easily understandable situations that all can relate to. They build up the necessary skills and knowledge to begin to engage with the idea of a problem-solving cycle.*

### **Recommendation 4: ordering of the aims**

The ordering of the aims has generated a lot of discussion within the mathematics community.

**In ACME's view it would be constructive to include a sentence that indicates that none of the aims should be prioritized over the others – all must be fulfilled throughout the curriculum.**

### **Recommendation 5: attitudes**

Some respondents felt that the aims should also include references to enjoyment of mathematics and to building mathematical behaviours, such as responding positively to challenge, and metacognitive traits such as evaluating progress towards a solution. Our

attention has also been drawn to the fact that the Alberta, New Zealand and Scottish curricula include statements about attitudes and dispositions.

**We suggest that these attitudes and dispositions, and others, could be incorporated into the preamble to indicate the value to future study of mathematics.**

**Recommendation 6: how the aims are reflected within the Programme of Study**

It is clearly important that by the end of the primary phase, children should be able to calculate accurately. However, they also need to develop mathematical understanding and reasoning and problem solving. Virtually all respondents noted that the three Aims in the draft were not reflected in the Programme of Study. In particular, they noted the overwhelming emphasis on calculation, that there is very little reference to mathematical reasoning (third aim), or to problem solving (second aim). These omissions were a significant contributor to the almost-universally negative responses expressed about the draft and must be addressed before the next version is presented for formal consultation.

Achieving an appropriate balance between the Aims is not an easy task, but **ACME believes that each of the Aims for the Mathematics National Curriculum must be fully reflected in the Programme of Study, otherwise there is a significant risk that some of them will disappear from the enacted curriculum. The National Curriculum should provide an entitlement for all pupils to experience an education that reflects the aims.** This is particularly important if the objective is to improve England's international rankings. PISA tests evaluate students' ability to apply mathematical knowledge and reasoning in unfamiliar contexts, abilities which are essential in the 21<sup>st</sup> Century.

**Recommendation 7: Ofsted and accountability**

**In order for the aims to be met, DfE will need to ensure that they are reflected in any accountability measures put in place for this curriculum, including generic Ofsted school inspections.**

**Recommendation 8: Ofsted and good practice in primary**

At present there are many instances within the PoS where there appears to be a mismatch with Ofsted's guidance to teachers and schools. Throughout this response we have attempted to identify some changes that could be made to ensure that the primary PoS supports various aspects of teaching and learning as identified by Ofsted in its subject-specific best practice reports.

**ACME recommends that the Department makes changes to the draft Curriculum to take account of the findings of recent Ofsted reports and ensures any remaining mismatches are clearly resolved.**

## 2. Progression and connections

### **Recommendation 9: achieving curriculum coherence**

The government has rightly stated its commitment to evidence-based policymaking and this ambition is welcomed by ACME. In this instance the focus has been on comparisons with High Performing Jurisdictions (HPJs) in terms of when various elements of mathematics are introduced in countries that perform well on international comparison tests.

ACME is concerned that the result of looking at which elements of mathematics are included in the primary curricula of HPJs, and when these are introduced, has resulted in a draft that lacks the essential coherence that forms the foundation of these curricula. The draft curriculum appears atomized to the extent that the big picture has been lost. A fragmented curriculum seriously risks lowering mathematical attainment, not raising it.

The London Mathematical Society describes this as ‘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 ... tradition – for example, in its approach to fractions.*

**ACME recommends that the curriculum is restructured so that mathematical concepts are introduced in sizable chunks rather than small parts each year, and in an appropriate sequence. To achieve this, ACME recommends that during the next phase of drafting, extensive use is made of the curriculum mapping work that has been undertaken in the past (e.g. in *Mathematical Needs*).**

A specific example of poor sequencing is the introduction of the symbols for multiplication and division in Year 1, before the foundations for conceptual understanding have been laid. Another example is the introduction of standard units without considering the need for measures and non-standard units. Other examples are identified in Part B.

### **Recommendation 10: making connections within mathematics**

The new curriculum presents an opportunity to improve teachers’, parents’ and pupils’ understanding of the connections between different areas of mathematics. There are instances where these connections are explicit, for example, **we welcome the connections made between division and fractions.**

However, the current draft curriculum does not make all the necessary links between topics. **For example the connections between measure and decimals need to be strong and explicit.** There are many other examples of where connections need to be explicit and these can be found in Part B of our response.

**A pictorial representation of the connections between various topics of primary mathematics could form part of the Programme of Study documentation.**

**Recommendation 11: making links between subjects**

Primary schools and their teachers are well placed to ensure that children make links between various subjects in the curriculum but often require support to see how mathematics can be so embedded.

**Opportunities for developing links with and from other areas of the Primary curriculum, both as motivations for the development of mathematical ideas and as applications of them, should be identified in exemplifications, so as to support teachers in building up coherent and flexible learning.**

**Recommendation 12: year-by-year layout**

There has already been a lot of discussion in the education sector about the proposed year-by-year presentation of the curriculum. ACME's position on year-by-year requirements has already been stated in our response to the Expert Panel Report.

Despite the welcome and clear statement regarding the flexibility schools have to '*introduce content earlier or later than set out*', there has been subsequent comment from officials that has confused schools.

**ACME recommends that the statement on the school curriculum in the preamble is reviewed to ensure that it articulates intentions, and that future Department statements are informed by this.**

A curriculum set out by Key Stage would support teachers in making positive and coherent curriculum choices for their pupils.

**Recommendation 13: connections with the secondary curriculum and EYFS**

One of the strengths of the review, which was welcomed by ACME at its inception, was the decision to reflect on the curriculum as a whole and it is unfortunate that this approach has been lost during the development process. It is not possible to develop a new primary curriculum which ensures appropriate preparation for the secondary phase without a view of what the end point in Key Stage 4 looks like

**Development of the next draft of the primary curriculum needs to link clearly and openly with the development of the secondary curriculum.**

Similarly, **connections with the new EYFS need to be addressed.** For example, multiple play-based experiences of mathematics, and informal units and recording, should continue well into Key Stage 1 and beyond, and this should be explicit in the PoS.



### 3. Level of challenge and pace

#### **Recommendation 14: increasing the level of challenge in primary**

There was widespread agreement that young children are capable of far more active learning and intellectual challenge than is implied by the draft curriculum.

In terms of overall mathematical achievement, respondents said that the curriculum was not sufficiently demanding in several important aspects. As one primary school teacher put it, *“I feel there should be more emphasis on children exploring mathematical conceptions to deepen their understanding. In my school in key stage 1 we place a great deal of emphasis on exploration to make connections and the results and abilities are outstanding; the children LOVE maths and work with great effort and enjoyment.”* A consultant wrote, *“Children’s ability to reason and make connections is underestimated by the draft curriculum, so the expectations in those areas should be increased.”*

**Within Part B we have identified some areas where there is scope for making the draft curriculum more challenging.**

#### **Recommendation 15: the pace of the curriculum**

In general, moving too quickly from the concrete to the abstract is counterproductive in terms of genuine fluency and robustness of mathematical learning. Similarly, throughout the mathematics curriculum, ensuring that children meet various models of concepts is an efficient use of time in the medium-term and supports deep learning that is robust in future use. Conversely, unrealistic expectations of early mastery, that are based on practice without conceptual understanding, encourage rote learning and negative attitudes that are not conducive to the develop of long-term confidence or competence to engage with mathematical ideas, and may adversely affect performance and understanding.

The draft curriculum moves topics to earlier years than the current curriculum – elements of the current Key Stage 3 are now in Key Stage 2, and much of Key Stage 2 is now in the earlier years. This increase in pace through the earlier years will not necessarily increase pupils’ mathematical knowledge; it is more likely to result in pupils having weaker foundations.

**Within Part B we have identified areas that are introduced too early and should be moved to later years. The Department should continue to refer to the significant body of research relating to cognitive development in mathematics. This can be drawn on when evaluating the most effective age to introduce certain topics.**

### 4. Slimming the curriculum

#### **Recommendation 16: identifying the essential content for the curriculum**

The stated objective of the curriculum review is to define the essential knowledge in each area, and ACME welcomes this objective.

We asked respondents to think about what the most important areas of the curriculum would be if the next version were to concentrate even further on a smaller number of topics in greater depth.

**There was broad agreement that number is of prime importance including understanding the number system - whole and rational numbers, operations and measurement of continuous quantities. However, responses also referred to the need for depth, structure, application, problem solving, use of a variety of approaches, and the need to develop a mathematical mindset as an essential core of the curriculum.**

#### **Recommendation 17: suggested topics to remove**

Although of more minor consequence than other issues referred to in this response, it should be noted that respondents frequently queried the justification for specifying learning Roman numerals and binary numbers.

ACME believes that these are in no way essential knowledge that should be incorporated in a curriculum that aims define the most important things to learn.

**The Department for Education should pursue the objective of defining the ‘essential’ content for the curriculum by removing areas highlighted by the mathematics community as unnecessary (such as Roman numerals and binary numbers – also see Part B).**

## **5. Aim 1: balance between procedural fluency and conceptual understanding**

#### **Recommendation 18: procedural fluency and conceptual understanding**

ACME has previously published a position statement on procedural fluency and conceptual understanding. In summary, the document stated that *both* must be developed side-by-side in the primary curriculum. It is a false dichotomy, rather than an ideological debate, since international evidence shows there is no such division – we are not educating our children properly in mathematics unless the two are developed in tandem. Having looked at the new evidence from the consultation, we remain convinced that this is correct. ACME members, as active mathematicians, fully understand the need for fluency in some procedures and recognize that ‘fluent’ includes sufficient understanding to select appropriate methods for given situations.

The Department’s work on primary pedagogy and the need for both conceptual and procedural fluency has also been referred to in the workshops we held. However, the draft curriculum appears to prioritise procedures. This is generally reflected throughout the draft in the emphasis on specific algorithms at a comparatively early stage of conceptual development. This was a serious source of concern to correspondents and workshop participants, and the draft should be revised to reflect the Department’s own work on primary pedagogy.

**Therefore, ACME recommends that the draft curriculum should be revised to place the development of conceptual understanding on an overtly equal footing with procedural fluency, and ensure that both are developed together.** This will minimize the risk that pupils are taught through rote learning in routine contexts.

### **Recommendation 19: division**

To be clear, ACME is not 'against' any particular long division algorithms, or the need for pupils to be able to divide long numbers – but the evidence from Ofsted is that it is unrealistic to expect all pupils to master this before the end of primary school. It is realistic to expect children to understand how to tackle a range of division problems, and how to interpret the outcomes.

**Whilst pupils should use effective and efficient methods, we do not believe that the substantial investment of time that would be needed to for all pupils to be fluent in a standard procedure by the end of Year 6 is justified by the educational outcome. ACME therefore recommends that the scope of the requirement for specific methods should be revisited by an informed group.** Such fluency would almost certainly only be achieved be at the expense of spending time on understanding what division means and when to use it. Indeed, recent research shows a positive correlation between pupils' understanding of a concept with their later success in mathematics.

These issues are explored further in ACME's position statement on primary arithmetic and will not be repeated here, other than to draw attention to Ofsted's own statements on this in *Mathematics: Made to Measure*.

### **Recommendation 20: multiplication**

On a related note, **ACME recommends that expectations are raised by extending the requirement to 'memorise' multiplication facts to include understanding them as well.** Recalling multiplication and division facts is essential, but understanding relationships between the facts adds the crucial extra level of power and flexibility to the knowledge.

## **6. Aim 2: Problem solving**

### **Recommendation 21: using and applying mathematics**

All respondents were of the view that the proposed Programme of Study is not sufficiently demanding in developing children's ability to solve problems in and outside mathematics. Although "problem solving" appears appropriately in the Aims, there is little in the Programme of Study to support this, apart from the mention of 'word problems', which may just be verbalised versions of routine exercises.

In the fuller understanding of 'problem solving', children might meet new mathematical ideas and methods through solving unfamiliar problems by selecting from and using their existing knowledge, rather than merely applying a learnt procedure. Primary teachers are well-placed to harness cross-curricular work to ensure children begin to

recognise and appreciate the power of mathematics to contribute to the description, analysis and potential of a wide range of situations, as well as harnessing other areas of the curriculum to motivate the development of ideas in mathematics, thus contributing to the multiple embodiments of mathematical concepts that are critical to deep and confident learning.

One research group commented that *“there is some evidence that pure practice of algorithms before use in related word problems results in pupils not being able to remember or apply what they have been taught”*. By contrast respondents talked about children’s need to develop the capability to deal with unfamiliar problems and open-ended situations, and the symbiotic relationships between these, conceptual understanding, mathematical thinking, and confidence and enjoyment of the subject.

The Programme of Study does not match with recent Ofsted advice *“to equip [pupils] to solve familiar problems as well as tackling creatively the more complex and unfamiliar ones that lie ahead”*. Several comments referred to Singapore in which problem-solving is a central part of the curriculum.

*“The new draft especially lacks a coherent vision regarding problem solving and the implementation of this curriculum as it stands would lead to a serious lack of developing elementary problem solving skills in primary school children, which would be difficult to rectify in their subsequent education.”* (Learned society)

Serious consideration needs to be given to how best to include using and applying<sup>1</sup> mathematics within the PoS. It is not clear whether this should be presented as a separate strand or embedded throughout the document. Very few respondents made reference to a separate strand although the RSS submission does include this suggestion.

**The Department needs to undertake focused work to incorporate using and applying statements in the Programme of Study.** This would help to redress the balance in the draft.

### **Recommendation 22: word problems**

At present, the vast majority of references to problem solving within the document relate to ‘word problems’. **The multiple references to ‘word problems’ should be broadened to encompass many other kinds of problem, for example by using a phrase such as ‘a variety of open-ended problems, including word problems’** This would be a straightforward way of raising expectations and demand, and the summary of submissions to ACME shows that this was a frequently raised issue in the mathematics community.

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<sup>1</sup> Successive reports which have drawn on a wide range of informants including employers, industrialists and universities have indicated the need for a mathematics curriculum to include regular and embedded use and application of mathematical knowledge and reasoning (Cockcroft, Smith, ACME MN, Vorderman) and nearly all countries now include these in their curricula. Previous NCs have described these as ‘Using and Applying’ and we have kept to this formulation as many of our teacher respondents used it.

## 7. Aim 3: mathematical reasoning

### Recommendation 23: supporting mathematical reasoning

**ACME recommends that there should be specific, frequent reminders within the POS to support teachers developing pupils' mathematical reasoning.** For example by including throughout the curriculum the requirements for children to *explain* (in words and eventually in writing), *suggest*, *compare different ways of* and *justify*. **An informed group should undertake work to ensure that happens in a useful way.** (See also recommendation 27 below.)

## 8. The language used in the Curriculum

### Recommendation 24: using mathematical language

Respondents to the ACME questionnaire, and those that attended discussion groups made notes of many instances where the mathematical sense and language of statements are inaccurate within the PoS. This is clearly not acceptable.

**The language in the curriculum document should avoid colloquial use that does not carry mathematical meaning [see, for example, statement 25 in Part B – squares are rectangles]. The next phases of the process should include a review of the draft specifically to check the mathematical accuracy of the document before publication.**

### Recommendation 25: clarity for the primary school teacher

In parallel with the above, **the draft document should also provide clarity for primary teachers and support should be provided for parents and others to understand mathematical language where this is used for necessary accuracy.**

### Recommendation 26: tone of the curriculum

The tone of the National Curriculum is important in guiding the approach to teaching adopted.

In some parts of the draft curriculum the language used creates the impression of a passive, 'done to' approach to teaching. This is exacerbated by the need for legislation to refer to what pupils should be taught (i.e. what teachers should do), rather than what pupils should learn. **Wherever possible, statements should be written in an active tense rather than a passive tense.** For example: pupils should experience, should compare, should work on tasks that

### Recommendation 27: oracy for mathematics

**We welcome the emphasis on spoken language across the curriculum; this should be more fully reflected in the Programme of Study by liberal use of words such as 'investigate', 'discuss', 'conjecture and convince', 'persuade' and 'explain', rather than simply 'solve' in each case.**

**The references to mathematical vocabulary should be extended beyond merely being able to ‘read and spell’ – understanding and using the vocabulary would increase the level of challenge in a positive way.** Using vocabulary well is essential to communicating mathematics to others, and helps clarify one’s own understanding of the subject.

Together, these changes would support teachers in developing Ofsted’s descriptions of ‘outstanding qualities of teaching mathematics’.

## 9. Delivery

### **Recommendation 28: professional development**

Many respondents to ACME’s consultation voiced concerns about how the draft curriculum could be effectively implemented, highlighting in particular the lack of specialist knowledge in the majority of the primary workforce. There is also a lack of expertise in local authorities.

**Any CPD should equip teachers to teach in ways that meet all of the aims of the curriculum, and contain an element of coaching and developing colleagues.**

These elements were in the MaST programme and also in the 20-day courses introduced in the early 1990s. It might be possible to roll out a programme evolving from MaST and earlier courses that could be specific to the needs of teachers arising from the new Mathematics National Curriculum, both in terms of subject knowledge and pedagogy, as the systems are already in place, to some degree, to enable such an initiative.

### **Recommendation 29: curriculum time**

The vast majority of respondents felt that the draft curriculum, if taught in depth, would require additional curriculum time and this could jeopardize pupil’s entitlement to a broad and balanced curriculum. Specifying the exact amount of time the mathematics curriculum should fill will not in itself guarantee good teaching. **However, there should be an expectation that pupils will do some mathematics nearly every day. In addition, ministers should ensure that the time needed for young people to master the proposed mathematics PoS, is consistent with the locally-influenced broad and balanced overall Primary curriculum envisaged.**

### **Recommendation 30: Use of ICT and restrictions on use of calculators**

**The statement on the use of ICT is warmly welcomed by ACME** – it follows the sentiment of the recent JMC report on Digital Technologies. There are excellent opportunities for using digital technologies to teach data handling and geometry, among other parts of the curriculum, and the statement will allow these to flourish.

**With respect to the appropriate use of calculators, ACME concurs that these should not be used as a substitute for weaknesses in arithmetic.** However, the CAN project showed the value of constructive use of calculators as a way of exploring



and deepening conceptual understanding of relationships between numbers and the number and place value sense on which later concepts and fluency depend.

**ACME recommends that the references to *inappropriate* use of calculators are expanded to indicate the nature of *appropriate* uses in Key Stage 1 and 2.**

ACME August 2012