ACME's response to the consultation on the draft programmes of study for the National Curriculum

April 2013

1 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.

This submission has been prepared by members of ACME in consultation with members of the ACME ‘Outer Circle’\(^1\), which includes many teachers and provides a breadth of experience for ACME to call on in developing its positions. ACME has also met with members of the Joint Mathematical Council (JMC) of the United Kingdom to hear the views of the wider mathematics community.

ACME is not providing a line-by-line commentary on the proposals, as many other organisations will have provided the department with such information. Rather, this response focuses on key issues that need to be resolved in order to meet the Government’s aspiration for a 21\(^{st}\) century curriculum for all.

\(^1\) http://www.acme-uk.org/about-acme/the-outer-circle
2 Overview

The original remit (January 2011) for the Government’s review of the National Curriculum was to:²

- give teachers greater professional freedom over how they organise and teach the curriculum
- develop a National Curriculum that acts as a benchmark for all schools and provides young people with the knowledge they need to move confidently and successfully through their education, taking into account the needs of different groups including the most able and pupils with special educational needs and disabilities (SEND)
- ensure that the content of our National Curriculum compares favourably with the most successful international curricula in the highest performing jurisdictions, reflecting the best collective wisdom we have about how children learn and what they should know
- set rigorous requirements for pupil attainment, which measure up to those in the highest performing jurisdictions in the world
- enable parents to understand what their children should be learning throughout their school career and therefore to support their education.

Whilst ACME supports these aspirations, we have reservations about the proposed curriculum. Some aspects of the draft curriculum will support these aims; others are likely to work against their achievement.

2.1 Professional Freedom

We recognise the importance given to ensure that schools and teachers have the freedom to develop and implement their own programmes of study. Presenting the Key Stage 3 curriculum in a Key Stage block will enable schools and teachers to use their professional freedom when developing a school curriculum. The curriculum should be similarly presented in Key Stage 1/Lower Key Stage 2/Upper Key Stage 2.

Professional freedom has to be balanced with the needs of students. As academies are not required to follow the National Curriculum, students moving between maintained schools and academies will not necessarily have continuity in their learning.

2.2 Provide young people with the knowledge they need

ACME agrees with the principle of the curriculum concentrating on the knowledge, skills and understanding that young people need to move confidently and successfully through their education. However:

- ACME is concerned that the Key Stage 2 Programme of Study in mathematics will not give young people the deep and rich understanding of elementary mathematics that they will need to provide a firm basis for progression to secondary school
- the aims of the draft mathematics curriculum identify the importance of problem solving and reasoning. However, the current Programme of Study does not support teachers in ensuring that the aims are embedded in their teaching. Therefore, young people will be less likely to progress confidently and effectively through their mathematical education.

2.3 Compares favourably with international curricula and reflecting the best research
Lessons learned in international contexts (as was expressed by the Expert Group\(^3\)) indicate that introducing a new curriculum on its own will produce very little change. In our own culture, evidence suggests that a focus on content can undermine the depth of the conceptual understanding needed for effective use of mathematics in solving problems, particularly in new contexts. It can also undermine teachers’ and pupils’ confidence and inclination to engage in mathematics.\(^4\)

Within this draft Programme of Study, international curricula have sometimes been over-ambitiously or inconsistently interpreted. [See Section 6.12]

2.4 Set rigorous requirements for pupil attainment
We welcome the Government’s aspiration to raise standards. Precise attainment expectations are not clear, given that the consultation on Key Stage 2 assessment and the draft criteria for GCSE Mathematics are not yet available. [See Section 8]

2.5 Enable parents to support their children
Parental/carer support for children is as important in secondary school as in primary school. Teachers will be supporting parents/carers. However, there are very few mathematics specialist teachers in Key Stages 1 and 2, and in Key Stage 3 lower attaining groups are often taught by non-specialists.

ACME is concerned that there is insufficient information in the curriculum for teachers and parents/carers. We propose the following changes:

- connections between content areas in Key Stages 2 and 3 need to be more explicit
- the progression within content areas should be made explicit
- the level of detail and format in Key Stage 3 should be comparable to the level of detail and format in Key Stage 2 (but retain its presentation in a Key Stage block).

2.6 Development process
ACME reiterates its previous concerns regarding the curriculum development process. The Secretary of State has expressed his view that this is a 21st century curriculum. A high quality development process is needed to produce such a curriculum because time is needed to:

- consult more widely, particularly with schools with outstanding mathematics teaching
- enable research to be fully integrated into the curriculum
- develop a joined up policy for assessment and curriculum
- enable appropriate resources and professional development to be put in place to ensure the curriculum is effectively embedded, including giving consideration to the impact of textbooks and how this can be best managed.

The development process for this curriculum has fallen short of a high standard. The time frame was too short and the time available poorly used and, at times, lacked transparency. The evidence used in decision making regarding the curriculum content and framework has not been published and the role of individuals and groups has not been made explicit.

The remainder of this paper gives ACME’s response to the questions the Department has asked about the proposed curriculum.

\(^4\) http://www.ofsted.gov.uk/node/2293; http://www.ofsted.gov.uk/resources/mathematics-made-measure
3 Headline messages

3.1 The aims
The aims for the mathematics curriculum are laudable, but they need to be re-ordered to privilege development of deep conceptual understanding for problem solving, and to be fully reflected throughout the Programme of Study.

3.2 Aspirations
Higher aspirations are welcome, but in mathematics this should be interpreted as prioritising development of deeper concepts and more demanding problem solving, rather than coverage of additional material. In addition, the most able should be entitled to an expert-developed ‘extended interpretation’ as described in Raising the Bar.\(^5\)

3.3 Progression
Coherence and progression have been improved since the previous version, but are still not explicit enough for effective use by most teachers, even with sustained subject-specific professional development and good quality support materials. Explicit progression between Key Stages 2 and 3 is a particular concern, and would be addressed by a more consistent, and detailed, presentation.

3.4 Entitlement
The curriculum should more fully reflect that all young people are entitled to the range of mathematical activity, including attention to their affective needs, as described in Mathematical Needs.\(^6\) This in itself represents a challenging aspiration.

3.5 Attitudes
It is recognised that greater and more effective participation in mathematics is essential for the long term health of the economy. Students should be engaged with, inspired by and successful at mathematics from an early age to ensure mathematics is a key subject post 16. There has been an increase in the amount of content in the draft Key Stage 2 curriculum and this is likely to be covered superficially. ACME recommends that some of the additional content proposed in Key Stage 2 is moved into Key Stage 3.

3.6 Presentation of the curriculum
The way the curriculum is presented will impact on its effectiveness. At present, the big ideas in mathematics are not made explicit in the draft, nor are the links within and between key stages. Making these links explicit would support the work of teachers and professional development providers. A mathematics glossary should be provided.

3.7 Continuing professional development
Provision needs to be made for high quality subject-specific professional development for all teachers of mathematics to ensure equity of provision for all children.\(^7\) This is a huge undertaking and a co-ordinated effort will be required.

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\(^5\) http://www.acme-uk.org/media/10498/20121212_acme_raising_the_bar.pdf.pdf
\(^6\) http://www.acme-uk.org/media/7627/acme_theme_b_final.pdf
\(^7\) http://www.ofsted.gov.uk/resources/mathematics-made-measure
4 Do you have any comments on the proposed aims for the National Curriculum as a whole as set out in the framework document?

We would like to see the overarching aims for the National Curriculum reflected in the subject-level aims and programmes of study. Our comments on the aims for the mathematics curriculum can be found in Section 6.2.

5 Do you agree that instead of detailed subject-level aims we should free teachers to shape their own curriculum aims based on the content in the programmes of study?

No, ACME does not agree with this statement. Subject-level aims are an essential component of a national curriculum. Schools and colleges should not be asked to set their own subject aims based on the prescribed content. The curriculum would lack integrity if there were no subject aims.

6 Do you have any comments on the content set out in the draft programmes of study?

6.1 Numeracy and mathematics statement

ACME welcomes the numeracy and mathematics statement in the draft National Curriculum (5.5). However, there are inconsistencies between the statement and the Programme of Study for mathematics. These include:

- the numeracy and mathematics statement mentions the cyclical process of collecting, presenting and analysing data, which is not included within the Programme of Study for mathematics. ACME recommends that it should be included
- good links are made between probability and risk and uncertainty in the numeracy and mathematics statement, but this is not carried through into the Programme of Study. [See Section 6.6]

These inconsistencies should be resolved.

6.2 Aims

The aims for mathematics stated in the draft are as follows:

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

- become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils have conceptual understanding and are able to recall and apply their knowledge rapidly and accurately to problems.
- reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, developing an argument, justification or proof using mathematical language
- can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

These aims are in some ways consistent with ACME’s view of the ideal aims for the mathematics curriculum. However, ACME believes that by trying to include more detailed descriptions of problem solving and mathematical reasoning, the aims have lost their clarity. In addition, the first aim confuses fluency and conceptual understanding. Also, the ordering of the aims does not reflect the priority of
the aims for the whole curriculum. ACME’s view is that the primary aim of the mathematics curriculum for 5-16 education is to ensure all pupils can solve problems, including problems within mathematics, by applying their mathematical knowledge. Developing fluency is one of the means towards this end.

ACME recommends the aims are revised to address our concerns. We have proposed two alternative approaches for the Department to consider. The first is to re-order the text, introduce a fourth aim and make some changes to the wording. The second approach would be to use the format used in the draft English Programme of Study.

Option 1 - example

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

- can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including within mathematics, in other subjects and in activities outside the classroom.

They will do this through:

- developing **conceptual understanding** and the ability to recall and apply their knowledge rapidly and accurately to problems
- **reasoning mathematically** by following a line of enquiry and developing and presenting an argument, a justification or a proof using mathematical language
- becoming **fluent** in the fundamentals of mathematics.

*The programmes of study are organised in a distinct sequence and structured into separate domains. Pupils should make frequent connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly complex problems. They should also apply their mathematical knowledge in science and other subjects.*

Option 2 - example

This option would need some further refining but is intended to show that there are alternative ways to articulate the aims of the mathematics curriculum.

*The overarching aim for mathematics in the National Curriculum is to promote high standards of mathematical problem solving by equipping pupils with fundamental concepts and methods and developing their use of, enjoyment of and appreciation for the power of mathematics. The National Curriculum for mathematics aims to ensure all pupils are able to:*

- follow a line of enquiry
- recall and apply their mathematical knowledge rapidly and accurately to solve problems
- apply their mathematics to a variety of routine and non-routine problems
- analyse problems and break them down into a series of simpler steps
- conjecture relationships and generalisations
- develop an argument, justification or proof using mathematical language
- persevere in seeking solutions.

*The programmes of study are organised in a distinct sequence and structured into separate domains. Pupils should make frequent connections across mathematical ideas to develop fluency,*
mathematical reasoning and competence in solving increasingly complex problems. They should also apply their mathematical knowledge in science and other subjects.

In addition, a mathematics glossary covering technical mathematical terms should be included as a non-statutory Appendix, in a similar manner to the English glossary. The glossary should include definitions, such as those below, for fluency, problem solving and mathematical reasoning. For example:

- **Fluency** includes the rapid and accurate recall of mathematical skills and knowledge. To be mathematically fluent requires sufficient depth of conceptual understanding to be able to recognise when and how to apply existing knowledge.

- **Mathematical reasoning** involves identifying and conjecturing about patterns, relationships, and generalisations; testing, evaluating, deducing, and justifying; and communicating ideas in mathematical language. It requires analysing information presented in different representations, recognising given information, identifying what additional information is needed and what forms of reasoning can provide it.

- **Problem solving** involves solving problems that are not routine, within and outside mathematics, requires work and thought before mathematical skills and knowledge can be applied. It requires identifying structures, breaking down problems into a series of simpler steps; making decisions about how to acquire, derive or model new information; and showing perseverance in seeking out solutions.

### 6.3 Working mathematically

ACME welcomes the inclusion of detailed description of what it means to work fluently, reason mathematically and solve problems at Key Stages 3 and 4. ACME recommends that the title for this section should be revised to be in line with the draft science curriculum, which has a similar section titled *working scientifically*.

ACME also recommends that the programmes of study for Key Stages 1 and for Lower and Upper Key Stage 2 each include a *working mathematically* section (similar to the science curriculum) that elaborates the three aims at an appropriate level for each key stage. ACME understands that this work may already have been undertaken during the drafting phase.

### 6.4 Problem solving

Exposure to simple mathematical models and the use of real data is essential to develop an understanding of how mathematics is used to understand and control our world. From the earliest key stages, problem solving within and outside mathematics should feature strongly and should therefore be more clearly expressed within the curriculum. At present, ACME is concerned that the new curriculum does not clearly build towards post-16 study, either the proposed new core mathematics qualifications or A level Mathematics.

Solving familiar problems more proficiently does not in itself lead to pupils becoming better at solving unfamiliar problems. The Notes and Guidance in Key Stages 1 and 2 should include more guidance about how to develop pupils’ skills in problem solving. This could be achieved if a layout similar to the science *working scientifically* section were to be included. The guidance in the remainder of the document should also refer more frequently to solving problems and exploring mathematical situations rather than ‘pupils should practice’.
6.5 **Clarity of language**

There are specific instances where the language used in the draft mathematics curriculum is inaccurate or ambiguous. ACME would be happy to discuss this in detail with the Department.

The quality assurance process needs refining for the final curriculum document. We suspect that many of the issues regarding clarity are a result of the less than perfect development process and the short timescales. The final document would benefit from thorough proofreading by mathematicians and curriculum experts prior to it being adopted.

6.6 **Probability and statistics**

ACME is disappointed that the cyclical process of collecting, presenting and analysing data outlined in numeracy statement does not appear in the curriculum in any key stage. This is a fundamental skill in most walks of life. ACME believes this should be a prominent attribute of the new curriculum.

ACME notes that the proposed curriculum splits probability and statistics in Key Stages 3 and 4. ACME recommends that further consideration be given to whether these sections should be grouped together to provide for greater coherence.

6.7 **Fractions, ratio and proportion**

The Department has drawn extensively on its comparative analysis of international mathematics curricula when setting Key Stage 2 standards and in particular has looked at how other countries cover fractions, ratio and proportion. However, the translation of this analysis into the current document is the area causing most concern.

Although children have some simple concepts of fractions quite early, ACME is concerned that pupils would be required to further abstract these concepts and calculate with fractions too early, without having the experience to underpin their understanding. Difficulties will be exacerbated for pupils in disadvantaged areas, where the acquisition of everyday language is an issue. This will add a further burden to schools that support pupils from disadvantaged backgrounds.

In addition, the present draft Programme of Study sets out statements on conceptual understanding using proportional reasoning as well as statements on calculation using fractions. The juxtaposition of these statements is confusing. We are pleased that proportional reasoning is included within the curriculum and this should be retained, but this area needs to be developed and refined.

It would help teachers if a standardised chart was developed that showed expected progression on fractions through the primary years, rather than every school producing something to get to grips with the curriculum changes.

6.8 **Being secondary-ready**

To be ‘secondary-ready’ in mathematics requires a good understanding of the foundations for ratio and proportional reasoning, the foundations of algebra, a firm understanding of the number system, appropriate development in geometrical and statistical reasoning, and a willingness and experience in tackling non-routine problems. In Mathematical Needs, ACME has noted the importance of learning

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8 There are many examples, but some drawn to our attention include: calculate and compare the area of squares and rectangles - squares are rectangles; arithmetical rules (e.g. a + b = b + a) - this is a mathematical truth, not a 'rule'; identify properties, e.g. equal lengths, circles, triangles, quadrilaterals and other plane figures, using appropriate language - 'equal lengths' is a property; the other items in the list are shapes; What is meant by the phrase “harder fractions” in Year 4?; compare and order unit fractions with the same denominator - There is only one unit fraction in a set of fractions with the same denominator?


to communicate mathematically, both written and oral, and we welcome the profile given to 'talking about mathematics' within the draft Programme.\textsuperscript{11}

Some of the content in Key Stages 1 and 2 does not contribute to readiness for secondary school and in fact may well prevent it. Students leaving primary school should have good mastery of the Key Stage 1 and 2 curriculum. By setting an excessively ambitious content-driven curriculum, and with the content covered more rapidly than previously, there is a high risk that teachers will give pupils only a superficial grounding of the content prior to the Key Stage 2 assessment, which pupils will not be able to use or build on when starting secondary school.

ACME recommends that some content be moved from Key Stage 2 into Key Stage 3 [see Section 6.7]. This would need to be done with care in order to maintain coherence within the curriculum, but could support transition. This would support young people in being able to reach Key Stage 4 with a more confident and deeper mathematical foundation. [See Section 6.9]

6.9 Key Stage 4

We are disappointed that the Key Stage 4 Programme of Study is not being consulted on formally at this time. It is essential that progression across the curriculum is considered as a whole. We will comment on the Key Stage 4 curriculum separately in more detail.

However, the Key Stage 4 curriculum should subsume, deepen and build on the Key Stage 3 curriculum in order to offer all students the opportunity of mastering Key Stage 3 content (and gain credit for that at GCSE). The draft Key Stage 4 content is ambitious and in ACME's view sets out aspirations for attainment at A/A*. Young people should only be expected to work with as much of the draft GCSE content as they can engage in confidently and with sufficient conceptual understanding.

6.10 ICT

ACME agrees that calculators should not be used as a substitute for good written and mental arithmetic, and that in primary and secondary schools, teachers should use their judgement about when ICT tools should be used for teaching, for learning and doing mathematics. There is evidence (CAN\textsuperscript{12}), however, that calculators can be an integral and highly beneficial tool in the development of deep understanding of the number system. Their use should therefore be at the discretion of teachers supported by resources which provide guidance on when and when not to use calculators and other ICT.

The numeracy and mathematics statement (5.5) refers to pupils being able to estimate when using calculators and other technologies to produce results and interpret them appropriately. ACME welcomes this statement. However, this statement is not repeated or reflected in the ICT statement in the mathematics Programme of Study.

We recognise that it is not necessary to insert references to every possible use of ICT, as these are tools that have many applications. However, the teaching community in mathematics is still not expert in this area. In addition, the use of ICT in mathematics encompasses using spreadsheets and other tools for handling large data sets, graphical packages, dynamic graphing tools and dynamic geometry tools. By referring only to calculators in the ICT section, there is a risk that teachers will avoid using or be unaware of the other technologies that mathematicians and other users of mathematics utilise and which could add to the mathematical experience of pupils.

\textsuperscript{11} \url{http://www.acme-uk.org/media/7627/acme_theme_b_final.pdf}
\textsuperscript{12} The Calculator Aware Number project: \url{http://www.nationalstemcentre.org.uk/elibrary/resource/5684/the-calculator-aware-number-curriculum-can}
References to such technologies should be referenced in the introductory section of the proposed curriculum or at the very least within the Programme of Study.

6.11 **Attitudes**

The Government has expressed its desire to increase post 16 mathematics participation. Negative attitudes to mathematics result in students being less likely to take up mathematics post 16. The specification of the curriculum should encourage improving attitudes towards mathematics.

There is good evidence that attitudes are commonly formed quite early in children’s experience of mathematics. There is a high risk that the proposed content in the Key Stage 2 curriculum will result in students losing confidence to engage with mathematics, exacerbating an existing problem. ACME is aware that there is already a dip in positive attitudes towards mathematics in Key Stage 3. There is a high risk that a Key Stage 1 and 2 curriculum that is too ambitious in terms of content, rather than depth, will adversely affect Key Stages 3 and 4. As a consequence, even more students will enter secondary school lacking confidence in their ability to engage successfully with mathematics.

6.12 **Evidence base**

Although the Department and Ministers have made frequent reference to the evidence base they have drawn on when drafting this curriculum, it is not clear which evidence has been used when decisions about content, sequencing and standards have been made. Comparing which countries study which topics at a given age is not the same as drawing on evidence of how pupils learn.

As the Government has so clearly expressed, particularly through the recent publication of Dr Ben Goldacre’s paper on evidence-based policy making in education,\(^\text{13}\) using evidence to inform policy is essential. The Department could instil confidence that it has drawn on relevant evidence and analysis by publishing a reference list of the literature used to inform decisions on content and sequencing proposed in the draft Programme of Study.

7 **Does the content set out in the draft programmes of study represent a sufficiently ambitious level of challenge for pupils at each key stage?**

[See Section 11].

The amount of content included in the curriculum is too ambitious. The suggested curriculum coverage for Year 5, if it is to be grasped by most pupils in adequate depth for building on, is too demanding and would even be an ambitious aspiration for the end of Year 6. This would challenge teachers considerably, even with sustained subject-specific professional development and good quality support materials. All pupils need to be able to access the curriculum content; pupils left behind during Key Stages 1 and 2 do not generally catch up in Key Stages 3 and 4. There is a danger that the proportion of such pupils will increase.

8 **Do you have any comments on the proposed wording of the attainment targets?**

The proposed attainment targets no longer provide a basis for assessment. The suggested wording that ‘by the end of the key stage, pupils are expected to know, apply and understand the matters, skills and processes specified in the relevant programme of study’ is difficult for teachers to interpret without reference to assessment criteria. At Key Stage 4, this issue should be resolved by the much more detailed information provided in GCSE specifications. We also await further details on the proposed Key Stage 2 assessments. Assessment criteria for both of these assessments (and any other reporting) will need to divide the curriculum into meaningful parts against which progress may be measured.

be reported and allocate specific weights to these parts for reporting on the subject as a whole. Exemplification should be provided of the expected performance at the end of each key stage; teachers would find such exemplification much more helpful if there were also exemplars of performance that fell slightly above, and slightly below, the expected performance.

While ACME understands the reasons behind removing ‘levels’, this has taken away the only link between the various key stages and leaves teachers with no framework for describing the progress of their pupils either within or across key stages. We anticipate that there will be mechanisms in places to enable teachers to report on progression across key stages and would welcome further clarification regarding what Ofsted and others will be looking for in terms of schools measuring progression within a key stage. This is needed both during the transition phase (i.e. those pupils now half-way through primary) and once the new curriculum is fully established.

9 Do you agree that the draft programmes of study provide for effective progression between the key stages?

The curriculum should indicate progression across all key stage boundaries. The progression across key stages is not explicit in the material that has been included. There is little in the various documents that indicates progression to teachers and other users. There needs to be a common format across the key stages to enable teachers, and parents/carers, to see progression across the primary/secondary divide. The lines of progression between the statements in each year group in Key stages 1 and 2 are also not easy to find and this should be addressed.

Also see Section 2.5.

10 Do you agree that we should change the subject information and communication technology to computing, to reflect the content of the new programmes of study for this subject?

No response.

11 Does the new National Curriculum embody an expectation of higher standards for all children?

Without knowing what the assessments will be, it is difficult to comment meaningfully on this. Instead, we have noted some principles regarding standards.

11.1 Mastery versus acceleration

The National Curriculum has defined standards by the amount of content in mathematics and several areas of content have been moved down a year or a key stage. However, as ACME has outlined in its paper Raising the Bar, and as the Government agrees, it is mastery of mathematics rather than acceleration through curricula that provides students with secure foundations.

The Government’s original intention was to reduce the amount of content in the curriculum so that pupils would be able to master less content but in more depth. The current draft is not consistent with this aim.

11.2 Developing the most able

As ACME has proposed in the paper Raising the Bar, the needs of the most able must be enhanced throughout the curriculum, but increasingly towards end of Key Stage 4, with exemplification of material for extended interpretation also required.

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14 This includes from the Early Years Foundation Stage to Key Stage 1, and from Key Stage 4 to Key Stage 5.

15 http://www.acme-uk.org/media/10498/20121212_acme_raising_the_bar.pdf.pdf
12 What impact - either positive or negative - will our proposals have on the 'protected characteristic' groups?
ACME does not have sufficient evidence to respond to this question.

13 To what extent will the new National Curriculum make clear to parents what their children should be learning at each stage of their education?
As parts of the mathematics Programme of Study will not be clear to teachers, they will also not be clear to parents/carers. [See Section 2.5; 6.8]

14 What key factors will affect schools’ ability to implement the new National Curriculum successfully from September 2014?

14.1 Influencing provision
Those who influence the provision of high-quality learning and teaching in classrooms need to understand what an effective curriculum looks like for mathematics in the classroom. These influencers include Ofsted, Heads, Senior Leaders and Heads of Department.

14.2 Non-specialist teachers
The draft Programme of Study will not be sufficient for all schools to create a high quality programme of study with good progression. In the hands of experienced mathematics specialists this might be possible. However, in more typical school and classroom contexts, more support and clarification is needed. The vast majority of primary schools do not have a specialist mathematics teacher. We also note that there are many non-specialists teaching in secondary schools, particularly at Key Stage 3.

For primary schools, we encourage Government to reach the goal of every school having access to mathematics specialist teachers to support all colleagues in ensuring high quality learning and teaching in all classrooms. We recognise that this is a longer term goal.

A medium-term goal would be to commit to increasing the total number of mathematics specialists in both primary and secondary schools. This would provide an increase in expertise in the system to support the effective implementation of the curriculum and the development of high quality learning and teaching.

In the short term, it would be strategic to provide funding to support current MaST students’ and graduates’ professional development with specific reference to the new curriculum to ensure effective implementation. Given the limited numbers that these efforts would reach, other teachers could be nominated to engage with this professional development, such as Mathematics Subject Leaders in Teaching Schools. Schools could also benefit from an extra professional development day specifically for preparing for the new mathematics curriculum (5-19).

In addition, it would be helpful to commission a suitably experienced team, perhaps from the mathematics subject associations and NCETM, to provide some guidance as to the key areas of

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professional development that are needed to support teachers in making the transition from the legacy of the National Strategies and the current curriculum to effective provision under the new curriculum. In the same way that many primary schools are not equipped to interpret the new curriculum successfully, the vast and complex range of professional development providers are not all equally well equipped to understand and provide the high quality professional development that is needed. Provision needs to be supported if successful implementation of this curriculum is to be achieved.

14.3 **Linking across primary and secondary**

The Programme of Study does not make the links between the primary curriculum and secondary curriculum explicit. Teachers will be expected to do this themselves, and many schools will not have the capacity to do this. Our suggestion is that the over-aspiration in terms of content could be in part addressed by shifting some material into Key Stage 3 and might support greater continuity, provided links within and across the curriculum (e.g. pre-algebra concepts identified) are also articulated.

14.4 **Curriculum resources**

Textbooks and published schemes have the potential to influence teachers’ interpretation of the curriculum very extensively.\(^{17}\) Many of these, particularly when produced over rapid timescales, are of dubious quality. To help ensure the quality of school interpretation of the Programme of Study, and reduce the reliance on published schemes, mathematics education experts should develop a supplement of examples making clear the expectation and pitch. This would exemplify the depth and detail needed and give schools some guidance in how to interpret the Programme of Study effectively for all learners.

14.5 **Supporting professional development**

Given the lack of infrastructure available, teachers will need access to training and guidance in how colleagues can support each other in developing the range of knowledge and understanding needed to develop their classroom practice.

14.6 **Timescale**

As ACME has said in its previous responses on this curriculum review, and others in the past, introducing changes such as these without time for teachers, resource providers and assessment teams to prepare properly is not advisable. Most high performing jurisdictions introduce curriculum changes over a longer time period than is planned in England. This enables good curriculum resources to be developed alongside new curricula and for teachers to have access to training developed alongside the curriculum changes.

The new curriculum should be fully supported by expert-developed valid assessment (assessment that addresses the range of valued outcomes) and accountability measures that are consistent with this assessment. Ofsted should explicitly evaluate the appropriate use of technology for teaching and learning mathematics, in line with recent Ofsted subject-specific training.

15 **Disapplication of the curriculum**

We recognise the challenge of transferring to a new curriculum, but would urge caution about encouraging all schools to embark on full-scale implementation without the prerequisite support in terms of professional development and the identification of good quality materials. Young people should meanwhile be entitled to the full range and depth of the current curriculum.

\(^{17}\) [http://www.acme-uk.org/media/9156/response%20to%20ofqual%20call%20for%20views%20on%20qualification%20support%20materials%20and%20services_final.pdf](http://www.acme-uk.org/media/9156/response%20to%20ofqual%20call%20for%20views%20on%20qualification%20support%20materials%20and%20services_final.pdf)