Advisory Committee on Mathematics Education

ACME response to the report by the Expert Panel for the National Curriculum Review

Executive Summary

- ACME supports the Panel's recommendation to split Key Stage 2. There is also some merit in rebalancing Key Stages 3 and 4 (the '2+3' model), but we have concerns about unintended consequences which will need to be addressed carefully. In particular, we would support a 2+3 approach only if it were accompanied by effective measures against inappropriate early entry.

- No evidence has been presented to support the suggestion that the primary mathematics curriculum should be specified year-by-year. To proceed with this would be counter to the professional advice of the community and would go against the stated principles of evidence-based policy making.

- Specialist teaching in Upper Key Stage 2 is an important question that requires further investigation and research. It is highly desirable for primary schools to have greater access to subject specialists, but the benefits should not be restricted to Years 5 and 6 – a whole-school effect should be sought. In practice, schools should be free to make local decisions on how they deploy the specialists that they have. There is a risk that specialist-only teaching will de-skill other teachers.

- A 'ready to progress' or 'mastery' curriculum may be appropriate, but should not be misinterpreted as to preclude teaching foundational ideas through complex settings. In particular, the Programme of Study should refer to mathematical ideas that *cannot* be expected to be fully understood at the relevant Key Stage in order to show the direction of travel. The importance of young people experiencing mathematical ideas which they are not yet ready to be assessed on should not be underestimated.

- ACME agrees that the Levels associated with Attainment Targets should be removed, but with the explicit statement that teachers may continue to refer to these to support their teaching if they wish. A gradual move – with a corresponding CPD programme that reprofessionalises teachers – would be prudent.

ACME Advisory Committee on Mathematics Education

Introduction

The Advisory Committee on Mathematics Education (ACME www.acme-uk.org) 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. The response to this consultation has been informed by input from the mathematics community through focused workshops and through the ACME Outer Circle, a group assembled to encompass a breadth of knowledge, support and influence which we consult on key issues. Our response is focused on mathematics.

ACME is pleased to present this response to the report of the Expert Panel for the National Curriculum Review. We hope that the comments below will be useful to the Department for Education as it prepares its own formal response to the report and sets the agenda for the ongoing development of a new National Curriculum.

ACME members welcomed the report and were appreciative of much of what it says. The comments below should be seen in that context. Our response is restricted to issues arising from the Expert Panel report itself, and has been prepared without access to the draft Programme of Study.

Aims and purposes of the Curriculum

1. ACME welcomes the Expert Panel's view that clear purposes for the National Curriculum will support the best possible selection of content. ACME's Mathematical Needs report *The Mathematical Needs of Learners*[1] includes some important statements on the role of mathematics and the nature of the subject, and the Department should refer to these as the National Curriculum is developed.

2. ACME feels that conceptual understanding and basic proficiencies should be the main focus of primary education. In *The Mathematical Needs of Learners* we showed how mathematics is a collection of complex proficiencies which are the basic knowledge and proficiencies of mathematics, and children need to develop these throughout their school life. The need for secure foundations is important for everybody, including those who will progress to more vocational routes.

[1] http://www.acme-uk.org/the-work-of-acme/proactive-projects/mathematical-needs-project

Year-by-year approach in primary mathematics

3. The Expert Panel's report begins with a commitment to basing recommendations on national and international evidence. The report goes on to state that evidence for the benefits of a year-by-year approach to specifying the National Curriculum is 'equivocal', and that such a curriculum 'is likely to be interpreted in an over-prescriptive way... inhibit[ing] adaptation to meet specific pupil needs and curriculum innovation more generally'. The evidence and rationale presented leads the panel to the conclusion that a year-by-year specification **should not** be used.

4. However, despite the assurances of an evidence-based approach, the report suggests that (primary school) mathematics could be an exception to this conclusion. ACME often argues for an approach to policy-making that is sensitive to the different needs of different subjects but in this case we can see no justification for making mathematics an exception.

5. Just as in other subjects, it is not necessary to specify the mathematics curriculum on a year-by-year basis for schools to teach with their own equivalent Scheme of Work. Indeed, it is healthy for a school to devise its own year-by-year programme from the National Key Stage curriculum – it allows for 'ownership', supports professional collaboration and deeper thinking for teachers, and promotes continuity, progression and coherence across the school. Evidence from the National Strategies suggests that a structure that requires local engagement may be most productive in raising standards. As the Panel's report notes, the National Strategies are an example of a year-by-year specification that did not lead to ongoing improvements in standards – there is no evidence to suggest that taking a similar approach in 2012 would be any more productive. Indeed, ACME argued in 2006 that the National Strategies 'left many teachers feeling stripped of their professional responsibility for curriculum planning'.[2]

6. Over-prescription through a year-by-year approach denies teachers the flexibility to vary teaching pace in order to ensure learning. Driving in new learning without solid foundations is pointless; describing the curriculum in two-year chunks encourages discussion and planning across years and allows the flexibility of revisiting ideas if children have forgotten, or have limited understanding, or need to appreciate them in a new context.

[2] http://www.acme-uk.org/media/6942/acme%20position%20paper%20on%20primary%20mathematics.pdf

7. There are also conceptual arguments against a year-by-year specification. We expect children to learn whole number over several years, starting with home and nursery experience pre-school, then we expect them to learn about decimal place value (which is much harder, because it is less easy to model and less likely to come up in everyday contexts) in a very few years. It is vital that their growth of understanding of decimal number can be monitored and teaching adapted to it over time, as appropriate, and not chopped up into fragments to fit into a year-on-year model. This is also true of several other complex concepts, such as subtraction.

8. No rationale for making mathematics an exception is provided in the Expert Panel report, and, in the absence of any evidenced argument otherwise, our position remains that a year-by-year approach should not be adopted. If the Department for Education proceeds with specifying the primary mathematics curriculum on a year-by-year basis it will be doing so against the professional advice of the mathematics community and without having presented a compelling rationale or evidence in its favour.

The structure of Key Stages

Splitting Key Stage 2

9. ACME supports the Expert Panel's recommendation that Key Stage 2 is split into two parts (upper and lower), creating a 2+2+2 model in primary schools. This would reflect what already happens in many primary schools – planning and responsibilities are often allocated across two-year spans. This model would provide better structure and support for teachers.

10. However, it should be noted that the benefits of this model would be jeopardised by the introduction of any additional statutory assessment at the end of Year 4 – not least as it would precipitate another period of 'teaching to the test'. Assessment of readiness to progress between upper and lower KS2 should be based on formative pupil-teacher and teacher-teacher dialogue in order to support progression in the full range of mathematics learning.

Changing the balance between Key Stage 3 and 4 (2+3 model)

11. The issue of the balance between KS3 and KS4 is of modest significance compared to other matters, and it is possible that different approaches may be desirable in other subjects – a one-size-fits-all across the curriculum may not be necessary or appropriate. Whichever model is adopted, it is important that the

notion of curriculum coherence is maintained, with the stages of the National Curriculum seen as a continuum. The structure of the Key Stages should be subservient to the continuum of the mathematics curriculum. We acknowledge that the views of communities representing non-compulsory GCSE subjects may be of particular importance here.

12. The Expert Panel recommends that Key Stage 4 is extended to 3 years, moving from a 3+2 model in secondary schools to 2+3. Feedback on this from ACME's discussions was mixed – there is some merit in this approach, but with potential risks that should be accounted for.

13. There is a significant risk that beginning GCSE mathematics courses in year 9 will contribute further to inappropriate early entry, and there need to be effective disincentives to this through a variety of levers. ACME published a paper in 2011 about the negative consequences on students of early entry to GCSE mathematics and would strongly recommend caution to ensure that acceleration is not prioritised over enrichment[3]. For this reason, any 2+3 recommendation must go hand-in-hand with the recommendation to broaden and deepen Key Stage 4 and must be supported by appropriate disincentives to early entry. It must be made clear to schools that the 2+3 model and the broadening of Key Stage 4 should be seen together, otherwise there is a risk that schools will adopt one aspect without the other. It is also important that 'broadening' is not understood to mean increasing curriculum clutter.

14. It should also be noted that an earlier start to KS4 runs the risk of students from socially disadvantaged groups embarking on a particular GCSE route with low expectations before they have had the benefit of being taught by a well-qualified mathematics specialist teacher; the decision of which tier a student should be entered for (foundation or higher) should not be made earlier than at present. No-one should be making potentially life-limiting choices before experiencing specialist teaching in the subject.

15. A three-year Key Stage 4 would support broadening and deepening GCSE mathematics, and would support innovations such as a linked pair of GCSEs. A two-year Key Stage 3 would allow for early intervention after the transition to secondary school. However, there is a risk this new structure could demotivate

[3] http://www.acme-uk.org/media/7392/early%20and%20multiple%20entry%20to%20gcse%20final.pdf

students, as they will have a reduced number of options of studies for a longer period of learning and therefore less opportunity to explore other subjects.

16. In summary, we would support a 2+3 model if it were accompanied by effective measures to ensure a coherent Programme of Study for all students. This requires effective mechanisms to discourage inappropriate early entry, and a commitment to two GCSEs in mathematics being the norm for most learners. Some schools are already adopting a 2+3 approach and it would be useful to investigate the effects in these cases.

Subject specialist teaching in upper KS2

17. ACME feels that significantly more specialist support is needed for primary mathematics. In §5.7 the Panel suggests that this could be achieved through mathematics being taught only by subject specialists in Upper Key Stage 2, and we welcome the opportunity to discuss this idea.

18. This specific question was also raised in the Cambridge Primary Review[4], and it is right that schools should have the flexibility to address local needs in this way if they wish. However, there is clearly a risk of de-skilling teachers and removing subject specialists from the lower primary stages. Further research is needed on the effects of deploying teachers in this way, in order to inform any national policies or local decisions.

19. In general, ACME feels that a better way to make use of subject-specialists in Key Stages 1 and 2 is to ensure that every school has a specialist subject leader who can upskill other teachers and drive improvement across the school. Parachuting specialist teachers in to mathematics lessons in Year 5 and 6 would mean that the benefits of having a specialist would be confined to the learning in those two years – schools should take the opportunity of access to subject leadership to ensure that there are beneficial effects on KS1 as well. This can be achieved through coaching other teachers.

20. Funding is clearly needed to develop primary teachers' mathematics subject knowledge and subject-specific pedagogy if primary teaching is to be improved. Moreover, there should be Early Years specialists with knowledge of how children learn mathematics from birth to age seven – attention at only Upper Key Stage 2 is insufficient.

[4] http://www.primaryreview.org.uk/

21. Even the most well-informed curriculum requires teaching which is aligned to its underlying theoretical justifications. For this reason, limited specialist resources need to be targeted throughout the school where they will be most effective, such as in a whole-school approach to measure, or number system, or calculation for example.

22. Different primary school situations clearly require different responses. While we value specialist knowledge in mathematics teaching, in many cases young children benefit most from the availability of this in their usual class teacher (who can then capitalise on their mathematics learning across the curriculum), so a priority should be to build on the success of MaST and develop all mathematics teaching in Primary; how that is implemented 'on the ground' should be left to the discretion of individual schools, who should prioritise in the light of local circumstances.

The Form of Programmes of Study and Attainment Targets

23. The two-column model for setting out the Programme of Study (as outlined in §7.8) is attractive and provides a vehicle for communicating the 'narrative' and connections between topics in mathematics – this was a key recommendation in *The Mathematical Needs of Learners*. It also provides support for the integration of foundations for later mathematics: the importance of young people experiencing mathematical ideas which they are not yet ready to be assessed on should not be underestimated. These should be spelt out, particularly for the benefit of non-specialist teachers – although this may mean that the Programmes of Study are more extensive than what can be assessed. The pre-algebra strand suggested is particularly valuable in this respect.

24. Related to this, we feel that the curriculum should make it explicit that not every mathematics lesson will lead to easily measurable progress being made. There should be encouragement for some lessons that allow students to explore and consolidate ideas, accepting that it may take some time for some ideas to be fully understood.

25. The notion of a 'ready to progress' or 'mastery' curriculum has received some support, but it is important to note that these phrases can be misinterpreted. In particular, a mastery curriculum must not discourage the idea of learning foundational concepts in complex settings, and the official documentation must make this clear. In *Mathematics in Higher Education and the Workplace*[5] we note

[5] http://www.acme-uk.org/the-work-of-acme/proactive-projects/mathematical-needs-project

that students often need to have studied mathematics to a level above that which is needed on a daily basis in order to be fully comfortable with the mathematics they are using, and the mastery approach must allow for this. Mastery should be formulated in a way that will promote a rich experience, and should include the ability to use mathematics unaided in a new context.

26. Exemplification of the new curriculum will be needed to support the removal of Levels, including at a level above and below the national standard. The mastery objectives may provide guidance for teaching programmes, but they are unlikely to provide useful guidance on students' progression and indicate the next steps in learning. We recognise the criticisms of Levels in the Expert Panel report, but to a degree the issue is the use to which they are put, and the meanings ascribed to them, rather than the concept itself. The Levels themselves are research-informed[6], and there is a risk that a replacement system will not be.

27. Nevertheless, ACME feels that teachers should be drawn away from the use of Levels in relation to Attainment Targets – particularly given that levels are often used as labels – but in removing the Levels we recommend that the Department explicitly supports teachers in the transition to a new model. It must be borne in mind that a substantial proportion of the workforce have only ever worked with levels, and that the level descriptors can support teachers in thinking about progression. The report is correct in its assessment of the misuses of Levels, but it should be noted that whatever comes to replace them will be a culture shock. A gradual move – with a corresponding CPD programme that reprofessionalises teachers – would be prudent here.

[6] The National Curriculum levels were developed from those used in Graded Assessment in Mathematics (GAIM) (Brown, 1992). GAIM was a development of the Concepts in Secondary Mathematics and Science (CSMS) study (Hart et al, 1981). As a result, the levels provide guidance to the teacher on progression in learning. Level- rather than age-based guidance can ensure that children at all stages of attainment are stretched and challenged.

Brown, M. (Ed.). (1992). Graded Assessment in Mathematics (GAIM). Walton on Thames: Nelson.
Hart, K., Brown, M. L., Küchemann, D. E., Kerslake, D., Ruddock, G., & McCartney, M. (Eds.). (1981). Children's understanding of mathematics: 11-16. London: John Murray.
The history is described in the evaluation of the National Curriculum:
Brown, M. (1996). The context of the research: the evolution of the national curriculum for mathematics. In D. C. Johnson & A. Millett (Eds.), Implementing the Mathematics National Curriculum: policy, politics and practice (pp. 1-28). London: Paul Chapman Publishing.

GCSE reform

28. ACME feels that before reforms are made to GCSEs the primary 'purpose' of the qualification should be determined. At present there are many different uses of GCSE mathematics – as a filter for the next educational stage, as a school accountability measure, as a measure of achievement at age 16 and many others. ACME plans to develop a position on this and explain how the primary purpose identified should drive GCSE reform, and we look forward to publishing a position paper later this year.

The role of Ofsted

29. As part of ACME's discussion of the Expert Panel report we considered the future role of Ofsted. Two discrete roles with respect to mathematics were identified:

    - Inspecting and validating schemes of work in mathematics in schools
    - Supporting the development of best practice approaches in schools, informed by subject-specific inspection findings

    In the latter role, Ofsted could offer a service to schools that is becoming less readily available as the involvement of Local Authorities in education diminishes.

30. Ofsted's programme of inspection should work with and reflect the Key Stage model adopted – a year-by-year approach to inspection would undermine decisions made regarding the structure of the National Curriculum. The subject-specific expertise that Ofsted inspectors need to carry out this role was also raised as a relevant concern.

ICT and Mathematics

31. ACME welcomes the introduction of a more flexible, local, approach to ICT as a school subject. However, we would not want this to detract attention from a need for use of digital technology in mathematics[7], including the need to understand algorithms and adapt them for new input-output relations. There are implications for the primary arithmetic and pre-algebra curriculum, such as the critical inspection of the efficiency of different approaches in different contexts.

[7] http://cme.open.ac.uk/cme/JMC/Digital%20Technologies%20files/JMC_Digital_Technologies_Report_2011.pdf

Risks

32. ACME welcomes the Panel's recognition of the risks arising from the pace of the National Curriculum Review and shares the Panel's concerns. The delay announced in January 2012 will help to ensure that the curriculum produced is of an appropriate standard and should enable a higher degree of coherence across subjects linked to mathematics. We also welcome the attention given by the panel to curriculum coherence – it is crucial that assessment, accountability, inspection, workforce capacity, CPD, teacher training, and other areas are considered alongside the curriculum if we are to improve the teaching and learning of mathematics. The challenges associated with the coherent implementation of such fundamental changes should not be underestimated: policy implementation must be undertaken with full cognisance of available research, properly funded and based on the best mathematics education expertise available, if it is indeed to result in improved learning for our young people.

Assessment of Impact

33. ACME recommends that the impact of the changes made in the light of the Expert Panel report is subjected to rigorous evaluation using standard instruments. Examples of such instruments include the Assessment of Performance Unit tests which are designed to monitor progress, or the Chelsea Diagnostic Mathematics Tests[8] which have recently been used by researchers on the ICCAMS project[9] to show changes in students' knowledge over time. Both of these depend on samples rather than individual testing.

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[8] http://www.mathshell.com/scp/tests.htm

[9] http://tisme-scienceandmaths.org/the-tisme-research-projects/iccams/