



ACME Outer Circle Event January 2012 Secretariat

This report summarises the Advisory Committee on Mathematics Education (ACME) Outer Circle Event held on Friday 27 January 2012 at the Royal Society, London. ACME is an independent advisory committee, based at the Royal Society. The Outer Circle is a group of 36 individuals chosen by the ACME committee to encompass a breadth of knowledge, support and influence on mathematics education policy. The purpose of the Outer Circle is to complement the expertise of the members of the committee.

Introducing the event, the new ACME chair, Professor Steve Sparks FRS (University of Bristol) said that he was looking forward to ACME building on its recent important contributions to the National Curriculum review and developing some interesting and innovative ideas on how to bring mathematics education to all post-16 students.

Session 1: The National Curriculum review – the report from the Expert Panel

The ACME Head of secretariat, Dr Rosalind Mist, introduced the theme of the first discussion. Following the publication of the [Department for Education Expert Panel's report in December](#), the Secretary of State for education, Michael Gove, had announced a change to the planned timetable for the introduction of the new National Curriculum. Instead of the new curricula for English, mathematics, science and PE being introduced in 2013 – and any other subjects in 2014 – the new curriculum for all subjects would be introduced in 2014.

ACME had been asked to prepare a response to the Expert Panel's report by the beginning of March 2012, and the purpose of the session was to inform the first draft of ACME's response. A second ACME discussion on the Expert Panel report was being arranged for 23rd February, which would reflect further on the first draft and provide an opportunity for those who were unable to attend the Outer Circle meeting to contribute.

Working in five groups, the members of the Outer Circle were asked to consider several issues from the report which had been identified by ACME as issues that needed further discussion

1.1 The proposed changes to Key Stage structures – 2+2+2 (primary) and 2+3 (secondary)

The views of members of the Outer Circle were mixed on the proposed 2+3 model at secondary level.

Arguments in favour of the 2+3 approach included:

- Increasing motivation in Year 9
- In the current two-year Key Stage 4 model, teaching time for the Mathematics Linked Pair pilot is tight. The 2+3 approach could help with effective delivery of the linked pair.
- Key Stage 4 over three years would allow for better coverage of functional mathematics and the assessment of the quality of written communication. Functional mathematics is designed to encourage the use and application of mathematics concepts and the assessment of these. The quality of written communication element is driving improvements in the way that mathematics is being taught in schools because the assessment questions require students to show clear, defined mathematical working.

Potential downsides of 2+3 included the following:

- It could mean that pupils would start to narrow their learning options at an earlier stage. Regardless of which model is adopted there should be a broad and wide curriculum for a larger cohort of students.
- Many schools already make the decision to start KS4 early – the 2+3 model is therefore not that far from current practice. However, in some cases this leads to GCSE mathematics being taken at the end of year 10, so that no mathematics is delivered in year 11. It was noted that ACME had recently produced a position statement on Early Entry – noting the rush to ‘get mathematics out of the way’
- Three years at KS4 could negatively affect student engagement, especially towards mathematics. There will be less choice for a longer period of learning and students might find this demotivating. At the moment, they can have more goodwill towards compulsory study of mathematics if they have the chance to explore other subjects.
- The highest achievers, who can do KS4 mathematics in two years, will not get any challenge in the third year of KS4. There would need to be capacity for some enrichment or stretch for these students;
- If the three years at KS4 model is adopted, would there be an argument to favour offering functional skills mathematics or the integrated GCSE? Would we risk closing off some opportunities for students?

For primary schools, the 2+2+2 model was seen more favourably, although there were some concerns about whether formal external assessment is implied at the end of each ‘Key Stage’, which would result in more time being spent preparing for statutory reporting.

There was broad agreement that internal coherence and development are the primary concerns for the mathematics curriculum, and that it should be conceptualised as a continuum from pre-5 to 16; intermediate points merely represent staging within a continuum - the structure of the Key Stages should be subservient to that. The model should be designed to encourage pupil progression throughout the curriculum.

There was broad support for the separation of the Programme of Study (an entitlement to a rich and varied diet laying foundations for later learning) from key learning outcomes.

Regardless of the shape of the Key Stage model adopted in the new National Curriculum, the Outer Circle agreed it should:

- have coherence within the National Curriculum. Young people do not experience continuity of learning at the moment because there is a lack of trust between schools at the transition level;
- be designed to serve the students' interest, and not those of the institution;
- allow early intervention for those young people in need of greater (short-term or longer-term) support;
- include flexibility in the system at Key Stages 3 and 4 to meet the needs of students, and not impose a 'one size fits all' structure.

Finally, it was noted that the changes were unlikely to apply to Academies and Free Schools.

1.2 The proposed removal of levels and focus on well-defined subject capabilities

The Outer Circle broadly supported the removal of levels as Attainment Targets. Delegates acknowledged that poor practice in the use of levels, in particular when they are used as labels for learners, can be damaging to young people's learning experience and achievement. The use of levels (and particularly the use of sub-levels propagated by inspection and school improvement strategies) can also lead to the atomisation of the curriculum, its content and assessment.

However, it was acknowledged that the removal of levels may not be straightforward. Levels are endemic and embedded in teaching in the primary phase. Comments from the discussions suggested that levels are only used by some teachers to label children to modify their teaching. As a result these teachers are horrified that the Expert Panel is suggesting the removal of levels.

If levels are removed in favour of a focus on well-defined subject capabilities, then there needs to be joined up thinking between Ofsted, providers of Initial Teacher Training etc, to support the new structure. A well-defined set of subject capabilities that cover all aspects of mathematics work and can be ordered and organised in appropriate ways to local conditions is needed to support teachers.

The removal of levels might offer several opportunities with regard to assessment. These include:

- the chance to define the “ready to progress” and “mastery” method of teacher assessment at the end of phases. What does “ready to progress” look like for each Key Stage? How is this differentiated from “mastery” progression? Indicators of when and how interventions should happen if children are not “ready

- to progress” need to be identified. What happens to students who reach the “ready to progress” stage early in their learning?
- wider use of Assessing Pupil Progress (APP) standard files and resources, which – where understood by school senior management – can be very effective at improving teachers' assessment skills. Another effect of the use of APP files is to encourage primary school teachers to collaborate with secondary teachers to discuss and explain Year 6 achievement and descriptors of assessment
 - a chance to gain more recognition for the value of ongoing assessment.

If levels are removed, the alternative system must support pupil progress through the whole National Curriculum. The attachment of levels/attainment to age should be avoided. Ofsted must understand this too in the use of its language.

1.3 Whether mathematics in the primary phase should have a year-by year specification

The Outer Circle endorsed and supported ACME's position on this issue, which is noted in the report of the Expert Panel. ACME expressed concern about a year-by-year approach to mathematics because of the constraint on flexibility to match learner needs.

Members of the Outer Circle noted that, assuming a 2+2+2 model at primary, year-by-year specification would be similar to the introduction of the strategies that have resulted in the fragmentation of planning and learning.

Delegates commented that the two-year curriculum cycle is popular in many primary schools because it:

- allows connections to be made across the curriculum;
- encourages teachers to plan together in teams to ensure coherence in conceptual understanding – concept development cannot be covered on year-by-year basis and would have a negative effect on student progress;
- allows schools to develop their own year-by-year scheme of work (a philosophy which underpins the success of the curriculum in Singapore).

1.4 Need for ICT as a separate subject

There were mixed views among the members of the Outer Circle regarding ICT as a separate subject in the National Curriculum. However, there was broad agreement that there needs to be a radical overhaul of ICT in schools. Many delegates shared the perception that the ICT 'brand' was damaged and this term should be ditched if a case is to be made for teaching the discipline as a discrete and separate National Curriculum subject. Other delegates suggested that ICT at Key Stage 4 in its current form is redundant as a separate subject.

However, there was support among members for retaining ICT in the National Curriculum and providing opportunities to use ICT in mathematics and other subjects. If ICT is not a stand-alone subject, ICT requirements need to be explicit in the National Curriculum. If these are not written in to the National Curriculum, there was concern that that ICT could disappear altogether.

Some discussion groups considered the need to disaggregate ICT into 'Digital Literacy' (use of office applications, the internet, online security and safety etc., which could be delivered as part of citizenship or integrated across other subjects) and 'Algorithmic Thinking' (including programming, analytical thinking and problem solving – which mathematics teachers may be in a good position to teach, either as part of mathematics or as a separate subject leading to a Computer Science GCSE). CPD support would clearly be needed in both cases.

1.5 The need for children to be taught by specialist teachers in years 5 and 6

The Outer Circle recognised the need for young people to have a strong foundation in mathematics by the end of primary education. Members welcomed the introduction of more mathematics specialist teachers in primary schools. Mathematics specialist teachers in primary school are drivers to achieving best pedagogical practice.

The Outer Circle reaffirmed its support for ACME's view that every school should have a mathematics specialist to improve mathematics experience of staff in primary schools, a recommendation which was adopted by *The independent review of mathematics teaching in early years settings and primary schools*, led by Sir Peter Williams and published in June 2008. It was noted that funding for the MaST programme had been cut.

However, the Expert Panel report was suggesting that mathematics lessons in upper KS2 should be taught separately from other subjects by a dedicated mathematics teacher. Discussion identified two potential issues with this deployment of specialists:

1. Allocating mathematics specialist teachers to years 5 and 6 could lead to the loss of opportunities to develop pupils' mathematical skills across subjects through a break up of teaching continuity. (One delegate commented that evidence from some middle schools (Years 5-8), which use MaST teachers from Year 6, shows there is no significant loss in class contact time for class teacher in this approach. However, the situation is different when part-time specialist teachers come in to schools to teach mathematics because there is not always an overlap with the external teacher and the school's teachers regarding mathematics covered, pupil progression in mathematics etc. Primary teachers' workloads can limit their communication with other colleagues to build up an understanding of mathematics covered outside of class.)
2. The introduction of mathematics specialist teachers in years 5 and 6 only is not compatible with the existing working model common in primary schools, in which teachers tend to cycle through the year groups (1+2, 3+4, 5+6). In addition, the

introduction of mathematics specialist teachers in years 5 and 6 only could lead to a deskilling of other teachers. It was argued that if mathematics specialist teachers remain as year 5 and 6 teachers, they would become removed from developments in teaching across years 1-4.

Therefore, the Outer Circle felt that the inclusion of specialist mathematics teachers should respect the existing working model of primary schools. Members of the Outer Circle were committed to a primary practice model that provides a firm basis for children through the same class/same teacher model, with input from specialist mathematics teacher(s) working at each school.

There was general agreement that there should be:

- a drive to re-emphasise the need for at least one MaST teacher in every primary school, and for funding to achieve this goal;
- a call for more funding for continuing professional development courses designed to enhance existing primary teachers' subject and pedagogic knowledge in mathematics, leading teachers to acquire an M-level subject-specific qualification.

1.6 How the development of GCSE takes place

Feedback on this issue is drawn from the comments from only one of the discussion groups.

At present GCSE fulfils many functions, not all of which are compatible. Its prime purpose could potentially be defined to be a measure of student achievement in mathematics at the end of a common core education rather than the quality of the teacher or the school. As such, GCSE should be taken at age 16, i.e. end of year 11, and not before or after.

The GCSE model should be conceived as a positive marker of achievement which gives the student confidence to know what mathematical pathways they are ready to progress to next, not a deficit or pass/fail model whereby nearly 50% of our young people are deemed to have 'failed' (in the widespread use of the term) mathematics at age 16.

So long as the GCSE is used as a measure of the success of a teacher, faculty, school, or Local Authority, its primary purpose will be undermined.

The group offered several suggestions for ways forward in the development of GCSE mathematics.

- It is important that the current crude, and high-stakes, measures of accountability are replaced. Without terminal assessment that measures what is actually valued in mathematics education, young people will not get an engaging and relevant mathematical experience that embraces the range of skills and processes that are valued at a later stage.

- All students should have a common core experience of mathematics, at least up to a level equivalent to the content of National Curriculum Key Stage 3 plus up to Key Stage 4 current grade D, which in many ways represents basic adult functionality with mathematics. (Opinions differed among the discussion group about whether all young people need mathematics beyond this level.)
- It is important that young people are not channelled into one of two models by the start of year 10: they must be allowed a variety of rates and levels of progression beyond that, especially since many have not had a specialist teacher in their mathematics education prior to this point.
- The current (2010) GCSE model, if implemented in depth, or preferably a form of linked pair based on the same principles, is a significant improvement on what was in place previously. It requires vigilant regulation to ensure that assessment reflects the intentions of the criteria and fully supports a deep and balanced mathematics education in the classroom.

1.7 The role of Ofsted

It was suggested that, in future, Ofsted could perform two discrete roles:

1. inspecting and validating schemes of work in mathematics in schools;
2. supporting the development of best practice approaches in schools, informed by inspection findings.

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

Delegates commented that the Ofsted inspection process and visits by inspectors can derail the curriculum in schools. If a Key Stage model is used, the year-on-year approach of Ofsted inspections will continue to undermine this model. Ofsted's programme of inspection should work with and reflect the Key Stage model adopted.

Session 2: ACME's new project: Post-16 Mathematics

Rosalind Mist explained that Michael Gove had indicated his desire for the vast majority of young people to be studying some form of mathematics post-16. This echoed ACME's previous work on post-16 mathematics: *Post-16 in 2016* and the *Mathematical Needs* project.

ACME is now taking a leading role in the mathematics and wider subject communities in seeking to increase the provision and take-up of appropriate post-16 mathematics provision. Various stakeholders in the mathematics and STEM communities are supportive of this work. As well as providing advice on the new pathway(s) needed, ACME also intends to inform both the review of A-level mathematics provision and the next steps for level 2 (and below) mathematics provision post-16.

To inform its advice on the new pathway(s), ACME has committed to produce a briefing paper outlining potential models for the structure of the provision for those students who have previously attained GCSE A*-C in mathematics, but for whom A-level mathematics is inappropriate. This briefing paper will be informed by extensive discussions with the mathematics and other communities (including HE, employers and pre-19 education). ACME will issue its call for input in February 2012. The briefing paper will also be informed by analysis of current level 3 mathematics qualifications, and an understanding of the current programme choices of students with GCSE A*-C who do not study mathematics currently.

This workshop aimed to explore the views of members of the Outer Circle on post-16 mathematics. Members were asked to address a series of questions in two discussion groups.

2.1 Do some young people need a new, different type of course?

Members of the Outer Circle felt that different mathematics pathways post-16 are required to widen and increase participation and engagement in mathematics – a view which is supported by the findings and recommendations of the *Evaluating mathematics pathways* report, published in July 2011.

There was broad agreement that there is a need for a post-16 mathematical provision designed for students (with a grade C at GCSE, for instance) who do not currently take A-level mathematics and intend to study a course in higher education which could benefit from greater mathematical ability, such as economics, business, IT, social sciences and humanities. HE attendees commented that those arriving for undergraduate degrees with 'only' GCSE mathematics were often insecure or 'rusty' even at that level.

Delegates suggested that the post-16 mathematical provision should go further and offer a Level 2 pathway geared to students who fail to achieve grade C at GCSE or who have only experienced foundation level mathematics at GCSE. Some delegates were particularly concerned that making students resit the GCSE mathematics exam until they achieve C grade was not in the best interests of the student.

The Outer Circle identified a number of existing qualifications that already support students with a grade C at GCSE and others which, with some modification, might offer a model for a new post-16 mathematics course.

- GCSE Use of Mathematics, currently being piloted (under the name of Level 1 and 2 Certificates);
- AS-level Use of Mathematics;
- Free Standing Mathematics Qualifications (FSMQs);
- Functional Skills Mathematics Entry Level 3;
- Bowland mathematics programme for 11-14, on which a 'Bowland+' post-16 course could be based;

- FE mathematics courses for mature students returning to HE.

Delegates commented that there are advantages (other than cost) to using an existing qualification as the basis for a new course, for example a new course with familiar components might be better understood by stakeholders.

It was noted that take-up of some of the existing mathematics options is low. The reasons for this may vary from qualification to qualification, e.g. lack of appeal/relevance to students, course poorly promoted/communicated to teachers and students, no clear pathway for progression, limited number of teachers, little or no recognition from HE etc. Building a clearer understanding of the reasons for this low take up would help to inform the development of a new course based on any of these qualifications.

Feedback during the discussion suggested that a course could be developed as one qualification designed with a core component supplemented with tailored, optional modules – based on the FSMQ modules, for example.

Delegates commented that a new course must also be attractive to teachers. Teachers and heads of department can hold damaging perceptions of hurdles and obstacles that need to be overcome when offering a new qualification.

2.2 What could a new mathematics course contain?

Members of the Outer Circle agreed that a new qualification should be broad enough to deliver mathematics knowledge, understanding and skills that build students' confidence and literacy to deal with mathematical matters/problems encountered in the workplace or through a variety of courses in HE.

It was suggested that the course should strike a balance between delivering common mathematical techniques and meeting mathematics problems in context. Alternatively, the course might be geared to building students' appreciation of the power/role of mathematics but not necessarily focused on honing technical fluency (i.e. students' ability to 'number crunch').

The content of a course will depend on the intended audience. Through their discussions the members of the Outer Circle identified several topics that would be appropriate for students to meet through a post-16 course:

- calculus;
- problem-solving;
- using algebra;
- using and applying functions;
- mathematics for spreadsheets;
- statistical literacy – interpretation of statistics, understanding of processes, understanding of 'risk' and what it means statistically;
- probability – understanding and evaluating probability in context;

- working with and analysing data – reading data from a graph, determining rates of change from a graph, understanding exponential growth;
- modelling and hypothesis testing;

It was agreed that the assessment model for a new course should foster good teaching and learning. Assessment should aim to reward students for what they can do, rather than penalise them for what they can't do.

A fit for purpose assessment model might focus on teacher assessment, with students building a portfolio of evidence during the course. The evidence for this portfolio could be gathered from other areas of interest to students – this would encourage them to apply mathematical knowledge, understanding and skills gained through the core content of the course in contexts relevant to their interests at A-level and beyond.

2.3 How would a new course fit with other existing courses?

Members of the Outer Circle agreed that a new course should aim to expand the numbers studying mathematics post-16 without encouraging a drain of students from AS/A2-level Mathematics. AS-level Mathematics should remain the stepping stone to A2 Mathematics qualification.

A new course could be designed to upskill post-16 students with C grade or less at GCSE so that they can consider AS mathematics for the second year of post-16 study. The course could deliver the higher level GCSE Mathematics learning experience as well as introducing some mathematical techniques met at AS-level. As such the course might be designed at half the size of an AS-level.

Based on the current A-level framework, there are two possible models for the inclusion of a 'mathematics enrichment' component:

1. the course is offered in addition to four AS-levels in the first year of post-16 study; or
2. the course occupies one of the four AS-levels students select.

The second model would narrow students' options at AS/A-level and therefore was seen to be problematic. If the 'mathematics enrichment' component was designed to run over two years, consideration must also be given to the significant workloads of other subjects in the A2 year. Could an online 'mathematics enrichment' course offer an alternative which maintains students' breadth of choice at AS-level and provides them with more flexibility in their mathematics study post-16?

The Outer Circle felt that if young people are to be encouraged to study more mathematics post-16, there must be buy-in from higher education and employers to attach value to these types of courses. Universities would need to include post-16 mathematics courses as a requirement for admission to degree courses. Access to clear and up-to-date advice and guidance on post-16 mathematics pathways and

requirements for study in HE is also vital to promote the courses. More training for teachers will be required to ensure that all students can readily access this.

Session 3: How can you become more involved with the work of ACME?

For the final session of the day, the delegates, in five groups, shared their views on how members of the Outer Circle would like to contribute to ACME's work. The aim of this discussion was to ensure that ACME works as efficiently and effectively as possible with its Outer Circle members. Group facilitators used the following questions to stimulate discussion:

1. What do you like about the current ways in which you engage with ACME?
2. What more would you like to do to engage in ACME's work?
3. What mechanisms would you find useful for engaging with ACME (e.g. more emails, face-to-face, discussion forums, etc?)
4. How do you see the role of the Outer Circle? How do you see your role within the Outer Circle?

The Outer Circle members agreed that the existing model is a good one. Delegates commented that the strength of the Outer Circle lies with its multiple connections through the diversity of its members' backgrounds and expertise.

Members of the Outer Circle welcomed the opportunities to be involved in and contribute to the development of ACME position papers through consultation. It was suggested that covering emails could usefully highlight areas of a draft response that feedback would be particularly welcome on, and should emphasise that responses can be in a variety of formats.

Although travel to attend face-to-face meetings can be an issue for members, this type of event is valued and the opportunities for face-to-face interaction and discussion are particularly useful. Rotating delegates from group to group during face-to-face discussion events is effective and to be encouraged.

Advance notice of meetings is essential to allow Outer Circle members to make arrangements to attend. Members welcomed the recent "prior-warning" emails highlighting forthcoming meetings and consultations as useful aids to manage their work commitments with attending Outer Circle meetings and submitting comments to consultations. It was suggested that a base for meetings located in the West Midlands may help to avoid excessive travelling for some Outer Circle members.

To supplement face-to-face meetings, some delegates suggested an online forum for engaging with ACME in discussions on mathematical education policy. The preferred online forum would be a private discussion group or closed, shared community. The online forum would allow the members to post comments in response to questions and discussions initiated by the ACME Secretariat, committee or other Outer Circle members. A forum facilitator would be required to monitor contributions. Benefits of an online forum include:

- it allows for considered response to questions, issues, documents etc;
- the electronic format ensures comments from all members of the Outer Circle are presented and recorded – this is not necessarily the case in face-to-face large group discussions/meetings;
- Outer Circle members are kept abreast of all developments in mathematical education policy while individuals can choose to follow themes and topics of personal interest/relevance. Themes/topics of some discussions at large group meetings can limit some Outer Circle members' ability to contribute to the discussion, e.g. primary school teacher's contribution to debate on issues in post-16 mathematics. However, Outer Circle members recognise that it is good that all members are made aware of issues across all the education sectors;
- the forum can act as a repository for minutes of meetings;
- reduced travel for Outer Circle members and associated costs for ACME.

Delegates suggested that virtual learning environment (VLE) software, such as Moodle and Elluminate, may provide the platform for an online discussion forum. Google Docs may also provide a platform for Outer Circle members to collaborate on an ACME document.

One delegate commented that the role of the Outer Circle is to 'add value' to the ACME committee. The Outer Circle provides an important sounding-board for the smaller committee to use to confirm that views and recommendations from ACME on mathematics education policy do not become personalised by committee members' jobs/roles/links. This can be especially important when responses deadlines are tight and fall between committee meetings or at times of the year when other pressures may restrict the extended involvement of committee members.

An ex-committee member commented that the small size of the committee, though valuable in many ways, can put pressure on its members' time. Particular factors in this are external or additional meetings, which often occur with minimal notice or in a variety of venues requiring members to travel. It was suggested that members of the Outer Circle should be used to help further 'support' the committee wherever possible and this could include attendance at external meetings with a role to report back to the ACME committee.