

22 June 2017

Response to the Government consultation on Primary Assessment in England

Summary

1. The Royal Society welcomes the Government's commitment to provide greater stability and set direction for the long-term system of primary assessment. Education systems need to provide stability for the curriculum and its assessment to support excellent teaching and reduce teacher workload. The success of students, teachers and education systems should be judged through appropriate and broadly based assessment and accountability measures.
2. Statutory assessment will impact strongly on how mathematics and science are taught in the classroom. Performance descriptors and assessment items could be improved with further input from relevant curriculum and assessment experts. STEM professional bodies are well placed to provide the expertise necessary to define and defend the content and standard of their subjects.¹
3. High-quality assessment of problem solving in public tests and assessments at all levels is essential in order to ensure the effective learning and teaching of problem solving, which is an essential skill for all pupils to master if they are to thrive in today's society.²

Introduction

4. The Royal Society is the UK's national academy of science. It is a self-governing Fellowship of many of the world's most distinguished scientists. The Society is concerned with the health of the nation's research, innovation and education system as a whole, with particular concern for the STEM subjects.
5. The Society's Education Committee and Advisory Committee on Mathematics Education (ACME) inform the Society's responses to Government policies with a view to improving the outcomes of teaching and learning in England and so secure a scientific and mathematically enabled population.
6. This response builds upon previous advice that the Royal Society has given on assessment and accountability in primary schools, primarily through ACME. This response incorporates evidence and insights gathered from a series of roundtables on early years and primary mathematics education held in 2016 with delegates from mathematics and nursery associations, charities, primary schools, Ofsted and the Department for Education.³
7. The following key principles inform the Society's advice on primary accountability:⁴
 - National standards over time should be monitored;
 - Schools should be held to account for learner progress;
 - School accountability should be based on a rounded view of pupil progress and rely on a wide range of indicators;

¹ The Royal Society. 2014 Vision for science and mathematics education. See

<https://royalsociety.org/~media/education/policy/vision/reports/vision-full-report-20140625.pdf> (accessed 2 June 2017).

² Advisory Committee on Mathematics Education. 2016 Problem solving in mathematics: realising the vision through better assessment. See <http://www.acme-uk.org/media/35168/acme%20assessment%20of%20problem%20solving%20report%20-%20june%202016%20-%20final.pdf> (accessed 2 June 2017).

³ Gifford S. 2016 The New Early Childhood Maths Group. *Maths Memos*. 9 November 2016. See <http://www.acme-uk.org/maths-memos-acme-blog/2016/11/9/the-new-early-childhood-maths-group> (accessed 2 June 2017).

⁴ Advisory Committee on Mathematics Education. 2013 Response to Department for Education consultation on primary assessment and accountability under the new national curriculum. See <http://www.acme-uk.org/media/13914/acmepaccountability2013.pdf> (accessed 2 June 2017).

- Appropriate information on individual pupil progress should be reported to parents.

The Early Years Foundation Stage Profile (EYFSP)

8. The Royal Society's vision is that all students are taught by well-qualified teachers who are themselves professional learners.⁵ However, a major concern identified during scoping work around early years mathematics is the lack of confidence and knowledge among the workforce about early mathematics development.⁶
9. The Characteristics of Effective Learning (CoEF) in the Early Years Foundation Stage Curriculum advocate that in planning and guiding children's activities, practitioners must reflect on the different ways that children learn, and then respond to these in their practice.⁷ The CoEF provide an important basis for exemplification and in the development of problem solving and reasoning for children and teachers.⁸
10. The APPG for Maths and Numeracy panel agreed that number sense should be the priority for early years mathematics. Research has shown that focusing on reasoning and understanding rather than knowledge is more likely to increase achievement in primary school. It therefore makes sense to consolidate children's basic number understanding in the early years, and to work with parents and practitioners in fostering number sense.⁹
11. It takes time for children to develop number sense as they need to gradually synthesise all the knowledge, skills and understandings involved. However, the EYFS has high expectations for reception children. Accelerated expectations are unlikely to foster understanding, especially for disadvantaged children.¹⁰

Baseline assessment

12. Assessing pupils at primary school ages has the potential to provide a benchmark of the progress the children have made at primary school and also a starting point from which to measure pupil progress at secondary school.¹¹
13. We have previously supported the principle of value-added measures, although we had some concerns then about whether it is possible to devise a robust baseline measure for very young

⁵ Advisory Committee on Mathematics Education. 2013 ACME's vision for professional development for teachers of mathematics. See <http://www.acme-uk.org/media/19384/etsflvision2014.pdf> (accessed 2 June 2017).

⁶ Advisory Committee on Mathematics Education. 2016 ACME seminar on early years mathematics. See <http://www.acme-uk.org/media/36171/notes%20early%20years%20seminar%2011th%20may%20final.pdf> (accessed 2 June 2017).

⁷ Mohammed R. 2015 Characteristics of Effective Learning: play and exploration in action. See http://eyfs.info/articles/_teaching-and-learning/characteristics-of-effective-learning-play-and-r160 (accessed 2 June 2017)

⁸ Gifford S. 2014 Early years mathematics: how to create a nation of mathematics lovers? See <http://www.acme-uk.org/maths-memos-acme-blog/2014/12/19/early-years-mathematics-how-to-create-a-nation-of-mathematics-lovers> (accessed 2 June 2017).

⁹ APPG. 2014 Maths and Numeracy in the early years. See http://www.nationalnumeracy.org.uk/sites/default/files/media/appg_paper_-_eys.pdf (accessed 2 June 2017).

¹⁰ Gifford S. 2014 Early years mathematics: how to create a nation of mathematics lovers? See <http://www.acme-uk.org/maths-memos-acme-blog/2014/12/19/early-years-mathematics-how-to-create-a-nation-of-mathematics-lovers> (accessed 2 June 2017).

¹¹ ACME. 2016 Written evidence submitted by the Advisory Committee on Mathematics Education (ACME) See <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/education-committee/primary-assessment/written/42301.pdf> (accessed 16 June 2017).

children. There is also a danger that schools could be incentivised to depress their baseline scores in order to inflate their value-added scores at the end of key stage 2.¹²

14. We advise piloting the different options for establishing a baseline so that their different impacts can be evaluated. It is imperative that the same measure is used for all schools.

Improving the quality of tests and assessment by teachers

15. The Society supports the principle of giving teachers more freedom over what they do in the classroom, including assessment. However, teachers must be given sufficient support and training in order to assess effectively. Many teachers plan their teaching around assessment. Teacher assessment guidance is therefore extremely important.¹³
16. At the ACME conference in 2016, some concerns were raised about the content and development of the teacher assessment guidance and it was suggested that the materials would be stronger if they were developed in partnership with mathematics experts.¹⁴
17. Curriculum and qualification reform should be undertaken by bodies of experts that have access to a full range of relevant evidence and expertise. The messages in the performance descriptors and assessment items produced by the Standards and Testing Agency are used by teachers and school leaders to exemplify curriculum intentions.
18. The high stakes of Key Stage 2 Tests mean that they are one of the strongest levers in bringing about changes to teaching and learning. However, unnecessary pressures and perverse incentives can lead to narrowness in the curriculum.¹⁵
19. High quality tests which avoid predictability and a formulaic structure can help to avoid this challenge. For example, tests which assess problem solving and reasoning in a suitable balance alongside fluency contain, by their nature, unexpected and probing items and so 'teaching to the test' is not possible.¹⁶
20. Assessment by teachers is essential for raising achievement and a summary of teacher assessment is appropriate for reporting to parents. Parents should receive information on a pupil's broad progress or achievement. Reporting that encourages comparison with other children can have a damaging effect on learner self-esteem, which then impacts on attainment. It is not appropriate to report to parents a pupil's scaled scores or ranking within the national cohort.¹⁷

¹² SCORE. 2013 Primary assessment and accountability under the new curriculum. See <http://score-education.org/media/13737/2013%20-%20dfe%20primary%20assessment%20accountability%20score%20response%20-%20final.pdf> (accessed 2 June 2017).

¹³ SCORE. 2013 Primary assessment and accountability under the new curriculum. See <http://score-education.org/media/13737/2013%20-%20dfe%20primary%20assessment%20accountability%20score%20response%20-%20final.pdf> (accessed 2 June 2017).

¹⁴ Advisory Committee on Mathematics Education. 2016 Influences and impact: policies for high-quality mathematics education 2016 ACME conference summary report. See http://www.acme-uk.org/media/36153/des4412_acme%20conference%20report%20final.pdf (accessed 2 June 2017).

¹⁵ The Royal Society. 2014 Vision for science and mathematics education. See <https://royalsociety.org/~media/education/policy/vision/reports/vision-full-report-20140625.pdf> (accessed 2 June 2017).

¹⁶ Advisory Committee on Mathematics Education. 2016 Problem solving in mathematics: realising the vision through better assessment. See <http://www.acme-uk.org/media/35168/acme%20assessment%20of%20problem%20solving%20report%20-%20june%202016%20-%20final.pdf> (accessed 2 June 2017).

¹⁷ Advisory Committee on Mathematics Education. 2013 Response to Department for Education consultation on primary assessment and accountability under the new national curriculum. See <http://www.acme-uk.org/media/13914/acmepaccountability2013.pdf> (accessed 2 June 2017).

The role of problem solving and reasoning in reducing the attainment gap

21. There is agreement that young people need to be able to use and apply mathematics and quantitative skills at a level appropriate for their chosen careers when they leave education. The Society has commissioned a report on the impact of socio-economic status on achievement in science which has yet to be published. However, early recommendations show that supporting the metacognitive reasoning could help to close the attainment gap between people of different backgrounds and that this is most important at age 10.
22. The Society therefore welcomes the strong emphasis on problem solving in recent reforms. However, the emphasis on reasoning and problem solving in the curriculum needs to be strongly reflected in the material developed for assessing primary children.¹⁸ High-quality assessment of problem solving in public tests and assessments would help to ensure the effective learning and teaching of problem solving throughout primary education.¹⁹ Assessment across all phases of education must provide learners with substantial questions, rich in challenge and problem-solving opportunity.
23. The ACME report on the assessment of problem solving describes the desirable characteristics of questions used to assess problem solving and considers the assessment of problem solving in public tests across all key stages of mathematical development.²⁰ Table 2 in the report sets out a list of desirable characteristics of questions used to assess problem solving. These include;
 - Avoiding predictability;
 - Building in choices;
 - Drawing conclusions;
 - Probing mathematical thinking.

Alternative approaches to moderation

24. The Society recommends that teachers have an increased role in assessing student achievement in public qualifications. Many of the world's successful education systems (Finland, New Zealand, Singapore and Ireland) entrust teachers with greater responsibility for assessment, with school-based performance assessments often helping to improve teaching.²¹
25. Teachers benefit from adopting a common, high-quality approach to assessment, implemented with effective professional development support.²²

¹⁸ Advisory Committee on Mathematics Education. 2013 Written evidence submitted by the Advisory Committee on Mathematics Education. See <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/education-committee/primary-assessment/written/42301.pdf> (accessed 2 June 2017).

¹⁹ Advisory Committee on Mathematics Education. 2016 Problem solving in mathematics: realising the vision through better assessment. See <http://www.acme-uk.org/media/35168/acme%20assessment%20of%20problem%20solving%20report%20-%20june%202016%20-%20final.pdf> (accessed 2 June 2017).

²⁰ Advisory Committee on Mathematics Education. 2016 Problem solving in mathematics: realising the vision through better assessment. See <http://www.acme-uk.org/media/35168/acme%20assessment%20of%20problem%20solving%20report%20-%20june%202016%20-%20final.pdf> (accessed 2 June 2017).

²¹ The Royal Society. 2014 Vision for science and mathematics education. See <https://royalsociety.org/~media/education/policy/vision/reports/vision-full-report-20140625.pdf> (accessed 2 June 2017).

²² Advisory Committee on Mathematics Education. 2013 Response to Department for Education consultation on primary assessment and accountability under the new national curriculum. See <http://www.acme-uk.org/media/13914/acmepaccountability2013.pdf> (accessed 2 June 2017).

26. A succinct and reliable online profile of pupils' individual strengths and areas for development, based on key aspects of 'secondary readiness', would help secondary schools to plan for, and realise, progress for all. This online assessment system would enable common information transfer between institutions which would enhance the sharing of best practice.²³ This would;

- Record progress against key elements of 'secondary readiness' throughout Key Stages 1-3, including conceptual understanding and problem solving strategies;
- Identify common gaps and misconceptions;
- Identify staging posts and threshold concepts in mathematical learning for a pupil who has successfully completed each two year phase;
- Provide exemplification;
- Produce a common assessment vocabulary across schools.

Multiplication tables

27. The Society recommends that expectations are raised by extending the requirement to 'memorise' multiplication tables to include understanding them as well. Recalling multiplication and division facts is essential, but understanding relationships between the facts adds the crucial extra level of flexibility and applicability to the knowledge.²⁴

Science sampling tests

28. The Society recommends placing experimental science and problem-solving at the heart of good assessment of science and mathematics. Experimental science has an important place in the primary curriculum. It can allow children to develop an enthusiasm for the sciences and see that it can provide satisfactory and rational explanations for phenomena they observe and experience.²⁵

²³ Advisory Committee on Mathematics Education. 2013 Response to Department for Education consultation on primary assessment and accountability under the new national curriculum. See <http://www.acme-uk.org/media/13914/acmepaccountability2013.pdf> (accessed 2 June 2017).

²⁴ Advisory Committee on Mathematics Education. 2012 ACME's response to the draft Primary National Curriculum for Mathematics published on 11 June 2012. See <http://www.acme-uk.org/media/10025/20120807%20-%20acme%20ncr%20response%20part%20a%20-%20final.pdf> (accessed 2 June 2017).

²⁵ The Royal Society. 2014 Vision for science and mathematics education. See <https://royalsociety.org/~media/education/policy/vision/reports/vision-full-report-20140625.pdf> (accessed 2 June 2017).