The Mathematical Association
Supporting Mathematics in Education

Commending Ofsted's report, *Mathematics: Made to Measure*

Mathematics, beyond its obvious and immediate intrinsic value, is a key subject not only in the development of an individual's ability to solve problems and to reason logically but also in its underpinning of conceptual development in other curricular areas and life in general. Consequently, moves to identify weaknesses in how it is learnt, taught and organised are central to an agenda of improvement. The Mathematical Association welcomes the publication of Ofsted's report, *Mathematics: Made to Measure*, and finds much to commend amongst its findings and suggestions. The report's exemplification of what is considered to be prime practice is a particular strength, providing the basis of professional discussions within departments. But the weaknesses observed, whether they have arisen from inadequate teaching or from poor policy decisions at school management level, will only be eradicated if the findings are followed through by inspection teams and by more appropriate self-evaluation in schools. Here we comment on a number of specific points:

1. Measuring and comparing performance

The measurement of performance and the use of the resulting data for purposes of comparison and accountability have been a feature of our education system for some time. One consequence of this has been the introduction of a certain amount of 'gaming', that is to say the giving of prominence to those aspects that are measured at the expense of other important aspects which are not. These effects are felt at institutional level. However, it is a rather perverse fact that conceptual understanding supersedes fluent recall and yet it is harder to assess. As a result, at the level of the individual pupil, we make judgements about the quality of understanding by looking in the wrong place. It may be that teachers are learning to 'play the game', but the potential for poor conceptual understanding in the pupils and dampened enthusiasm among potentially inspirational teachers are heavy prices to pay.

It is reassuring, nevertheless, that Ofsted is aware of the problem of gaming and prepared to comment on it unfavourably:

> These tactics (designed to increase the number of A* to C passes) account for the rise in attainment at GCSE; this is not matched by better teaching, learning and progress in lessons, or by pupils' deeper understanding of mathematics.[1]

The Mathematical Association has produced a position paper on measuring and comparing performance, including the dangers of gaming to achieve goals thought attractive to parents, local authorities and the media.[2] In it, we argue that the measurement of performance (whether expressed in such a way or through terms such as 'appraisal' or 'objectives for improving provision') brings certain pressures to bear on schools and on teachers, some no doubt positive and others which have clear, adverse effects on teaching and learning mathematics. We conclude by recommending that there should be a change of emphasis:

(a) Performance measurement should be used to support:

- pupils to understand the quality of the range of their mathematical skills and, with the support of their teachers, identify their next areas for development,

[1] *Mathematics: Made to Measure*, Ofsted, March 2012, §40, p.19.
[2] 'Detailed position paper of measuring performance', The Mathematical Association, available via 'We Say' at www.m-a.org.uk, 1 December 2012.

- schools to celebrate success and to identify and take measures to counter underachievement.

(b) Performance tables should be based upon a rich mix of metrics that between them cover, as fully as is possible, what we mean by a good (mathematical) education. This would ensure that the tables could not be gamed; the only way to climb up the tables would be to improve the education provided.

(c) Consideration should be given to withholding performance tables from the public, or else limiting their extent and educating the public and the media as to how to guard against their misuse and misunderstanding.

(d) National performance should be monitored by an independent body using sampling techniques, backed by evidence gathered from the classroom by Ofsted.

2. Failure to progress as expected

The problem of the increasing variation in attainment with age has long been a feature of mathematics in this country. The '7-year gap' at age 11, which featured so tellingly in the Cockcroft Report over three decades ago, is now superseded by Ofsted's reporting of an even greater disparity at age 16.[3] But the accession of schools to the demands for accountability is surely one cause of this worsening position. Factors identified by Ofsted in its report, notably the issue of wanton acceleration, have been brought into sharper focus by the availability of adverse statistical evidence. The Mathematical Association has voiced pedagogical concerns in a position paper on Enrichment.[4]

We are not at all clear that there should be an expectation for all pupils to show the same rate of progress. Some pupils learn faster and others more slowly, hence in large part their differing attainment at different stages. The expectation of half a level a year is a mean and whilst helpful in broad terms, the variation in the rate of learning, largely overlooked in Ofsted's report, is also important.[5]

It is likely that stagnation at Key Stage 1 is not unrelated to the fact that children's attainment depends not only on what and how they are taught but also on their innate abilities and stages of development.[6] This is likely to be fairly constant over a population of children. The variables are the changing curricular and assessment requirements. Steady and sustained improvement is precisely what we would wish to see; if it were more dramatic, questions would be raised from inside and outside education.

Ofsted's second recommendation appears to rest on a false premise.[7] In suggesting that we

> raise ambition for more-able pupils, in particular expecting those pupils who attained Level 5 at Key Stage 2 to gain A* or A grades at GCSE

there is an assumption that pupils having such success on the tests at primary school will be able to move on immediately and seamlessly to more advanced work on arriving at secondary school. In practice, many pupils arrive at secondary school with artificially-boosted attainment (scoring Level 5 on the test but lacking the understanding which Level 5 ought to imply). Some of these pupils have gaps in their understanding of significant aspects of Level 5 and indeed Level 4. The recommendation therefore, may contain an element of wishful thinking.

With regard to poor success at AS, we believe that a notable factor is the prevalence of teaching to the test at GCSE.[8] But clearly, the need for a firmer understanding of algebra and a greater facility with algebraic manipulation pre-16 are not to be underestimated.

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[3] *Mathematics: Made to Measure*, Ofsted, March 2012, p.6.
[4] 'Policy on enrichment', The Mathematical Association, available via 'We Say' at www.m-a.org.uk, 4 December 2010.
[5] *Mathematics: Made to Measure*, Ofsted, March 2012, §19, p.15.
[6] Ibid., p.6.
[7] Ibid., Recommendations, second bullet, p.9.
[8] Ibid., §18, p.14.

All teachers are expected to show improvement in performance for each child that they teach. This often leads to various strategies to enhance apparent attainment measured at the end of the term/year. The next teacher finds that many children are not really confident at the level they are said to have attained, but s/he too is expected to show improvement. This goes on year after year. The teacher who sees the need to fill in gaps at lower levels and/or to consolidate and develop understanding before moving on may well find that their pupils appear to have made less progress than expected, even though they may be better prepared for the mathematics they will meet in the future. Such teachers may well be seen as unsatisfactory and be creating problems for themselves. It is in the interest of teachers to ensure that in the short term attainment shows significant progress, but this is often not in the interests of the children.

The nature of mathematics is such that it is often necessary to re-visit or back track and in some cases go back to the beginning and start again. Unless teachers are encouraged to do this and can be confident that apparent lack of progress will not be seen as a cause of concern by school leaders, parents and inspectors, we cannot see how significant improvements to real attainment can be made.

3. Acceleration and its effects

The issue of early and repeated presentation for GCSE Mathematics has no doubt been one factor in Ofsted's focussing on the relationship between attainment at age 16 and pupils' understanding of mathematics during their post-16 studies. But whether it be at this critical point or any other, the report makes a most powerful statement: 'attaining a key threshold does not represent adequate mastery for the next stage of mathematics education'.[9] In our policy on early and repeated presentation for GCSE Mathematics, The Mathematical Association makes the comment that 'most pupils are best served by digging deep, building robust, fluent and confident use and understanding of mathematics'.[10] Accordingly, we are most supportive of Ofsted's raising this matter as a cause for concern in *Mathematics: Made to Measure* and agree with the conclusion drawn that such 'policies and practices are not in the best interests of the pupils' future education and employment'.[11] And it is wholly appropriate that Sir Michael Wilshaw HMCI should lay emphasis on this damaging practice in his Foreword.[12] Also to be welcomed is the explicit association of the term 'satisfactory teaching' with approaches designed to get pupils through tests and examinations, and by contrast, 'a consistently higher standard of teaching' with the use of a variety of strategies, with building pupils' fluency and understanding, and with a focus on problem solving.[13]

In its report, Ofsted is rightly critical of 'teaching to the test' as a tactic designed to garner as many results at the appropriate level, reiterating a point they had made in an earlier report, *Mathematics: Understanding the Score.*[14] This is epitomised by the discredited practice of early entry to GCSE for pupils who have not been taught the whole syllabus in the hope that they will scrape the all important C grade, and can then give up mathematics to concentrate on getting their C grades in other subjects. The report noted that:

> In a few schools, pupils had stopped studying mathematics on gaining grade C in Year 10 or early in Year 11, when not all had attained their potential.[15]

So, some pupils who are capable of getting a top grade at GCSE, progressing on to A Level, and possibly pursuing a technical career, are having their life chances sacrificed on the altar of 5 or more C grades at GCSE. We are pleased that Ofsted has brought attention to such a dramatic example of schools' meeting their targets at the expense of a sound education.

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[9] Ibid., seventh key finding, pp.8-9.
[10] 'Policy on early and repeated presentation for GCSE Mathematics', The Mathematical Association, available via 'We Say' at www.m-a.org.uk, 12 June 2010.
[11] *Mathematics: Made to Measure*, Ofsted, March 2012, §§170–172, p.67; §§195–207, pp.76–79; the quoted conclusion is given in §179.
[12] Ibid., p.4.
[13] Ibid., p.7.
[14] Ibid., §210, p.82; *Mathematics: Understanding the Score*, Ofsted, 2008.
[15] *Mathematics: Made to Measure*, Ofsted, March 2012, §197, p.77.

4. Addressing weaknesses and countering social disadvantage

The Mathematical Association agrees with Ofsted on a range of issues relating to the need for teachers to focus on pupils' specific weaknesses and to target support to groups across the ability and social spectra. On the widening gap in attainment with age, Ofsted notes that 'low attainment too often becomes a self-fulfilling prophecy', and comments that 'pupils known to be eligible for free school meals fare particularly badly'.[16] This is not acceptable, and indeed, it does not have to be so:

> The best schools tackled mathematical disadvantage with expert insight and ambitious determination, with policies and approaches understood and implemented consistently by all staff to the benefit of all pupils. Developing such expertise should be the goal for all schools.[17]

With the deployment of the best secondary teachers to classes being prepared for examination, there is a price to be paid in terms of the quality of learning for the less able, a practice that contributes to the widening of the gap. The Mathematical Association agrees with Ofsted that it is iniquitous that 'pupils in the lowest sets received the weakest teaching'.[18] In the short term, school managers should be encouraged to consider changes in the ways in which teachers are deployed so as to reduce this iniquity, although the longer-term aim should be the development of a greater proportion of mathematics teachers who are highly qualified in their subject specialism and excellent in the classroom.

To consider a specific case, it is worrying that little intervention is offered to pupils from lower sets, where raising an F to a D is not seen as important as raising a D to a C. Society has got into the habit of labelling less academic pupils as failures, rather than appreciating what they can offer to the world in terms of practical, social and caring skills, and the way in which teachers are deployed in some schools is promoting this unfortunate situation. Simply put, not enough resources are allowed for pupils who are not fulfilling their potential at lower levels – these pupils need functional numeracy in the simplest sense of the word to better prepare them for adult life. It is of concern that with greater automony over their budgets, academies and schools may choose to spend even less on those deemed out of reach of that C grade.

But is there some danger that the report itself might make the problem worse? For example, take the report's argument that:

> … it was also the case that the lowest attaining pupils needed to make the most progress and therefore required the best teaching, but too often did not receive it.[19]

It is not obvious that the lowest attaining pupils need to make the most progress. All pupils have the same need to make progress. Ofsted's statement appears to be have been made on the understanding that a C grade for everyone is the only objective, and this would tend to condemn the most able to underachieve.

In terms of the guidance given to schools, it may be that some good case studies in genuine intervention as opposed to crude blanket curriculum coverage would be useful. The one-size-fits-all stems back to poor Assessing Pupils' Progress (APP) practice, where teachers do not really know their pupils' areas of weakness. There has also been an emphasis on whole class teaching, which has led to what the report has identified as excessive amounts of teacher presentation. We need to train a new generation of teachers in genuine differentiation.

5. Teaching able mathematicians

Ofsted makes numerous references to our national failure to provide suitable experiences for the most able mathematicians. For such pupils, opportunities to explore mathematics are few and the algebraic demands of courses are limited. Part of the problem lies with arrangements for assessment, which are currently under review by the Government. When timelines are

[16] Ibid., first key recommendation, p.8.
[17] Ibid., p.8.
[18] Ibid., p.4.
[19] Ibid., §136, p.56.

contracted to accommodate early and repeated presentation and when examinations have a compensatory character, it tends to be algebra that it squeezed the most. These points are made strongly in the following three paragraphs of the report:

> A principal concern is that pupils are not being adequately prepared by their Key Stage 4 experience. This can lead to poor retention and success rates on AS mathematics courses. A contributory factor is the reduction in demand on the higher tier GCSE following the switch from three to two tiers of entry which has led to less A* and A material being assessed on the papers. Some of the schools did not … invest the time required to develop conceptual understanding and fluency in topics such as algebra, … which are so important for sixth-form study.[20]
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> … not all of the schools appeared to recognise that a grade B performance at GCSE did not constitute the best grounding for AS/A-level mathematics … Demanding algebra topics were too often a casualty of the limited time for completing GCSE by the end of Year 10, yet essential for successful advanced-level study.[21]
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> Attaining a key threshold should ideally represent adequate mastery of skills and sufficient depth of conceptual understanding to give preparedness for the next stage of mathematics education but … national progress data suggest strongly that this is not so. Part of the problem is that external assessment in mathematics at all ages is generally based on a compensatory model: success with some questions in a test or examination compensates for poor performance on others, irrespective of the relative importance of the topic being assessed. This is particularly pertinent at higher tier GCSE where, for example, pupils can attain grade A having mastered little in the way of algebra.[22]

Whilst we want almost everyone to leave school equipped with a basic common set of skills and knowledge in mathematics, this is not sufficient. We also want every child to discover what he or she has the potential to be really good at, and then to become really good at it, so that it forms one of the building blocks of a sense of self-worth, and the basis of gainful employment. All the current metrics focus only on the base level, so it is no wonder that a major theme of the report is underachievement of the most able at GCSE, with the expectation that pupils who are performing well by the end of the primary phase continue to perform at the highest levels through secondary school.[23]

This is a worthy ambition, but it is not really a recommendation because it does not say what should be done. The Mathematical Association supports the restricted use of performance targets and tables to allow a school to understand and improve its own performance, but we recognise that if one of their key functions continues to be as a vehicle for interschool comparison, then a range of metrics provides the most reliable information and obviates gaming. It is better to measure, and set targets on, not just the number of Cs but also the number of A*s, with similar targets at end-of-key-stage assessments, and AS/A-level. And for the exceptional young mathematicians who have the capacity to meet the challenges of the assessments earlier than usual, there should be no hiatus in their studies. Courses (including FSMQs), teachers and resources must be available so that they can develop into professional mathematicians, engineers and scientists in due course.

6. Supporting inexperienced and non-specialist teachers

In our submission on 'Training our next generation of outstanding teachers', The Mathematical Association suggested that it would be 'sensible to work towards the introduction of a higher minimum mathematical requirement for primary trainees of GCSE grade B or A'.[24] We note that such a position is now being adopted by the Government.[25]

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[20] Ibid., §198, p.77.
[21] Ibid., §171, p.67.
[22] Ibid., §22, p.15.
[23] Ibid., p.9.
[24] 'Training our next generation of outstanding teachers', The Mathematical Association, response to Q1b, available via 'We Say' at www.m-a.org.uk, 8 October 2011,
[25] DfE press notice, 26 October 2012.

Primary teachers cannot all be expected to become strong in mathematics but they can gain knowledge about the hierarchical nature of mathematics learning and the ineffectiveness of focussing on disparate skills. It is essential that there is improved initial training, particularly for teachers who transfer from other careers, as well as appropriate and readily-available in-service training, and this is also true for secondary teachers. This might go some way towards addressing the shortcomings of the current situation, as outlined by Ofsted in relation to some teachers being underskilled in curricular content and its pedagogy.[26] As argued in the report:

> It is important to have clear guidance, understood by all staff, on approaches to secure conceptual understanding and progression in lessons. This is especially important to support less experienced, temporary and non-specialist teachers.[27]

Indeed, this has been the very point made by The Mathematical Association in recent times.[28]

7. Other matters

- **A central role for exploring mathematics**

  We fully support Ofsted's remarks about the need for investigative work and problem solving to be given greater emphasis and be integrated into the teaching of content.[29]

- **ICT**

  There is reference in the report to the 'underdeveloped use of information and communication technology to enhance learning'.[30] It is the last three words of this comment which are important. ICT is used widely but most typically as if using chalk on a blackboard. We would urge teachers to learn from Ofsted's examples of prime practice in using ICT as an integral part of pupils' learning and in support of conceptual understanding. The use of software to develop mathematical modelling skills is rarely seen in the classroom. This is a barrier to the promotion of advanced reasoning skills among able mathematicians and, in our view, an opportunity lost.[31]

- **Non-specialists judging specialists**

  The Mathematical Association is concerned about the quality of mathematics lessons being judged by non-specialists, for instance during a school's self-evaluation process or even by external inspectors. There is a need for a mathematics specialist to be included in each inspection team, which is not necessarily the case at present.

- **A possible inaccuracy**

  We would question the accuracy of statements in §17 of the report.[32] The reference is to the period January 2008 to July 2011 during which A-level specifications were not changed (except for Edexcel reorganising its Further Pure units); further the AS/A2 Mathematics core has not changed in total since the beginning of Curriculum 2000 (although the distribution between AS and A2 was adjusted for first teaching in September 2004).

Finally ...

If mathematics teachers are 'made to measure' the progress of their pupils, then let the measures used be those which support the individual learner to make progress. Let us design programmes that are 'made to measure' in the sense of being bespoke, crafted to individual needs — building on strengths, reducing deficiencies in conceptual understanding and improving technical fluency.

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[26] *Mathematics: Made to Measure*, Ofsted, March 2012, eleventh key finding, p.9.
[27] Ibid., p.7.
[28] 'Training our next generation of outstanding teachers', The Mathematical Association, responses to Q6 and Q9, available via 'We Say' at www.m-a.org.uk, submitted July 2011.
[29] *Mathematics: Made to Measure*, Ofsted, March 2012, Recommendations, third bullet, p.10.
[30] Ibid., §44, p.20.
[31] Ibid., §§64-67, pp.28-30.
[32] Ibid., §17, p.14.