

School Mathematics Examinations MEI's contribution to IMA's discussion

Introduction

This is MEI's response to a recent article "School Mathematics Examinations"¹ written by the IMA's Schools and FE Committee.

The article raised a number of very important issues and suggested ways in which they might be addressed but it was too short to allow full exploration of the relationships between the issues and the suggested solutions to them. Thus it did not allow the issues to be placed in context. Words like "curriculum development", "pedagogy", "accountability" and "regulation" did not feature; nor did the underlying ideas.

So, while we look forward to the conclusions of the discussion arising from the article, we would question whether it is possible to do justice to the subject without analysing the current situation and exploring ideas in far greater detail.

Accountability

At present the use of examination results as accountability measures leads to a fundamental conflict of interests between institutions and their students. In our view, this underlies many of the issues raised in this paper. If so, the solution lies in recognising and working to remove the root cause.

Although it is both possible and desirable for teachers to teach beyond the requirements of any examination, there is a widespread acceptance that "what you assess is what you get". The current system of school accountability, including performance tables and Ofsted inspections, makes this inevitable because it places such high value on students' performance in public examinations. Consequently, many teachers' efforts are unduly focused on improving their students' performance in examinations; for example, concentrating on students at the C-D borderline in GCSE Mathematics. This encourages students to view mathematics merely as an examination hurdle, rather than as a problem-solving tool that they will find useful throughout their lives.

GCSE Mathematics

Dissatisfaction with the current two-tier GCSE examinations is widespread among teachers of A Level Mathematics; they are concerned that it is not preparing students well for the transition to A Level. This was highlighted in MEI's 2009 report "The effects of 2-tier GCSE Mathematics on transition to AS and A Level"².

Some of the motives behind the introduction of the current two-tier examinations were educationally sound, in particular the concern that students who embarked on GCSE study at foundation tier under the three-tier system knew that they could not get grade C and so were demotivated from the start of the course. However, this was muddled with a desire for regulatory conformity across subjects and so insufficient thought was given as to whether the new arrangements would

- allow all students to demonstrate what they could do,
- support approaches to teaching that would improve students' engagement with mathematics as a problem-solving tool and emphasise skills valued by end-users.

The new twin Mathematics GCSEs offer a genuine prospect of producing a GCSE examination system which equips students with the skills and competencies sought by end users, both employers and educators. We hope that the IMA will use its influence to ensure that the pilots starting in September 2010 have the maximum chance of success; an important element in this is recognition of the need for appropriate professional development for the teachers involved.

The changes to the single GCSE for teaching from 2010 may improve matters but there is a danger that students will be unable to cope with some of the problem solving questions which are to be introduced; it is very difficult to assess this skill in timed, written examinations.

While we welcome greater emphasis on problem solving, we would recommend caution; it could all go badly wrong. We recommend two courses of action before any step change in the level of problem-solving is introduced into examinations.

- There should be research into what has happened in the past so that we don't repeat earlier mistakes.
- There should also be extensive professional development for teachers to equip them with knowledge of problem-solving pedagogy.

Considerable effort is currently expended in implementing particular regulatory processes in an attempt to ensure that mathematics examinations are at the same standard. In recent years, this has resulted in mathematics GCSEs which are so similar that there seems little point in having more than one. However, this would not necessarily be the outcome if there were a different regulatory framework, as outlined below.

A Level Mathematics

There is much greater general satisfaction with the current A Level Mathematics specifications than with GCSE Mathematics. This has been seen in responses to the discussion surrounding proposed changes to A Level and in the increased numbers of students taking A Level Mathematics and Further Mathematics. However, there is evidence that some teachers choose A Level Mathematics specifications by deciding which examination they believe will be easiest for their students, rather than considering which will promote good learning and so be in their students' long term interests.

Text books

The IMA article suggests that:

“If a single national examination were introduced, publishers would need to compete on the quality of the material they publish, rather than offering books specifically written for the examinations of a single awarding body, often by one of the senior examiners, as is so common today.”³

As an organisation with very considerable experience in producing textbooks, and of the publishing world, we would say that this just does not ring true.

It is certainly the case that there are weak textbooks and that some of them sell well, as has always been the case. We do not believe there to be a link between this situation and the existence of either one or many specifications and so we see no reason to expect that a marked improvement in quality of teaching materials would follow a reduction in the number of specifications. Until recently, there was a single national examination at Key Stage 3 but the quality of textbooks was variable. If the competitive market had been sufficient to ensure high quality, there would have been little need for the supplement of examples in the KS3 national strategy.

We suggest that the reason why poor textbooks sell well is that, following the lead of many examinations, they focus on techniques rather than concepts, their applications, mathematical thinking and real understanding. Their success in the marketplace is all to do with the pressure for examination results with the associated perception that they are more important than students’ understanding of mathematics. The need for awareness of better pedagogy and the importance of the quality of teaching are forgotten.

Since the content of all the GCSE Mathematics specifications from 1999 to 2009 has been identical, following the wording of the National Curriculum, any textbook can be used to teach any specification. However, there is a marked preference for using an examination board endorsed book. This may well be linked to using the examiners as authors and publicising the fact; there is a thinly veiled message *“This is how you get the marks on this examination”*. We believe this practice to be profoundly wrong.

There are serious issues relating to the relationship between textbooks and examinations for general qualifications and we would like to make the following recommendations.

- Examination boards should be disallowed from endorsing textbooks or forming any commercial links with publishers.
- Where an examiner is an author or co-author of a textbook, publishers should be disallowed from mentioning the fact in the book or in any of their publicity.

This would not exclude the publication of dedicated textbooks for syllabuses, like SMP (formerly) and MEI, whose development is external to an examination board and whose motivation lies in a particular underlying vision and pedagogy.

A single set of examinations?

The IMA article suggests that we would be better served by single national specifications. We would urge the IMA to consider a more visionary approach to meeting our national needs. We fear that the direction of travel implied in the article would result in a very dull mathematics provision.

In particular, it would effectively remove the possibility of curriculum development.

There is a long and distinguished history of independent curriculum development in this country. In mathematics SMP and, more recently, MEI took the lead and there have been equivalent bodies in science and technology. As a result many people in UK schools and colleges have benefited from a rich education. We are sure that the IMA would not wish to deprive future generations of a similar experience but we are in no doubt that that would be the consequence of having a single set of examinations in each subject.

However, we agree that there is little point in having essentially the same syllabus examined by three competing awarding bodies, particularly if the regulations force them to set very similar examination papers.

The IMA article talks about allowing “pilots” but this misses the point. A pilot is, by definition, limited in duration and uptake. None of the successful syllabuses of the past would have evolved if this had been the only available development route. We recommend that “external” syllabuses should be allowed and encouraged; these would be provided by reputable bodies. At the moment the only external provider in mathematics is MEI but in the past there were several and it would be good to see bodies such as the IMA, MA and ATM encouraged to take up this role.

The challenge is to find the best mechanisms to encourage diversity and innovation, and we hope that the IMA will turn its attention to this, rather than promoting what we see as a simplistic way forward.

Mathematics is a beautiful and exciting subject. Which people and organisations are best placed to convey this to young people? Is it government departments or quangos, staffed by civil servants, or is it the mathematics community and the enthusiasts who are prominent within it?

Regulation

A related challenge is to find effective mechanisms for regulation. At the time of writing this, the newly formed Ofqual are consulting about the methods they should use. They must ensure comparability at various levels:

- between the different awarding bodies offering examinations on essentially the same specifications for the same qualifications in the same subjects;
- between different specifications for the same qualification in a subject;
- between qualifications at the same level in different subjects.

At the moment regulation definitely fails in the last of these. There is plenty of evidence that some subjects are more harshly graded than others. The STEM subjects fare particularly badly and this makes them unattractive options for any but the strongest students. It is nothing short of a national scandal that this situation has been allowed to persist over many years, and particularly since the introduction of accountability measures that are based on the assumption that all subjects are equal.

We fear that Ofqual may be tempted to disallow different specifications for the same qualification on the grounds that it is difficult to ensure comparability, while completely ignoring the much bigger challenge of ensuring inter-subject comparability. It is a matter of national importance for Ofqual to develop a methodology between subjects.

When that is done, it will then be relatively easy to adapt it to different specifications in the same subject. A key element in all this will be the use of high calibre people with appropriate experience and expertise. A few years ago, QCA disbanded its subject teams and so Ofqual does not have the appropriate subject knowledge in-house. It is essential that this is rectified; otherwise they will be unable to fulfil their remit.

New specifications are accredited by checking whether they meet qualification and subject criteria. The success of this process depends on writing criteria which will ensure high quality specifications. However, writing such criteria before seeing draft specifications demands a greater level of expertise than is needed to judge the quality of finished specifications; all eventualities must be foreseen when the criteria are written.

Our recommendation is that, in future, subject criteria are written as overarching statements, with particular specifications filling in the detail of exactly what is to be examined. There may, however, need to be a national core of content, e.g. for Mathematics GCSE to ensure smooth progression to A Level. It will then be for Ofqual to determine whether any particular specification meets the subject criteria and is of the same demand as other specifications for the same qualification; this is entirely achievable, given appropriate expertise.

We would also recommend that in the case of new and pilot qualifications the subject criteria are written particularly lightly, if at all. Innovation needs to be encouraged, not stopped in its tracks.

What system of awarding bodies would be in the country's best interests?

We currently have 3 national awarding bodies for GCSE and A Level Mathematics in England, all running examinations of effectively the same syllabus at GCSE and quite similar ones at A Level. We accept that this is not the ideal situation and see two possible ways forward. In each of these, the position of external syllabuses, as described earlier, would need to be protected.

- Either we continue with three awarding bodies but require them to run significantly different syllabuses
- Or there is one awarding body for mathematics which, as well as running a set of national syllabuses, is required to engage with bodies carrying out curriculum development and innovation.

We would not, at this stage, state a preference between these two alternatives because further work would obviously be needed to determine the relevant remits, and the devil will always be in the detail. The IMA might, however, wish to consider the pros and cons for each.

Notes

- 1, 3. School Mathematics Examinations, Mathematics Today, IMA 2009
2. "The effects of 2-tier GCSE Mathematics on transition to AS and A Level", MEI, 2009, http://www.mei.org.uk/files/pdf/Two_tier_GCSE.pdf