

THE INSTITUTE OF MATHEMATICS AND ITS APPLICATIONS

INCORPORATED BY ROYAL CHARTER

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CHARITY No. 1017777



Dame J. Higgins FRS
Advisory Committee on Mathematics Education
The Royal Society
6-9 Carlton House Terrace
London
SW1Y 5AG

16 March 2010

Dear Dame Julia,

School Mathematics Examinations

We are writing to you to encourage you to consider, and hopefully support, a view that we have begun to develop about school mathematics examinations.

As you may be aware, the IMA's Schools and FE Committee published a short article in the December edition of *Mathematics Today* about issues relating to school mathematics examinations. The article, the text of which is attached in the appendix, invited responses to two key questions. Several readers, not all of whom are members of the IMA, sent responses, the majority of which supported arguments put forward in the article. The IMA intends to summarise these responses in the next edition of *Mathematics Today* and place the full responses on its website.

The principal concern we addressed relates to the kinds of challenges set to candidates in GCE and GCSE mathematics examinations. The starting point on which our arguments are based is that mathematics assessment should reflect what we value about the subject, and should therefore provide substantial questions, rich in challenge and problem-solving opportunity, that leave teachers and their students in no doubt that solving problems in context and demonstrating reasoning ability are highly valued mathematical skills. Our concern is that this kind of rigorous assessment is gradually disappearing from GCE and, particularly, GCSE mathematics examinations in England.

This analysis is also reflected in the take up of IGCSE, IB and Pre-U examinations, where schools and colleges frequently observe that studying for these examinations is better for their students' mathematical development and also better preparation for the next stage of education.

We have considered what might be the causes of this dilution of mainstream public examinations. It is clear that awarding organisations have significantly improved their technical performance in the preparation of examinations which offer candidates the opportunity to demonstrate what they know, understand, and can do. So the question

arises why they have not also increased the extent to which examinations reflect the mathematical qualities that the mathematics education community would most welcome.

At a technical level, examiners are rightly wary of questions in which candidates might possibly go badly wrong, as these are both difficult to mark and are likely to be wasteful of marks (as the use of the marks in this question means that other aspects of the curriculum are not addressed). But this should be a minor consideration in relation to the much more important question of assessing the kind of qualities that success in these examinations should denote.

If the provision of public examinations were really comparable to an economic marketplace, we might expect that competition between awarding organisations would, over time, resolve all such issues. However, it is clear that having three competing awarding organisations has not, in itself, delivered what is wanted.

One argument given in favour of the IGCSE examination is that it is significantly more challenging than the GCSE. It is clear that if any of the GCSE examinations were regarded as significantly more challenging than the others; its candidates would soon be entered for one of the less demanding examinations. The need for all the GCSE examinations to be seen to be no more demanding than their competitors produces downward pressure on standards, and makes it much less likely that highly valued but challenging problems will be set.

Our conclusion has been that the introduction of appropriately challenging mathematics papers, for both GCSE and GCE, will not happen whilst multiple examinations exist that are intended to assess the same curriculum in the same way. We are convinced that a suitable outcome can only be achieved when there is a single national mathematics examination. This need not mean the introduction of a single national awarding organisation. It might instead mean that existing awarding organisations would tender for a single national contract to award mathematics examinations for a period of perhaps three years. In parallel with the mainstream specification, it would be desirable and pragmatically sensible to encourage the development of new approaches to assessing the curriculum which might later be incorporated in the mainstream specification.

The examinations themselves should perhaps be subject to annual scrutiny by a panel including teachers from schools, colleges and universities, to ensure that they do indeed reflect the current values of the mathematics education community.

We would be very grateful if the Committee would give consideration to the ideas raised in this letter, with a view to formulating its own position on these matters. We would be delighted to meet you to discuss these ideas further, if you would find that valuable.

Yours sincerely,



Chris Belsom
Chair, Schools and Further Education Committee

School mathematics examinations

The IMA's Schools and FE Committee is concerned about the extent to which school mathematics examinations fail properly to assess the skills and competencies that are valued by higher education and employers. A system of school mathematics examinations is needed that encourages and rewards the problem solving and reasoning as well as the technical skills that mathematics should develop. The current arrangements provide examinations that increasingly emphasise lower-order skills, supported by text books that avoid challenging learners sufficiently, preferring instead to offer instructions for success in standard examination questions.

An appropriate system of GCSE and GCE mathematics examinations should provide substantial questions, rich in challenge and problem-solving opportunity, that leave teachers and their students in no doubt that solving problems in context and demonstrating reasoning ability are highly valued mathematical skills.

Such a system must not, however, be inflexible and difficult to change. An appropriate system would be needed so that teachers and awarding organisations could work together to promote trials of new examinations to improve existing provision and address new needs.

Discussing these issues, committee members talked about some of the features of the present system that might contribute to the problems.

The arrangements for several competing specifications at GCSE, for example, do not seem to be leading to improvements in the examinations themselves. Whilst the awarding organisations are plainly increasingly expert in providing papers that are accessible to the vast majority of candidates, the richness of the mathematical demands of the papers have been decreasing. Is there a case for concluding that the existence of multiple GCSE specifications is actually the cause of this malaise, as awarding bodies put ever more emphasis on ensuring that their papers do not in any way seem more challenging than those of their rivals?

Mathematics examinations are too important to be allowed to suffer from such a failure of competition. Some have argued that a single national mathematics GCSE should be developed for all candidates, so that there would be a level playing field in terms of demand. This would allow a gradual improvement in the emphasis on the kinds of mathematical challenge that users want the examinations to assess. Similar arrangements could be made for GCE.

Text books, if of high quality, cover the material in ways that stimulate excitement and challenge in learning. They are good preparation for any examination, and achieve this by seeking to provoke deep mathematical understanding. 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.

The IMA's Schools and FE Committee intends to consider the issue further at its meeting in February and would welcome the views of members which they are asked to send to Vanessa Thorogood (Education Officer) at: vanessa.thorogood@ima.org.uk by 1 February 2010.

The questions we would like members to address are:

1. Do you favour a single set of examinations (apart from pilots) for GCSE and/or for GCE?
2. What system of awarding bodies do you believe would be in the country's best interests?

IMA S&FE Committee