

Double Award GCSE Mathematics

Exemplification

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Section A

Rationale

The decision to move to a double award for GCSE Mathematics presents a window of opportunity for an improved mathematics provision at this level.

There are various ways in which a double award can be organised and some of these would not result in any significant improvement on the present system. The work presented here stems from a conviction that it will only be possible to decide on the most advantageous approach when a number of models are developed in considerable detail. To choose a model without that level of information would be no more than a thought experiment, albeit one influencing the futures of millions of young people.

This work is presented by MEI and builds on ideas presented in the report “Delivering Curriculum Pathways in Mathematics”¹, written for QCA in 2005. It illustrates the model which MEI believe to be most appropriate. All the MEI professional staff have contributed to it, as well as two external consultants, in total some 11 mathematicians, all of whom are experienced in curriculum development work.

MEI is a registered charity and this work has been undertaken at its own expense, in accordance with its charitable aim of improving the quality of mathematical education in this country.

Principles

There has been considerable discussion within the mathematics community about the principles that should underpin the design and delivery of the double award. This exemplification is based on five such principles; the first three of these were first enunciated by the Mathematical Association.

1. No additional content should be required for the double award beyond that in the present National Curriculum.
2. There should be no reduction in mathematics teaching time for any student.
3. Those proceeding to AS and A Level should be expected to have taken both GCSEs.
4. Schools and colleges must ensure that all those who would benefit from taking both GCSEs are able to do so.
5. The content and demand of the two GCSEs should be such that the first is a valuable qualification on its own, but that both are accessible to a substantial proportion of students.

Outline of the design

In the model presented, there are two different GCSE subjects. For the sake of this paper, these are entitled GCSE 1 and GCSE 2.

Syllabuses

The syllabuses for GCSE 1 and GCSE 2 are given at the end of this document. The syllabus for GCSE 2 subsumes the content of GCSE 1. The overall content is the same as that of the present National Curriculum; no new topics have been included (in accordance with Principle 1), nor have any been excluded.

GCSE 1 consists of essentially concrete mathematics and the assessment is largely through recognisable contexts.

GCSE 2 is more abstract. Although some of the assessment questions are context based many of them are, by design, abstract.

Assessment

Paper 1 80 marks	Paper 2 100 marks	Paper 3 120 marks
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Both of the two GCSE subjects have the same pattern of assessment.

- A foundation tier candidate takes papers 1 and 2 and is eligible for grades C to G.
- A higher tier candidate takes papers 2 and 3 and is eligible for grades A* to D.
- Paper 2 is common to all candidates.
- A grade is awarded on the total mark for a candidate's two papers.

Features

The overall assessment structure necessitates a number of features that either differ from current practice in the existing GCSE or are completely new.

In the current GCSE most of the topics in GCSE 1 are examined at a standard that is consistent with grade C or below. In contrast, in GCSE 1 paper 3 more searching questions are set on this basic material, allowing the possibility of grades up to A*. Thus a candidate who obtains a good grade on GCSE 1 has demonstrated a high level of understanding of the more elementary material and its use in problem solving. The current GCSE does not allow this to happen.

Correspondingly, GCSE 2 paper 1 consists of very elementary questions on more advanced material. A Foundation tier candidate in GCSE 2 would be unable to obtain a grade C overall without a high mark on this paper.

The strict association between content and grades encapsulated in the document “Targets and Tariffs” is no longer applicable; the validity of this association was questioned in the evaluation report on the possible 2-tier GCSE models.²

The exemplar examination papers include a number of innovative types of question, particular the extended questions on the two compulsory papers 2, which have data released a month in advance of the papers, in a similar way to FSMQs. The style of the most basic paper, GCSE 1 paper 1 is unlike anything currently found in GCSE but is also similar to that used in the Level 1 FSMQ. The model does not, of course, require papers to be set in these styles; however, it seems a pity when looking at a new structure not to consider the possibility of new styles of assessment materials.

The exemplar examination papers have been condensed in this document by removing the spaces for students to answer in, but full versions are available on the MEI website, together with the answers.

Delivery

The scheme is designed to allow 4 different levels of entry.

GCSE 1 Foundation Tier

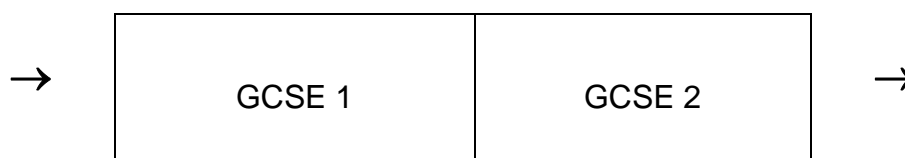
GCSE 1 Higher Tier

GCSE 1 Higher Tier + GCSE 2 Foundation Tier

GCSE 1 Higher Tier + GCSE 2 Higher Tier

GCSE 1 will be taken by virtually all students. For most it will be a Year 11 examination, although some may take it earlier. A substantial proportion (at least 50%) are expected to take GCSE 2 as well and all schools will be required to offer it to those students who would benefit (Principle 4).

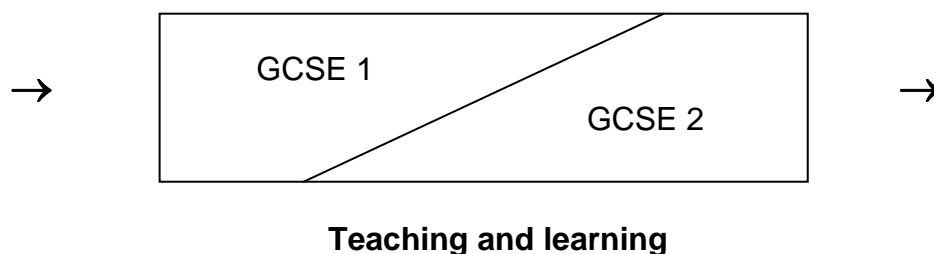
The allocation of material to GCSE 1 and 2 may be represented as the sequential model illustrated below.



Content

However, this is not an accurate representation of many students’ learning pattern. GCSE 1 consists largely of concrete mathematics and GCSE 2 contains a significant amount of abstract work. The ability to do abstract work

is built up over time and good teachers foster it by providing students with increasing amounts of suitable work over a prolonged period, often starting in a small way at quite an early age. The diagram below gives a better representation of the expected teaching and learning.



Comparison with the present provision

In what ways will this be an improvement on the present GCSE?

Meeting students' needs

The attainment of students in mathematics varies widely, covering a range of at least 10 learning years at the age of 16³. The 2-tier GCSE offers only two options, each of which covers the requirements of students with an attainment range of about 5 learning years. Consequently, the assessment, and the associated teaching, is poorly focused on the needs of many students. By contrast with the present “2 sizes fit all” GCSE, the double award model presented here has 4 levels of entry which will allow and foster appropriate teaching for many more students. They will be presented with an appropriate level of challenge rather than mathematics that is either much too hard for them, or much too easy.

Better preparation for future employment

The Smith report highlighted the fact that employers are often dissatisfied with the capabilities of young people entering the work force⁴. The emphasis of GCSE 1 is on developing intuitive understanding and using mathematics in context. By opening up the possibility of achieving grades A*-B on the kind of mathematics that many people are likely to encounter in employment, GCSE 1 will directly address these concerns.

Preparation for further study of mathematics and related subjects

Currently, even students achieving grade A/B in Mathematics may have weak algebraic skills. These students often experience difficulties if they go on to study AS/A-level in Mathematics or related subjects. This inadequate preparation leads to the perception that Mathematics, Physics etc are harder than other subjects at AS and A-Level and so fewer students opt for them. GCSE 2, with its concentration on mastery of more abstract skills, would be a more suitable preparation, without the addition of any more content overall.

Better routes of progression

Currently GCSE in mathematics does not always successfully build on prior attainment at KS3. The most able students sometimes feel as though too much time is spent going over material which they already understand, whereas less able students may feel that they have insufficient time to deal with previous misconceptions which hamper their progress. Focusing GCSE 1 on a narrower range of content, some of which students will have encountered at KS3, while emphasising the applications of this content, allows students who have not understood it at KS3 to approach it from a different perspective, while also allowing students who have understood it to extend and develop their understanding. GCSE 2 provides opportunities to further extend the more able.

An alternative to coursework

The intention was that the GCSE Mathematics Coursework would allow students the time to use mathematics to explore a situation in depth and to use ICT in handling and interpreting a complex set of data. However, the value of coursework as a learning tool has been undermined by a variety of factors, all related to its assessment: excessive help from parents, teachers and others; plagiarism over the internet, inappropriate tasks and marking criteria. Consequently coursework is not expected to survive. However, that does not remove the importance of providing students with experience of undertaking mathematical investigations and tasks, of glimpsing what doing mathematics for real is like. In this scheme this gap is filled by the extended context questions on Paper 2 of each GCSE.

By issuing material in advance for teachers to explore with their students, the extended context questions allow for students to be guided in their understanding and to use ICT appropriately. Testing their understanding in examination conditions ensures there is genuine evidence of student attainment. This retains those aspects of mathematics coursework that are of educational value and which cannot be tested through more traditional examination questions.

Links to other subjects

Students sometimes struggle with the mathematical aspects of their studies in science, business, the social sciences or the humanities. Although they have been taught the necessary skills in mathematics lessons, they do not easily transfer them because they do not always realise that mathematics is useful. Moreover, the numbers usually encountered in realistic applications are harder to deal with than the numbers usually encountered in mathematics lessons. The emphasis of GCSE 1 on working in context, with realistic numbers, will foster greater transferability of knowledge and skills.

Points for discussion

This section addresses a number of issues that have arisen during the development of this exemplification, or in discussions leading up to it, either within the MEI team or in the wider mathematics community.

They are presented in question and answer format but in many cases the answers are only the first step in a process that will be informed by further discussion and by trials on this exemplification and further development work.

How was content allocated to the two syllabuses?

The starting point was provided by the two Programmes of Study for KS4 in the National Curriculum. Three criteria were then used to decide on possible changes.

- Topics should be presented coherently.
- GCSE 1 should be a valid and valuable qualification in its own right.
- It should be possible to set sufficiently demanding questions on GCSE 1 paper 3 to justify the award of A* and A grades.

Could the allocation be improved?

It would be very surprising if the allocation could not be improved, rather like getting a hole in one. The allocation evolved during the process of setting the papers and no doubt this process will continue when they are discussed outside the group that set them.

Further information will be provided when the question papers are attempted by real students. However, it will need to be borne in mind that they are testing syllabuses for which students have not been taught and for which they have not revised.

The critical question is how much content should be put into GCSE 1. There are conflicting arguments.

- If the content is set at rather a low level, many students will achieve success and so might be encouraged to take GCSE 2 as well. However, they will then have a lot more work to do and may well become demoralised by GCSE 2.
- By contrast, if the content of GCSE 1 is set at quite a high level, fewer students will achieve success and be motivated to take GCSE 2. However, those that do take it will find they have relatively little extra work to do.

Ultimately, the allocation will probably be a matter of professional judgement.

It is also the case that to make the outline of content in this document into a workable specification for teaching and examination purposes, more detail and exemplification will be needed.

Is the difficulty level of the papers appropriate?

The circumstances under which the papers were produced make it impossible to know whether they have hit the right standard. The double award does not yet exist and no students have been prepared for it. So it is likely that the papers will give the impression of being on the hard side if they are trialled on real students.

The purpose of writing these papers was to give a sense of the demands likely to be placed on students in the GCSE courses, rather than to provide actual assessment material. It would be easy enough to make them a little easier or a little harder, but that is not really the point.

For GCSE 1, the important question is: “Is someone who can answer these sort of questions well prepared for the world of work?” The equivalent question for GCSE 2 is whether those that take it have been prepared for moving on to further study, typically AS and A Level.

These questions can only be considered if the exemplar papers are sufficiently close to the standard at which real papers would be set, and the team responsible for setting them believe this to be the case.

What about Functional Mathematics?

The demand for Functional Mathematics stems from the perception that many students taking the present GCSE are not functional in mathematics. With the introduction of double award GCSE, a well-designed GCSE 1 could overcome this problem.

Introducing a qualification in Functional Mathematics does not address the questions of when will it be taught and whether the teaching will be effective. The scheme presented in this exemplification does, however, provide possible answers. The same teaching will often be required to support both GCSE 1 and the Functional Mathematics qualification and because GCSE 1 is, by design, functional in its character, there is a realistic prospect of the teaching being effective.

Paper 2 of GCSE 1 could in fact prove very suitable as a test of Functional Mathematics. There would be two major advantages in this approach.

- The need for a separate examination for Functional Mathematics would disappear
- Mark thresholds could be designed so that it would be impossible to fail Functional Mathematics and still obtain grade C in GCSE; this would resolve anomalies that will always be present if GCSE and Functional Mathematics are assessed differently but a pass in Functional Mathematics is a requirement for a GCSE pass.

Could students take one paper early?

With the assessment scheme used in this exemplification it would be possible for students to take one paper in a tier before the other(s).

There is a risk, at this exemplification stage, of giving too much attention to what is essentially a point of detail at the expense of the more serious issue of whether this is the best design for the double award GCSE. However, this does lead onto another question which is more central to the double award GCSE.

Could students enter all 3 papers in one of the GCSE subjects?

It would be possible, particularly if paper 1 was taken early. In that case, a candidate would be entered for both tiers and the higher grade from the two would be taken. Although this would involve taking an extra examination paper, it could well prove attractive and helpful to those students who are uncertain whether to enter foundation or higher tier. The outcome could be that more students attempt the higher tier in one or other of the GCSEs.

There are twice the number of possible outcomes from double award than from the present single GCSE and so students will overall be more finely differentiated. This means that more students will be genuinely uncertain about their best entry pattern. This would be one way of helping them.

Will some schools only run GCSE 1 and not GCSE 2?

This is a serious concern and one that needs to be addressed at the strategic level. It should be national policy that every student who would benefit from GCSE 2 should have the opportunity to take it.

A number of measures could be taken to ensure that all schools offer the double award.

- Double award should be the standard route to AS and A Level.
- Failure to offer it should naturally contribute to a bad Ofsted report for the school.
- The standard should be set so that GCSE 2 is accessible to a majority of students; if it is taken by enough students nationally it will be unacceptable to the community it serves for a school not to offer it.

For some schools, particularly those that do not currently offer higher tier GCSE, this will involve a change of culture, and not before time.

Will some students will take GCSE 1 early and then give the subject up?

It is hard to see how this could arise, since there is a statutory requirement for students to continue mathematics up to the age of 16. The fact that such concerns have been raised indicates the need to work towards a culture where this practice would be unthinkable in England, as it would be in many parts of the world.

References

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