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UCAS/DfES CURRICULUM DEVELOPMENT GROUP
CDG/06/11

Mathematics questionnaire
(including response to discussion points from the University of Cambridge)

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1. Background

The Smith report, *Making Mathematics Count,* published in February 2004, began with a discussion of the importance of mathematics for its own sake, for the economy and for science, technology and engineering. Adrian Smith suggested that the government create a high-level post for mathematics in the DfES. This has been realised and Celia Hoyles is the Chief Adviser for Mathematics.

The supply of teachers of mathematics remains a source of concern. The training bursary, currently £7000, is to be increased to £9000 in September. Newly-qualified teachers (NQTs) are to receive £5000 on completion of their induction year.

The report recognised that everything must be done to support and nurture those teachers currently in post. The support needs to meet the different requirements of, for example, primary mathematics co-ordinators, F.E. lecturers in mathematics, teachers of numeracy skills and non-specialists in secondary schools.

A National Centre for Excellence in the Teaching of mathematics (NCETM) to provide advice, development and dissemination of mathematics CPD is about to open. The NCETM will co-ordinate all CPD provision nationally. The centre will open officially in June 2006. The director, David Burghes, and four assistant directors have been appointed. Nine regional directors are to be appointed in the near future.

Following the government's response to Smith, QCA received a remit to take forward several of the recommendations relating to curriculum and qualifications.

The White Paper, *14-19 Education and Skills,* led to further remits for QCA. These include the Key Stage 3 Curriculum review, a system of diplomas, reviewing GCSE coursework and revising A levels.

2. Discussion

2.1 Pathways and associated projects

Following Recommendation 4.11 of *Making Mathematics Count* QCA has contracted two teams to work on the development of curriculum pathways in mathematics for 14-19 year olds. One team is from the University of Leeds and the other is a consortium between King's College, London and Edexcel.

Phase 1 work began with a critique of the models from *Making Mathematics Count.* In September 2005, both teams provided detailed curriculum and assessment structures consistent with the 14-19 Education and Skills White Paper. Draft standards for Entry level, Level 1 and Level 2 functional skills were submitted and forwarded to the Functional Skills Board. Both contractors have considered which aspects of their models require trialling in Phase 2. Diagrams of the two suggested models are attached. The invitation to tender for Phase 2 work was sent out to awarding bodies at the end of April and contracts will be awarded in May.

There are three further projects whose results are to be incorporated into the Pathways project. Brief details about these projects are attached as an Annex.

Discussion Points

Q1. Do you have any comments on the models that the contractors have produced?

No

2.2 Developments in GCSE

Following the trial of two tier GCSE mathematics examinations last summer, an independent evaluation report suggested that the trial papers included too little A/A* material. Candidates involved in the trial were asked to sit both the three-tier GCSE and the two-tier GCSE. Their final award was the better of the two grades attained. 70% of the candidates got the same grade in both examinations. Following the trial, GCSE criteria have been revised to increase stretch and challenge. We have accredited two-tier GCSE specifications that meet the new criteria.

QCA held a consultation on the place of coursework last year. There was a marked difference between responses from mathematics teachers and those from other subjects, with mathematics teachers much more critical of coursework. As a consequence, a separate consultation about mathematics coursework has just been held. It is likely that GCSE Mathematics will have less or no coursework. It is not yet clear whether the revised specifications will be introduced in 2007, or whether the change will be deferred until the broader changes are introduced in 2010.

Discussion Points

Q3. Do you think that removing coursework from GCSE Mathematics would have an impact on HEI?

Little, if any

Q4. Is there a requirement for the skills assessed in GCSE Mathematics coursework in HE courses?

No

2.3 Double Award GCSE Mathematics

In January 2006, QCA sent advice to Ministers on the development and introduction of two free-standing GCSE qualifications in mathematics. Lord Adonis, in his response to the advice, agreed that GCSE mathematics should be developed to allow:

- two free-standing single award GCSEs;
- GCSE 1 acting as 'gatekeeper' covering the whole of the key stage 4 programme of study;
- The second GCSE should broaden and deepen candidates' understanding of mathematics, and have similar content to GCSE 1.

In taking forward the new GCSE, QCA will work closely with CCEA and DELLS and engage key stakeholders including ACME.

The model for the two single awards in mathematics has yet to be decided. As an example, one GCSE could use a modelling approach, applying mathematics to employment, life and the study of other subjects. Contexts for this would include financial capability. The other could be focused on pure mathematics and an appreciation of the nature of mathematics and mathematical thinking. Alternatively, one could focus on more straightforward questioning while the second includes a focus on reasoning and proof, with students expected to devise solutions to multi-step problems.

Either GCSE is expected to provide preparation for A level, but it likely to be thought desirable for students to take both as a preparation for A level. If possible, the model should be devised so that study of both would be a natural decision for the candidate to take. It could be comparable to AS/A2 study. The government have stated clearly that they '…do not want a position where students study less mathematics than they do currently.'

Discussion Points

Q5. Would studying two separate GCSEs in mathematics, one more challenging than the other, encourage students to choose to study mathematics at A level and beyond?

This is very hard to judge

Q6. Do you have any suggestions that we could take into account when devising the second GCSE?

The model where one GCSE focuses on more straightforward questioning while the second includes a focus on reasoning and proof, with students expected to devise solutions to multi-step problems, is much more attractive to us.

2.4 A revised approach to the AEA Standard

The Government White Paper, *14-19 Education and Skills* published in February 2005, expressed the view that more could be done to stretch and challenge our brightest students. It stated the intention to strengthen A levels through a number of measures.

These included increasing stretch for the most able by introducing harder, Advanced Extension Award (AEA)-style questions into separate sections at the end of A level papers. This may prove difficult to implement and may not be an appropriate method for all subjects. QCA has since been given the remit to extend this exploration. As well as trialling papers that include optional more challenging questions, we intend to trial a separate optional paper and to trial the introduction of extra demand to an A2 paper with an extended grading scale. We are currently in negotiation with awarding bodies about this.

In mathematics, perhaps more than in any other subject, differentiation is related to the tasks set, rather than to the way candidates respond differently to the same tasks. For this reason, candidates who are not expected to achieve the top GCE grades are unlikely to do well on AEA-style questions. However, such candidates may not be able to judge soundly their ability to respond effectively to AEA-style questions. A consequence of offering AEA-style questions to all candidates may therefore be reduced reliability of the normal GCE assessment.

Discussion Points

Q7. Of the three approaches to AEA-style assessments that QCA is to trial, which is most likely to provide useful information for HEI?

A separate AEA-style paper is in Mathematics likely to provide the most useful information. But it is important that all high achieving students are encouraged to take this, and that its delivery is properly resourced in schools and colleges (unlike the existing AEAs).

Q8. How well do the three approaches to AEA-style assessments reflect the need in mathematics for candidates to be offered tasks that differentiate between candidates of different abilities?

They all reflect the need to some extent. As indicated above, the separate paper option is probably the best option in terms of reliability of assessment without undermining the nature of A level assessment.

Q9. Will there be an increase over time in the extent to which HEI incorporate into offers a requirement for achievement in the AEA assessment, where appropriate?

If A level achievement levels continue to rise, then it is inevitable that HEIs will seek to make more challenging/discriminating offers for their more competitive courses. Including a requirement for achievement in the AEA assessment is one obvious way in which more challenging/discriminating offers could be realised.

2.5 GCE

The timeline for changes to GCE Mathematics more generally, is that revised specifications will be introduced in 2011, following trialling and piloting from 2006.

A key issue is the number of units in A level qualifications. While the majority of subjects are changing from 6 units to 4 from 2008, science subjects (except Psychology) are retaining 4 units. The pathways contractors in mathematics have proposed different approaches, with Kings/Edexcel suggesting 4 unit qualifications, and Leeds suggesting 6 unit qualifications. The impact of this issue is most keenly felt in the way it impacts on the core content. From 2004, this has been set out in 4 units of the current 6, with 2 core units in AS and a further 2 in A level. Any change from 6 units will need to address the question whether the subject core should be decreased or increased, since two-thirds of four units is an awkward number.

A related question is the extent to which GCE A level Mathematics should provide a range of different routes. The current choice is between different application areas. In practice, this choice is usually exercised by teachers rather than students. It is possible to devise an A level which is fully specified and offers no choice of routes; an example is the Kings/Edexcel proposal.

Discussion Points

Q10. Do HEI consider it feasible that mathematics and science subjects could retain 6 unit A level qualifications after 2011 with the majority of other subjects using 4 units?

Obviously this is feasible. The real question is whether this is desirable.

Q11. Are there advantages to having an element of choice in GCE?

As different students will have different Mathematical needs depending on their other subjects of study there are advantages in retaining an element of choice in GCE. However, our experience is that this choice is almost always made by teachers and almost always based on either a judgement of their ability to teach the material or a judgement on the "easiness" of the unit. Thus many students do not do the best set of units to complement their other subjects of study or in preparation for their intended course of study in HE. Unless this issue can be effectively resolved, it would be better as far as HE is concerned if there was no choice. Then, at least, all students who had done A level would, in theory, know the same stuff, and we could tailor our courses appropriately.

Q12. Should the core be adjusted in any way for GCE Mathematics from 2011?

This depends on how much choice is retained. The core should not be reduced under any circumstances. As indicated above, there are arguments in favour of increasing the core.

2.6 Functional skills

QCA has developed draft standards for functional mathematics and has recently held a consultation about the draft standards. Copies of the draft standards for Level 1 and Level 2 are attached for information. QCA has also been given a remit to develop standards at Level 3, though these will not be produced until later in the year.

The standards have been designed to provide qualification developers with sufficient information to design appropriate qualifications. In mathematics, the standards emphasise the crucial importance of students engaging with substantial tasks that include the three stages of:

- Making sense of situations and representing them
- Processing and analysing the mathematics
- Interpreting and communicating the results of the analysis

The standards also establish the level of demand of the mathematics that may be required, by reference to National Curriculum, and Adult Numeracy, levels.

Finally, the standards give an indication of the kinds of mathematical topics that are likely to be addressed by suitable problems, in brief descriptions under the headings:

- Quantity
- Space and shape
- Change and relationships
- Uncertainty

The government intends that functional mathematics at Level 2 should be a hurdle for the achievement of GCSE Mathematics at grade C or above. This will apply to the revised GCSE specifications that are to be introduced from 2010.

Discussion Points

Q13. How important is it to HEIs that students should demonstrate competence in functional skills, including functional mathematics?

This depends importantly on what subject the students want to study. However, it is obviously desirable more generally that young people have competent functional Mathematics skills.

Q14. Do the draft standards include the most essential requirements?

Yes

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Richard Browne/Barbara Linton
Post-14 Mathematics team
QCA
May 2006

Annex

ICT project (Recommendation 4.7)

Last year, QCA appointed three project teams that produced 'vignettes' exemplifying aspects of learning mathematics with ICT that impact on the curriculum.
More recently, a working group has been convened to develop ideas and strategies for promoting appropriate use of ICT in qualifications. Questions have been posed about what qualification specifications in mathematics should require, in particular:

a. What should they say about 'cognitive skills', in mathematics or in ICT, as opposed to techniques?

b. How should they identify opportunities to link mathematics and ICT?

c. How should they avoid being an impediment to the integration of mathematics and ICT?

d. What forms of assessment should they propose?

e. Would they need to specify teaching approaches as well as topics?

Statistics and Handling Data project (Recommendation 4.4)

The Royal Statistical Society Centre for Statistical Education produced questionnaires to survey mathematics, geography and science teachers in schools in England. The survey results were gathered in Autumn 2005. The analysis of the results led to the following

a. materials for handling data need to be developed to strengthen links between mathematics and other subject

b. a group comprised of the RSSCSE team together with mathematics, geography and science teachers met to draft materials

c. delivery should be through mathematics classes

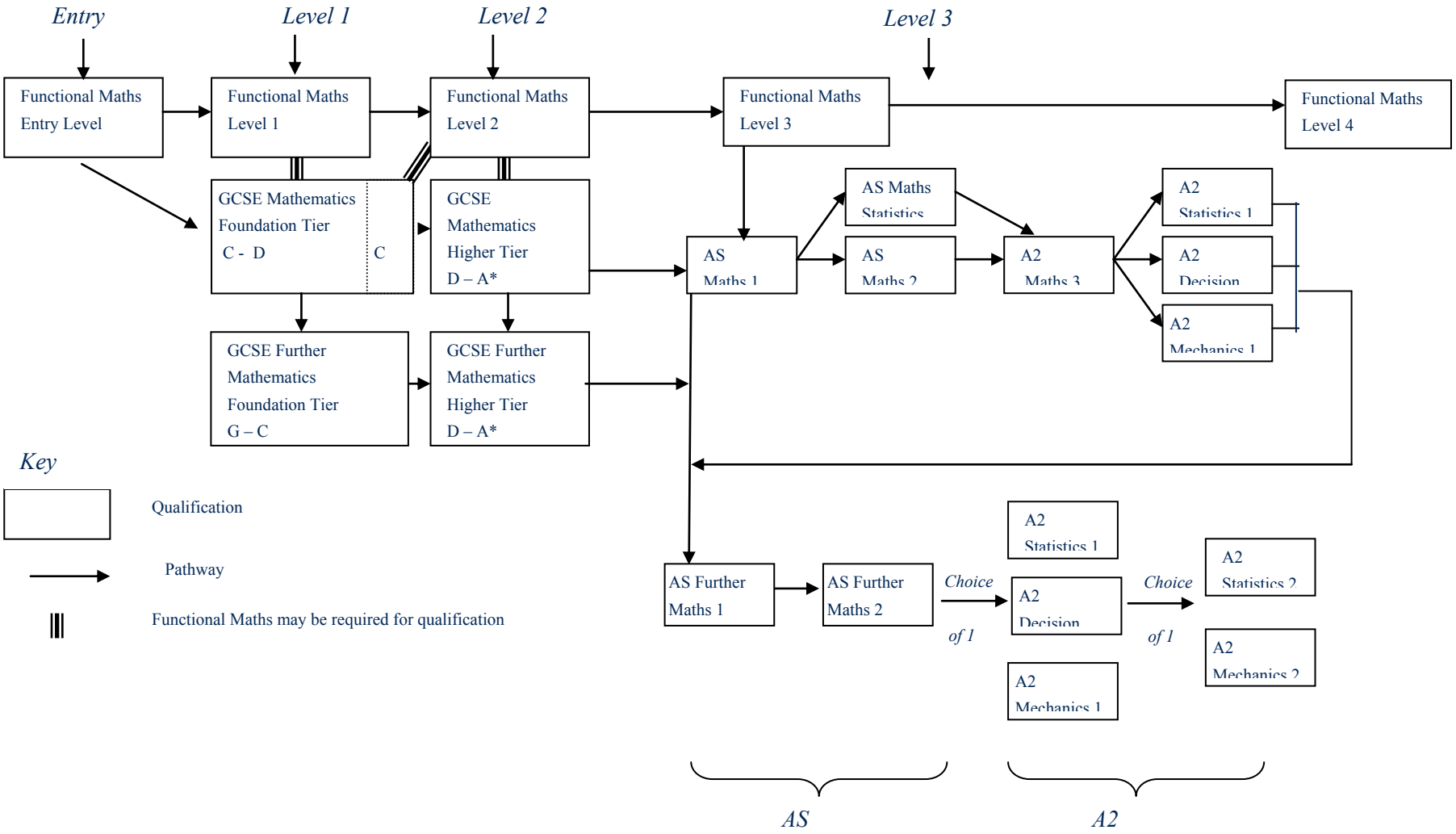
d. teachers' notes to support all mathematics teachers, including non-specialists and mathematicians without a background in statistics

Extension curriculum (Recommendation 4.5)

Two teams of writers, co-ordinated by Jeff Goodwin, are writing extension materials intended to deepen student's knowledge of different areas of the curriculum. Materials on number were developed for Year 8 students. The trialling of these materials informed the production of Year 10 materials on geometry. The trialling of the materials was completed in March 2006. Currently, we are exploring the possibilities for publishing the materials.

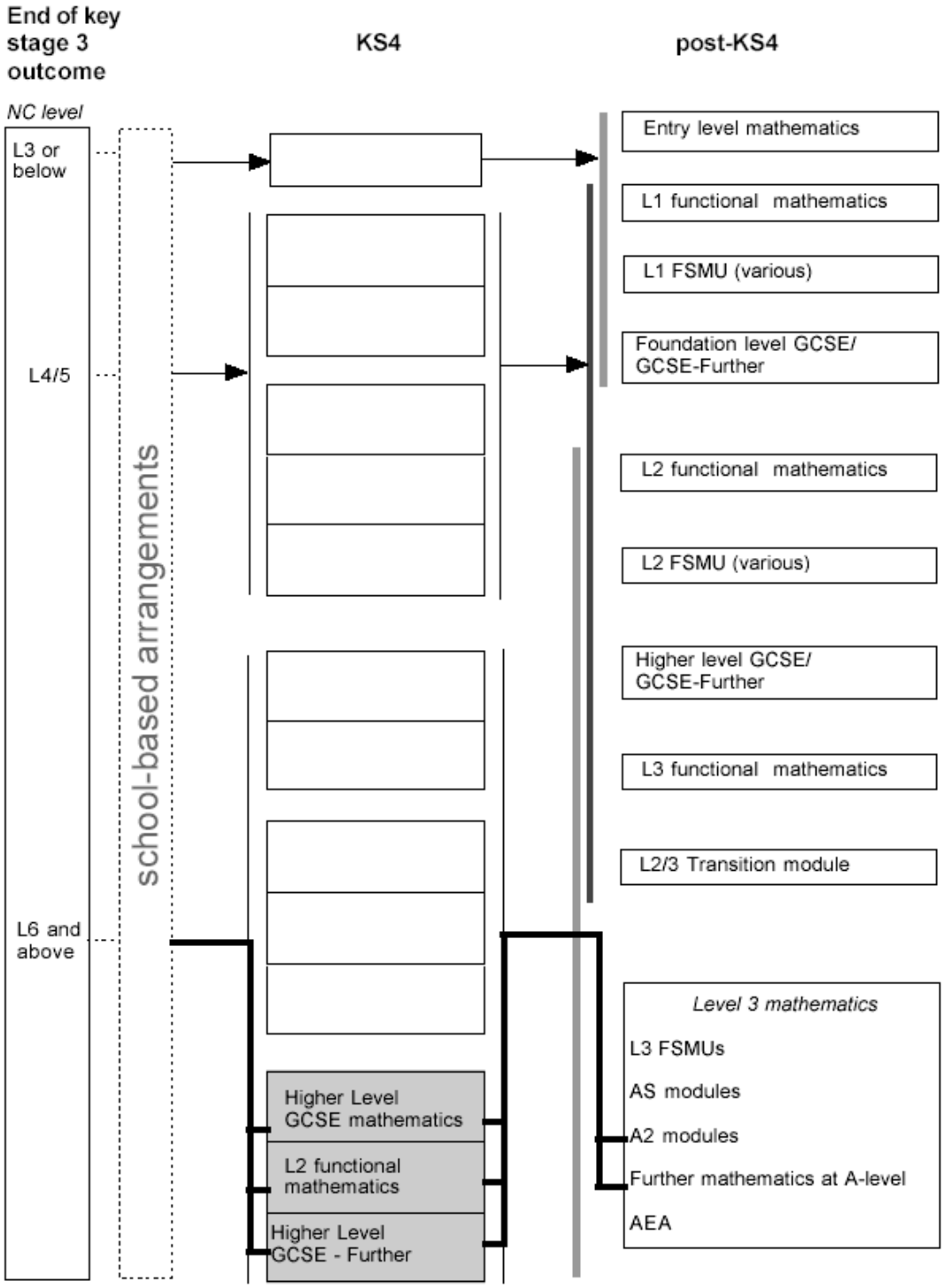
King's/Edexcel model

Model Entry Points:



Leeds Model 5

March 2006



GCSE - Further is (so-called) GCSE Further Mathematics