Qualifications and Curriculum Authority

Evaluation of participation in GCE mathematics

Appendix L: Seminar for case study centres, 8 February 2007 QCA

QCA Research Faculty

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The seminar

The main contact at each of the 19 case study centres participating in the Qualifications and Curriculum Authority's (QCA) evaluation of participation in A level mathematics was invited to attend a seminar held in February 2007. Each contact was asked to attend with one AS and one A2 mathematics student. The seminar had two main purposes: to seek validation of the evaluation findings to date and to research staff and student experiences since the evaluation was last in contact with them in spring 2006. The chosen method of validation and research was focus groups to enable discussions with the staff and, separately, with the students.

Many of the case study centre contacts kindly agreed to attend the seminar with or – owing practicalities – without students. However, nationwide snowstorms on the day of the seminar had a serious effect on the attendees' ability to travel to the seminar. As a result, only five case study centres were able to send a contact, and only one of these centres was able to send students, with one at AS and one at A2 as intended. In addition, one A level mathematics teacher from an additional centre participated in the discussions on the invitation of QCA mathematics staff.

All of the case study centres were sent a questionnaire for staff in advance of the event. This requested quantitative data about participation levels for comparison with the same data collected in previous years of the evaluation. This is analysed in a separate report which forms another appendix to the main report of the evaluation**.**

The seminar began with a QCA presentation on the context for the evaluation and its overall purpose. This was followed by the research part of the day with a focus group for the four staff and a group interview with the two students. The findings of the evaluation so far were then presented to the staff and students, who then went back into their groups for the validation part of the day. We are very grateful to these staff and students for attending the event, listening to the presentations and taking part in intensive discussions about A level mathematics.

The students

The two interviewees were a female A2 student (J) and a male AS student(B), both from the same comprehensive school. These students spent almost three hours discussing with QCA staff their experiences of studying mathematics and their views of the evaluation findings so far. The strength of the resultant information is therefore its depth rather than the breadth provided by other elements of the evaluation's research. The following sections of the report are structured according to themes identified in the discussion with the students.

Transition from GCSE to A level

Both students had found the transition from GCSE mathematics to A level mathematics to be unproblematic. The students felt that there was little difference between C1 and GCSE mathematics. S1 was also thought very similar to GCSE, despite the fact that it can be taken in the A2 year. M1, however, seemed harder than S1.

(B) had found 'up to the end of C1… relatively easy' and taking the first year of the Free-standing Mathematics Qualification (FSMQ) seemed to have helped. (B) didn't see much difference between C1 and C2, but (J) thought there was a more pronounced difference than between GCSE and C1, and found C2 'a lot harder' than C1. However, she had also taken FMSQ, which prepared her for A level both in terms of expectations and subject knowledge, and found that C1 was not much of a leap compared with her other subjects (German and physics).

Difficulty

The students didn't indicate that mathematics was more difficult or required substantially more time than the other subjects they are taking at A level. In fact, their enjoyment of mathematics seems linked to them finding it easier than their other subjects. Physics appeared harder (B), as did German (J) and this reflected how they perceived their aptitudes.

One student said that mathematics is not as hard as it's made out to be. It is hard, even for the 'really brainy people' but 'it's got easier', and it's not the case that the highest performers stay that way throughout GCSE and A level. By A2 it was no longer possible to tell the difference between those with higher or lower prior attainment because the A* students 'get really cocky' and the GCSE B grade students progress past them.

Physics

Physics helped the students with their mathematics. Both found that the practicals helped them to understand the abstract concepts they were asked to visualise in mathematics. Indeed, the students stress the need for relevant examples in mathematics in the next section.

Context and relevance

Both students enjoy the subject but sometimes it lacks appeal. The problems they are asked to solve are presented in contexts that lack relevance to them. One student (B) said that the teachers 'always just give us charts with height of class A and you can't make it personal'. He suggested that the context could be more relevant to 'teenagers' by bringing in 'some data on consoles you might connect to it and remember it much better'. The other students' comments were in agreement with these issues, saying that 'you need an area of interest to link it to everyday and then it will become more interesting'. There was also a lack of 'stress…made on the links' to other subjects. Both gave the example of relating mathematics to sport to make it more interesting.

Support

Drop-in sessions where one of the students said she could drop in to discuss any problems with the homework she had been set were useful.

Both of the students had had access to additional support outside of schools, with one (B) able to call on the explanations of his family, and one (J) taking the initiative by getting a tutor to help with the problems she was encountering with C3.

Image

Mathematics appeared to suffer from an image problem. This resulted, at least in part, from the apparent level of difficulty of the subject at A level and the unattractive way it was sold at the A level subject open day for year 11 students. Teachers' presentation of the subject was markedly different from the way that media studies and psychology were marketed. Psychology 'had leaflets and made it seem like it was a simple and everyday subject'. In fact it appeared that the presentation of mathematics at the open day with its 'projections and detailed presentations' had 'put people off doing it' (B).

The students thought that ‘tasters’ for all the subjects where teachers deliver a single lesson to students after they finish their GCSEs and before the summer holiday to help them decide which AS subjects to take. This could help potential A level mathematics students to see that it is ‘a lot more interesting than GCSE and goes a lot deeper’. Currently, tasters are only available once the students have chosen their AS subjects and, whilst the chemistry taster was ‘great’, the mathematics taster was boring.

Students needed to seek out careers information about mathematics-related careers because it was not readily available. Some students don’t realise that A level mathematics can lead to other subjects at degree level, such as medicine. One of the students suggested students should be informed about this and the message that: ‘If you do mathematics A level you can earn 15% more’ should be pushed because it encourages students to choose the subject.

Unlike in other subjects, there are ‘no cool trips’ in mathematics and mathematics appears detached from the real world compared with other subjects where you get to be ‘out analysing things because that is what they do in their normal lives’ (J).

‘Mathematics needs to be more appealing – mathematics in space' (B), or 'trips to Alton towers and sport' to demonstrate what students are being taught and to ‘make it more exciting’ (J).

One of the students (J) told how ‘everyone says that mathematics at A level is really hard’ but it's ‘not really’ the media who say this.

One student (B) told how ‘all boffs [in mathematics] are made fun of and ignored’ and this ‘peer pressure makes it difficult’. Some students say that mathematics is hard even when they do not actually find it hard ‘because they do not want other people to think they are clever’.

Why mathematics?

This student went on to say that she chose mathematics by deciding ‘what I wanted to do at uni and worked backwards’ but ‘probably would have done mathematics’ anyway because she enjoyed it and was successful at it and her dad encourage her too. This was despite the fact

that: ‘You do see a lot more men than you do women in mathematics’. Then, when she started mathematics, she found that what people said about the difficulty of the subject was not quite true.

The other student had wanted to be a mathematics teacher but then he found that it was a choice between mathematics and further mathematics or taking a different subject, and decided that teaching was not for him but rather accountancy. He also felt that mathematics is an important subject that can contribute to the solution of important global issues.

Choosing A2 mathematics

Student (J) hadn’t planned to take mathematics at A2 but her results encouraged her to continue with the subject, which would be relevant to the degree course she wanted to do. Student (B) has always planned to take the full A level as he enjoys it and needed it for his career.

Transition from AS to A2

The A2 student commented upon a marked increase in the difficulty of the subject at A2. Her comments suggest that the course is more difficult and that teachers expect more of their students:

> I think at AS you’re fed more (slowly) into it – there is a gentle push to continue it. The teachers are trying to make it easier and then you find this huge leap between AS and A2 and the teachers are no longer sympathetic ‘cos you’re doing mathematics. At AS I never went to drop-in sessions and at A2 I tried to do the same thing and it didn’t work, it is that much harder. I didn’t realise, but once you realise that you need to, you need more determination to do it. Student (J).

Teachers and teaching

Both students prefer their teachers to take a more ‘individual’ approach than whole-class teaching allows. One student noted that when a teacher ‘makes a point of responding to you as an individual’ then ‘people seem to respond to that more’. Both students preferred to be set work for them to get on with by themselves in class and then have the teacher ‘coming to the desk ‘cos they give you more work that you can get on with to stretch you, and if you’re struggling they can help you’. This contrasts with: ‘If it’s the whole class you can get isolated

'cos you've been doing it more quickly'. So for students who are progressing more quickly than the pace of the class, and perhaps for those progressing more slowly, this 'individual' approach to teaching was suggested by the students.

Optional units

The students' school decides which optional units the students will take. (J: 'We are told what we do') and everyone does M1 and S1. Student (J) would have preferred M1 and M2 so that she could make further progress in mechanics by building on M1 rather than taking S1. Taking S1 doesn't make sense after taking M1 because 'you're not being challenged' when 'you expect the last ones to be the hardest you do'. She was aware that it is possible to take more optional units through further mathematics but she had not wanted to take this in addition to mathematics.

Further mathematics

Student (J) had not wanted to take further mathematics (FM) since it would have taken up another one of her subject options and meant that she couldn't do another, different subject to mathematics, in her case physics or German. She suggested a different approach that would have stretched and challenged her; 'an alternative A level in mathematics which you started with a harder version of C1 and so on'**.** In this alternative approach, students could switch between the easier or harder A level up until, say, January depending on how they were managing. That way, students would be able to try out and do 'harder' mathematics without 'losing' another subject option to mathematics. Students wouldn't be 'specialising too soon' in the subject and keep their university options more open.

As for the Use of Mathematics qualification, the students were not aware of the subject but did not see a particular need for it.

Coursework

One of the students (B) was glad to hear that mathematics did not involve coursework, which he disliked. The fact that the coursework did not appear to have a right or wrong answer contributed to this dislike. Both students wanted to know their mark for the coursework, which was not given to them. One of the students described this as 'frustrating' after putting 'so much effort into it'.

Exams and preparation

Student (B) found the C1 exam ‘really, really easy’ and student (J) said that the C1 exam was ‘quite easy’. They both found that spending time on working through past papers was the best preparation for the exams. (B) reported that his class spent the 4 weeks prior to the C1 exam on past papers and (J) said that students were given ‘a pack of six’ past papers. Both emphasised the importance of practise through revision in getting ready for the exams. Having spent a lot of time preparing for exams, (B) had found C1 easy and (J), who said that she revises ‘incredibly hard’ and enjoys because it helps her to see ‘how things fit together’ had also enjoyed exams when she found she knew the answers.

The A2 student (J) reported that 'C1 was quite easy but it was nice for it to be easy. If I was going to give you any advice [talking to B] I would say get as many marks as you can in C1 ‘cos lots of people didn’t put in enough work at C2. They did some amount of work and got a C in it or something. In C1 the questions given to you are more direct. In C2 you have to think for yourself "what are they asking me to do?", because they build on each other'.

Resits

The students at their centre pay for all resits. Neither of the students had resat any mathematics units but some students at the centre do resit mathematics units. Teachers recommend that students resit units ‘if you do badly’ rather than if ‘you got a couple of marks off an A’ when ‘they probably won’t let you’. So, teachers did not seem to be encouraging resitting in order to maximise scores or grades. The ‘normal reason’ for resitting is to ‘get the university entry standards’. As far as the students were aware, universities are not seeking individual unit scores or grades but one student (B) had heard that they might do, and that Oxbridge might not ‘accept resits’.

However, both students were very clear that the structure of the qualification encourages teachers and students to adopt an approach of maximising scores in the AS core units (C1 and C2), and particularly C1, rather than in the more complex A2 core units (C3 and C4).

Student (J): ‘If I was going to give you any advice I would say get as many marks as you can in C1’ because the same amount of work translates into a higher grade in C1 than in the subsequent core units.

Student (B): ‘You want to get the highest mark in the easier papers so that you don’t have to work so hard next year, next year is supposed to be much harder'.

As a result, the tendency is for students to resit the earlier core units where it may be easier to pick up more marks:

Student (J): ‘…they’re trying to get the majority of the marks on the easier papers. You try really hard in C1 and C2, and in C3 and C4 you can drop a bit more of it and it doesn’t matter that much. In C3, if you do badly, instead of going back to C3 you go back to C1 to get more marks there instead.'

The students said that ‘a lot of people would do it this way’ and saw this as a way ‘you can cheat the system’ but felt ‘it should be changed’. They appreciated the modular structure with the reduction in ‘stress’ that it entails but argued that it should no longer be possible to compensate for lower levels of proficiency at C3 and C4 with higher marks gained through resits ‘at the lower levels’. One way of resolving this would be to ‘make it proportional to the difficulty’ perhaps by weighting units accordingly.

Utility/comfort hypothesis

Student (B) felt that the hypothesis ‘kind of rings true’, and student (J) commented that if she hadn’t been good at mathematics and enjoyed it she wouldn’t have taken it. She found that it was required for her degree and chose it on this basis, feeling that she would enjoy it and succeed. For her peers, the motivation for choosing mathematics was related to enjoyment rather than careers. However, it seemed that mathematics was often relevant to the degrees they were planning to take.

Mathematically extremely able students hypothesis

Student (J) responded to this hypothesis by suggesting that the nature of mathematics, where you are either ‘right or wrong’, makes differences in levels of ability more obvious than ‘in other subjects [where] it is up to the teacher to decide if they like your style as well'. Thus it is ‘a bit the same in physics, chemistry and biology’ but ‘not so obvious in English’: ‘I think people are just as good at studying in English but it is easier to spot in mathematics’.

(J) and (B) both suggested that people are suited to subjects according to ‘natural’ predispositions and (B) developed this idea by emphasising the role of the family in encouraging students' development in certain disciplines from early childhood onwards ‘through how they’ve been brought up’. It seemed that people think about problems differently depending on their natures.

The staff

Six A level mathematics teachers from four schools and two colleges took part in the focus group. The following sections of the report are structured according to the themes identified in the discussion with these teachers.

Recruitment

The teachers generally said that more students had started A level mathematics in September 2006 than in September 2005. One teacher reported that recruitment had recovered towards levels last seen before the implementation of Curriculum 2000. One school already had a very high take up of mathematics and in this case recruitment levels seemed unaffected. Some of the teachers suggested that informal feedback from students taking the A level to students making their A level subject choices – for example between siblings – had begun to make a difference and was to some extent a factor in the improvement.

GCSE entry criteria

The centres generally require a grade B in GCSE mathematics on the intermediate or higher tier for acceptance onto the A level mathematics course. But one school only accepts B at higher tier and one college accepts C on GCSE higher tier and B on intermediate tier. In practice, centres preferred students to have at least a B on the higher tier and one teacher felt that students should really have an A or an A* if they wanted to take A level mathematics. In

one case, students at the threshold are pointed towards other mathematical A levels such as statistics. Some of the centres provide bridging units for students on the intermediate tier or encourage them to catch up on algebra independently before beginning the A level. One centre recognised that the C1 unit is useful in this regard but others felt that the GCSE provides only limited preparation for the level.

Comfort and utility

Research undertaken as part of the evaluation had generated a hypothesis that boys are more likely to choose mathematics A level for its potential utility for university or their future career, and girls are more likely to choose mathematics if they feel comfortable about their aptitude for the subject. There was some support for the assertion that comfort is an important factor in the participation of girls in A level mathematics in the comments of some of three of the teachers:

> There is an issue of reassuring girls… They don't see 'maths' as a career.

> I have more girls in set 1 in year 11, but it is difficult to persuade them to do A level. They are capable but they don't believe they are. They have a comfort zone in other subjects and they go for those.

> I have lots of female students, many of whom took GCSE statistics, which they tend to think helps.

Two of the teachers raised the absence of coursework from A level mathematics as an additional factor for girls:

> Girls enjoy coursework; boys do not. Girls go on to AS subjects with coursework.

> Is there an opportunity there? If other subjects are losing coursework at GCSE, that might also make other subjects less attractive.

A 'clever core'

The evaluation had also interpreted the research evidence as suggesting that, as the size of the A level mathematics cohort reduced year-on-year, the remaining students tended to be the most highly attaining students, which it termed a clever core of students choosing the subject. A couple of the teachers responded on this point by saying that although this was true in previous years, there are now students with a wider range of ability taking A level mathematics. However, these and other teachers felt that: 'We need to encourage more people to have a go [at A level mathematics]', and a few suggested that the only way to achieve this might be for them to study a less demanding form of A level mathematics. By contrast, one teacher from a school with 100% take up of A level mathematics felt that neither mathematics nor further mathematics is demanding enough to stretch the most able.

Relative difficulty

The teachers' experience was that A level mathematics has been, and remains, more difficult than other A level subjects, and that universities are not asking for the subject as much as they used to. Since students perceive this to be the case, and because they are usually under pressure to maximise their grades in order to gain their place at university, they tend to choose the subjects they will get the highest grades in rather than mathematics. Some of the teachers felt that universities conditional offers of places should reflect this relative difficulty, to remove the disincentive to studying mathematics at A level that is currently holding sway. One teacher summed this up and alluded to a similar problem in physics:

> Universities are not playing the game. Kids have cottoned on that they can get As another way, with less effort… Universities want As and Bs so students are put off mathematics because it's harder. Students wanting to do medicine are turned off mathematics because they need 3 As; mathematics is harder to get an A in. The problem is getting over the barrier that mathematics is harder. Students know they need to put more effort into mathematics and physics.

In contrast to the clever core issue outlined above, another teacher made this call for action to recruit what some of the teachers reported to be a large group missing from the subject::

> We must put a stop to bright students who don't do A level mathematics, but who could. Maybe this has always happened, but they voted with their brains, as it's easier to get good grades in other subjects.

The comments from the teachers therefore suggest that students act strategically in choosing their A levels and that teachers understand and accept this basis for subject choices. This was tempered by some other comments suggested that some students choose mathematics according to enjoyment or usefulness.

Mathematically extremely able

When asked about the hypothesis that some students are 'mathematically extremely able', a couple of teachers said that their students' levels of ability tend to be polarised. The effect is those students tend either to gain A/B grades or D/E but not C grades. The remainder of the discussion relates to distinguishing between different levels of ability and is reported in the FM and Advanced Extension Award (AEA) section below.

Transitions: GCSE to AS

Some of the teachers had found that the C1 unit in the A level introduced in 2004 is less difficult than P1 unit in the Curriculum 2000 A level. Some noted that the content of C1 was similar to or the same as parts of GCSE mathematics but that it in this way it helps students to make the transition to from GCSE to A level. However, they did not link this to any change in the take up of mathematics but neither was this ruled out. On the other hand, one teacher was slightly less positive about this point of transition, findings that there were gaps in places and links in others, but this did not seem to be an issue of any particular concern.

A couple of the teachers said that their students experience the progression from C1 to C2 as a more significant point of transition than the move from GCSE to A level. The teachers characterised this as better than previously because although there is still a 'shock', it 'comes later now', it is 'not as severe' as under the Curriculum 2000 A level. The significance of this transition from C1 to C2 could be minimised, as one teacher suggested, through GCSE statistics, which makes C2 and S1 'easier'.

Transitions: AS to A2

The teachers also found that C1 to C2 was a more significant point of transition than C3 to C4. The change from the pure units to core units had contributed to this. The teachers were clear that C2 should be delivered in the first year of study whereas in the past they had had to make a difficult choice as to whether P2 should be studying at the start of the second year instead.

In the past, delivering P2 in the first year could ‘make year 12 harder than year 13’ but there is no such dilemma or issue with the new A level.

At some of the centres, the teachers said that AS mathematics students generally plan to continue with the subject at A2. At one centre, which takes a linear approach to the course, students are required to decide what they will take at A2 at the start of AS. Students are rarely permitted to continue mathematics if they have chosen AS only. One teacher said their centre has a policy that students must pass AS mathematics to progress to A2 mathematics. These are generally GCSE grade B or intermediate-tier students. One teacher had found that students taking optional units in mechanics often continue beyond AS.

A teacher from one of schools had found that although students generally intend to progress to A2 mathematics, they do sometimes drop out during AS or at the end of AS. Several teachers commented on this issue of AS students changing their minds about A2 mathematics. They generally attributed this to students dropping their lowest graded AS subject, which is often mathematics, and this seems linked to comments elsewhere that it is a relatively difficult qualification. This point was supported by the experience of one of the teachers who had found that physics results were worse one year and students tended to drop this instead of mathematics. The overall picture here is that although structural changes to the A level were positive, and AS mathematics is being completed in one year, the subject continues to be a regular casualty of the reduction from four AS subjects in year 12 to three A2 subjects in year 13.

Optional unit choice

The teachers, on the whole, seemed content with the choice of optional units available to students. When asked about limiting the students to a choice of just three routes (mechanics, statistics or decision mathematics but no combinations), some of the teachers were not sure that it would be feasible because of timetabling and setting constraints, but one teacher thought that it would work.

The teachers made some specific comments about the content of S1 and decision mathematics. One teacher had found that the ‘S1 material at the bottom end is a bit woolly’ and suggested adding hypothesis testing into S1. The experience of another teacher was that ‘hardly anything in S1 is beyond GCSE mathematics coursework’.

Several comments were made about decision mathematics. It appears that D1 and D2 have a different appeal to statistics and mechanics units, particularly for less able mathematicians. Specific comments were that some students 'like' it and 'the historical bits are brilliant.' 'It's useful that it relates to the real world. Weaker students like it and do well.' 'Sometimes they do better than brighter kids', particularly 'if they have weaker algebra skills'. They were agreed that decision served an important role and should remain.

Most of the centres are offering two AS and A2 optional units in combination with each other. One of these centres is large enough to provide the full range of AS/A2 choices and is also offering students the opportunity to take two AS optional units (D1 and S1). A couple of the centres were offering only the AS optional modules S1 and M1. The size of their centres prevented them from offering a choice. One said that whichever order S1 and M1 were taught, the first one was problematic. A couple of centres said the less able students were guided into D1 and D2 but one said that this was less the case than since 2004. The table below shows the A level optional unit offer at each centre.

Centre	**AS**	**A2**
1	M1/M2; S1/S2	
2	M1/M2; D1/D2; S1/S2	D1/S1; large
3		S1/M1
4	S1/S2	
5		M1/S1
6	M1/M2; S1/S2; D1/D2	

Resitting

In general, the teachers thought that some students take too many resits for A level mathematics, but a few pointed out that the number of students taking several resits is low. Some therefore felt that capping the number of resits that each student can take was unnecessary; others felt that this would be a positive step. Some seemed willing to consider the idea of de-coupling AS from A2 to reduce the impact of resits on A level results.

Some of the teachers reported that students sit C1 and C2, then develop their level of understanding in sitting C3 and C4, and then resit C1 or C1 and C2 to gain a higher score than in their first sitting. One teacher said that some students go back to resit S1 too. It was felt that students act strategically, resitting the easier, early units. This agrees with the information provided by the students at the seminar. The strategy of resitting the early units was successful in many cases but one teacher had found that 'they rarely do better' because 'they forget they have to do more work'. In general, the teachers talked about resits in terms of students maximising their scores but one teacher also mentioned that GCSE B grade and intermediate-tier student 'retake until they get AS'.

A couple of teachers felt that first units were in fact sometimes taken too early, in the January of year 12, when they could be left until the end of the AS year. However, one teacher reported that some centres find January sessions useful for motivating students.

Further mathematics and Advanced Extension Awards

The teachers talked about FM as providing 'stretch' for 'brighter students'. Various other comments were made: Oxbridge prefers students with FM, according to two of the teachers; AS FM is easier than it used to be but it is ideal for the students; teacher numbers can make it difficult to provide FM; some good mathematics student decide against FM because it would mean spending even more time doing mathematics (reflected in the information provided in the student group); and, FM should be worth more than other A levels.

The teachers saw a role for an additional qualification, such as AEA, to distinguish different levels of ability and provide stretch for the most able. Some offered the AEA or sixth-term examination papers (STEP) but there were issues relating to recognition of these courses, finding space in the timetable for them, and taking these courses in year 13. A few suggested that this stretch needs to be available in year 12 too.

